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Implementing  
the Action Plan

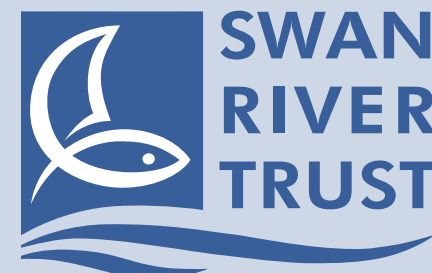
August 2001

## Swan-Canning Cleanup Program

# Caring for the Canning

A plan to revitalise the Canning,  
Southern and Wungong rivers

DRAFT





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**SWAN RIVER TRUST**

Swan-Canning Cleanup Program

# **Caring for the Canning**

A plan to revitalise the Canning,  
Southern and Wungong rivers

A supporting document to the  
Swan-Canning Cleanup Program Action Plan

August 2001



**WATER AND RIVERS**  
COMMISSION

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## Author

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## Working Group

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<i>Wayne van Lieven</i>	City of Gosnells
<i>Mark Tonti</i>	Water Corporation
<i>Syl Kubicki</i>	Water and Rivers Commission

## Comments and Advice

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*Declan Morgan, Darryl Miller, Dr Andrew Storey, Dr Luke Pen, Dr Kerry Trayler and Dr Tom Rose*

All photographs in this plan are by the author, unless otherwise stated.

# Acronyms

<b>AgWA</b>	Agriculture Western Australia	<b>MfP</b>	Ministry for Planning
<b>BMPs</b>	Best Management Practices	<b>PRI</b>	Phosphorus Retention Index
<b>BOD</b>	Biochemical Oxidation Demand	<b>RoB</b>	Ribbons of Blue
<b>CCCG</b>	Canning Catchment Coordinating Group	<b>RIWI Act</b>	Rights In Water Irrigation Act
<b>CoA</b>	City of Armadale	<b>SCCP</b>	Swan Canning Cleanup Programme
<b>CoC</b>	City of Canning	<b>SRT</b>	Swan River Trust
<b>CoG</b>	City of Gosnells	<b>UCSWCT</b>	Upper Canning Southern Wungong Catchment Team
<b>COAG</b>	Council of Australian Governments	<b>W&amp;RC</b>	Water and Rivers Commission
<b>DEP</b>	Department of Environmental Protection	<b>or WRC</b>	
<b>EP Act</b>	Environmental Protection Act	<b>WC</b>	Water Corporation
<b>EPA</b>	Environmental Protection Authority	<b>WSUD</b>	Water Sensitive Urban Design
<b>EPP</b>	Environmental Protection Policy	<b>WAMA</b>	Western Australian Municipal Association
<b>EWPs</b>	Environmental Water Provisions	<b>UWA</b>	University of Western Australia
<b>ICM</b>	Integrated Catchment Management		

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# Executive summary

The Canning River and its tributaries are a natural asset of the southern suburbs of Perth. The Canning River System:

- provides drinking water to the Perth metropolitan area;
- is an important ecological corridor, providing habitat and refuge to aquatic and terrestrial life;
- provides recreational opportunities such as cycling, swimming, fishing, bushwalking and canoeing;
- has important cultural and spiritual significance to Aboriginal communities;
- has historical significance to people in the Canning Catchment;
- provides riparian land owners with a source of water; and
- flows into the Swan River Estuary, a scenic and recreational icon of Perth that also supports an important ecosystem.

As with many urban river systems, the Canning River System is showing signs of stress from this multitude of uses. Intense, often toxic algal blooms have been regularly recorded in the river system since 1994, an indication that it is under significant stress due to intense modification and poor land use management within the catchment.

The Swan-Canning Cleanup Program Action Plan recommended that a river management plan be developed and implemented for the Canning River System. The development of this plan commenced in July 1999. Soon after a Working Group of local stakeholders was established to assist in the development of the plan.

This plan has been prepared to complement an existing management framework for the Canning Catchment. It is

a river management plan and as such focuses on the riparian zone, dealing with catchment issues where appropriate.

Section 1 of this plan outlines how the plan came about, how the plan relates to other existing projects in the catchment and how comment can be made on the plan. Section 2 is a detailed description of the river system. Section 3 describes in detail what is leading to the ecological and aesthetic decline of the Canning River System. It then outlines the desired objective in response to that problem and what needs to be done to achieve the objective.

The issues discussed in this plan are outlined over, with the corresponding objective to address that issue.

To achieve the vision of this plan, the Working Group developed a number of recommendations that will be implemented through seven management programs.

Each of the proposed recommendations have been assigned against an organisation that is considered to have key responsibilities in a particular area. It will be the responsibility of each of these organisations to facilitate the implementation of specific recommendations contained within the plan, in consultation with key stakeholders. In order for the plan to be successfully implemented it will require a coordinated approach with a number of organisations and groups working together in partnership to achieve the vision identified in the plan.

This plan is intended to guide certain aspects of river management in the Canning Catchment for the next five years. It is assumed after this time, the recommended actions and management programs will need to be revisited by the major stakeholders operating in the catchment.



Issue	Objective
<ul style="list-style-type: none"> <li>Flow in the Canning River System has been significantly modified. This has contributed to the degradation of ecological values, a loss of river power and flooding flows.</li> </ul>	<ul style="list-style-type: none"> <li>Manage river flows so the important ecological values of the river system are maintained, balancing the ecological requirements with the human demands for water.</li> </ul>
<ul style="list-style-type: none"> <li>Meeting the ecological water requirements of the river alone will not improve the ecological health of the river. It is only one part of river restoration and management.</li> </ul>	<ul style="list-style-type: none"> <li>Incorporate environmental water provisions (EWP) into an overall river management program.</li> </ul>
<ul style="list-style-type: none"> <li>The Kent Street Weir creates an impounded body of water upstream of the weir during summer. Low flow and insufficient mixing of the water column lead to conditions favourable to algal blooms.</li> </ul>	<ul style="list-style-type: none"> <li>Prevent the conditions that lead to algal blooms upstream of the Kent Street Weir</li> </ul>
<ul style="list-style-type: none"> <li>There has been a loss of social focus and importance of the Canning River System.  Community awareness and knowledge of river management issues need to be raised to promote behavioural change and community participation in catchment and river management.</li> </ul>	<ul style="list-style-type: none"> <li>For the broader community to be well informed about important river management issues and take action to protect and enhance the river system.</li> </ul>
<ul style="list-style-type: none"> <li>The Canning River System is still highly utilised for private abstraction. Abstraction peaks during periods of low flow and over-abstraction can contribute to drought.</li> </ul>	<ul style="list-style-type: none"> <li>Reduce the reliance on the river for abstraction and promote water conservation techniques.</li> </ul>
<ul style="list-style-type: none"> <li>Nutrients from a variety of land uses are leaching in to the river, contributing to algal blooms. Improved land use management is required to prevent nutrients, contaminants and turbid water entering the river system.</li> </ul>	<ul style="list-style-type: none"> <li>Improve water quality entering the river by promoting best management practices and encourage the community to understand the link between human activity and the health of the river.</li> </ul>
<ul style="list-style-type: none"> <li>Many tributaries have been modified into drainage networks. This has led to a loss of tributary habitat, biodiversity, loss of landscape amenity and recreational opportunity, and ability to process nutrients. Drains can have ecological value and assist in water quality protection if they are appropriately designed and maintained.</li> </ul>	<ul style="list-style-type: none"> <li>Improve water quality entering the river by promoting best management practices and encourage the community to understand the link between human activity and the health of the river.</li> </ul>
<ul style="list-style-type: none"> <li>Fringing vegetation has been lost through stock grazing, human development and the creation of drains.</li> </ul>	<ul style="list-style-type: none"> <li>Re-establish river banks with fringing vegetation.</li> </ul>
<ul style="list-style-type: none"> <li>River pools are an important summer refuge and habitat for aquatic and terrestrial flora and fauna. River pools have been lost due to sedimentation and modification of the flow regime.</li> </ul>	<ul style="list-style-type: none"> <li>Re-establish deep river pools in the Canning River System.</li> </ul>
<ul style="list-style-type: none"> <li>Urban development in the Canning Catchment is growing at a rapid rate. Development often results in increased nutrient export if best management practices are not incorporated into developments.</li> </ul>	<ul style="list-style-type: none"> <li>Encourage the use of efficient best management practices in new developments to reduce nutrient and pollutant export.</li> </ul>



## Vision

*To revitalise the Canning River System to a healthy ecosystem where algal blooms are kept to a minimum and a diverse range of aquatic life exists, and to ensure it is a resource that can be enjoyed and used responsibly by all people.*

### What is really meant by this vision?

The vision can also be described as the 'desired future state' for the Canning River System. Listed below is a detailed description of this desired future state.

#### Ecology

- Algal blooms are kept to a minimum in the Canning River System.
- The river supports healthy populations of terrestrial and aquatic life.
- There is a diverse river environment that supports floodplains, pools and riffles.
- The river has stabilised banks that are vegetated with native species and free of weeds.
- The river has the capability to recover from disturbances.

#### Water quality

- Water entering and flowing down the Canning River System meets water quality guidelines.

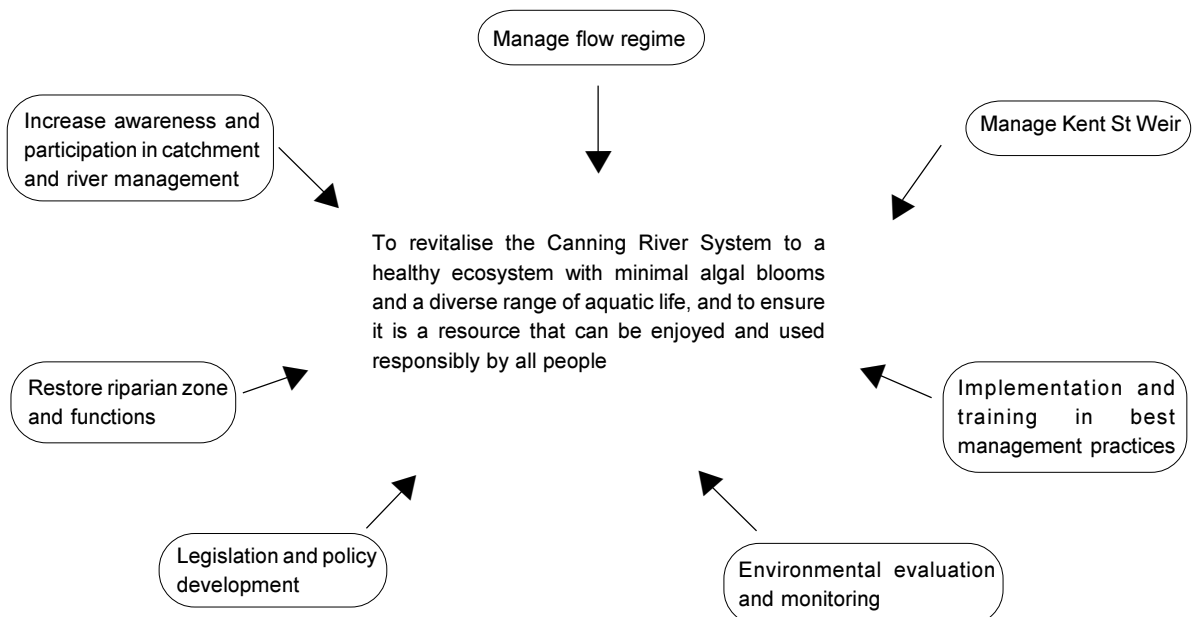
#### Human uses

- The river can meet the needs of abstraction rights and public water supply, whilst providing adequate water to the environmental values of the river.
- The river can provide a variety of environmentally acceptable recreational opportunities.

#### Community

- The river is socially important to the people of the Canning Catchment.
- The community are aware and involved in management of the river.

## Management Programs





# Section 1. Introduction

## 1.1 What are the issues?

The Canning and Southern Rivers and Wungong Brook (hereafter referred to as the Canning River System, see Map 1)) are a natural asset of the southern suburbs of Perth. The Canning River System:

- provides drinking water to the Perth metropolitan area
- is an important ecological corridor, providing habitat and refuge to aquatic and terrestrial life
- provides recreational opportunities such as cycling, swimming, fishing, bush walking and canoeing
- has important cultural and spiritual significance to Aboriginal communities
- has historical significance to people in the Canning Catchment
- provides riparian land owners with a source of water
- flows into the Swan River Estuary, a scenic and recreational icon of Perth that also supports an important ecosystem.

As with many urban river systems, the Canning River System is showing signs of stress from this multitude of uses. Intense, often toxic algal blooms have been regularly recorded in the river system since 1994, an indication that it is under significant stress due to intense modification and poor land use management within the catchment.

The major issues affecting the Canning River System identified by this plan include:

- Flow in the Canning River System has been significantly modified. This has contributed to the degradation of ecological values, a loss of river power and flooding flows
- Meeting the ecological water requirements of the river alone will not improve the ecological health of the river. It is only one part of river restoration and management
- The Kent Street Weir creates an impounded body of water upstream of the weir during summer. Low flow and insufficient mixing of the water column leads to conditions favourable to algal blooms.
- There has been a loss of social focus and importance of the Canning River System. Community awareness and knowledge of river management issues need to be raised to promote behavioural change and community participation in catchment and river management.

- The Canning River System is still highly utilised for private abstraction. Abstraction peaks during periods of low flow and over-abstraction can contribute to drought
- Nutrients from a variety of land uses are leaching in to the river, contributing to algal blooms. Improved land use management is required to prevent nutrients, contaminants and turbid water entering drains.
- Many tributaries have been modified into drainage networks. This has led to a loss of tributary habitat, biodiversity, landscape amenity and recreational opportunity, and ability to process nutrients. Drains can have ecological value and assist in water quality protection if they are appropriately designed and maintained.
- Fringing vegetation has been lost through stock grazing, human development and the creation of drains.
- River pools are an important summer refuge and habitat for aquatic and terrestrial flora and fauna. River pools have been lost due to sedimentation and modification of the flow regime.
- Urban development in the Canning Catchment is growing at a rapid rate. Development often results in increased nutrient export if best management practices are not incorporated into developments.



*Toxic algal bloom in the Canning River near Kent Street Weir, 1998 (Photo: B Boardman)*

It is evident that our behaviour and practices must change if the Canning River System is to continue to support a diversity of uses. The consequences of not acting are evident. The Canning River System will continue to decline, affecting not only the ecology of the river but everyone who uses it. It is therefore the responsibility of everyone who lives, works or uses the Canning River and its catchment to halt the degradation and contribute to its revitalisation.

## 1.2 Vision for the Canning River System

The vision includes the thoughts and desires of the community and stakeholders in the Canning Catchment. It has been derived from workshops, community forums and other associated plans and projects.

*To revitalise the Canning River System to a healthy ecosystem where algal blooms are kept to a minimum and a diverse range of aquatic life exists, and to ensure it is a resource that can be enjoyed and used responsibly by all people.*

### What is really meant by this vision?

The vision can also be described as the 'desired future state' for the Canning River System. Listed below is a detailed description of this desired future state.

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- The river has stabilised banks that are vegetated with native species and free of weeds
- The river has the capability to recover from disturbances

#### Water quality

- Water entering and flowing down the Canning River System meets water quality guidelines

#### Human uses

- The river can meet the needs of abstraction rights and public water supply, whilst providing adequate water to the environmental values of the river

- The river can provide a variety of environmentally acceptable recreational opportunities

#### Community

- The river is socially important to the people of the Canning Catchment
- The community are aware and involved in management of the river

## 1.3 Swan-Canning Cleanup Program and Integrated Catchment Management

The Swan-Canning Cleanup Program (SCCP) Action Plan was released in May 1999 and is administered by the Swan River Trust. The Water and Rivers Commission assists in the implementation of the SCCP Action Plan, along with other State and local government agencies. Contained within the Action Plan are forty-four (44) recommendations aimed at improving the health of the Swan-Canning River System.

A key recommendation (No. 7.8) of the SCCP Action Plan was the development and implementation of a management plan for the Canning River. This recommendation has been partially fulfilled through the development of this plan. Implementation of this plan will commence after the public consultation period.

This plan has been written so that it is consistent with the Environmental Protection (Swan and Canning Rivers) Policy Approval Order 1998. This Environmental Protection Policy (EPP) guides local and State government agencies in management of the Swan and Canning Rivers, outlining measures that are required to achieve environmental quality objectives for the river system. This EPP will be reinforced by the Comprehensive Management Plan or *Riverplan* which is due to be released soon.

This plan is linked to other projects and programs being undertaken by State and local government and community groups in the Canning Catchment.

