The Yanco Creek System Natural Resource Management Plan

STAGE 1.
(to be reviewed after five years)

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State water ...improving life with water

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FOREWORD

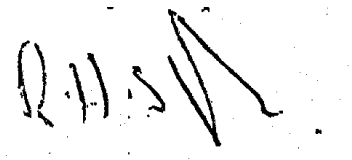
The Yanco Creek System Natural Resource Management Plan is the first step on the journey towards sustainable natural management of our unique environment. The plan has been developed as an outcome of the community consultation that took place during the latter part of 2002 and further consultation between September and November 2003. It was recognised that there is a need for a major upgrade of the infrastructure that delivers water to our communities. A number of issues were identified and this plan sets out how we will go about the work which needs to be undertaken. The work is a mixture of physical works, policy development, monitoring and coordination of projects – all which are aimed at ensuring the long-term environmental sustainability of the creek system.

An Integrated Catchment Management principled approach has been adopted by the governments of the Murray Darling Basin, and identifies natural resource management as a human activity, based on the values that our society holds, and acknowledges a sharing of responsibility. This plan takes a similar approach. The plan has been developed using integrated catchment principles as developed by the Murray Darling Basin Commission with a key principle being community participation in decision making.

YACTAC is of the view that this plan should be considered as a sub-regional implementation plan that will help achieve and be consistent with the outcomes and actions in the Murrumbidgee and Murray Catchment Blueprints, which is the overarching natural resource management strategy for the catchments. These blueprints in association with existing Water Sharing Plans and Regional Vegetation Management Plans will be the basis of Catchment Action plans to be formulated by the newly formed Catchment Management Authorities.

The Yanco Creek System Natural Resource Management Plan asks for commitment from both individuals and organisations; to share responsibility for underpinning the health and productivity of the Yanco Creek System both now and for future generations. The plan was formally launched by the Hon. Craig Knowles, Minister for Natural Resources at a function held at the Rice Research Station "Old Coree" on March 1 2004.

The Yanco Creek and Tributaries Advisory Council wish to express our gratitude for the contributions made by Murrumbidgee Private Irrigators Executive Officer Lee Furness, Department of Infrastructure, Planning and Natural Resources Staff Peter Beal and Rob Scriven, State Water River Operations Officer Jim Parrett, and their respective organisations for the considerable time and effort they have put into this plan.



Richard Sleigh
Chairman
Yanco Creek and Tributaries Advisory Council

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EXECUTIVE SUMMARY

The Yanco Creek System

The Yanco Creek System (YCS) is a regulated stream of the Murrumbidgee River System. Water is diverted at the Yanco Off-take down the Yanco Creek, and the Colombo Creek where it joins with the Billabong Creek. This water can be directed down the Forest Creek also where below Warriston Weir, the system becomes an unregulated stream supplying domestic water to landholders until it joins the Edward River upstream of Moulamein.

The YCS is a jewel of the Riverine Plains and is the most prominent geographical feature of the area it traverses. The flow of water and riparian environ of the creek system, serves as life giving blood to a range of significant wetland areas that are highly valued by the community and must be better managed for the future sustainability of the biodiversity of the area. Key wetland areas are Dry Lake, Lake Urana, Wilsons Creek Anabranch, Wanganella Swamp, Kerribirri Swamp, *Rhyola* depressions and flood runners, break out areas on *Back Nullum* and Box Swamp on *Blue Gate*.

The people of the Riverine plain take great pride in the YCS for the great value it has in supplying water to their vast area of southern New South Wales. The community has thought the priority and importance of the system to Government in honouring its obligations has waned over recent decades in terms of providing delivery of water to agriculture and rural communities and securing the future of its ecological integrity.

The community is committed and determined to see their vision of YCS realised. This vision is that the YCS be managed in a collective and shared manner involving all stakeholders in fulfilling partnerships to enhance the long term future of the waterway. This is needed to provide sustainable irrigated agricultural production, healthy habitat for all is dependent flora and fauna and waster supply for the rural communities.

The YCS has approximately 250 licensed water users and is some 800 km in length. The YCS is the longest network of creeks in Australia. The average water volume used in the YCS is 160,000ML annually. Due to the area the system covers and vagaries of the Australia climate and landscape it is a very complex water supply system to operate. It is an absolutely critical water supply to a vast area of the Riverine Plains of NSW and supplies water to several towns along its path. These are Morundah, Urana, Oaklands, Jerilderie, Conargo, Wanganella and Moulamein.

The Need for a Natural Resource Management Plan (NRMP)

In recent years a number of key natural resource issues have bought about a review of the system from a range of Environmental, Economic and Social perspectives. It is now abundantly clear from community input and extensive assessment of the system's natural resource assets by Government Agencies and other experts, that unless the YCS receives immediate attention in a concerted effort by all stakeholders, the fruits of the system enjoyed by all including the environment may be eroded away by decisions taken to manage the larger Murray Darling Basin. This situation is borne out by there being no provision for an environmental flow in the current Water Sharing Plans and the existing inherent water delivery losses that can occur in the system when distributing water to meet demands.

Unsustainable volumes of water escape from the creek system through evaporation that occurs in weir pools, in low lying areas where high level creek flows escape the stream channel and spread over adjoining farmland. Water is also lost into a network of old prior streams where the flow recharges the groundwater.

Additionally, inflows that stem from dry land areas in the catchment, particularly from the upper Billabong, that flow over the weir at Darlot to meet end of system target flows expected of State Water are also recorded as delivery losses and make the total water delivery escapes in the system appear excessive. These in-system flows play a role of acting as environmental flows in the reaches below Darlot and are not a true indicator of inefficient use of water by system users and operators.

There is also a need to ensure the ongoing enhancement of the biodiversity of the creek corridor and the riparian zone. The area is rich in native fauna and flora being in the fligh path of endangered species like the Superb Parrot (Polytelis swainsonii) and providing ritical habitat for the Southern bell Frog (Litoria reniformis). Land holders are committed to ensuring the protection of wetlands, the refinement of appropriate wetting and drying regimes of the wetlands, protecting remnant vegetation, and increasing the numbers of native fish in the creek.

The YCS Natural Resource Management Plan (NRMP) is a strategic document that provides a framework to manage the system into the future. The plan will also serve as a sub-regional integrated action plan for a vital part of the Murray/Murrumbidgee and Murray Darling basin catchment.

Key Issues

Four key issues have been identified in this plan and are supported by 30 key management actions.

The four key issues are:

- Maintaining and improving the health of the creek and mimicking natural flooding events where possible.
- Maintaining and improving the riparian habitat (creek corridor biodiversity) along the creek system.
- Improving the overall deliverability and efficiency of supply for the entire creek system.
- Developing community ownership, participation and empowerment to improve the future management of the system's natural resources.

It is intended that the YCS NRMP will isolate issues threatening the productive and ecological values of the YCS and form the basis from which progress towards improving the natural resource status of the system can be measured.

To be successful, implementation of the strategic plan must develop on-going partnerships between community and government stakeholders to enable action in a co-ordinated and integrated manner.

Forest Creek

The YCS NRMP contains a section on issues relating primarily to the Forest Creek. These issues were documented in the Forest Creek Management Plan which for various reasons was not implemented. The section deals specifically with a lack of water in the lower reaches of the Forest Creek Anabranch, management of the Wanganella Swamp, and flooding of the Cobb highway. Other issues contained in the Forest Creek Management Plan such as cumbungi and willow infestation form part of the overall YCS NRMP.

Environmental Outcomes

Implementing the YCS NRMP will achieve the following environmental outcomes:

- Water delivery losses as defined in this plan to be reduced to an acceptable level of 20% taking account of key factors such as accession losses to the groundwater system, overbank escapes in times of high flow and flood, evaporation and pilfering.
- Through the benefits of all actions undertaken as part of the plan that a net saving of 36 GLs of water to be achieved for alternate purposes such as environmental flows and off-sets for funding to undertake on-going maintenance and increased understanding of the system through more extensive scientific and technical investigations.
- That riparian health including native endangered flora and fauna species to improve by 8% by the year 2010.
- That predetermined and measurable water quality parameters at established monitoring sites improve by 5% by the year 2010.
- Enabling the State and Federal governments' natural resource management agenda to be realised.

Socio-Economic Outcomes

Implementing the YCS will achieve the following socio-economic outcomes:

- Securing the viability and sustainability of the rural communities who depend on irrigated agriculture for their livelihoods. Over 90% of the riparian zone is in private hands and is dependent on landholders being economically viable to ensure its management for future generations. Environmental outcomes can only be realised when socio-economic outcomes are realised.
- Ensuring future prosperity for the state and the nation.
- Enabling communities to invest in the well being of their natural environment.
- Developing community ownership, participation and empowerment in the management of their natural resources.

Management Actions and How They relate to the Key Issues

The Management Actions have been designed to relate to the key issues identified in the plan. The following is a list of the Key issues with the related management actions from the NRMP. A full list of the management issues is contained in Section 1.6.

Key Issue: Maintaining and improving the health of the creek and mimicking natural flooding events where possible.

Action Number	Action
ACTION 3.13(A)	That the current flow regime of YCS be investigated and modified if necessary, to best mimic natural flooding regimes and particularly wetlands.

ACTION 3.13(B)	That a scoping study be undertaken to identify and establish management needs to maintain and enhance key wetlands including natural wetlands and those created by water escapes and weir pools.
ACTION 3.14(A)	That the current water quality monitoring regime in place be assessed with a view to ensuring that it provides timely and accessible information on appropriate water quality parameters.
ACTION 3.14(B)	That a salinity audit of the YCS be undertaken that determines salt sources, its distribution and location in the system, so as to instigate management actions to control its accumulation and impact on the system and to measure export quantities.
ACTION 3.14(F)	That an integrated water quality and ecological monitoring framework be established to assess the effect of plan implementation. This to include riverine environment, in-stream water quality and town water supplies.
ACTION 3.14(G)	That a review be undertaken of flow and water quality recording network to meet current and future requirements, and with particular emphasis on the lower reaches of Colombo Creek to determine end of valley flow and salt load export from the Murrumbidgee valley.
ACTION 3.15(A)	(i) That all land managers including farmers, irrigation companies, government agencies, local councils and regional weed management groups implement and coordinate weed eradication programmes along riparian areas of YCS. (ii) That YACTAC ensure weed identification, reporting and controls are key components in establishing a prioritised works and monitoring programme along the YCS. (iii) That control works programmes are formulated in consultation with government agency staff and comply with relevant legislation and noxious weed protocols.
ACTION 3.16(B)	That current research techniques e.g. daughterless carp (induced sterility measures) to control the persistence and spread of carp into inland waterways be supported.
ACTION 3.16(C)	That the YACTAC NRMP strategies and actions are consistent with Murray and Murrumbidgee Catchment Blueprints.
ACTION 3.19(A)	That any creek works be undertaken following a coordinated and integrated approach involving consent authorities and with regard to whole of system strategy.
ACTION 3.19(B)	That YACTAC investigate the possibility of the YCS NRMP and associated works, be used as a pilot project for trialling improved integrated approvals being developed by government agencies.
ACTION 3.21	That the YACTAC requests appropriate authority to have a formal and permanent consideration of environmental flow requirements for the YCS.
ACTION 3.25(B)	That YACTAC ensure that works are carried out in accordance with the regulations contained in the National Parks Act 1974 pertaining to Aboriginal sites of cultural significance.
ACTION 3.27(A)	That the Landholder proposal currently being drafted be supported and endorsed on completion to expedite its implementation to return 11.5 GL's of water for environmental flows.

ACTION 3.27(B)	That the following revised target flows for Warriston Weir be implemented as soon as possible: **Target 1. Unregulated/rain rejection flows** • That unregulated/rain rejection flows be permitted to pass through the Forest Creek system for environmental purposes. (It should be noted that from an operational point of view this is extremely difficult to implement because of the inadequate capacity of the Forest Creek off-take and the Forest Creek Regulated Section to allow those flows to pass through.) **Target 2. 'Summer' target flow at Warriston Weir** • That a target flow of 80Ml/day at Warriston Weir be provided from the beginning of November to end March. **Target 3. 'Winter' target flow at Warriston Weir** • That a minimum target flow of 60Ml/day at Warriston Weir be provided from beginning of April to end October.
ACTION 3.27(C)	That funding be secured for infrastructure to return flows to Billabong Creek.
ACTION 3.27(D)	That proposed changes to the flow regime be monitored annually to assess the social, economic and environmental impact.
ACTION 3.28(A)	That the operation of the Forest Creek off-take regulator and its impact on the Wanganella Swamp be considered in wider YCS assessment of environmental outcomes and related flows.
ACTION 3.28(B)	That McCrabb's regulator and adjacent spillway be modified and appropriately upgraded.
ACTION 3.28(C)	That the operation of McCrabb's regulator be monitored as a consequence of the modifications in (B) above.
ACTION 3.29	That flooding of the Cobb Highway at Wanganella be mitigated by redesigning and refurbishing the Estuary Creek Regulator and McCrabb's regulator.

Key Issue: Maintaining and improving the riparian habitat (creek corridor biodiversity) along the creek system.

Action Number	Action
ACTION 3.5(A)	That a draft strategic program be developed for willow removal, bank stabilisation and revegetation providing prioritisation and timeframes for any proposed staged development.
ACTION 3.5(B)	That the program of willow removal, bank stabilisation and revegetation be submitted and approved by relevant government agencies.
ACTION 3.6	That the extent of cumbungi in the Yanco Creek system be monitored, with a view to the possible need for future control. This is to involve possible targeted areas where chemical control options would be trialled and monitored to determine efficient and effective control measures.
ACTION 3.15(B)	That land managers, implement recognised best practice management techniques for the management of stock adjacent to riparian areas. Best management practices may include fencing off areas to exclude grazing stock and allowing natural regeneration.

ACTION 3.15(C)	Those areas of high conservation value riparian areas be identified with a view to developing 'best management practices' and using funding incentives to maintain and improve riparian and wetland habitat. Best management practices may include fencing off areas to exclude grazing stock and allowing natural regeneration.
ACTION 3.15(D)	That DIPNR and CMA's through incentive programs continue to raise community awareness of the value of protecting riparian habitats, and the importance this plays in contributing to ecologically sustainable management.
ACTION 3.17	That the YACTAC seek access to vegetation management incentives to facilitate the opportunity to achieve better management outcomes from managing the riparian pathway for conservation purposes.

Key Issue: Improving the overall deliverability and efficiency of supply for the entire creek system.

Action Number	Action
ACTION 3.2(A)	Request appropriate bodies to initiate a comprehensive water balance study of the entire Yanco Creek System to clarify definitions and interpretations of losses occurring in the system. This will improve the overall understanding of water losses and transport of flows within the system and of those which there is little control over in relation to delivery capabilities. i.e. channel capacities, weir distribution volumes and travel times.
ACTION 3.2(B)	Target for reduction of transmission losses to be from the current 43% to 20% over ten years. This equates to 35GL water savings per year.
ACTION 3.4	YACTAC to consult with DIPNR, NSWF, DEC and State Water on applying an integrated approach for works along the system in order to meet legislative requirements. A holistic approach taking in the needs of both users and the environment for the entire YCS help achieve a streamlined consent process for the project.
ACTION 3.7	State Water Asset Management Branch liaise with DIPNR, NSWF and DEC staff where necessary and make provision in a State Water maintenance budget to include remedial works to prevent losses.
ACTION 3.8(B)	That all engineering options to improve operational and environmental management of the Yanco Creek system be appropriately assessed to determine their feasibility and cost benefit.
ACTION 3.9(B)	Following the Weir Review of the YCS, undertaken by State Water, YACTAC review the document with a view to developing a strategic approach to weir removal or retention that is consistent with the outcomes and objectives of this plan.
ACTION 3.9(C)	Where viewed appropriate and in line with operational needs and government policy, that State Water assist with the cost of refurbishment of important in-system flow structures.
ACTION 3.10	That YACTAC seek a meeting with the Murrumbidgee Customer Service Committee to pursue improvements to State Water's water ordering system including information and education of users on its use and the need for compliance.

ACTION 3.11(A)	That YACTAC instigate a demand management strategy be used during water shortages, for future management of supply in the YCS over the irrigation season.
ACTION 3.11(B)	That irrigators continue to order water weekly, with a two week forecast, as part of on-going management of supply in the YCS.
ACTION 3.14(E)	That a detailed hydrological analysis and modelling for the YCS be undertaken prior to any changes to existing structures or flow management.
ACTION 3.22(A)	That YACTAC, DIPNR and State Water develop a Memorandum Of Understanding with Murray Irrigation Limited and Coleambally Irrigation Cooperative Limited which guarantees supply of water from their channel systems to the YCS under agreed conditions.
ACTION 3.22(B)	That the YACTAC, DIPNR and State Water establish formal agreements with irrigation companies for surplus flows entering the system which would place parameters on flow volumes, timing of releases and water quality targets.
ACTION 3.23	That State Water in collaboration with relevant agencies (local government, community etc) establish and make a permanent commitment to an annual system maintenance program based on targeted work priorities to enhance the long term sustainability of the YCS.

Key Issue: Developing community ownership, participation and empowerment to improve the future management of the system's natural resources.

Action Number	Action
ACTION 3.1	That YACTAC in conjunction with State Water and NSW Agriculture explore measures to increase information flow to enable landholders to make strategic decisions in terms of what crop or pasture to grow for any year, and enable tactical decisions in terms of specific watering regimes for any given summer irrigation period.
ACTION 3.3	YACTAC in conjunction with State Water instigate a working party to investigate seasonal delivery policies for the YCS.
ACTION 3.8(A)	That YACTAC be proactive in discussing partnering opportunities with Murray Darling Basin Commission, Pratt Water and Snowy Hydro.
ACTION 3.9(A)	That YACTAC DIPNR and State Water undertake a combined information program to increase landholder awareness of weir ownership and/or licence conditions included in relevant legislation.
ACTION 3.12	That the YACTAC promote the availability of flow information on the Yanco Creek System to the YCS community in an accessible and easily understood format.
ACTION 3.14(C)	That YACTAC meet with Irrigation Companies and the EPA with a view to determining the licence requirements and conditions as they effect YCS and that this be made available to members.

ACTION 3.14(D)	That YACTAC work with the EPA and Local Councils and other bodies such as Fire Brigades and rescue squads to establish emergency management plans to control environmental emergencies. e.g. road accidents/chemical spills.
ACTION 3.14(H)	Provision of water quality and monitoring data to ensure landholders are better informed in related decision making.
ACTION 3.16(A)	Community participation programs to promote the control and commercial use of carp be supported and enhanced.
ACTION 3.20	That YACTAC set up a funding sub-committee to pursue all funding opportunities for the implementation of the NRMP.
ACTION 3.24	YACTAC to make members aware of limited provisions pertaining to compensation contained in the Water Act 2000.
ACTION 3.25(A)	That the YACTAC form an implementation steering group that is tasked with ensuring adequate consultation with stakeholders in the development management and review of the Natural Resource Management Plan.
ACTION 3.26	That YACTAC continue to support efforts by groups such as NSW Irrigators Council to improve the public's perception of irrigated agriculture.
ACTION 4.1(A)	That YACTAC seek external funding to initiate on-ground works which includes the employment of implementation personnel.
ACTION 4.1(B)	That all water users in the YCS contribute to the NRMA via a levy being $1.50 per megalitre on entitlement and $2.00 per megalitre on usage. This is to be charged as part of State Water annual water accounts.

Project Management

YACTAC believe that given the complexity and cost of the project that an independent Project Management Committee (PMC) will be set up. The PMC would comprise three YACTAC members, representatives from the CMA's and State Water and three independent members. Nominations for the independent members have been called for. The PMC will have a terms of reference, set reporting formats and timeframes and will have multiple accountabilities including YACTAC, irrigators, funding bodies, CMA's and DIPNR. We believe that a PMC is the most efficient and transparent way to manage a project of this size and nature.

Cost and Funding of the NRMP

The cost of implementing the plan are set out in the budget at the end of Section 4 and are estimated to cost $23.4 million. This plan is fundamentally different from most other plans in that landholders have committed to funding the plan on 20% cash and 20% in kind basis. YCATAC is seeking Government assistance for 60% of the costs associated with the plan. This is unique in that landholders are directly investing in natural resource management. We have consulted with landholders on the basis of putting a compulsory levy on their water accounts. This has been overwhelmingly accepted. State Water have advised that they are unable to place a compulsory levy on the water accounts as State Water are bound to the IPART process. Initial alternate advice sought by YACTAC on implementing a levy on water accounts for funding the plan has been that CMAs have the capacity within their governing legislation to impose levies and this option is being further investigated. Regardless of this, the levy is a steadfast commitment on behalf of the landholders to progress their NRMP.

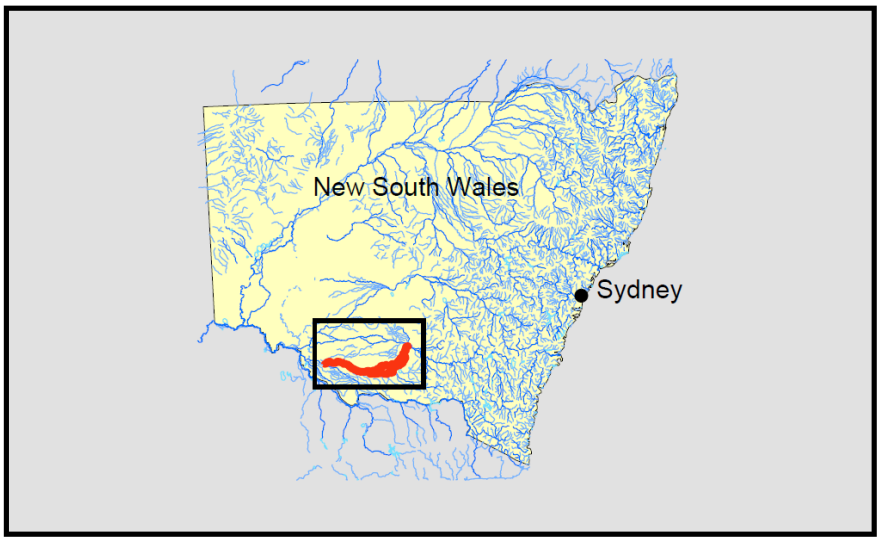

Figure 1: Location of Yanco Creek System in N.S.W.

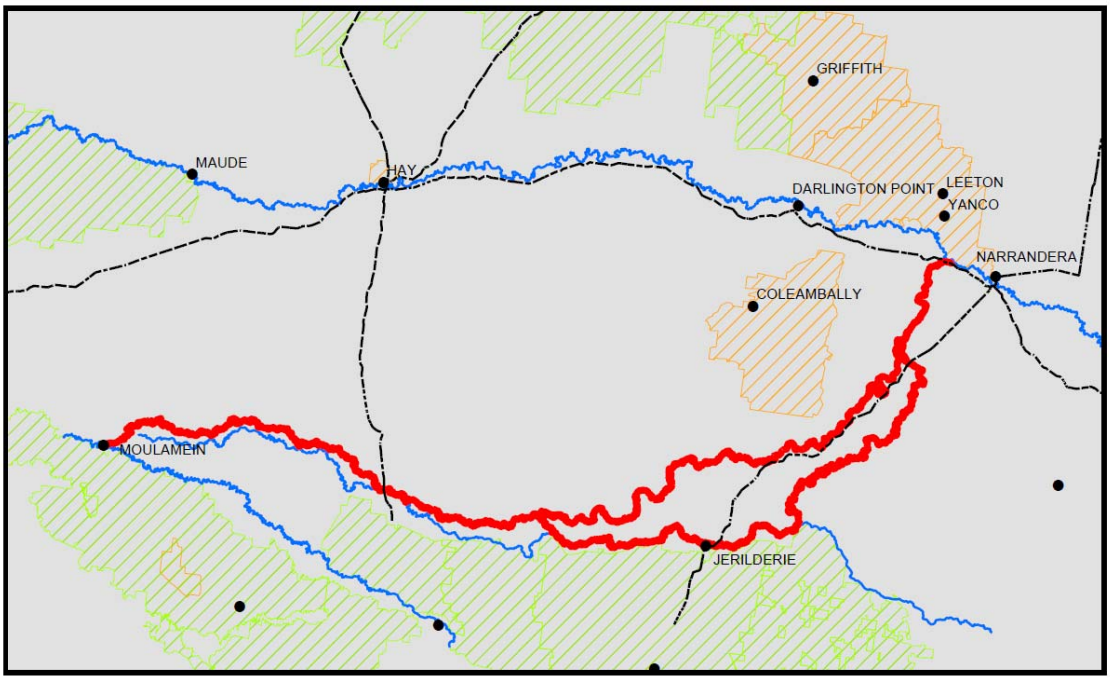

Figure 2: Yanco Creek System

1. PLAN CONTEXT AND BACKGROUND.

1.1 BACKGROUND TO THE YANCO CREEK SYSTEM NATURAL RESOURCE MANAGEMENT PLAN (YCS NRMP)

The plan was developed over concern regarding:

- Transmission losses over the Yanco Creek and related tributaries, particularly under high regulated flows.
- The need to be able to deliver more timely flows to system users.
- The impact of introduced trees and other exotic vegetation such as willows and their impact on riparian ecology, channel capacity and over-bank flooding in transfer of high flows.
- Broader issues of creek health including sustainable development and use of the Yanco Creek and its tributaries.
- Timeliness of developing a consolidated view of the management of the creek, given concern over transmission losses raised by the Murrumbidgee River Management Committee; the formation of the Murrumbidgee Catchment Management Board, and the requirement for water savings as part of Government Agreements with 'Snowy Water Savings'

Impetus for the plan grew through an approach from the Yanco Creek and Tributaries Advisory Council (YCATAC) to Department of Infrastructure, Planning and Natural Resources (DIPNR), to form a partnership in the development of the plan. Subsequently the YCATAC Executive Officer and DIPNR officers introduced the concept of the strategic plan to the YCATAC AGM in September 2002, and presented an overview of possible issues that might form the plan basis, and sought feedback at meetings throughout the area in late October 2002. At these meetings potential plan objectives were presented as:

1. To maintain and improve the health of the creek and mimic natural flooding events where possible.
2. To improve the overall deliverability and efficiency of supply for the entire creek system.
3. Maintain and improve the riparian habitat along the creek system.
4. Engage all members in decision making.

Details of the community consultation process and a list of key issues nominated by stakeholders are included as Appendix 1.

1.2 RELATIONSHIP TO THE FOREST CREEK MANAGEMENT PLAN

In October 1998, a community meeting was held in the Forest Creek area, where landholders and interested stakeholders identified their vision for the Forest Creek system. This arose as a response to concerns regarding the management of the Wanganella Swamp system and long-standing concerns regarding difficulty of supply of water to the lower reaches of the Forest Creek system.

Without a management plan it was felt that the lower reach of the Forest Creek system was likely to become an increasingly ineffective water carrier, sustaining an increasingly inefficient use of water. This current flow regime was degrading wetland areas that are permanently inundated and had encouraged the extensive growth of Cumbungi (*Typha domingensis)*. Water was taking longer to reach downstream landholders and over time it was likely that problems with water delivery would increasingly affect adjacent, upstream landholders.

For various reasons, the Forest Creek Management Plan has not been implemented. In 2001 the YCATAC began discussing the need for an overall Natural Resource Management Plan (NRMP) for the entire creek system which would include the Forest Creek System.

Given the amount of work that has gone into the Forest Creek Management Plan it was decided for the purposes of the YCS NRMP that:

- Issues specific to the Forest Creek system would form a stand-alone part of the YCS NRMP. These are specifically lack of water in the reaches of the Forest Creek Anabranch, Management of the Wanganella Swamp, and Flooding of the Cobb Highway.
- Issues pertaining to the overall Yanco Creek System (including the Forest Creek System) would be included as part of the overall NRMP.
- The Forest Creek part of the NRMP would only include recommended management options and not all options that were considered.

1.3 SCOPE OF THE PLAN

The YCS NRMP encapsulates water delivery and environmental issues surrounding Yanco, Colombo, Billabong and Forest Creeks. It includes the immediate creek surrounds, stock and domestic systems and also the influence irrigation areas. Broader dry land areas are outside the scope of the NRMP.

Figure 1 displays location of Yanco Creek System in NSW and Figure 2 displays location within the Murray/Murrumbidgee River system.

1.4 TARGETED OUTCOMES OF THE PLAN

Implementing the YCS NRMP will help achieve the key interests of YCATAC and other stakeholders by reaching the following outcomes:

- Water delivery losses as defined in this plan will be reduced to an acceptable level of 20% taking into account key factors such as accession losses to the groundwater system, overbank escapes in times of high flow and flood, evaporation and pilfering.
- Through the benefits of all actions undertaken as part of the plan that a net saving of 36 GLs of water will be achieved for alternate purposes such as environmental flows and off sets for funding to undertake on-going maintenance and increased understanding of the system through more extensive scientific and technical investigations.
- That riparian health including native endangered flora and fauna species will improve by 8% by the year 2010.
- That predetermined and measurable water quality parameters at established monitoring sites will improve by 5% by the year 2010.

Achieving these targets will ensure the natural environment ecosystems and agricultural systems are maintained and improved so that future use can be continued and the resource base is not depleted.

1.5 STATUS OF THE PLAN

The YCS NRMP is an advisory plan to influence private and public sector management of the creek. The plan has no regulatory powers. It aims to achieve natural resource management outcomes by awareness and coordinated investment. Using cost-sharing principles with Creek users and stakeholders, it is hoped this document will attract funding from external sources to address issues identified from the planning process.

The Plan is consistent with natural resource targets and associated management actions set out in both the Murrumbidgee and Murray Catchment Blueprints as detailed in the tables below. The plan is set to become a sub-regional plan consistent with objectives in the soon to be compiled Catchment Action Plans which will be required by each Catchment Management Authority. The development of the plan is supported by the Customer Service Committee of State Water, South Area and the Murrumbidgee River Management Committee along with related government agencies.

Summary of integration of the Yanco Creek System Management Plan and the Murray Catchment Blueprint

YCS Management Plan Objectives	Related Blueprint Target	Related Blueprint Action
Maintain and improve the riparian habitat along the creek system. To improve the overall deliverability and efficiency of supply for the entire creek system. To maintain and improve the health of the creek and mimic flooding events where possible.	Interim Water Quality Management Targets – Sedimentation. Progressive reduction from 2002 levels in the average annual quantity of sediment entering rivers from the landscape and being transported between reaches as suspended sediment. A reduction in the loss of soil and nutrients from cropping and grazing systems through improved land management. Undertaking soil erosion management on those sites identified as suffering from accelerated erosion and key contributors to sediment yield. Improving riparian vegetation to stabilise river banks and to trap sediment. Managing the stream and river sediment bed loads. Biodiversity management. Retain and mange for conservation, existing riparian vegetation and restore and manage for conservation 80% of the total land of the riparian zone whilst recognizing and maintaining riparian rights. By 2012 restore and actively manage at least 20% of the total unvegetated area (7000 hectares combined area in total) of the riparian zone in each management unit. Improve the extent and quality of habitat for fish and aquatic species in the Murray through: a) Provision of fish passage on at least 5 additional weirs by 2012 following a weir survey within the region to be undertaken by 2005 to determine priorities and design. b) Provision of fish passage by the removal of redundant weirs identified in a weir survey of the	(Numbers relate to Blueprint Activity Number which are not ranked) **A146** 870 hectares of riparian zone revegetated and managed for conservation. **A143** Actively manage for conservation 32,800 hectares of remnant vegetation. **A144** Restore and regenerate 7600 hectares under-represented Broad Vegetation Types. A149 Improve Water Use Efficiency **A010** provision of fish passage on 5 additional weirs. **A011** Weir Survey and Review **A013** Provision of fish passage by the removal of redundant weirs. **A014** Establish baseline data for aquatic populations and distribution. **A019** Restoration of 10 high conservation wetlands.

Developing community ownership, participation and empowerment for managing the system's natural resources.	region to be undertaken by 2012. c) Restoring by agreement with landholders, 5 high conservation value floodplain wetlands covering an area of not less than 5000 hectares by 2012. Through community cooperation, participation and agreement, develop and implement an effective means of species recovery of at least 10 threatened species listed as occurring in the Murray Catchment by the year 2012. Maintain the population of selected locally threatened birds, mammals, reptiles and where possible increase these populations by 10% by 2022.	**A020** Species recovery plans. **A021** Paper identifying the research needs of the region being prepared by DIPNR. **A022** Develop indicators of riverine health for new river health targets. **A023** Analysis of impacts of management actions to achieving targets. **A024** Socio-economic research.

SUMMARY OF INTEGRATION OF THE YANCO CREEK SYSTEM MANAGEMENT PLAN AND THE MURRUMBIGDEE CATCHMENT BLUEPRINT

YCS Management plan objective	RELATED BLUEPRINT TARGET	Related Blueprint action
	WATER QUALITY & FLOW	
▪ Maintain and improve the riparian habitat along the creek system ▪ To improve the overall deliverability and efficiency of supply for the entire creek system.	***WMT1.*** Protect and enhance 1500 kilometres of stream bank using native riparian vegetation for bank stabilisation and runoff filtration. ***WMT2.*** Along those stream reaches, which yield the highest sediment and nutrient loads, control stream bank and gully erosion using structural control works covering a total length of fifty kilometres.	***WMA1.*** Protect, enhance and re-establish existing riparian native vegetation. ***WMA2.*** Manage stock access. ***WMA3.*** Manage problem weeds (eg black willows) ***WMA4.*** Construct stream bank and gully erosion control works.
▪ To maintain and improve the health of the creek and mimic natural flooding events where possible	**Biodiversity** Maintain diversity (as described in the NSW Biodiversity Strategy) of indigenous aquatic biota and processes by: A reduction in the species diversity ratio of alien to native fish by 25%. (Note: This	***BMA12.*** Retain, enhance and revegetate riparian and aquatic native vegetation. ***BMA13.*** Revegetate the priority riparian and aquatic native vegetation communities

YCS Management plan objective	RELATED BLUEPRINT TARGET	Related Blueprint action
	component of the Management Target does not relate to notified trout waters gazetted under the Fisheries Management Act 1994). A reduction in the abundance ratio of alien to native fish by 50%. A 10% increase in aquatic invertebrate diversity as measured by currently accepted diversity indices (eg SIGNAL scores) and richness; complying with ANZECC guidelines for protecting biodiversity. Establishment and long term maintenance of native aquatic plants for 10 linear kilometres of Murrumbidgee River. Improved river productivity related to natural spatial patterns. Increased extent and duration of floodplain inundation consistent with Water Sharing Plans.	***BMA14.*** Enhance structural habitat for aquatic biota. ***BMA15.*** Enhance aquatic connectivity ***BMA17.*** Protect sites of relatively intact aquatic biodiversity ***BMA18.*** Manage in stream habitat complexity by maintaining and improving channel complexity and in stream vegetation.
▪ Developing community ownership, participation and empowerment for managing the system's natural resources.	**Catchment Target:** By 2012 achieve a *net gain* in the community's capacity to implement natural resource management activities. Net gain refers to a measurable increase over existing capacity in: a) the community's awareness of the social, cultural and economic values of the Murrumbidgee River catchment and; b) The community's effective participation rate in natural resource management activities at the sub-catchment level.	***CBMA9.*** Develop targeted initiatives and strategies to increase the understanding, skills and motivation of the community to take positive action for NRM. ***CBMA10.*** Facilitate an increased investment on public and private land through exploring and developing cost sharing mechanisms .

1.6 MANAGEMENT ACTIONS

This plan suggests a number of management actions needed to implement the plan. As each recommended Management Action was established, responsibilities for actions, the timeframe needed for completion and the priority of the task was determined. These emerged when YACTAC collected community views on where priority areas along the system existed, when an assessment of the importance of a task to operational needs of the system, and from gauging likely cost benefit of the action in meeting the objectives of the plan. The key management actions are as follows.

Action Number	Action
ACTION 3.1	That YACTAC in conjunction with State Water and NSW Agriculture explore measures to increase information flow to enable landholders to make strategic decisions in terms of what crop or pasture to grow for any year, and enable tactical decisions in terms of specific watering regimes for any given summer irrigation period.
ACTION 3.2(A)	Request appropriate bodies to initiate a comprehensive water balance study of the entire Yanco Creek System to clarify definitions and interpretations of losses occurring in the system. This will improve the overall understanding of water losses and transport of flows within the system and of those which there is little control over in relation to delivery capabilities. i.e. channel capacities, weir distribution volumes and travel times.
ACTION 3.2(B)	Target for reduction of transmission losses to be from the current 43% to 20% over ten years. This equates to 35GL water savings per year.
ACTION 3.3	YACTAC in conjunction with State Water instigate a working party to investigate seasonal delivery policies for the YCS.
ACTION 3.4	YACTAC to consult with DIPNR, NSWF, DEC and State Water on applying an integrated approach for works along the system in order to meet legislative requirements. A holistic approach taking in the needs of both users and the environment for the entire YCS help achieve a streamlined consent process for the project.
ACTION 3.5(A)	That a draft strategic program be developed for willow removal, bank stabilisation and revegetation providing prioritisation and timeframes for any proposed staged development.
ACTION 3.5(B)	That the program of willow removal, bank stabilisation and revegetation be submitted and approved by relevant government agencies.
ACTION 3.6	That the extent of cumbungi in the Yanco Creek system be monitored, with a view to the possible need for future control. This is to involve possible targeted areas where chemical control options would be trialled and monitored to determine efficient and effective control measures.
ACTION 3.7	State Water Asset Management Branch liaise with DIPNR, NSWF and DEC staff where necessary and make provision in a State Water maintenance budget to include remedial works to prevent losses.
ACTION 3.8(A)	That YACTAC be proactive in discussing partnering opportunities with Murray Darling Basin Commission, Pratt Water and Snowy Hydro.
ACTION 3.8(B)	That all engineering options to improve operational and environmental management of the Yanco Creek system be appropriately assessed to determine their feasibility and cost benefit.
ACTION 3.9(A)	That YACTAC DIPNR and State Water undertake a combined information program to increase landholder awareness of weir ownership and/or licence conditions included in relevant legislation.
ACTION 3.9(B)	Following the Weir Review of the YCS, undertaken by State Water, YACTAC review the document with a view to developing a strategic approach to weir removal or retention that is consistent with the outcomes and objectives of this plan.

ACTION 3.9(C)	Where viewed appropriate and in line with operational needs and government policy, that State Water assist with the cost of refurbishment of important in-system flow structures.
ACTION 3.10	That YACTAC seek a meeting with the Murrumbidgee Customer Service Committee to pursue improvements to State Water's water ordering system including information and education of users on its use and the need for compliance.
ACTION 3.11(A)	That YACTAC instigate a demand management strategy be used during water shortages, for future management of supply in the YCS over the irrigation season.
ACTION 3.11(B)	That irrigators continue to order water weekly, with a two week forecast, as part of on-going management of supply in the YCS.
ACTION 3.12	That the YACTAC promote the availability of flow information on the Yanco Creek System to the YCS community in an accessible and easily understood format.
ACTION 3.13(A)	That the current flow regime of YCS be investigated and modified if necessary, to best mimic natural flooding regimes and particularly wetlands.
ACTION 3.13(B)	That a scoping study be undertaken to identify and establish management needs to maintain and enhance key wetlands including natural wetlands and those created by water escapes and weir pools.
ACTION 3.14(A)	That the current water quality monitoring regime in place be assessed with a view to ensuring that it provides timely and accessible information on appropriate water quality parameters.
ACTION 3.14(B)	That a salinity audit of the YCS be undertaken that determines salt sources, its distribution and location in the system, so as to instigate management actions to control its accumulation and impact on the system and to measure export quantities.
ACTION 3.14(C)	That YACTAC meet with Irrigation Companies and the EPA with a view to determining the licence requirements and conditions as they effect YCS and that this be made available to members.
ACTION 3.14(D)	That YACTAC work with the EPA and Local Councils and other bodies such as Fire Brigades and rescue squads to establish emergency management plans to control environmental emergencies. e.g. road accidents/chemical spills.
ACTION 3.14(E)	That a detailed hydrological analysis and modelling for the YCS be undertaken prior to any changes to existing structures or flow management.
ACTION 3.14(F)	That an integrated water quality and ecological monitoring framework be established to assess the effect of plan implementation. This to include riverine environment, in-stream water quality and town water supplies.
ACTION 3.14(G)	That a review be undertaken of flow and water quality recording network to meet current and future requirements, and with particular emphasis on the lower reaches of Colombo Creek to determine end of valley flow and salt load export from the Murrumbidgee valley.
ACTION 3.14(H)	Provision of water quality and monitoring data to ensure landholders are better informed in related decision making.
ACTION 3.15(A)	(i) That all land managers including farmers, irrigation companies, government agencies, local councils and regional weed management groups implement and coordinate weed eradication programmes along riparian areas of YCS. (ii) That YACTAC ensure weed identification, reporting and controls are key components in establishing a prioritised works and monitoring programme along the YCS. (iii) That control works programmes are formulated in consultation with government agency staff and comply with relevant legislation and noxious weed protocols. (iv)

ACTION 3.15(B)	That land managers, implement recognised best practice management techniques for the management of stock adjacent to riparian areas. Best management practices may include fencing off areas to exclude grazing stock and allowing natural regeneration.
ACTION 3.15(C)	Those areas of high conservation value riparian areas be identified with a view to developing 'best management practices' and using funding incentives to maintain and improve riparian and wetland habitat. Best management practices may include fencing off areas to exclude grazing stock and allowing natural regeneration.
ACTION 3.15(D)	That DIPNR and CMA's through incentive programs continue to raise community awareness of the value of protecting riparian habitats, and the importance this plays in contributing to ecologically sustainable management.
ACTION 3.16(A)	Community participation programs to promote the control and commercial use of carp be supported and enhanced.
ACTION 3.16(B)	That current research techniques e.g. daughterless carp (induced sterility measures) to control the persistence and spread of carp into inland waterways be supported.
ACTION 3.16(C)	That the YACTAC NRMP strategies and actions are consistent with Murray and Murrumbidgee Catchment Blueprints.
ACTION 3.17	That the YACTAC seek access to vegetation management incentives to facilitate the opportunity to achieve better management outcomes from managing the riparian pathway for conservation purposes.
ACTION 3.19(A)	That any creek works be undertaken following a coordinated and integrated approach involving consent authorities and with regard to whole of system strategy.
ACTION 3.19(B)	That YACTAC investigate the possibility of the YCS NRMP and associated works, be used as a pilot project for trialling improved integrated approvals being developed by government agencies.
ACTION 3.20	That YACTAC set up a funding sub-committee to pursue all funding opportunities for the implementation of the NRMP.
ACTION 3.21	That the YACTAC requests appropriate authority to have a formal and permanent consideration of environmental flow requirements for the YCS.
ACTION 3.22(A)	That YACTAC, DIPNR and State Water develop a Memorandum Of Understanding with Murray Irrigation Limited and Coleambally Irrigation Cooperative Limited which guarantees supply of water from their channel systems to the YCS under agreed conditions.
ACTION 3.22(B)	That the YACTAC, DIPNR and State Water establish formal agreements with irrigation companies for surplus flows entering the system which would place parameters on flow volumes, timing of releases and water quality targets.
ACTION 3.23	That State Water in collaboration with relevant agencies (local government, community etc) establish and make a permanent commitment to an annual system maintenance program based on targeted work priorities to enhance the long term sustainability of the YCS.
ACTION 3.24	YACTAC to make members aware of limited provisions pertaining to compensation contained in the Water Act 2000.
ACTION 3.25(A)	That the YACTAC form an implementation steering group that is tasked with ensuring adequate consultation with stakeholders in the development management and review of the Natural Resource Management Plan.
ACTION 3.25(B)	That YACTAC ensure that works are carried out in accordance with the regulations contained in the National Parks Act 1974 pertaining to Aboriginal sites of cultural significance.
ACTION 3.26	That YACTAC continue to support efforts by groups such as NSW Irrigators Council to improve the public's perception of irrigated agriculture.
ACTION 3.27(A)	That the Landholder proposal currently being drafted be supported and endorsed on completion to expedite its implementation to return 11.5 GL's of water for environmental flows.

ACTION 3.27(B)	That the following revised target flows for Warriston Weir be implemented as soon as possible: **Target 1. Unregulated/rain rejection flows** • That unregulated/rain rejection flows be permitted to pass through the Forest Creek system for environmental purposes. (It should be noted that from an operational point of view this is extremely difficult to implement because of the inadequate capacity of the Forest Creek off-take and the Forest Creek Regulated Section to allow those flows to pass through.) **Target 2. 'Summer' target flow at Warriston Weir** • That a target flow of 80Ml/day at Warriston Weir be provided from the beginning of November to end March. **Target 3. 'Winter' target flow at Warriston Weir** • That a minimum target flow of 60Ml/day at Warriston Weir be provided from beginning of April to end October.
ACTION 3.27(C)	That funding be secured for infrastructure to return flows to Billabong Creek.
ACTION 3.27(D)	That proposed changes to the flow regime be monitored annually to assess the social, economic and environmental impact.
ACTION 3.28(A)	That the operation of the Forest Creek off-take regulator and its impact on the Wanganella Swamp be considered in wider YCS assessment of environmental outcomes and related flows.
ACTION 3.28(B)	That McCrabb's regulator and adjacent spillway be modified and appropriately upgraded.
ACTION 3.28(C)	That the operation of McCrabb's regulator be monitored as a consequence of the modifications in (B) above.
ACTION 3.29	That flooding of the Cobb Highway at Wanganella be mitigated by redesigning and refurbishing the Estuary Creek Regulator and McCrabb's regulator.
ACTION 4.1(A)	That YACTAC seek external funding to initiate on-ground works which includes the employment of implementation personnel.
ACTION 4.1(B)	That all water users in the YCS contribute to the NRMA via a levy being $1.50 per megalitre on entitlement and $2.00 per megalitre on usage. This is to be charged as part of State Water annual water accounts.

1.7 DURATION OF THE PLAN

This plan is an operational document for a ten-year period to 2014. A mid term review will be conducted after 5 years with an assessment of the implementation of recommendations. Adaptive management principles will be pursued to modify and add to the plan during this period. Principles and recommendations contained in the plan will be subject to on-going review and changes to reflect the changing nature of the current operational environment. An example of this could be changes to funding options or changes to government policy and the like.

1.8 HOW WILL THIS PLAN MAKE A DIFFERENCE?

The YCS adds to the economic and social well being of communities along its reach. These communities also recognise its value to provide environmental services (eg. provision of habitat, diversity for the landscape, refuges for wildlife). Maintenance and improvement of these values requires a co-ordinated effort from communities, stakeholders and Government. Otherwise the isolated action of individuals may not be sufficient to maintain these values.

This plan will assist strategic management of the YCS by documenting the extent of existing problems, nominating specific actions as to a way forward, and guide investment into key creek works. Strategic multi-faceted investment and upgrade to the entire YCS will have a number of advantages to all stakeholders. Examples of these include:

- Facilitate the securing of better environmental conditions in the riparian zone to protect and enhance habitat for the system's dependant flora and fauna.

- More timely delivery of flows will help to maximise efficient application of irrigation water thus reducing potential yield losses and undermining the agricultural productive capacity of the region.
- Result in a more motivated and empowered community participating in the management of the system that will provide an improved basis for future decision making.
- Assist the achievement of broader river and catchment system management objectives for the greater Murray Darling Basin. Examples of this would include improved water quality and greater attainment of down stream flow targets.
- Additionally, economic saving based on current transmission losses could amount to $23.4 million based on the assumption of 160,000 ML/yr average use and aiming to reduce losses to 25% is 36,000 ML/yr @ $650/ ML average price of water based on all user types.

Maps of the Yanco Creek System infestation of cumbungi, willows, large woody debris are contained at the back of this document.