These include:

- *Upper Canning Southern Wungong Catchment Management Plan* (Everall, 1999)
- Canning River Oxygenation Trial (Kent Street Weir to Greenfield Street Footbridge)



- Sediment Remediation Trial (Phoslock™) between Kent Street Weir and Nicholson Road, Cannington
- City of Canning Integrated Catchment Management Strategy
- Swan-Canning Industry Project
- Phosphorus Awareness Project

It is well documented that the ecological health of a river system is determined by what goes on in its catchment. In 1999, the *Upper Canning Southern Wungong Catchment Management Plan* was released by the Upper Canning Southern Wungong Catchment Team. The Catchment Plan covers the Cities of Armadale and Gosnells and has full support from both Councils. *Caring for the Canning* is designed to complement the *Upper Canning Southern Wungong Catchment Management Plan* by helping to achieve one of its goals - 'protecting and improving water quality in rivers'.

The Upper Canning Southern Wungong Catchment Team and Canning Catchment Coordinating Group have provided valuable input into the development of this plan. The implementation of this plan and the *Upper Canning Southern Wungong Catchment Management Plan* will coincide and in doing so will strengthen existing partnerships between all levels of government and the community. This will result in improved catchment and river management for the Canning River System.

## 1.4 Study area

The study area comprised the Canning River from the Canning Dam to the Kent Street Weir and the Southern River-Wungong Brook from the Wungong Dam to its confluence with the Canning River (Map 1).

The Canning River flows down from the Darling Scarp, onto the Swan Coastal Plain and then north-west to the Swan River Estuary. The Southern River-Wungong Brook also originates in the Scarp, flowing west onto the coastal plain and heading north to meet with the Canning River in Maddington.

## 1.5 Development of this plan

In September 1999, a Working Group was established to discuss the objectives and formulate the recommendations for this plan. Each organisation involved in the preparation

of the plan will participate in implementing the recommendations. Successful implementation of many of the recommendations will require a partnership approach from a few organisations.

The following organisations were represented on the Working Group:

*Canning Catchment Coordinating Group*  
*Upper Canning Southern Wungong Catchment Team*  
*City of Gosnells*  
*City of Canning*  
*City of Armadale*  
*Water Corporation*  
*Water and Rivers Commission*

Although not represented on the Working Group, the Swan River Trust, Agriculture Western Australia and the Canning Wungong Southern Rivers Advisory Committee provided input into the development of the plan.

## 1.6 How to use this plan

This plan is divided into 6 sections.

### Section 1: Introduction

This section highlights the risks to the Canning River System and the vision for the river. It also describes how this plan is related to other projects under way in the Canning Catchment.

### Section 2: River Description

This is an inventory of the Canning River System. It describes the current state of the river system, including infrastructure, biophysical characteristics, river functions and their importance.

### Section 3: Revitalising the Canning River System

This section describes in detail what is leading to the ecological and aesthetic decline of the Canning River System. It then outlines the response required to alleviate these problems and specific actions to help accomplish this.

### Section 4: Management Programs

This section groups the actions into specific management programs that all aim to achieve the vision of the plan.

### Section 5: References

### Section 6: Appendices

This is a collection of data that provides supporting information to the plan.



## 1.7 Implementation

The vision outlined in this plan is reflected in other plans and projects for the Canning Catchment. A number of these projects are already under way and are contributing to the achievement of this vision.

The actions listed in this plan will be implemented through seven management programs. These management programs will work towards the achievement of this vision.

## 1.8 How you can be involved

This plan has been written with input from a number of major stakeholders, including community catchment groups, sub-regional catchment groups, surface water users, local government authorities and State government agencies that operate in the Canning Catchment.

This is a draft version of the plan and the Swan River Trust and Water and Rivers Commission would like to know what you think about the plan, especially the recommendations included in the management programs.

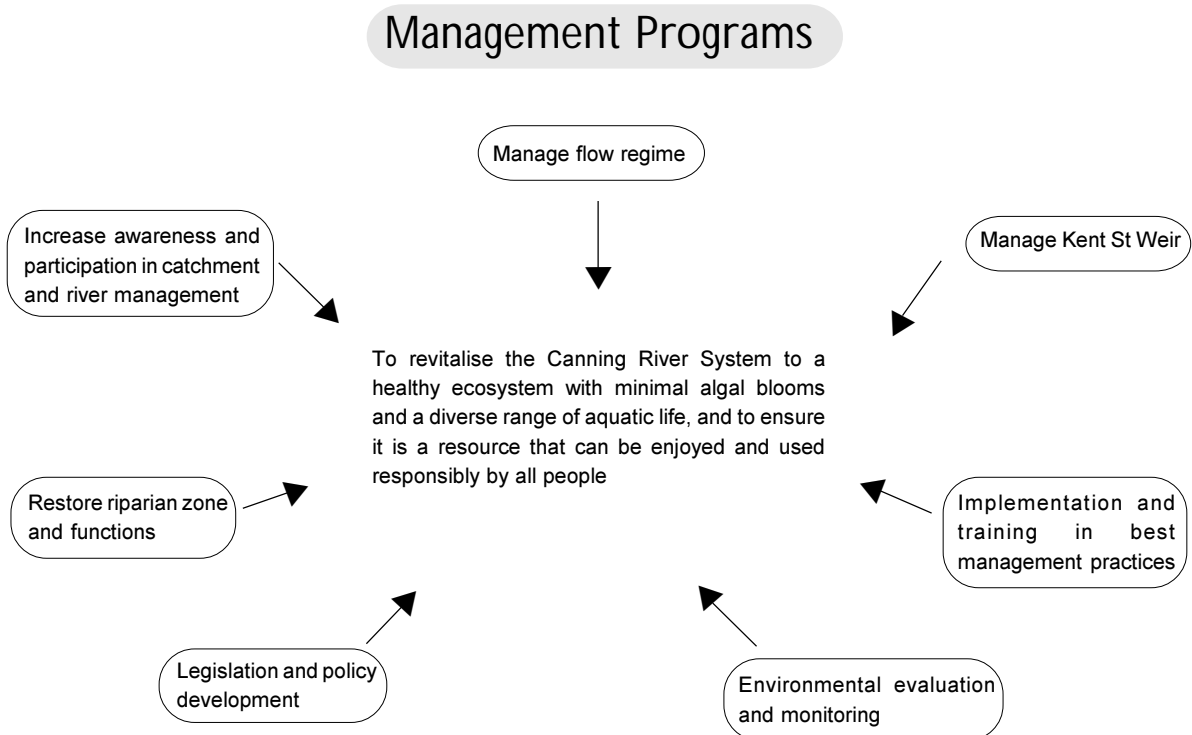
The draft plan will be available for public comment until for a period of twelve weeks after the launch date. During this time, the Project Officer will meet with interested groups or individuals who would like to discuss any aspect of the plan. This is your opportunity to suggest any changes, express your opinion and provide information that you think should be included.

Public submissions can be made via the Swan River Trust's website:

<http://www.wrc.wa.gov.au/srt>

All comments should be sent to:

Regional Manager  
Water and Rivers Commission  
Swan Goldfields Agricultural Region  
7 Ellam Street  
VICTORIA PARK, WA 6100  
Telephone: 6250 8000  
Facsimile: 6250 8050



# Section 2. River description

## 2.1 Human development in the Canning Catchment

The Canning River has guided the pattern of urban development in the Canning Catchment over the past 170 years. During early European settlement, the land surrounding the Canning River was used for farming and horticulture. This has gradually been replaced by residential housing, however some pockets of farmland remain.

The Upper Canning Catchment and much of the Southern-Wungong Catchment is still largely rural or special rural, although the Ministry for Planning have recently prepared a draft structure plan for much of the Southern-Wungong Catchment which proposes large areas of urban development.

There are industrial areas throughout the Canning Catchment, with the largest being Kewdale-Welshpool. Smaller light industrial areas and commercial precincts are scattered around the catchment, adding to the diversity of land uses.

Human development has resulted in the replacement of native vegetation with impervious surfaces such as roads, car parks and roofs. To allow development to occur many drains have been constructed to minimise the threat of flooding. This has resulted in the modification of natural tributaries into drains and it has also altered the local hydrology. Consequently, there has been a loss of tributary habitat and ecological processing in these tributaries.

The input of nutrients to the river has increased due to fertiliser applications, septic tank overflow, industrial discharges, animal wastes and domestic detergents. The composition of organic matter entering the river system has also changed from eucalypts to more easily

decomposed leaves, soft pasture plants and animal manure (SRT, 1999).

As the urban population increased in the 20<sup>th</sup> Century, so did the demand for potable water supplies. The Kent Street Weir was first built in 1926, supplying surrounding properties and villages with water for irrigation and domestic use. The population continued to increase and so the Canning Dam was constructed in 1940 and the Wungong Dam in 1976. Both are utilised for public water supply today. This has resulted in a dramatic reduction and alteration of flow to the river system.

## 2.2 Rainfall

In the Canning Catchment, 80% of the annual rainfall occurs between May and September, typical of a Mediterranean climate. The average annual rainfall is 1250 mm at Canning Dam. Figure 1 displays the annual rainfall variation from the average of 1250 mm from 1895 to 1999. Since 1975 the average annual rainfall has been well below the long-term average and this may be attributed to climatic variability.

## 2.3 Flow regime

### 2.3.1 Flow regime and its importance

Typically, the further a river is removed from its historic hydrology, the more the environment and its ecological value are affected (Storey *et al.*, 2000). A flow regime that has a predictable seasonal cycle is vital to aquatic life in a river system. Riverine plants and animals have evolved over thousands of years to cope with seasonal events such as winter flows and floods, low flows and drought. Human development of rivers and their catchments often results in unpredictable flow regimes.

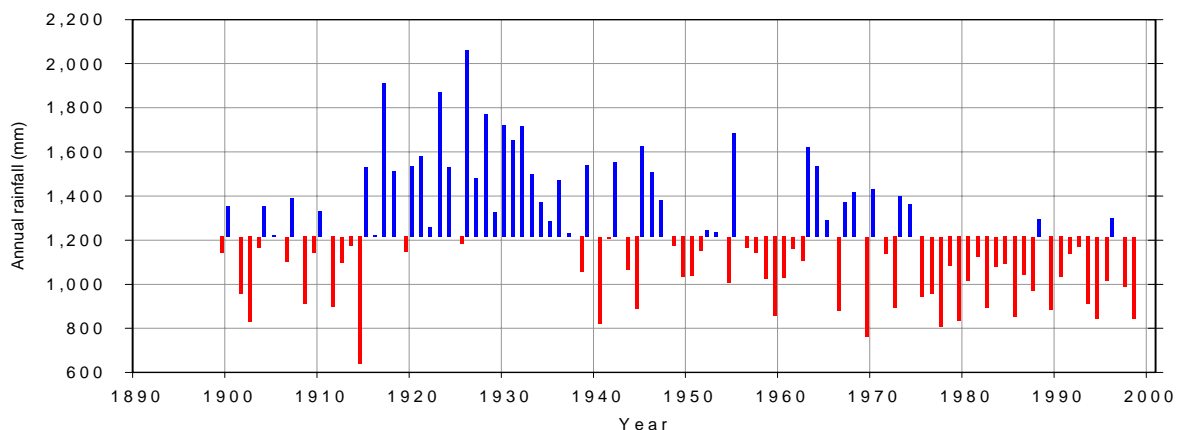


Figure 1: Average rainfall variation from mean (1250 mm) from 1900 to 1999



Rivers are important ecological corridors that are biologically diverse, supporting many different species of plants and animals. Each of these species is dependent on water in some way. Many species of fish require high flows to stimulate their breeding cycle, others may need it so they can migrate into connected floodplains that they use as nurseries to raise their young. Flooded gums and other species of fringing vegetation consume water through their roots, however they also require floods to stimulate germination of their seed bank. Figure 2 illustrates the importance of seasonal high flow events to the ecology of lowland river systems.

Collectively the fauna, flora and water-dependent ecological processes present in a river system are referred

to as its 'ecological values'. The Canning River System has been studied by a number of groups and research scientists, so we have a good understanding of the ecological values of this river system.

There has also been a considerable amount of research conducted by research centres and universities Australia-wide that have determined the water requirements for a variety of ecological values of fresh water river systems. These research programs have examined the importance of seasonal flows, duration for which flows are required and the consequences of too much or too little water in a river system.

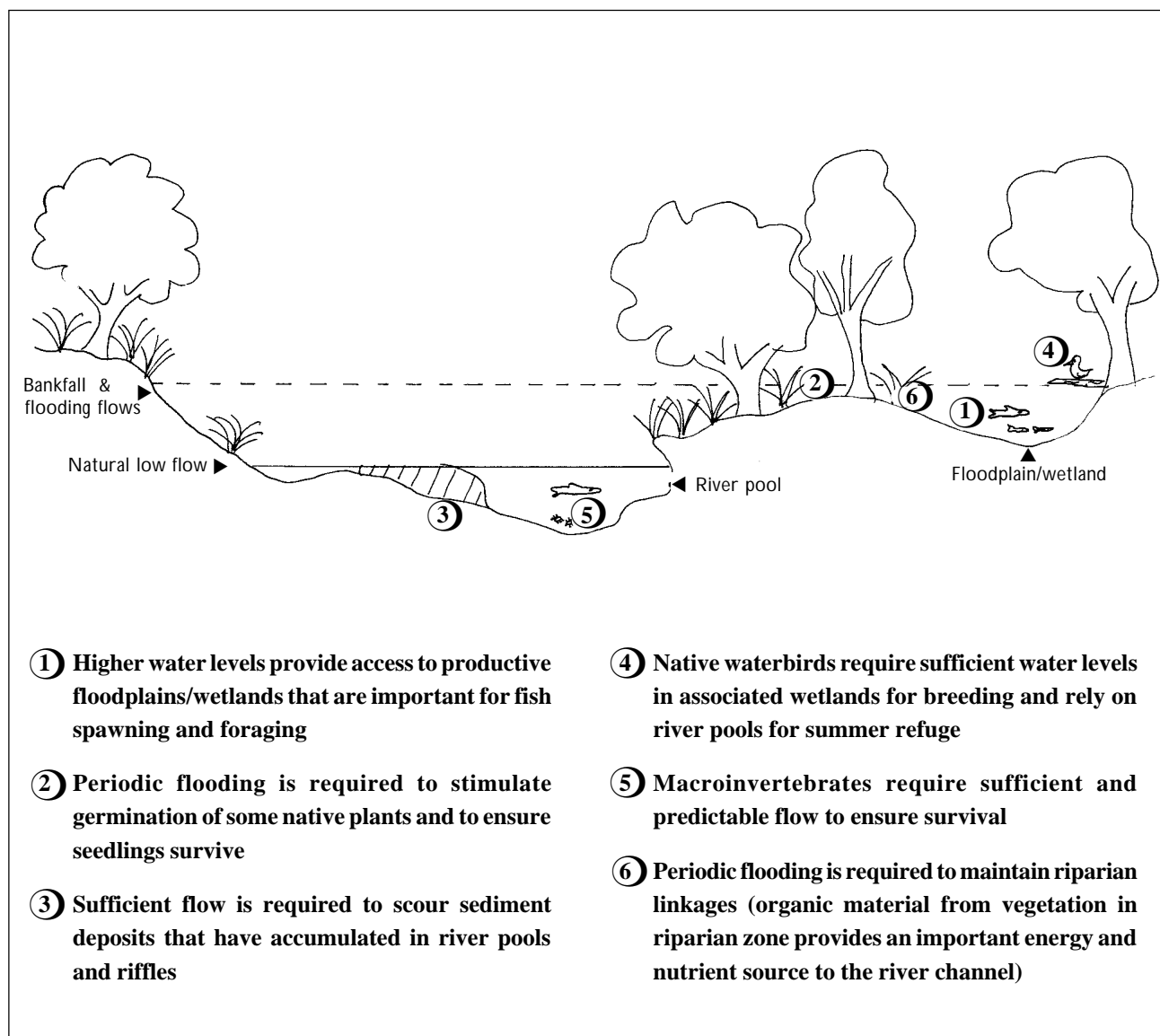


Figure 2: Ecological water requirements of lowland reaches of the Canning River System

**Table 1: Important ecological values of the Canning River System and their essential water requirements**

Ecological value	Water requirements
Macroinvertebrates	<ul style="list-style-type: none"> <li>• Permanent flow and predictable/seasonal flows are important so macroinvertebrates can synchronise their life cycles</li> <li>• Low flow leads to deoxygenation, accumulation of pollutants and desiccation which can alter macroinvertebrate populations and consequently riverine food webs</li> </ul>
Fish	<ul style="list-style-type: none"> <li>• Predictable flows are needed for fish to breed successfully</li> <li>• Sufficient water levels to maintain diversity of habitats and breeding grounds</li> <li>• Flows to discourage Mosquitofish</li> <li>• Sufficient water level so fish can traverse natural obstacles during migration</li> </ul>
Fringing vegetation	<ul style="list-style-type: none"> <li>• Periodic flooding to disperse seed, stimulate germination and ensure seedlings survive</li> <li>• Recharge shallow groundwater tables that are important during periods of drought</li> <li>• Discourage and prevent weed growth</li> </ul>
Channel maintenance	<ul style="list-style-type: none"> <li>• Maintain channel width and depth and a diversity of habitats</li> <li>• Scouring out sediment from riffles and pools</li> </ul>
Waterbirds	<ul style="list-style-type: none"> <li>• Depend on flooding of shallow floodplain for breeding</li> <li>• River pools are an important summer refuge</li> </ul>
Ecological processes and energy flows	<ul style="list-style-type: none"> <li>• Periodic flooding to maintain riparian linkages (organic material from vegetation in riparian zone provides an important energy and nutrient source to the river channel)</li> </ul>

*Refer to Appendix 1 for a detailed description of water requirements for each identified ecological value.*

### 2.3.2 Consequences of modifying natural flow regimes

Modifying a natural flow regime can affect the breeding success of aquatic organisms and in the long term it can significantly modify the ecology of the system and its capability to repair itself after disturbances.