Plate 1: Honourable Minister Craig Knowles signs a copy of "Song of Running Water", the history book of the Yanco Creek System, at the launch of the Yanco Creek System Natural Resource Management Plan on 1 March 2004 at "Old Coree", Rice Research Australia Jerilderie – pictured in the foreground, David Harris (DIPNR), Hon. Craig Knowles, Elise Schumacher (Senior Policy Advisor to the Minister), Richard Sleigh (Chairman, YACTAC), Robert Shuttle (State Water).

1.9 CONSULTATION PROCESS

The following outlines the consultation process undertaken thus far by the YCATAC in preparation of the YCS NRMP. The YCATAC believe that a fair and thorough consultation process is necessary to ensure that the NRMP reflects the issues of the landholders along the creek system and that there is general consensus on the way forward to manage the system into the future.

1 July 2002 YCATAC convened a meeting of its Executive at Conargo to discuss the issues surrounding a NRMP. At that meeting the Executive drafted four key issues that a NRMP should address.

2 The Executive presented the four key issues and the need for a NRMP to its Annual General Meeting held at Jerilderie in September 2002.

3 In October 2002, 4 meetings were held along the YCS to discuss the issues associated with a NRMP. Meetings were held at Euroley, Conargo, Jerilderie and Wanganella. Approximately 80 irrigators attended those meetings. Notes of the meetings were recorded and are attached in Appendix 1(A). Irrigators were also invited to record their issues and concerns via telephone and a pre-printed form. The results of this are also contained in Appendix 1(B).

4 In February 2003 a meeting was held with the Forest Creek Management Plan Management Committee to look at the issues raised in that plan. Relevant Management actions specific to Forest Creek were identified and amended to account for changed circumstances. It was agreed by the Forest Creek Management Committee to have these issues included in the YCS NRMP along with all other management actions applicable to the whole of the YCS.

5 In late September 2003, 200 copies of the draft plan were printed and dispatched to relevant stakeholders. This included all licence holders in the system, NSW Government Agencies, Local Government Shire Offices, and other interested parties.

6 In late October 2003 a further round of public meetings were held at the same strategic locations in the system to gain feedback and suggestions on how to improve the plan and what should be considered as part of an implementation plan and the most appropriate way to manage the project. The YCATAC put forward a proposal to fund 40% of the project costs by the licence holders. This would be 20% in cash and 20% in kind. The cash component would take the form of a compulsory levy on all water users being $1.50 per ML on entitlement and $2.00 per ML on usage. The levy would be in place for an initial 3 year period after which time it would be reviewed. A proposal was also put forward to form a Project Management Committee to oversee the project. It would be made up of representatives from YCATAC, independent persons and government representatives. Invitations were extended for written submissions and a survey was circulated to all licence holders to gauge interest and support for the proposal put forward by YCATAC. (The results of this are included in Appendix 2.)

7 Following the public meetings, feedback and comments were reviewed by the authors and where appropriate were included.

8 Due to the complexities surrounding the issues in the Forest Creek, the Forest Creek Working Party were invited to rewrite that part of the document.

9 Other sections of the plan where given to other interested parties to gain their thoughts to ensure their comments were fully addressed.

10 Several deputations were made including Minister of Infrastructure, Planning and Natural Resource Management, Minister of Utilities, government departments at a state and regional level.

11 Work has also commenced to compile the Implementation Plan.

12 The Minister of Infrastructure, Planning and Natural Resource Management formally launched the plan at a function at Rice Research Australia, Jerilderie on March 1 2004.

13 In May 2004 the final plan was reviewed and endorsed by YCATAC.

14 In July 2004 a letter detailing the major changes between the draft and the final was mailed to all license holders along with the final plan.

Plate 2: Landholder Consultation Meeting held at the Conargo Hall, Conargo on 29 October, 2002

DESCRIPTION OF THE YANCO CREEK SYSTEM

2.1 THE PHYSICAL SYSTEM

Water diversion and supply distribution into the YCS forms a major part of the effluent regime of the Murrumbidgee River. Since European settlement of the riverine plains and the construction of irrigation infrastructure over a long history, the Yanco Creek and its tributaries is now a regulated stream providing life giving water critical to the survival of vital ecosystems and to rural communities over a vast track of the Riverina.

With the facility of Yanco Weir in place west of Narrandera, water is distributed down the Yanco Creek flowing south-west to Tarabah Weir located just south of the junction of Yanco Creek and Colombo Creek. Tarabah Weir allows for diversions into the Colombo Creek (Simpson 1994). It takes a mostly southerly flow-path where it joins the Billabong Creek upstream of Jerilderie.

The Billabong Creek, having its origins in the Holbrook/Culcairn region, flows through Jerilderie along to Hartwood Weir where water can be directed into the Forest Creek System. Forest Creek is a high level effluent of Billabong Creek (Simpson 1994), and is a regulated stream of the Murray River until it reaches Warriston Weir, where it becomes an unregulated stream until it flows into Eight Mile Creek providing a domestic and stock water supply. It then passes through Wanganella Swamp into the Forest Creek Anabranch which inturn flows back into the Billabong Creek System downstream of Wanganella Township (Simpson 1994).

The Yanco Creek traverses vast plain country in a south-westerly direction and meets up with the Billabong Creek downstream of Hartwood Weir and upstream of Conargo township. Flows down the Yanco can be supplemented in peak summer demand periods by water that passes through the Coleambally Irrigation Area via the Coleambally Catchment Drain and Drainage Canal (DC800). Flows into the Billabong Creek can be supplemented through Murray Irrigation Limited (MIL) Finley and Berriquin Escapes.

Eventually the Billabong Creek meets the Edward River and finally joins the Murray River downstream of Deniliquin (Simpson 1994).

The Yanco Creek System meanders over a length of approximately 799km of the riverine plain causing the creek to meander considerably. The channel capacities of the creek accommodate relatively low flows and there are significant travel times for water supply deliveries to reach their destinations (Refer Section 2.3).

2.2 HISTORY OF THE SYSTEM

The Edward River was discovered on 3 January 1840 by John Webster and James McLaurin. Two years later Augustus Morris followed the Billabong Creek to its junction with the Edward and then along its banks to the Murray. During this period the NSW Colonial Government had forbidden occupation of land west of Yass. By the early 1840's land seekers were moving west with mobs of sheep and cattle seeking watered country.

Prior to 1856, under natural conditions, the Yanco/Billabong Creek System would have been a mostly dry intermittent system that received flows at certain flood levels. For the Yanco Creek, flows would have only occurred when the Murrumbidgee exceeded daily flow rates greater than 40,000 ML/day (4% of the time) (White *et al*., 1985).

In 1856, lobbying by Pastoralists allowed the Yanco Creek off-take to be enlarged to provide increased flows into the system. Numerous weirs were constructed by landholders along the system to retain water when flows ceased. By 1858 there were 23 runs along the 230km of the Billabong creek all receiving unimpeded access to its water. In the same year, George Desailly (owner of Coree) built a dam that completely blocked the creek so that settlers below him were waterless except when the dam overflowed.

In 1885 the settlers on the Upper Yanco adopted a plan to finance a cutting that would link the creek with the waters of the Murrumbidgee. A Committee was set up and the following year 100 men completed a cutting about 6 miles long. The sluggish waters however only soaked into the surrounding soil or evaporated. It took another six years to deepen the cutting and install a pump. Once again the result was a failure. It took quite a few more years to dig a deep and properly graded cutting, 8 miles long before settlers were able to watch a free flow of water from the Murrumbidgee into the Yanco. Just before the turn of the century, a joint government-settlers fund financed the new McKinney Cutting.

Due to the importance of flows in the system, *the Yanco Colombo and Billabong Creeks Trust* was established in 1921, to take responsibility for the operation and maintenance of works associated with the building of the Yanco Weir (Simpson 1994). In May 1923 the NSW Government announced that construction work had started. In February 1928 the weir was formally handed over to the Yanco, Colombo and Billabong Creeks Water Trust.

In 1950 limited irrigation of 12.5ha per riparian landholder was permitted. In 1957 the wall height of Burrinjuck was raised to give additional storage capacity and irrigation was extended. Further irrigation expansion was allowed when Blowering Dam on the Tumut River was completed in 1969.

The 1970's saw granting of irrigation licences and subdivision of riparian holdings along the system increase. By 1980 *the Yanco Colombo and Billabong Creeks Trust* was dissolved and control of the system was assumed by the Department of Water Resources, who placed an embargo on the issue of further licences that still prevails today. Following this, much of the system was declared under sections of the Water Act (1912) allowing for greater control of supply obligations and conditions on licence holders. Additionally, the removal of drop boards from the many private weirs constructed was undertaken. The Department of Water Resources also took further action to improve delivery of water by constructing the present day Yanco Creek off-take in 1980 (Simpson 1994). The YCS Advisory Council was also formed in 1980, in response to the restrictions placed on irrigators compared to those applied to the designated Murrumbidgee and Coleambally Irrigation areas (Landale in Tolhust 2002).

In the late 1980's the Department of Water Resources deregulated rice growing and allowed licensed pumpers on the Yanco Creek system to grow rice, winter/summer cereals, pastures, horticulture and viticulture. Within a short space of time activation of unused ("sleeper") licences throughout the system and the expansion of the current licences to use more of their annual entitlement increased markedly, placed greater demand on supply and delivery of water. In recent years this has become particularly pronounced in the spring-summer months when reliable supplies are needed for filling rice bays and for panicle initiation of rice plants. This increase in demand for water involved a review of the water resource allocation. 155,000 megalitres of water annually at 100% entitlement was deemed sufficient for the system. The growing of winter cereals, pasture, rice and other summer crops accounts for 75-80% of all irrigated land (by area) in the Yanco-Billabong Creeks System (Simpson 1994). In recent years (since 2001), there has been less land area sown to rice.

2.3 HYDROLOGICAL REGIME

The bulk of water entering the Yanco Creek System is supplied by the Yanco off-take, which is situated on the Yanco weir pool on the Murrumbidgee River. From this structure maximum in-stream bank flows are delivered over the majority of the year for irrigation purposes. Supplementary flows are provided by three outfall drains from the Coleambally Irrigation Area and numerous drains and escapes along the Billabong Creek and associated Murray Irrigation Districts. Flows have been regulated from the off-take based on predicted flow requirements provided by State Water for the various sections of the system. Predicted flow requirements are based on planned crop area, past usage and anticipated demand. In most years with the combined effect of inflows from irrigation supplies and natural rainfall, over bank flows do occur throughout the system (Simpson 1994). Statistics detailing volumetric allocation within the YCS are depicted in Table 1.

Table 1 - Yanco/Colombo/Billabong Creek System Volumetric Allocation Summary

	No. Licences	Total Area (Ha)	Irrig. (ML)	Town (ML)	Other (ML)	Total (ML)	Pumping Cap. (ML\Day)
YANCO CREEK							
Off-take - Morundah	**14**	**1,871**	**11,211**		**241**	**11,452**	**274**
Morundah - Catch Drain	4	556	2,916		16	2,932	130
Catch Drain - Bobaroo	41	5,342	27,052		61	27,113	955
Bobaroo - Puckawidgee	15	2,976	12,944		171	13,115	496
Subtotal	**60**	**8,874**	**42,912**	**0**	**248**	**43,160**	**1,581**
COLOMBO CREEK							
Morundah - Jctn. Billabong	33	2,547	15,292	814	1,019	17,125	458
BILLABONG CREEK							
Jctn. Colombo – Algudgerie	32	3,402	20,289	605	660	21,554	641
Subtotal	**65**	**5,949**	**35,581**	**1,419**	**1,679**	**38,679**	**1,099**
Algudgerie - Puckawidgee	17	2,589	10,827		197	11,024	480
(FOREST CREEK)**	13	1,441	8,646		379	9,025	234
Subtotal	**30**	**4,030**	**19,473**	**0**	**576**	**20,049**	**714**
Puckawidgee - Darlot	**36**	**3,813**	**23,150**	**18**	**2,025**	**25,193**	**1,014**
Darlot - Moulamein	**21**	**2,110**	**11,686**		**1,309**	**12,995**	**543**
(Outfall Drain/Euroly Creek*)	23	2,911					493
Washpan Creek						1,833	
Cuddell Creek						1,326	
TOTAL	**249**	**29,558**	**144,013**	**1,437**	**6,078**	**154,687**	**5,718**

* Not 22C: No allocation assignment

** Does not include 36.5 GL for Forest Creek Unregulated Section as per the Murrumbidgee Regulated Water Sharing Plan.

River regulation volumes based on previous operational limits are proving unable to cater for the increases in summer cropping for several reasons including:

- An inability to predict an increasing demand in the various sections of the Yanco Creek System because of the long travel time and excessive losses
- Unsatisfactory flow monitoring systems
- Physical constraints- lack of re-regulatory capacity in the system due to things such as overshot weirs.
- Channel capacity restrictions due to infestation of willows, large woody debris (LWD) and cumbungi.

Current Water Flow Travel Times

It takes approximately 5-6 weeks for regulated flows to pass from the Murrumbidgee irrigation dams (Blowering & Burrinjuck) through the YCS to Moulamein.

- Dams to Yanco Off take 7-8 days
- Yanco Offtake to Tarabah Weir 2-3 days
- Morundah to DC800 (Yanco) 7 days
- DC800 to Puckawidgee (Yanco) 7 days
- Tarabah to Innes Bridge (Colombo Creek) 8 days
- Innes Bridge to Jerilderie (Billabong) 2 days
- Jerilderie to Hartwood Weir 4 days
- Hartwood to Conargo 1–2 days
- Conargo to Darlot 7 days
- Darlot to Moulamein 7-10 days
- Forest Creek Offtake to Warriston Weir 5-6 days

Appendix 3 shows the average daily flow volumes for the system in megalitres.

2.4 FLOW CONSTRAINTS

There are a number of locations along the Yanco Creek to Morundah section where restrictions occur and inhibit the supply and delivery of water. These restrictions are commonly known as in-stream impediments. A maximum 1400 ML/day can be diverted from the Murrumbidgee River. Higher diversion volumes can be diverted; however this tends to cause flooding and increased system losses. Flow rates need to be monitored closely in the Washpan Creek where it leaves the Yanco creek and flows over Spillers Regulator before travelling and returning to the Yanco before Tarabah Weir at Morundah.

Flooding of private property can occur when the bank-full capacity of Colombo Creek exceeds 600-650ML/day. Despite de-snagging works in 1992 that achieved a 15% increase in capacity along this section of Colombo Creek, further removal of strategic obstructions needs to be considered along with a review of operational weirs accompanied by community consultation. This work has to also comply with current legislation including the Fisheries Management Act, 1994, the Threatened Species Conservation Act, 1995, and the Occupational Health & Safety Act, 2000.

Other supply sources such as escapes and drainage channels also have supply limitations. Table 2 depicts creek flow impediments and system losses within the YCS

Table 2: Creek flow impediments, system loses and location of weir structures within the YCS (ML/day)

Section	Off take to Morundah	Morundah to DC 800	DC 800 to Puckawidgee	Conargo to Wanganella	Wanganella to Darlot	Columbo Creek	Junction to Jerilderie	Jerilderie to Algudgerie	Algudgerie to Hartwood	Forest Creek	Hartwood to Conargo	Darlot to Moulamein	Totals
Length of Reach	44 kms	108 kms	106 kms	68 kms	64 kms	148 kms	46 kms	28 kms	61 kms	27 kms	20 kms	79 kms	799 kms
Total No. of Willows	350	>600	>500	>180	>30	>720	>400	>320	100	>220	>75	>15	>3510
Total No. LWD	>500	>600	>4240	>150	>135	>1850	>760	>600	>450	>120	>200	>105	>12980
Total No. Floodrunners and Ox Bows	9	7	7	8	1	11	2	4	5	3	8	1	66
Total No. Wetlands	2				2							1	5
Total No. Cumbungi and other weed Infestations	2	11	13	5	2	5	8	8	4	14	3		75
Weirs – State	2					3	1	1	1	2			10
Weirs – Private		1	4	7	1	5			4	3		1	26

Losses Average ML/day	**Off take to Morundah**	**Morundah to Darlot**	**Columbo to Conargo**	**Darlot to Moulamein**	
1998/99	16.5	16.8	39.2		
1999/00	35.4	63.7	25.6		
2000/01	48.0	38.7	23.9		

Losses Average ML/day	**Off take to Morundah**	**Morundah to DC800**	**DC 800 to Puckawidgee**	**Puckawidgee to Darlot**	**Columbo Creek**	**Junction to Jerilderie**	**Jerilderie to Conargo**	**Darlot to Moulamein**	
2001/02	89.2	27.3	105.3	109.5	61.8	35.5	29.1		
2002/03	57.3	41.7	52.0	57.5	59.7	26.9	38.8		

Note: Losses calculated as averages over the season

2.5 THE BIOPHYSICAL ENVIRONMENT

Climate

The general climate of the YCS is characterised by hot summers and mild winters. Rainfall is winter dominant and averages at 400-450mm per annum. June usually is the wettest month and February the driest. Dry periods and droughts are common with 29 drought years being experienced between 1900-1986 (Dalton in Porteners, 1993). Evaporation rates can be as high as 1,400mm over the spring and summer season and around 400mm in the Autumn-Winter period. Overall, rainfall does not contribute significantly to runoff and creek flows.

Topography

The Riverine Plain is made up of mostly low relief land sloping gradually to the west. It is traversed by numerous prior streams, ancestral rivers and present day creek and river systems.

Prior streams are often depicted by meandering low depressions up to 2m in depth with associated winding sandy ridges. Prior streams are generally higher than the surrounding floodplain. For example Colombo Creek is a high level effluent of Yanco Creek (White *et al*., 1985). Ancestral rivers are remnants of river channels usually larger than the Murrumbidgee and Murray and can be seen scrolling out below the general floodplain nearby. The present YCS is almost entirely positioned on ancestral sediments. When this occurs, sub surface diversion of flow away from the present stream can take place to fill ancestral channels. Forest Creek is situated higher than Billabong Creek and consequently flows from Forest Creek tend to flow back to the Billabong Creek or the Edward River via small interconnecting creeks and breakaways. To counter this block banks have been installed along many of these creeks to contain the flow in the system.

Soils

Soils of the Riverine Plain are mostly of a depositional nature stemming from the presence of prehistoric water courses. On the more elevated areas, the Red-brown earths prevail and sit adjacent to the paths of ancestral rivers. The duplex soils are weakly structured overlaying a well structured clay base. They are moderately fertile and can be hard setting when structural breakdown occurs affecting infiltration rates.

In the floodplain areas of the Murrumbidgee River and associated creek systems, grey and brown clays prevail. They are moderately deep and show consistent textural development through the profile. They typically form deep wide cracks when dry and are less susceptible to erosion than sandy red clay soils. Grey clays occur on flooded and poorly drained floodplains, while brown clays are frequent on the higher floodplain areas (Murphy & Eldridge, 1991).

Vegetation

The YCS forms a significant riverine corridor of Black Box (*Eucalyptus largiflorens)* woodland occurring higher in the landscape to River Red Gum areas (*Eucalyptus camaldulenis)* on the fringes of the waterways because they provide:

- valuable habitat for native flora and fauna;
- examples of aspects of the original communities;
- a seed source for future revegetation, and
- corridors for the movement of flora and fauna.

Vegetation types vary according to key landscape features. Along the riparian zone black box can appear as a discontinuous stand of both individual trees and/or clumps. Other vegetation species having an association with it include Cooba (*Acacia salicina)*, River Cooba (*Acacia stenophylla)*. Shrub species include Lignum (*Muehlenbeckia florulenta)*, Short-leaved Bluebush (*Maireana brevifolia)* and Nitre Goosefoot (*Chenopodium nitrariaceum)*.

In areas where creeks are less defined and where water movement is slower Cumbungi (*Typha orientale)* infests both the sides of the creek and can extend across the full width of the creek in severe locations. The infestation occurs in areas where the flow is low in volume or restricted and this is evidenced by widespread infestation in numerous parts of the YCS.

On floodplains often co-habitating with Black Box are Hooked Needlewood (*Hakea tephrosperma)*, Miljee (*Acacia oswalsii)*, and Bull Oak (*Allocasuarina luehmannii)*. The understorey contains mostly native and introduced pasture species with few shrubs.

A large part of the Riverine Plain consists of rangeland being mostly treeless. In these areas Nitre Goosefoot, Dillon Bush (*Nitraria billardieri)* and Cottonbush (*Maireana aphylla)* extend beyond the Black Box fringed water-courses. The Dillon Bush has increased markedly corresponding to changes in land use since European settlement mainly bought about by overgrazing. This has removed the Bladder Saltbush (*Atripex vesicaria)* and Old Man Saltbush (*Atripex nummularia)* (Noble & Whalley in Porteners, 1993).

The main introduced flora species causing environmental damage in the YCS are Willows *(Sallix spp.*) and African Box Thorn (*Lycium ferocissimum)*. The extent and impact of willows will be discussed in depth later in this document. Willows are considered to be one of the major water impediments, causing over-bank flooding and a deterioration of water quality in the entire creek system.

In-stream Ecology and Stream Condition

There is very little information on the ecology and stream health of Yanco Creek. This is an obvious concern for deciding future management of the natural resources in the YCS and is addressed in clear recommendations of improvement for the system as stipulated in Management Action 3.14 (F) and 3.15 (B). However a small amount of aquatic invertebrate data is available from the First National Assessment of River Health (FNARH).

A single sample from Yanco Creek at Morundah illustrates reasonable aquatic richness (as shown in Table 3). A number of invertebrates are strongly associated with snags, including freshwater prawns, riffle beetles and shrimps, where they graze on the algae on the surface of the snags. They are thus an important food source for snag associated fish such as Murray Cod (*Maddullochella peelii)* and Yellowbelly (*Macquaria ambigua)*. Another group of grazing invertebrates inhabits aquatic plants, such as cumbungi and common reed (*Phragmites australis)*. These include the aquatic moths, caddis flies and shrimp. Many other species inhabit the water body, including the water bugs, while others are associated with the sediment, including the oligochaetes and Chironomids. However, they all directly or indirectly make use of organic material entering the stream from riparian vegetation, LWD/snags and aquatic plants or from phytoplankton (floating algae) in the water column.

Table 3. Aquatic Invertebrates collected in Autumn 1998 in Yanco Creek

Date	Site and habitat	Aquatic Invertebrate Families Present	Species where known	Common Name
Autumn 1998	Yanco Creek @ Morundah pool edge	Atyidae	*Paratya australiensis*	Shrimps
		Palaemonidae	*Macrobrachium* spp.	prawns
		Parastacidae	*Cherax* spp.	yabbies
		Collembola		springtails
		Hydrometridae	*Hydrometra* spp.	water measurers
		Vellidae	*Microvelia* spp.	water striders
		Hydroptilidae	*Hellyethir*a spp.	caddies flies
		Oligochaeta		worms
		Corixidae	*Micronecta, Sigara* spp.	water boatmen
		Elmidae	*Coxelmis n- fasciata*	riffle beetles
		Notonectidae	*Anisops* spp.	back swimmers
		Pyralidae		aquatic moths
		Dytiscidae		water beetles
		Chironomidae:Tanypodinae, Orthocladiinae, Chironominae		midges
		Carabidae		scarab beetles
		Ecnomidae		caddis flies
		Temnocephalidea		flatworms
		Leptoceridae	*Triplectides* spp.	Cased caddisflies

Bird Habitat

The riparian woodland corridors along the YCS provide important habitat for numerous bird species. Various species are able to survive in part due to the nesting sites provided in tree hollows and roosting sites for protection. Various wetlands along the creek, particularly Wanganella Swamp system provide breeding, feeding and roosting habitat for a range of waterbird species, including some migratory and endangered bird species.

Mammals, Reptiles, Amphibians and Fish

The YCS supports one of the few remaining populations of native Freshwater Catfish (*Tandanus tandanus)* in the Murray/Murrumbidgee region. Local NSW Fisheries officers have indicated YCS is likely to be an important passage for fish migration between the Murray and Upper Murrumbidgee Rivers. Appendices 4, 5 and 6 outline lists of vulnerable species in the YCS, including mammals and reptiles.

Introduced Pest Species

It is generally accepted that Carp (*Cyprinus carpio)* have invaded much of YCS. They are present in large numbers and have adversely affected water quality. Additionally, Mosquito fish (*Gambusia affinis)* have also been observed in the YCS. This species is partly responsible for the decline in the number of Australian native fish species and frogs. Goldfish (*Carassius auratus)* and Redfin (*Perca fluviatilus)* are also considered likely to be in YCS (*pers. comm*. Angel, 2000). Feral pigs (*Sus scrofa)* have been a past problem in areas containing dense stands of Cumbungi and lignum.

Wetlands

River regulation has altered the natural flow regime of many watercourses in the Murray and Murrumbidgee catchments. The YCS contains a number of different wetland types that reflect the water distribution and operational management of flows in the system. The approximate number and collective surface area of wetlands along the Yanco Creek System is currently being determined using satellite imagery from the report River flow/ wetland inundation relationships for the mid-Murrumbidgee River (Frazier, 2001).Wetlands occur in the YCS occur as natural swamps such as Wanganella and in weir pools created by the construction of the weirs. While few have a complete drying phase as would occur in an unregulated system each has developed and adapted to provide an environment for a wide range of flora and fauna habitat. The presence of each wetland area has become an integral part of the YCS and changes to any part of the system, either in the form of infrastructure upgrade or removal in the case of weirs, or of flow regime will need to be determined and evaluated from a range of perspectives.

All the wetlands along Yanco Creek can be considered to be "natural", even if the regulation of the creek has resulted in them being full more often than would have occurred pre-regulation. The only wetlands which would be considered to be man made would be those which were actually constructed (eg. farm dams, banked off creek lines). As a general rule, regulated (irrigation season) flows should be excluded from all the wetlands on the YCS. Environmental flow requirements of wetlands within the YCS need to be determined by DIPNR to ensure the ecological integrity of key wetlands are maximised and to determine flow volumes needed for agricultural productivity and environmental purposes. The YCATAC is cognisant of this requirement and proposes relevant management actions to address this.

YCS and NPWS Nature Reserves

The YCS community is well aware of the unique natural environment that they manage and consequently have established numerous wildlife refuges and nature conservation reserves under National Parks Act (1974). These modify activities to protect native flora and fauna and are voluntarily adopted by landholders.

Plate 3: Artificially created wetland due to high summer flows

2.6 WATER QUALITY AND FLOW MONITORING OF THE YANCO CREEK SYSTEM

Preliminary Environmental Health Status of the YCS – Molino-Stewart Report

Environmental consultants, Molino Stewart, provided a report on the health status of the YCS in 1999. The assessment was conducted on the quality of riparian and in-stream habitat present and the erosional stability of stream banks. The method used was a modified version of assessment used on Victorian streams performed by Mitchell 1990. The assessment was carried out rating the condition of three distinct features. These were:

- Riparian Habitat
- In-stream Habitat
- Streambank Stability

Ratings were based on scoring of health at each site from 1-3 based on criteria contained in Appendix 7, and rankings of the stream condition assessment are listed in Table 4

Table 4 - Stream Condition Assessment of the YCS

Segment	Riparian Habitat Rating	In-stream Habitat Rating	Streambank Stability Rating
Off-take to Morundah	1	1-2	1
Yanco Creek: Morundah to DC 800	1	1-2	1
Yanco Creek: DC 800 to Conargo	1	2	1
Conargo to Darlot	1-2	2	1
Darlot to Moulamein	1-2	2	1
Colombo Creek: Morundah to Billabong Jctn.	3	2-3	2
Billabong Creek: Jctn to Jerilderie	1-2	1-2	1
Billabong Creek: Jerilderie to Hartwood Weir	1-2	1-2	1
Forest Creek: Hartwood Weir to Warriston Weir	2-3	3	1-2

Source: Molino Stewart Report 1999.

Review of Water Quality Data

A brief review of water quality data collected by DIPNR (and its prior organizations) was undertaken during March 2003. This review did not set out to statistically analyse water quality or resultant trends through time, but merely determine the nature of water quality within the Yanco-Colombo system and comment on some apparent patterns in the data. The results reported here should be viewed as the starting point for any water quality analysis rather than the definitive outcome.

Water Quality and Flow Characteristics in the Yanco Colombo System

Water quality records collected at the five currently active water quality stations (Table 5) throughout the Yanco-Colombo system over the last 10 years (1993-2003) were assessed for the following parameters:

- Total suspended sediment and Turbidity
- Total phosphorous,
- pH,
- Dissolved oxygen and
- Electrical conductivity.

Table 5. Water quality stations currently operational within the Yanco-Colombo system.

Station Name	Acronym	Station Number	Location
Yanco Creek at Offtake	YANCKS	410007	upper reaches of Yanco Creek, immediately downstream of Murrumbidgee River
Yanco Creek at Morunda	YANMOR	410015	mid reaches of Yanco Creek downstream of Tarabah Weir
Yanco Creek at Bridge 321	YANCKB	410169	lower reaches of Yanco Creek, downstream of the DC800 drain from CIA.
Colombo Creek at Morunda	COLMOR	410014	upper reaches of Colombo Creek downstream of Tarabah Weir
Colombo Creek at Urana Road	COLURA	410100628	lower reaches of Colombo Creek

Flow Interpretation

The analysis and interpretation of river flow information is a detailed and specialist discipline, beyond the scope of this paper. However, it is difficult to attempt an interpretation of water quality in natural systems without also considering the influence of flows and flooding.

To this end, flow data from 1980 to the present was examined for coarse, unquantified, patterns and trends (Figure 3). It is the interpretation of the author that over the last twenty years flood events in the Yanco-Colombo system have decreased in both frequency and magnitude while there has been a steady but distinct increase in non-event flows, particularly in the upper reaches in the system. This is interpreted as increased flow regulation and is at odds with natural water quality processes associated with the system.

Flow exceedence curves (Figure 4) show the influence of re-regulation and drainage flows from the Coleambally Irrigation Area (Buchan, 1994). Under most flow conditions (approximately 85% of the time) greater volumes of water flow into the upper reaches of Colombo Creek (COLMOR) than continue down Yanco Creek past YANMOR station. These flows in the Yanco are then "topped up" via the Coleambally Catchment Drain and as a result of drainage waters via the DC800 to the extent that greater volumes of water pass YANCKB than YANMOR for up to 85% of the time.

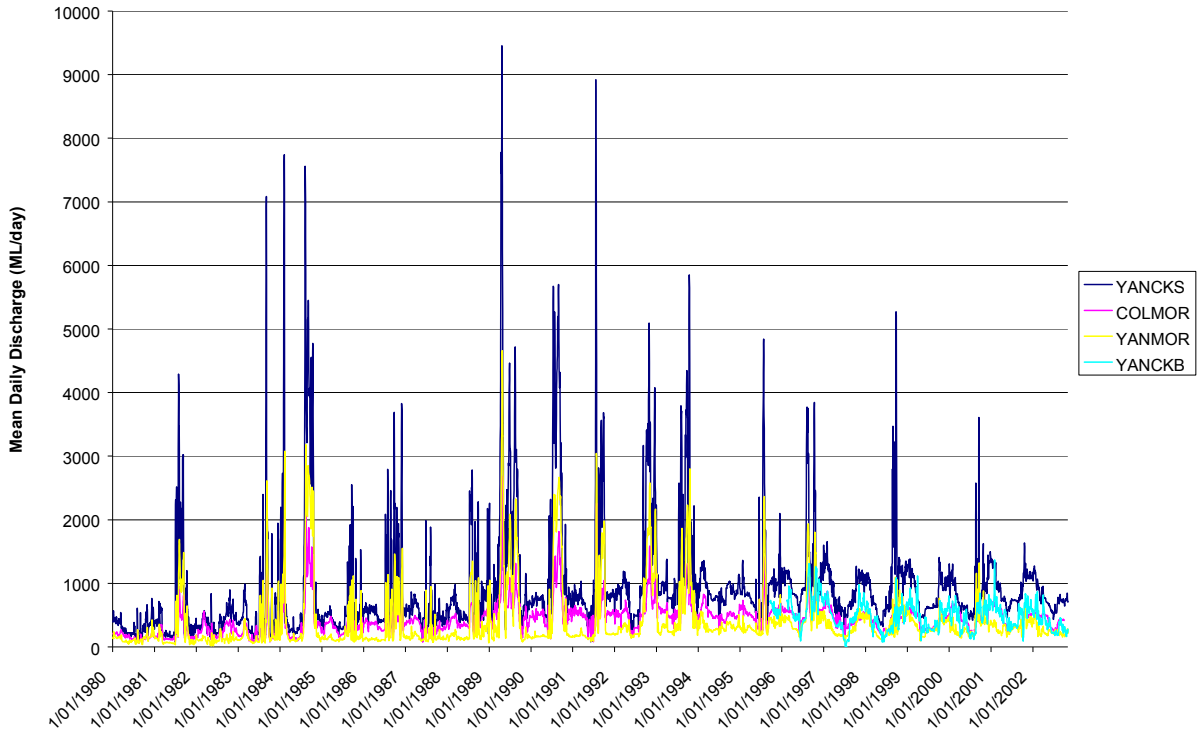

Figure 3. Mean Daily Discharge for Yanco-Colombo system 1980 - present

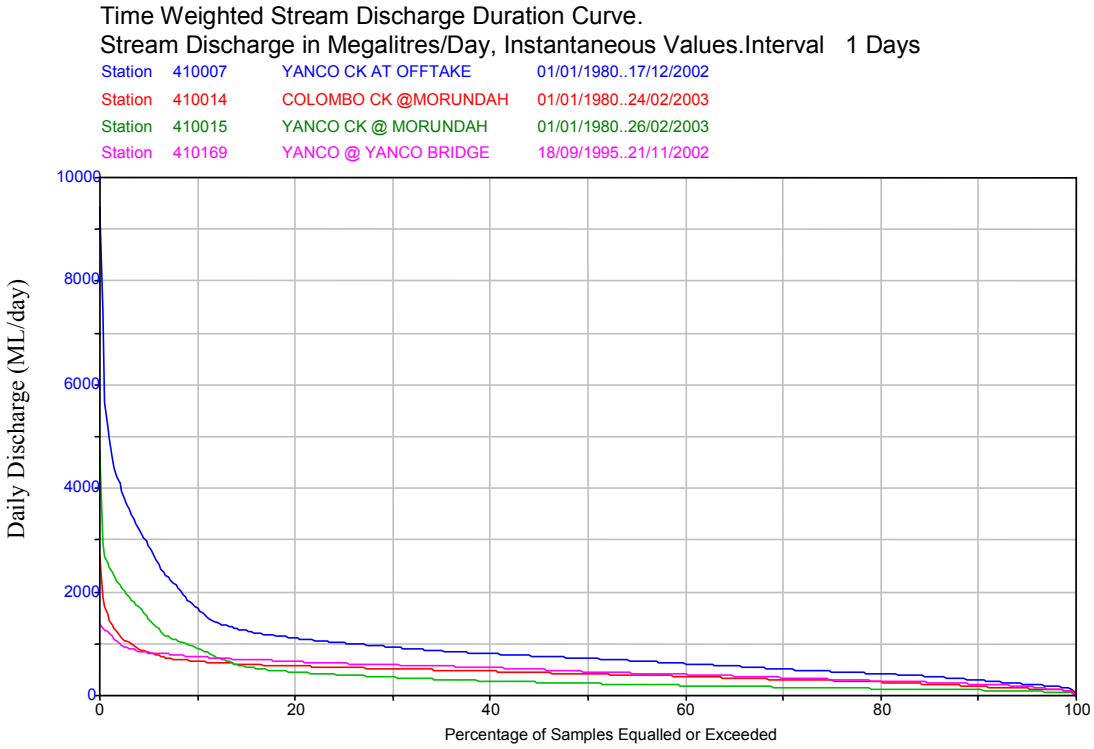

Figure 4. Flow duration curve for Yanco-Colombo system 1980 - present

Suspended Sediment and Turbidity

Suspended sediment concentration is a measure of the mass of particulate matter held in suspension for a given volume of water and is expressed, in this case, as milligrams per litre (mg/L). Turbidity measures the "cloudiness" of water by estimating the light reflectance and scattering properties caused by suspended particulate matter.

Suspended sediment concentrations and turbidity show very similar patterns in terms of variability at each station (Figures 5 and 6). This is expected as turbidity provides a good correlation to suspended sediment concentrations in sediment rich streams. There is a pattern of increasing sediment concentrations as water moves further downstream along Yanco Creek. This pattern is less apparent in the Colombo Creek.

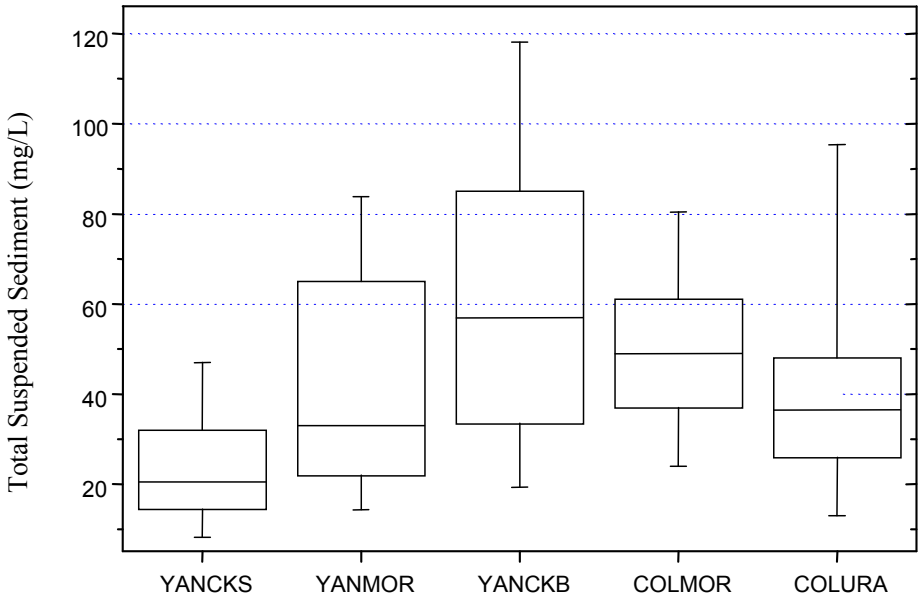

Figure 5. Total suspended sediment data for Yanco-Colombo system 1993-2003

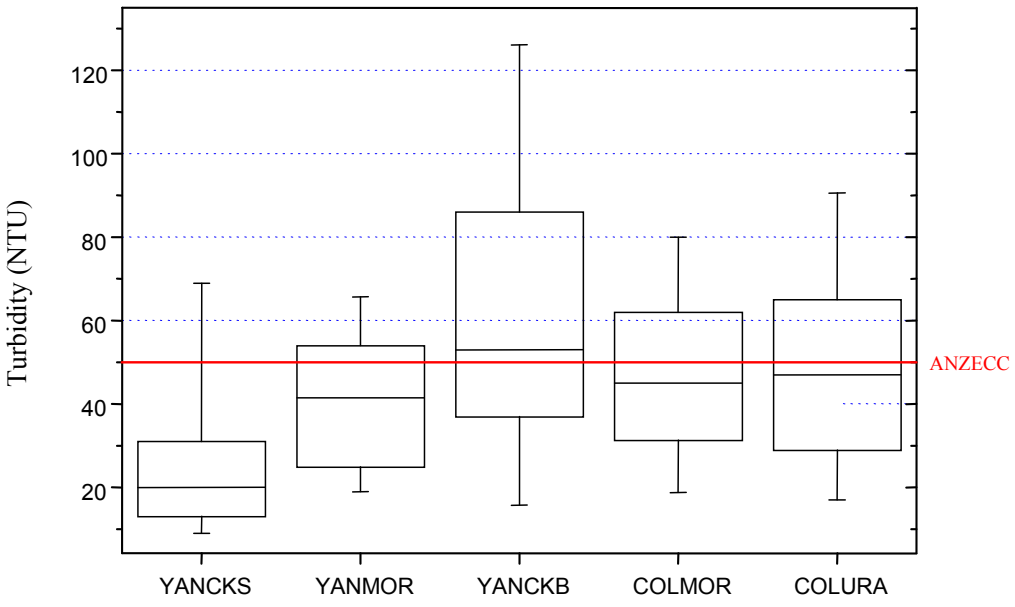

Figure 6. Turbidity data for Yanco-Colombo system 1993-2003.

Likely causes of increasing levels of suspended particulate matter along the Yanco system are stream-bank instability, particularly when subject to altered flow and flooding regimes due to stream regulation, and point source discharges such as irrigation drainage (particularly at YANCKB). There is evidence of sediment deposition in the lower reaches of the Colombo Creek with dense Cumbungi growth and siltation as sediment drops out of suspension at low flow velocities.

ANZECC (2000) guidelines for aquatic ecosystem health suggest a high-end default turbidity trigger value for lowland rivers as 50 NTU. This value is exceeded by more than 50% of observations at YANCKB and more than 25% of observations at YANMOR, COLMOR and COLURA.

High levels of suspended sediment are recognised as a threat to water quality within the Murrumbidgee Catchment Blueprint and the Yanco-Colombo system is showing localised signs of decreasing health in this regard. The situation would be improved by greater flow variability with increased frequency of flood pulses, to help flush the system, and reduced non-flood flows to allow for bank stabilisation through revegetation and settling of suspended sediments. Implementation of the Coleambally Irrigation Area Land and Water Management Plan should result in decreased drainage volumes and sediment concentrations discharged to Yanco Creek.

Total Phosphorous

Total phosphorous concentrations showed a similar rising pattern along with sediment concentrations as water moved further downstream (Figure 7). This is an expected outcome, as a large proportion of total phosphorous is known to bind to suspended sediment particles. ANZECC guidelines for aquatic ecosystem health set a default guideline of 0.05 mg/L. This value is exceeded in more than 50% of all readings at all stations except the most upstream station, YANCKS.

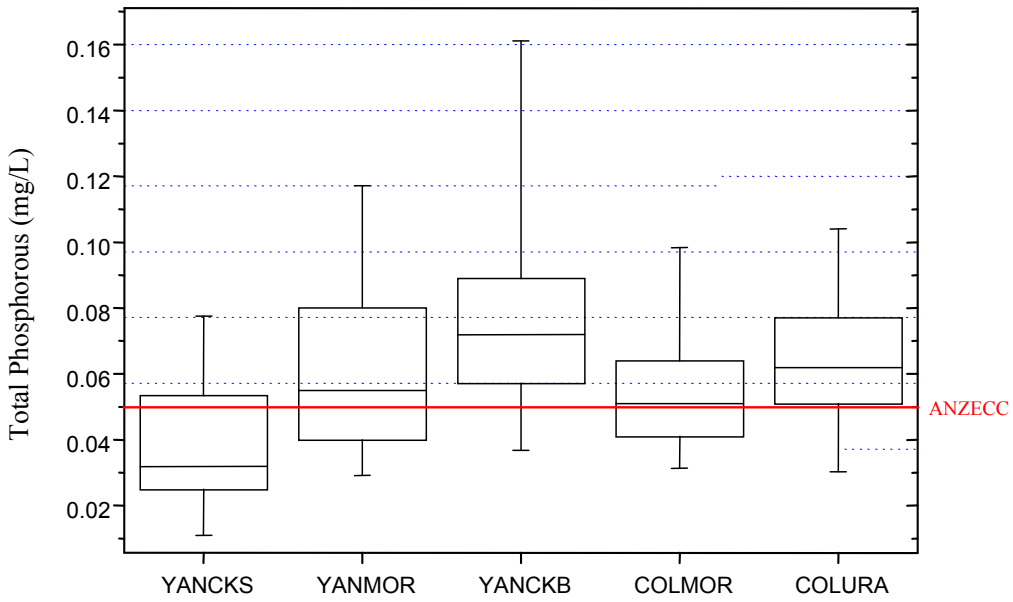

Figure 7. Total Phosphorous for Yanco-Colombo system 1993-2003

It is anticipated that phosphorous concentrations are directly related to elevated suspended sediment concentrations and, are best addressed through the same processes of flow management, bank stabilisation and reduced point source discharge.

pH

Water pH in the Yanco-Colombo system is generally neutral to slightly alkaline (Figure 8). However, samples were occasionally neutral to mildly acidic, particularly at the more downstream stations, perhaps indicating increased biological influences. All samples fell within ANZECC guidelines for ecosystem health (6.5-8.0).

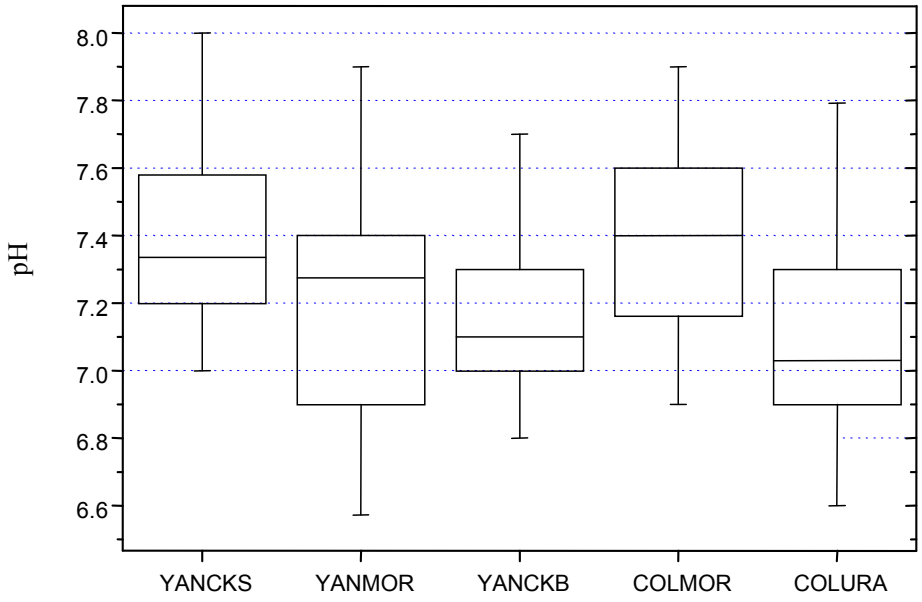

Figure 8. pH for Yanco-Colombo system 1993-2003

Dissolved Oxygen

Dissolved oxygen concentrations tend to decrease from upstream to downstream (Figure 9). It is suspected this is due to eutrophication processes associated with the input of nutrient rich water combined with reduced flow velocities and elevated water temperatures experienced in the lower reaches of each creek system. Under eutrophic conditions the rapid growth and multiplication of bacteria depletes the oxygen from the water, reducing the amount of saturated oxygen available for other organisms. Under extreme cases this may cause fish kills and mass mortality among other aquatic biota.

ANZECC guidelines recommend a lower threshold of 85% saturation for ecosystem health in lowland streams. Median dissolved oxygen concentrations at both COLURA and YANCKB are below this value, as are 25% of readings at COLMOR.

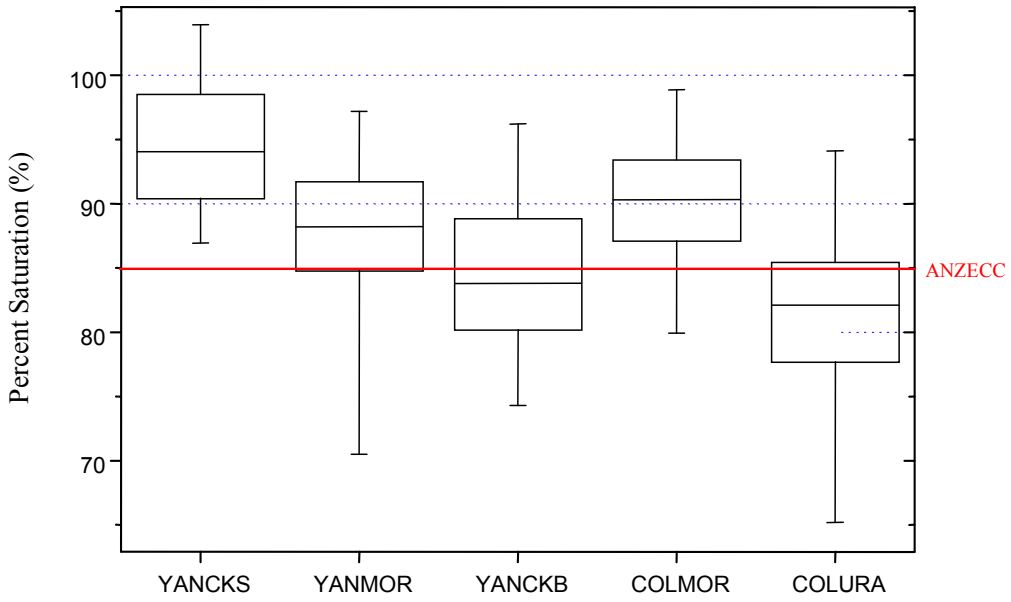

Figure 9. Dissolved Oxygen concentration for Yanco-Colombo system 1993-2003.