The construction of water supply dams and private dams, diversion of springs, private on-stream abstraction, environmental releases and the installation of weirs have significantly modified the flow regime in the Canning River System. The river does not experience the same flow regime as it did prior to the construction of the Canning and Wungong Dams.

This modified flow regime, along with other disturbances that are unrelated to flow modification, have led to a

decline in the ecological health of the river system. The ecological impacts of this modified flow regime are outlined below.

**Table 2: Impacts of modified flows on the ecology of the Canning River System**

Impacts of modified flows on the ecology of the Canning River System	Resultant impacts (ecological and social)
Reduced scouring has altered the geomorphology of the river channel including the sedimentation of river pools in some parts of the river	<ul style="list-style-type: none"> <li>• Loss of summer refuge for in-stream fauna</li> <li>• Restricted canoe access in some reaches</li> </ul>
Reduced flow in spring may have reduced the breeding habitat necessary for certain species of native fresh water fish	<ul style="list-style-type: none"> <li>• Affects breeding success and recruitment of native fresh water fish</li> </ul>
Reduced flows and stagnant summer/autumn conditions have provided a suitable habitat for successful breeding of the introduced Mosquitofish	<ul style="list-style-type: none"> <li>• Mosquitofish dominates the fish fauna of the river</li> </ul>
Reduced flooding results in adverse impacts in the floodplain	<ul style="list-style-type: none"> <li>• Reduced germination of fringing vegetation</li> <li>• Weed invasion</li> <li>• Loss of carbon energy and nutrient transfer from the floodplain to the river channel</li> <li>• Loss of important nursery grounds for juvenile/larval fish</li> </ul>

### 2.3.3 Current management of the flow regime

When the Canning Dam was built, there was an undertaking to release summer flows into the rivers, primarily to protect riparian rights (W&RC, 1996).

Water is still released into the Canning River and also Southern River-Wungong Brook via riparian release points, also known as environmental release points (see Map 2). These release points are located where the Water Corporation's scheme water supply pipes (trunk mains) cross the river. The water released into the river is chlorinated scheme water, the impacts of which, if any, are being examined by the Water and Rivers Commission.

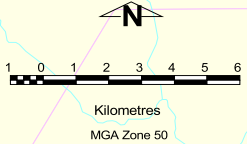
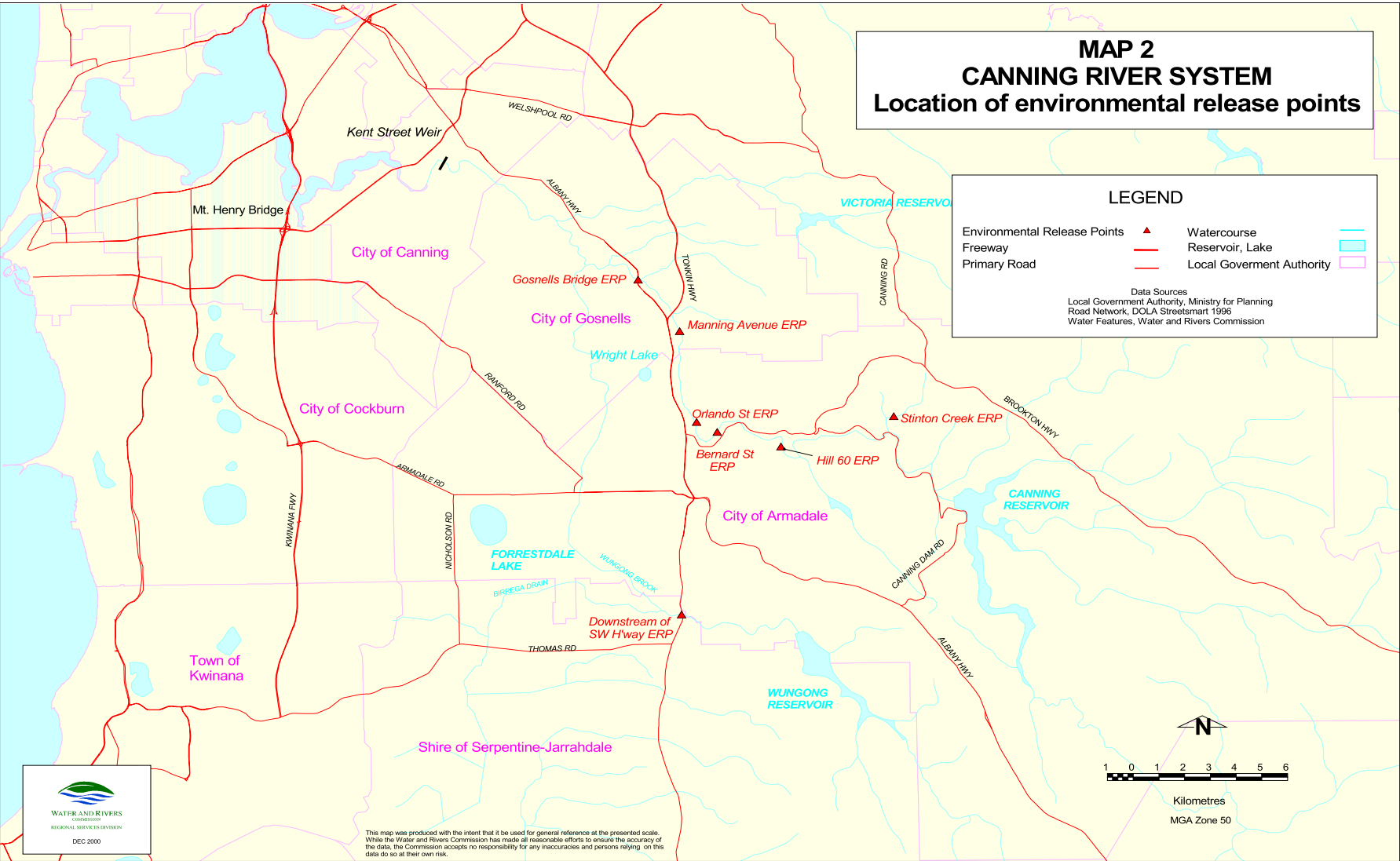
The release points are turned on in late spring when flows begin to recede and have primarily been used in the past to satisfy the irrigation demand along the river. Each release point is managed separately and turned on by the Water Corporation upon request by the Water and Rivers Commission.

## MAP 2 CANNING RIVER SYSTEM Location of environmental release points

**LEGEND**

Environmental Release Points	▲	Watercourse	
Freeway		Reservoir, Lake	
Primary Road		Local Government Authority	

Data Sources  
Local Government Authority, Ministry for Planning  
Road Network, DOLA Streetsmart 1996  
Water Features, Water and Rivers Commission



This map was produced with the intent that it be used for general reference at the presented scale. While the Water and Rivers Commission has made all reasonable efforts to ensure the accuracy of the data, the Commission accepts no responsibility for any inaccuracies and persons relying on this data do so at their own risk.

Water releases are maintained until autumn rains replenish the flow. They cease during large summer storm events, as experienced in January 2000, or when the closest upstream release point is providing adequate flow at that site.

Table 3 lists the release points, approximate length of operation and estimated volumes released for the past three summers. It is important to note that these figures are only estimates, gauged on turns of the release valve. Water meters were installed on all release points in late 1999 to accurately measure future release volumes.

**Table 3: Estimated discharge volumes for 1997-2000**

Release No.	Name/Location	Average period of operation	Volume Released (ML)		
			1997-1998	1998-1999	1999-2000
<b>Canning River</b>					
1	Stinton Creek (Araluen Botanic Park), Roleystone	Oct-May	557.2	588.0	492.8
2	Hill 60, nr Stocker Rd, Roleystone	Nov-Apr	243.5	282.6	69.0
3	Bernard St, Kelmscott	Dec-Apr	0 *	0 *	168.0
4	Orlando St, Kelmscott	Dec-Apr	40.8	328.2	211.2
5	Manning Ave, Martin	Dec-Mar	11.2	0 *	84.0
6	Albany Highway bridge, Gosnells	Dec-Apr	19.5	43.8	79.0
<b>Wungong Brook</b>					
1	Main valve (east of SW highway), Wungong	Nov-May	786.6	693.7	498.3
2	South Western Highway, Wungong	n/a <sup>#</sup>	n/a <sup>#</sup>	n/a <sup>#</sup>	102.0

\* These release points were under repair and turned off for this period.

# The second release on Wungong Brook, South Western Highway, was not constructed until 1999.



***Environmental release point, Albany Highway Bridge, Gosnells***

## 2.4 Soils and nutrients

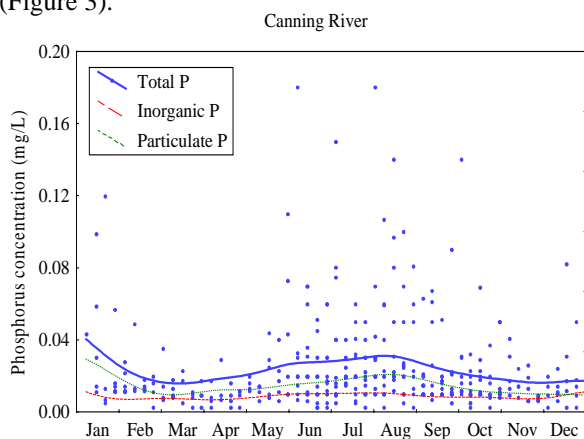
The Upper Canning Catchment and the Southern-Wungong Catchment have different physical characteristics, the most pronounced being soil types and landform. The Upper Canning Catchment contains soils with a high phosphorus retention index (PRI), such as the duplex Pinjarra Plain soils. Most of the catchment is on the Darling Escarpment, with steep valleys. The Southern-Wungong Catchment is relatively flat and consists mostly of Bassendean Sands that have a poor Phosphorus Retention Index PRI.

The nature of these soils and landform influences the nutrient and sediment export from these catchments.

### Upper Canning River

Water in the Upper Canning River has low nutrient concentrations. This is due to a number of factors including soils with a high PRI and less urban and agricultural development in the upper catchment.

Seasonal water quality data in the Upper Canning River reveals that total phosphorus concentrations are low. However the majority of this is particulate phosphorus (Figure 3).



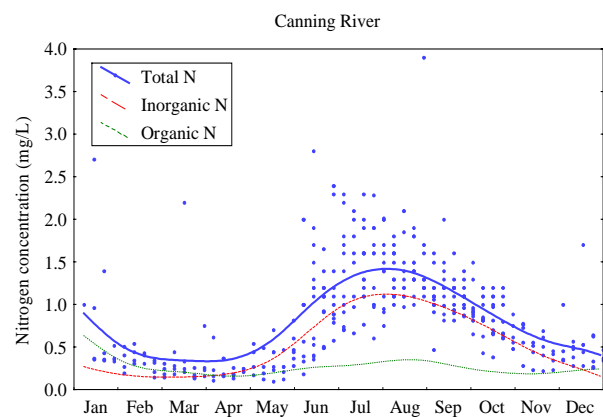
**Figure 3 : Seasonal phosphorus concentrations (mg/L) in the Upper Canning River**

Phosphorus tends to bind to soil that contains iron and aluminium oxides, such as the clays and laterites of the Upper Canning Catchment. If this soil erodes and is washed into the river, it contributes to the concentrations of particulate phosphorus.

If left unchecked, erosion of phosphorus-enriched surface soils can become a major source of particulate inputs of phosphorus to surface water and associated aquatic systems (Gerritse, 1999). High loads of organic matter, from animal manure and soft-leaved exotic trees, can also

contribute to high concentrations of particulate phosphorus.

Seasonal data indicates that total nitrogen concentrations in the Upper Canning River are related to flow, peaking during the highest rainfall months. This seasonal pattern can also be related to the rise and fall of groundwater levels (W&RC, 2000). Figure 4 indicates that inorganic nitrogen is higher than the organic component of nitrogen. However, it is important to note that the land surrounding the Canning River monitoring site supports land uses such as orchards and market gardens, which typically have high fertiliser use, a source of inorganic nitrogen.

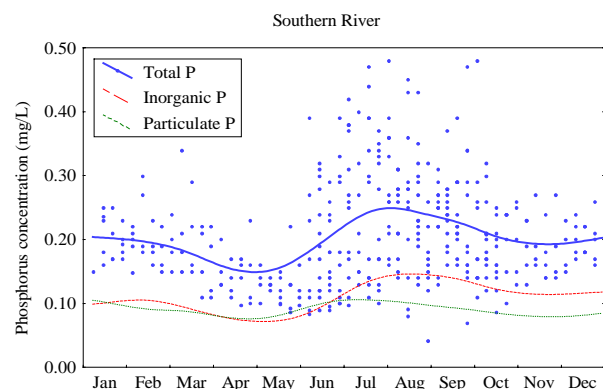


**Figure 4: Seasonal nitrogen concentrations (mg/L) in the Upper Canning River**

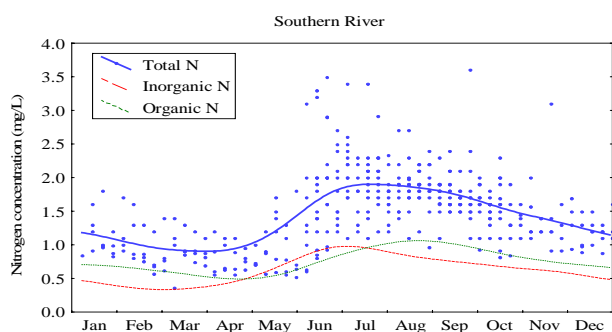
### Southern-Wungong Catchment

The Southern-Wungong Catchment is one of the highest contributors of nutrients to the Swan-Canning Estuary.

Seasonal monitoring data reveals that total phosphorus and total nitrogen concentrations peak in the catchment in late July to August (see Figures 5 & 6), suggesting they are related to flow. The Southern-Wungong Catchment has typically high groundwater levels. Inorganic phosphorus and nitrogen are highly soluble and easily transported when groundwater levels fluctuate.



**Figure 5: Seasonal phosphorus concentrations (mg/L) in the Southern River/Wungong Brook**



**Figure 6: Seasonal nitrogen concentrations (mg/L) in the Southern River-Wungong Brook**

## 2.5 Water quality

### What is water quality?

Water quality is influenced by a range of factors including:

- Nutrient concentrations (including phosphorus and nitrogen)
- Dissolved oxygen concentrations
- Heavy metals, herbicides and pesticides
- Light availability
- Pathogens and bacteria

### Nutrients

Nutrients are essential for aquatic ecosystems. Once nutrients enter an ecosystem, they are naturally cycled throughout the food web. Nutrient cycling transfers compounds essential for growth from one habitat to another. However human activities generally deliver excess quantities of nutrients, especially nitrogen and phosphorus to the river system, which overwhelms this cycling process. The amount of available nutrients exceeds the ecosystem's capacity to recycle nutrients and hence they are available to nuisance algae.

Phosphorus and nitrogen are the two main nutrients of interest in an aquatic ecosystem. For algae to reproduce, phosphorus and nitrogen need to be available, however one nutrient may limit the growth of algae more than another and this is termed a 'limiting nutrient'.

Determining the limiting nutrient in a river is quite complex and is dependent upon a number of factors including the season. At this stage, there is uncertainty as to what the limiting nutrient is in the Canning River System. Until such time as this is confirmed, management efforts should aim at reducing the input of both nutrients.

### Phosphorus

Phosphorus is present in waterways as:

- dissolved phosphate
- dissolved polyphosphate (commonly found in detergents)
- phosphorus in dissolved and particulate organic compounds
- phosphate attached to particles of sediment, clay and organic matter (Lovett and Price, 1999).

When bottom waters and the sediment surface become anoxic (low in dissolved oxygen), sediments release phosphorus to the water column.

### Nitrogen

In terrestrial and aquatic ecosystems nitrogen is most commonly present as ammonium nitrate and organic nitrogen. Unlike phosphorus, nitrate is not bound in soil and rapidly leaches to groundwater and surface water (Gerritse, 1999). Ammonium and nitrate are easily utilised for plant growth, including algal blooms.

Nitrogen does not often accumulate in excessive amounts due to a process called denitrification. Denitrification converts nitrates into nitrogen gas that escapes into the atmosphere. This natural cycling of nitrogen can prevent excessive build up. For denitrification to occur, nitrification must occur first and this requires oxygen. Low oxygen concentrations in bottom waters can therefore reduce the rate at which nitrogen can be removed from the river (SRT, 1999).

### Dissolved oxygen concentrations

Oxygenation of the water column occurs at the surface. When the water flows over riffles, woody debris and granite outcrops the turbulent flow creates a larger surface area over which aeration can occur (Pen, 1999). In still water, such as that upstream of the Kent Street Weir, the surface waters are well oxygenated, however the bottom waters are not. For the entire water column to be oxygenated, sufficient mixing and turbulence is required. When there is insufficient mixing, any oxygen available at the bottom is quickly used up by the decomposition of organic matter.

**Table 4: Common pollutants, possible sources and potential impact on waterways**

Pollutant	Source	Impact on waterway
Organic nitrogen and phosphorus	<ul style="list-style-type: none"> <li>• Leaves from soft-leaved exotic trees</li> <li>• Lawn clippings (blown in from adjacent parks)</li> <li>• Animal waste</li> <li>• Septic tank overflow/sewer overflows</li> </ul>	<ul style="list-style-type: none"> <li>• The system has difficulty processing excess nutrients so they are utilised by nuisance species for primary production</li> </ul>
Inorganic nitrogen and phosphorus	<ul style="list-style-type: none"> <li>• Fertiliser</li> <li>• Animal urea</li> <li>• Domestic detergents (car washing, scrubbing dirty floors)</li> <li>• Septic tank overflow/sewer overflows</li> <li>• Industrial effluent</li> </ul>	
Sediment	<ul style="list-style-type: none"> <li>• Disturbed and/or exposed soil</li> <li>• Pavement and vehicle wear</li> <li>• Organic matter (e.g. leaf litter, grass)</li> </ul>	<ul style="list-style-type: none"> <li>• Smothers important habitat</li> <li>• Lateral erosion of river channel</li> </ul>
Heavy metals	<ul style="list-style-type: none"> <li>• Vehicle wear</li> <li>• Spillage/illegal discharges</li> <li>• Underground fuel tank leakage</li> <li>• Atmospheric deposition</li> <li>• Industrial effluent</li> </ul>	<ul style="list-style-type: none"> <li>• Bioaccumulation</li> <li>• Some can kill organisms on contact</li> </ul>
Gross pollutants	<ul style="list-style-type: none"> <li>• Littering</li> <li>• Deciduous trees</li> <li>• Vehicle wear</li> </ul>	<ul style="list-style-type: none"> <li>• Visual pollution</li> <li>• Hazard to humans (broken glass, syringes)</li> <li>• Hazard to animals (fishing lines, bags, bands, rope)</li> </ul>
Pathogens and bacteria	<ul style="list-style-type: none"> <li>• Animal faeces</li> <li>• Leaking sewerage/septic systems</li> </ul>	<ul style="list-style-type: none"> <li>• High biological oxygen demand (BOD) reducing dissolved oxygen concentrations in water column</li> </ul>
Toxic chemicals	<ul style="list-style-type: none"> <li>• Pesticides and herbicides</li> <li>• Illegal discharge</li> <li>• Leaking sewerage/septic systems</li> </ul>	<ul style="list-style-type: none"> <li>• Some can kill organisms on contact</li> <li>• Bioaccumulation</li> </ul>

A lack of dissolved oxygen in the water column adversely affects in-stream organisms such as fish, macroinvertebrates and bottom dwelling organisms. Under low oxygen conditions, sediments release nutrients into the water column, which may fuel toxic algal blooms.

The Swan-Canning Cleanup Program's Canning River Oxygenation Trial aims to reduce the release of phosphorus and increase the rate of denitrification (nitrogen removal) from the system. In turn, this will reduce the nutrients available for nuisance algae. Detailed results of this trial are available from the Swan River Trust.

### Heavy metals, herbicides and pesticides

Heavy metals can come from a variety of human activities, including runoff from industrial activities, leaching of metals from waste disposal dumps, illegal discharges and vehicle wear. Herbicides are used frequently to control weeds on rural and urban properties and along drains and waterways. Pesticides are used to control invertebrate pests.

Both heavy metals and pesticides cause similar problems in waterways. Once ingested, the chemicals accumulate in animal tissue over many years and pass through food chains, causing long-term contamination of riverine foodwebs.



## Light availability

Fringing vegetation influences the amount of light reaching the river and thus water temperature. High water temperatures can adversely affect the structure and dynamics of aquatic plant and animal communities.

Warm water temperatures can cause the following problems:

- increase in the breakdown of organic matter, which increases oxygen consumption,
- adverse impacts on the growth and metabolism of some aquatic species,
- thermal stratification, which leads to deoxygenation of bottom waters.

In slow flowing waters, such as the impoundment upstream of the Kent Street Weir, suspended sediment and silt settles to the bottom and light penetration is increased, providing conditions ideal for photosynthesis and thus algal blooms.

## Pathogens and bacteria

Pathogens and bacteria may reach the Canning River System from agricultural and urban areas. Sources of pathogens are:

- human waste which enters nearby drains when septic tanks flood or fail,
- animal waste from domestic animals and livestock,
- animal waste from wildlife.

High levels of bacteria or pathogens are a health risk to people, wildlife and domestic animals. They also consume oxygen and generate offensive odours.

## 2.6 Algal blooms and eutrophication

Human activity can lead to sudden increases in nutrient inputs and the rapid accumulation of phytoplankton growth, including toxic algal blooms (SRT, 1999). In recent years toxic algal blooms have occurred regularly in the area upstream of the Kent Street Weir. The most severe bloom was in 1994 when the river was closed to recreational use for several months.

The Swan River Trust began sampling for algal blooms in 1994. Table 5 lists algal blooms that have occurred in the Canning River since sampling began. Anecdotal evidence suggests blooms did occur in the river prior to 1994 but not as regularly.

**Table 5: Algal blooms recorded by the Swan River Trust in the Canning River since 1994**

Date	Location	Species
Jan-Mar 1994	Upstream Kent St Weir	<i>Anabaena</i> spp.
Feb-Mar 1994	Upstream Kent St Weir	<i>Microcystis</i> spp.
Feb-Apr 1994	Upstream Kent St Weir	<i>Anabaena</i> spp.
9 April 1996	Wharf St	<i>Oscillatoria</i> spp.
20 Jan 1997	Kent St Weir	<i>Anabaena</i> spp.
20 Jan 1997	Bacon to Wharf St	<i>Anabaena</i> spp.
29 Jan 1997	Kent St	<i>Anabaena</i> spp.
29 Jan 1997	Greenfield St	<i>Anabaena</i> spp.
3 Feb 1997	Bacon to Wharf St	<i>Anabaena</i> spp.
13 Jan 1998	Kent St Weir to Greenfield St	<i>Anabaena</i> spp.
20 Jan 1998	Kent St Weir to Greenfield St	<i>Anabaena</i> spp.
27 Jan 1998	Kent St Weir to Greenfield St	<i>Anabaena</i> spp.
3 Feb 1998	Kent St Weir to Mason's Landing	<i>Anabaena</i> spp.
17 Feb 1998	Kent St Weir to Mason's Landing	<i>Anabaena</i> spp.
24 Feb 1998	Bacon St	<i>Anabaena</i> spp.
3 Mar 1998	Wharf St	<i>Anabaena</i> spp.
10 Mar 1998	Ellison Drive	<i>Anabaena</i> spp.
12 May 1998	Wharf St	<i>Microcystis</i> spp.
12 Jan 1999	Wharf St	<i>Anabaena</i> spp.
19 Jan 1999	Kent St Weir	<i>Anabaena</i> spp.
9 Mar 1999	Kent St Weir	<i>Anabaena</i> spp.
Oct 1999	Roley Pool, Roleystone	Unidentified
9 Nov 1999	Bacon St	Unidentified
11 Jan 2000	Kent St Weir & Bacon St	<i>Anabaena</i> spp.

Although *Anabaena* and *Microcystis* are commonly referred to as blue-green algae, they are actually not algae but cyanobacteria. For the purposes of this report however, they will be referred to as algae.

*Anabaena* and *Microcystis* are the most common species found in the lower reaches of the Canning River, however other species are also washed in from the catchment. Recently, a tropical species of cyanobacteria (*Cylindrospermopsis* cf. *raciborskii*) was found in a drain flowing into the Canning River. This was thought to have come from imported soil in a new residential estate.

The Canning River and its tributaries also experience excessive macrophyte growth of the aquatic weeds, *Salvinia* spp. and *Hydrocotyle ranunculoides*. In the early 1990s the area upstream of the Kent Street Weir was blanketed with *H. ranunculoides* in summer. The Swan River Trust implemented a weed control program, physically removing tons of this weed. In recent years the Trust has conducted follow-up spraying and removal which has kept this weed under control.



Nutrient enrichment is not the only cause of algal blooms and excessive macrophyte growth. The availability of light, fresh water, high water temperatures, lack of turbulence in the water column and store of nutrients in the sediments all influence the growth of algae and macrophytes.

The impoundment of the Canning River by the Kent Street Weir has resulted in a seasonal fresh water lagoon with large expanses of still water. This results in a long retention time of water. The increased retention time and lack of shading of the river channel results in increased light penetration and high water temperatures. If there is insufficient light in the water column, nutrient enrichment will have little effect on algal growth (Lovett and Price, 1999).

The Canning River does not experience saline stratification, as with the Swan River, however it does experience thermal stratification. The lack of mixing between bottom and surface waters due to the impoundment of fresh water during summer results in warm water at the surface and cooler water on the bottom. This lack of mixing prevents oxygen replenishment from surface to bottom. Any available oxygen left at the bottom is used up by the decomposition of organic matter, which can be built up after the collapse of previous algal blooms. By this stage, the conditions are right for the sediments to release nutrients into the water column.



*Hydrocotyle ranunculoides* blanketing the Canning River, 1992 (Photo: V Klemm)



The same site following removal of the weed (Photo: V Klemm)

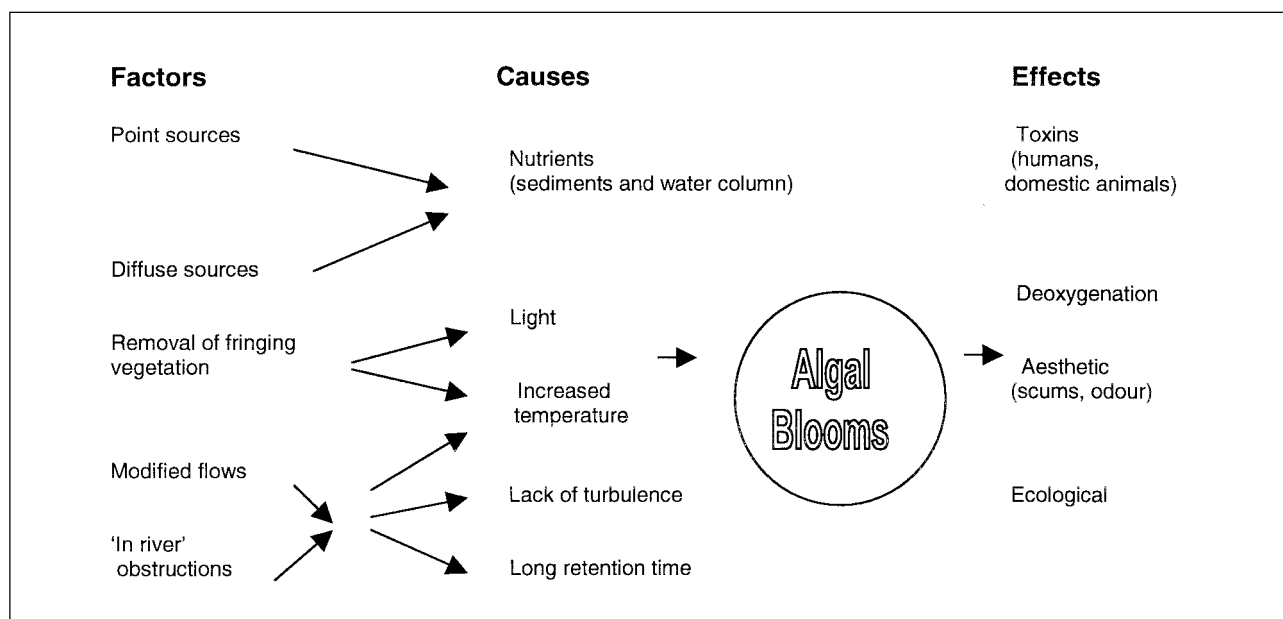
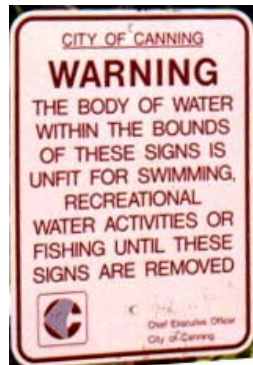


Figure 7: Conditions leading to algal blooms (derived from NSW Agriculture, 1997)

The excessive growth of algae and macrophytes can lead to the following problems:

- Reduced oxygen concentrations in the water column can cause the death of worms and other bottom dwelling invertebrates which are important prey for fish and other high-order predators like waterbirds.
- The frequency of algal blooms and their subsequent collapse has the potential to reduce biodiversity in parts of the river.
- Algal blooms have the potential to produce harmful toxins. These toxins can cause skin irritations in humans and harm domestic pets and livestock if they drink or wade in the water. This reduces the recreational amenity of the water.
- Excessive macrophyte growth can provide shade and reduce water temperatures, however it blocks the river channel reducing recreational amenity.



*Sign advising the public not to use the Canning River (Photo: Phytoplankton Ecology Unit)*

## 2.7 Drainage networks

Drainage systems are developed to meet the community's need to minimise the threat of flooding. For many years, the main focus of drainage networks has been on hydraulic capacity and rapid transport of stormwater rather than water quality (EPA, 1998).

In the Canning River Catchment, minimal rainfall is experienced from November to April. This allows nutrients and pollutants to accumulate in the soil and on impervious surfaces throughout these dry months. When the first major rains occur, often referred to as the 'first flush', the accumulated pollutants are transported in a large pulse to the nearest drain or waterway. In Perth, the first flush effect is often compounded by soil with non-wetting properties, which may act as an impermeable surface during the first flush (W&RC, 1997a).

Many of the natural tributaries in the Canning River Catchment have been modified into drains. This modification has involved the removal of fringing vegetation, alteration of the river bed and destruction of pools and riffles. This removes the tributaries' natural ability to slow down flow, settle out sediment and nutrients, as well as provide habitat for aquatic and terrestrial fauna.



*Bickley Brook, Kenwick. This is an example of a modified watercourse flowing into the Canning River*

The groundwater levels on the Swan Coastal Plain are frequently very close to the surface and the extensive network of drains often intercept the groundwater. For example, the Southern River Catchment is made up of numerous seasonally inundated wetlands and damplands so the water level is at the surface or near the surface. When drains are constructed in these areas to dry out the land for development, they often intercept and drain groundwater, even in summer. As a consequence, many of these drains flow year round, continuously transporting nutrients and pollutants to the Canning River System.

Urban and rural drains that flow permanently through summer contribute to eutrophication of the river system. In summer they deliver stagnant, nutrient-rich, warm water that is rich in organic material to the river system. This water has a high biological oxygen demand, impacting on a system that is already under stress from low summer flows.