Electrical Conductivity

Salinity as electrical conductivity (EC) is highly variable throughout the system ranging from below 50 µS/cm to 350 µS/cm. This variability is apparent at all sites indicating the influence of source waters from the Murrumbidgee River (Figure 10). Median EC at YANCKB is elevated relative to other sites perhaps indicating the influence of irrigation drainage from the Coleambally Irrigation Area. Low volume winter drainage is known to be highly saline due to groundwater interception between irrigation channels and a perched shallow groundwater lens.

ANZECC guidelines are quite variable for EC and the values obtained are not considered likely to have a significant impact on aquatic ecosystems, nor any agricultural, domestic or cultural uses of the water. The vast majority of readings fall below the median end-of-valley target of 245µS/cm specified in the Murrumbidgee Catchment Blueprint.

The results suggest that stream salinity is not currently a major issue within the Yanco-Colombo system. This may change if there is a significant increase in stream salinity in the Murrumbidgee River downstream of Narrandera, however this seems unlikely in the short term. Furthermore, actions implemented under the Murrumbidgee Catchment Blueprint, should lead to reductions in stream salinity and Irrigation Area discharge volumes.

One issue that needs to be addressed is the lack of continuous salinity and flow metering at the end of the Colombo system. This does not allow for end-of-valley discharge to be accurately determined. This is considered important, particularly if further water resource development in the region is likely.

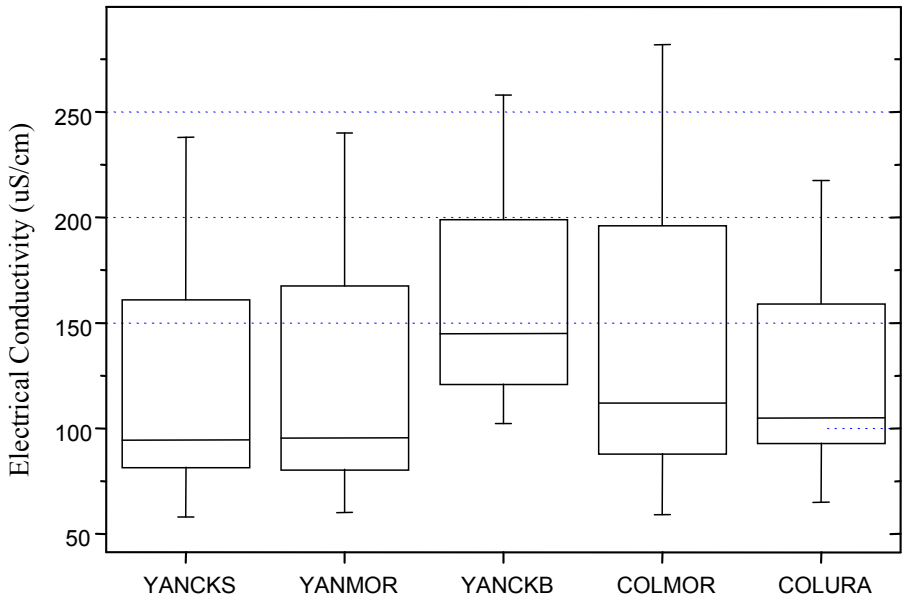

Figure 10. Electrical Conductivity Yanco-Colombo system 1993-2003

Summary of Water Quality

Water samples were collected and analysed by DIPNR from a total of 16 sites along the Yanco/Billabong Creek System. These included eight sites along the regulated portions of the Creeks System, seven sites on the drains from the Murray and Coleambally Irrigation Areas, and one site on the main tributary, being the Upper Billabong Creek. The parameters measured included salinity, nutrients, turbidity, dissolved oxygen, pesticides and biological indicators.

Salinity

The salinities generally increase with distance downstream, probably due to the combined effects of higher salinity inflows from tributaries, evaporation and groundwater inflows. This is presented in Appendix 8.

The salinities of inflows to the Creeks System from tributaries is quite variable and can be of poor quality for both human use and the environment (>1500uS/cm). In the Upper Billabong Creek the highest salinity flows from its headwaters occur in summer periods and are the result of dryland salinity. The creek flows will generally be low during these periods and the Upper Billabong Creek inflows will be substantially diluted by the regulated flows in Conargo Creek.

The salinity of flows in the drains from the irrigation areas is lower during the irrigation season than in winter because of the diluting effects of escapes and regulated releases from the channel systems. The higher salinity flows in the winter are due to saline groundwater discharges from the irrigation areas.

Stream salinity trends of streams in the Murray-Darling Basin have been calculated by Walker et al. (1998). These show that stream salinity in the Upper Billabong Creek is increasing by 5% per year, and by 3% per year in the lower reaches of the Billabong Creek. While this increase is one of the highest in the state, it appears that it is not causing high salinity increases in the lower portion as the salinity in the Murrumbidgee River at the Yanco Off-take is 3% per year increase also. The salinity threshold for various salinity classes of irrigation water have been specified for the National Water Quality Management Strategy (ANZECC, 1992) and are presented in Appendix 9.

In summary, the salinity of flows in the Yanco-Billabong Creeks Systems is generally low and most users would have little risk of salinity problems occurring. At worst, flows in the YCS are of medium salinity level, which may cause some yield reduction in low salt tolerant plant species. Salinity impacts on the aquatic ecosystem would be slight.

Nutrients

The total phosphorus (TP) concentrations of the Murrumbidgee River at the Yanco Off-take are similar to the concentrations that could be expected in undisturbed streams in the central plains zone (DIPNR, 1995), using the criteria developed for Preliminary Guidelines for Victorian Inland Streams (EPA, 1995).

Total Phosphorus concentrations of flows in the Yanco-Billabong Creeks System are significantly higher than those of the Murrumbidgee River and are generally above the threshold at which damage to the ecological community will occur (EPA, 1995). These elevated TP concentrations will increase the risk of algal blooms occurring in off-stream storages or in portions of the streams that are stagnant.

The maximum TP concentrations recorded in the Creeks System would provide very low phosphorus loadings on irrigation soils and there is no risk of the water being detrimental for irrigation supply due to nutrient concentrations.

Turbidity

In the regulated portions of the Yanco-Billabong Creeks System turbidity generally increases with distance downstream. Using the criteria developed for the State of the Rivers Report (DIPNR, 1995), the turbidity is good at the Yanco Off-take, poor in the upper reaches of the Creeks System and declines to very poor in the lower reaches.

By comparison with inland rivers, the Yanco-Billabong Creeks System is relatively turbid and is more turbid than the River Murray at the confluence with the Murrumbidgee (Mackay and Eastburn, 1990). This is possibly a reflection of bank erosion that is occurring at high flows that are maintained for extended periods in the Creek's System, but it is more likely attributable to the impact of common carp (*Cyprinus carpio)*.

Test results showed that the Yanco-Billabong Creeks System flows would be unsatisfactory for domestic use, and would restrict growth of aquatic plants and the abundance of aquatic animals. The high turbidity flows possible would also cause clogging of irrigation pipes.

Dissolved Oxygen

The Dissolved Oxygen levels in the Yanco-Billabong Creeks System are generally within the healthy range and are fairly uniform throughout. The number of drain samples taken indicate that these flows are healthy.

Pesticides

A limited amount of pesticide sampling has been carried out in the Yanco-Billabong Creeks Systems, mainly at sites along the drains of the Murray and Coleambally Irrigation Areas.
On most sampling occasions in the Murray Irrigation Area, concentrations of pesticides were below the detection limits.

Molinate was the only chemical that exceeded the environmental guideline by at least one unit at five sites. These recordings are often due to rainfall events causing drainage waters to escape from rice bays.

Biological Indicators

Limited surveys conducted in the Yanco-Billabong Creeks System indicate that invertebrate fauna are in a healthy state.

Fish population data is collected at only one site in the regulated section of the Yanco-Billabong Creeks System on Colombo Creek. At this site approximately equal numbers of introduced and native fish species have been recorded in recent years. However, the introduced species were significantly larger in body weight compared to the native fish recorded.

Anecdotal reports have indicated that Golden Perch, Macquarie Perch and Murray Cod are species under significant stress in recent years. Common carp and Redfin to a lesser degree are considered to be the most common species (O'Connell, 1997).

Algae

Monitoring for algae in the Yanco-Billabong Creeks System has been carried out at 5 sites. These results show that no blooms of blue-green algae were recorded and that at most sites the algal count was at or below the Low Alert level. Compared to the River Murray, the Yanco-Billabong Creeks System has a relatively low abundance of algae, which may be related to the high turbidity of the Creeks system (O'Connell, 1997).

Pathogenic Micro-organisms

The measure of this is based on the suitability of water for drinking after measuring the concentration of bacteria, viruses, and protozoa. Guidelines for the maximum concentration of faecal coliforms have been prepared by ANZECC (1992) as follows:

Drinking water supplies	No faecal coliforms
Recreational water	150 faecal coliforms/100 ml
Irrigation and livestock water	1000 faecal coliforms/100 ml

Testing in the Yanco-Billabong Creeks System has been carried out at 15 sites. No samples exceeded the guidelines for irrigation and livestock watering. Overall, around 50% of the 96 samples taken through out the Yanco-Billabong Creeks System passed the guidelines for primary contact recreation (swimming) and there were no apparent trends of water quality decline through the Creeks System.

Plate 4: Diversion of flow by LWD, resulting in erosion and turbidity.

2.7 AGRICULTURAL IMPORTANCE

Irrigation has delivered substantial benefits to regional communities and the nation as a whole. In 1997, irrigated agricultural production in Australia was valued at almost $9.4 billion with NSW contributing approximately $2.7 billion of the total. According to the ABS, irrigated agriculture uses just 1.5% of agricultural land in NSW but accounts for nearly 35% of production.

The Murrumbidgee Valley is the major rice-growing valley in Australia and is renowned for its horticultural produce and wines. Irrigated agriculture covers just 4% of the area of the catchment but contributes 41.6% of the total production. Across the valley, agriculture is the second largest employer after retail, providing jobs for nearly 12% of the working population.

Agricultural production is the lynch pin of the economic prosperity enjoyed by many residents of the area. There are no statistics, which enable us to place a value on the agricultural production of the Yanco Creek and its Tributaries. We do know, however, that the YCS divert 2.57% of the water available for irrigation in New South Wales.

The area is the base of some of Australia's most famous Merino Studs. Tolhurst (1991) author of "Song of Running Water" describes YCS as "nurturing possibly the single most diverse strip of agricultural experiment and development in Australia". The establishment of irrigation into this area has enabled production of mixed cropping, irrigated pastures, rice farming, horticulture and viticulture.

Plate 5: Agriculture on the Yanco Creek System

Table 6 describes the approximate value of agricultural production on the Yanco Creek system based on the percent irrigated. The values are based on the Agricultural Census at 31 March 1999 and can be found on the website of the New South Wales Irrigators Council, (www.nswirrigators.org.au).

Table 6: Approximate Value of Irrigated Agriculture in the YCS

Crop	Total Value of Production in NSW	Percent Irrigated	Irrigated Value	YCS Approximate Production Value
Grapes	249,322,394	83.3%	207,733,027	5,338,738
Livestock Slaughtering	1,795,543,812	3.1%	55,985,520	1,438,827
Livestock Products	1,432,808,478	19.3%	275,909,357	7,090,870
Fruit (Excluding Grapes)	411,351,135	77.5%	318,885,796	8,195,364
Vegetables	251,120,019	82.5%	207,193,188	5,324,864
Pasture and Grasses	150,230,881	51.4%	77,200,936	1,984,064
Crops for Hay	47,549,115	24%	11,411,787	293,282
Cereals for Grain	1,888,005,143	23.2%	437,685,063	11,248,506
Other Crops	1,437,795,924	71.6%	1,055,364,696	27,122,872
Total Agriculture	**7,699,726,901**	**34.4%**	**2,647,369,375**	**68,037,387**

(NB: This has been calculated by taking 2.57% of the Agricultural Census figures for Total Value of Production in NSW as at 31 March 1999. 2.57% is the amount of water diversions. It is designed to give an indication of the likely value only.)

In economic terms, the value of that production to the communities along the creek system could be anywhere between $204,000,000 and $340,000,000.

Plate 6: The YCS provides water for vital agriculture and unique riparian ecosystems along its 800 km length.

2.8 INDIGENOUS SIGNIFICANCE

The major waterways of the Murray and Murrumbidgee River systems were the main source of food to the various tribal groups known to have lived in the area. The five main groups were Wiradjuri, Yota-Yota, Baraba-Baraba, Wamba-Wamba and Wadi-Wadi. Fish was the principal component of their diets for eight months of the year. As YCS was known to be an ephemeral stream prior to regulation, indigenous habitation was likely to be sporadic. These tribal groups may have exerted changes to the environment in the YCS as a result of burning shrub lands to flush out animals for hunting. Because of the Aboriginal people's dependence on the waterways for food, the riparian environment including the river bank, floodplains and lagoons along with nearby sand-hills, may contain culturally significant sites.

A significant piece of evidence of Aboriginal habitation in the YCS and associated tributaries was discovered in December 1989 when a human scull, that of a woman, was found in an excavation by Urana Shire Council in the lake bed of Lake Urana. In high flood events such as 1974 the Billabong can flood to the north and enter Lake Urana, which in turn spills into Lake Cocketgedong before it enters the Colombo Creek. The thermoluminescence dating method used to date the human skull found it to be between 20,000-30,000 years old. This compares to ages of Aboriginal habitation found in Lake Mungo. (Page K Dare-Edwards T 1994) The NSW National Parks & Wildlife Service holds a data base to register and conserve known sites. The National Parks and Wildlife Act 1974 encapsulates all sites of Aboriginal significance registered or not, through legal requirement, to notify the discovery of any sites. Any consent process for works as a result of actions contained in the plan will adhere to existing protocols with regard to cultural significance.

In research of significance of the YCS had to Aboriginal communities and consultation with key indigenous contacts revealed no known information. Additionally, no recordings were available from a check of the NSW National Parks & Wildlife Service significant sites data base.

2.9 EUROPEAN SIGNIFICANCE

The Australian Heritage Commission has established a Register of National Estate. Heritage sites and items of State significance in NSW are listed on the NSW State Heritage Resister. Local Councils can also identify and include locally significant sites and items on their Local Environment Plans. Although there is scant information on sites of European significance, it is imperative that they are considered in the implementation of this plan. Additionally, the significance of the YCS and its presence in the landscape along with the community's dependence on it for the past wealth and future sustainability of the region, makes it a "prized jewel" to local people.

Plate 7: "Old Coree" Homestead

3. EXAMINATION OF COMMUNITY AND STAKEHOLDER CORE ISSUES AND RECOMMENDED ACTIONS.

CORE ISSUE: IMPROVING THE OVERALL DELIVERABILITY AND EFFICIENCY OF SUPPLY FOR THE ENTIRE CREEK SYSTEM.

ISSUE 3.1

Supply and Delivery of Water

The major supply of water for the YCS is derived from the Yanco Weir off-take west of Narrandera on the Murrumbidgee River. Other supply is sourced from DC800 and Coleambally Catchment Drains (CCD) as part of the Coleambally Irrigation Area and from the Finley escape in the Murray Irrigation Area.

At the Yanco creek off-take, 1400ML/day is the maximum that can be supplied without major flooding occurring. In times of high flow demand in the creek system, up to 1400ML/day can be directed into the system but considerable flooding occurs at several points in local areas. Most of the channel along the upper sections of the creek is limited by its capacity to accommodate 2000ML/day before bank overtopping occurs. The supply of water to the Yanco Creek System (YCS) is dependent on many factors. These include variability of inflows into the upper reaches of the two major irrigation storages (Blowering and Burrinjuck), the capacity of in-stream infrastructure such as weirs and channels to distribute the water and the extent of physical flow impediments. These in-stream impediments include private and public weirs, siltation slugs, large woody debris (LWD), cumbungi and willows. Cumbungi infestation also adds to effective travel times dictated by stream gradients (Simpson 1994). Water is also known to be escaping into runners at different flow levels and into prior streams.

With the advent of summer cropping in the 1980's, water demand management has become a critical issue. Information flow between landholders and State Water needs to improve to overcome the physical supply constraints of this system and the impact of the Finley Escape, which has become an important source of supplementary water during summer. This is not a new suggestion. A 1994 report concluded that water users must be made aware of the system's capacity limitation, so that crop areas better reflect the risk of under-supply during an extended dry period (Simpson, 1994). The Annual Allocation Plan developed by the Murray and Murrumbidgee River Management Committees determines operational aspects of water allocation in each of the respective river valleys.

ACTION 3.1

That YACTAC in conjunction with State Water and NSW Agriculture explore measures to increase information flow to enable landholders to make strategic decisions in terms of what crop or pasture to grow for any year, and enable tactical decisions in terms of specific watering regimes for any given summer irrigation period.

Responsibility: Appropriate bodies
Timeframe: 2005-2007
Priority: High

ISSUE 3.2
System Losses

State Water, being the supply manager of water on behalf of DIPNR, have estimated flow losses of up to 52% are occurring within the system (9% operational and 43% transmission). It has determined the major causes of these losses and can locate with some accuracy where the major losses are occurring. However, information regarding the locations of groundwater recharge, escapes and prior streams in the system will be required to build up a complete picture of the system. Such a water balance study will also enable a greater understanding of the relative contribution of willows, cumbungi etc in system losses.

ACTION 3.2 (A)
Request appropriate bodies to initiate a comprehensive water balance study of the entire Yanco Creek System to clarify definitions and interpretation of losses occurring in the system. This will improve overall understanding of water losses and transport of flows within the system and of those which there is little control over in relation to delivery capabilities. i.e. channel capacities, weir distribution volumes and travel times
Responsibility: Appropriate bodies
Timeframe: 2005-2007
Priority: High

ACTION 3.2 (B)
Target for reduction of transmission losses to be from the current 43% to 20% over ten years. This equates to 35GL water savings per year
Responsibility: All
Timeframe: 2005-2015
Priority: High

Plate 8: Yanco Weir

ISSUE 3.3
Seasonal Flows

Since the increased uptake of available water attached to licences and the deregulation of the rice growing along the creek system, the demand for water at critical times (spring through to summer) has increased to a point where reliable supply is difficult. Additionally, while the best attempts are made to distribute water in timely quantities, invariably problems arise. Given the constraints on the system, the supply of transfers into the creek system may not be able to be continued. The high flows in the system required at times of high demand are reversed to the natural ecosystems of the riparian environment and wetlands, and can adversely impact habitat for flora and fauna along the creek.

Continuous improvement of operations has been initiated by State Water. However, supply and usage flows need to be better modelled with a view to developing seasonal delivery policies. If these were appropriately advertised and localized to sections of the creek, water could be made more readily available.

ACTION 3.3
YACTAC in conjunction with State Water instigate a working party to investigate seasonal delivery policies for the YCS.
Responsibility: YACTAC and State Water
Timeframe: 2005
Priority: High

ISSUE 3.4
Improvement of Creek Flows

The extent of stream meandering in many parts of the system, combined with physical impediments to flow such as willow infestation, LWD and cumbungi, reduces flow considerably. Additionally there are competing water delivery distribution demands, such as ensuring adequate water is at key points along the system to meet water use demands that impact on managing and improving creek flows.

The most immediate and significant factor impacting stream flow are "chokes". These result from the build up of LWD, willow invasion and the build up of Cumbungi in sections of the creek system.

At earlier consultation meetings, willow removal was viewed as a key priority of the maintenance work schedule for the creek system and the desire was expressed for works to commence where infestation is the greatest.

Considerable concern was conveyed about restrictions placed on landholders to undertake flow improvement works on sections of the creek on their own accord, due to the perceived bureaucratic procedures within relevant legislation such as the Native Vegetation Conservation Act 1997, the Rivers & Foreshores Improvement Act 1948, Water Management Act 2000, Fisheries Management Act 1994 and Threatened Species Conservation Act 1995.

ACTION 3.4
YACTAC to consult with DIPNR, NSWF, DEC and State Water to develop and apply an integrated approach for works along the system in order to meet legislative requirements. A holistic approach taking in the needs of both users and the environment for the entire YCS should help achieve a streamlined consent process for the project.
Responsibility: YACTAC, DIPNR, NSWF, DEC and State Water
Timeframe: 2005
Priority: High

ISSUE 3.5

Willow Removal (Salix spp.)

Willow trees have traditionally been planted along the YCS at weir sites and homesteads. These trees have suckered and spread, and in some places are now restricting the flow of water. Their invasive capacity is such that flow restrictions could be expected in the future in areas where willow trees are not currently a problem. The main species of willow (*Salix babylonica)* in the Yanco Creek reproduces vegetatively (i.e. from roots, twigs or branches deposited in moist soils and propagating).

Willows also provide a totally different and much poorer living environment for native plants and animals, than the local natural eco-system. The strong fibrous roots of willows, and their ability to grow in continually wet soil also enables them to exert a strong influence on stream behaviour. Fibrous willow roots and dense willow foliage trap large amounts of silt and build up the streambed, which can decrease channel capacity, exacerbate flooding and change flood patterns. Willows can also reproduce prolifically from seed, and cross-pollination between different willow species can occur. Willows can germinate in massive numbers and form islands in watercourses. When managing willows along watercourses it is important to consider the creek system further downstream. Willows, like many land and water management issues, have consequences beyond the local environment.

Advice is available from DIPNR on best management practice for willows. A programme to remove willows must take a holistic approach by considering the full range of issues such as the prevention of broad scale removal of willows that can impact on creek banks causing erosion and sedimentation, consider staged and progressive revegetation strategies and ongoing maintenance to avoid reinfestation of willow regrowth. Water needs of the environment such as that required for breeding habitats and adjacent billabongs and wetlands should be considered. There is potential for offsetting actions such as fencing off sections of the YCS and removing grazing stock to allow natural regeneration to provide protection for creek banks and provide long term security for native flora and fauna using the YCS corridor.

Action 3.5(A)

That a draft strategic program be developed for willow removal, bank stabilisation and revegetation providing prioritisation and timeframes for any proposed staged development.
Responsibility: YACTAC in collaboration with the relevant government agencies
Timeframe: commence 2005 and remain ongoing.
Priority: High

Action 3.5(B)

That the program of willow removal, bank stabilisation and revegetation be submitted and approved by relevant government agencies.
Responsibility: YACTAC in collaboration with the relevant government agencies
Timeframe: commence 2005 and remain ongoing.
Priority: High

Plate 9: Willow infestation of the stream

Plate 10: Cumbumgi blocking the stream

ISSUE 3.6

Excessive Growth of Cumbungi

Shallow, slow-flowing water over long stretches of low gradient waterway has encouraged the invasive growth of cumbungi across the creek in many locations along the creek system.. Excessive growth of cumbungi has restricted the flow of water, which encourages sediment and organic matter to settle out of the water and accumulate in the dense mat of cumbungi rhizomes. The build up of organic matter further slows the flow of water, and further enhances the sediment-rich environment in which the cumbungi grows. This problem is a compounding one.

Cumbungi is a native perennial that grows in stationary or slowly-flowing water up to 2m deep (Sainty & Jacobs, 1981). It relies on its starch-rich rhizome to survive periods of cold and water stress. Tall, dense spring growth provides canopy dominance during summer and early autumn and ensures the replacement of carbohydrate reserves that enable spring growth and canopy dominance the following season. In addition, their bulky rhizomes occupy most of the space available in the subsoil. The result is dense, monospecific stands of cumbungi, especially in deeper water. The water regime is probably the most important factor controlling the extent of cumbungi growth, as this defines the area in which it can potentially grow (Finlayson *et al*., 1983).

For a number of reasons cumbungi control by spraying, dredging or cutting has not been supported as an appropriate long-term, economically viable solution to water supply and environmental concerns in the creek system.

These reasons included the:

- considerable costs associated with an on-going cumbungi control program;
- length of affected watercourse;
- dead black box trees and stumps in the creek channel, which would make it very difficult to carry out an effective dredging or cutting program;
- unknown long-term, cumulative impact of a spray program on the creek environment;
- ecological impact of dredging a natural watercourse.

It is considered more appropriate, that management of cumbungi is achieved by changing the flow regime. Over a number of years it is anticipated that the combination of a changed flow regime and some stock grazing will help to reduce existing stands of cumbungi and prevent new growth. This should increasingly improve the passage of winter/spring freshes. The off-take to Morundah has only 2 major infestations of cumbungi and this is due to the greater velocity of flows in this part of the creek. Recent experience is revealing that apart from faster in-stream velocities being the most effective at controlling colonisation of cumbungi, the plant does not like a shaded environment and hence where good shade is cast by native vegetation, the plant does not establish or persist.

ACTION 3.6

That the extent of cumbungi in the Yanco Creek system be monitored, with a view to the possible need for future control. This is to involve possible targeted areas where chemical control options would be trialled and monitored to determine efficient and effective control measures.

Responsibility: landholders, DIPNR and State Water

Timeframe: 2005 ongoing

Priority: medium (future control may be required to assist flow management)

ISSUE 3.7
Creek Breakouts

At various locations along the YCS at times of supply when demand is high, overtopping and bank breakouts are occurring resulting in losses. Breakouts occur in a number of forms. Water can escape the supply system via:

- Overtopping existing stream banks in low areas.
- Escaping into wetlands and or flood runners.
- Constriction of flow due to infestation of willows and snags.

Creek breakouts add to transmission losses, which are already high in the YCS.

ACTION 3.7
State Water Asset Management Branch liaise with DIPNR, NSWF and DEC staff where necessary and make provision in a State Water Maintenance budget to include remedial works to prevent losses.
Responsibility: State Water and DIPNR.
Timeframe: 2007
Priority: Medium

Plate 11: Flooding from breakout

ISSUE 3.8

Alternative Supplies and Water Saving Schemes

Investigations were encouraged to be undertaken by the community to determine the feasibility and construction costs of alternate supply channels away from the creek at strategic locations. Channels with capacities to handle greater volumes could be constructed and would result in less restriction on flow. Such channels may have merits if compared against the high cost of undertaking environmental works to remove willows and control other impediments as planned.

The ecological impact of such a proposal would require careful scrutiny, as it involves the drawing of water into such a channel and delivering it across the present creek. An advantage of an alternate supply channel is that flows could be managed in the creek system for ecological benefits such as enhancing habitat conditions. This and other proposals such as piping irrigation supplies to strategic distribution points are now being considered, and are worthy of further investigation.

Several initiatives are currently underway to explore avenues of water savings within the catchment and these include:

- The Living Murray (Murray Darling Basin Commission)
- Pratt Water
- Snowy Savings

YACTAC need to explore the potential for partnering with these organisations to further the implementation of the YCS NRMP.

ACTION 3.8 (A)
That YACTAC be proactive in discussing partnering opportunities with Murray Darling Basin Commission, Pratt Water and Snowy Hydro.
Responsibility: YACTAC
Timeframe: 2004 Ongoing
Priority: High

Preliminary investigations by State Water have been undertaken on a range of engineering options to improve supply and to reduce the adverse impact of a regulated stream on natural ecosystems. Examples of these include:

- Constructing alternative supply channels away from the creek using accessing supply via diversionary structures to improve irrigation supplies and to enable distribution of flows into the creek that mimic natural flow patterns.
- Construction of a more direct supply channel emanating from DC 800 out of the Coleambally Irrigation Area.
- Modifications that will involve a structure to better control diversionary flows into the Yanco Creek System at the Yanco Creek Regulator. The benefit of this would be improved delivery and control of environmental flows on the Murrumbidgee River.

ACTION 3.8 (B)
That all engineering options to improve operational and environmental management of the Yanco Creek system be appropriately assessed to determine their feasibility and cost benefit.
Responsibility: State Water and DIPNR
Timeframe: 2005 Ongoing
Priority: Medium

ISSUE 3.9
Weirs

The Molino Stewart Report (1999) identified 101 structures including weirs, regulators, block dams and by-wash dams on the Yanco Creek System. The impact of both State Water controlled and private weirs impinges on the system to supply sufficient water reliably. It is widely acknowledged that the presence of many structures along the creek, principally private weirs, provide positive benefits by allowing individual landholders better access to water, but they also inhibit flow throughout the whole system. This is mainly due to weirs being overshot in design. Weirs can create artificial wetlands, but also allow micro habitats for chokes such as willows and cumbungi to grow. This also promotes accidental flooding causing other problems to landholders and to State Water.

Presently, many of the weirs serve to supply stock and domestic water to homesteads and farms. As assets, many are in various states of repair and require refurbishment or removal. Since detailed assessments of these were undertaken prior to the 1980s, many weirs have had drop boards removed to place less restriction on flow. It has been stated that a resolution was made to remove all but the strategic weirs in 1980, but this never took place.

There was broad agreement during the community consultation process that weirs had both positive and negative impacts on flow. A clear example is the value of 8-mile Weir and the use of it by a ski club. This has enabled an asset of significant recreational amenity to be developed. Presently State Water is undertaking a review of all weirs along the valley and YACTAC will await the outcome of this review before making any recommendations on weir removal or otherwise.

Currently, some confusion exists as to which weirs are privately owned or owned by State Water and the responsibility or performance of any conditions associated with individual weir structures. Weirs, although privately "owned", are situated on the waterway that is a responsibility of government and therefore a public liability exists. State Water as the control authority for weirs along the system is currently undertaking a detailed operational and environmental investigation of the weirs on the Murrumbidgee River including the Yanco Creek System. In the future, the removal and/or modification of existing structures may be taken out of the hands of irrigators due to State Water having to meet its obligations under new OH&S and Public Liability legislation. The flow-on costs and ramifications of this investigation are likely to be considerable. It was urged by water users and community interest groups that an assessment of weirs be undertaken. Thus the State Water weir review is timely and will assist YACTAC in its decision making. Steps to remove and/or improve existing structures should only be undertaken after other flow improvement and other control works are carried out and following an open community consultation process. It was suggested the upper section of the system should be the first priority.

ACTION 3.9(A)
That YACTAC, DIPNR and State Water undertake a combined information program to increase landholder awareness of weir ownership and/or licence conditions included in relevant legislation.
Responsibility: YACTAC, DIPNR and State Water
Timeframe: 2005
Priority: Medium

ACTION 3.9(B)
Following the Weir Review of the YCS, undertaken by State Water, YACTAC review the document with a view to developing a strategic approach to weir removal or retention that is consistent with the outcomes and objectives of this plan.
Responsibility: YACTAC/DIPNR/State Water
Timeframe: 2005
Priority: High

ACTION 3.9(C)
Where viewed appropriate and in line with operational needs and Government policy, that State Water assist with the cost of refurbishment of important in-system flow structures.
Responsibility: State Water
Timeframe: 2005 ongoing
Priority: Medium

Plate 12: Algudgerie Weir

ISSUE 3.10
Water Ordering

The issue of management of the creek system, including procedures for water ordering, was ranked number two priority by participants at a meeting to discuss the *Strategic Plan for the Yanco and Billabong Creeks System* (Molino Stewart, 1999).

In recent years, a number of factors have combined to make it increasingly important that water ordering procedures are improved. With expansion and uptake of sleeper and dozer licences in the Yanco/Billabong Creek system, more water is required over a much shorter period of time than previously.

Accurate delivery of water in the Yanco/Billabong Creek System is difficult because of long travel times and considerable transmission losses. However, the introduction of Supervisory Control and Data Acquisition (SCADA) into the Yanco/Billabong Creek system will allow State Water to critically examine the travel times between gauging stations and to respond more appropriately to water supply problems. The introduction of voice activated ordering as a central ordering system, will assist staff to more accurately identify discrepancies in the audit of water usage throughout the Yanco/Billabong Creek system. This means for example, that the need to supplement en route supplies by external means (for example via Finley Escape) can be identified and addressed more effectively.

Improved communication amongst landholders during the irrigation season could also help to ensure that daily pumping does not exceed supply. This is particularly important on Forest Creek, as flows below Warriston Weir are very vulnerable to pumping activities above Warriston Weir during summer.

A number of landholders have expressed frustration at the current Interactive Voice Response (IVR) ordering system. State Water have indicated that they are developing an internet based system which may make ordering easier.

ACTION 3.10
That YACTAC seek a meeting with the Murrumbidgee Customer Service Committee to pursue improvements to State Water's water ordering system including information and education of users on its use and the need for compliance.
Responsibility: YACTAC
Timeframe: 2005
Priority: Low

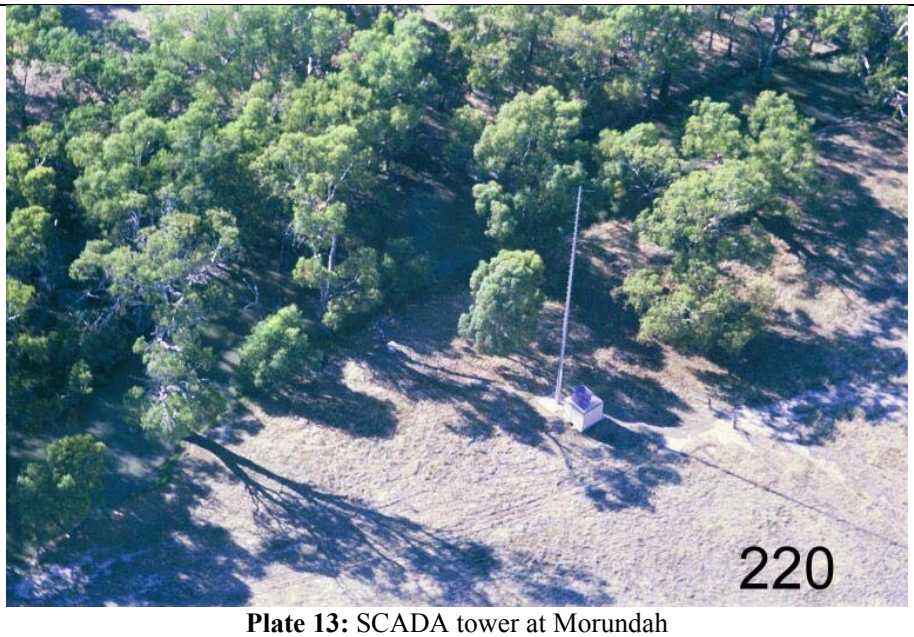

Plate 13: SCADA tower at Morundah

ISSUE 3.11
Demand Management during the Irrigation Season

During the 1999/2000 irrigation season a demand management plan was required to maximise supply availability during the summer growing period. This plan involved weekly orders, with a two week forecast of water requirements. Irrigators feel strongly that this demand management plan has set a precedent for future management of the Yanco Creek System.

ACTION 3.11(A)
That YACTAC instigate a demand management strategy and it be used during water shortages, for future management of supply in the YCS over the irrigation season.
Responsibility: YACTAC, DIPNR and State Water
Timeframe: Annually
Priority: high

ACTION 3.11(B)
That irrigators continue to order water weekly, with a two week forecast, as part of on-going management of supply in the YCS.
Responsibility: Irrigators, State Water
Timeframe: ongoing
Priority: high

ISSUE 3.12
Improve the Provision of Stream Flow Information

Landholders, particularly those on the unregulated section of the creek below Warriston Weir, need to be able to access flow information so that they can anticipate stock management requirements. This is especially important during summer.

Murrumbidgee Diversion and Flows (Appendix 10) is a daily report available to landholders via the fax for the cost of a phone call (50c/minute). Flow at Warriston Weir has recently been included on this information sheet. Landholders can also subscribe to the **Faxstream** on a yearly basis to automatically receive press releases about allocation levels and off-allocation announcements. Daily river information is available on the following website www.waterinfo.dipnr.nsw.gov.au.

ACTION 3.12
That YACTAC promote the availability of flow information on the Yanco Creek System to the YCS community in an accessible and easily understood format
Responsibility: YACTAC, State water
Timeframe: 2005
Priority: Low

CORE ISSUE: MAINTAINING AND IMPROVING THE HEALTH OF THE CREEK AND TO MIMIC NATURAL FLOODING EVENTS WHERE POSSIBLE.

ISSUE 3.13

Ecological Management of the Creek System

The health and vitality of the riparian environment and its related ecosystems along the Yanco Creek & Tributaries System is an important issue to all water users. Maintained and improved water quality and the health of waterways are also key components of the Murray and Murrumbidgee Catchment Blueprints to meet measurable environmental health targets.

The present condition and future sustainability of native flora and fauna as part of the areas biodiversity, was a key issue conveyed by the community.

The Impact of Seasonal Flow Patterns on In-stream Ecology and Wetlands

There is concern that high flows in streams (eg Colombo Creek) typically experienced in summer when water demands peak, are opposite to the natural patterns. ie wetlands along the system are receiving inflows at the wrong time. This adversely impacts on stability of stream banks, native vegetation regeneration, fish breeding cycles, and flooding events. While irrigators need water for summer cropping regimes, the regulation of flows into wetland areas may need to occur.

Flows of varying heights sustain a number of wetland areas along the YCS. Generally, the community recognises that these areas are an important part of the creek system and should be protected for their environmental values.

If the necessary reduction in creek height cannot be achieved through other means, the installation of a number of regulators (NSW Fisheries approved), in fill channels, and break away points, may be necessary. Due to the current hydrological regime of Yanco Creek, some wetlands (eg. Molley's Lagoon), are remaining full throughout many irrigation seasons. In deep lagoons such as Molley's, the "topping up" with irrigation water is of no ecological benefit, as most lagoons with similar geomorphology will hold water between seasons, if not for several years, without "topping up'.

To some extent those wetlands which are sporadically connected with the creek during irrigation season are of ecological benefit to the system, (particularly the shallow wetlands which do still dry out) providing habitat for fauna including fish, water birds, frogs, reptiles etc.

However those wetlands which are permanently inundated are likely to become degraded over time. The visible symptoms of this degradation are death of river red gums, bank erosion, reduction in water quality and loss of aquatic plant diversity and cover. During irrigation season the operation of regulators to keep water out of such wetlands would benefit the wetlands and produce water savings in the system. Generally speaking, the substantial water losses associated with the wetland-creek connection during high operational flows cannot be outweighed by a perceived ecological benefit. The Yanco Creek wetlands would benefit from management that allowed flooding in late winter/spring and exclusion from high irrigation flows to produce a natural draw down during the warmer months. As long as Yanco Creek can still be managed to receive environmental flows of a sufficient height and duration to fill wetlands, there should seldom be any ecological need for wetland filling throughout irrigation season. Any future proposals for works on Yanco Creek (eg. upgrading, installation or removal of regulators or weirs) will need to consider the possible effects on riparian and wetland ecology.

EXAMPLES OF KEY WETLANDS ALONG YANCO CREEK

Dry Lake

This vast shallow lake is one of the most significant and largest wetlands on the Yanco Creek System. It fills via a channel off Yanco Creek when the Murrumbidgee River exceeds a height of 5.13 Metres or 22,500 ML/Day at Narrandera. The connecting channel has also been known to fill with water during periods of high operational flows in Yanco Creek, during high allocation irrigation seasons. Dry Lake last filled from environmental releases in 2000 and held water for approximately 6 months.

Currently the lake holds water in an area of approximately 200 ha. Historically, however, the surface area of the lake was possibly over 400 ha before a drainage line was cut into the south western end of the Lake. This drainage line was most likely excavated in a bid to empty the lake earlier to allow for lake bed cropping. The current owners are seeking to fill in the drain and manage the lake to maximise ecological benefit.

Molleys Lagoon

This deep narrow lagoon forms part of the fill channel to Dry Lake and during high allocation seasons sometimes receives irrigation flows throughout summer. This site has been an Integrated Monitoring of Environmental Flows (IMEF) study site since 1998. Early indications are that this lagoon is being over-watered.

Funds are available from a number of sources for Murray and Murrumbidgee catchment landholders in NSW to restore and protect the natural values of wetlands on their properties. Funds can be used for fencing to control grazing, earthworks to re-establish more natural water flows, and revegetation. Landholders must be willing to show other landholders their rehabilitation work (eg. allow the wetland to be used as a demonstration site for field days), and must be willing to meet at least half of the cost of the work, either financially or as in-kind assistance such as labour or materials.

Kerribirri

The natural topography through this property comprises low-lying country, flood runners, and a small creek (Kerribirri Creek) that flows out of Forest Anabranch to the south east. These areas total approximately 750ha in size. Instalment of structures such as weirs during the 1930s, and more recently the impact of dense cumbungi growth, has encouraged the movement of water into these low-lying areas and they now receive much more water than they would have naturally. Construction of a retaining bank and numerous block banks during the 1950s was designed to prevent water breaking out of the main creek and flooding low-lying country between the Forest Anabranch and Billabong Creek.

A large depression that is fed from Kerribirri Creek holds water all year, and provides an important water storage. A licensed block bank and pipe structure crosses this creek at the cottages further downstream and holds water between Kerribirri Creek off-take and the block bank.

While much of the water in low-lying areas dries up over summer, there are other deeper depressions, apart from the storages mentioned above, that remain permanently inundated.

Rhyola

Low-lying areas on *Rhyola* sustain extensive areas of dense lignum, with nitregoosefoot on adjacent high ground. Annual grasses and roly poly comprise much of the groundcover. The main flood runner is fringed with black box trees, juncus and nitregoosefoot.

Rhyola is a renowned cattle grazing property, and stock favour the shade and water provided by wetter areas, particularly during summer. However, where dense lignum and nitregoosefoot are growing, stock access is difficult. Kangaroos inhabit these less accessible areas.

An area to the north of the Forest Anabranch on *Rhyola* has previously been declared a 'Wildlife Sanctuary' through an agreement between the landowner and the National Parks and Wildlife Service. These areas were originally declared to protect waterbirds from duck shooters.

ACTION 3.13(A)
That the current flow regime of YCS be investigated and modified if necessary, to best mimic natural flooding regimes and particularly wetlands.
Responsibility: DIPNR and Murrumbidgee and Murray Wetlands Working Groups, State Water and Landholders.
Timeframe: 2007
Priority: Medium

ACTION 3.13(B)
That a scoping study be undertaken to identify and establish management needs to maintain and enhance key wetlands including natural wetlands and those created by water escapes and weir pools.
Responsibility: DIPNR and Murrumbidgee and Murray Wetlands Working Groups, State Water and Landholders.
Timeframe: 2006
Priority: High

Plate 14: Wetlands on the Yanco Creek System

ISSUE 3.14
Water Quality

In addition to the DIPNR water quality report in Section Two, the Molino Stewart Report also concludes that the overall water quality of the Yanco-Colombo system is not as bad as might be expected. However there is a need to establish a more rigorous monitoring regime to ensure that the YCS is at least maintaining the baseline position and developing an appropriate water quality monitoring regime for the future.

DIPNR Murrumbidgee Region currently monitors water quality at five stations within the Yanco-Colombo System. The Billabong Creek and lower section of the YCS including the Forest Creek are monitored by DIPNR staff in the Murray region of DIPNR. This monitoring regimes serves to provide general water quality assessment. To adequately address specific water quality issues and/or works and to source sufficient data to control and measure performance in meeting water quality targets will require targeted monitoring programs. It is recommended that such programs be integrated into the catchment planning process. Additionally, a continuous salinity and flow monitoring station at the lower reaches of Colombo Creek would enable a determination of end of valley flow and salt load export from the Murrumbidgee valley.

ACTION 3.14(A)
That the current water quality monitoring regime in place be assessed with a view to ensuring that it provides timely and accessible information on appropriate water quality parameters.
Responsibility: DIPNR
Timeframe: 2006
Priority: Medium

ACTION 3.14(B)
That a salinity audit of the YCS be undertaken that determines salt sources, its distribution and location in the system so as to instigate management actions to control its accumulation and impact on the system and to measure export quantities.
Responsibility: DIPNR
Timeframe: 2006
Priority: Medium

Water quality has been recognised as a major issue for future management of the system. Water quality has a critical influence on all the interested parties and issues of the system. Prompt action is needed to maintain any deterioration at its current level and begin to build a regime to start making improvements into the future. Remedial works as part of the natural resource management plan will be one of the key steps in achieving improved outcomes.

Two of the critical measuring parameters of water quality, Total Phosphorus and Turbidity, have been recorded at levels above generally accepted limits. Phosphorus levels in a range of samples and tests conducted by DIPNR were frequently above the EPA (1995) threshold at which damage to the ecological community will occur, potentially increasing the threat of algal bloom outbreaks in prolonged dry and low flow periods. Stream Turbidity is good at the Yanco Off-take, but rapidly deteriorates in the upper reaches and becomes severe in the lower reaches. All the drains in the system have high median turbidity levels. There is some concern of rising salinity from known dry land saline areas in the upper Billabong.

In the future, salinities of the irrigation drains may increase due to the implementation of the Berriquin Surface Drainage Scheme where it is likely to intercept high water tables and collect possible salts in the increased drainage of groundwater flows (Molino Stewart, 1999).

As water quality is such a critical determinant of Catchment Blueprint targets and therefore assisting to arrest the decline of the Murray Darling Basin, it is vital that an appropriate and properly resourced water quality monitoring system is established for the entire Creek system. This will require a detailed investigation to be performed of what water quality monitoring is needed, and where it should be located in the creek system, along with the provision of suitable resources to record and monitor the water quality status of the system.

There is also considerable opportunity for community participation in aspects of the water quality monitoring needed. For example, in addition to the need for established scientific water quality monitoring sites to be set up and resourced, school groups and farmers could carry out and report on data recorded at their location in the system under suitable guidelines. This would help to build better creek system ownership and improved understanding of the system.

Closely tied to supply and water flow agreements needed between the Irrigation Companies, State Water and water users represented by YACTAC; water quality management aspects such as chemical contingency plans need better public advertisement and should be openly policed. Currently, Irrigation Corporations are required to meet EPA licence conditions. Future agreements may need to account for irregular events when excessive discharges of contaminants such as molinate and other nutrient concentrations occur in the drainage channels that supply water to Yanco Creek System users. Such discharges have the potential to enter drains from the Finley Escape, Berrigan Escape and Wollami East Escape as well as from DC800 out of the Coleambally Irrigation Area. The management of chemical contaminants clearly has legal implications impacting on economic livelihoods and damage to environmental ecosystems. Collaborative efforts to improve existing arrangements and establish new guidelines will be an important benefit to all stakeholders.

ACTION 3.14(C)
That YACTAC meet with irrigation companies and the EPA with a view to determining the licence requirements and conditions as they effect the YCS and that this be made available to members.
Responsibility: YACTAC and EPA
Timeframe: 2004
Priority: Medium

ACTION 3.14(D)
That YACTAC work with the EPA and Local Councils and other appropriate bodies such as Fire Brigade and rescue squads to establish emergency management plans to control environmental emergencies. e.g. road accidents/chemical spills
Responsibility: YACTAC, EPA, Councils, State Water
Timeframe: 2008
Priority: Medium

In terms of water quality, the lower Yanco-Colombo is a eutrophic system driven by sediment and nutrient supply, much of which originates from the upper reaches of the system through altered flows and the influence of irrigation drainage to lower Yanco creek. The influences of these factors result in decreased water quality downstream.

However, the adoption of more natural flow regimes throughout the system are likely to yield improved water quality as greater flow variability would enhance periodic flushing of the system as well as increasing bank stability and riparian vegetation condition. Removal of obsolete weirs and other structures, particularly within the lower reaches of the Colombo Creek, would also improve water quality.

ACTION 3.14(E)
That a detailed hydrological analysis and modelling for the YCS be undertaken prior to any changes to existing structures or flow management.
Responsibility: DIPNR and State Water
Timeframe: 2006
Priority: High

Related to improving the water quality of the system is a need to also monitor the ecological health of the system. This is because environmental health is not only concerned with water quality, but the overall ecological health of the system. There will also be a need to ensure that actions arising from the plan, when implemented, are targeted and effective in improving the overall health status of the YCS. Immediate changes occurring because of works will also have to be monitored and evaluated to ensure the objectives of the plan are met.

The implementation of the Murray and Murrumbidgee Catchment Blueprints will involve extensive water quality and ecological assessments, and these will assist the YCS in determining the overall health of the catchment. It will also enable the YCS to be benchmarked along side other systems in the catchment.

ACTION 3.14(F)
That an integrated water quality and ecological monitoring framework be established to assess the effect of plan implementation. This to include riverine environment, in-stream water quality and town water supplies.
Responsibility: YACTAC, DIPNR, State Water, EPA, CSIRO, Local Government
Timeframe: 2005
Priority: High

ACTION 3.14(G)
That a review be undertaken of flow and water quality recording network to meet current and future requirements, and with particular emphasis on the lower reaches of Colombo Creek to determine end of valley flow and salt load export from the Murrumbidgee valley.
Responsibility: DIPNR
Timeframe: 2007
Priority: High

ACTION 3.14(H)
Provision of water quality and monitoring data to ensure landholders are better informed in related decision making.
Responsibility: YACTAC, Landholders, DIPNR, EPA, NSW Agriculture
Timeframe: 2006
Priority: High

Plate 15: Streambank Erosion caused by willows diverting flow

CORE ISSUE: MAINTAINING AND IMPROVING THE RIPARIAN HABITAT (BIODIVERSITY OF THE CREEK CORRIDOR) AND ECOLOGICAL HEALTH OF THE SYSTEM

ISSUE 3.15

Protection of Riparian Land and Wetlands

WEED MANAGEMENT

Apart form the burden of major infestations of weed such as Willows and Cumbungi, the YCS has many sections of the water way that are free of serious detrimental weeds. The best sections of the creek are where flow is less impeded and willows have not colonised. Low stocking densities typical of the region and well managed cropping operations away from the creek have facilitated this fortunate situation. Clearly, willow and cumbungi control will be the major components of the works and maintenance programme proposed for the YCS.

However, in recent years, the lack of maintenance on the creek system, the augmentation of irrigation area outfall drains into the system and potential for import of weeds from purchased stock feeds during several drought years confronts al stakeholders to be forever vigilant to prevent major and rapid riparian degradation. Weeds that establish quickly and over long sections of the creek tend to have serious consequences through competition by choking out native plants that are important to native terrestrial and aquatic fauna species and domestic livestock. They also often adversely affect water quality by shielding light and allowing excessive build up of nutrient.

Control method options for serious spreading weeds tend to be limited and very costly. Additionally, a variety of approvals are necessary to undertake control works and to comply with stringent government legislation such as the Protection of the Environment Act 1997, Water Management Act 2000, Native Vegetation Conservation Act 1997, Threatened Species Conservation Act 1995, and Fisheries Management Act 1994. A coordinated approach that focuses on prevention is seen as the best strategy to apply to keep weeds out of the system. In recent years, several major weeds have begun to colonise along sections of the YCS. These have the potential to spread and render control near impossible thus undermining the intrinsic value of the creek and key wetlands of the system. Of particular note is the recent discovery of the spread of Lippia (*phyla nodiflora*) and infestations of Arrowhead *(Saggitaria montevidenis)* Due to the preferred location of both these plants on the waters edge and on the banks and immediate edges of the creek, chemical control, grazing and physical removal is both difficult and dangerous. In Victoria, the installation of seed interceptor structures on irrigation area escape drain outfalls is proving an effective control measure and should be evaluated for use in the YCS.

PROPOSED ACTION 3.15(A)

(i) That all land managers including farmers, irrigation companies, Government agencies, local councils and Regional Weed Management Groups implement and coordinate weed eradication programmes along riparian areas of the YCS.

(ii) That YACTAC ensure weed identification, reporting and controls are key components in establishing a prioritised works and monitoring programme along the YCS.

(iii) That control works programmes are formulated in consultation with government agency staff and comply with relevant legislation and noxious weed protocols.

(iv) That alternative control methods are evaluated and adopted using community education measures to prevent the further spreading of weds. E.g. installation of seed interceptor structures on escape drain outfalls.

Responsibility: YACTAC to coordinate Stakeholders
Timeframe: 2005 and ongoing
Priority: High

GRAZING MANAGEMENT

As efforts are being directed towards protecting the environmental values of the YCS and its associated wetlands through more appropriate flow management, it is important that grazing management is also addressed.

Stock moving along the travelling stock route affect only a part of the whole wetland system. A study conducted in 1990 suggested that travelling stock did not appear to be adversely affecting aquatic herb diversity at the time of the study, although the abundance and vigour of some species was being reduced. This was apparent when comparing the flood-out areas on the travelling stock route with similar areas on private properties fringing the swamps along Eight Mile Creek, where extensive stands of palatable sedges and fragile herbs could still be found (Roberts & Pasma, 1990).

This study also stated that an increase in grazing pressure, especially over summer as stock move in for water and green pick, could result in localised elimination of palatable and soft-stemmed wetland species and an expansion of flood-loving weedy species. This would destroy the value of the Wanganella Swamp system.

Currently stock on private land tend to be moved away from Wanganella Swamp during winter. The swamp paddocks are grazed during spring and then de-stocked as the wetland areas dry back in late summer, to prevent stock bogging in exposed mudflats (*pers. comm*. McCrabb, 2000). The TSR adjacent to the Wanganella Swamp is the most heavily grazed area on this stock route because it provides the best feed. On average, a mob of 600-800 stock is moved along the stock route 8-10 times a year. They are likely to spend around 7-10 days at the Wanganella Swamp, depending on seasonal conditions (*pers. comm*. Mullins, 2000).

It is important that stock on private and Crown land are managed to minimise the impact of grazing on the Wanganella Swamp system.

PROPOSED ACTION 3.15(B)

That land managers implement recognised best practice management techniques for the management of stock adjacent to riparian areas. Best management practices may include fencing off areas to exclude grazing stock and allowing natural regeneration.

Responsibility: land managers (private and RLPB), with assistance from DIPNR and Lands Department
Timeframe: 2005 and ongoing
Priority: high

Riparian land is land that adjoins, or directly influences, a body of water. This section of the plan is concerned with the land immediately adjacent to the YCS, including the creek bank itself. Riparian land differs from adjacent areas in several ways. It generally occupies the lower parts of the landscape, where there is usually more water, both in the vegetation and the soils. The soils are often rich in organic matter, with good soil structure and a better supply of nutrients available to support plant growth. The contrast with surrounding vegetation can be especially marked in arid and semi-arid environments, such as the southern Riverina, where the strip of riparian vegetation along YCS is a unique feature in the landscape.

Riparian land that supports native vegetation in good health often contains a high diversity of living organisms. This land provides food and nesting sites for wildlife and can provide a refuge for plants and animals during times of stress, such as prolonged drought or fire. Riparian vegetation can slow the overland movement of water, and filter sediment and nutrients. Wildlife benefits from riparian habitat in a variety of ways. Some animals, for example many frog species, are dependent on riparian habitats throughout their life. Many animals use riparian lands for breeding or as refuge for young. Others depend on daily access to riparian lands and vegetation for drinking, feeding or roosting.

The YCS is a red river gum and black box fringed watercourse, typical of streams in the Riverina that are subject to occasional flooding. The watercourse generally supports a mixture of stands of black box woodland, and scattered individual trees. The black box occurs in association with the occasional river cooba, and the understorey is dominated by nitre goosefoot, lignum, short-leaved bluebush and a mixture of native and introduced pasture species.

Generally the condition of black box trees is good, though stands are dominated by mature species. The condition of understorey species varies along the creek, and probably reflects the grazing management on individual properties. Generally, regeneration of black box and understorey species is marginal. In some places, riparian vegetation has been lost through permanent inundation and/or burning (to control cumbungi).

PROPOSED ACTION 3.15(C)
Those areas of high conservation value riparian areas be identified with a view to developing 'best management practices' and using funding incentives to maintain and improve riparian and wetland habitat. Best management practices may include fencing off areas to exclude grazing stock and allowing natural regeneration.
Responsibility: YACTAC, Landholders, RLPB, Lands Department, LCIA's, DIPNR
Timeframe: 2006
Priority: High

Being productive land, the riparian zone is vulnerable to overuse and to practices that can degrade land and water quality. The riparian zone is subject to varying levels of grazing pressure. Stock usually favour riparian areas because of the availability of water, fodder and shade. However, uncontrolled stock access can:

- **Damage important native habitat and in some cases, cause the loss of species**
  Stock selectively graze the seedlings of some species, preventing the establishment of new plants of that species.
- **Reduce water quality and damage in-stream ecosystems**
  Direct input of nutrients through manure and urine add substantially to the loads of nitrogen and phosphorus within the stream, and these nutrients can support excessive growth of nuisance plants and algae.
- **Lead to soil compaction and erosion**
  Soil compaction may affect the ability of seeds to germinate and reduce the rate at which rainfall or run-off infiltrates the soil. Overgrazing by livestock opens up patches of bare soil which can then erode. Stock movement along the water edge disturbs and pugs the soil, leaving it prone to being washed away when rain increases the stream flow.
- **Encourage weed invasion**
  The disturbance created by livestock through grazing of plants and exposure of bare ground, together with increased nutrient levels from animal manure and urine, creates an ideal situation for the establishment of weeds.

Grazing of riparian land, even of native vegetation, may not be incompatible with the maintenance of wildlife habitat, provided that grazing is planned and managed with care. This takes some planning and effort, but many landholders are discovering that in the long-term, substantial benefits can be gained in the form of enhanced production, improved water quality, stable stream banks and healthy riparian vegetation.

The key aspects of riparian zone management include:

- Retention of riparian vegetation;
- Stock management; and
- Revegetation of degraded riparian areas.

Legislation exists to protect riparian land by restricting activities such as clearing within 20m of streams, and other development within 40m of a watercourse. Specifically, the principal pieces of legislation pertaining to activities on riparian areas are the Native Vegetation Conservation Act 1997, the Water Management Act 2000, the Rivers & Foreshores Improvement Act 1948 and the Environmental Planning & Assessment Act 1979. Other important legislation such as the Threatened Species Conservation Act 1995, the Fisheries Management Act 1994 will also be considered in any proposed works undertakings.

General information and technical advice regarding the protection of riparian land, and financial assistance for management activities, are available from DIPNR and Greening Australia.

ACTION 3.15(D)
That DIPNR and the CMA's through incentive programmes continue to raise community awareness of the value of protecting riparian habitats, and the importance this plays in contributing to ecologically sustainable management.
Responsibility: DIPNR, and Wetland Working Groups
Timeframe: 2005 and ongoing
Priority: Medium

Plate 16: Cattle grazing

ISSUE 3.16

Influence of Common Carp.

The community considers Common Carp as one of the major causes of declining native fish numbers due to their territorial dominance, and to turbidity resulting from their digging in the floor of streams and into banks in search of food. In recent decades Common Carp numbers in the system have risen dramatically. This has had a deleterious effect on the water quality in the YCS. The increase of LWD in the creek has been attributed to *inter alia*, the infestation of Common Carp which has undermined bank stability, allowing trees to fall into the creek. This also causes deterioration in water quality. From Discussions with farmers and anglers fishing in the YCS there is anecdotal evidence to suggest many sections of the system are seeing a return of native fish species. However, despite observations of declining Common Carp numbers, the battle to control Common Carp remains and there is an urgent need to develop an overall control strategy through further research on aspects of flow management such as peaks, timing and duration, and their impacts on aquatic fish species breeding and control. Research of this nature will help ensure that there is sufficient information on the deleterious impact on water quality and turbidity. The future management of creek flows will have direct bearing on the presence of pest aquatic species such as Common Carp. For example, if high flows are released in spring for durations up to 10 days, spawning conditions for Common Carp recruitment will be ideal. Counter to this, native fish species benefit from high flows and flood conditions for nutrient transport along the system and for an improved feeding source. Therefore, a balance of facilitating conditions for native fish species has to be measured against control of conditions suited to pests like Common Carp as well as operational and supply practicalities in a regulated creek system.

ACTION 3.16(A)
Community participation programs to promote the control and commercial use of carp be supported and enhanced.
Responsibility: YACTAC and NSW Fisheries
Timeframe: 2005 and on-going
Priority: High

ACTION 3.16(B)
That current research techniques e.g. daughterless carp (induced sterility measures) to control the persistence and spread of Common Carp into inland waterways be supported.
Responsibility: YACTAC
Timeframe: 2005 and on-going
Priority: High

ACTION 3.16(C)
That the YACTAC NRMP strategies and actions are consistent with the Murray and Murrumbidgee Catchment Blueprints.
Responsibility: YACTAC and DIPNR
Timeframe: 2005
Priority: High

ISSUE 3.17
Vegetation Management

The community conveyed a strong view that voluntary stock exclusion from YCS waterways be encouraged, particularly to assist with revegetation and regeneration. Excluding stock from sensitive areas would also prevent water pollution and disturbance. Appropriate funding incentives would increase the uptake of such 'Best Management Practices', by partly offsetting fencing or alternate watering point costs. The CMA's will have to prepare Catchment Action Plans as part of their main responsibilities. YACTAC should ensure that the outcomes expected from the YCS Natural Resource Management Plan are consistent with the Catchment Action Plans.

ACTION 3.17
That the YACTAC seek access to vegetation management incentives to facilitate the opportunity to achieve better management outcomes from managing the riparian pathway for conservation purposes.
Responsibility: YACTAC
Timeframe: 2004 onwards
Priority: Medium

ISSUE 3.18
Environmental Regulation

Water users at the community forums staged along the catchment expressed a considerable degree of frustration about the degree and inflexibility of environmental regulation and controls in order to carry out works. The YCS community has found it difficult to accept the need for the greater control and planning under more stringent environmental legislation over the last decade. Specifically, frustration was conveyed about perceptions of bureaucratic and restrictive procedures influencing the timeliness for approvals to undertake environmental works on farmers' individual properties. The situation was pronounced in obtaining approvals for works under various Acts including the Local Government Act, NVC Act 1997, RFI Act 1948, Fisheries Management Act 1994, Threatened Species Conservation Act 1995 and the EPA Act 1979 and Water Act 2000.

The community expressed a desire for Governments to more fully recognise the contribution that agricultural improvements have on conservation and management of the environment. Fundamental to this, is the need for acceptance by government and the broader community that irrigated agriculture can be managed in a responsible and sustainable way. This Natural Resource Management Plan seeks to confirm this by including consideration of the environment and the needs of irrigators. Irrigators also seek acknowledgment of their role in planning and proposing reform, just as minority interest groups do. This will need to be reflected in future management plans and agreements that relate to the YCS.

ISSUE 3.19
More Flexible Approval Procedures For Riparian Works.

Works that result in impacts on core habitat of native flora and fauna involve the clearing of riparian vegetation (exotic or native), disturbance to the bed or bank of prescribed waterways, or the removal of large woody debris (snags) in the stream, require consent from relevant State Government agencies unless an exemption applies. The key piece of NSW Government legislation of which other Acts listed below have to take into account is the Environmental Planning and Assessment Act 1979. In addition Federal Legislation also places obligations for consideration under the Environmental Protection and Biodiversity Conservation Act 2000. Watercourses in NSW are subject to a variety of legislative controls aimed to control integrity of the waterway, mitigate soil erosion and sedimentation, maintain water quality, and conserve native flora and fauna. These Acts are administered by several natural resource management agencies such as DIPNR, NPWS, NSW Fisheries and EPA.

The Department of Infrastructure Planning and Natural Resources (DIPNR) administers both the Native Vegetation Conservation Act 2003 and the Rivers & Foreshores Improvement (RFI) Act 1948. This latter Act is to be repealed by the Water Management Act 2000.

As part of the NSW Government's new approach to natural resource management, the newly formed Murray and Murrumbidgee Catchment Management Authorities will be tasked to complete Catchment Action plans. It is anticipated that many elements of the Western Riverina Regional Vegetation Management Plan will be included in these plans with a strong focus on advisory activities, planning and incentive programmes to be part of Property Vegetation Plans viewed as the vehicle to achieve discernable improved catchment outcomes.

It is envisaged that most of the environmental works that will assist with targeted reduction in system losses and flow impediments will involve removal of exotic trees (mostly willows), targeted cumbungi infestations, weeds, and some removal, re-alignment and lopping of LWD. These works require the owner of the land on freehold land to gain consent from DIPNR, NSWF and NPWS. Works that entail removal of willow trees within State protected land will be assessed under the NVC Act 2003 and the Fisheries Management Act 1994.

Works that involve excavation of the bank out to the prescribed distance, or require excavation or re-alignment of the Creek bed, are assessed under the RFI Act 1948 and consent is required from NSWF and DEC.. In the assessment of both types of works, an eight part test and appraisal is required by decree under the EP&A Act 1979. In these situations, works applications under the relevant pieces of legislation need a management plan showing:

- what features occur at the site,
- what works are proposed and how the work is intended to be carried out,
- what measures will be undertaken to minimise adverse affects to the surrounding and associated environmental assets of the area.

DIPNR Staff assessing applications can assist with information and the contents of such plans.

It is recommended that using the YACTAC NRMP, that DIPNR, State Water, NSWF, DEC and landholders develop local implementation plans to identify sections of the creek that require consent authority under the various Acts. Such plans would need to be assessed and prioritised as part of a whole system strategy. Under this arrangement, the likely appointment of a project officer to assist with the implementation of the NRMP could achieve considerable efficiencies to expedite the commencement and completion of works. For example, joint inspections by the relevant agency officers could be co-ordinated in determining consent and achieve more complementary conservation measures.

DIPNR is developing measures to streamline approval procedures for efficiency gains and improved integration. These arrangements will enable land users to better plan future land use and seek the appropriate approvals under one application. Consent approvals and conditions will be based on the likely level of the impact a proposed work. Put simply, a low level impact work proposal will require only minimal information to be supplied by the proponent and hence can be processed more expediently.

The anticipated approach to remedial works along the riparian pathway of the YCS, will adopt a prioritised and co-ordinated schedule of works, and should result in major efficiencies and less frustration for all stakeholders in the consent process.

ACTION 3.19(A)
That any creek works be undertaken following a coordinated and integrated approach involving consent authorities and with regard to a whole of system strategy.
Responsibility: YACTAC, State Water, DIPNR, NSW Fisheries and NPWS
Timeframe: 2005
Priority: High

ACTION 3.19(B)
That YACTAC investigate the possibility of the YCS NRMP and associated works, being used as a pilot project for trialling improved integrated approvals being developed by Government Agencies.
Responsibility: YACTAC, DIPNR and State Water
Timeframe: 2005
Priority: High

Plate 17: Field Day – The Gerrin Inspection

ISSUE 3.20
Funding

The YCS has suffered considerably in the last ten years due to a lack of resources being allocated for maintenance of the system. As a result, water delivery difficulties have arisen due problems such as LWD build ups, siltation and cumbungi growth infestations. Previously, when the system was administered by the Yanco Trust, an annual budget was allocated to undertake maintenance works. Following the handing over of management responsibility to the then Department of Water Resources, and changes to funding allocation procedures, on-going works maintenance lapsed. State Water, being recently moved into the Ministry for Energy and Utilities is considering making between $60,000-80,000 available annually.

A key objective of producing the natural resource management plan for the system is to set a framework to conduct maintenance works. These will help reduce the current heavy losses from the system and result in a more timely and reliable delivery of water. Complementing this, the NRMP recommends that incentives for assistance to undertake irrigation education, and design and management packages such as 'Waterwise', will bring about additional water use efficiencies in the entire system. It is the expressed desire of the communities along the reaches of the system to possibly negotiate a specific budget for the system for on-going maintenance, for on-farm water use efficiencies. This could be jointly administered by the key stakeholder community representative groups (YACTAC & MPI) and relevant government agencies.

In planning a pathway for a maintenance program, it is incumbent on all the water users to make a measurable financial, and/or 'in-kind' contribution to works needed for the continued function of the system both for water delivery and to maintain and improve the ecological integrity of the system. This does not deter from the significant contribution that landholders already make to caring for the creek, and their commitment to carry out much of the monitoring and reporting work needed in the future, to audit the performance of the system.

There are a number of sources of funding available for implementing works. Many of these require a dollar for dollar contribution from landholders. That is any dollar given by a funding body for related outcomes, is matched by an equal either dollar or in-kind contribution from the landholder.

A simple way of funding any works which flow from this document may be via a levy on entitlement. This is common practice in other river valleys in New South Wales where capital and provision for ongoing maintenance has occurred. Alternatively, the YACTAC may be able to raise a loan for the works from the Government which would then be paid back through a levy on entitlement.

What needs to be understood is, that the total cost of the works required will not be met by the government alone.

ACTION 3.20
That YACTAC set up a funding sub-committee to pursue all funding opportunities for the implementation of the NRMP.
Responsibility: YACTAC
Timeframe: 2004
Priority: High

ISSUE 3.21

Environmental Flow Provision to be included in Regulated Water Sharing Plan.

The Murrumbidgee Regulated Water Sharing Plan, intended to commence in January 2004 and operate until 2013, aims to manage the system under the environmental flow rules (Rule 4) developed by the Murrumbidgee River Management Committee. Environmental flow rules have operated in the Murrumbidgee River System since 1998. The Murrumbidgee River Management Committee openly acknowledges that flow rules may need to be altered at any time, to address an environmental contingency such as bird breeding, fish breeding or wetland watering. The current operating rules allow for a volume of 25GL of water to be set aside each year (when available allocation exceeds 60%) for environmental contingencies and is not available for consumptive use. Provision also exists for use of unreleased translucency water as environmental contingency allocation.

In addition, provisional storage enables the 25 GL to be set aside at 60% allocation to be carried forward to the next water year. This increases linearly from 25 GL at 80% allocation, to 200 GL at 100% allocation. Provision exists for the storage of unreleased translucent water as provisional storage in the following years.

The Water Sharing Plan will set up an 'Environmental Water Allowance Reference Group' to provide advice on the release rules for the environmental water allowances. The intention being put up for discussion is for this reference group to comprise Murrumbidgee Catchment Management Board representatives, and Customer Service Committee representatives. This action may take some time to establish.

In addition, under the Water Management Act 2000, under which the Water Sharing Plans sit, a 12 month review of Environmental Flow Rules will be carried out. The likely model for this task will be the establishment of a Review Group comprising DIPNR staff experts and Community Representatives with permitted decision making delegation. It is envisaged this group will commence the task in February 2004.

ACTION 3.21
That the YACTAC requests appropriate authority to have a formal and permanent consideration of environmental flow requirements for the YCS.
Responsibility: YACTAC
Timeframe: 2005
Priority: High

ISSUE 3.22

Negotiation of Water Quality and Quantity Agreements with Associated Water Authorities

Of particular concern to landholders is the future supply of water during the irrigation season, from the Murray Valley via MIL's Finley Escape Channel, from the Murrumbidgee Valley via the CICL Catchment Drain, and DC800. Maximum daily in-flows are 250 ML/d from Finley Escape, 150 ML/d from the catchment drain, and 200 ML/d from DC800. Finley Escape Channel is recognised within MIL's Licence (IC2) as a credited escape, which facilitates the arrangement for delivering flows to the Murrumbidgee Valley. This supplementary flow has become a critical source of water for the Billabong Creek below Jerilderie and the Forest Creek system. It has also recently been recognised as a potentially valuable way of assisting with the delivery of environmental flows to the Wanganella Swamp system.

The existing arrangement that MIL customers receive their water requirements as a priority (*pers. comm.* Watts, 1999). There is no legal or binding agreement to supply supplementary water to the Murrumbidgee Valley via MIL escapes (Molino Stewart, 1999). The existing arrangement with CICL is that as part of their operating licence they are required to deliver water through the catchment drain and DC800. The original quantities as specified are not currently being delivered due to concerns over in-system flooding and environmental concerns.

Further improvements to assist delivery of water to match demands and in monitoring the flows through the system, would be achieved by DIPNR and State Water, also by negotiating a formal agreement with Coleambally Irrigation Cooperative Limited and Murray Irrigation Ltd. This would guarantee the supply of water from their channel systems to the Yanco-Billabong Creek Systems under agreed conditions. These conditions would have to include maximum flow rates, procedures to be adopted in wet periods where drainage capacity is required, and limitations to supply resulting from supply channels being overcommitted.

There also appears to be no formal agreements in place for the acceptance of surplus flows from irrigation areas. This is not a problem at the moment given the drought, however during times of high rainfall, surplus flows into the creek may have a detrimental effect by causing bank erosion and flooding. It is imperative that agreements are put in place for the timing and quantity of surplus flows from irrigation areas.

ACTION 3.22(A)
That YACTAC, DIPNR and State Water develop a Memorandum Of Understanding with Murray Irrigation Limited and Colleambally Irrigation Cooperative Limited which guarantees supply of water from their channel systems to the YCS under agreed conditions.
Responsibility: YACTAC, DIPNR, State Water, MIL, CICL
Timeframe: 2006
Priority: High

ACTION 3.22(B)
That the YACTAC, DIPNR and State Water establish formal agreements with irrigation companies for surplus flows entering the system which would place parameters on flow volumes, timing of releases, and water quality targets.
Responsibility: YACTAC, DIPNR, State Water, MIL, CICL
Timeframe: 2006
Priority: High

ISSUE 3.23
Maintenance work

There is widespread concern regarding insufficient funding and works to maintain delivery and water quality to users. There needs to be an established on-going maintenance program that sets out a schedule of works that is visible and accountable. Insufficient attention has been directed to the control of willows, removal of snags and bank maintenance work to keep a check on water quality. Programs to describe works, location, priority and funding arrangements should be widely circulated. Additionally a review and forward year planning program of works completed and pending, with key stakeholders should be developed.

State Water has set up a number of Customer Services Committees that meet on a quarterly basis to assist State Water with determining priorities for maintenance and to give irrigators an avenue for consultation with State Water. There is a need for YACTAC to ensure that State Water commits to a program of on-going maintenance of the creek system.

ACTION 3.23
That State Water in collaboration with relevant agencies (local government, community etc) establish and make a permanent commitment to an annual system maintenance program based on targeted work priorities to enhance the long term sustainability of the YCS.
Responsibility: State Water and YACTAC
Timeframe: 2005
Priority: High

ISSUE 3.24

The Water Management Act (2000) and Compensation Triggers

The Water Management Act 2000 repeals the Water Act 1912 principally as well as several other Acts. Within the Water Management Act 2000, various management plans, such as the Murrumbidgee Regulated Water Sharing Plan, determine future management of water resources and sets benchmarks to define water access rights. These are provided by establishing operating rules within each of the management plans. If the Government elects to change the operating rules without notice and without due compliance to the process of permitted alterations contained in the plan, claims can be made for compensation. The conditions, on which claims can be made, come into play on January 2004 and are explained in Section 87 of the Water Management Act 2000.

ACTION 3.24
YACTAC to make members aware of limited provisions pertaining to compensation contained in the Water Act 2000.
Responsibility: YACTAC
Timeframe: 2005
Priority: Low

Plate 18: Wollomi Escape

CORE ISSUE: DEVELOPING COMMUNITY OWNERSHIP, PARTICIPATION AND EMPOWERMENT TO IMPROVE THE FUTURE MANAGEMENT OF THE SYSTEM'S NATURAL RESOURCES.

ISSUE 3.25

Community Engagement

The Natural Resource Management Plan for the YCS has evolved out of a number of preceding studies, meetings and community concern. Accordingly YACTAC resolved that the YCS needed an overall natural resource management plan in order that issues could be explored by the whole community and developed into coordinated strategies and remedial actions. It was also felt that an essential ingredient to the success of any plan was to engage the whole community in the decision making process. YACTAC has sponsored meetings throughout the YCS and has also canvassed license holder views by a mail-out. License holders have also been encouraged to contact local delegates with any issues they may have. Community consultation and partnership remains a core issue of the YCS NRMP.

It has been suggested that a sub-committee of the YACTAC take on the role of ensuring adequate consultation and participation in the development and review of the plan. This sub-committee could also include individuals with particular knowledge, for example with environmental expertise or local knowledge of the particular parts of the creek. The sub-committee would also need to take on a role of liaison with the Murrumbidgee and Murray Catchment Management Authorities, the River Management Committees and Customer Services Committees, such integration and cooperation is paramount, as funding bodies would need to be confident that local NRM plans such as that being developed by YCTAC, is consistent with the Murrumbidgee and Murray Catchment Blueprints.

It is envisaged that this steering group would report back at regular intervals to the community, and play an important role in preparing proposals for external funding and exploring cost-sharing arrangements.

ACTION 3.25(A)
That the YACTAC form an implementation steering group that is tasked with ensuring adequate consultation with stakeholders in the development, management and review of the Natural Resource Management Plan.
Responsibility: YACTAC
Timeframe: 2004 and ongoing
Priority: High

As previously stated, YCS was known to be an ephemeral stream prior to regulation, and indigenous habitation was likely to have been sporadic. State Government requires that sites of cultural significance be protected from destruction under the National Parks Act 1974.

ACTION 3.25(B)
That YACTAC ensure that any works are carried out in accordance with the regulations contained in the National parks Act 1974 pertaining to Aboriginal sites of cultural significance.
Responsibility: YACTAC
Timeframe: 2005 and ongoing
Priority: High

ISSUE 3.26

Perceptions of Government and Other Groups

Local communities in the Yanco Creek and Tributaries area have expressed concern about the inaccurate perceptions about the way farms are managed and the detrimental impact irrigated agriculture is having on the environment. The 2002/2003 drought has further fuelled comment by the media and green groups that crops such as rice are a luxury that the driest continent on the earth can ill afford. Currently the rice industry is worth between $700m and $1 billion annually to the Australian economy.

The challenge for Australia is to produce significantly more food and fibre to meet the demands of an increasing world population. The desire in Australia is to do this in the context of environmental responsibility.

In 1996/97, 30% of the State's agricultural production was grown by irrigation using only a small fraction of the State's catchment areas. This provided the State with $2.4 billion of food and fibre and a further $7 billion to $10 billion worth of jobs and economic activity in downstream processing and service activity.

Professor Lindsay Flavey at the National Workshop on Integrated Catchment Management, said

> "Moral responsibility extends to care of our fellow human beings as well as care of the environment … Food Demand is most easily described in terms of population growth… Food demand appears likely to double in the next three decades".

- *World population will increase from its present level of 5.2 billion to 8.4 billion by 2025. The population of the Asia Pacific region will double by the year 2025 from 2.7 billion to 5.4 billion.*
- *UNICEF estimates that over 40,000 children under 5 die every day from starvation and malnutrition and a third of the world go to sleep hungry every day.*
- *The president of the UN's international Commission on Irrigation and Drainage, Shahrizaila Abdulla said "we have a twin problem here, not only to deal with population growth but also the growing demands of nutritional requirements because as countries get affluent, the need is even greater to have larger calories input, a diversified input also". Malaysia, for example changed from 90% self sufficiency in food in 1974 to 65% in 1995.*

A necessary precondition for a secure, caring and sustainable future is that the food and fibre production objectives and the environment objectives are attained. It is misguided to consider the issue as trading off environmental goals against production goals. It is not a question of balance but a question of how to achieve both sets of objectives.

ACTION 3.26

That YACTAC continue to support efforts by groups such as NSW Irrigators Council to improve the public's perception of irrigated agriculture.
Responsibility: YACTAC
Timeframe: 2004 and ongoing
Priority: Medium

CORE ISSUE – ISSUES UNIQUE TO THE FOREST CREEK

ISSUE 3.27

Lack of Water in the Lower Reaches of the Forest Anabranch

Currently, landholders at the lower end of the creek system are most effected by this situation- particularly *Woorooma* and *Blue Gate*; and to a lesser extent *Nullum*, *Mooroolbark* and *Back Nullum* – with smaller volumes of water taking longer to reach these landholders as each year passes. *Murgha, Boxgreen* and *Inverness* have had permanent water available for stock and domestic from the Forest Creek and the Murgha Creek Anabranch. Recognition of the problem led the six landholders below *Rhyola* to attempt to instigate action to restore the environment and water flows by removing cumbungi in the mid 1980's, however EPA approval was denied.

Although The Forest Creek is an unregulated watercourse and there is no legal obligation to supply water, a Department of Water Resources report in 1994 stated that; "it could be argued that there is a moral obligation to supply stock and domestic requirements…." (Simpson, 1994). This argument is based on the history of supply and history of landholder expectation generated as ratepayers of the Trust that administered the system between 1921 and 1980.

It should also be remembered that properties have been bought and sold along the Lower Forest Creek over the last century with the value of these permanent creeks for stock water making these properties of premium value for investment

Reliable delivery of stock and domestic water below *Rhyola* has required additional volumes of water as the result of a combination of factors;

- Some irrigators extracting water before water has been provided down stream for stock and domestic use which has priority.
- The extensive invasion of cumbungi in the creek, particularly below *Rhyola*; has slowed the flow of water
- Despite construction of block banks, breakaway flows still occur in several key places where structures, excessive growth of cumbungi and low creek banks allow backed-up water to move out of the creek channel. This occurs at the Wanganella Swamp and on *Rhyola*;
- Extensive wetland areas on *Rhyola* fill before water flows further downstream. In addition, Forest Creek sometimes backs up to Murgha Creek where Murgha Creek re-enters the Forest anabranch. This tends to occur after a particularly dry summer when the Forest Anabranch begins to flow again, and Murgha Creek is virtually dry. These flow patterns delay the passage of water to properties further downstream on the Anabranch;
- Increased regulation upstream;
- Increased demand for water upstream, for irrigated agriculture;
- Seepage to prior streams reduces the end-of-system flow;
- Willow trees planted at various locations along the creek in some places are restricting the flow of water.

Original Option: Provide an alternative water supply below Rhyola

The six landholders of eight properties below *Rhyola* have put forward the option of returning the Lower Forest and its anabranches to ephemeral streams, and an alternate supply of water be available. They proposed that replenishment flows no longer be supplied for stock and domestic requirements below *Rhyola* and that this flow be returned to the Billabong Creek via a channel on the Western boundary of *Rhyola*. Then half the water savings generated by this changed flow regime would be transferred to existing licences on the Billabong Creek or Edward River, as all landholders below Rhyola have frontage to either or both of these watercourses.

The plan formulated provided water savings or 5.65 gigalitres for environmental flows and would enhance habitat without excessive financial hardship to the landholders.

In an effort to avoid this financial inequity, the plan to provide each of these properties with irrigation water to offset the devaluation and finance the establishment and ongoing costs of the alternate water systems that will be required.

However this plan was presented by David Harris to the Lower Murray Darling Community Consultative Committee and rejected as they did not consider it appropriate to provide landholders with access to irrigation water from water savings they generated.

New Proposal Being Drafted.

With recent developments and recognition of the need for equity in good natural resource management and the priority given environmental water to be accessed through water savings, the landholders again met with David Harris Regional Director DIPNR. At his suggestion an alternate proposal is currently being drafted that would produce water savings of 11.5 gigalitres, when approved, that could be redirected to environmental flows.

Water savings have been identified through the development of the option to reduce the replenishment flows at Warriston Weir below the current minimum of 36.5 GL. The revised target flows are 25Gl at Warriston Weir so the water savings generated are estimated at a minimum of 11.5GL annually.

The plan would

- Return flows below *Rhyola* to unregulated natural ephemeral stream flood flows.
- Enhanced biological diversity in the lower Forest Creek & Murgha Creeks through the creation of new habitat
- Provide landholders with the financial ability to develop, service and maintain appropriate re-watering infrastructure and fencing where the Creek has acted as a permanent fence.
- Ensure landholders are not disadvantaged by asset devaluation.

From an ecological, economic and social perspective, this option was selected by all interest groups as the most appropriate way to deal with this management issue, This option is consistent with the vision statement in that it would:

- *Enable the efficient supply and delivery of good quality stock and domestic water to landholders in the lower reaches of the Forest Creek all year round (via an alternate supply);*
- *Allow for the efficient passage of unregulated flows;*
- *Maintain, and where possible enhance, the ecological sustainability of the Forest Creek system.*

The proposal from the landholders should be embraced and endorsed by the government as it was the only option that provided a "triple bottom line" outcome by:

- Generates water savings for a minimum annual environmental flow of 11.5 Gl
- Positive environmental outcome for habitat and sustainability
- Controls the negative financial impacts on the six landholders
- Can be implemented immediately
- Importantly, this option would improve the overall operational efficiency of the Billabong/Yanco Creek system, and generate water savings in the Murrumbidgee Valley.

The plan has had strong "in-principle" agreement from the Regional Director DIPNR, David Harris and Jon Cobden, Regional Director Pratt Water, and clearly fits all recently stated government objectives in resource management.

Importantly, this option would improve the overall operational efficiency of the Yanco/Billabong Creek system, and generate water savings in the Murrumbidgee Valley that could be shared between the environment and consumptive users.

Water savings have been identified through the development of options to reduce the replenishment flow at Warriston Weir below the current minimum 36.5Gl. The revised target flows are 25Gl at Warriston Weir so

the water savings generated are estimated at a minimum of 11.5Gl annually to be shared between the environment and the properties below *Rhyola.*

IMPACTS OF FLUCTUATING FLOWS ABOVE RHYOLA.

Considerable concern has been expressed regarding the impact of rapid and unexpected fluctuations in water levels below Warriston Weir resulting from supply error or extractions upstream in excess of water orders. This exposes mudflats and has implications for the safety of stock. While it is recognised that the Yanco/Billabong creek system is a very complex system to manage, landholders believe that greater control of flow (particularly below Warriston Weir during summer) needs to be achieved. In the future, State Water will be able to meet water orders with increasing accuracy. It is the responsibility of landholders to ensure that water orders match water use.

ACTION 3.27(A)
That the landholder proposal currently being drafted be supported and endorsed on completion to expedite its implementation to return 11.5 GLs of water for environmental flows.
Responsibility: DIPNR and State Water
Timeframe: 2004
Priority: high

ACTION 3.27(B)
That the following revised target flows for Warriston Weir be implemented as soon as possible,

Target 1. Unregulated/rain rejection flows
- That unregulated/rain rejection flows be permitted to pass through the Forest Creek system for environmental purposes. (It should be noted that from an operational point of view this is extremely difficult to implement because of the inadequate capacity of the Forest Creek off-take and the Forest Creek Regulated Section to allow those flows to pass through.)

Target 2. 'Summer' target flow at Warriston Weir
- That a target flow of 80Ml/day at Warriston Weir be provided from the beginning of November to end March,

Target 3. 'Winter' target flow at Warriston Weir
- That a minimum target flow of 60Ml/day at Warriston Weir be provided from beginning of April to end October.

Responsibility: DIPNR and State Water
Timeframe: 2004
Priority: High

ACTION 3.27(C)
That funding be secured for infrastructure to return flows to Billabong Creek.
Responsibility: DIPNR, State Water, YACTAC
Timeframe: 2005
Priority: high

ACTION 3.27(D)
That proposed changes to the flow regime be monitored annually to assess the social, economic and environmental impact.
Responsibility: DIPNR, State Water and interest groups
Timeframe: commence 2005
Priority: high

ISSUE 3.28

Management of the Wanganella Swamp System

Management of water within and through the Wanganella Swamp system is regarded as an issue from both an environmental and a supply perspective. From an environmental perspective, the wetland system supports a relatively rich diversity of plant species (Roberts and Pasma, 1990) and is considered to be of regional significance for waterbirds (*pers. comm*. Maher, 1999). The wetland system also provides other important ecological and social benefits including improved water quality, flood mitigation, opportunities for scientific research, recreation, education, and aesthetic values.

From a supply perspective, the Wanganella Swamp and McCrabb's regulator are regarded as restrictions to flow. Water slows down as it passes through cumbungi and disperses through inundated low-lying areas, before finally passing through the regulator (600mm pipe) (or flowing over the adjacent spillway if the water level is high enough) and into the Forest Anabranch.

In addition, during times of high flow return flows to Billabong Creek reduce the potential flow-through to downstream users. Water breaks away from the Wanganella Swamp to the north in three locations, and these three breakaways converge to flow under the Zara Road and into Billabong Creek. These flows are not controlled by structures, and vary significantly with the size of the flow entering Wanganella Swamp under the Cobb Highway. Water used to escape from the wetland only during flood flows, however since construction of McCrabb's regulator (1987) and the creation of a weir pool, breakaway flows have generally occurred every year between May and December (*pers. comm*. McCrabb, 1999).

The Murrumbidgee Regulated Water Sharing Plan allows for a 100 ML per day system flow and this is for the unregulated section of Forest Creek which facilitates the requirements of Wanganella Swamp. This flow rate exceeds the minimum requirements of the swamp for both summer and winter periods to facilitate bird breeding requirements.

ACTION 3.28(A)
That the operation of the Forest Creek off-take regulator and its impact on the Wanganella Swamp be considered in wider YCS assessment of environmental outcomes and related flows.
Responsibility: DIPNR, State Water
Timeframe: 2005
Priority: high

MODIFICATION OF McCRABB'S REGULATOR AND ADJACENT SPILLWAY

McCrabb's regulator and adjacent spillway were installed on the western edge of Wanganella Swamp in 1987 (without the prior knowledge or consent of the landowners). The purpose of these structures was to maintain a relatively stable water level in Wanganella Swamp after a natural flood event had initiated waterbird breeding. A number of concerns have been raised regarding the design, location, operation, and overall impact of these structures.

Design

The regulator comprises drop boards and a steel gate that can be manipulated to control the flow of water through a 600mm pipe. Experience suggests that the size of this pipe can be insufficient to meet downstream requirements, particularly during summer (*pers. comm*. Holden, 2000).

Location

The location of the regulator creates a weir pool that extends approximately 1, 200m upstream. This is a smaller pool than had originally been intended. For example, most Ibis breed beyond the extent of the weir pool, just downstream of the Cobb Highway. Due to the gradient of land through Wanganella Swamp it is not possible to extend the influence of the weir pool any further.

Operation

McCrabb's regulator has not been operated since 1990 due to staffing changes within DIPNR (*pers. comm*. Holden, 2000), and the structure has remained open since this time. This is thought to have contributed to a considerable build-up of silt within the weir pool, as water has remained backed up at a constant shallow level without the ability for higher velocity freshes to carry silt through the wetland. There has also been less opportunity for seasonal fluctuations in water level, which are important for maintaining natural ecological processes within the wetland.

The combination of these factors has lead to the conclusion that the existing regulator and spillway do not serve a useful purpose within Wanganella Swamp.

It has been proposed that the regulator and spillway be modified to accommodate 100 ML per day plus flows. It has also been identified that some initial de-silting (subject to relevant Government Agency consent) upstream of the regulator may be required to facilitate the passage of flows. This may not be necessary as the silt is very soft, and the flow of water may carve a path through the silt very easily. Any work would need to be undertaken with regard to the local topography, as a natural levee here is responsible for pooling water where waterbirds breed (*pers. comm*. Maher, 2000). The natural topography of the site should not be disturbed, and work would also need to be consistent with environmental legislation. Government Agencies such as DIPNR, NSWF and DEC are available to assist in any design modifications and formulation of operating protocols.

If a new regulatory structure is required, it has been suggested that Murray Irrigation Limited (MIL) be approached for assistance, as they have previously expressed interest in developing a joint venture for the management of Wanganella Swamp (Molino Stewart, 1999).

MAINTAINING A FLOW PATH THROUGH THE WANGANELLA SWAMP

According to Roberts and Pasma (1990), siltation was still occurring through the Wanganella Swamp system (particularly Wanganella Swamp), but was probably most severe in the weir pool above McCrabb's regulator. Their study showed that the flow-path through Wanganella Swamp was consistently less than 0.5m. In contrast, the main channel in Eight Mile Creek was generally 1.5-1.85m deep, except for one 'hole' of about 2.4m just upstream of the Cobb Highway. Recent observations have shown that a channel does still exist through Wanganella Swamp, but that a considerable quantity of very fine organic material and silt has settled in the channel and on the bed of the wetland, particularly in the vicinity of the channel.

It is envisaged that modification of the McCrabb's regulator may need to be accompanied by a proposal of desilting and removal of some cumbungi in the Eight Mile Creek channel just upstream of the regulator, to facilitate the passage of flows. The condition of the flowpath should be assessed each year to determine the extent of siltation and whether changes in the growth pattern of cumbungi are dramatically affecting the passage of flow. Any work must be consistent with environmental legislation.

ACTION 3.28(B)
That McCrabb's regulator and adjacent spillway be modified and appropriately upgraded.
Responsibility: DIPNR and State Water
Timeframe: 2005
Priority: high

PROPOSED ACTION 3.28(C)
That the operation of McCrabb's regulator be monitored as a consequence of the modifications in (B) above.
Responsibility: DIPNR and State Water
Timeframe: 2005
Priority: high

ISSUE 3.29

Flooding of the Cobb Highway, Wanganella

The Cobb Highway at Wanganella has been covered by flood-water when particularly high flows are experienced in the Eight Mile Creek. Large flood events are beyond the control of most structures. The Cobb Highway will at times be flooded because at Wanganella, the Highway crosses low-lying floodplain country that is readily inundated when flows overtop the shallow banks of Eight Mile Creek.

Two arms of the Eight Mile Creek pass beneath the Cobb Highway. The southern arm (smaller) passes through two box culverts and the maximum capacity of these two culverts has been calculated as approximately 1,000Ml/day. The northern arm passes through four box culverts and the maximum capacity of these four culverts is approximately 1,900Ml/day. This would enable a total flow in Eight Mile Creek of approximately 2,900Ml/day. This is a theoretical maximum based on a head difference of 0.1m across the culvert, and assumes that the water can get away on the downstream side. Given that there is a considerable build-up of cumbungi on the downstream side of the culverts, water will tend to back-up and slow the flood flow. Therefore, the maximum capacity is likely to be less than this calculation suggests (*pers comm*. Nankivell, 1999).

Local observations have identified that water does back up against the eastern side of the Highway during floods, and that floodwater will also back-up against the western side of the Highway, and move from west to east through small balancing culverts under the road (*pers. comm*. McCrabb, 1998).

This issue is linked to the redesign and refurbishment of McCrabb's regulator. This will enable the flow regime to be better managed to mitigate flooding of the Cobb Highway at Wanganella.

It is not the purpose of this Plan to prevent flood events from occurring, as it is recognised that they play an important role in sustaining the ecology of creek and river systems. Options for managing cumbungi and improving flow through the Wanganella Swamp (for example, removal of McCrabb's regulator and spillway, and some de-silting subject to relevant government agency consent to facilitate the passage of flows) will help to address problems that currently occur during small and moderate floods because of the growth of cumbungi in the Wanganella Swamp system.

ACTION: 3.29
That flooding of the Cobb Highway at Wanganella be mitigated by redesigning and refurbishing the Estuary Creek Regulator and McCrabb's regulator.
Responsibility: State Water and DIPNR
Timeframe: 2005
Priority: High

4. IMPLEMENTATION COSTS OF YCS NRMP

The implementation of the YCS NRMP represents an investment in a secure future of the environmental integrity of the entire system and improved efficiency of water delivery. This investment is expected to require financial and in-kind outlay by the community at large, Governments and water users over a minimum period of 10 years, for most of the works items. Obviously, some works for the maintenance of the system will be ongoing.

The YCS NRMP is a strategic plan and thus provides background and context, outlines core issues and possible actions, and provides indicative costings. The Implementation Plan will specify proposed works such as willow control and removal/realignment of LWD, detailed costings, and prioritise works within each section of the YCS. Along with this is the need for staff to be employed to undertake the management of any contracts that are let for physical works. Additionally there is a need for a project officer who will undertake duties such as making funding applications, liaising with statutory authorities and assisting with policy development.