## 2.8 Taking surface water

The Canning River and its tributaries sustained Aboriginal communities long before European settlement. Land surrounding the Canning River was first developed by Europeans for farming in the 1800s. Ever since, the Canning River System has provided land owners abutting the river with fresh water to irrigate crops and pasture and the Perth metropolitan area with a public water supply.

### Canning River

The Canning Dam was completed in 1940. Around this time, there was considerable concern amongst downstream land owners that the dam would reduce the quantity of water available for their use. The government of the day gave assurance that the summer flow into the Canning River would be released for the irrigation of existing commercial orchards and other agricultural pursuits (W&RC, 1996). As land use changed and the original lots were subdivided, additional demand was placed on the river system.

The Canning River was proclaimed under the *Rights in Water and Irrigation Act (1914)* in 1942, making non-riparian use subject to licensing. Later that year, the Canning River Irrigation Advisory Committee was established (W&RC, 1996). That Advisory Committee amalgamated with the Wungong Southern Rivers Irrigation Advisory Committee and is now referred to as the Canning Wungong Southern Rivers Advisory Committee. This Committee is made up of five local land owners and one

Water Corporation representative. Generally the local landowner representatives are licensed or riparian users.

In 1996 the Water and Rivers Commission produced an Interim Allocation Policy for the Canning River with advice from the Advisory Committee. This Interim Policy was developed to protect the ecological values of the river. It also outlined minimum flow requirements, however these were rough estimates and were to be followed up with a scientifically based ecological water requirements study, which has been done as part of this plan.

The Canning River Interim Allocation Policy (W&RC, 1996) outlines certain management principles that are currently used by the Advisory Committee when making licensing decisions. These are:

1. No additional water allocations will be made;
2. Water use is to be progressively reduced to a level that matches the availability;
3. Water users must adopt best practice water conservation and efficiency measures;
4. Pumping restrictions will be applied during periods of inadequate flow;
5. Individual pumping rates are to be limited to prevent an excessive reduction in the river flow.

There are 116 private licensed users on the Canning River. The majority of these are between Kelmscott and Gosnells. Of these 116 licensees, 59 also have a riparian right. There are many more properties that abut the river and have a riparian right but not all of these properties use this right to take water from the river.

The quantity of water allocated to private licensed users is approximately 1.31 ML/yr. The total riparian use is unknown. Most water taken from the river is during summer when flows are at their lowest.

### Southern River-Wungong Brook

The Southern River and Wungong Brook were proclaimed under the *Rights in Water and Irrigation Act (1914)* in 1976, shortly after the construction of the Wungong Dam earlier the same year. These rivers were actively licensed for a number of years, however upon advice from the Wungong Southern Rivers Irrigation Advisory Committee, licensing was suspended in 1985.

In February 2000, the Canning Wungong Southern Rivers Advisory Committee made a decision to resume licensing along the Southern River-Wungong Brook, in an effort to



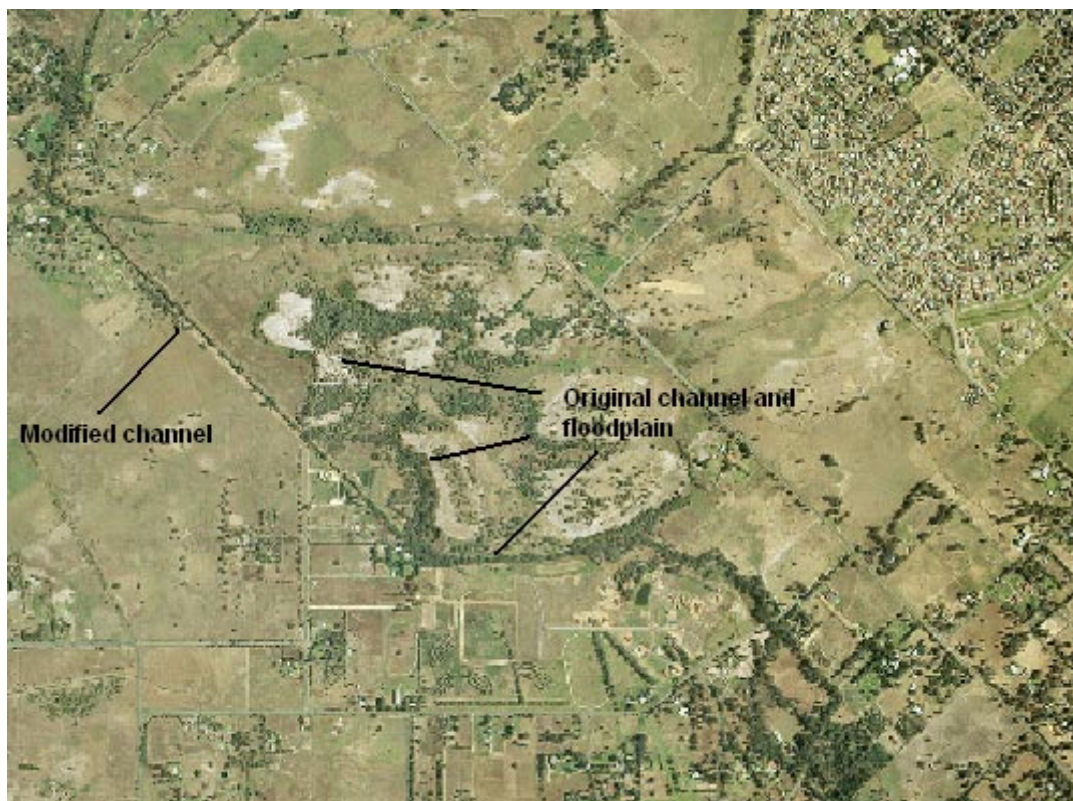
improve management of water resources along the river. The Advisory Committee has decided that before licences are reissued, a water use survey will be conducted along the entire length of the river. This will determine the total consumptive use.

Birrega Drain intercepts Wungong Brook downstream from the release point on Wungong Brook (see Map 2). There is a weir on Wungong Brook that raises the water level and backs up water so it flows down Birrega Drain, which drains into the Peel-Harvey Catchment. There has been debate for many years as to whether the water released for Wungong Brook should be allowed to flow into Birrega Drain. The water released upstream is intended for Wungong Brook-Southern River.

## 2.9 Fringing vegetation and weeds

Fringing vegetation is extremely valuable to ecosystem processes. The riparian zone of the Canning River System supports a higher diversity of flora and fauna than the adjoining land. Fringing vegetation provides the following benefits:

- provision of in-stream shade from the harsh summer sun
- provision of energy and nutrients to aquatic organisms
- the roots of fringing vegetation bind the soil and therefore stabilise the banks and prevent erosion
- provision of habitat and refuge to terrestrial flora and fauna
- branches break off and logs fall into the river channel, providing woody debris, an important habitat to aquatic organisms



*Figure 8: Aerial photograph, February 2000, illustrating the straightened, modified channel of Wungong Brook that drains water away from the original channel and floodplain*

- filters out sediment and nutrients passing from the land to the river. This is an important function when the adjoining land is cleared and supports human activity. The potential to remove pollutants before they enter the river can also occur via deep-rooted vegetation intercepting nutrient-enriched groundwater.

Although many acknowledge the importance of riparian land, human settlement along the Canning and Southern Rivers and Wungong Brook has resulted in its degradation. This has been caused by clearing, river training, modification of flows, erosion and sedimentation, uncontrolled stock access, fire and weed invasion.

Weed invasion is particularly bad along the Canning River. Nowhere else in the south-west do vines, tall grasses and woody weeds dominate the river valley to the extent and intensity that they do on this river (Pen, 1993, 1999). The worst instances of weed invasion are around Kelmscott and Gosnells where the middle and understorey is dominated by a wide range of woody and climbing weeds. This invasion of weeds threatens native plant communities and some local native fauna that depend on native vegetation for food and shelter.

Along most of the river system, grazing was uncontrolled for many years. When the river was fenced off, soft-leaved exotic weeds replaced the understorey and have increased the organic loads along the Canning and Southern Rivers. Much of Wungong Brook is still grazed, so exotic weeds have not had the opportunity to establish themselves.

Much of the Wungong Brook-Southern River was modified into a straight trapezoidal drain many years ago. The channel was excavated and levee banks created to improve drainage and open up the surrounding land to development. This occurred mostly between Rowley Road, Brookdale and Allen Road, Westfield. Figure 8 outlines sections of the original channel and associated floodplain.

The modification of the Wungong Brook-Southern River has led to considerable problems. The channel has minimal fringing vegetation and is thus deprived of the benefits that fringing vegetation provide. There is virtually no woody debris and the banks are exposed to erosion or are infested by weeds.

Storey (1998) conducted a fish and fish habitat survey of the Canning River and its tributaries. Out of 17 sites surveyed, McNeill Rd Bridge, Southern River (see photo below) was



*Southern River, McNeill Road Bridge, 1999. This part of the river has been straightened and resembles little more than a drain with virtually no ecological value*



the only site in the main river channel where no native species of fresh water fish were observed. Only one single fish was found, that being the introduced Mosquitofish that prefers warmer waters. Local residents have now formed a catchment group for this part of Southern River, and are undertaking river restoration projects in that area.

There has been some successful regeneration of native plant species along the lower reaches of the Canning River in Maddington. In all cases this is mainly due to the regeneration of *Eucalyptus rudis* and *Melaleuca raphiophylla* on farmland which has been less intensively used as the surrounding land has become urban (Pen, 1993).

## 2.10 Sedimentation

Sedimentation is a natural riverine process but poor land use management has resulted in excessive quantities of sediment entering the river channel through drains and tributaries. This has been coupled with a loss of scouring flows since the construction of the dams and climatic variability in the past 25 years. The river is therefore

unable to scour the sediment under the current flow regime. These sediment deposits are an obstruction to flow and can modify the geomorphology of the river.

Anecdotal evidence from many people suggests a number of deep pools on the Canning River System have filled as a result of sedimentation. These pools provide an important summer refuge for in-stream fauna, particularly freshwater cobbler. Not only do these sediment deposits fill deep pools, they also smother the river bed and woody debris, also important habitats.

Fine sediments can be carried quickly downstream in suspension, whilst coarser sediments are typically rolled along the bed. As a result, coarse sediments can build up in the river causing large silt deposits (Pen, 1999).

Some weeds are particularly good colonisers and take advantage of the opportunity that fresh sediment deposits provide. Depending on flow conditions, weeds can completely cover and consolidate sediment deposits within a few seasons, thereby stabilising them and making them harder to flush out.



***Large sediment deposit in a river pool, Kelmscott***

# Section 3. Revitalising the Canning River System

This section presents the main issues identified and dealt with by this plan. Under each issue an objective has been listed and the response/s required to achieve the objective. Some of the responses have been carried out by this or other associated plans. Where further action is required to achieve the objective, recommendations have been listed. These recommendations are then repeated in Section 4 where all the recommendations are grouped under appropriate management programs for implementation.

## 3.1 Meeting the ecological water requirements

Issue:

*Flow in the Canning River System has been significantly modified. This has contributed to the degradation of ecological values, a loss of river power and flooding flows.*

Objective:

*Manage river flows so the important ecological values of the river system are maintained, balancing the ecological requirements with the human demands for water.*

Response: what needs to be done to meet this objective?

- Identify ecological features and values of the river and their water requirements
- Develop environmental water provisions for the river
- Develop a formal water resource allocation plan for the Canning River System that allocates water to the ecological values, consumptive values and social values of the river

### 3.1.1 What are the ecological water requirements of the Canning River System?

**Ecological water requirements (EWRs)** are the water regimes needed to maintain the ecological values of water-dependent ecosystems at a low level of risk.

In October 1999 a study was commissioned to identify preliminary ecological water requirements for the Canning River System. The study was undertaken by the Aquatic

Research Laboratory, University of Western Australia, on behalf of the Water and Rivers Commission.

The aim of the study was to estimate the flows required to enable the Canning, Southern and Wungong Rivers to function as an ecologically healthy system. The process used to identify the ecological water requirements is outlined in Appendix 2.

Once the water requirements of each ecological value were identified, these were pulled together to determine the monthly flow volumes suitable to all of these ecological values. This process was used for six sites on the Canning River System.

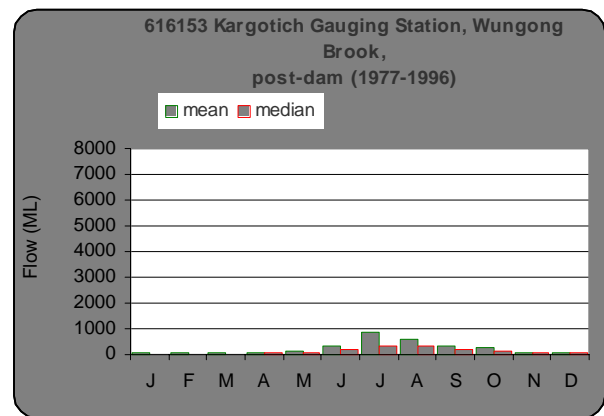
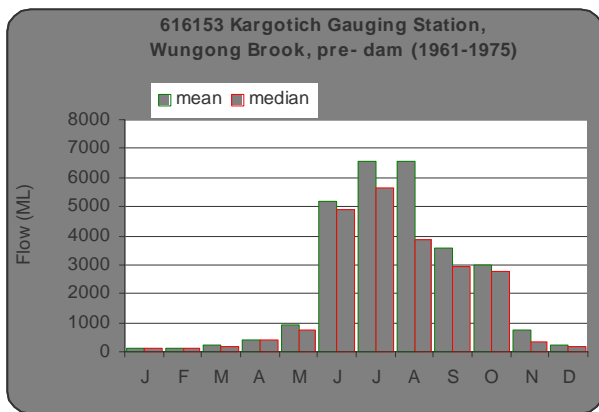
The results of the study suggest that the Canning River was a permanently flowing waterway prior to regulation. Although the Canning River can never be returned to its pre-dam condition, it needs to be maintained as a permanent system with water flowing all year round, to maintain its important ecological values. The exception to this may be during periods of drought.

An important finding of the preliminary ecological water requirements study was that the Canning River System does not experience the seasonality of flows that it did prior to regulation. The current flow regime peaks in winter and gradually reduces during spring with low flows during summer. Prior to regulation, flows peaked in winter and then high flows would have been experienced again during spring. It is important that seasonality of flow is re-introduced to maintain the ecological values of the river system.

Figure 9 illustrates the differences in seasonality of flow and flow volumes in the Wungong Brook before and after the Wungong Dam was constructed. However, the period from 1977-1996 (post dam period) has also been the driest period on record with below average rainfall almost every year (see Figure 1).

### 3.1.2 Developing environmental water provisions for the river

The ecological water requirements developed as part of this process are the 'first estimates' for the Canning River System. This needs to be confirmed through further research and trial releases, planning for this will commence in 2001. During this time, the social and consumptive water requirements of the river will also need to be determined. After this, the environmental water provisions will be identified.



**Figure 9: Mean and median annual flows recorded at Kargotich gauging station, Wungong Brook (S616153) pre and post dam construction**

**Environmental water provisions (EWPs)** are the water regimes that are to be maintained, and are determined through water allocation planning and environmental assessment processes (EPA approval) that may involve some compromise between ecological, social, consumptive and economic goals.

Environmental water provisions are the flow regimes that can be met after considering the ecological, social and consumptive uses of the river. The aim is to ensure the important ecological values of the river system are maintained, whilst providing water for important human uses such as public water supply, recreation and private abstraction. This process requires community consultation, experimentation with flows, monitoring and approval from the Environmental Protection Authority.

### 3.1.3 Trial release

The preliminary ecological water requirements developed as part of this study have been calculated using limited hydrological and ecological data. Simply maintaining the estimated flow volumes would not be a responsible management approach to achieving the objective of improving the ecological health of the river system.

To achieve a better understanding of the flow regime needed to maintain the rivers' ecological values, a trial release program is proposed for the Canning River. This trial release program will aim to restore some of the seasonality and variability of flows that would have occurred prior to the construction of the dams.

The preliminary ecological water requirements study estimated the flow required for the ecological values of

the river, including the timing of these flows. One example is that native fish require increased flows during spring to ensure successful breeding. The trial release will release water into the river during spring to maintain the water levels required to assist fish reproduction. An essential part of this trial will be to conduct biological surveys to evaluate if the trial release is successful in achieving its aims (ie. an increase in fish spawning).

A major finding of the preliminary ecological water requirements study was that the Canning River System has very low channel 'roughness'. This means that the river has very few natural obstacles left in it that help to reduce the velocity of water and maintain water levels.