Preliminary estimates for implementing the YCS NRMP are expected to cost $23.4 Million. Costings of works for the implementation of the YCS NRMP were prepared following detailed on ground surveys of the entire length of the creek system by officers of State Water and DIPNR. Works included in the plan can be seen below in Table 7.

Funding Considerations

It is proposed to source funding mainly from external sources being primarily the Catchment Management Authorities, Murray Darling Basin Commission and the Joint Government entity. At the October 2003 consultation meetings, YACTAC put a funding proposal to members that they pick up 20% of costs in cash and 20% in kind. The cash component would be done via a levy on their water accounts in July. The levy would consist of a $1.50 per megalitre charge on entitlement and a $2.00 per megalitre charge on usage. It is proposed to put the levy on for a period of three years and then review it.

Costing Considerations

Works have been largely costed using standard costs (exclusive of GST) for natural resource management works compiled in the preparation of the Murrumbidgee Catchment Blueprint. In some instances, other cost sources were used. In some instances, best estimates were used as a basis for the budget with the realisation that individual projects would have to be properly specified and put to tender to determine accurate pricing. This would be done prior to funding being released from the government or other funding agencies.

Based on the need to develop and manage cost sharing arrangements, the extent and size of natural resource management issues along the YCS, and the timeframe of implementation required, provision is made for employment of a Project Co-ordinator and Implementation Co-ordinator.

ACTION: 4.1(A)
That YACTAC seek external funding to initiate on-ground works which includes the employment of implementation personnel.
Responsibility: YACTAC, State Water and DIPNR
Timeframe: 2004
Priority: High

ACTION: 4.1(B)
That all water users in the YCS contribute to the NRMP via a levy being $1.50 per megalitre on entitlement and $2.00 per megalitre on usage. This to be charged as part of State Water annual water accounts.
Responsibility: YACTAC
Timeframe: 2004
Priority: High

Table 7: Costing Schedule for Works Identified in YCS NRMP

Focus	Activity	Unit	Duration	$/Unit	Sub Totals	Comment
Staffing						
Project Co-ordinator	Co-ordinate an inter agency approach for assessments and approvals, prepare funding proposals and administration	eft/pa	3 years	95,000	285,000	includes on-costs, vehicle running and overheads
Implementation Co-ordinator	Implement on ground works, prepare contract and tender documents, prepare implementation plan and Administration	eft/pa	5 years	95,000	475,000	as above
Scoping Consultancies	Scope engineering works Benefit/cost analysis of proposals	Contract	5 years		1,000,000	
Willows						
initial	initial removal of willows	per tree	3 years	1250	4,375,000	in excess of 3500 individual willows to be removed
	Rehabilitation of stream banks after willow removal				1,500,000	
ongoing	ongoing eradication program	pa	10 years	75,000	750,000	to be reviewed after 5 years
LWD						
initial	management control works	per LWD	5 years	350	4,550,000	in excess of 12,980 LWD to be managed.
ongoing	ongoing maintenance program	pa	10 years	35,000	350,000	to be reviewed after 5 years
Floodrunners						
initial	construction of banks to prevent escape flows and losses	per runner	5 years	7,350	500,000	in excess of 68 floodrunners to receive improved management
	construction of regulators to effectively operate environmental flows.	per runner	5 years	33,000	500,000	in excess of 15 wetlands to be more sensitively managed to mimic natural conditions.

Cumbungi initial ongoing	maintenance of problem areas study and maintenance	per area pa	5 years 10 years	50,000	500,000 200,000	50 major problem areas
Weirs private State	Weir investigation and re-engineering solutions including re-regulation capabilities Investigation	 per weir	12 months 12 months	 0	1,500,000 To be investigated 0	in excess of 26 private weirs cost bourn by State Water
Revegetation** native tree planting	replanting denuded areas affected by maintenance works	per km	5 years	2,000	950,000	in excess of 475 kms requires Replanting with overstorey and Understorey species
Fencing** **Fish Stocking**	protect tree planting areas Re stock creek with native fish	per km	5 years 10 years	3,000 10,000	712,500 100,000	in excess of 475 kms of fencing Required to protect replanting
Total **Incidental Costs** **Establishment of an improved Water Quality Monitoring and Evaluation System.** **Data Collection and Recording for Environmental Performance Monitoring** **Project Total**		 10% 10%			18,247,500 1,824,750 1,824,750 1,500,000 **23,397,000**	

Note: ** 50% of total cost being bourne by landholders

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GLOSSARY

Allocation The amount of water a licence holder can extract from the river during a year (does not include off-allocation water). This is calculated by multiplying the amount of entitlement to water of a water licence by the percentage allocation for the current water year (declared by DLWC). This depends on how much water is in the dams and the minimum inflow of tributaries below the dam.

Anabranch A stream that leaves the river and re-joins it further down.

Biodiversity The variety of all life forms, comprising genetic diversity (within species), species diversity (between species) and ecosystem diversity.

Block Bank An earth bank placed in a waterway or on a floodplain to divert water passage.

Cap A limit on the amount of water which may be diverted from the river for consumptive uses, eg the Murray Darling Basin Ministerial Council announced a cap on water use in the Murray Darling Basin in 1995.

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

Catchment Management Authority New South Wales Government Agency with responsibility for Catchment Management. They are based on regional areas and report to an appointed board who in turn reports to the Minister of Natural Resources.

Channel Capacity The volume of water which can pass along the river channel at a certain point without spilling over the tops of banks.

Confluence The point at which two or more streams flow together.

Contingency Allowance A volume of water reserved in a supply dam for release in response to ecological and/or water quality needs, eg release may be required to maintain water levels in a wetland to enable waterbirds to complete breeding, or to flush an algal bloom.

Dryland Salinity Accumulation of salt in the soil and water of non-irrigated areas, caused by clearing vegetation in areas with saline water tables; the uptake of water by plants is reduced, allowing the watertable with soluble salts to rise, killing plants and creating bare areas of land prone to erosion.

Ecosystem Any system in which there is an interdependence upon an interaction between living organisms and their immediate physical, chemical and biological environment, such as a pond, forest or wetland.

Effluent Creek A creek which leaves a watercourse and does not rejoin it (the opposite of a tributary).

Environment The *Protection of the Environment Administration Act 1991* defines the environment as:

components of the earth including:

- land, air and water
- any layer of the atmosphere
- any organic or inorganic matter and any living organism
- human-made or modified structures and areas, and includes interacting natural ecosystems that include components of the above.

Environmental Flows Flows, or characteristics of flow patterns, which are either protected or created for environmental purposes.

Ephemeral Temporary or intermittent, for instance a creek or wetland which dries out periodically.

Extraction Water taken from rivers for off-stream or consumptive use.

Fishway A structure designed to enable fish to move through a physical barrier (dam or weir) in a waterway. Sometimes called a fish ladder.

Flood Runner A natural channel in a floodplain which carries flowing water only during a flood.

Floodplain Flat land adjacent to a river that is inundated when the river overflows its banks during floods.

Floods Flows which are high enough at their peak to overrun river banks or cause flow through to high-level anabranches, flood runners or wetlands.

Flow Regime The pattern of flow in river which can be described in terms of quantity, frequency, duration and seasonal nature of water flows.

Freshes Flows that produce a substantial rise in river height for a short period, but which do not overrun the river banks or inundate adjacent land.

Groundwater Underground water filling the void in rocks; water in the zone of saturation in the earth's crust.

Habitat The type of environment in which plants and animals occur.

Hydrology The study of the distribution and movement of water.

Indicator Any physical, chemical or biological characteristic used as a measure of environmental quality.

Median value The middle value in a sequence.

Megalitre (ML)	One million litres.
Natural Flow Regime	The likely pattern of flow before European settlement in Australia.
Off-Allocation Flows	Water which has not been released from storage, but comes from dam spills and/or inflows from tributaries below the dam.
Regulated	A river or creek where water is released from major government-owned storages to meet diversion requirements.
Regulator	A structure used to control the flow of water, for example, diverting water away from the main channel down an effluent stream.
Retaining Bank	A constructed embankment to prevent river overflow.
Riparian Zone	Land which adjoins, or directly influences a body of water.
Tributary	A river or creek which flows into a larger river.
Unregulated	A river or stream where water is not released from major storages to meet user requirements. There may still be dams or weirs built on unregulated streams by private users.
Watertable	The surface of a groundwater body.
Wetland	Areas that are wet for a long enough period such that the plants and animals living in them are adapted to, and often dependent on, living in wet conditions for at least party of their life cycle. The inundation determines the type and productivity of the soils and plant and animal communities.

LIST OF ABBREVIATIONS

Where terms in the Yanco Creek System Natural Resource Management Plan are used they mean the following:

ABS	Australian Bureau of Statistics
ANZECC (2000)	Australia & New Zealand Environment & Conservation Council- *Guidelines for Water Quality Monitoring and Reporting.*
ARMCANZ	Agriculture & Resource Management Council of Australia & New Zealand
CCD	Coleambally Catchment Drain
CIA	Coleambally Irrigation Area
CICL	Coleambally Irrigation Co-operative Ltd
COLMOR	DIPNR water quality and flow station 410014, Colombo Creek at Morunda
COLURA	DIPNR water quality and flow station 410100628, Colombo Creek at Urana Road.
CMA	Catchment Management Authority
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DIPNR	Department of Infrastructure Planning and Natural Resources
DLRA	Department of Lands & Rural Affairs
EC	Electrical Conductivity
EP & A	Environmental Planning & Assessment
EPA	Environmental Protection Authority
IMEF	Integrated Monitoring of Environmental Flows
IPAP	Integrated Procedures & Assessment Protocols
IVR	Interactive Voice Response
LEP	Local Environmental Plan
LGA	Local Government Area
LWD	Large Woody Debris (commonly known as snags)
MCMB	Murrumbidgee Catchment Management Board
MEU	Ministry of Energies and Utilities
MI	Murrumbidgee Irrigation
MIA	Murrumbidgee Irrigation Area
MIL	Murray Irrigation Ltd
ML	Megalitres- 1 Million Litres = 1ML
MPII	Murrumbidgee Private Irrigators Inc.
MRCSC	Murrumbidgee River Customer Service Committee
MRMC	Murrumbidgee River Management Committee
NPWS	National Parks & Wildlife Service
NRMP	Natural Resource Management Plan
NTU	Nephebmetric Turbidity Units
NVC	Native Vegetation Conservation Act 1997
OH & S	Occupational Health & Safety
RFI	Rivers & Foreshores Improvement Act 1948
SCADA	Supervisory Control and Data Acquisition
TS	Total Phosphorus
WAMC	Water Advisory Management Committee
WMA	Water Management Act 2000
WRRVMP	Western Riverina Regional Vegetation Management Plan
WSP	Water Sharing Plan
YANCKB	DIPNR water quality and flow station 410169, Yanco Creek at Bridge 321
YANCKS	DIPNR water quality and flow station 410007, Yanco Creek at Offtake.
YANMOR	DIPNR water quality and flow station 410015, Yanco Creek at Morunda.
YCATAC	Yanco Creek and Tributaries Advisory Council Inc
YCS	Yanco Creek System

APPENDIX: 1 (A)

NOTES OF LANDHOLDER MEETING ON MONDAY 28 OCTOBER, 2002 AT PHIL LENEHAN'S WOOLSHED, "WIRRANI", MORUNDAH

PRESENT:
Richard Sleigh & Wendy Spencer - Yanco Creek & Tributaries Advisory Council
Jim Parrett & Phil Dempsey - State Water;
Peter Beal – Dept of Land & Water Conservation; and
Lee Furness – Murrumbidgee Private Irrigators.
Arthur James, B Bolton, Wayne Durnan, Paul Andrews, Ross Stockdale, Bob Baul, Roy Baul, Don Roffe, Phil Cock, John Mills, Philip Lenehan, John Austin, Michael Coughlan, Anna Coughlan, Carole Dalgliesh, Russell Dalgliesh, Mark Rowe, Anne Kennedy, Douglas Kennedy, Douglas Milvain, Andrew Steiner, Mark Savage.

APOLOGIES:
Rob Scriven – Dept of Land & Water Conservation

The meeting opened at 2:05 p.m.

- Richard Sleigh introduced himself as the Chairman of the Yanco Creek & Tributaries Advisory Council, which liaise with the Department of Land and Water Conservation with creek issues.
- Richard introduced everyone and explained that the purpose of these meetings was to develop a plan to improve the creek system, which would then be used to obtain outside funding.
- Peter Beal then explained the reasons for the plan.
- Jim Parrett gave a slide presentation of problems already identified on the creek and how they could be remedied.
- Lee Furness introduced herself and explained Murrumbidgee Private Irrigators involvement and the work that had been done to date to identify what issues were important.
- Peter Beal then gave a brief outline of the process to apply for funding.

Afternoon tea was then offered to everyone.

Question time commenced at 3:15 p.m.
The following lists the issues raised.

- Below Yanco Creek a storm blew through and silt has built up considerably.
- In this section there are worries about cumbungi.
- Also timber that has blown into the creek, if not removed, will become a real problem.
- Peter Beal responded that the Native Vegetation Act must be taken into account when removing cumbungi and snags and that Fisheries would need to be involved.
- The question was raised as to how much could be put down the creek and Jim Parrett responded that it was not a question of putting more water down the creek but of reducing losses which are currently around 52% down to, hopefully, 24%. The volume of water sent down the creek at peak times is 2000 ML per day, if the impediments were reduced State Water could have the amount of water sent down to meet orders.
- Colombo Creek was not, historically, an irrigation creek – if works are carried out won't it become a delivery canal? It was explained that the entire system needs to run all year round for town plus stock and domestic water.
- It was pointed out that the creek is 800 kms long, that is 1:4.
- People had heard a rumour about a channel for Coleambally and it was explained that there is a feasibility study being done at the moment and a draft has gone to Coleambally for comment. The initial costing on this is $20 million.
- The suggestion was made that a pipe system could be developed with money from the Federal Government.

- The suggestion was made to start with willows and see what savings have been achieved, and then go on to the cumbungi and weirs.
- The point was raised that weirs would hold water if the drought continues and if allocation is as low as 25%. It was then explained that if water were held upstream that the bottom end would run dry.
- Flood issues – there is erosion on the bend of one property where, in years to come, sheds might be taken down.
- At one property, in about 1984, willows were taken out but not taken away. The owner has planted new trees and worries that these would be taken out via this plan. An assurance was made that consultation would be held before anything was done.
- Snags are a natural attrition of red gums and could be due to high flows.
- Complaint was made that this plan is only about supplying water for irrigators and that one landholder did not believe that his voice would be heard or that anything he said would make a difference. It was explained that the aim was to improve the health of the creek for everyone.
- Concerns were raised for organic properties with the poisoning of willows and it was explained that poisonous sprays could be used and that State Water would take water samples as part of quality assurance.
- One landholder believed that if it were up to government nothing would get done and feels that rice is the problem and this is how the health of the creek has fallen over the last 10 years.
- Concerns about the quality of water from Coleambally were raised and it was explained that an Environmental Officer could provide a boom to stop rubbish from flowing down the creek. Mark Shepherd is based in Leeton, but has just received a scholarship to go to Oxford, so State Water would now be using a fellow from Queanbeyan.
- Concerns were raised with regard to measures being in place for road accidents where diesel or other substances might flow into the creek and whether State Water was involved with these. It was explained that there were systems in place, which came under the control of the Fire Brigade and the Environmental Protection Agency.
- The issue of funding and what time frame would be employed was raised and it was explained that we are looking at trying to obtain funding by the end of 2003 with work to be carried out over a 5 year period.
- Concerns were raised over private rubbish dumps, which could go into the creek as a result of flooding.

Richard Sleigh thanked everyone for their comments and for attending the meeting, which closed at 4:05 p.m.

NOTES OF LANDHOLDER MEETING ON TUESDAY 29 OCTOBER, 2002 AT THE IAN GILBERT ROOM, JERILDERIE SHIRE COUNCIL, JERILDERIE

PRESENT:
Richard Sleigh & Wendy Spencer - Yanco Creek & Tributaries Advisory Council
Jim Parrett & Phil Dempsey - State Water;
Peter Beal – Dept of Land & Water Conservation; and
Lee Furness – Murrumbidgee Private Irrigators.
Michael Gregory, Jann Robertson, Bill Robertson, Rick Mailler, Anthony Herlick, Ross Wells, Arthur Sleeman, Alan Brunt, Pete Sleeman, Neville Ham, Felicite Aull, Tim Westblade, Steven Day, Trent Gooden, Jim Morgan, Allen Hunt, Geoff Ham, John Graham, Tom Holt, G Rorato, Jeremy Barlow, Mark Wettenhall, John Purcell, Troy Hamilton.

APOLOGIES:
Rob Scriven – Dept of Land & Water Conservation

The meeting opened at 10:15 a.m. with introductions as in the Meeting on 28 October.

Question time followed with the following listing the issues raised.

- Funding – how much will it cost? The reply was made that this process was to find the problem areas, make up the plan and then evaluate the cost.
- It was suggested to eradicate small areas of cumbungi first. It was then explained that cumbungi does not like fast flowing water, so if willows and snags were managed to allow flow this would stop the cumbungi spreading.
- What were the restrictions on spraying? It was reported that spraying is quite restrictive due to organic farmers, Council's, EPA and Fisheries guidelines, which would not allow poisonous sprays to be used.
- Has some work already commenced? It was reported that the surveys for the redesign of Hartwood Weir have already been done.
- Concerns were raised about clearing all weirs thus not being able to stop water. State Water replied that they are not aware of anyone suggesting taking out all weirs as some are in strategic points.
- The point was raised that no money has been spent on the creek system over the last 10 years while huge amounts of funding have gone into the Murrumbidgee, Murray and other systems such as the Goulburn Valley. The losses in our system are becoming a real issue and we must take this opportunity as we have been neglected.
- It was felt that regulation was necessary and that Wetlands are good, but they are being watered in the summer instead of the winter when they need it.
- It was reported that yesterday, at the meeting, bank erosion seemed to be their main concern.
- The issue of flooding was raised. It was pointed out that there had not been a flood for a long time and there is a concern that if the snags and willows, in particular, are going to cause huge problems if a flood occurs.
- Cumbungi was not felt to be a high priority if flooding occurred, as it would lie down and die.
- Jim Morgan, from Lockhart, spoke on behalf of the Colombo Ski Club and stated that their weir was important and the club was worried that if this weir were pulled out it would render it unsafe for skiers. Jim stated that this area has been developed over many years, since the 1960's, with many hours spent and asked the meeting to consider young people who use this area for recreation. He asked the meeting to be mindful of the fact that, in the west, there is little of this type of opportunity for our youth.
- Concerns were raised over the amount of water being sent down Forest Creek and Wanganella Swamp and where did it go. The reply was made that it comes downstream for stock and domestic and runs into the Billabong.
- Representatives from the Ski Club asked if the removal of the ski club weir was a priority. It was reported that no, we are here to start with consultation of all interested parties. From here a draft plan will be drawn up which will then be sent to all members for comment at the AGM in 2003.

- Concerns were raised over the profile irrigators are receiving in Sydney. Recently, when visiting the museum in Harris Street, Sydney, it was reported that a video was running which crucified irrigators, showing canals, rice growing and salted areas, which, it was claimed, irrigation causes.
- The involvement of Fisheries was queried and it was reported that they don't get involved with willows, but are concerned about snags as they provide a habitat for native fish.
- One opinion was that the top end should be dealt with and forget about the rest.
- It was suggested that, because water is such a big issue, couldn't we get someone important to fly over and make a decision. Members were encouraged to lobby themselves, as individuals, as it is a major environmental issue. It was also explained that the Native Vegetation Act, with best practices and codes, might allow us to circumvent the normal bureaucratic process to get approval.
- The point was raised that we could make the greenies work for us – say to them that with willows removed water will be saved which could then go back to the Snowy.
- The Water Sharing Plan has no water for environmental flows in our system.
- It was asked if dredging could be done in some places, pointing out that the Billabong, over the last few years, has had an enormous amount of silt laid down.
- The results of recent willow trials were questioned and it was reported that Bioactive roundup with ring barking had proved successful but that the best process is total removal.
- Willows were felt to be the worse problem by one landholder.
- It was asked whether there were figures available for losses in each section. It was reported that State Water does have these figures but was not including them in these meetings.
- A time frame for funding and subsequent works was queried and it was reported that the aim was to have the document complete by June 2003 with works commencing in 2004.
- It was asked if DLWC had any money and it was reported that State Water did have some and that Jim Parrett was currently trying to do pilot schemes, however, there is no routine funding.

Richard Sleigh thanked everyone for their comments and for attending the meeting, which closed at 11:45 a.m.

Morning tea was then offered to everyone.

NOTES OF LANDHOLDER MEETING
ON TUESDAY 29 OCTOBER, 2002 AT THE CONARGO HALL, CONARGO

PRESENT:
Richard Sleigh & Wendy Spencer - Yanco Creek & Tributaries Advisory Council
Jim Parrett & Phil Dempsey - State Water;
Peter Beal – Dept of Land & Water Conservation; and
Lee Furness – Murrumbidgee Private Irrigators.
Mark Wettenhall, Neville Armytage, Hunter Landale, Tony Bull, Greg Brunt, Colin Sandford, Rob Landale, R Bradshaw, Tim Ceagan, Robert Armytage, Michael Burke, Mac Wallace, Michael Bull, Tony Bull, Craig Heath, Mark Byrne, Tim Cowper.

APOLOGIES:
Rob Scriven – Dept of Land & Water Conservation

The meeting opened at 2:05 p.m. with introductions as in the Meeting on 28 October.

Question time followed with the following listing the issues raised.

- Jim Parrett, from State Water was asked to run through the figures of variation. Jim made the point that; from 16 November the Yanco Creek System would have it's own operator, rather than the current procedure where the Murrumbidgee and Yanco Creek are together. It is hoped that this will help with delivery of water to the bottom end.
- The question was asked if any research has been done in recharge areas. State Water response was negative although Algudgerie has been pin pointed. The meeting was informed that the target was to bring the creek back into its natural boundaries.
- The issue of restricting rice growing was raised and one landholder indicated that he would be happy to see this restriction at around 60% of licences. The meeting was informed that the peak demand period refers to summer crops in general, however this landholder felt that the ability of the system to handle the water could be used to restrict areas of cropping.
- Storage dams were addressed and the meeting was informed of the feasibility study on Hartwood Weir. It was pointed out that the main problem of storage is due to the fact that the whole area is very flat and evaporation is a really big problem.
- The meeting, in general, supported the idea of regulation of rice growing and also supported on farm storage.
- Questions were raised on any restriction on removing willows and cumbungi and the meeting was informed that nothing can be removed without approval from NBCA.
- The top end was thought to be the highest priority with losses due to flood out.
- Willows were also perceived as a problem with deliverability.
- Concern was raised that creek blockages could cause flooding.
- Our system is the receiver of the flood by MIL. It was asked if there were agreements with MIL and/or Coleambally as to when the water comes out of drains. The meeting was informed that the quantity from Coleambally has been reduced to 200 ML and of the cost, approximately $20 million, for the proposed new channel from the Feasibility Study. Litigation is a big issue with Coleambally.
- The Chairman called for local issues.
- Drainage was felt to be a high priority issue. There are concerns because we are expected to take their drainage water and it was felt that we could use this as a lever to improve the creek system. How we manage taking their drainage should be a big part of the study with a view to the detriment to water quality resulting in more cumbungi, weeds, etc.
- It was asked if State Water could clarify Coleambally and MIL drainage from a licencing point of view.
- It was asked if Fisheries were going to have to be involved. Jim replied that yes, at some point, this would be necessary and he intended to take them on site inspections to get the ball rolling with pilot schemes.

- It was pointed out that much of the timber that has fallen into the creek is a result of carp damage to the banks.
- A suggestion was made to take levels to find out exactly what gains would be achieved by removing impediments to make the study objective, rather than subjective.
- One opinion was that the first priority was to get rid of unused weirs.
- Part of the plan will be to obtain compensation for landholders who suffer due to the removal of a weir.
- The point was made that, some time ago in the 80's, State Water had decreed that all unlicenced weirs had to be removed – this did not happen.

Richard Sleigh thanked everyone for their comments and for attending the meeting, which closed at 03:15 p.m.

Afternoon tea was then offered to everyone.

NOTES OF LANDHOLDER MEETING
ON MONDAY 30 OCTOBER, 2002 AT THE WANGANELLA HALL, WANGANELLA

PRESENT:
Russell Ford & Wendy Spencer - Yanco Creek & Tributaries Advisory Council
Jim Parrett, Phil Dempsey & Greg Jones - State Water;
Peter Beal – Dept of Land & Water Conservation; and
Lee Furness – Murrumbidgee Private Irrigators.
Ian Gibson, Anthony Gorey, Sally Dye, Bob Crawford, Colin McCrabb, John Radeski, Mark Byrne, Ken McCrabb, Mary McCrabb, Peter McCrabb, Andrew Wallace, Betty Wallace, John Wallace, Michael Elmes, Mac Wallace, Mike Gatacre, Hunter Landale

APOLOGIES:
Rob Scriven – Dept of Land & Water Conservation

The meeting opened at 10:15 a.m. with Russell Ford as Chair and introductions as in the Meeting on 28 October.

Question time followed with the following listing the issues raised.

- Hunter Landale said he believed that these meetings were great as a first step. He believes the next step will be a degree of support from individuals and that the Delegates of the Council should be responsible to get comments back. It was hoped that all Delegates knew the landholders in their area and should contact them all.
- Has the Forest Creek plan been thrown out? Jim replied that, no, but it has been superceded as everything now has to go through the blueprint.
- Landholders are very disappointed that nothing was done after all the work that was put into the plan.
- Jim explained to all present that he has had initial discussions with David Whitehouse from the Murray region and that they are happy for the Murrumbidgee region to oversee the entire project. David will take one visit and then had it over to the Murrumbidgee region as, although Forest Creek is in the Murray region it is on Murrumbidgee water.
- Jim also explained that the Forest Creek Plan will be used to form part of this plan so all the work done to date will not have to be redone. He stated that the Plan was very good and pertinent sections will be used for this plan.
- Warriston Weir is a problem with so much water.
- The issue of funding was raised and it was asked if there are any splits in funding.
- Murrumbidgee Wetlands group is keen to be involved. Wetlands are getting water at the wrong time.
- Jim informed the meeting that the aim was to have regulators at the side of the creek, rather than across it, which could dam off wetlands in the summer and then let water out in the winter.
- It was asked if Fisheries were represented on the Council. The reply was made that, no, however they would need to become involved further into the process. The Narrandera officer is quite practical and will be consulted.
- It was asked if the volume of water being currently sent down the system was locked in concrete with the worry that all this work will be done and then the amount of water would decrease. The reply was made that it does not look like that will happen at the moment. It will only change if government policies change. Jim informed the meeting that the amount of water sent down the creek was to meet allocations, which will not change without changes to policies.
- Lee pointed out that drought sharpens peoples focus and that presently this is a win, win situation – a win for creek users and a win for the government.
- The problem of drainage was raised. Don't want everybody's rubbish so we are looking towards having a robust system.
- It was asked if there were any objections in other meetings to the removal of willows and what costs were involved. The reply was made that only one lady had objected, more from the point of view that other trees

she had planted to try to firm up the banks might be taken out, otherwise there was total agreeance. The cost is approximately $200 per tree for excavation. The plan will try for total removal with a follow up maintenance program. It is hoped to have this maintenance program under the State Water budget.

- Concerns were raised about the quality of the water after willow removal and it was explained that the water would be sandy at first but after approximately 2 years the creek would clean itself out.
- It was asked why, when MIL took over and given $80 million, were we left out. MIL are now spending the interest on this money to improve their system. It was explained that the money was given because they are a closed system; whereas ours is an open system, and it was also pointed out that they had to do a land and water management plan to get that funding.
- The first round of funding will be used for Hartwood Weir in approximately 6 months.
- It was asked who would be paying for the removal of unlicenced weirs. The reply was made that if weirs needed to be removed they would be included into the plan. There is also a government plan through OH&S where all weirs will be inspected for safety. If deemed unsafe the public liability cost itself would be prohibitive. All weirs, either for removal or upgrading, will be part of the funding proposal. Unlicensed weirs, however, would probably not receive any compensation.
- It was suggested that there should be targets on water quality with limits on MIL and Coleambally as to what levels they can put into our system.
- It was pointed out that if 1400 was put down and we did not loose 700 of it then this would lessen the need for DC800.
- It was asked what the like life of the plan would be. The reply was that the short term was 5 – 10 years with an overall long term for sustainability.
- The problem of cumbungi removal was raised and any suggestions would be appreciated as it is a particularly difficult plant to eradicate. It was noted that an increased flow would help to right the presence of cumbungi.
- On Forest Creek 6 properties have had no water since 1996. This will be included in the plan. The suggestion was made that a stock and domestic pipeline could solve this problem.
- Jim informed the meeting that he is endeavouring to get funding from State Water to start work next year, outside the plan.
- It was suggested that landholders should assist and it was explained that landholders will need to assist as "in kind" contribution.
- The issue of a long term maintenance budget was raised and Jim reported that we will be looking at achieving this through the State Water budget rather than a levy on licence holders.
- Landholders should be informed that their input will help.
- The issue of snag removal, and the involvement of Fisheries, was raised and it was felt that the plan should set up a protocol for snag removal to alleviate the need for Fisheries to be involved in every instance.
- Access to the riparian zone must form part of this plan. Jim will be seeing the Lands Office for the top end where there is a great deal of Crown Land and leases.
- If we develop some guidelines in this plan all agencies should not have to inspect every site and we should get freer movement.
- The point was raised that, legally, we can't even remove cumbungi without access to the riparian zone.
- It was asked what powers we have to keep all the savings that would be made within the creek system. The answer to this was none, however, it was pointed out that to have an environmentally, sustainable creek system is attractive and should provide a lever to keep the savings. If, however, we needed to get money from the Snowy then we must expect a trade off.
- We should try not to be perceived as an irrigation system but as a living creek system.

Russell Ford thanked everyone for their comments and for attending the meeting, which closed at 12:10 p.m. Afternoon tea was then offered to everyone.

APPENDIX: 1 (B)

KEY ISSUES COLLECTED FROM SURVEY OF WATER USERS

Meeting Date	Location	Name	Creek Section	Deliverability	Environmental/Wetlands/ Operational flooding:	Losses:	Access:	Any other comments:
28.10.02	Lenehan's Woolshed	Don Rolfe, Windella Homestead	Offtake to Morundah					Take notice of metre reader. His experience should be of value as he sees all aspects of situation.
28.10.02	Lenehan's Woolshed	John Austin 6959 6212	Offtake to Morundah	Willow trees, cumbungi, creek has been de-snagged for at least 80 odd years. Fish still exist	Flooding should only coincide with seasons when it would naturally occur	Statement that flooding (wetlands) creates fodder for cattle is folly. Cattle destroy Wetlands. Irrigate properly for stock fodder. If serious about wetlands - fence stock out and protect.	Movement along creek should be mindful of spiny burr grass.	Creek eco-system is most seriously damaged by carp - visually, floating rubbish should be addressed. Yanco Creek Bridge, Sturt Highway crossing has the potential to create a major environmental incident. A plan should be in place, or equipment readily available. I have set aside about 200 acres of creek frontage for the environment. This area has had nil agricultural activity for 7 years (weed control only). Notable Change: 1 Proliferation of native trees and grasses; 2 Platypus seen in quiet sections of creek; 3 creek bank protected.
28.10.02	Lenehan's Woolshed		Morundah to DC800		If plenty of water yes, if not plenty of water NO			Snags should be reduced. Silt is bad especially if water is lowered. Stock find it hard to get a drink.
28.10.02	Lenehan's Woolshed	John Mills Parkwood	Offtake to Morundah	Many trees have fallen in and tend to restrict the flow. Partly caused by European carp which dig in the banks.		Flooding seems to occur during a dry time, which is not a natural occurrence.	One main creek crossing is sometimes not usable at back of farm and since creek runs at a higher level at the peak irrigation season.	
28.10.02	Lenehan's Woolshed			Ability of depth to deliver				

Meeting Date	Location	Name	Creek Section	Deliverability	Environmental/Wetlands/ Operational flooding:	Losses:	Access:	Any other comments:
28.10.02	Lenehan's Woolshed	Michael & Anna Coughlan	Yanco – Offtake to Morundah – Morundah to DC800 – Morundah to Billabong Junction	Do not irrigate. Stock and domestic chief function of creeks		Willows		Stock & domestic main game. Therefore need high water quality, no chemicals – our land is organically certified. Need biodiversity in fauna & flora including fish. Wetlands/cumbungi very important to eco system. Willows should come out – snags stay. Sure no one in DLWC knows answers e.g. Lachlan with weirs and Murray with logs/snags.
28.10.02	Lenehan's Woolshed	DC Milvain	Morundah to Billabong Junction	No Problem	N/A	Nil	No Problem	Serious discussion re "weirs" with large property owners between Morundah and Jerilderie should be undertaken.
28.10.02	Lenehan's Woolshed	Mark Rowe	Offtake to Morundah	Need to investigate means of reducing high summer flows. Maybe limit the % of allocation that can be extracted over the summer months & encourage autumn & spring irrigation. In the longer term, summer irrigation in the lower reaches of the system may need to be phased out completely. Modeling to show the losses in the various reaches could be very enlightening and may be necessary to drive the management changes that will be required to held restore some health to the creek system.	Escapes from creek beds of irrigation flows should be eliminated if economically feasible. Water 'saved' by doing this should be used to mimic natural spring floods.	The current losses are unacceptable. Rehabilitating the creek system will take time and money. There is unlikely to be enough of, especially the latter, to make drastic improvements in the short term. Restricting summer usage to a % of allocations could be a way to dramatically reduce losses immediately. Good returns for winter cereals and the low allocation has probably already facilitated this for the current season. It may be an opportune time to capitalize on this management change and formulate a 'seasonal delivery policy'.	Continual stock access to creeks is causing major problems. Fencing off creek watering points will be necessary to allow banks to re-vegetate and stabilize.	Water users should pay some of the cost of rehabilitating the system. It would be unreasonable to expect the community to fund much of the work which will be largely for private benefit. The exception would be restoration of natural flooding – the public good emanating from these would need to be protected (i.e. by managing wetlands for predominantly conservation outcomes).

Meeting Date	Location	Name	Creek Section	Deliverability	Environmental/Wetlands/ Operational flooding:	Losses:	Access:	Any other comments:
28.10.02	Lenehan's Woolshed	Wayne Durnan	Morundah to Billabong Junction	The Colombo Creek has never been, and should never be seen as, a canal, only to deliver water to downstream creeks.	I'm in favour of beneficial flooding for wetlands.	Removal of willows and cumbungi in blocked areas would increase flow.	Satisfactory	A river system that supports native fish, fauna and flora, supplements underground water supplies and provides water for stock & domestic use, all rear round is an integral part of the ecosystem. The Colombo Creek is also used as a major sporting and recreational facility, and as such, plays an important role in the local community.
29.10.02	Jerilderie	Ian Girdwood	Morundah to Billabong Junction	Pull all willows out and make sure all the weirs are kept clear.	On the Colombo where there are weirs there should be no flooding, as the weirs have made a new environment over the last 70 years.			We must think of the way we like the creek to run – Do we want creeks to irrigate out of or – an irrigation system by using creeks.
29.10.02	Jerilderie	Jeremy Barlow	Colombo Junction to Jerilderie	I have not experienced any deliverability problems to date due to the fact that there is a good reservoir of water on my area of the creek. But the willows must be a huge problem for pushing water past the end of Carnarney and Pittfour.	I think it's a good idea. However I suggest that it is not necessary to do it every year. But if carried out in years of higher rainfall or when our storage dams are at a much higher rainfall than the last 3 years.	Willows must be addressed and perhaps a few areas need to be de-snagged or realigned. Our losses will get worse as time goes on. I am familiar with Billabong Creek only and it has no flow capacity due to willows blocking stream.		I believe if willows were removed the cumbungi problem will be minimal and losses will be reduced significantly due to the creeks ability to run water. The weirs should be reviewed but I think they probably serve the same purpose as what they were put there for. Obviously Work Cover will determine the R & M that will be required. Jim Parrett hit the nail on the head – if the willows aren't attended to there will be no creek in a short time to come, particularly for the purpose of reliable irrigation. Note: Re Restricted areas on Carnarney to Innes Bridge. On the stretch of the creek from main dwelling at Carnarney running back east to Innes Bridge, there are perhaps 6 lots of single or 2 trees that would cost minimal to pull out now (cost say $10,000 max) From main dwelling to west boundary where creek exits the property there are 3 major areas of willows over perhaps 2 – 3 km that have the creek completely covered. These areas are made of say 200mtrs of continuous willows and spreading (est cost 60-80k)??

Meeting Date	Location	Name	Creek Section	Deliverability	Environmental/Wetlands/ Operational flooding:	Losses:	Access:	Any other comments:
29.10.02	Jerilderie	Michael Gregory	Jerilderie to Hartwood	Willows a major problem that should be removed immediately. Some weirs should probably go.	Fine at 'normal' times of the year.	Must be minimized where practical. Carp are having a major effect on banks, siltation and native fish populations. We should be proactive in pushing for their control.		Willows on each creek should be removed concurrently so that the potential damage from floods is not exacerbated in one section. Fencing should be encouraged along the creeks by promotion of easy access to all available funding for this. Fact sheet suggests State Water receive ~ $680,000 p.a. What maintenance are they doing?
29.10.02	Jerilderie	Alan Brunt	Colombo Junction to Jerilderie	A constant flow as a sharp flow causes areas where stock are bogged and die.	Moderate flooding does affect our land, but with small damage, extreme flooding causes 300 ha of our land to go under floodwater.			Removal of willows will give a better flow BUT this has to be done in conjunction with weir maintenance because in peak irrigation season the levels or supply of passing water fluctuates at a high degree.
29.10.02	Jerilderie	A Sleeman	Jerilderie to Hartwood	Removal of willow trees. Seems mainly to Colombo junction to Jerilderie.	Possible.	Need working on	Seems okay except in high rice growing years.	
29.10.02	Jerilderie	John Whitehead	Morundah to Billabong Junction	All weirs should be controlled by an "official" sliding gate – say 1200 mill wide	Some wetlands should be retained.	The weirs that cause flooding i.e. cumbungi evaporation must have the water height reduced. The creeks must be made to run within their banks.		Let us not forget that there are farmers etc. in South Australia who also need water. (It is very easy to be greedy)
29.10.02	Jerilderie	Tim Sheed	Colombo Junction to Jerilderie	Problems at peak demands exacerbated by willows and losses esp. Forrest Creek.	The Wetlands I am aware of in this system were naturally ephemeral.	Aim to get losses down to 20% of inflows would be a major saving and improve deliverability.		
29.10.02	Jerilderie	WD & JC Robertson Woodside, Jerilderie	DC 800 to Conargo 6 miles west of DC800	Being autumn and spring waterers we need the level of the creek maintained as it was this year – 2002.	If a flood is necessary to enhance the wetlands, the back waters should be filled to give the red gum trees a boost in the winter only. It would require 4 feet above the normal creek level at our pump site.	We don't have any visible losses in our section of the creek but we have a lot of snags due to the bushfires in 1987. There are no willows or cumbungi in our section of the creek (below Yanko Station boundary and the Wilson Road Bridge).		The video being shown at the moment at the Power House Museum in Harris Street, Ultimo Sydney depicts irrigators in a very poor light and claiming they are destroying the land and the environment.

Meeting Date	Location	Name	Creek Section	Deliverability	Environmental/Wetlands/ Operational flooding:	Losses:	Access:	Any other comments:
29.10.02	Jerilderie	D Milthorpe Somerset	DC800 to Conargo	Cumbungi		What are salt tests etc of each inflow into system? When Yanko and Bundure Stations were cut up for sale in 1974 I asked my late cousin, Professor Fred Milthorpe, of Macquarie University, one of the top world botanist, about Bathurst Burrs which overran the properties – What advice, if any have you had on Cumbungi?		We have a very complex problem – if we get rid of willows will cumbungi disappear? – I doubt it – where is proof? – will creek flow fast enough etc? – Cumbungi transpires a lot of water as do gum trees – too many licences issued for below rainfall years – we need expert advice in many fields before intelligent comments can be made – i.e. amount of water coming down Tumut River has effect on us. (Fax included pg 81)
29.10.02	Jerilderie	Adrian Dore, Upper Wantagong Station P/L	Morundah to Billabong Junction	We have no problems.		No problems with the removal of willows and certain amounts of cumbungi.		If weirs are removed or lowered, because I live on a backwater, we will lose water for the garden and house. As this is the original creek if water levels changes the water should be diverted back to the original creek.
29.10.02	Jerilderie	Bernard Pinnuck	Jerilderie to Hardwood	We need as much water as the creek can deliver without it being wasted.	Need to be stopped in summer months by levy bank, de willow, and possibly canal around sensitive areas.	Are too high, we need to de willow and realign snags – this will lower the creek and may slow losses into the aquifers.	Is most important – 5.5 meg per day in January is not enough.	We need to get on with the job of fixing the creek. There must be holes in the creek, which are losing hundreds of megs a day. This should be a priority.
29.10.02	Jerilderie	DC & FA Aull, Mundoora Pastoral Co, Jerilderie	No answer			in overall system.	We have no problems with willows/snags but there is a huge problem in parts of the creek.	
29.10.02	Jerilderie	Victor Stonnill “Cocketged ong” Urana	Morundah to Billabong Junction	Good			Good	Deliverability and Access will be severely affected with the removal of weirs in this section of the creek.
29.10.02	Jerilderie	Colombo Creek Ski Club	Morundah to Billabong Junction					(Letter Included pg 82)

Meeting Date	Location	Name	Creek Section	Deliverability	Environmental/Wetlands/ Operational flooding:	Losses:	Access:	Any other comments:
29.10.02	Jerilderie	Andrew Sleigh "Kooringal" Jerilderie	Morundah to DC800 and Jerilderie to Hartwood		Plan should include provisions for wetlands/red gum flooding – winter.	Agree with presentation. Willow/snag removal. Weirs sensitive issue – feasibility study extended.		Most efficient labour and costing to undertake works required is to utilize Landholder's resources and experience; on a cost sharing basis - provide landholders $ subsidy/incentive - provide landholders with technical advice Plan should look at LIMITING or PREVENTING additional water into creek system from other valley/source. Cap current allocation – use as a trade off – for plan implementation. Plan to include monitoring of losses, thus being accountable to money spent. Plan to have achievable outcomes and time frames. Plan to include Red Gum management within X distance from creek. To be successful plan has to be drawn up with CMB Targets in mind, both Murray & Murrumbidgee. Has to prove water savings. Those losses prevented/saved by implementation of plan to be used as carrot to obtain funding; or kept within creek system. Have concerns that creek system may, in future, be detached from Murrumbidgee administration/delivery.
29.10.02	Conargo	Craig Heath	DC800 to Conargo	For us we have problems in winter. We grow winter crops under centre pivots and the creek is allowed to fall so low that when we pump, we have to have a channel dug to keep the water deep enough.	We have two Wetland areas above and below us. Home to sea eagles, brolga's etc. A few people would be very upset if these had to go. Any water lost into these areas should be counted in the environmental flow. Some anabranches could be regulated so that they only fill during flooding, not when rice people are wanting their big flows. Much fencing would need to be done as			Getting rid of carp high priority – willows cumbungi chokes.

Meeting Date	Location	Name	Creek Section	Deliverability	Environmental/Wetlands/ Operational flooding:	Losses:	Access:	Any other comments:
					some of them form boundaries to properties not just internal paddocks.			
29.10.02	Conargo	Robert Armytage	Jerilderie to Hartwood	Removing old weirs and willow trees, trees across creek.	Only in above average rainfall or in heavy demand periods.		Bad areas in Hartwood station.	With the removal of a lot of the old weirs and the new Hartwood weir operational more water could be pushed down the Billabong and into the Yanco through the new weir.
29.10.02	Conargo	Mark Byrne FS Falkiner	Conargo to Darlot – Forrest Ck	Forrest Creek – 100 ml delivered over Warriston Weir/day. Removal of willows to free up flow. Maintenance of breakouts/earth banks/ weirs to ensure water is contained in banks and designated creek direction.	Needs to be contained within designated system – too much water going beyond system e.g. water changing from Forrest to Billabong.	Maintenance of existing structures e.g. earth retaining bank on the north/east side of McCrabbs regulator is blown out allowing Forrest water to flood dryland areas and running into Billabong Creek.		FS Falkiner is strongly opposed to any consideration to reduction of 100ML/day flow over Warriston Weir. Conversion from overflow to underflow and construction of fish ladders should be a State Water expense (Weirs licensed).
30.10.02	Wanganella	Betty Wallace		Water must have clear flow to the end of the system so it can be delivered when ordered.	Flooding must only occur during the winter when it is a good season and dams have plenty of water. Before dams were built the creeks dried up and rivers died back to waterholes keeping them weed free. Now with water essential all year round for towns and irrigation the main rivers must be cleared of problem trees and weeds and the small creeks left dry in summer. The better weirs, where water is not obstructed in peak flow times, should be left, but weirs that completely bock off the river should be removed.			Seeing the Government refused to let landholders clear in and along rivers they should do the major clearing and maintain the waterways free of weeds and obstructions.

Meeting Date	Location	Name	Creek Section	Deliverability	Environmental/Wetlands/ Operational flooding:	Losses:	Access:	Any other comments:
30.10.02	Wanganella	Anthony Gorey, Dhuramein Nominees	Darlot to Moulamein	European carp, snags, salinity in the water, reliable supply of water to lower section of creek system.	Only flood when necessary and to receive some cut backs in water as other users e.g. no high security.	To be managed as efficiently as other water users.	Full access to all parties concerned with wetland areas.	Investigate water transferred down Eurolie Creek to supply below Darlot. Encourage the removal of carp from the waterways to reduce turbidity. Better land practices in areas east to reduce salinity problems.
30.10.02	Wanganella	RB & JA Crawford	Darlot to Moulamein	Remove willows in chokes – Replace the effect with capital work to allow a certain amount of wetland to be maintained.	In exchange for capital works funding.	Evaporation from weir pool – Pool estimated at 600ML – Not an issue as weir has been replaced since 1920 and creek edge has developed at FSL.	All creek banks easily accessed.	We have the last licensed overshot weir on the creek and it needs a fish walk that allows a certain amount of undershot flow. Can we access funds? All users of creek should contribute to remediation works. Preferable on users pay system based on licensed allocation. Other system 1 – based on creek frontage; 2 – based on area served. Weirs only removed if government can absolutely guarantee water delivery. Weirs only removed after the chokes are removed. Once the creek has settled down, if they still present as a barrier, then remove from upstream location first.

Phone and Written Submissions

- YCATAC acknowledges several telephone call representations on the YCS NRMP made to the YCS NRMP Working Group from the following:

  Mrs Gwen McGlaughlin
  "Cooinee Woods"
  Jerilderie NSW

  Mr Bill Duffy
  "Rhyola"
  Moulamein NSW

  Mr Mike Gattacre
  "Woorooma"
  Moulamein NSW

- **Fax from David Milthorpe to Richard Sleigh on 29 October 2002**

I fax these quick thoughts as you have another meeting tomorrow.
With due respects personally I think we are given an impossible task to come with practical ideas and expert advice is need in several fields.

First: If willows are main trouble and to be removed – How many are there? How much cost per tree? Are they to be removed from creek and cut up for firewood, etc?
If start top end of creek is it correct unless all trees are removed about same time as water will be held up in places by cumbungi.

Should we start at bottom end (not places like Forrest Creek) and do a trial section? If we cannot receive a grant put a levy on creek landowners (assume legal).
Engineers I assume would or should build a small scale experimental model before rushing in. It would not tell you if it get rid of cumbungi.

For a few years rice growers could sell off some water or use more other than summer.
The projects could cost many millions for little return.

Cumbungi a major weed infesting watercourses and irrigation, damage from extensive rhizomatous root system in spring and early summer and make prolific growth during summer. With onset of winter the plants come back, leaving a mass of dry leaf and stem which if not burnt builds up at base of plants. This accumulation of organic matter can eventually alter the structure of shallow waterways; eradication over large areas is difficult and costly

From book “Plants of Western NSW”.

Trusting some of these thoughts may be helpful.

Yours sincerely, D Milthorpe

▪ Submission from Colombo Creek Ski Club

Yanco Creek Natural Resource Management Plan - Feedback Sheet

Name: Colombo Creek Ski Club 22nd November 2002
Creek Section: Colombo

Losses

The Colombo Creek Ski Club began in 1968 with a small group of skiers from the Boree Creek area.
Over the years it has increased in numbers, to a present day membership of over 261 with many of their family and friends visiting also.

During this time the Ski Club area has been improved immensely with the building of toilet facilities, the planting of trees, establishment of a lawn area, barbeque area, a boat ramp and a fenced off area with a watering system.

In the early years of the Club, the land was leased from the owner, Mrs Holt. After a number of years, Mrs Holt generously donated this land to the Colombo Creek Ski Club. In her wisdom, she could see that this action would be beneficial to many users of the water for many years to come.

Hundreds of man-hours have gone into establishing the ski site. It is a facility that has been developed and nurtured into what it is today, by contributions solely from members and skiers. The area is a natural environment for individuals and families who live in such a harsh, isolated environment to meet during the hot summer months for some sport and recreation.

It is vitally important to encourage the youth of our area to socialize, recreate and spend their time and money in our communities, to keep our rural areas and towns alive. If they leave our regions and go to the cities they tend to not return. Please don't rob the young people of this great recreational facility.
The Club has an excellent safety record during its 34-year history.

By removing the weir, the water area would be greatly reduced, affecting the safety of the skiers, leaving us with no option but to close our Club. The boat-launching area would be above water level, inaccessible for any other use and all the facilities maintained by members would be rendered obsolete. The whole picturesque environment would be lost. Water skiing competitions, for example Zone Tournament and State Championship's would be lost to other areas, resulting in a reduction in revenue for local businesses through visiting competitors and families. Businesses supplying food and drinks, ice and fuel and those providing ski equipment and maintenance materials from local workshops would be disadvantaged.

This is a facility that throughout its existence has never been vandalised. Visitors have always treated the area with respect, which on its own demonstrates its value to the community. The area has always been kept tidy by those that benefit from it and members spend time and money cleaning up, if required at the beginning of each skiing season.

Many people would be affected by changes to the Colombo Creek weir, to produce little monetary gain for a small increase in water flow. We understand that the Colombo Creek has significant water losses and we are totally agreeable and will support in any way possible the removal of Willow trees and cumbungi weed

We would love to see that this facility is maintained and nurtured for many generations to come. Third generation local families are now using this area as a major choice of recreation this summer. Removal of the weir will realise a loss of a small oasis in the middle of a dry plain and a loss to the people that enjoy all it has to offer.

We hope that we have been able to demonstrate the importance of our weir as a social and environmental issue.

Allan Hunt
President
Colombo Creek Ski Club

Trent Gooden
Secretary
Colombo Creek Ski Club

APPENDIX: 2

COMMUNITY AND STAKEHOLDER FEEDBACK ON DRAFT PLAN

Submissions and Feedback from the Draft Natural Resource Management Plan October 2003

Written Submissions

	Name	Property	Town	Notes
1.	David Milthorpe:	Somerset	Jerilderie	2 faxes to Lee Furness
2.	Jim Todd:	ex YCTAC Committee		via Hunter Landale at Conargo Meeting
3.	John Knight:	Aintree	Deniliquin	originally to Lee Furness
4.	John Moorehouse:	ex YCTAC Committee		via Hunter Landale at Conargo Meeting
5.	Mike Gatacre:	Wooroma	Moulamein	via Bob Crawford at Wanganella Meeting
6.	Peter Robertson:	Woodside	Jerilderie	originally to Richard Sleigh
7.	Ross Purcell:	Bettina Lodge	Jerilderie	faxed to Richard Sleigh
8.	M & A Coughlan:	Tarabah	Morundah	received 6.11.03
9.	Angus Crawford	Blue Gate Stn	Deniliquin	received 28.11.03

Surveys

	Name	Creek Section	Received	Meeting	
1.	John Mills	DS to Morundah	29.10.03	Morundah	
2.	Kel Baxter	Colombo	30.10.03	Jerilderie	
3.	Anonymous	Jerilderie/Algudgerie	30.10.03	Jerilderie	
4.	John Whitehead	YC/CC	30.10.03	Jerilderie	
5.	S Burns	Forest Creek	30.10.03	Conargo	
6.	I Gibson	Bottom	31.10.03	Wanganella	
7.	Michael Gregory	Jerilderie/Hartwood	30.10.03	Jerilderie	Faxed
8.	AR & C Menegazzo	Conargo	30.10.03	Conargo	Faxed
9.	B J Bolton	Bingegong	06.11.03	Morundah	Post
10.	David Leeds	Above DC800	10.11.03	Jerilderie	Post
11.	John Webb	Yanco & Wilson anabranch	10.11.03	Jerilderie	Post
12.	Victor Stonnill	Colombo Creek	20.11.03		Faxed
13.	N Armytage		24.11.03	Conargo	Post
14.	Jeff Osmond	Ndra Rural Lands	25.11.03	Morundah	Faxed
15.	B Pinnuck	Above Algudgerie Weir	26.11.03	Jerilderie	Faxed
16.	Ian Girdwood	Colombo	29.11.03	Jerilderie	Post
17.	Michael Elmes	Billabong/Forest	26.11.03		Post
18.	Anonymous		26.11.03	Wanganella	Post
19.	Richard Sleigh		26.11.03	Jerilderie	Post
20.	Anonymous		28.11.03		Post
21.	Anonymous		28.11.03		Post
22.	Hugh Cameron	Yanco	02.12.03	Jerilderie	Faxed
23.	Geoff Ham	Billabong u/s Jerilderie	02.12.03	Jerilderie	Faxed
24.	Tim Sheed	Billabong east of Jerilderie	13.12.03		Post
25.	AD & HJ Glenn	Athole, Morundah	13.12.03		Post

Meeting	No.	Name	Creek Section	Q. 1	Q2 F	Q2 U	Q 3 - 1	Q 3 - 2	Q 3 - 3	Q 3 - 4	Q 3 - 5
Morundah	1	John Mills	DS to Morundah	10-50%	$1.00	$2.00	No Rest.	Greater Sec	Environ	Living Murray	
Jerilderie	2	Kel Baxter	Colombo	10-50%	$2.00	$1.50	Greater Sec	No Rest.	Environ	Living Murray	Savings returned to landholder in proportion of contribution to plan, states share returned to rivers
Jerilderie	3	Anon	Jerild/Algudgeri e	10-50%	$1.00	$2.50	Greater Sec	Environ (1)	No Rest	Living Murray	
Jerilderie	4	John Whitehead	YC/CC	10-50%	$1.00	$1.00	Greater Sec	Environ	No Rest (2)		
Conargo	5	S Burns	Forest Creek	10-50%	$1.50	$2.00	Greater Sec	Environ	Living Murray	No Rest.	

No.	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q 10
1	No response	No response	No response	Would like to see willows killed and pulled out	Would like dead tree snags removed	No response	No response
2	Management actions to reduce losses	Not enough emphasis on weirs – upgrading issues – as regulators – wetland management – for water efficiency – environment. Not enough discussion on alternate supply via Colly & MIL to increase water efficiency	Level of joint venture funding needs to be included once agreed, to show commitment of landholders	Plan cannot be seen as trying to turn creek into a channel which could be a conclusion by others	Linkage between management actions and budget not clear	Less on LWD. More on supply efficiency	Willow removal, Weir Review, Alternate supply investigation, Snag management
3	No response	No response	No response	No response	No response	No response	No response
4	Quicker flow. Reduce Losses	Nil, at the mo	No response	See 4	Seems OK	Did not view	Govt help State & Fed
5	No response	No response	No response	No response	No response	No response	No response

Meeting	No.	Name	Creek Section	Q. 1	Q2 F	Q2 U	Q 3 - 1	Q 3 - 2	Q 3 - 3	Q 3 - 4	Q 3 - 5
Wanganella	6	I Gibson	Bottom	10-50%	$1.50	$2.00	Greater Sec	Environ	'No Way' to No Rest		
Jerilderie	7	Michael Gregory	Jerild-Hartwood	10-50%	$1.50	$1.50	Greater Sec	Environ	No Rest	Living Murray	
Conargo	8	AR & C Menegazzo	Conargo	10-50%	$2.00	$2.00	Greater Sec	Environ	Living Murray	No Rest	
Morundah	9	B J Bolton	Bingegong								
Jerilderie	10	David Leeds	Above DC800	10-50%	$1.50	$2.00	Greater Sec	Other – Political bargaining power	Environ	Living Murray	No Restrictions

No.	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q 10
6	No response	No response	No response	No response	No response	No response	No response
7	Good detail	Weak science suggesting environmental "degradation", e.g. Walker et all calculated salinity would increase: Models & predictions are no basis for actions.	More research should be encouraged to define natural parameters of creek habitat & credible investigation into bio diversity	No response	More emphasis needed on the rich & abundant bio diversity existing already & that protection & propogation are core. Currently reads a bit like a disaster manual, which understates the good things happening and the natural state of ???	Hard to know how costs will run until work is started – so suggest we take this budget as a starting point & get into it. State Water should be upfront with some funding.	1. Promote/support research – carp, willow control, existing biodiversity, existing natural parameters – this could be cheaply done. 2. Willow, willows & willows. 3. Carp, snags, etc
8	That irrigators contribute at least 40% of cost so that we get a proper say in how things are done	No problems with any of the Plan	No response	No response	No response	Fair	Finding Water Losses and eliminating losses.
9	No response	No response	No response	No response	No response	As I am only stock & domestic No Irrigation Licence – I really cannot quote on this.	Snags and cumbungi
10	It was a start to what needed to be done in the eyes of political interest & environmental interests	Lock of insight to the outcomes of the works once completed	No response	I question whether at the end of this process, we will have any control of the process and final outcome. Although we make use of this resource, the creek is owned by the Crown & controlled by the Crown & unless we have guaranteed security on our entitlements, this may be in vane to our irrigation prospects.	However, I believe we cannot neglect our environmental obligations & therefore this impacts on the whole of the Yanco Creek System Community. Hence I believe this burden should not only fall on the shoulders of the irrigators financially or otherwise.	No response	Action 3.14E

Meeting	No.	Name	Creek Section	Q. 1	Q2 F	Q2 U	Q 3 - 1	Q 3 - 2	Q 3 – 3	Q 3 - 4	Q 3 - 5
Jerilderie	11	John Webb	Yanco/Wilson ana	10-50%	$1.00	$1.00	Greater Sec	No Rest.	Environ	Living Murray	
	12	Victor Stonnill	Colombo Creek	No Resp	No Resp	$1.50	Greater Sec	No Rest.	Environ	Living Murray	
Conargo	13	N Armytage		10-50%	$1.50	$1.50	Greater Sec	No Rest.	Environ	Living Murray	
Morundah	14	Jeff Osmond - Narrandera Rural Lands Protection Board		No Resp	No Res	No Resp	No Resp	No Resp	N/A	N/A	
Jerilderie	15	B Pinnuck	Above Algudgerie	NA	$2.00	$2.00	Greater Sec	No Rest.	Environ	Living Murray	

No.	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q 10
11	Professional Layout	Left treatment of weirs out of mainstream thinking, treatment, assessment, etc.	Weirs must be treated as part of total plan.	No	Before commenting let us see inclusions from meetings of October 29-31 2003	Still assessing	Still reviewing
12	No Response	No Response	No Response	No Response	No Response	No Response	No Response
13	No Response	No Response	No Response	No Response	No Response	No Response	No Response
14	No Response	No Response	No mention (specifically) of the "Key threatening processes" within the "Threatened Species, Fisheries Management Act". Removal of large woody debris (snags) has been made. $13.6m has been targeted to removal of LWD and this may be prevented under the TSFM Act. Urgent comment from National Parks (?) should be obtained. Ground water recharge study should be undertaken to determine if system losses are all negative?	No Response	No Response	Majority of cost is targeted to Removal of Willows $4.37m and L.W.D. $13.6m. The cost of each $1250 willow ($1050 L.W.D.) should be revisited and explained/justified.	No Response
15	No Response	I feel we should start at the top where the water comes in. That's where the greatest wastage of water is.	The possibility of spray willows, cumbungi with round-up, to kill trees before any earthmoving equipment is used. Willows are very easy to kill if sprayed at the right time.	My concern is if I am to put money in expectation of the savings to be given as extra allocation, when there is 500GL to be found for Living Murray. I think any savings would be hard to hang on to.	It has been well covered in the plan. I think for us to get back to 20% losses in 10 years. More use of drains to feed creek, i.e., a new drain out of Coleambally, guaranteed supply from MIL into Billabong.	Is there Government money available to do some of these works? After all it is a creek not irrigation canal. If it is going to guarantee supply in high demand months, I would pay a levy to be determined.	3.4, 3.5, 3.9 (A) (B), 3.23

Meeting	No.	Name	Creek Section	Q. 1	Q2 F	Q2 U	Q 3 - 1	Q 3 - 2	Q 3 – 3	Q 3 - 4	Q 3 - 5
Jerilderie	16	Ian Girdwood	Colombo	51-74%	$2.00	$1.00	Greater Sec	Environ.	Living Murray	No Rest.	
	17	Michael Elmes	Billabong/Forest	10-50%	$1.50	$2.00	Greater Sec	No Rest.	Environ.	Living Murray	
Wanganella	18			10-50%	$2.00	$2.00	Greater Sec	Environ.	No Rest.	Living Murray	
Jerilderie	19	Richard Sleigh		10-50%	$1.50	$2.00	Greater Sec	Environ.	No Rest.	Living Murray	
	20			No Resp	$1.00	$2.00	Greater Sec	Environ.	Living Murray	No Rest.	

No.	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q 10
16	No Response	No Response	No Response	Looking at some way to bypass some of the worst areas for the creeks where there high water loss or slow flows.	No Response	No Response	No Response
17	Has it ever been established at which points create the greatest losses? I know there is no measuring point between Conargo & the end of the line. Who knows, 20% of losses may occur between Conargo/Wanganella where the Billabong flows through the Boonoke sandhills. This loss may go into an aquifer that supplies half the stock water for country between Billabong/Murrumbidgee. If this were the case it would not be a loss but accounted for, in a case like this there would be significant economic gains.	No Response	No Response	No Response	No Response	No Response	No Response
18	No Response	No definition of what constitutes a loss.	Fully analyzing what constitutes a loss.	Run the MP as a 3x3 program	Make the execution summary more precise. Review the document by an outsider.	No Response	Flow restrictions in upper Colombo. Work out what constitutes the loss – is say 80% of the loss (52%) actually an environmental flow to the Murray system or to the Wanganella swamp.
19	No Response	No Response	No Response	No Response	No Response	No Response	No Response
20	Increasing flow rate of ponded and slow flowing water should reduce evaporation. Overall endeavour to try & do something positive.	The uncertainty of reducing losses – what adverse effect it may have – method of measuring stream flow, take-off, along stream, also metering of pumps – this alone could amount to 10%	No Response	No Response	No Response	No Response	Increasing stream flow. Keeping abreast of new technology sorting out statements that are untrue or unlikely. 50% loss is high, however, the Government must reconcile the need to keep forest areas healthy.

Meeting	No.	Name	Creek Section	Q. 1	Q2 F	Q2 U	Q 3 - 1	Q 3 – 2	Q 3 – 3	Q 3 - 4	Q 3 - 5
	21			No resp	$1.00	$2.00	Greater Sec	No Resp	No Resp	No Resp	No Resp
Jerilderie	22	Hugh Cameron	Yanco	10-50%	$1.50	$2.00	Environ.	Greater Sec	No Resp.	Living Murray	
Jerilderie	23	Geoff Ham	Billabong upstream of Jerilderie	10-50%	$1.50	$2.00	Environ.	Greater Sec	No Resp.	Other – more off allocation flows	Living Murray
	24	Tim Sheed	Billabong east of Jerilderie	10-50%	$1.50	$2.00	Greater Sec	No Rest.	Environ.	Living Murray	
	25	AD Glenn, per H J Glenn	Athole, Morundah	10-50%	$1.00	$1.50	Greater Sec	Environ.	Living Murray	No Rest.	
	26	Gary Williams		51-74%	$3.00	No entry	Greater Sec	No Resp	No Resp	No Resp	No Resp

No.	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q 10
21	Implement the levy and see what we get for our money.	No Response	No Response	No Response	No Response	No Response	No Response
22	Positive Plan for the Future	No Response	No Response	I am concerned about creek levels dropping once willows and snags are removed.	No Response	No Response	No Response
23	The vision of the first major assault on willows.	No Response	No Response	No Response	No Response	No Response	No Response
24	No Response	No Response	No Response	No Response	No Response	No Response	No Response
25	No Response	Neither Andrew nor I have the knowledge or experience to comment. The small acreage of our country is leased; we do want to keep our licence (Est. J O Glenn) are prepared to pay what is fair.	No Response	No Response	No Response	No Response	No Response
26	No Response	No Response	No Response	No Response	No Response	No Response	No Response

Tarabah, Morundah. NSW. 2700. Received 06.11.03

The Secretary,
Yanko Creek & Tributaries Advisory Council.
PO Box 471,
Narrandera.
NSW. 2700

2 d November, 2003.

Dear Sirs/Madams,

Congratulations on the management plan. I believe the plan to be comprehensive and gives us a direction to move in.

There seems an general agreement that willows are enemy number one.

My main concern relates to Table 7, on page 57, specifically under Staffing. This whole section is rubbish. There are already people employed to run the creek, Jim Parrett and Phil Dempsey are two. All work will be contracted out and Phil has had experience in problems like willows. Lets do the willows under existing DLWC funding and see what a huge difference this one action would make. Removing the willows meets every criteria- cost effective, doesn't need a team of consultants etc to tell us what a good idea it would be, it is a noxious weed, not native and once completed will require very little expense to maintain extinction. Let's not get another layer of bureaucracy when we have existing people to do the job. De-snagging is just going to cost a fortune and will have to be done again in 10 years.

1 also feel strongly that a small amount of tweeking can save heaps of water, things that would allow creek to be run lower. E.g. water limited during Jan/Feb., water more expensive in summer, no transfers down creek. 1 believe we need sustainable actions.

1 believe that existing funding is available for revegetation and particularly fencing riparian areas. Maybe the Council could arrange information on existing funding to be distributed to people along creek. In the Management plan, riparian land gets a pretty good review. Most of our water quality problems seem to be coming from catchments of Billabong and Murrumbidgee. If Council has not already done this, maybe they could meet with these catchments and encourage them to set goals/time table to improve water quality exiting their area.

Yours sincerely,

Michael and Anna Coughlan.

D.B. MILTHORPE & SON
Somerset Merino Stud
Jerilderie
20.10.03

The Executive Officer
Murrumbidgee Private Irrigators

Dear Lee,

Re: Creek Plan

Surely our creek system is dovetailed in with the Tumut River – If it can only carry so much water what are we gaining by improving creek flow except reducing losses.

Surely we are dovetailed in with Darling River – We have to send so much to South Australia and lately none going down Darling means more percentage has to come from Snowy etc.

In report these issues do not appear to be addressed – the Nation has some major problems to address.

Some locals have suggested to me that water should not be allowed to be sold off over $10.00 a megalitre – This will not work in practise – Some have developed too much irrigation land and want water on the cheap when it is scarce – "A Black Market would develop"

Before white man interfered Forests and swamps did not flood every year – Do we know what effect this has on diseases, insects, etc.

If there are big losses of water in our creek system and they cannot be improved on not only should rice be grown on Murrumbidgee but winter cereals as well looking at things from a National outlook.
Yours sincerely
David Milthorpe

26.10.03
The Executive Officer, MPI

Dear Lee
Re: Creek Draft Management Plan

Licenses will not be tied to properties and water is becoming more expensive.

Fruit, vegetables, dairy products give a greater return than wool and meat, hence, in future surely some water will be sold off creek system, i.e., less water to go down creek system.

All the issues I have raised in my faxes should, in my opinion, have been addressed in the Management Plan.

See you on Thursday
Yours sincerely
David Milthorpe

Yanco Creek System
Comments on the Management Plan
(Jim Todd)

I think that the paper is incomplete without something of the historical background to this creek system.

Occupation by non-aboriginal people took place around the 1840s by enterprising people who moved into the area and occupied it wherever there was water for their stock. Wherever the water supply proved to be not fully reliable as on this Yanco Creek system, they soon began to take action to improve that reliability. Little is documented about this, but much of it consisted of putting earth banks across the streambeds to store water. Most of these failed being washed out by the next high (or not so high) flow in the stream. From time to time you come across the evidence of these old banks. The failure of these attempts to secure the water supply led to the development of more secure structures, some of which also failed.

Prior to the construction of Burrenjuck Dam, flow in the Murrumbidgee River was very irregular. The higher of these irregular flows would have provided flows into Yanco Creek. In dry seasons there would have been substantial periods with no flows into Yanco Creek.

The plan refers to work done by landholders to improve the diversion of Murrumbidgee water into the Yanco Creek. The stories seem to attribute this to Samuel McCaughey. An amazing amount of work was done including a concrete regulator in the deep cutting close to the Sturt Highway upstream of the highway bridge over the creek (which collapsed). He also built a small concrete regulator in Yanco Creek at the start of Colombo Creek to improve the diversion to Colombo Creek and slightly deepened that creek for about 1 00m. (The spoil heaps are still visible). He also deepened Colombo Creek through the site of the original Morundah village (This was about 500m east of the present Newel] Highway. It was probably located at the shallowest section of the creek and **therefore was the best crossing place.** For the same reason it was also said to be very flood liable. The village re-located when -the railway was built.)

There were a number of substantial structures built in the streams to retain water from the intermittent flows in these streams. Among these was Chesneys Weir on Colombo Creek. During the 1890 drought, McCaughy on Coonong Station completely stopped the flow in Colombo Creek and used the water to irrigate. There was, in 1982, aerial photos in the Finley office of the W.C.& I.C. on which this irrigation layout was still clearly visible. McCaughey's action resulted in protracted legal action and eventually the Water Act 1902 in NSW.

This resulted in some control of these structures in the creek system by licensing them with conditions on their operation generally designed to allow a reasonably free flow of water through the system in the spring and retain stored water through the dry summer period.

The construction of Burrenjuck Dam greatly reduced the frequency of these higher flows in the Murrumbidgee River high enough to divert water into Yanco System. This resulted in the formation of the Yanco, Colombo, and Billabong Creek Trust and the construction of the old weir in weir in the Murrumbidgee to divert water into the creek system. As a result, the reliability of the water supply in the creek system was better than it had ever been.

This meant that most of the structures were no longer necessary. Some were simply allowed to deteriorate toward eventual failure. Some were carefully retained and even replaced as they fell into disrepair. There is evidence on the ground that Chesneys Weir

has been built 3 times. There seems to have developed an emotional attachment to these works and, in this dry land, to the broad stretch of water (and Cumbungi) impounded by them.

If there is a move to have the unnecessary structures removed, we must no be surprised if there is a move to get a Heritage classification on some of them.

Water losses

From the "plan" 1 calculate that the "losses" from the system amount to some 43,300 ml. The loss would perhaps be better called "water un-accounted-for". The suggestion that this 43% loss could be reduced to 20% can be utterly rejected.

This system has a water surface length of about 1,000 km, 800 km, if you omit to lower sections of Forest Creek. My figures have to be very approximate but 1 assess that the evaporation from this surface, and the eva po-tra nsp i ration from the bordering trees and growth would amount to some 32,000 ml per year.

Add to this, the fact that, from the offtake to the MR321 bridge, Yanco Creek overlays an ancestral bed of the Murrumbidgee River in what would be an intake area for the ground-water resource west from that area, which must also cause some loss (if that is really a loss) at least from the creek system. In short, 1 see no chance of reducing these losses.

Water Ordering

This has always been a hope-less matter - even in the irrigation areas and districts. The "ordering in advance" whether 4 day or 7 day, has been used to provide a legal-type method of dealing with the complaints (if not the problems) and their real purpose has been to control the "just help yourself system which would, of course, be preferred by the water users.

What, in this plan is called "time of travel" for water flows in this system is really "the time to effect a change of flow to a particular point in the system and it not constant from one point to another. 1 have made the point before - in the lower parts of this system, the water has to be released from storage for a crop for which the grower has not yet made the final decision to plant.

This, however, can be managed. There is quire a lot of "fat" in the system. At any time there is a large amount of water actually in transit in the system and, to a limited extent, this can be drawn on so long as the shortages or surplus can be "made up" as quickly as possible. What is needed is:

1 That the person controlling the stream system is reasonably aware of the farming activities planned by the water users - what crop, and the areas planned.

2. The evapo-transpiration rates for these crops at their various stages in their growth. The C.S.I.R.O. at Griffith did a lot of work on this some 30 40 years ago.

3. Average evaporation and rainfall records for the area

4. Day-to-day evaporation and rainfall records, the rainfall in particular at various points in the system.

With this information, the controller can use the "fat" in the system to cover and correct the day-to-day discrepancies in the flows.

"Aintree"
Deniliquin NSW
23.10.03

Lee Furness
Executive Officer MPI

Dear Lee,

Re: Draft Natural Resource Plan Yanco Creek in particular. Our Property "Moonyanco" is situation near Conargo. We pump from 2 sites from to Yanco Creek arm. I would like to make some comments relating to the Moonyanco section of about 24 kms single frontage, however, I do not feel that I could make much useful comment about the other sections, that should be up to those landholders concerned.
The significant features of our section is that from the upstream boundary to the Homestead is a 3 metre fall the Yanco Creek therefore is quite fast running. There are willow trees at the Homestead we don't want the, however, they do not cause a restriction to the stream as it is very wide there.

There is one snag of timber and about four inside bends of Cumbungi once again very little restriction good channel on outside of bend. One day with excavator all that maybe necessary; access is possible but frontage is extremely dense with a lot of dad timber branches, etc., mainly black box some red gum.

Cost to improve stream flow is very marginal.

Riparian zone we have been talking about fencing the Riparian Zone we would have to line the fence line along way back from the creek to obtain a clear straight fence line more or less make it another paddock and supply stock water to stock by using the ana-branch or flood runners. There is about 500 p.a. of extremely dense timbered areas with virtually no feed values at all.

Endangered Species They are over the top worrying about protecting BATS. Plains-Wanderer maybe resolving itself as well as other species on the basis that seasonal conditions the bniggest factor that determines bird and other wildlife.

Thank You
John Knight
Moonyanco

1 / 11 Corbett Court
DENILIQUIN NSW 27 10

YANCO CREEK SYSTEM

Careful control of flows in the creek systems and use of water cropping should be given the most careful consideration.

Due to the very limited grades of this area which is basically an artesian overflow system. Timing of the flows is very difficult and thought could be given to approximating fairly natural spring flows.

These flows could be used to provide late season flows for watering wheat, barley, oats and other cereal when normal winter rains are low. And would approximate normal spring rains and snowmelts on the hill catchment areas.

Cumbungi controls could roughly parallel more usual spring and early summer floods for control of this plant.

Cumbungi drowns in approximately two metres of water, and then the leaf matter breaks down and leaves a clearer flow channel for next seasons flow.

Alternatively in no winter flows it rots to ground level or less and so natural water flows along the creek can occur.

Perhaps thought could be given to arranging a no flow situation along the creek every five or so years.

Native fish and bird life thrive under high flow conditions. The breeding cycle of fish is very fast and small sprat can be seen returning to the depleting channels in four to six weeks. Bird breeding is rapid and the young are commonly fed from this native sprat, return period.

Both of these breeding cycles originally occur in a five, ten or thirteen year cycle depending on which cycle occurred and counted by our cycle of counting.

Phragmites follows a similar cycle to cumbungi but drowns less frequently and regenerates from dormant root systems more rapidly.

RICE GROWING

If not already required the growing of rice should be subject to strict limitations of pretesting to proposed areas by Electro magnetic testing and then limited areas of planting.

The water needs of this crop are higher than other grains and occur at the time of year when flows and areas are subject to something in the order of 1.2 to 1.6 metres of evaporation loss very undesirable during the summer season.

For many farmers rice is a very desirable income, yet in the long term 1 am of the feeling that it should be phased out, and water kept for relatively quick autumn flows to irrigate or pre irrigate for winter pastures or other early cereal crops.

SNAGS

Removal of these should be given very careful consideration, as these provide much of the natural shelter for all natural water life. (In some other areas where snag removal was used, the overall loss of river water life was great and now snag replacement procedures have been used).

WILLOW REMOVAL

These imported plants cause damage to waterways and native water life and should be removed as soon as practicable.

The issues of "Australian Geographic" April-June 2003 has a very interesting article Page 100 -105. The use of the procedure recorded there could be very helpful.

CARP

Various forms of European Carp (actually Chinese originally) cause serious damage in the soft alluvial soil such as the Yanco Creek System. And encouragement should be given to the various research programs, hopefully leading eventually to their elimination.

J. Moorhouse

P.S.

ROADS All roads are shown on the plans in the Plan.

During one flood period the road access Wanganella to Conargo was cut. Probably about 10 - 15km east of Wanganella town, most likely from memory the 1972 flood.

At some earlier time a bank had been built to stop flows in the Forest Creek returning to the Billabong Creek, then strengthened provide seasonable road passage.

Unfortunately the bank road had not been built high enough and was seriously damaged by overtopping. Repairs could not be undertaken for some six or more months.

Although the matter of an improved bank height and safe access was discussed twice with Shire engineers no real action followed.

SUGGESTION

The work necessary is to widen the whole bank and build higher than the cereal ground and provide shallow flood ways either side of the bank. Say 50 metres away for occasional flood conditions.

When funding for work along the creek system is being considered this work could be proposed so that sensible road access could be retained in most flood times and expensive repairs avoided as an after event.

Wooroma
Moulamein 2733
31 October 2003

To: Bob Crawford
Windouran
Yanco Creek & Tributaries Advisory Council

Re: YCTAC Meeting at Wanganella 31.10.03.

- Bob, please offer an apology for me being unable to attend todays meeting.
- I authorize Bob Crawford of Windouran to vote on my behalf at todays meeting. Underneath I raise some strong view that I would like stated today.
- Despite all the good intention of YCTAC, DIPNR & State Water all have failed to supply water to the lower reach properties. Since 1996 over 300,000 ml has flowed over Warriston Weir and not reached the confluence of the Forest Creek & Billabong Creek on 90 kilometres downstream. If this were in private industry bankruptcy or sackings would occur.
- Neadoug P/L, which owns the Woorooma licences on the Billabong & Forest Creeks is adamant the only way to resolve the problem is the alternate water supply where the identifier of the saving receives the fair share of savings necessary to have compensation to those lower reach properties.
- Neadoug is not in favour at all of any levies on water usage and licenced allocation to improve flows. This is clearly the responsibility of DIPNR and State Water and YCTAC not for the individual consumptive users to prop up an inefficient supplier of the water
- I have ideas that could save 40,000 ml water annually, however, I have not had much support. It seems to simple it must be too difficult to implement by the supplier. Also some individuals do not accept water is a fragile and valuable resource and are very greedy and do not respect other individuals or the system. These users will eventually reduce everyones entitlements.
- This new plan like the old Forest Creek Management plan does nothing for the lower end users of the Forest Creek. Once again the hard issues have been avoided and the softer options taken.
- What relationship or action has been planned between YCTAC and Pratt Water Foundation. Has YCTAC been able to source some of the $100 million funding?

Yours sincerely
William M Gatacre

Richard Sleigh
Chairman
Yanko Creek and Tributaries Advisory Council
Bowen Station
Jerilderie NSW 2716

"Woodside"
Jerilderie NSW 2716
23d October 2003
Ph/Fax 03 58867119

Dear Richard,

Congratulations on the release of your teams Draft Yanko Creek System Natural Resource Management Plan.

1 would like to bring these points to the attention of the Council.

* Point 1.3, whilst the broader dryland areas are conveniently ignored in the scope of the plan, the major achievable water savings highlighted by the plan are transmission losses. The Plan calls for these losses to be cut from 47% to 20% within ten years. Surely the importance of groundwater recharge to all farmers in the affected area cannot be simply ignored. While 1 am aware that not enough is known about groundwater recharge in any river system its importance to the general environment should not be dismissed in the scope of this plan.

* 1 am yet to be convinced that any benefit can come from fencing the stream banks to exclude grazing under our districts normal low intensity stocking rates (i.e. without irrigated pastures).

* Can someone please inform the experts that before intensive irrigation, the natural time for high stream flows is in late Spring/early summer? Common sense says that high flows will occur when the combination of storm rains and snow melts reach their maximum potential.

* Regarding the subject of vegetation and wildlife, would it not be sensible to encourage individuals attempting to do the right thing.

Yours sincerely,

Peter Robertson

Ross Purcell
'Bettina Lodge'
Jerilderie NSW 2716

Dear Sir,

Just a few queries I have. I would like to know if there is any plan to clear willow regrowth in the Billabong Creek from Newell Highway to Bolton St bridge. After the expensive operation they under took some years ago and may I add not a very successful exercise if something isn't done very shortly it, will turn into another major job.

As well as the hold cumbungi is getting on the creek system.

The other concern is in regards to natural resource management plan is where the 406 million will be spent and if the new councils being set up will swallow a large portion of this money.

As well as who determines make of natural resources management committees.

Yours sincerely

Ross Purcell

Received: 28 November 2003

Blue Gate Station
Deniliquin
NSW 2710
10 November, 2003

Lee Furness
Murrumbidgee Private Irrigators Inc
PO Box 723
Griffith NSW 2680

Dear Madam

As the representative of the owners of the above property, which has frontages to the Billabong Creek, the Edward River and a double frontage to the Forrest Creek, I wish to respond to the Yanco Creek Natural Resource Plan.

The Yanco creek is just another victim of over allocation of scarce resources by various State Governments over the years. The creek itself is in exactly the position that the hydrologists engaged by the late Tom Holt foreshadowed. This inefficient creek system has been tragically over allocated

Spending $20 million on cleaning up the creek will no doubt lead to increased and more efficient flows, but this does not necessarily mean greater access to water for the lower end of the system. It will mean that there will be an increase in land devoted to irrigation at a time when it is clearly obvious to the most blinkered view that we have over allocated our river systems. The mentality of that if there is water going past your property it should he pumped out onto a crop is out of date but unfortunately still exists.

The supply of water to the lower reaches of the Forest Creek has been non-existent for a number of years due to the inefficiencies along the creek. The man made Wanganella swamp has now become a very important bird breeding area and should be and no doubt will be maintained for this reason. The landholders from Rhyola down recognised a number of years ago that supplying the lower reaches of the creek was costing too much in wastage and agreed to a proposal that it would be far more efficient for the system if they received a non tradable and non irrigable stock and domestic allocation from either the Edward river or the Billabong Creek in lieu of water in the Forest Creek.

This proposal had the support of the Department and the landholders and for reasons unknown to me it has not seen the light of day. To this day, I am unsure why this proposal fell over as it meant a saving of several thousand megalitres of a scarce resource, which could have been usefully used for other purposes. The water in the lower Forrest creek when flowing filled underground aquifers in Nullum and Blue Gate and ensured that there was enough hydrolic pressure on Blue Gate to push salts etc, leaking into these aquifers from excessive downstream irrigation, west.

Angus Crawford

Director/Manager

Department of
Infrastructure, Planning and Natural Resources

Contact: Gary Croker
Phone: 02 6923 0400
Fax: 02 6921 7308
Email: Gary.Croker@dipnr.nsw.gov.au

Richard Sleigh
C/- The Secretary
Yanco Creek and Tributaries Advisory Council.
PO Box 471
Narrandera NSW 2700

12 January 2004

Dear Richard

Subject: Comments on the Draft document titled *The Yanco Creek System Natural Resource Management Plan*

Please find the Department of Infrastructure, Planning and Natural Resources' (DIPNR) response to the draft document circulated for comment. Many of the comments refer to emerging changes in legislation with references to the newly gazetted Catchment Management Authorities Act 2003 and the Native Vegetation Act 2003. I acknowledge and commend the partnership approach with DIPNR in developing the document and the comments below are intended to be constructive and to assist the Yanco Creek and Tributaries Advisory Council in improving the management of the Creek System.

General comments

With the imminent creation of Catchment Management Authorities (CMA5), it is important to recognise the role these organisations will have on natural resource management, both in the Yanco Creek vicinity and the Murrumbidgee and Murray catchments. The implementers of the Plan will need to liaise closely with both CMAs. Much of that area covered by this plan is within the area dealt with in the Murray Catchment Blueprint. It is critical that both the Murray and Murrumbidgee Catchment Blueprints be specifically referred to, and the actions and strategies in the Yanco Creek Plan reflect these documents. Incentives for riparian management together with terrestrial vegetation management and restoration/revegetation will need to be targeted in the Plan. Additions to the existing map showing catchment boundaries, Catchment Management Authority boundaries and perhaps local government boundaries would be useful.

Under the Water Management Act 2000, the State Water Management Outcomes Plan (SWMOP) provides an overarching set of state wide targets and outcomes for water management in NSW. There does not appear to be any reference to the SWMOP in the preparation of Yanco Creek Plan. Of particular relevance for Yanco and similar creeks is the matter of bank-full flows. The Yanco plan should at least acknowledge the SWMOP.

Generally, this plan moves towards substantial on-ground works, but lacks emphasis on the need for geomorphic and hydraulic data that would be a prelude to such actions. In particular, reference is made to the proposed action to "manage" 12980 units of large woody debris. There is little explanation of how the 12980 units were derived and careful consideration needs to be given before any large woody debris is removed. In fact, recent scientific studies have lead to the reintroduction of snags back into streams, which appears to be at odds with the intent of this Plan. There is a need to seek comment and/or consent from NSW Fisheries, Department of Environment

and Conservation and DIPNR prior to any works commencing. In the particular, some scientific argument for the removal (or retention) of large woody debris should be included.

Specific recommendations for changes to the text

Section 2. 1 Paragraph 6.

It is incorrect to say that the length of the creek causes it to meander. The meanders are a result of topography and/or speed and quantum of flow.

Fourth dot point. Channel capacity constraints are more to do with natural capacity of the creeks than with willows and large woody debris, It is considered that cumbungi is less important.

Page 9. Table 2.

This table does not recognise natural creek bed capacity as an impediment to flow. It would also be worthwhile to introduce weighting for the various impediments. Perhaps an investigation of the hydrological effect of these 'blockages' would provide some critical facts and figures.

Section 2.6. Page 15

Some comments on climate would provide a more complete picture within this section. It is well recognised that climate over the last 100 years (where reliable observations are available) has distinct 'wet' and 'dry' periods, and drivers such as the Southern Oscillation Index/ENSO (short term trends) and Inter-decadal Pacific Oscillation Index (longer-term trends) have been documented as climatic indicators. For example, floods have decreased over the last 20 years, but this needs to be considered in context of longer- term climate. The period from the 1970's to the early 1990's is acknowledged as a relatively wet period in the Riverina, whereas there has been a marked decreased in flows throughout the southern Murray- Darling Basin since then. Hence the reduction in flooding is more likely to be indicative of longer-term fluctuations in climate than increased regulation.

Issue 3.2

Action 3.2 (B) targets a reduction in transmission losses from the current 43% to 20% over ten years. There is no explanation of how this desirable outcome was arrived at, or whether it is achievable. Although it is mentioned in the Plan, the following sequence needs to be emphasised:

1. Determine exactly what the cause of these losses are,

2. Prepare an activity plan based on (1) to reduce losses on a prioritised basis.

Issue 3.7.

This is a short and simple explanation of a complex issue. The problem of break-outs could also be partially overcome by reducing the operating level of the creek. The water that escapes also has an environmental benefit or cost. The environmental assessment mentioned in the Action Box may well determine that remedial works are not warranted. The Department is concerned about creating an ongoing engineering issue for Yanco Creek.

Issue 3.10. Paragraph 3.

It is unclear how the SCADA discussion fits into the water ordering issue. The document could provide more information on State Water's plan to "critically examine" water flow in the system.

Issue 3. 15 (b) Page 40.

In this section, an additional strategy to protect high conservation areas would be to consider re-zoning the land (eg 7a Environmentally Sensitive Land) under the respective Council's Local Environment Plan (LEP). This would provide a protective mechanism to control inappropriate land use in high conservation riparian areas.

Issue 3.16 Page 41.

The report could comment on the effect of flow management as a tool to control European carp.

Issue 3.19 Page 42.

With the Native Vegetation Conservation Act 1997 to be repealed with the commencement of the Native Vegetation Act 2003, the Western Riverina Regional Vegetation Management Plan (WRRVP) will not be gazetted. The Murrumbidgee and Murray CMAs will utilise elements of the WRRVP as they develop Catchment Action Plans however the regulatory components may not be acted on. As an alternative, consideration might be given in this section to refer to Property Vegetation Plans under the Native Vegetation Act 2003.

Issue 3.22 page 45 paragraph 2

The two Actions on page 46 appear to affect the licensing arrangements for the corporations and any negotiations should involve DIPNR. The statement attributed to Simpson (1994) is now outdated. Several changes to water management and regulation have occurred since this date make this quote invalid.

Issue 3.24

This section does not adequately explain Section 87 (regarding compensation) within the

Water Management Act 2000.

Issue 3.27 *page 51 (Action 3.27a) Target 1.*

This would be better described as arrangements to better share flows that are excess to downstream consumptive requirements between the Billabong Creek and Forest Creek systems. It is also not clear what the intended outcomes are for the 'environmental purposes'.

Page 52 (Action 3.27 (17.

This section implies that rostering is required for irrigation pumpers when flows at Warriston Weir are regulated at or near to target flows. The target flows at Warriston Weir are provided for stock and domestic use not for irrigation.

Page 57 & 58 Costing Schedule.

Costs need to be identified for weirs that are targeted for removal.

Thank you for the opportunity to comment and I trust that the issues raised in this letter are taken into account in your deliberations prior to the finalisation of the document. I have arranged for Rob Scriven and Peter Beal to follow up on these issues should the Advisory Council require further assistance from the Department.
Yours sincerely
Warwick Ford
A/Regional Director, Murray-Murrumbidgee

Our ref: MPI 031

3 December 2003

Ms Lee Furness
Executive Officer
Murrumbidgee Private Irrigators Inc.
PO Box 723
GRIFFITH NSW 2680

Dear Ms Furness

Yanco Creek System – Draft Natural Resource Management Plan

Thank you for giving NSW Fisheries the opportunity to comment on the *Draft Natural Resource Management Plan* for the Yanco Creek System.

NSW Fisheries is responsible for conserving fish stocks, fish habitat, marine vegetation, threatened fish species and aquatic biodiversity and for achieving sustainable recreational and commercial fisheries. As such the Department is concerned about potential impacts on the aquatic environment of the Yanco Creek system that may arise from works proposed by the Management Plan. The following comments have been prepared in response to reviewing the Draft Natural Resource Management Plan for the Yanco Creek system and recent site inspections of the system attended by officers from State Water and NSW Fisheries.

General

From NSW Fisheries perspective one of the main problems with the Yanco Creek system is that its capacity to convey water is being regularly exceeded by regulated flows. It is noted that the current maximum (regulated) flow in Yanco Creek at the offtake is 1400ML/d. The statement on page 26 that at 1400ML/d "considerable flooding occurs at several points in local areas" tends to suggest that 1400ML/d is too high and therefore ecologically unsustainable.

It is clear from reading the plan that this issue is also recognised by landholders and State Water. However, the Plan seems to suggest that the most appropriate way to address the problem is to increase the capacity of the creek by erecting block banks across flood runners to prevent loss of water (eg Action 3.7) and removal of snags which impede the flow. NSW Fisheries is not supportive of the erection of additional block banks as these serve as fish passage barriers during natural high flow events. The more appropriate approach is to reduce the flow rate into the creek to a level that reduces losses to an insignificant level. Such a flow rate is more likely to be ecologically sustainable.

Therefore it would be appropriate to include an action that encompassed the concept of determining the ecologically sustainable maximum regulated flow level for the Creek and implementing a phase in period to reduce flows to that level over a reasonable period of time (eg 5 to 10 years).

Note that Section 65 of the Water Sharing Plan for the Murrumbidgee Regulated River Water Source states that the maximum operating channel capacity shall be determined taking in to account various issues, so there is an intent for this to happen anyway.

Notwithstanding the above, NSW Fisheries supports the removal of **unnatural** flow blockages in the system such as willows and weirs. Indeed these should be the highest priority.

In conclusion I would like to reiterate that the most appropriate way to address the Yanco Creek "water supply problem" is to firstly:

1. Remove willows and redundant and unnecessary weirs, then
2. Review the water carrying capacity of the Creek and determine the ecologically sustainable capacity, then
3. Implement rules to reduce the current flow volume down to the ES volume.

When all that has been done it would then be appropriate to reassess the need to "manage" snags (see below).

Large Woody Debris

Large woody debris or snags are critically important habitat for many native fish species, several of which have been listed as threatened under NSW and Commonwealth legislation. Recognising the continued loss of this particular habitat type and the associated impacts on threatened fish species, the Minister for Fisheries listed "removal of large woody debris" as a Key Threatening Process in November 2001. As a consequence of this listing, a threat abatement plan is currently being prepared by NSW Fisheries in liaison with key stakeholder groups.

NSW Fisheries is particularly concerned at the emphasis being placed on the need to remove snags from the Yanco Creek System for the purpose of achieving water delivery efficiencies. Given the above, a widespread program of snag removal would be considered an activity that would have a significant environmental impact. As such an Environmental Impact Statement and Species Impact Statement would need to be completed and assessed before any such program could be undertaken. It is difficult to envisage how such a program could be approved. NSW Fisheries certainly would not support, or give approval to, any widescale proposal to remove snags.

Following the recent inspection of Yanco Creek it appears that in reality, there are few locations where removal of snags is being considered. The concerns of landholders appear to be centred around the potential for debris accumulation in the immediate vicinity of certain snags and also around streambank erosion due to redirected flow as a result of the current state of alignment. These concerns can be adequately addressed in most instances by lopping or realignment. Removal is generally not necessary.

As a general principal, lopping should be considered the first priority for the management of snags. Where lopping will not solve the immediate problem, re-alignment should be considered as the next possibility, followed by relocation. Removal of a snag is the least desirable alternative and should only be adopted as a last resort. It is NSW Fisheries understanding that these alternate management methods are being considered by State Water as part of the management arrangements for snags in the Yanco Creek system. Such an approach is supported by NSW Fisheries.

Therefore, I strongly suggest that the Plan be reworded to discuss the issue of snags in terms of "snag management" rather than "desnagging " or "snag removal", as is currently the case. This will reduce the potential for misunderstanding and generation of unrealistic expectations among the local community. More discussion of the environmental value and ecological role of snags/LWD and the legislative situation is also warranted.

Riparian Zone Management

NSW Fisheries note the intentions expressed in the draft plan to enhance the management of the riparian zone. However the actions are unlikely to lead to significant improvements. The reality is

that few landholders will undertake riparian zone repair unless they receive substantial assistance or are compelled to do so. The plan should commit to a more pro-active program of riparian zone repair. Perhaps a partnership arrangement with an organisation such as Greening Australia could be explored. An alternative approach would be inclusion of conditions on water licences requiring Best Management Practice of riparian zones.

Weirs

In the last several years there have been a number of initiatives and programs that have been implemented to address the environmental impacts that arise from the existence and operation of weirs and other regulating structures on native aquatic species and their habitat. These have included the development of the NSW Weirs Policy and the undertaking of a statewide review of all existing weirs to determine their suitability for removal or retrofitting to allow for fish passage past these structures.

In May 2002 the "Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams" was gazetted as a Key Threatening Process under the threatened species provisions of the *Fisheries Management Act 1994*. This listing was in recognition of the impacts that weirs and other regulating structures have had, and continue to have, on threatened aquatic species.