It is therefore recommended that a number of restoration techniques are applied prior to the commencement of the trial. This will help to slow the velocity of water and maintain the recommended water levels. For example, establishing woody debris in the river channel immediately upstream of a river pool will assist in reducing the velocity of flow upstream but will help to scour out the river pool. Recreating floodplains and/or wetlands (shallow, seasonally-flooded areas connected to the river at high water) in the lower reaches will improve habitat diversity for successful native fish reproduction.

If a number of restoration techniques are applied at key locations, the ecological water requirements would be met with less water and the overall objective of improving ecological health would still be achieved.

It is envisaged that the results of the trial release strategy will provide essential information required to develop the environmental water provisions.



### 3.1.4 Social uses of water

The social needs for water can include:

- water required for recreational and tourism activities
- water required to maintain Aboriginal and other Australian heritage features
- water to maintain landscape and aesthetic aspects and
- water to maintain educational and scientific aspects

To identify the social values of the Canning River System, the Water and Rivers Commission will consult with the local community through workshops and letter drops. Some of these issues have already been considered at the ecological water requirements workshop held in December 1999 at Kelmscott Hall (Appendix 3).

The workshop found that people were concerned with:

- loss of flushing flows and resultant infilling of pools
- reduced populations of marron and freshwater cobbler
- continuing degradation of the river including weed invasion and sedimentation

When developing environmental water provisions, the primary consideration is usually given to the ecological values. However, there appears to be a strong social demand to improve the ecological health of the Canning River System. Recreational pursuits will also be considered when determining the social values of the rivers.

### 3.1.5 Consumptive uses of water

Consumptive use refers to water used for public water supply and private abstraction.

This includes the Canning and Wungong Dams that are used by the Water Corporation to supply the Perth metropolitan area with scheme water, private dams and springs and riparian and licensed surface water users that are located along the river system.

Consumptive use will be determined through consultation with the Canning Wungong Southern Rivers Advisory Committee, licensed surface water users, riparian users and the Water Corporation. It is acknowledged that consumptive use in the Canning River System is high and has contributed to the degradation of the ecological health of the river. Whilst developing the environmental water

provisions, consideration will be given to the need for this high consumptive demand, however it is possible that consumptive use will have to be reduced and/or efficiency increased. The Environmental Water Provisions Policy for Western Australia (W&RC, 2000) states that where environmental water provisions cannot be met in the short term 'a strategy will be developed in consultation with users and other stakeholders, to ensure such provisions are met within the minimum practicable time'.

### 3.1.6 Formal water resource allocation plan

The proposed environmental water provisions for the Canning River System will need to be approved by the appropriate Cabinet Ministers. The environmental water provisions will form part of a water resource allocation plan for the rivers, which shall replace the Canning River Interim Allocation Policy (W&RC, 1996). The water resource allocation plan will include guidelines for consumptive use, drought response strategies and the existing local rules as set by the Canning Wungong Southern Rivers Advisory Committee. It is expected that the water resource allocation plan will be complete by 2005.

### 3.1.7 Monitoring and revision of environmental water provisions

As previously stated, the ecological water requirements presented in this plan are the first estimates of what water levels and/or flows are required by the ecological values of the Canning River. They have been formulated with limited hydrological and ecological data. Monitoring is essential so river managers and the community can be confident that environmental water provisions are meeting their required objectives.

As outlined in Figure 10, environmental water provisions for the Canning will be regularly reviewed. The development of environmental water provisions is set to continue Australia-wide. This will result in more trial releases, further research and scientific developments. The Canning River will be one of the first waterways in Western Australia to have environmental water provisions developed, therefore it is essential that environmental water provisions are considered in an adaptive context and reviewed in light of monitoring results and further research.

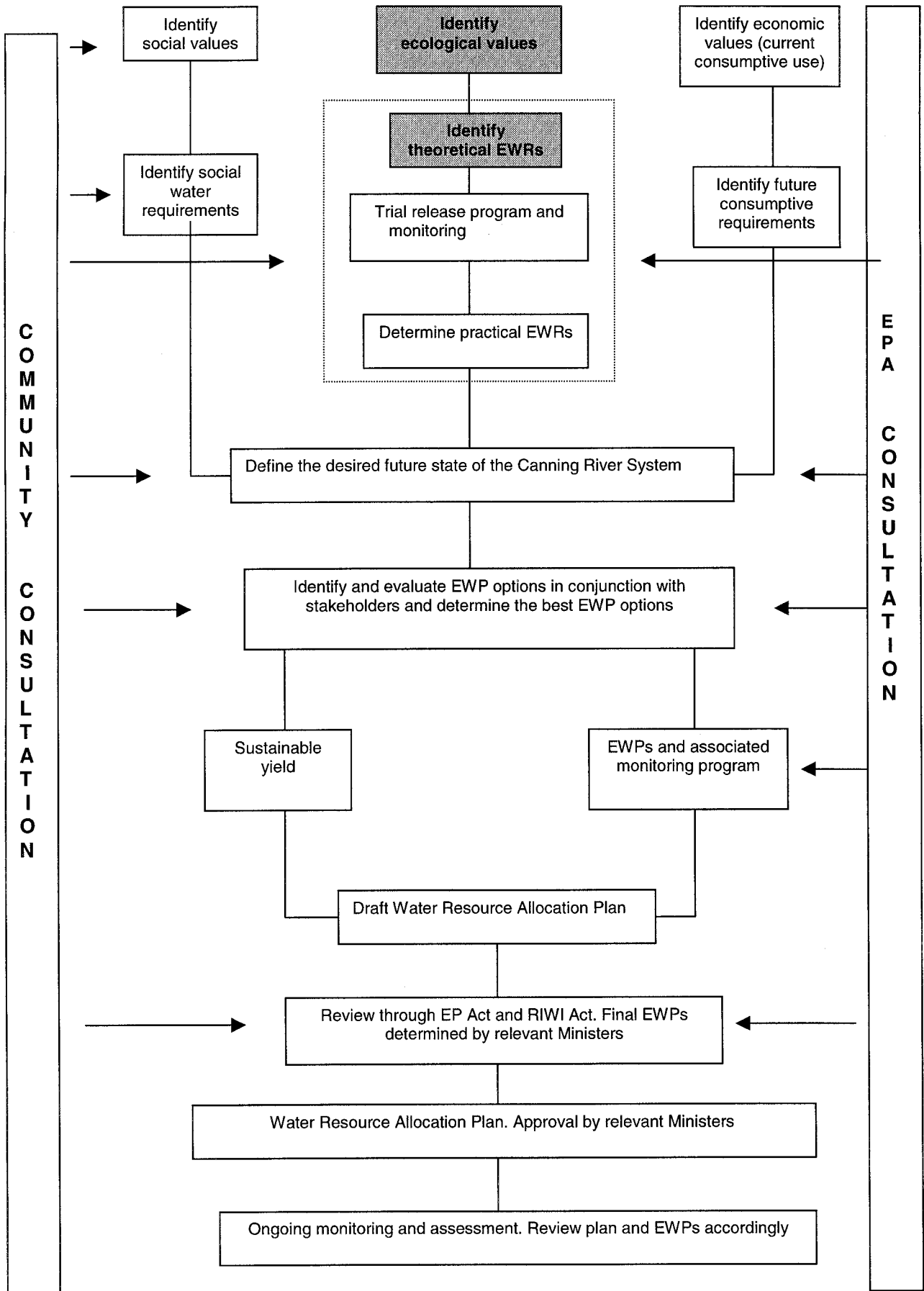


Figure 10: Proposed process for developing environmental water provisions in the Canning River System (shaded boxes indicated step is complete)

Section 3.1			
No.	Recommendation	Proposed organisation	Partner
A1	The Canning River System should be maintained as permanently flowing waterway and the quantity released from the environmental release points should never be less than historically released	W&RC	WC
A2	In consultation with stakeholders, develop and implement a trial release program at selected sites in the Canning River System and report on the results of this trial release	W&RC	WC
A3	Conduct an appropriate sampling program to measure the effectiveness of the trial release program. This program should sample for the following parameters: <ul style="list-style-type: none"> <li>• water quality</li> <li>• erosion and sedimentation downstream of environmental release points</li> <li>• aquatic invertebrates</li> <li>• fish species populations and structure</li> </ul> This monitoring program can form part of the ecological health monitoring program outlined in recommendation C2	W&RC	WC
A4	Staff gauges (water level markers) need to be installed to calculate water levels and flow volumes during the trial release	W&RC	WC
A5	Determine Environmental Water Provisions (EWPs) for the Canning River System following the process outlined in Figure 10	W&RC	WC
A6	Incorporate the EWPs into a water resource allocation plan for the Canning River System	W&RC	
A7	Investigate the ability to provide a release from near the dam wall on Wungong Brook to maintain summer flows between the Wungong Dam and the release point at South Western Highway	W&RC	WC
A8	Investigate if additional environmental release points are required on the Southern-Wungong Rivers to attain recommended EWPs in all parts of the system. Evaluate the cost of additional releases	W&RC	WC
A9	Review the EWPs as required, taking into account results of the monitoring program	W&RC	

### 3.2 Environmental water provisions and river management

Issue:

*Meeting the ecological water requirements of the river alone will not improve the ecological health of the river. It is only one part of river restoration and management.*

Objective:

*Incorporate environmental water provisions (EWPs) into an overall river management program.*

Response: what needs to be done to meet this objective?

- Raise awareness of what EWPs are and what they can achieve
- Work with catchment groups to ensure EWPs and river restoration projects complement each other

Many people attribute the degradation of the Canning River System to low flows, heavy abstraction and loss of flooding flows in winter. There is no doubt that the modified flow regime has caused significant ecological

problems in the river, however degradation can also be attributed to land use practices and human activity within the catchment that are distinct from the modified flow regime.

To improve the ecological health of the Canning River System it is vital that water is formally allocated to the ecological values of the river. However this is only one part of effective river restoration and management. Environmental water provisions need to form part of an overall river management program.

To improve the ecological health of the Canning River System will require more than just additional water. The Canning River and its tributaries have had large quantities of woody debris, boulders and aquatic plants removed and much of the fringing vegetation has been cleared and replaced with weeds. River pools have also been filled due to sediment coming in from the catchment. The channel also has been incised (eroded down) in sections due to more rapid runoff from the urbanised catchment.

As a result, water flowing down the Canning River and its tributaries does not have the natural obstacles usually present to slow flow down and raise the water level. Consequently, even during high rainfall events the river cannot reach its 'bankfull' level which is important to its ecological values.

Figure 11 illustrates the differences in flow and water levels between a cleared river channel and a vegetated river channel with woody debris present. Contrary to

some beliefs, woody debris does not increase flood risk when placed correctly.

It is evident that a large amount of river restoration is required to complement the development of environmental water provisions in the Canning River System. One cannot occur without the other, it must be acknowledged that they are intrinsically intertwined.

The following areas will need concentrated efforts from all people in the Canning Catchment to ensure that the Canning River System can be revitalised to an ecologically healthy system. The task is too great for one group, organisation, State or local government to undertake. It must be done as a partnership approach.

#### **Catchment management**

- water quality protection
- adoption of best management practices (BMPs) in land use management
- land use planning and development that acknowledges environmental constraints

#### **Riparian Management**

- riparian revegetation
- replacement of in-stream habitat (i.e. woody debris, boulders, native aquatic plants)
- channel stability (re-establishment of sedges and rushes, tree planting)
- controlling livestock access



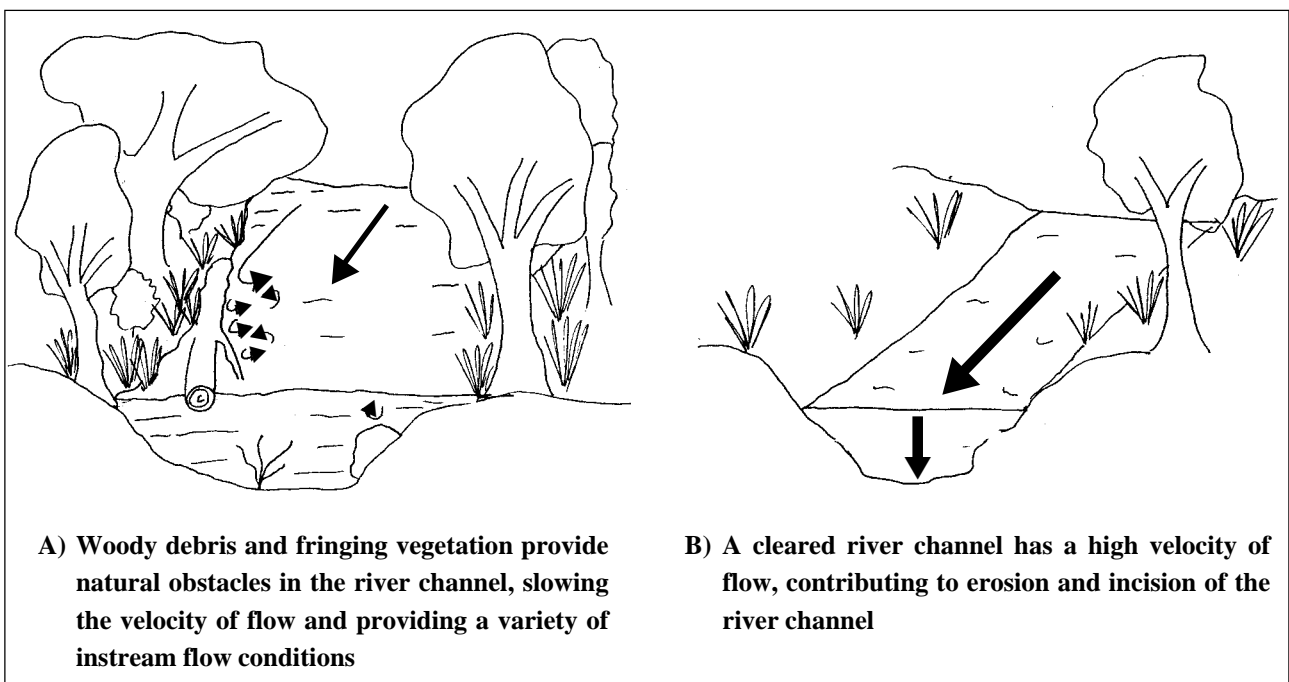
*Sampling for fish, Southern River (Photo: A Storey)*

**Section 3.2**

No.	Recommendation	Proposed organisation	Partner
A10	Increase public awareness through newsletters, pamphlets and catchment groups that developing environmental water provisions forms just one part of the overall river restoration program	W&RC	



*Uncontrolled livestock access and the resultant loss of fringing vegetation and erosion. Note in the background the fenced off, vegetated area. (Photo: H Bucktin)*



*Figure 11: Differences in flow and water levels between a cleared river channel and a vegetated river channel*



### 3.3 Managing the Kent Street Weir impoundment

Issue:

*The Kent Street Weir creates an impounded body of water upstream of the weir during summer. Low flow and insufficient mixing of the water column leads to conditions favourable to algal blooms.*

Objective:

*Prevent the conditions that lead to algal blooms upstream of the Kent Street Weir.*

Response: what needs to be done to meet this objective?

- Identify the best option to improve water quality, maintain recreational amenity and maintain the ecological values upstream and downstream of the weir

The Kent Street Weir has altered the natural hydrological regime of the Canning River in that area. There was some discussion in *Swan-Canning Cleanup Program Action Plan* (SRT, 1999) of the effect the Kent Street Weir has on water quality and the plan listed possible options to better manage the weir. This section evaluates these options in greater detail and provides recommendations for future management of the Kent Street Weir.

#### 3.3.1 Options for the Kent Street Weir

It is evident that some intervention is required to improve conditions in the Kent Street Weir impoundment, also referred to as the Kent Street Weir pool. There needs to be sufficient flow and mixing to increase oxygenation of the water column and sediments which would lead to an improvement in water quality. Three possible options for the management of the Kent Street Weir are presented below.

##### Option 1

###### Removal of the Kent Street Weir

There has been considerable discussion amongst the community as to what the removal of the Kent Street Weir involves. Some perceive it to mean complete removal of the weir, including the walk and cycle way. Others understand that removing the weir involves permanent removal of the weir boards only, which are used to trap fresh water upstream during summer and autumn.

In any case, both options have similar disadvantages. Removing the entire structure would be met with community resistance, as it is an important social feature of the Canning River and is heritage listed due to its historical associations.



*Kent Street Weir, Cannington*

Permanently removing the weir boards has social ramifications. If the weir boards were not in place over summer, the river channel would narrow and make it difficult for canoeing. It would also affect the aesthetic appeal of the Kent Street Weir Park in summer.