It is imperative that any proposals for weir removal, installation of fishways or construction of new regulating structures be undertaken in full consultation with NSW Fisheries. This will ensure that considerations relating to the recovery of native fish populations are addressed and incorporated at the earliest stages of the design process thereby avoiding possible cost blowouts. This involvement should be reflected in the actions of the management plan that address this issue (eg 3.7, 3.9(B)). The involvement of NSW Fisheries in the development of the Implementation Plans for the Yanco Creek system and selected site specific inspections is strongly supported.

Threatened Species

The Yanco Creek System is included in the range of the Lower Murray River Catchment Endangered Ecological Community . This means that the community of fish and aquatic invertebrate species, which occurs within the Yanco Creek System, is considered endangered and must be considered in the planning process for any potential works or activities. There are also a number of individual species and populations that have also been listed as either endangered or vulnerable under the respective Schedules of the Fisheries Management Act that occur within the Yanco Creek System which must also be considered in developing and undertaking proposed work programs. NSW Fisheries is willing to provide any information that may be required by State Water for the preparation of threatened species assessments, required as part of the proposed works program.

Fish sampling records

On page 23 of the Management Plan, reference is made to fish population data that has been collected from a site on Colombo Creek but there is no indication as to the source of this data and when it was collected. This is important if this information is to be used as part of any baseline study for the Yanco Creek system.

Liaison with NSW Fisheries

In the Action summary table on pages (iv) and (v) of the draft Plan NSW Fisheries has not been listed as a responsible agency despite the fact that several actions have a direct impact on aquatic species and their habitat. NSW Fisheries has the following comments to make with respect to the highlighted management actions:-

- **Action 3.4** – As NSW Fisheries has an approval role for works undertaken in the Yanco Creek System, it would be appropriate for the Department to be included in the application of Integrated Procedures Assessment Protocols to ensure that a streamlined approvals process is in place for all works undertaken as part of the *Draft Natural Resource Management Plan*.
- **Action 3.5** – specific information is required on how the prioritisation of works will be undertaken. It is assumed that environmental concerns will be a component of the prioritisation process and that relevant agencies will be involved in the priorisation process, or if not, be permitted to have an input into the prioritised works list.
- **Action 3.8(b)** – NSW Fisheries should be consulted to ensure that appropriate fish passage requirements are included in the design of any engineering options.
- **Action 3.9(a)** – Environmental impacts of weirs and NSW Fisheries legislative requirements with respect to weirs and barriers that obstruct fish passage should be incorporated in this information program.
- **Action 3.9(b) –** The weir review of the Yanco Creek System should be undertaken in conjunction with staff from NSW Fisheries to ensure that fish passage concerns / considerations are included in the review process. Weir removal and / or retention should be consistent with the Fisheries Management Act and the NSW Weirs policy.
- **Action 3.13 –** Any investigation of the flow regime of the Yanco Creek System should include consideration of the flow requirements of native fish species and should look at all aspects of the flow regime such as the natural timing and volumes of flow (ie incorporating periods of low flow in summer) and not just natural flooding regimes. Environmental flow requirements for wetlands should be determined by DIPNR in association with NSW Fisheries.
- **Action 3.14(f) –** any monitoring program developed for the Yanco Creek System should include the monitoring of aquatic biota so as to provide a complete assessment of the state of aquatic health in the Yanco Creek System.

NSW Fisheries approvals

In developing the works program it should be recognised that the majority of works will require one or more approvals from NSW Fisheries. These are for "dredging and reclamation works", works that "obstruct fish passage" and possibly "harm to threatened species". Such approvals are subject to an environmental review process. It is the responsibility of the applicant to provide all the relevant information required for the assessment process to be undertaken. It is sensible and advisable to put forward a package of works for approval rather than deal with them individually.

It is important to note that while the proposed IPAP process may integrate all DIPNR approvals into one application, approvals to be issued by other government departments such as NSW Fisheries are not included in this process. The current Management Plan does not adequately reflect this situation (second last paragraph on p43 of the Management Plan).

McCrabb's Regulator and adjacent spillway

The Management Plan refers to McCrabb's regulator and adjacent spillway on the western edge of Wanganella Swamp and to the fact that since 1990 the regulator has not been operated due to staffing changes within DIPNR. The Plan also suggests that's the existing regulator and spillway do not serve a useful purpose within Wanganella Swamp. NSW Fisheries is willing to be involved in any proposals to modify the existing structure or develop appropriate operating protocols that will benefit the local aquatic environment.

The development of the Natural Resource Management Plan and associated Implementation Plans for the Yanco Creek system is a positive step forward in the future management of Yanco Creek in terms of meeting the needs of the environment and of water users. NSW Fisheries is keen to be involved in this process and looks forward to working with State Water and Yanco Creek and Tributaries Advisory Council during this process.

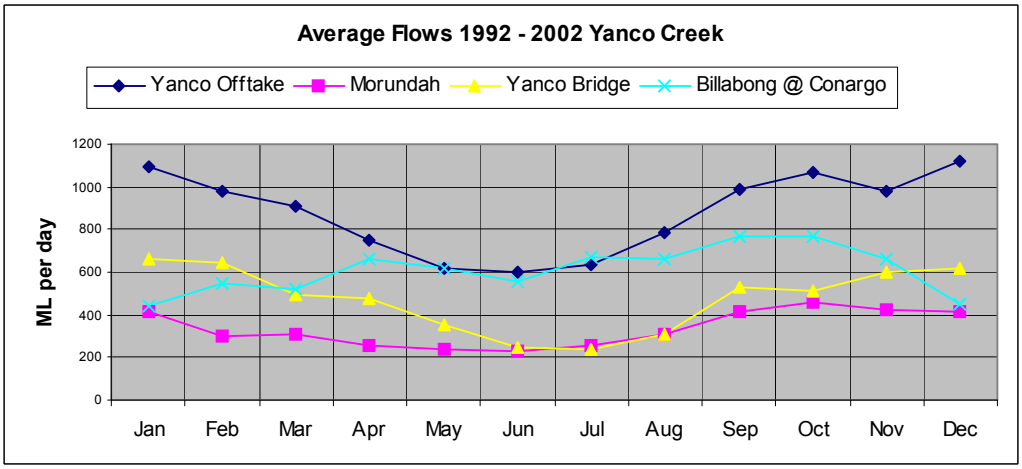
If you wish to discuss any of the above matters or require further information please contact Nicole McKirdy at the Narrandera Office on 6959 9028 in the first instance.

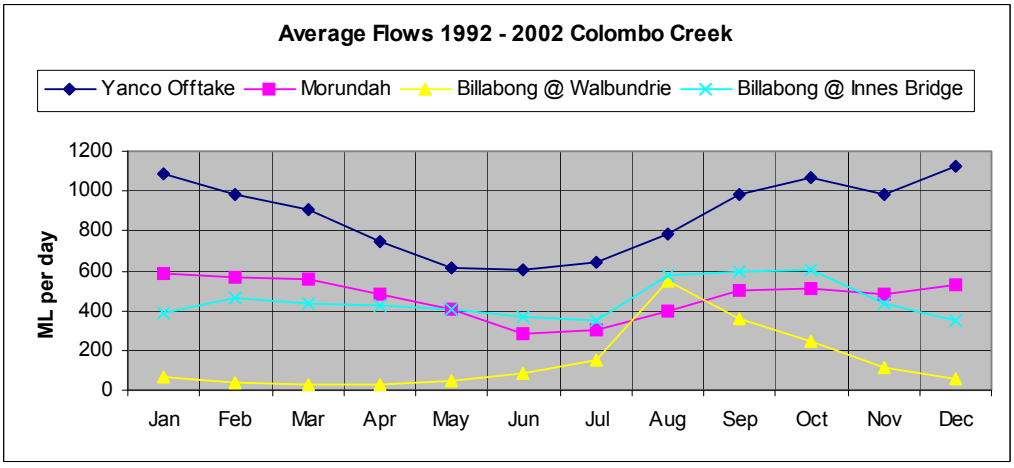
Yours sincerely,

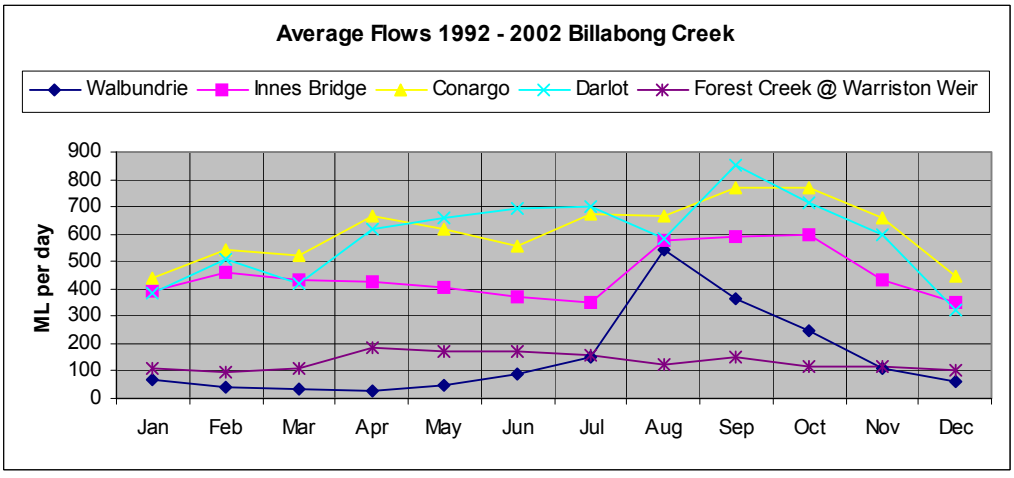
Allan Lugg
Senior Conservation Manager (South)

APPENDIX: 3

AVERAGE DAILY FLOW VOLUMES IN MEGALITRES (ML) FOR THE YCS







APPENDIX: 4 (A)

Threatened Species Conservation Act Biological Database Lists

No.	Vegetation Type	Species		Location	General Description	Changes
1.	Western Grey Box Woodland	*Western Grey Box *(Eucalyptus microcarpa)* Hooked needlewood *(Hakea tephrosprema)* Yellow Box *(Eucalyptus melliodora)* Emu-bush *(Eremophila longifolia)* White Cypress Pine *(Callitris glaucophylla)* Sugarwood *(Myaporum platycarpum)* Yarran *(Acacia melvillei)* Bull-oak *(Allocasuarina luehmannii)* Butterbush *(Pittosporum phylliraeoides)* Quandong *(Santalum acuminatum)* Moonah *(Melaleuca lanceolata)* Yellow Gum *(Eucalyptus leucoxylon)* Narrow-leaf hopbush *(Dodonaea viscosa* subsp. *augustissima)* Wedge-leaf hopbush *(Dodonaea viscosa* s subsp. *cuneat)*	Grey Wattle *(Acacia brachybotrya)* Western Black Wattle *(Acacia hakeoides)* Torny Saltbush *(Rhagodia spinescens)* Golden Wattle *(Acacia pycnantha)* Punty Bush *(Senna* spp.*)* Miljee *(Acacia oswaldii)* Native Blackthorn *(Bursaria spinosa)* Gold Dust Wattle *(Acacia acinacea)* Ruby Saltbush *(Enchylaena tomentosa)* Leafless Cherry *(Exocarpus aphyllus)* Box grass *(Paspalidium constrictum)* Climbing Saltbush *(Einadia nutans)* Spear Grass *(Stipa* spp.*)* Mat Rush *(Lomandra* spp.*)* Windmill Grass *(Chloris truncata)* Whitetop *(Danthonia* spp.*)*	Elevated flats and rises of the Murray River floodplain, on red-brown earths and clay.	Open, well developed woodlands with diverse understorey and grass layer has been largely cleared.	Now sparse and isolated tree clumps with little regeneration and no understorey. Often weed invaded. Widespread need for management for regeneration and enhancement from seed.
2.	Boree Woodland	*Boree *(Acacia pendula)* Yarran *(Acacia melvillei)* Cooba *(Acacia salicina)* Miljee *(Acacia oswaldii)* Yarran *(Acacia homolophylla)* Moonah *(Melaleuca lanceolata)* Emu-bush *(Eremophila longifolia)* Thorny Saltbush *(Rhagodia spinescens)*	Cottonbush *(Maireana aphylla)* Old Man Saltbush *(Atriplex nummularia)* Roly-Poly *(Sclerolaena muricata)* Punty Bush *(Senna* spp.*)* Whitetop *(Danthonia* spp.*)* Curly Windmill Grass *(Enteropogon acicularis)* Speargrass *(Stipa* spp.*)*	Level to depressed plains in the east of the Riverina, on grey and brown clays and red earths.	Once open woodland/shrublands with moderate structural and species diversity.	There has been a general degradation and loss of woodland structure with a depletion of perennial shrubs and grasses. Great opportunities for broadscale regeneration under rotational grazing. Increased grazing potential with re-introduction of shrub layer.
3.	Bimble Box Woodland	*Bimble Box *(Eucalyptus populnea* subsp. *bimbil)* Belah *(Casuarina pauper)* Budda *(Eremophila mitchellii)* Wilga *(Geijera parviflora)* Hooked needlewood *(Hakea tephrosprema)* Willow Wattle *(Acacia salicina)* Emu-bush *(Eremophila longifolia)* Spreading saltbush *(Atriplex pseudocampanulata)* Berry saltbush *(Atriplex semibaccata)* Ruby saltbush *(Enchylaena tomentosa)*	Common Wallaby-grass *(Austrodanthonia caespitosa)* Rough Spear-grass *(Austrostipa scabra* subsp. *falcata)* Golden Everlasting *(Bracteantha bracteata)* Clustered Everlasting *(Chrysocephalum semipapposum)* Nodding saltbush *(Einadia nutans* subsp. *nutans)* Spider Grass *(Enteropogon acicularis)* Dwarf Bluebush *(Maireana humillima)* Ridge Sida *(Sida cunninghamii)*	Valleys and floodplains. Alluvial, red loams	Open Bimble Box woodland on floodplains and wide valleys with a grassy understorey.	There has been a considerable contraction in area and a general degradation and loss of woodland structure with a depletion of perennial shrubs and grasses. Few intact examples remain.

No.	Vegetation Type	Species		Location	General Description	Changes
		Woolly Bassia *(Sclerolaena lanicuspis)*	Dissected New Holland Daisy *(Vittadinia dissecta var. hirta)*			
4.	Prior Stream Callitris Woodland	*White Cypress Pine *(Callitris glaucophylla)* Buloke *(Allocasuarina leuhmannii)* Kurrajong *(Brachychiton populneus subsp. trilobus)* Gum Coolibah *(Eucalyptus intertexta)* Bimble Box *(Eucalyptus populnea* subsp. *bimbil)* Wilga *(Geijera parviflora)* Hooked Needlewood *(Hakea tephrosprema)* Deanne's Wattle *(Acacia deanei)* Hakea Wattle *(Acacia hakeoides)* Cattle-bush *(Alectryon oleifolius* subsp. *canescens)* Narrow-leaf hopbush *(Dodonaea viscosa* subsp. *augustissima)* Narrow-leaf Desert cassia *(Senna artemisioides* subsp. *zygophylla)* Eardley's saltbush *(Atriplex eardleyae)* Berry saltbush *(Atriplex semibaccata)* Ruby saltbush *(Enchylaena tomentosa)*	Common bluebush *(Maireana decalvans)* Goat-head *(Malacocera tricornis)* Hedge saltbush *(Rhagodia spinescens)* Common Wallaby-grass *(Austrodanthonia caespitosa)* Golden Everlasting *(Bracteantha bracteata)* Clustered Everlasting *(Chrysocephalum semipapposum)* Black anther Flax-lily *(Dianella revoluta)* Nodding Saltbush *(Einadia nutans* subsp. *nutans)* Common Wheat-grass *(Elymus scaber)* Many-flowered Mat-rush *(Lomandra multiflora)* Pussy-tails *(Ptilotus spathulatus)* Short-winged Copperburr *(Sclerolaena brachyptera)* Twiggy Sida *(Sida intricata)* Mulga Mitchell Grass *(Thyridolepis mitchelliana)*	Sandy rises of prior streams, sand ridges. Aeolian, well drained sandy loams and loams.	Low woodland to woodland of prior streams, dominated by White Cypress Pine and shrubs scattered over a grassy understorey.	There has been a general degradation and loss of woodland structure with a depletion of perennial shrubs and grasses.
5.	Old Man Saltbush Shrubland	*Old Man Saltbush *(Atriplex nummularia)* Thorny Saltbush *(Rhagodia spinescens)* Bladder Saltbush *(Atriplex vesicaria)*		Level to depressed plains, grey or brown clays and often in low-lying situations with black box woodland	Once extensive and diverse perennial shrubland with well-developed herb and grass layers.	Now old stands with low diversity, invasive perennials and low native annuals.
6.	Bladder Saltbush Shrubland	*Bladder Saltbush *(Atriplex vesicaria)* Slender Grasswort *(Sclerostegia tenuis)*		Level to depressed alluvial plains, on deep grey, cracking clays to red-clay loam.	Moderate/high species diversity of shrubland/grassland.	Contraction of area and depletion of some diversity. Need for continued strategic management and regeneration.
7.	Belah-Rosewood Woodland	*Belah/Black Oak *(Casuarina pauper)* *Rosewood *(Alectryon oleifolius* subsp. *canescens)* Black Bluebush *(Maireana pyramidata)* Leafless Cherry *(Exocarpus aphyllus)* Yarran *(Acacia melvillei)* Wilga *(Geijera parviflora)*		Aeolian sandplains in the far north of the Riverina, on red or brown calcareous earths.	Once open woodland with diverse chenopod shrub layer.	Regeneration variable and shrub layer depleted. Great opportunity for controlled grazing management.

No.	Vegetation Type	Species		Location	General Description	Changes
8.	Lachlan Callitris Mixed Woodland	*White Cypress Pine *(Callitris glaucophylla)* *Gum Coolibah *(Eucalyptus intertexta)* Bimble Box *(Eucalyptus populnea* subsp. *bimbil)* Belah *(Casuarina pauper)* Bull-oak *(Allocasuarina luehmannii)* Rosewood *(Alectryon oleifolius)* Wilga *(Geijera parviflora)*	Narrow-leaf Emu-bush *(Eremophila sturtii)* Budda *(Eremophila mitchellii)* Narrow-leaf Desert cassia *(Senna rtemisioides* subsp. *zygophylla)* *Aristida* spp. *Eragrostis* spp. Enteropogon spp.	Aeolian sandplains and minor dunefields typically on earthy sands. Depth of sand sheet is critical determinant of species distribution.	Once a woodland with a predominantly grassy understorey and a sparse shrub layer.	Changes to disturbance regimes have promoted the prevalence of woody shrubs and small trees. Need for strategic grazing management and re-introduction of understorey and groundcovers for increased diversity and structure. In some locations where there has been heavy regeneration there is a case for managed thinning.
9.	Black Box Woodland	*Black Box *(Eucalyptus largiflorens)* Cooba *(Acacia salicina)* River Cooba *(Acacia stenophylla)* Miljee *(Acacia oswaldii)* Butterbush *(Pittosporum phylliraeoides)* Nitre Goosefoot *(Chenopodium nitrariaceum)* Thorny Saltbush *(Rhagodia spinescens)* Old Man Saltbush *(Atriplex nummularia)* Ruby Saltbush *(Enchylaena tomentosa)*	Spotted Emu Bush *(Eremophila maculata)* Spreading Emu Bush *(Eremophila divaricata)* *Senna* spp. Leafless Cherry *(Exocarpus aphyllus* Lignum *(Muehlenbeckia florulenta)* Warrego Summer Grass *(Paspalidium jubiflorum)* Whitetop *(Danthonia* spp.*)* Climbing Saltbush *(Einadia nutans)*	River floodplains, low-lying areas and creek lines, on grey soils.	Once open woodland with a well developed and diverse but variable understorey.	Now still open woodland but with a depleted low diversity understorey. Tree layer capable of regeneration. Need for shrub layer enhancement and strategic grazing management.
10.	Mallee Woodland	*Dumosa Mallee *(Eucalyptus dumosa)* *White Mallee *(Eucalyptus gracilis)* *Oil Mallee *(Eucalyptus oleosa)* *Black Mallee Box *(Eucalyptus porosa)* *Slender-leaf Mallee *(Eucalyptus leptophylla)* *Grey Mallee *(Eucalyptus socialis)* Sugarwood *(Myoporum platycarpum)* White Cypress Pine *(Callitris glaucophylla)* Wait-a-while *(Acacia colletioides)* Narrow-leaf Hopbush *(Dodonaea viscosa* subsp. *angustissima)* Umbrella Wattle *(Acacia oswaldii)* Bramble Wattle *(Acacia victoriae)* *Senna* spp. Kidney Saltbush *(Atriplex stipitata)* Cottony Goosefoot *(Chenopodium curvispicatum)* Ruby Saltbush (*Enchylaena tomentosa*) Erect Saltbush *(Maireana pentatropis)* Shrubby Bluebush *(Maireana pyramidata)*	Pimelea Daisy-bush *(Olearia pimeleoides)* Hedge Saltbush *(Rhagodia spinescens)* Oblique-spined Bassia *(Sclerolaena obliquicuspis)* Horned Bassia *(Sclerolaena diacantha)* Stiff Westringia *(Westringia rigida)* Pointed Twin-leaf *(Zygophyllum apiculatum)* Shrubby Twin-leaf *(Zygophyllum aurantiacum)* Rough Spear-grass *(Austrostipa scabra* subsp. *scabra)* Balcarra Spear-grass *(Austrostipa nitida)* Knotty Spear-grass *(Austrostipa nodosa)* Sandhill Goodenia *(Goodenia willisiana)*	Sandplains, swales and dune crests. Aeolian, sandy red loams	Tall shrubland to low woodland dominated by multi-stemmed mallee eucalypts.	Still a low woodland but with a depleted low diversity understorey. Need for strategic grazing management.

No.	Vegetation Type	Species		Location	General Description	Changes
		Satiny Bluebush *(Maireana turbinata)* Nitre-bush *(Nitraria billardierei)* Mallee Bitter-pea *(Daviesia arenaria)*	Hard-head Saltbush *(Dissocarpus paradoxus)* Nodding Saltbush *(Einadia nutans* subsp. *nutans)* Woolly-fruit Bluebush (*Maireana sclerolaenoides)* Slender Bluebush *(Maireana pentagona)* Minnie Daisy *(Minuria leptophylla)* Lambs-tails *(Ptilotus exaltatus* var. *exaltatus)* Rough Porcupine Grass *(Triodia scariosa)* New Zealand Spinach *(Tetragonia tetragonioides)*			
11.	Cottonbush Shrubland	*Cottonbush *(Maireana aphylla)* Dillon Bush *(Nitratia billardierei)* Roly-Poly *(Sclerolaena muricata)* Streaked Poverty bush *(Sclerolaena tricuspis)*		Depressed alluvial plains on grey clay soils, often disturbed.	Derived from diverse chenopod shrubland /woodland/grass-land complex. Considered a disclimax community resulting from past grazing pressure.	Structure and diversity can be maintained and improved with strategic grazing.
12.	Murray Callitris Mixed Woodland	*Murray Pine *(Callitris gracilis* subsp. *murrayensis)* *White Cypress Pine *(Callitris glaucophylla)* Yellow Box *(Eucalyptus melliodora)* Butterbush *(Pittosporum phylliraeoides)* Needlewood *(Hakea leucotera)* Hooked Needlewood *(Hakea tephrosprema)* Bull-oak *(Allocasuarina luehmannii)* Sandalwood *(Santaium lanceolatum)* Quandong *(Santalum acuminatum)* Cooba *(Acacia salicina)* Emu-bush *(Eremophila longifolia)* Sugarwood *(Myoporum platycarpum)* Moonah *(Melaleuca lanceolata)* Rosewood *(Alectryon oleifolius)* Narrow-leaf Hopbush *(Dodonaea viscosa* subsp. *angustissima)* Grey Wattle *(Acacia brachybotrya)*	Yarran *(Acacia melvillei)* Miljee *(Acacia oswaldii)* Western Black Wattle *(Acacia hakeoides)* Wilga *(Geijera parviflora)* Native Blackthorn *(Bursaria spinosa)* Thorny Saltbush *(Rhagodia spinescens)* Ruby Saltbush *(Enchylaena tomentosa)* Punty Bush *(Senna* spp.*)* Box Grass *(Paspalidium ocnstrictum)* Climbing Saltbush *(Einadia nutans)* Spear Grass *(Stipa* spp.*)* Finger Panic Grass *(Digiaria* spp.*)* Mat Rush *(Lomandra* spp.*)* Windmill Grass *(Chloris truncata)* Whitetop *(Danthonia* spp.*)*	Sandy rises of old source bordering dunes and prior streams on red and brown sands and loam.	Once open to thick woodland with a diverse and well-developed shrub understorey.	Now open, sparse and degraded woodland. Loss of understorey diversity and structure and often heavily weed invaded. Little to no regeneration south of the Lachlan River under normal grazing conditions. Only regenerates in above average rainfall years. Need for strategic destocking and re-introduction of understorey and increased diversity and structure. In some locations where there has been heavy regeneration there is a case for managed thinning.
13.	Bimble Box/Callitris	*Bimble Box *(Eucalyptus populnea subsp. bimbil)*	Narrow-leaf Hopbush *(Dodonaea*	Rocky outcrops of	Low open woodland	In some locations there have

No.	Vegetation Type	Species		Location	General Description	Changes
	Mixed Woodland	*White Cypress Pine *(Callitris glaucophylla)* Currawang *(Acacia doratoxylon)* Kurrajong *(Brachychiton populneus* subsp. *trilobus)* Belah *(Casuarina pauper)* Budda *(Eremophila mitchellii)* Gum Coolibah *(Eucalyptus intertexta)* Mulga *(Acacia aneura)* Western Silver Wattle *(Acacia decora)* Cattle-bush *(Alectryon oleifolius* subsp. *canescens)* Lobed-leaf Hop-bush *(Dodonaea lobulata)*	*viscosa* subsp. *angustissima)* Green Fuchsia Bush *(Eremophila serrulata)* Narrow-leaf Emu-bush *(Eremophila sturtii)* Grey Mallee *(Eucalyptus morrisii)* Narrow-leaf waxflower *(Philotheca linearis)* Small Vanilla-lily *(Arthropodium minus)* Blue Burr-daisy *(Calotis cuneifolia)* Hairy Burr-daisy *(Calotis hispidula)* Tall Raspwort *(Gonocarpus elatus)* Slender Violet-bush *(Hybanthus monopetalus)* Rock Isotome *(Isotoma axillaris)* Many-flowered Mat-rush *(Lomandra multiflora)* Wonga Vine *(Pandorea pandorana)* Mulga Mitchell Grass *(Thyridolepis mitchelliana)*	Sedimentary, sandstone-conglomerate, sands and loams with a gravelly surface.	with exposed rock and sparse groundcover	been only minor changes. Other areas are now more open, sparse and degraded.
14.	Riverine Forest/Woodland	*River Red Gum *(Eucalyptus camaldulensis)* Black Box *(Eucalyptus largiflorens)* Cooba *(Acacia salicina)* River Cooba *(Acacia stenophylla)* Lignum *(Muehlenbeckia florulenta)*	Nitre Goosefoot *(Chenopodium nitratiaceum)* Slender Cherrry *(Exocarpos strictus)* Common reed *(Phragmites australis)* Rush *(Juncus* spp.*)* Warrego Summer grass *(Paspalidium jubiflorum)*	River and creek levees and adjacent flats of grey soil.	Once a mixture of open woodland and forest of a diverse age and size with moderate ground flora diversity.	Now open forest with thick forest areas of even age and sized trees. There is also low species and structural diversity. Need for continued grazing and forestry management.
15.	Black Bluebush shrubland	*Black Bluebush *(Maireana pyramidata)* Pearl Bluebush *(Maireana sedifolia)* Eastern Flat-top saltbush *(Atriplex lindleyi)*		Lake lunettes, low rises, undulating plains, red-brown sands, loams, duplex soils.	Diverse and vulnerable landsystem.	Tend to be degraded because of soil type/location and grazing pressure.
16.	Lignum, Nitre Goosefoot, Canegrass, Reed beds, wetlands	*Lignum *(Meuhlenbeckia florulenta)* *Nitre Goosefoot *(Chenopodium nitratiaceum)* *Canegrass *(Eragrostis australasica)* Rush *(Juncus* spp.*)* Black Box *(Eucalyptus largiflorens)* – on edges and high ground		Infrequently flooded channels, depressions and river flats on heavy grey cracking clays.	Once diverse in both structure and species	Now depleted species diversity with many highly degraded and weed invaded.
17.	Dillon Bush Shrubland	*Dillon Bush *(Nitratia billardierei)* Spear Grass *(Stipa* spp.*)* Whitetop *(Danthonia* spp.*)*		Depressed alluvial plains on grey clay soils, often disturbed.	Derived from diverse chenopod shrubland/ woodland/grassland complex. Considered	Structure and diversity can be maintained and improved with strategic grazing.

No.	Vegetation Type	Species	Location	General Description	Changes
				a disclimax community resulting from past grazing pressure.	
18.	Mixed Chenopod Shrubland	Bladder saltbush *(Atriplex vesicaria)* Slender grasswort *(Sclerostegia tenuis)* Cottonbush *(Maireana aphylla)* Dillon Bush *(Nitratia billardierei)* Roly-Poly *(Sclerolaena muricata)* Streaked Poverty bush *(Sclerolaena tricuspis)*	Level to depressed alluvial plains, on deep grey, cracking clays to red-clay loam.	Moderate/high species diversity of shrubland/ grassland.	Structure and diversity can be maintained and improved with strategic management and regeneration.
19.	Native Grassland	*Whitetop *(Danthonia caespitosa)* *Curly windmill grass *(Enteropogon acicularis)* *Speargrass *(Stipa* spp.*)* *Swainsona* spp. *Rhodanthe* spp. *Leucochrysum* spp. *Cotula* spp. *Leptorhynchus* spp. *Brachycome* spp. *Wahlenbergia* spp.	Level alluvial plains in the east of the Riverina, on grey to brown clay soils.	Once perennial tussock grassland with a diverse annual plant composition.	Extensive areas of less diverse but valuable native pasture grasslands Some have been derived from grassland/woodland/shrubland types. Still areas of high species diversity but also many degraded with annual exotic grasses. Need for continued strategic grazing management of this valuable resource.

* Denotes dominant or key species.

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APPENDIX 4 (B) – *Threatened fauna predictions*

			Riverine forest	Black Box woodland	Callitris mixed woodlands	Mixed Box woodlands	Cotton bush shrubland	Lignum / Nitre goosefoot / canegrass	Native grassland	Old man saltbush shrubland	Bladder saltbush shrubland	Dillon bush shrubland	Black Bluebush shrubland	Belah/rosewood woodland	Prior stream Callitris woodland	Open areas	Boree woodland	Rocky ridge woodland	Mallee woodland	Cleared
Southern Bell Frog	*Litoria raniformis*	Probably restricted to larger waterbodies, has been recorded utilising rice bays and vegetated dams.	BS	BS				BS												
Spotted-tailed Quoll	*Dasyurus maculatus*	Probably used to disperse along the riverlines but not many left	LC	LC											LC					
Brush-tailed Phascogale	*Phascogale tapoatafa*	Hollow dependant.	LC	LC																
Koala	*Phascolarctos cinereus*	More productive euc forests	LC	LC																
Brush-tailed Rock-wallaby	*Petrogale penicillata*	Would have ranged across non rocky areas but most of the life is on and near the hills																LC		
Kultarr	*Antechinomys laniger*	Probably extinct in region. Lives in open areas in woodlands or shrublands and grasslands.		FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB	FB		FB	FB	FB	
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	Feeds over most vegetation but roosts in hollows	FR	FR	F	FR	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Large-footed Mouse-eared Bat	*Myotis adversus*	Feeds over water, roosts in caves and large trees	FR	FR																
Greater Long-eared Bat	*Nyctophilus timoriensis*	Feeds in scrubby areas, roosts in hollows and crevices	FR	FR	FR	FR								FR	FR		FR	FR	FR	
Little Pied Bat	*Chalinolobus picatus*	Feeds over wide areas, roost in hollows and crevices	FR	FR	FR	FR								FR	FR	F	FR	FR	FR	F
Australasian Bittern	*Botaurus poiciloptilus*	Rivers and reeds																		FF
Magpie Goose	*Anseranus semipalmata*	Wet areas including flooded grasslands etc						FF								FF	FF			FF
Freckled Duck	*Stictonetta naevosa*	Waterbodies																		
Blue-billed Duck	*Oxyura australis*	Waterbodies																		
Brolga	*Grus rubicundus*	Wet areas for breeding	F	F				F	F	F	F	F				F	F			F
Black-tailed Godwit	*Limosa limosa*	Lake margins																		
Great Knot	*Calidris tenuirostris*	Lake margins																		
Osprey	*Pandion haliaetus*	Major rivers	R																	
Square-tailed Kite	*Lophoictinia isura*	Feed over woodlands and nearby shrublands etc, nest near water	FB	FB	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Black-breasted Buzzard	*Hamirostra melanosternon*	Feeds widely, nest in large trees	FB	FB	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Grey Falcon	*Falco hypoleucos*	Woodlands	FB	FB	F	F	F	F	F	F	F	F	F	F	FB		F	F	F	
Malleefowl	*Leipoa ocellata*	Scrubby and litter rich areas			FB	FB								F			F		FB	
Australian Bustard	*Ardeotis australis*	Open areas, no longer breeding in NSW					F	F	F	F	F	F	F			F				F

			Riverine forest	Black Box woodland	Callitris mixed woodlands	Mixed Box woodlands	Cotton bush shrubland	Lignum / Nitre goosefoot / canegrass	Native grassland	Old man saltbush shrubland	Bladder saltbush shrubland	Dillon bush shrubland	Black Bluebush shrubland	Belah/rosewood woodland	Prior stream Callitris	Open areas	Boree woodland	Rocky ridge woodland	Mallee woodland	Cleared
Plains-wanderer	*Pedionomus torquatus*	Open grassy areas							FB							FB				
Bush Thick-knee (Curlew)	*Burhinus grallarius*	Mostly in the river associated areas now	FB	FB	FB	FB									FB		FB		FB	
Painted Snipe	*Rostratula benghalensis*	Wetlands						F												
Glossy Black-cockatoo	*Calyptorhynchus lathami*	Hollows and food trees. Veg containing she-oaks plus the neighbouring large trees for nesting																FB		
Pink Cockatoo	*Cacatua leadbeateri*	Hollows	F	FB	FB	FB	F	F	F	F	F	F	F	F	F	F	F	FB	FB	
Superb Parrot	*Polytelis swainsonii*	Association of red gum and box sites	B	F	F	FB											F			
Swift Parrot	*Lathamus discolor*	Blossom feeding	F	F	F	F												F	F	
Turquoise Parrot	*Neophema pulchchella*	Woodlands and forests	F		FB	FB												FB		
Barking Owl	*Ninox connivens*	Forests and woodlands	FB																	
Masked Owl	*Tyto novaehollandiae*	Forest areas with large hollows and open feeding areas. May not breed in inland areas nowadays. Will use caves	FB	FB		FB												FB		
Gilbert's Whistler	*Pachycephala inornata*	Mostly mallee but lots of others at times. Dense shrub layer needed.	FB	FB	FB	FB								FB				FB	FB	
Chestnut Quail-thrush	*Cinclosoma castamotus*	Dense understorey				FB								FB				FB	FB	
Regent Honeyeater	*Xanthomyza phrygia*	Flowering Eucalypts and woodlands	F			F														
Painted Honeyeater	*Grantiella picta*	Mistletoe	FB														FB			
Pied Honeyeater	*Certhionyx variegatus*	Flowering shrubs																		
Striated grasswren	*Amytornis striatus*	Spinifex or hilly scrub																FB	FB	
Thick billed grass wren	*Amytornis textilis*	Probably gone					FB	FB		FB	FB	FB	FB							
Southern scrub robin	*Drymodes brunneopygia*	Mallee and shrublands																	FB	
Western Blue tongue lizard	*Tiliqua occipitalis*	Mallee/Triodia											LC	LC					LC	
Red lored whistler	*Pachycephala rufogularis*	Mallee																	LC	

KEY
FB= feeds and breeds
BS=breed and shelter under debris
LC= life cycle

FR=feeds over and roosts in
FF= feeds in if flooded
F= feed
R= roost

DATA SOURCE

The predicted records are generated by Bioclimatic analyses (Busby 1991) run through the WinERMS (NPWS) program. These analyses are based on there being suitable climatic conditions for the species to occur in the search area. However, this does not necessarily mean that its required habitat is there. Sources of distribution records used to make these predictions include the RAOU Bird Atlas, Australian Museum specimen register, CSIRO Wildlife Collection register and the Atlas of NSW Wildlife.

Murray Elliss (Zoologist, NPWS), John Brickhill(Naturalist, NPWS) and Rick Webster(Ecologist, Ecosurveys P/L) made comments on the listing of species and their use of different habitat types.

For further information regarding threatened species visit NPWS website at www.npws.nsw.gov.au/wildlife/tsprofile.htm

APPENDIX: 5
NPWS THREATENED SPECIES ATLAS

Threatened Species (common name / *scientific name*)	**Primary Habitat**	**Threats to habitat/ species**	**Recovery Plan Actions and Other Recommendations**
Barking Owl *Ninox connivens*	Large, old growth, hollow bearing eucalypts. South/ west Riverina. Formerly common along the Murrumbidgee and Lachlan Rivers. Also in East and almost certainly in north.	■ Clearing of woodland vegetation, particularly large hollow-bearing trees, for agriculture and firewood harvesting. ■ Frequent fire that leads to degradation of under-storey vegetation which is critical as habitat and foraging substrate for its prey. Secondary poisoning.	■ Retain existing woodland and open forest remnant stands, especially those containing hollow-bearing trees that provide nesting sites. ■ Retaining vegetation along watercourses to protect roosting areas. ■ Retaining a buffer (no disturbance) of native vegetation at least 200m radius around known nest sites. ■ Appropriate use of pesticides. ■ Recovery plan not yet drafted.
Masked Owl *Tyto novaehollandiae*	Large, old growth, hollow bearing eucalypts. South/ west Riverina. Formerly common along the Murrumbidgee and Lachlan Rivers.	■ Reduction of prey numbers and loss of nesting sites through loss of hollow bearing trees. ■ Probably all the threats that are mentioned for Barking Owl.	■ Retention of large stands of native vegetation, especially those containing hollow-bearing trees that provide nesting sites. ■ Retaining a buffer (no disturbance) of native vegetation at least 200m radius around known nest sites. ■ Recovery plan not yet drafted.
Bush Stone-Curlew *Burhinus grallarius*	Open grassy woodlands, riparian forests with low sparse native grasses and fallen timber.	■ Clearing, degradation and fragmentation of grassy woodland habitat. ■ Foxes and cats. ■ Loss of under-storey habitat (eg. native grasses, leaf litter, coarse woody debris) through grazing, burning, weed invasion.	■ Retention of existing native vegetation. ■ Fencing of suitable woodland habitats, particularly those with unimproved pasture and an intact native ground plant layer. Encourage good grazing management within remnants which maintains species diversity while limiting grass height. Some limited tree regeneration is appropriate. ■ Encouraging landholders to increase the size of existing remnants, plant trees and to establish buffer zones of unimproved uncultivated pasture around woodland remnants. ■ Limiting firewood collection. ■ Encouraging landholders to leave fallen branches and debris on the ground beneath trees. ■ Regional fox control programs ■ Draft Recovery plan in progress.
Australian Bustard *Ardeotis australis*	Occurs in grasslands, light scrubland and woodlands. Apparently moves in response to rainfall. Preferred habitat is grassland. Once common now a vagrant.	■ Overgrazing, reducing ground cover ■ Loss of habitat through clearing and cultivation ■ Foxes and cats ■ Low breeding potential	■ Grazing regimes that allow for the maintenance of preferred vegetation structure. ■ Protection of known and potential habitat ■ Regional fox control programs ■ Draft Recovery plan in preparation
Plains-wanderer *Pedionomus torquatus*	Sparse native grasslands dominated by white top and spear grass on red-brown soils.	■ Loss of grassland habitat ■ Pasture improvement, over grazing (particularly	■ Grazing regimes that allow for the maintenance of preferred vegetation structure. ■ Protection of known and potential habitat

Threatened Species (common name / *scientific name*)	Primary Habitat	Threats to habitat/ species	Recovery Plan Actions and Other Recommendations
		during drought), weed invasion ■ Predation by foxes ■ Drought and fire	■ Irrigated areas are 2 kms from habitat to provide a buffer from fox predation ■ Regional fox control planning ■ Sensitive grazing of habitat at appropriate times ■ Monitoring, survey and benchmarking ■ Reservation of habitat ■ Draft Recovery plan in preparation
Malleefowl *Leipoa ocellata*	Mallee woodlands in Carrathool Shire majority of NSW population is west of the Lachlan River, south to around Goolgowi.	■ Loss of habitat, habitat fragmentation ■ Isolation of populations leaves small populations vulnerable to catastrophic events ■ High fire frequency in mallee ■ Predation by foxes	■ Protection and maintenance of known or potential habitat ■ Fire control/management ■ Grazing management in key habitat ■ Regional fox control programs ■ Recovery plan in preparation
Striated Grasswren *Amytornis striatus*	Poorly known species in Riverina. Mature spinifex usually associated with Mallee eucalypts and sandy soils.	■ Fire ■ Grazing ■ Clearing ■ Predation by foxes and cats	■ Retain old spinifex clumps and mallee ■ Regional fox control programs in habitat areas ■ Recovery plan not yet drafted.
Shy Heathwren *Hylacola cautus*	Sedentary species. Mallee woodlands with dense low heathy understorey.	■ Clearing of suitable habitat ■ Grazing pressure that reduces the density of ground cover ■ Predation by foxes and cats.	■ Protection and maintenance of known or potential habitat ■ Regional fox control programs ■ Recovery plan not yet drafted.
Redthroat *Pyrrholaemus brunneus*	Sedentary species, inhabits discrete pockets in far west of Riverina around Balranald. Mostly Old Man Saltbush and Black Bluebush. At eastern edge of range.	■ Overgrazing of saltbush and bluebush destroys habitat, prevents regeneration of suitable vegetation. ■ Frequent fires.	■ Protection and maintenance of known or potential habitat ■ Recovery plan not yet drafted.
Painted Honeyeater *Grantiella picta*	Migratory species. Associated with mistletoe in woodlands particularly *Acacia pendula* (Boree) *Acacia aneura* (Mulga) *Acacia homophylla* (Yarran) *Acacia melvillei* mallee and *Allocasurina leuhamanni* (Buloke). Also dry forest including box/pine. Specialist feeders on mistletoe fruit.	■ Clearing and degradation of woodland and mallee habitat. ■ Lack of regeneration from overgrazing ■ Isolation, degradation and clearing of patches of Boree, Yarran and *Acacia melvillei*. ■ Selective removal of mistletoe	■ Retaining suitable foraging and nesting trees, including those trees that host mistletoe. ■ Encouraging regeneration of habitat by fencing remnant stands. ■ Recovery plan not yet drafted.
Regent Honeyeater *Xanthomyza phrygia*	Woodland, usually Ironbark. Associated with White Box, Yellow Box and Mugga Ironbark. Nomadic-relies on nectar.	■ Clearing, degradation and fragmentation of habitat, in particular, logging of larger, mature trees in Box – Ironbark forests that provide reliable nectar and nesting sites.	■ Retaining and enhancing stands of suitable open Box - Ironbark forest or woodland habitat. ■ Encouraging regeneration of feed / nesting trees by fencing remnant stands and new plantings.

Threatened Species (common name / *scientific name*)	Primary Habitat	Threats to habitat/ species	Recovery Plan Actions and Other Recommendations
	At western edge of range.	■ Poor regeneration of suitable foraging and nesting sites.	■ Identifying areas where the species occurs regularly, and those areas used occasionally as refuge. ■ Draft Recovery plan in preparation
Pied Honeyeater *Certhionyx variegatus*	Widespread but nomadic and irregularly seen. Inhabits primarily acacia scrub, mallee, spinifex and eucalypt woodlands, usually when shrubs (particularly *Eremophila*) are flowering.	■ Clearing of shrubs that provide nectar and interrupt nomadic movements. ■ Over grazing by goats	■ Retaining and enhancing stands of suitable habitat. ■ Reducing grazing pressure, especially by goats. ■ Encouraging regeneration of feed / nesting trees by fencing remnant stands and new plantings. ■ Recovery plan not yet drafted.
Southern Scrub robin *Drymodes brunneopygia*	Distributed in disjunct populations. Recorded in Nombinnie, Cocoparra and The Charcoal Tank Reserves. Inhabits mallee usually with dense shrubs in the understorey. Sedentary	■ Clearing and fragmentation of habitat. ■ Brushcutting ■ Foxes and cats ■ Fire which reduces the amount of cover for the bird	■ Retaining and enhancing stands of suitable habitat. ■ Fox and cat control ■ Recovery plan not yet drafted.
Chestnut Quail-thrush *Cinclosoma castanotus*	Mostly mallee, but also recorded in Belah/Pine and eucalypt woodland. Sedentary	■ Clearing and fragmentation of habitat. ■ Foxes and cats ■ Fire which reduces the amount of habitat and food for the bird	■ Retaining and enhancing stands of suitable habitat. ■ Fox and cat control ■ Recovery plan not yet drafted.
Gilberts Whistler *Pachycephala inornata*	In mallee, eucalypt woodland and Pine forest always with a dense understorey. Feeds on or near the ground.	■ Clearing and fragmentation of habitat. ■ Removal of shrubs and litter through forestry clearing, overgrazing and frequent fires. ■ Fire frequency ■ Inadequate knowledge of species requirements.	■ Retaining and managing habitat to retain dense understorey. ■ Avoid burning "old" mallee. ■ Retain and enhance corridors between habitat. ■ Recovery plan not yet drafted.
Red-lored Whistler *Pachycephala rufogularis*	**Rarest extant bird species in Riverina.** Currently confined to Mallee communities with low dense cover and mixed plant communities aged between 5- 30 years. Requirements poorly known. Still found in Round Hill NR and Nombinnie NR.	■ Fire threatens remaining populations, and reduces food sources ■ Clearing and fragmentation of habitat ■ Excessive grazing reducing nesting habitat and food sources	■ Retaining and enhancing stands of suitable habitat. ■ Retain and protect suitable habitat from fire and overgrazing. ■ Recovery plan not yet drafted.
Major Mitchell's (Pink) cockatoo *Cacatua leadbeateri*	Most commonly recorded threatened species in western directorate (NPWS) Commonly seen in the NW of the region, lives mainly in dry woodlands with mallee, pine and belah.	■ Clearing woodlands and feeding areas ■ Non replacement of hollow bearing trees ■ Illegal nest robbing	■ Retain known and potential habitat ■ Retaining hollow bearing trees, ■ Protect hollow bearing tress when burning off ■ Encourage regeneration of habitat by fencing off areas. ■ Be observant of nest sites and report illegal poaching activity to NPWS. ■ Develop a network of woodland habitat in your area.