Reverting back to an estuarine condition has ecological problems too. The fresh water impoundment upstream of the weir acts as a summer refuge to waterbirds, turtles and supports native macrophytes. The intrusion of saline water upstream of the weir during summer could lead to the death of salt-intolerant species.

Salt intrusion would also provide salt-marsh mosquitoes with a suitable habitat to breed. This would cause mosquito problems in the residential areas surrounding the river.

The narrowing and lowering of the river channel will result in the formation of billabongs and the drying out of backwaters. A narrower river channel would decrease the habitat available for successful fish breeding.

Removing the weir boards would not necessarily prevent algal blooms upstream of the weir. The area would be subject to tidal influences and therefore saline stratification. This would restrict the mixing of bottom waters and lead to conditions susceptible to algal blooms, probably of the brackish-water tolerant species such as blue-green *Nodularia* spp. (SRT, 1999).

## Option 2

### Replace the Kent Street Weir

Maintain the weir in its current location but remove the weir boards, pylons and concrete sill and replace with a hydraulic controlled weir system. This structure could be manipulated throughout summer to improve mixing upstream of the weir. The walk/cycle way would still remain.

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• A structurally sound weir will remove the health and safety risk to crew that remove/replace weir boards</li> <li>• Reduces ongoing maintenance costs of installing and replacing weir boards</li> <li>• Channel width maintained</li> <li>• Disrupts the water column, preventing anoxic conditions</li> <li>• Easier manipulation of the weir</li> <li>• Prevents saline intrusion upstream of the weir</li> </ul>	<ul style="list-style-type: none"> <li>• High infrastructure costs</li> <li>• Increased flushing of nutrients and organic matter into lower estuary</li> <li>• Removal of lower part of historic structure</li> <li>• Large pulses of fresh water may increase stratification in lower estuary</li> </ul>

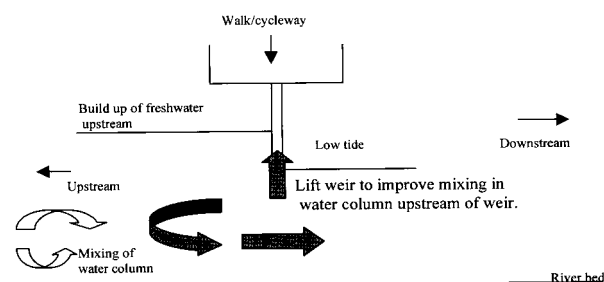
Removing the weir boards and replacing them with a hydraulic controlled weir system would allow easier manipulation of the weir. The weir could remain closed in summer until there is a sufficient build up of water/water level from a storm event or the environmental releases. The weir could then be opened on a low tide to allow the build up of water to flush downstream and prevent saline water intruding upstream.

Removing the bottom section of the weir will require removal of part of the heritage-listed structure. This would require consultation with the Heritage Council of Western Australia and the local community. It is important to note that the weir was not designed to take the extra weight of the walk and cycle way and has structural problems, including ‘concrete cancer’, which have reduced its life expectancy.

In 1999, work was done on the weir to reinforce the concrete columns and reduce the safety risk to workers who install and remove the weir boards. It is uncertain how long this has extended the life of the weir.

Replacing the bottom section of the weir would solve the problems associated with a deteriorating structure. It would also allow the weir boards to be replaced with a manageable and safe structure that could be manipulated to disrupt the water column upstream of the weir and prevent anoxic conditions.

This could be coupled with an increase in river flow at critical times to either increase mixing of the water column or to break up any bloom formations that have occurred. The only way to artificially increase flow in the Canning River System is by discharging water from the environmental release points (see Section 2.3.3). These release points are attached to the scheme supply and have a limited volume they can actually discharge into the river.



**Figure 12: Diagrammatical presentation of Option 2 – Installing an hydraulically-controlled weir system to enable improved mixing of the water column**

## Option 3

### Modify central weir boards and supplement summer flow with water from environmental release points

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Disrupts water column and flushes out algal blooms</li> <li>• Easier manipulation of the weir</li> <li>• Channel width maintained</li> <li>• Prevents saline water intrusion upstream of the weir</li> </ul>	<ul style="list-style-type: none"> <li>• Large pulses of fresh water may increase stratification in lower estuary</li> <li>• Increased flushing of nutrients and organic matter into lower reaches</li> <li>• High infrastructure costs</li> <li>• Lower part of the weir (concrete sill) will prevent complete mixing</li> <li>• Uncertainty about life expectancy of the weir. This may be a temporary solution.</li> </ul>

The aim of this option is the same as option 2, increase mixing and prevent conditions leading to algal blooms from occurring. The main difference is that this option suggests that the existing structure should have only the central weir boards modified and to retain the bottom section of the weir. A major disadvantage to this option is the uncertainty about the life expectancy of the weir. To spend money on a deteriorating structure could be viewed as a band-aid solution and uneconomical.

## Conclusion

It is evident that without a change in management approach, the conditions in the Kent Street Weir pool are not expected to improve and algal blooms will persist. Any option for the Kent Street Weir should focus on reducing the frequency and intensity of algal blooms upstream.

Some people want to remove the weir boards permanently and revert back to the natural hydrological regime that existed before the weir was constructed. However, the Canning Catchment has been intensively developed and the Canning Dam was built after the Kent Street Weir was installed so the flow regime in the river has been significantly altered. The rock bar at Fremantle has also been removed, which has increased tidal flushing of the Swan-Canning Estuary. Thus the natural hydrological regime could never be fully restored.

Removing the weir permanently would cause saline stratification in the area upstream of the weir. This would restrict the water column from mixing and thus algal blooms would persist in this area.

Option 3 is not a long-term solution considering the structural problems associated with the concrete pylons of the weir. There was discussion in the SCCP Action Plan (1999) of constructing a new structure next to or near the Kent Street Weir to manipulate flow. This would be an expensive option as the Kent Street Weir would still require upgrading to eliminate the structural problems.

Option 2 appears to be the most viable, long-term solution for the Kent Street Weir. The costs associated with replacing the bottom section of the weir are high but will lead to improved management of the water quality and hydrology of that section of river. The walk and cycle way would still remain.

If the bottom section of the weir is reconstructed, it will need to be designed to flush out bottom or surface waters, depending upon the conditions. Taking bottom water will prevent conditions favourable to blooms and remove the anoxic waters often present in the weir pool. Algal blooms occur near the surface and will often die on contact with saline water. Therefore the ability to remove water from the surface would also be advantageous when a bloom is present. The only concern is that when algal blooms decompose, they lead to anoxic conditions. However, the Canning Estuary downstream of the Kent Street Weir is tidal and is flushed more efficiently than the fresh water section.

The ecological impacts of flushing an algal bloom and/or organic loads downstream need to be determined by the Swan River Trust and approved by the Environmental Protection Authority.

The ability to manipulate the weir boards to improve flushing and oxygenation of the water column will be dependent upon creating a sufficient water level upstream of the Weir. This relates directly to the development of environmental water provisions (EWPs) for the Canning River System (see Section 3.1.2). If the agreed EWPs result in increased summer flow in the Canning River, this may achieve the water levels and mixing required by this option.



Section 3.3			
No.	Recommendation	Proposed organisation	Partner
B1	Retain the function of the Kent Street Weir to maintain <ul style="list-style-type: none"> <li>• ecological values</li> <li>• social values</li> <li>• amenity</li> </ul>		
B2	Obtain an engineering estimate of the structural integrity and life expectancy of the weir and ability to withstand high flows and floods	W&RC	
B3	Conduct a feasibility study on what the impacts would be if a toxic algal bloom and/or high organic loads were released into the lower Canning River	W&RC	
B4	Establish a water quality monitoring site immediately downstream of the Kent Street Weir	W&RC	

### 3.4 Social importance and community involvement

Issue:

*There has been a loss of social focus and importance of the Canning River System.*

*Community awareness and knowledge of river management issues need to be raised to promote behavioural change and community participation in catchment and river management.*

Objective:

*For the broader community to be well informed about important river management issues and take action to protect and enhance the river system.*

Response: what needs to be done to meet this objective?

- Improve the social importance and cultural connection of the community and the river
- Increase community participation in river management and monitoring programs

Many people claim that the social focus of the Canning River System has changed. The Canning River System is a significant element in the landscape for Nyungar communities who lived along the river or on flat land adjacent to it (SRT, 1997). The Canning River, like most waterways, has a special spiritual significance to Nyungars.

The river was also an important cultural icon during European settlement. It was one of the only sources of fresh water for early settlers and was used as an important means of transport. Children once learnt to swim in the Canning River at the base of Wharf Street, Cannington (Richards, 1991).

One look at the Swan River reveals its social importance to the people of Perth, with surrounding property values reaching millions of dollars. However, inappropriate planning along the Canning, Southern and Wungong Rivers has led to properties backing onto to the river instead of facing it. This has resulted in the Canning River System being treated more as a drain than a precious asset to the South-East Corridor.

There are ways of improving the amenity and encouraging community ownership of the Canning River System. The river runs through some of the hottest suburbs in Perth so there is a potential to increase recreational use in certain reaches of the river during summer. This may include swimming, cycling, guided riverwalks and canoeing, but should avoid activities that degrade amenity by reducing water quality or degrade fringing vegetation.

To assist in re-establishing the cultural connection with the Canning River System, the general public should be encouraged to participate in river management projects or monitoring programs. With some training, community members can participate in monitoring and sampling programs. This enables people to understand more about how the river ecosystem functions and how best to manage it.

It is recommended that an ecological health monitoring program be established in the Canning River Catchment. Monitoring ecological health can include the following parameters:

- status of fringing vegetation, erosion and shade
- species diversity and abundance of aquatic life (including macroinvertebrates, fish, frogs, birds, mammals and reptiles)
- water quality

Biological parameters often have more meaning to the general community than water quality concentrations.

Ecological surveys will be required as part of the trial release program proposed for the Canning River System (Section 3.1.3). It is envisaged that the community can become involved in this survey work and this can then be expanded into a monitoring program for the catchment. This information can be reported to the wider community, with the aim of raising awareness and encouraging action.

<b>Section 3.4</b>			
<b>No.</b>	<b>Recommendation</b>	<b>Proposed organisation</b>	<b>Partner</b>
C1	Improve the social focus of the Canning River System by encouraging appropriate community events, facilities and recreational opportunities along the banks of the river	W&RC, CoA, CoG, CoC	UCSW CT, CCCG
C2	Develop and implement an ecological health monitoring program that includes: <ul style="list-style-type: none"> <li>• community involvement in sampling</li> <li>• sampling of biological indicators</li> <li>• a suite of indicators that best monitor the ecological status and/or changes of the catchment</li> <li>• publication of these results in a public awareness campaign (refer to recommendation E1)</li> </ul>	W&RC (Ribbons of Blue)	UCSW CT
C3	Support community projects that are designed to achieve on-ground management and community participation in river management	W&RC, SRT	



*Student from Leeming Senior High School monitoring macroinvertebrates in Booragoon Lake during Ribbons of Blue ‘Snapshot’ 1999 (Photo: F Davies)*

## 3.5 Surface water allocation and management

### Issue

*The Canning River System is still highly utilised for private abstraction. Abstraction peaks during periods of low flow and over-abstraction can contribute to drought.*

### Objective

*Reduce the reliance on the river for abstraction and promote water conservation techniques.*

Response: what needs to be done to meet this objective?

- Promote water conservation techniques and principles
- Encourage land owners to investigate other potential sources of water

Riparian and licensed surface water users who pump water from the river are often blamed for causing the problems associated with low flows. The majority of land owners use this resource responsibly, however the cumulative abstraction from the river during summer does reduce flow.

During February to March 2000, the Water and Rivers Commission conducted a water use survey of the north-eastern bank of the Canning River, between Kent Street Weir and Canning Dam. The results of the survey indicated that the majority of riparian land owners on this side of the river are either under-utilising their allocation or make no use of it at all. The Water and Rivers Commission is in the process of reviewing these licences with the land owners, and reducing their licensed allocation where appropriate.

Historically, many springs in the upper reaches of the Canning River Catchment flowed into the river. The majority of these springs have been diverted into private dams for irrigation purposes. Many land owners along the river believe that this has had a detrimental effect on flows in the Canning River.

### Water conservation

Land owners connected to the Water Corporation's scheme supply are urged to be 'WaterWise'. The WaterWise program encourages people to recognise that we live in a dry climate where water is a precious resource. Scheme users are encouraged to adopt water conservation principles such as planting native species and irrigating between 6pm and 9am.

Similarly, it is recommended that riparian land owners conserve water by following these principles. Surface water is a precious commodity that riparian land owners and licensees are sharing with the environment and the community. Where possible, surface water users should only pump from the river from 6pm and 9am when evaporation rates are low. Surface water should not be used in a wasteful manner. Restricting the area to be irrigated, planting native species and irrigating once every couple of days instead of every day will reduce water use from the river.

### Water reforms and environmental water provisions

The Council of Australian Governments (COAG) Water Law Reform Framework Agreement requires that the environment be formally recognised in the water allocation planning process. As stated in Section 3.1, environmental water provisions (EWPs) will be determined for the Canning River System. Ecological, economic and social values of the river system will be considered when developing EWPs.

The water law reforms that were introduced to Parliament last year, propose to establish water resource management committees. It is envisaged that these committees will replace the existing Canning Wungong Southern Rivers Advisory Committee. Under the proposed reforms, the water resource management committees will develop local rules and policies that will be incorporated into the water resource allocation plan (recommendation A6).

This may include rules on sharing water during periods of drought, controlling activities that impact on the watercourse (i.e. dams) and managing the flow of water to protect the use of streams for recreational activities (W&RC, 1998).

The water resource allocation plan will also include environmental water provisions (EWPs) for the Canning River System. The EWPs will specify how the water will be allocated and managed to meet various needs, including public water supply, private abstraction and water required by the ecological values of the river (ecological water requirements).

### Riparian right

The quantity of water and its use for properties with a riparian right is open to interpretation. The *Rights in Water and Irrigation Act (1914)* states that landowners

with a riparian right may take water free of charge for domestic use for their family and to water stock.

If the freehold title for a property was granted before 1914, the *Rights in Water and Irrigation Act (1914)* states that those lots have a further right to take water for a garden not exceeding 2.0 Ha associated with the dwellings.

However, the Canning River Interim Allocation Policy recommended that all riparian landowners limit irrigation to 0.2 hectares (half an acre) to assist in reducing water use on the Canning River.

During the Canning River water use survey (Allen, unpub.) the majority of land owners who were using in excess of their riparian right were unaware of the restrictions imposed by the Canning River Interim Allocation Policy (W&RC, 1996).

There is clearly a need to clarify if the properties concerned were alienated from the Crown before or after 1914 (Allen, unpub) and for the Water and Rivers Commission to publicise the meaning of ‘riparian right’ and its entitlement to water.

### 3.6 Reducing nutrient export

Issue:

***Nutrients from a variety of land uses are leaching in to the river, contributing to algal blooms. Improved land use management is required to prevent nutrients, contaminants and turbid water entering the river system.***

### Objective

***Improve water quality entering the river by promoting best management practices and encourage the community to understand the link between human activity and the health of the river.***

Response: what needs to be done to meet this objective?

- Promote the use of best management practices for all land uses
- Support existing projects that aim to raise awareness of what individuals and business can do to reduce nutrient export

The Canning River Catchment supports a variety of different land uses and a large population. Nutrient and pollutant loss from the catchment will depend upon how the land is managed. There are many simple techniques land owners can use to reduce nutrient and pollutant loss from their properties.

Best management practices (BMPs) are specific for each type of land use or development. It is a generic term that refers to the techniques and practices land owners or managers can use to prevent pollution. For example, BMPs for mechanical workshops may include bunding oil and fuel, appropriate storage and recycling of liquid waste and appropriate storage and recycling of car batteries. BMPs for agricultural/horticultural activities may include fertiliser management, planting of windbreaks and soil amendment.

Section 3.5			
No.	Recommendation	Proposed organisation	Partner
D1	Require land owners to evaluate what best management practices they could use before being re-issued licences on the Wungong Brook-Southern River	W&RC	
D2	Include water efficiency conditions on Surface Water Licences when licences are re-issued	W&RC	
D3	Develop a long-term incentive scheme that encourages riparian and licensed users to use water from the main scheme supply	W&RC	WC
D4	Clearly define the riparian right entitlement and promote this through a leaflet for riparian land owners that includes best management practices for irrigation and up to date information on licensing and water reforms	W&RC	

Provision of information is an important aspect of water quality protection. It is important that this information is widely available to residents, industries, commercial ventures and developers. Many people realise the need to protect our waterways but may be unaware of the contribution they make to river degradation or what they can do to prevent it.