Threatened Species (common name / *scientific name*)	Primary Habitat	Threats to habitat/ species	Recovery Plan Actions and Other Recommendations
			■ Recovery plan not yet drafted.
Glossy Black cockatoo *Calyptorhynchus lathami*	Range includes the Lachlan, Cocoparra and Narrandera ranges within the planning area. Occurs in hilly rocky country where Casuarinas occur and requires hollows to nest in.	■ Clearing of woodlands containing food trees almost exclusively Allocasuarina seeds. ■ Removal of nesting trees usually at the base of hills ■ Grazing which removes food sources ■ Fire resulting in the temporary loss of foraging habitat ■ Competition for nesting sites with possums	■ Retain known and potential habitat ■ Retaining hollow bearing trees ■ Protect hollow bearing tress when burning off ■ Encouraging regeneration of nesting and feed trees by fencing remnant stands and new plantings ■ Manage grazing pressure. ■ Appropriate fire regimes ■ Recovery plan not yet drafted.
Swift Parrot *Lathamus discolor*	Irregular Winter migrant to Murray Shire; Communities that feature winter flowering eucalypts. Ironbark communities; lower Grey box/Yellowbox / Whitebox Woodlands and Black box. At western edge of range.	■ Clearing, degradation and fragmentation of habitat, in particular, logging of larger, mature trees in Box-Ironbark forests that provide reliable nectar and lerp sites.	■ Identifying areas where the species occurs regularly, and those areas used occasionally as refuge. ■ Retaining and enhancing stands of suitable open Box-Ironbark forest or woodland habitat, including along roadsides and remnant stands in agricultural areas. ■ Recovery plan complete
Turquoise Parrot *Neophema pulchella*	Grassy Forests and woodlands. At western edge of range.	■ Clearing of grassy woodland habitat. ■ Degradation of grassy woodland habitat through activities such as heavy grazing and firewood collection. ■ Fragmentation of habitat ■ Predation by foxes and cats. ■ Kills that occur when parrots feed on grain spilt onto roads.	■ Retaining and enhancing existing grassy woodland vegetation. ■ Limiting habitat degradation by fencing remnant stands and managing grazing pressure. ■ Encouraging regeneration of habitat by fencing remnant stands and new plantings. ■ Fox and cat control programs. ■ Recovery plan not yet drafted.
Superb Parrot *Polytelis swainsonii*	Nesting largely restricted to the Murrumbidgee and Edwards rivers. Nests in large mature healthy Red Gums. Requires feeding sites with in 10km of nesting sites. Feeds in Box and Boree woodlands and associated grasslands. Prefers to fly along wooded corridors.	■ Clearing of hollow bearing nest trees. ■ Clearing and degradation of feeding areas. ■ Poor regeneration of nesting trees and food resources. ■ Mass kills that occur when parrots feed on split grain on roads. ■ Illegal trapping of birds, which also often results in destruction of hollows.	■ Retaining remnant vegetation especially within 10 km of nest sites. ■ Retaining mature hollow-bearing trees within riparian zones. ■ Cover grain trucks during harvest season ■ Encouraging regeneration of nesting and feed trees by fencing remnant stands and new plantings ■ Managing grazing pressure. ■ Retaining and enhancing corridors. ■ Be observant of nest sites and report illegal activity to NPWS. ■ Draft Recovery plan in preparation.

Threatened Species (common name / *scientific name*)	Primary Habitat	Threats to habitat/ species	Recovery Plan Actions and Other Recommendations
Regent parrot *Polytelis anthopeplus*	Confined to areas where mallee occurs adjacent to riverine woodlands. Nests in riverine woodlands and feeds in mallee. Occurs on the Murray river downstream of the Wakool confluence, occasionally seen on the Murrumbidgee to Balranald. At eastern edge of range.	▪ Clearing of mallee and Red gum ▪ Illegal trapping by bird poachers and orchardists. ▪ Road kills ▪ Occupation of nest sites by introduced honey bees	▪ Retaining remnant vegetation especially within 10 km of nest sites ▪ Retaining and enhancing Red gum/ mallee associations ▪ Retaining and enhancing corridors. ▪ Be observant of nest sites and report illegal activity to NPWS. ▪ Cover grain trucks during harvest season ▪ Draft Recovery plan in preparation.
Blue Billed Duck *Oxyura australis*	Large permanent and intermittent wetlands and swamps. Nests in Cumbungi or similar.	▪ Potential threats include disruption to natural hydrological regimes, loss of habitat, clearing and grazing of Cumbungi, illegal hunting	▪ Restore natural hydrological regimes. ▪ Protect wetland habitat. ▪ Recovery plan not yet drafted.
Freckled Duck *Sticonetta naevosa*	Large permanent and intermittent wetlands and swamps. Nests in Cumbungi or similar.	▪ Potential threats include disruption to natural hydrological regimes, loss of habitat, clearing and grazing of Cumbungi, illegal hunting	▪ Restore natural hydrological regimes. ▪ Protect wetland habitat. ▪ Recovery plan not yet drafted.
Magpie Goose *Aneranas semipalmata*	Prefers large shallow swamps or dams with rushes and adjacent grassland. Formerly probably an abundant bird in the region. Now only a rare vagrant.	▪ Loss of habitat through grazing, clearing, cultivation and altered water regimes. ▪ Shooting and poisoning ▪ Predation on eggs and goslings ▪ Human interference, birds have low tolerance of humans	▪ Retain and enhance suitable habitat. ▪ Protect wetland habitat ▪ Don't shoot or disturb birds. ▪ Recovery plan not yet drafted.
Australasian Bittern *Botaurus poiciloptilus*	Favour wetlands with large areas (>5ha) of tall dense vegetation.	▪ Draining and clearing of wetlands ▪ Salinity ▪ Overgrazing of wetland vegetation ▪ Predation by foxes	▪ Restore natural hydrological regimes ▪ Fence out wetlands so they are not overgrazed. ▪ Protect wetland habitat ▪ Keep pesticides and herbicides away from wetlands ▪ Recovery plan not yet drafted.
Brolga *Grus rubicunda*	Open swamplands. Frequently on plains in Urana, Lachlan River, from Condobolin to Lake Cargelligo. Once common in region.	▪ Egg mortality- predation, illegal egg collecting, flooding of nest sites and trampling of eggs by stock. Fox predation on young chicks. ▪ Hydrological changes particularly drainage of swamps and marshes ▪ Shooting, declining in frequency ▪ Grazing, competition for food sources and trampling modifies plant communities	▪ Using fencing and grazing to produce a suitable wetland. ▪ Restore natural hydrological regimes. ▪ Protect suitable wetland habitat ▪ Control feral animals ▪ Recovery plan not yet drafted.

Threatened Species (common name / *scientific name*)	Primary Habitat	Threats to habitat/ species	Recovery Plan Actions and Other Recommendations
Great Knot *Calidris tenuirostris*	Recorded at Tullakool evaporation ponds and Griffith. Migrating in August from Siberia the birds utilise fresh and saltwater inland lakes. More commonly seen on the coast. Only rare vagrant to Riverina.	■ Few threats because of its infrequency and irregularity of visits ■ Habitat destruction ■ Loss of open wetlands through re-vegetation.	■ Using fencing and grazing to produce a suitable wetland. ■ Restore natural hydrological regimes. ■ Protect wetland habitat ■ Control feral animals ■ Recovery plan not yet drafted.
Black-tailed Godwit *Limosa limosa*	Visits Australia during summer, "passes through" Riverina using exposed muddy shores around large lakes. Recorded in Fivebough and Nericon swamps.	■ Hydrological changes particularly artificial water level control. ■ Few threats because of its infrequency and irregularity of visits. ■ Loss of open wetlands through re-vegetation.	■ Using fencing and grazing to produce a suitable wetland. ■ Restore natural hydrological regimes. ■ Protect wetland habitat ■ Control feral animals ■ Recovery plan not yet drafted.
Painted Snipe *Rostratula benghalensis*	Very shy bird. Inhabits fringes of swamps and marshy areas where there is sufficient cover. Most often seen in freshly flooded areas.	■ Predation ■ Overgrazing eliminates vegetation cover used for shelter ■ Cultivation ■ Changed flood patterns	■ Using fencing and grazing to produce a suitable wetland. ■ Restore natural hydrological regimes. ■ Protect wetland habitat ■ Control feral animals ■ Recovery plan not yet drafted.
Square-tailed Kite *Lophoictinia isura*	Rare bird in Riverina, preferring open forests and woodlands. Breeds along wooded water courses, mainly in the south. Occupy large territories, therefore require large areas of wooded country.	■ Clearing of woodland habitat. ■ Degradation of open forest and woodland habitat through activities such as heavy grazing and firewood collection. ■ Clearing of trees along watercourses, illegal egg collecting,	■ Retaining existing open forests, woodland vegetation, and vegetation within drip lines. ■ Limiting habitat degradation by fencing remnant stands and managing grazing pressure. ■ Encouraging regeneration of habitat by fencing remnant stands and new plantings. ■ Reinstate woodland corridors ■ Recovery plan not yet drafted.
Osprey *Pandion haliaetus*	Rare non-breeding vagrant. Occasional sightings along large inland rivers.	■ NSW population recovering from eggshell thinning caused by DDT. ■ Clearing of nesting trees ■ Hunting success, turbidity and siltation reduces visibility of prey.	■ Record sightings ■ Recovery plan not yet drafted.
Grey Falcon *Falco hypoleucos*	Recorded in Griffith, Leeton, Conargo and Carrathool shires. Observed along watercourses, plains and woodlands. Population stronghold is in arid and semi arid areas.	■ NSW population recovering from eggshell thinning caused by DDT. ■ Clearing of mature trees close to watercourses. Clearing of marginal land together with overgrazing in semi arid areas ■ Competition from larger raptors. ■ Fragmentation of habitat.	■ Retain known and potential habitat. ■ Recovery plan not yet drafted.

Threatened Species (common name / *scientific name*)	Primary Habitat	Threats to habitat/ species	Recovery Plan Actions and Other Recommendations
Black-breasted Buzzard *Hamirostra melanosternon*	Formerly moderately common in Riverina, now more common in the NW of the state. Prefer timbered watercourses. Nest in dead trees or on dead limbs. Occupy large territories.	▪ Clearing of woodland habitat. ▪ Degradation of open forest and woodland habitat through activities such as heavy grazing and firewood collection. ▪ Clearing of trees along watercourses, illegal egg collecting, secondary poisoning.	▪ Retaining existing open forests, woodland vegetation and vegetation along water courses. ▪ Limiting habitat degradation by fencing remnant stands and managing grazing pressure. ▪ Encouraging regeneration of habitat by fencing remnant stands and new plantings. ▪ Reinstate woodland corridors ▪ Recovery plan not yet drafted.
Grey-crowned Babbler *Pomatostomus temporalis temporalis*	Open Woodlands dominated by mature eucalypts with regenerating trees, tall shrubs and native groundcover.	▪ Clearing and fragmentation of preferred habitat ▪ Habitat degradation as a result of weed invasion and grazing ▪ Reduction in family group size	▪ Retain and enhance existing woodland remnants ▪ Reinstate woodland corridors ▪ Existing remnants be increased in size ▪ Recovery plan not yet drafted
Diamond Firetail *Stagonopleura guttata*	Eucalypt woodlands, forests and mallee with a grassy understorey	▪ Clearing and fragmentation of preferred habitat ▪ Remnants less than 200ha ▪ Overgrazing of grassy understorey	▪ Retain and enhance existing woodland remnants ▪ Reinstate woodland corridors ▪ Existing remnants be increased in size ▪ Recovery plan not yet drafted
Brown Treecreeper *Climacteris picumnus victoriae*	Open euclaypt woodland lacking a dense understorey	▪ Clearing and fragmentation of preferred habitat ▪ Remnants less than 200ha ▪ Loss of hollow bearing trees ▪ Overgrazing of grassy understorey	▪ Retain and enhance existing woodland remnants ▪ Reinstate woodland corridors ▪ Existing remnants be increased in size ▪ Recovery plan not yet drafted
Speckled Warbler *Pyrrholaemus sagittata*	Woodlands with grassy understorey	▪ Clearing and fragmentation of preferred habitat ▪ Remnants less than 100ha ▪ Removal of dead fallen timber ▪ Predation by feral animals (foxes)	▪ Retain and enhance existing woodland remnants ▪ Existing remnants be increased in size ▪ Regional fox control Plan, control of feral animals ▪ Encourage protection of fallen timber ▪ Recovery plan not yet drafted
Hooded Robin *Melanodryas cucullata cucullata*	Eucalypts, acacia shrublands, Belah woodlands, Rosewood and Cypress Woodlands	▪ Clearing and fragmentation of preferred habitat ▪ Remnants less than 100-200ha ▪ Removal of dead fallen timber ▪ Grazing and weed invasion	▪ Retain and enhance existing woodland remnants ▪ Existing remnants be increased in size ▪ Encourage retention of fallen timber ▪ Recovery plan not yet drafted
Black-chinned Honeyeater *Melithreptus gularis gularis*	River Red Gum forest woodland	▪ Clearing and fragmentation ▪ Remnants less than 200ha ▪ Competition with aggressive Honeyeater species	▪ Retain and enhance existing woodland remnants ▪ Existing remnants be increased in size ▪ Recovery plan not yet drafted
Brush-tailed Phascogale *Phascogale tapoatafa*	Box-Ironbark woodlands and forests; nests in hollow-bearing trees.	▪ Clearing and/or fragmentation of preferred habitat. ▪ Loss of fallen trees on the forest floor due to inappropriate firewood collection. ▪ Loss of hollow-bearing trees, large old trees.	▪ Maintenance of healthy ecosystems, particularly with a range of shrubs (size & species) and on areas of dissected topography. ▪ Limit firewood collection ▪ Appropriate fox and feral dog control.

Threatened Species (common name / *scientific name*)	Primary Habitat	Threats to habitat/ species	Recovery Plan Actions and Other Recommendations
		▪ Predation from feral foxes, dogs and cats.	▪ Recovery plan not yet drafted.
Koala *Phascolarctos cinereus*	River Red Gum forest and associated woodlands	▪ Clearing and/or fragmentation of preferred habitat. ▪ Predation from feral dogs and foxes. ▪ Road-kill caused by vehicular traffic. ▪ Disease	▪ Retain and enhance suitable habitat and feed trees. ▪ Identify presence of core and potential koala habitat. ▪ Retention, re-vegetation and maintenance of vegetation corridors between feeding areas. ▪ Fox and feral dog control. ▪ Recovery plan preliminary draft.
Tiger Quoll *Dasyurus maculatus*	In Riverina probably largely confined to forest along major rivers, and extensive areas of woodland. Elsewhere found in variety of forest and woodland types, wherever there is suitable prey sources; shelters in complex rocky outcrops and in hollows of large fallen trees. In Riverina is now only a vagrant.	▪ Competition with feral foxes and cats for preferred prey items. ▪ Loss of preferred den sites. ▪ Adverse changes in the relative availability of preferred prey sources caused by habitat degradation. ▪ Poisoning	▪ Identify presence of core habitats especially areas of thick under-storey, hollow logs and rocky outcrops. Then, undertake steps that mitigate against identified threats to these areas. ▪ Appropriate fox and feral dog control and use of 1080 baits ▪ Recovery plan not yet drafted.
Kultarr *Antechinomys laniger*	Thought to be extinct in the Western Riverina planning area. Recently recorded around Cobar/Bourke. Prefers sparsely vegetated, arid to semi arid areas with cracks in soil.	▪ Overgrazing causing vegetation loss and loss of soil structure ▪ Cultivation removes refuge habitat ▪ Inappropriate fire regimes ▪ Predation by foxes and cats	▪ Protection and maintenance of known or potential habitat ▪ Further research ▪ Regional fox control programs ▪ Recovery plan gazetted
Stripe-faced Dunnart *Sminthopsis macroura*	Has been recorded at Willandra NP. An arid zone species that is flexible in habitat preferences	▪ Grazing which reduces perennial groundcover which this species prefers. ▪ Cultivation ▪ Predation ▪ Flooding may temporarily reduce populations.	▪ Protect known and potential habitat sites from cultivation ▪ Appropriate grazing regimes ▪ Control of feral animals.
Brush-tailed Rock wallaby *Petrogale penicillata*	Presumed extinct in Western Riverina. Inhabits broad range of rocky outcrops	▪ Competition with goats for food and shelter ▪ Isolation of population places them at risk from catastrophic events and genetic introgression ▪ Predation by foxes, eagles and dingoes	▪ Retention of habitat ▪ Reduced grazing on perimeter of habitat ▪ Control of feral animals ▪ Recovery plan in preparation

Threatened Species (common name / *scientific name*)	Primary Habitat	Threats to habitat/ species	Recovery Plan Actions and Other Recommendations
Little Pied Bat *Chalinolobus picatus*	Very little is known about this species. Recorded in the southern Riverina. Occurs exclusively in arid and semi-arid areas in a range of habitat types.	■ Clearing of hollow bearing trees may eliminate species from woodland areas ■ Possibly predation by cats on roosting sites	■ Retain hollow bearing trees ■ Control of feral animals.
Large-footed Myotis *Myotis adversus*	Recorded on the Murray River near Tocumwal. Roosts close to fresh water, primarily in caves but will use tunnels, trees, mines and buildings.	■ Population and distribution suspected to be reduced ■ Disturbance of colonies particularly in colder months when hibernating ■ Loss of hollow bearing trees	■ Retain hollow bearing trees and encourage regeneration of hollow bearing trees.
Greater Long-eared Bat *Nyctophilus timoriensis*	Recorded in the planning area. Dry open woodlands and around red gums that line watercourses and lakes on the inland plains of semi arid zone.	■ Clearing of hollow bearing trees ■ Grazing and clearing can result in poor regeneration of hollow bearing species. ■ Predation by cats on bat species whilst roosting has been observed.	■ Control of feral animals ■ Retain hollow bearing trees and encourage regeneration of hollow bearing trees.
Western Blue Tongue *Tiliqua occipitalis*	Preferred habitat appears to be mixed mallee/spinifex communities. Recorded in Carrathool shire.	■ Potential threats include clearing, ripping of rabbit warrens (lizards live in warrens), predation by foxes and cats and possibly secondary poisoning from baits	■ Further research to locate populations and species requirements. ■ Recovery plan not yet drafted.
Southern Bell Frog *Litoria raniformis*	Permanent water/ billabongs	■ Potential threats include disruption to natural hydrological regimes, loss of habitat, disease and predation by introduced fish and terrestrial predators, including foxes and cats.	■ Protect, breeding sites especially vegetation around pools ■ Restore natural hydrological regimes. ■ Draft Recovery plan in preparation
Daisy *Brachyscome muelleroides*	Southern Riverina, Murray River on damp areas around clay pans, lagoons in mud or water.	■ Clearing, trampling by stock, weed invasion, water regulation, recreational activity.	■ Locate new populations and extend the ranges of known populations ■ Erect exclosures around populations and protect them from weeds and grazing pressure. Ensure exclosures have gates so that pasture growth can be managed. ■ Recovery plan not yet drafted.
Mossgiel Daisy *Brachyscome papillosa*	Occurs from Mossgiel to Urana and has been recorded in grassland areas around Jerilderie. Prefers clay soils within Bladder saltbush communities.	■ Clearing, trampling by stock, weed invasion ■ Modification of bladder salt bush country.	■ Locate new populations and extend the ranges of known populations ■ Erect exclosures around populations and protect them from weeds and grazing pressure. Ensure exclosures have gates so that pasture growth can be managed. ■ Recovery plan not yet drafted.
Chariot wheels *Maireana cheeli*	Southern Riverina mainly between Deniliquin and Hay. Heavier clay soils with Bladder saltbush or Cotton bush.	■ Modification of bladder salt bush country. Grazing in the absence of more palatable species. Clearing also sowing of improved pastures.	■ Sympathetic management of suitable chenopod shrubland habitat. ■ Locate and protect populations. ■ Recovery plan not yet drafted.

Threatened Species (common name / *scientific name*)	Primary Habitat	Threats to habitat/ species	Recovery Plan Actions and Other Recommendations
Darling Pea *Swainsonia plagiotropis*	Jerilderie. Found in grasslands on heavy soils, especially on the edges of depressions.	▪ Loss and degradation of habitat by clearing and over-grazing, pasture improvement, cultivation, earthworks, fertilisers and water use. ▪ Grazing during flowering and fruiting, trampling by stock. ▪ Rabbits. ▪ Inappropriate tree planting in grasslands. ▪ Weed invasion	▪ Appropriate grazing regimes. Light grazing at appropriate times to maintain an open grassland. ▪ Fire, prolonged wet conditions or soil disturbance may be necessary to break the seed and allow germination. ▪ Rabbit control ▪ Weed control ▪ Recovery plan not yet drafted.
Darling Pea *Swainsonia murryana*	Scattered through out western NSW, recorded at Deniliquin, Hay extending north to Willandra NP. Found in grasslands on red/ brown soils.	▪ Loss and degradation of habitat by clearing and over-grazing, pasture improvement, cultivation, earthworks, fertilisers and water use. ▪ Grazing during flowering and fruiting, trampling by stock. ▪ Rabbits. ▪ Inappropriate tree planting in grasslands. ▪ Weed invasion	▪ Appropriate grazing regimes. Light grazing at appropriate times to maintain an open grassland. ▪ Fire, prolonged wet conditions or soil disturbance may be necessary to break the seed and allow germination. ▪ Rabbit control ▪ Weed control ▪ Recovery plan not yet drafted.
Darling pea *Swainsonia sericea*	Grassland and eucalypt woodland, sometimes with Callitris.	▪ Unknown. Same as above	▪ Same as above ▪ Recovery plan not yet drafted.
Swainsonia pyrophila	. Known fire ephemeral. Plant is a short lived perennial appearing after fires. Poorly known. Vulnerable.	▪ Inappropriate fire regimes. ▪ Clearing of mallee ▪ Possibly goats	▪ Periodic burning of habitat ▪ Recovery plan not yet drafted.
A Copper Burr *Sclerolaena napiformis*	A number of populations near Jerilderie Also present on TSR between Mathoura and Moama.	▪ Overgrazing ▪ Weed invasion ▪ Clearing of habitat	▪ Light intermittent grazing ▪ Protection and management of known populations. ▪ Recovery plan not yet drafted.
Winged Peppercress *Lepidium monoplocoides*	Semi- arid parts of western plains. Riverine plain species, both in the Riverina and the Darling Riverine Plains near Moree. Most recently in grassland on the Hay plains. Occurs on seasonally moist to waterlogged sites on fertile soils. Open woodland.	▪ Loss and degradation of habitat, pasture improvement, cultivation, earthworks, fertilisers and water use. ▪ Grazing during flowering and fruiting, trampling by stock.	▪ Fence off known populations and protect from grazing ▪ Locate new populations and extend the ranges of known populations ▪ Recovery plan not yet drafted.
McBarron's Goodenia *Goodenia mabbarronii*	Annual herb recorded around Tocumwal. Grows in damp sandy soils, often where there has been recent disturbance.	▪ Grazing, pugging and trampling ▪ Roadside disturbance ▪ Competition with exotic weed species	▪ Locate new populations and extend the ranges of known populations ▪ Sympathetic management of known populations ▪ Recovery plan not yet drafted.

Threatened Species (common name / *scientific name*)	Primary Habitat	Threats to habitat/ species	Recovery Plan Actions and Other Recommendations
Curly-bark wattle *Acacia curranii*	Recorded around Hillston. Prefers rocky outcrops found in both mallee and pine woodlands.	■ Clearing, generally during firebreak construction ■ Overgrazing, particularly goats ■ Quarrying ■ Low seed viability and lack of fire to germinate seed	■ Locate new populations and extend the ranges of known populations ■ Sympathetic management of known populations ■ Recovery plan not yet drafted.
A spear grass *Austrostipa metatoris*	Has been recorded in Carrathool and Wakool Shire . Recorded in a variety of sandy habitats in both grassland and woodland.	■ Clearing ■ Possibly rabbits and overgrazing	■ Locate new populations and extend the ranges of known populations ■ Erect exclosures around populations and protect them from weeds and grazing pressure. ■ Recovery plan not yet drafted.
A spear grass *Austrostipa wakoolica*	Grows on Murray river tributaries, usually on grey silty clay or sandy loamy soils in a variety of open woodlands. Recorded around Jerilderie and Finley.	■ Clearing ■ Habitat reduction and modification ■ Altered water regimes ■ Invasion by exotic species and grazing ■ Rainfall dependant	■ Locate new populations and extend the ranges of known populations ■ Erect exclosures around populations and protect them from weeds and grazing pressure. ■ Recovery plan in preparation.
A Starwort *Callitriche cyclocarpa*	One recording in Riverina near Swan Hill. Grows in floodwaters and along river banks.	■ Grazing ■ Changes to water regimes ■ Cultivation	■ Recovery plan not yet drafted. ■ Locate new populations and extend the ranges of known populations ■ Monitor and research on known population to improve knowledge of species.
An orchid *Caladenia arenaria*	Sclerophyll forests and on sandhills usually under Callitris	■ Clearing ■ Grazing ■ Weed Invasion ■ Hybridisation ■ Physical disturbance ■ Collection ■ Small population size	■ Recovery plan in preparation ■ Various research to do with pollination, weed control, grazing pressure, hybridisation and germination is being conducted to recover this species.
Amphibromus fluitans	Recorded along the Murray River from Wodonga to Echuca. Found mainly in permanent swamps but also recorded in swamp margins, dam beds, and in hard clay.	■ Loss of wetland habitat ■ Introduced grasses ■ Altered water regimes ■ Grazing and trampling by stock.	■ Recovery plan not yet drafted. ■ Locate new populations and extend the ranges of known populations ■ Monitor and research on known population to improve knowledge of species.
Spotted throat Cowslip *Diuris tricolor*	Two recordings in western NSW. Bimble box community on red earth soil Under pine, yellow box and grey box in the east Riverina	■ Clearing ■ Grazing ■ Weed Invasion ■ Physical disturbance	■ Grazing management ■ Weed control ■ Survey and exclusion zones for logging operations ■ Recovery plan not yet drafted.
A Rush *Eleocharis obicis*	Recorded at Condobolin and Hay. Grows in ephemerally wet situations.	■ Grazing ■ Clearing	■ Recovery plan not yet drafted. ■ Locate new populations and extend the ranges of known populations ■ Monitor and research on known population to improve knowledge of species.

The predicted records are generated by Bioclimatic analyses (Busby 1991) run through the WinERMS (NPWS) program. These analyses are based on there being suitable climatic conditions for the species to occur in the search area. However, this does not necessarily mean that its required habitat exists. Sources of distribution records used to make these predictions include RAOU Bird Atlas, Australian Museum specimen register, CSIRO Wildlife Collection register and the Atlas of NSW Wildlife.

References:

NPWS (2000) Wildlife Management Manuel for the Riverine Plains. NPWS, Hurstville.
Ayers, D, Nash,S. Baggett,K.(1996)Threatened Species of Western New South Wales. NPWS, Hurstville.
NPWS (1999) Threatened Species Management species information. NPWS, Hurstville.

Key: Yes = implementation of the RVMP will provide a positive (even partial) outcome for the recovery action listed beside it.
No = implementation of the RVMP will produce an outcome detrimental to the recovery action listed beside it
-- = the RVMP has no influence on the recovery action listed beside

Notes:

1. Recovery actions for the Square-tailed kite refer to retaining vegetation within drip lines – an action not agreed to by the RVC. A YES is marked against that action on the basis that drip lines will be accepted by the RVC.
2. A NO is marked against a number of bird species for the action to reinstate woodlands (cleared under consent or exemption), and remnants be increased in size (rather than 'No Net Loss', for these species the RVMP would need to provide a 'Net Increase' outcome).
3. Recovery actions for Barking Owl and Masked Owl refer to a 200m buffer around nest trees. The current draft RVC provisions for PNF refer to 100m buffers only. A NO has been marked against those actions.

APPENDIX: 6

THREATENED SPECIES, FISHERIES MANAGEMENT ACT

As of July 1998 amendments to the Fisheries Management Act 1994 providing for the protection of all threatened fish and marine plants native to NSW waters came into effect. This legislation provides for the protection, conservation and recovery of threatened species, populations and ecological communities and makes provision for the management of key threatening processes. Threatened species fall into two categories, endangered and vulnerable. These amendments also provide for the preparation of recovery plans, which are designed to promote the recovery of a threatened species, population or community aimed at returning the species etc to a position of viability in nature. The Act also makes provision for the preparation of threat abatement plans.

Current listings which pertain to the Murray, Murrumbidgee and Lachlan River catchments

Endangered species

- Trout Cod
- Murray Hardyhead

Vulnerable species

- Macquarie perch
- Silver perch
- Southern pygmy perch

Endangered population

- Western population of purple spotted gudgeon
- Western population of olive perchlet

Endangered ecological community

- Lower Murray river ecological community

Key Threatening Processes are processes which adversely affect two or more threatened species or which could cause a species to become threatened.

- Introduction of fish to fresh waters with a river catchment outside their range.
- Removal of large woody debris (snags)
- Degradation of native riparian vegetation
- The installation and operation of instream structures and other mechanisms that alter natural low regimes of rivers and streams (resulting in cold water pollution and river regulation)

APPENDIX: 7

Assessment Ratings used in the Preliminary Report

	Riparian Habitat Rating	In-stream Habitat Rating	Streambank Stability Rating
1 Excellent	▪ Undisturbed bank – little grazing impacts ▪ Mature red gum and/or box overstorey for 20m from top of bank ▪ Extensive groundcover of grasses, forbs, herbs and rushes ▪ Extensive cover of woody debris	▪ Very few weirs ▪ Natural flow regimes ▪ Extensive cover of snags ▪ Natural submergent and emergent vegetation	▪ No removal of bank vegetation ▪ No evidence of streambank erosion
2 Moderate	▪ Moderate grazing pressures ▪ Partial clearing of red gum/ box overstorey ▪ Sparse woody debris ▪ Partially cleared floodplain within 20m	▪ Low number of small weirs ▪ Perennial flows with higher winter flows ▪ Some removal of snags ▪ Dense patches of reedbeds	▪ Some removal of vegetation ▪ Occasional streambank erosion
3 Poor	▪ Eroded/denuded banks / heavily grazed ▪ Little overstorey ▪ Little woody debris ▪ Agriculture to top of bank	▪ One or more weirs providing full barrier to fish passage ▪ Large number of small weirs ▪ Perennial flows ▪ Extensive reed beds ▪ Few snags	▪ Little streambank vegetation ▪ Evidence of substantial erosion

Source: Molino Report, 1999

APPENDIX: 8

SALINITY DATA FOR YANCO BILLABONG CREEK SYSTEM – MOLINO STEWART REPORT

Site	**Electrical Conductivity (µS/cm)**			Data
Name	Min	Max	Median	Period
Main Streams				
Colombo Ck @ Morundah	70	350	101	1995-1998
Colombo Creek @ Urana Road	78	259	128	1995-1997*
Yanco Ck upstream DC800	73	268	135	1991-1997*
Billabong Ck @ Jerilderie	88	477	249	1993-1997*
Billabong Ck @ Conargo	111	426	197	1992-1997*
Billabong Ck @ Darlot	135	447	237	1978-1997*
Billabong Ck @ Moulamein	152	517	240	1991-1997*
Tributaries				
Coleambally Catchment Drain	162	475	319	1993-1996
DC800	158	1170	238	1993-1994
Billabong Ck @ Walbundrie	96	3750	980	1790-1997*
Berrigan Escape	80	1300	122	1995-1997*
Finley Escape	55	460	98	1991-1997*
Wollami East Escape	5	274	153	1996-1997*
Wollami Escape	96	617	174	1995-1997*
Coleambally Outfall Drain	198	1690	312	1992-1997*

Source: O'Connell (1997)

APPENDIX: 9

GUIDELINES FOR NATIONAL WATER QUALITY MANAGEMENT STRATEGY

General Guidelines for Salinity of Irrigation Water

Class	Electrical Conductivity Threshold (µS/cm)	Comments
Low-salinity water	280	Low risk of salinity problems
Medium-salinity water	800	Medium salt tolerant plants can be grown, provided moderate leaching occurs
High-salinity water	2 300	Adequate drainage, salinity controls and medium salt tolerant plants needed.
Very high-salinity water	5 500	Not suitable under ordinary conditions. Requires permeable soils, adequate drainage, considerable leaching and salt-tolerant crops.
Extremely high-salinity water	>5 500	Only on permeable well-drained soils under good management or for occasional emergency use.

Source: Molino Report (1999)

APPENDIX 10

Murrumbidgee River Diversions and Flows

STATE WATER

SITE		Saturday 23-Aug-2003		Sunday 24-Aug-2003		Monday 25-Aug-2003	
Burrinjuck	Percent		15.6		16.3		20.0
	Discharge		256		256		256
	Rain		5.5		39.0		21.0
Blowering	Percent		34.8		35.2		36.0
	Discharge		556		650		650
	Rain		0.4		57.0		32.0
Gundagai	8am Gauge	1.32	1544	1.57	2674	3.55	18063
	24 Hr Mean		1492		1911		9321
Wagga	8am Gauge	0.87	2179	0.93	2418	1.45	5361
	24 Hr Mean		2303		2253		2797
Berembed U/S FSL = 4.94	8am Gauge	4.96	3131	4.96	3129	4.95	3119
D/S	8am Gauge	1.07	2643	1.03	2514	1.02	2466
	24 Hr Mean		2846		2626		2504
MIA Canal Diversion	8am Flow	0.87	260	0.86	253	0.76	//57
	24 Hr Mean		250		252		//57
Bundidgerry Regulator U/S	8am Gauge	4.26	5330	4.32	5510	4.34	5570
Narrandera Regulator Canal	8am Flow		615		665		280
	24 Hr Mean		590		640		473
Beavers Creek @ Mundowey	8am Gauge	0.83	45	0.80	36	0.81	38
Narrandera River	8am Gauge	2.24	3369	2.19	3116	2.14	2789
	24 Hr Mean		3571		3222		2979
Yanco Creek Offtake	8am Gauge	1.59	367	1.58	364	1.57	359
Yanco Weir U/S	8am Gauge	2.23	2153	2.23	2153	2.22	2153
D/S	8am Gauge	1.50	3567	1.44	3354	1.36	3034
Gogeldrie Weir U/S FSL = 6.10	8am Gauge	6.10	7400	6.09	7383	6.10	7388
D/S	8am Gauge	1.55	2258	1.60	2420	1.58	2359
Discharge	24 Hr Mean		1867		2229		2449
Sturt Canal Offtake Diversion	8am Flow		40		40		40
Darlington Point	8am Gauge	1.23	2017	1.29	2179	1.40	2492
	24 Hr Mean		2551		1955		2397
Carrarathool	8am Gauge	1.83	3948	1.65	3434	1.37	2711
Hay Weir U/S	8am Gauge	8.60	12900	8.60	12900	8.60	12900
D/S	8am Gauge	1.88	1115	2.09	1576	2.29	2066
Maude Weir U/S	8am Gauge	5.95	4840	5.95	4835	5.95	4847
D/S	8am Gauge	0.90	660	0.87	620	1.18	1155

TELEPHONE: Jim Parrett (02) 6953 0755 **FAX:** (02) 6953 3569

LEGEND: LHS figures are Gauge or Pool Height: EHS figures are Flow or Pool Volume

APPENDIX 10

Murrumbidgee River Diversions and Flows

STATE WATER

SITE		Saturday 23-Aug-2003		Sunday 24-Aug-2003		Monday 25-Aug-2003	
Redbank Weir U/S	8am Gauge	5.52	5367	5.56	5436	5.59	5480
D/S	8am Gauge	0.15	271	0.15	269	0.15	267
Balranald Weir D/S	8am Gauge	0.55	224	0.56	233	0.56	233
Conductivity	8am Reading		88		82		83
Yanco Ck @ Morundah	8am Gauge	0.90	146	0.92	153	0.89	143
Columbo Ck @ Morunda	8am Gauge	1.05	195	1.05	193	1.03	188
Billabong Ck @ Innes Bridge	8am Gauge	1.86	843	1.99	951	2.00	956
Billabong Ck @ Walbundrie	8am Gauge	0.84	202	0.81	177	1.16	509
Billabong Ck @ Jerilderie	8am Gauge	0.43	450	0.54	712	0.60	856
Billabong Ck @ Hartwood Weir	8am Gauge	1.85	370	1.82	352	1.87	384
Billabong Ck @ Puckawidgee	8am Gauge	1.57	687	1.48	610	1.46	585
Billabong @ Darlot	8am Gauge	1.48	803	1.54	854	1.54	857
Yanco Ck Catch Drain	8am Gauge	0.93	0	1.00	0	1.00	0
Yanco Ck DC800 Drain	8am Gauge	0.35	5	0.43	24	0.54	77
Yanco Ck DC500 Drain	8am Gauge	1.05	20	1.09	29	1.08	28
Coleambally Outfall @ Bundy	8am Gauge	0.80	9	0.85	16	0.87	20
Yanco Ck @ Yanco Bridge	8am Gauge	0.39	65	0.60	170	0.59	181
Coleambally Diversion	8am Gauge		879		445		15
	24hr Mean		1109		652		
Tombullen Storage	8am Gauge	3.65	10304	3.76	10724	3.75	10703
Inlet	24hr Total		1100		390		0
Outlet	24hr Total		0		0		0

7 DAY FORECAST ORDERS	Date	30-Aug-03	31-Aug-03	1-Sep-03
MIA Canal (Yanco + Mirrool)		300	300	150
Sturt Canal		50	50	50
Coleambally Main Canal		0	0	0

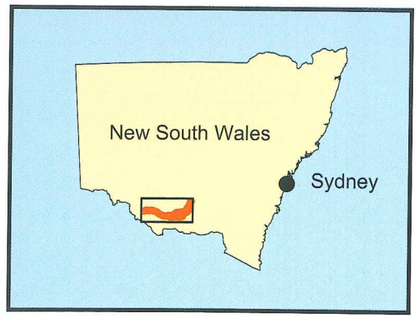
RAINFALL (mm) & Weather
25/08/2003

Cool, overcast and windy

Rainfall: Maude 13mm, Hay 16mm, Gogeldrie 22mm, Leeton 36 mm, Berembed 22mm, Kyeamba 35mm, Belmore Bridge 25mm

TELEPHONE: Jim Parrett (02) 6953 0755 **FAX:** (02) 6953 3569

LEGEND: LHS figures are Gauge or Pool Height: EHS figures are Flow or Pool Volume



LOCATION MAP

Legend

- Major Towns
- State Weirs
- Licensed Weirs
- Yanco Creek System
- Billabong Creek
- Edward River
- Forest Creek
- Main Rivers
- Irrigation Areas
- Irrigation Districts

Murrumbidgee River
YANCO
Tombullen Outlet Regulator
Tombullen Inlet Regulator
Yanko Weir (Old Weir)
Yanko Weir (New Weir)
Spillers Regulator
COLEAMBALLY
Tarabah Weir
Sheepwash Weir
Two Mile Weir
Six Mile Weir
Eight Mile Weir
Cheseleys Weir
Sheepskin Weir
Yanco Creek
Colombo Creek
Four Mile Weir
Sheepwash Weir
Cocketegedong Weir
Windouran Weir
MOULAMEIN
Caroonboon Weir
Billabong Creek
Forest Creek
Wanganella Town Weir
Four Mile Weir
Four Mile Weir
McCrabbs Regulator
Estuary Creek Regulator
Chinamans Weir
Tracey's Weir
Junction Weir
Mortimers Dam
Picannie Weir
Hartwood Weir
Hartwood Weir
Forest Creek Offtake
Warriston Weir
Warriston Weir
Road Paddock Weir
Lower Woolshed Weir
Algudgerie Weir
Algudgerie Weir
Jerilderie Town Weir
Jerilderie Weir
JERILDERIE
Edward River
Colligen Creek Weir
Stevens Weir
Yallakool Creek Weir
WAKOOL
Wakool River Offtake Regulator
Little Barbers Pipe Regulator
DENILIQUIN
Billabong Creek

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Kilometres

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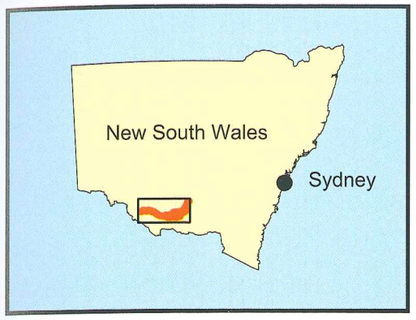
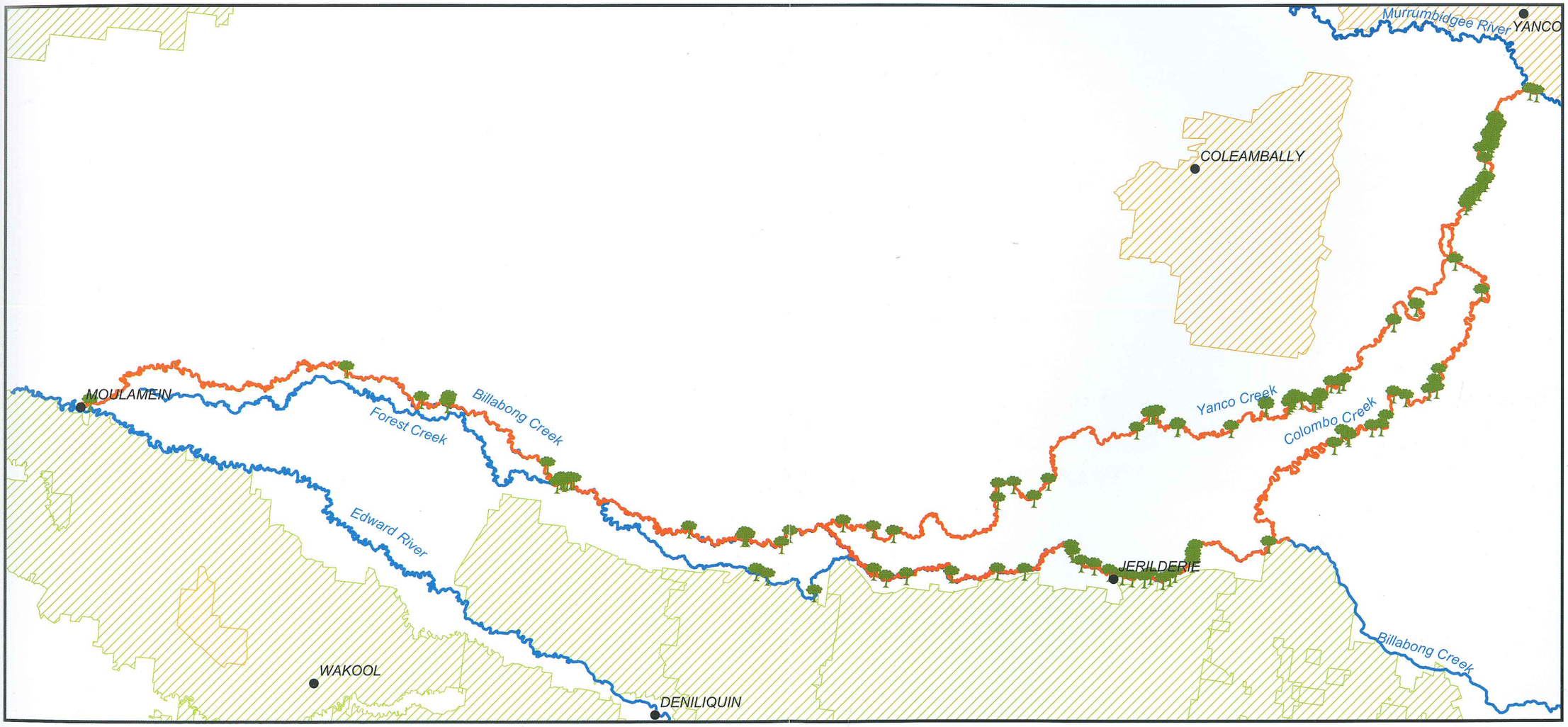
YANCO CREEK SYSTEM - WEIRS



LOCATION MAP

Legend

- Major Towns
- Willows
- Yanco Creek System
- Billabong Creek
- Edward River
- Forest Creek
- Main Rivers
- Irrigation Areas
- Irrigation Districts



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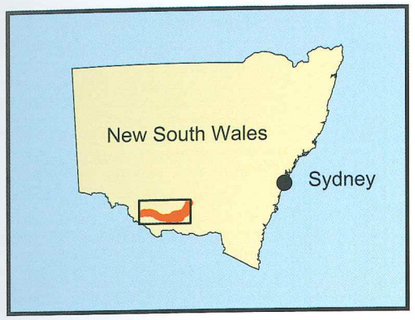
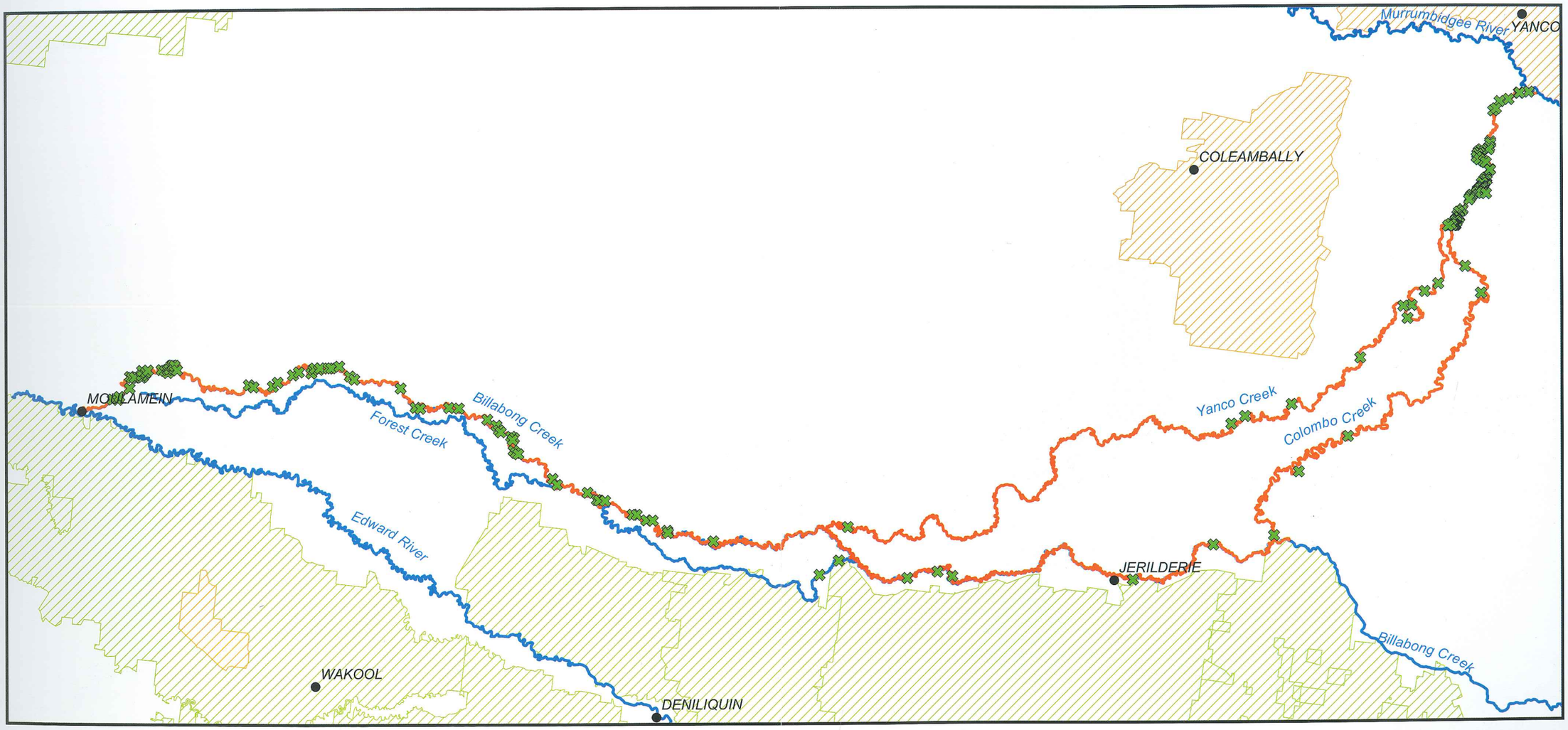
YANCO CREEK SYSTEM - WILLOWS



LOCATION MAP

Legend

- Major Towns
- Snags
- Yanco Creek System
- Billabong Creek
- Edward River
- Forest Creek
- Main Rivers
- Irrigation Areas
- Irrigation Districts



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YANCO CREEK SYSTEM - SNAGS