A number of projects are under way in the Canning Catchment that aim to provide relevant information to land and business owners so they can make an informed decision about their actions.

One of these projects is the Swan-Canning Industry Project. This project aims to promote BMPs that can be used by industry in order to prevent pollution of nearby drains and waterways. A core component of this is professional training for small business owners and local government officers. This training highlights the risks various chemicals have on the environment and how they should be stored, used and disposed of to prevent pollution.

To reduce the loss of nutrients from farm land in the Swan-Canning Catchment, Agriculture Western Australia are training farmers and small property owners how to design and implement their own farm plan. Not only will this reduce nutrient and possibly sediment loss from individual properties but it will also save the land owner money in fertiliser costs and erosion control.

In residential areas, many people do not realise that they may contribute to the pollution of the river. Diffuse pollution is the main source of nutrients and pollutants in the Canning River System. Over-fertilised lawns, overflowing septic tanks, domestic detergents from car washing and animal waste all contribute to the pollution of the river.

A number of projects have been set up by concerned residents that aim to raise the awareness of water quality protection in the general community. The Yellow Fish Road Program is a stormwater drain awareness program that paints yellow fish above roadside drain inlets, encouraging local residents to establish the connection between the stormwater system and our rivers.

The Phosphorus Awareness Project was established in the Canning Catchment and aims to protect water quality by promoting appropriate fertiliser practices for soil types found in the region and identifying the connection between residential properties, the stormwater drainage system and the Canning River (Sampson, unpub.).

## Best management practices for public land

Local parks and public open space are highly visual and are often seen as setting an example to the local community of how land should be managed. Over-watering and over-fertilising is costly and sets a poor example. The assessment and application of nutrients in their correct amounts can reduce nutrient runoff greatly.



*Light industry spill kit, used for containing chemical spills*

Soil and leaf tissue analysis determines the amount of fertiliser required for optimum plant growth. This reduces the amount of wasted fertiliser that would otherwise runoff or infiltrate to the nearest drain or waterway. This technique is currently used by some land owners and local government authorities in the Canning Catchment.

Deciduous trees are ideal for certain gardens, allowing sunlight into buildings during winter and providing shade in summer. However if they are planted in locations where their leaves can make their way into drains and rivers they can cause problems. When the leaves decompose in water they consume oxygen and add to the nutrient loading in the river.

## 3.7 Drainage management

Issue:

*Many tributaries have been modified into drainage networks. This has led to a loss of tributary habitat, biodiversity, loss of landscape amenity and recreational opportunity, and ability to process nutrients. Drains can have ecological value and assist in water quality protection if they are appropriately designed and maintained.*

Objective:

*Improve the ecological value, recreational opportunity and aesthetics of modified waterways and drains.*

Response: what needs to be done to meet this objective?

- Where possible, return modified watercourses to living streams
- Identify sub-catchments that contribute high pollutant loads and determine effective treatments that can be used to reduce these pollutant loads



### Section 3.6

No.	Recommendation	Proposed organisation	Partner
E1	<p>Trial a 'clean up our river' campaign in the Canning Catchment. Begin with promotional material in the local papers. This should include:</p> <ul style="list-style-type: none"> <li>• best management practices for a variety of land uses</li> <li>• ecological status report (refer to recommendation C2)</li> <li>• facts about river systems including historical information</li> <li>• a survey of community attitudes at the commencement and finish of the campaign</li> </ul>	W&RC	UCSW CT, CCCG
E2	Promote the Swan River Action Program (Adult Awareness Program) in the Canning Catchment	SRT	UCSW CT, CCCG
E3	Support effective existing community projects that focus on water quality protection and raise awareness of best management practices in residential areas	W&RC, WC	
E4	Distribute small property manual 'The land is in your hands' to all ratepayers in special rural and rural areas	AgWA, W&RC	CoA, CoG, CoC
E5	Actively encourage participation in Agriculture WA property management workshops to promote BMPs for small landholdings	AgWA	W&RC, SRT, UCSW CT
E6	Develop and promote a user-friendly chart that recommends the most effective types of fertilisers and mulches to use in the Canning Catchment, based on soil types	W&RC	CCCG AgWA
E7	Hold a training course for retail nursery staff to promote the guide outlined in recommendation E6	W&RC	
E8	<p>Support the following recommendations of the Swan-Canning Industry Project:</p> <ul style="list-style-type: none"> <li>• develop a framework to facilitate local government management of local light industry pollution issues</li> <li>• promote best management practice in pollution prevention as the preferred approach to managing environmental risks</li> <li>• increase industry participation in the adoption of simplified environmental management systems as part of their operational processes</li> </ul>	SRT	CoA, CoG, CoC
E9	Develop and adopt a drainage and nutrient management plan or guidelines for all grassed public open space areas as a joint Council initiative. Where new areas of grassed public open space are being created, provide developers with these guidelines	CoA, CoG, CoC	
E10	Promote the use of local native species in landscaping the land managed or to be managed by the local government authority	CoA, CoG, CoC	
E11	Adopt and implement a policy of cleaning up leaves dropped by deciduous trees before they enter stormwater systems connected to the river and its tributaries	CoA, CoG, CoC	

## Living streams

Although we may not be able to return many of these modified watercourses back to their natural form, they can be modified to create a system that supports aquatic life and improves the quality of water entering the Canning River, whilst still maintaining the function of conveyance.

Turning a drain into a 'living stream' is a simple process whereby weeds are removed and native fringing vegetation is reintroduced. This has a multitude of benefits including:

- an increase in stream cover and lower water temperatures, hence less algal growth
- increase in nutrient uptake by fringing vegetation
- trapping of sediments by sedges and rushes
- provision of wildlife habitat
- reduction in velocity/erosive capacity of water
- bank stabilisation

In addition to nutrient and sediment removal, living streams have the potential to increase biological diversity, ecological structure, conservation values and aesthetic values of unsightly drains.

## Drain retrofitting

Existing drainage systems are not designed to improve water quality. They basically transport poor water quality runoff from the catchment to the river. However, these drainage systems can be 'retrofitted' to include litter racks, sediment traps, often at a small cost.

The installation of constructed wetlands and continuous deflective separators is likely to significantly improve water quality. The cost of these treatments may be high, but if they are designed and maintained properly, they may significantly improve the water quality entering the Canning River System. This can be weighed up against the cost that the community must absorb with continuous poor water quality and frequent algal blooms in the river system itself.

Retrofitting trials are being conducted Statewide. Mills Street Drain flows into the Canning River downstream of the Kent Street Weir and will undergo retrofitting in the near future.

Modifying drains and incorporating changes into the existing drainage network is not a simple task. Many of the drains in the Canning Catchment are local government drains that lead into the Water Corporation's main drainage network. To modify these drains requires an integrated approach from local government and the Water Corporation. The cost associated with modifying an existing drain is higher than the cost of constructing a new, environmentally sensitive drainage network. For this reason best management practices need to be considered in the initial plan of any urban development.

To prioritise drain retrofitting in the Canning River Catchment the drains that are contributing the highest load of pollutants need to be identified. This can be determined by looking at existing water quality data and identifying catchments that have land uses with the potential to contribute high nutrient loads.



*Menzies Drain, Cannington: an example of a drain being modified into a 'living stream' Photo: R Paice*

### Section 3.7

No.	Recommendation	Proposed organisation	Partner
F1	Establish a 'living stream' demonstration site upstream of Kent Street Weir and assess the effectiveness of streamlining drains in urban catchments	W&RC	UCSW CT, WC
F2	Support a student project at a Western Australian University to monitor and report on the water quality and ecological health at this demonstration site and existing living stream sites in the Canning Catchment, including Bannister Creek and Southernwood Creek	W&RC	CCCG
F3	Implement the principles of living streams where appropriate as opposed to piping open drains	CoA, CoG, CoC	
F4	Identify drainage sub-catchments that contribute significant pollutant loads to the main river channel based on: <ul style="list-style-type: none"> <li>• land use and land capability</li> <li>• modelling, Geographic Information System (GIS)</li> <li>• snapshot sampling</li> <li>• known erosion points</li> </ul>	CoA, CoG, CoC	W&RC
F5	Map local government drainage networks starting with priority sub-catchments	CoA, CoG, CoC	
F6	Using the 'Middle Canning Catchment Strategy: Stages 1 and 2' and the 'Urban Water Management Project: South East Corridor' and the results from F4, develop a summary document that outlines: <ul style="list-style-type: none"> <li>• priority drainage sub-catchments for retrofitting</li> <li>• effective treatments to use in retrofitting taking the physical characteristics of the Canning Catchment into account</li> <li>• costs associated with retrofitting options</li> </ul>	W&RC	CoA, CoG, CoC
F7	Engage Keep Australia Beautiful to conduct an annual litter audit of priority sub-catchments on Tidy WA Day by: <ul style="list-style-type: none"> <li>• noting and analysing litter and debris entering the stormwater system</li> <li>• publicising the results through recommendation E1</li> </ul>	W&RC	
F8	Conduct a survey of local drainage maintenance and determine where maintenance practices, particularly sediment removal may require upgrading/revision	CoA, CoG, CoC	
F9	Ensure dry street sweeping is conducted in preference to wet street sweeping. Street sweeping should be encouraged to occur in priority sub-catchments prior to the first flush to remove pollutant build up and prevent litter and debris from entering the waterways	CoA, CoG, CoC	
F10	Review design guidelines for new Water Corporation drains to ensure they are consistent with the 'Middle Canning Catchment Strategy: Stages 1 & 2', 'Urban Water Management Project: South East Corridor' and WRC Manual for Managing Urban Stormwater Quality in WA	WC	



### 3.8 River restoration and rehabilitating fringing vegetation

Issue:

***Fringing vegetation has been lost through stock grazing, human development and the creation of drains.***

Objective:

***Re-establish river banks with fringing vegetation.***

Response: what needs to be done to meet this objective?

- Support community groups and local government authorities in river restoration
- Hold training courses for interested members of the community
- Prioritise revegetation and restoration works

Fringing vegetation discourages algal growth, increases nutrient uptake, provides woody debris to the river channel, increases biodiversity and reduces water temperature. It is integral that river restoration focuses on replacing native fringing vegetation along the Canning, Southern and Wungong Rivers. This will be especially beneficial for

the Southern River, which was largely denuded of fringing vegetation in its middle reaches.

River restoration is an evolving art that involves much more than planting trees. It requires careful planning, including:

- recognition of site characteristics and hydrological zone
- consideration of channel form
- site stabilisation
- weed removal and control
- consideration of regional stream ecology
- appropriate plant species selection
- stock and people control
- maintenance (ie. weeds)
- monitoring and evaluation

Since river restoration is an evolving discipline, it is recommended that groups and individuals liaise with officers experienced in river restoration techniques prior to commencing large projects. There may also be some approvals that need to be obtained from the Swan River Trust or under the Aboriginal Heritage Act when planning a project.



***Tree planting, Todd Place, Huntingdale***

Section 3.8			
No.	Recommendation	Proposed organisation	Partner
G1	Encourage and support each local government authority in acquiring skills in river restoration and revegetation techniques	W&RC	SRT
G2	Request that Job Description Forms for Horticultural Officers and/or Parks and Gardens staff include rehabilitation skills and an interest in environmental issues as desirable criteria	CoA, CoG, CoC	
G3	Include Horticultural Officers, Parks and Garden staff and/or Environmental Officers from each LGA on the Swan Catchment Centre's 'Environmental Educators Network' list, so that they are informed of upcoming events and training workshops on natural resource management	W&RC	
G4	Provide support and coaching to new and existing community volunteer groups. Assist groups in acquiring the technical skills and confidence they require to initiate and/or participate in river restoration works	W&RC	
G5	Organise a property planning course for riparian land owners that focuses on riparian management issues including: <ul style="list-style-type: none"> <li>• weed control and disposal techniques</li> <li>• river restoration principles</li> <li>• erosion control</li> </ul>	AgWA	UCSW CT, W&RC
G6	Support community projects that aim to re-establish woody debris in the rivers	W&RC	UCSW CT
G7	Using the results of the foreshore assessment surveys; <ul style="list-style-type: none"> <li>• prioritise revegetation and weed removal works</li> <li>• develop a revegetation strategy for these priority areas</li> <li>• organise and conduct on-ground works</li> </ul>	W&RC	UCSW CT

### 3.9 Restoring river pools

Issue:

*River pools are an important summer refuge and habitat for aquatic and terrestrial flora and fauna. River pools have been lost due to sedimentation and modification of the flow regime.*

Objective:

*Re-establish deep river pools in the Canning River System.*

Response: what needs to be done to meet this objective?

- Map the location of river pools that have been filled through the process of sedimentation
- Determine the most appropriate method of removing sediment deposits from river pools

Preventing erosion is the best cure for sedimentation in rivers. Many of the sediment deposits in the Canning River System are a result of human development, including roads, subdivisions and stormwater drains.

The City of Armadale are currently producing an 'Erosion Prevention and Sediment Control Manual' that focuses on how to prevent erosion from earth disturbing activities by taking into account the local conditions of the Upper Canning Catchment.

Lloyd (1997) found that much could be done to reduce erosion in the Canning Catchment. The impacts that erosion can cause are not well understood and even where erosion control measures are used, they are often inadequate (Lloyd, 1997). The cost of erosion control is often minimal and can be incorporated into the costs of new developments (ie. meshing around building developments).

There has been some discussion of what to do with the existing sediment deposits in river pools. The current



flow in the river is inadequate to enable natural flushing of pools. To re-establish the pools in the river, river restoration is required.

The installation of woody debris above river pools may increase the velocity of water and scour of the pools and is being considered as part of the trial release program proposed for the Canning River (see Section 3.1.3). Removing sediment may be another option, however this requires careful consideration.

Any attempt at sediment removal should be careful not to trigger an erosion event or cause down-cutting of the river channel. However, sediment removal may have a place in river restoration if carefully planned and may enable us to understand the rate of sedimentation in the Canning River System.

### 3.10 Incorporating best management practices into developments

Issue:

***Urban development in the Canning Catchment is growing at a rapid rate. Development often results in increased nutrient export if best management practices are not incorporated into developments.***

Objective:

***Encourage the use of efficient best management practices in new developments to reduce nutrient and pollutant export.***

Response: what needs to be done to meet this objective?

- Promote professional training in water sensitive urban design (WSUD)
- State and local policies and legislation need to incorporate WSUD as a requirement of all new developments.

Urban development in the Perth metropolitan area is growing at a rapid rate. Urban development has historically resulted in excess nutrients, sediment and pollutants entering aquatic systems.

All land use planners, developers, engineers and consultants need to understand and be able to incorporate the principles of WSUD into new developments. This will go a long way to ensuring that there is improved drainage design and maintenance to assist in protecting water quality.

### Legislation and policy

Education and training is a key element in protecting water quality in our waterways. However, a mix of regulatory and non-regulatory mechanisms is likely to be required to achieve an improvement in water quality in the Canning River System.

There are many Acts, policies and regulations with a focus on water quality protection in Western Australia. However there is no legislation dealing principally with stormwater management or that requires developers or local governments to comply with water sensitive urban design criteria (W&RC, 1997b).

The current philosophy of water quality protection allows a substance to enter a waterbody, as long as the concentrations of the pollutant fall within the range of contaminant acceptability (i.e. ANZECC guidelines, 1992).

These guidelines for acceptable limits of pollutants may not consider the multiple stresses of each system. The Water and Rivers Commission has considered the establishment of a Stormwater Quality Coordinating Committee that would be responsible for the development of a strategy that identifies water quality criteria amongst other things. These water quality criteria could be determined on a case by case basis for each catchment, taking into consideration other stresses in the system (i.e. modified flows).

Section 3.9			
No.	Recommendation	Proposed organisation	Partner
H1	Map sedimentation and erosion 'hot spots' in the main river channel of the Canning, Southern and Wungong Rivers. Identify tributaries that contribute/have the potential to contribute high sediment loads to the rivers	W&RC	
H2	Establish a trial of removing a sediment deposit from a river pool in the main river channel of the Canning, Southern and Wungong Rivers and monitor the extent of sedimentation over time	W&RC	UCSW CT

### Section 3.10

No.	Recommendation	Proposed organisation	Partner
11	Organise a catchment-based workshop on urban stormwater quality and design specifically for the Canning Catchment. This will be a forum for Local Government staff, stormwater design and maintenance contractors/consultants, planning consultants, land owners , engineers and Water Corporation staff to workshop specific catchment issues	W&RC	CoA, CoG, CoC
12	Seek formal accreditation for professionals attending the Urban Stormwater Quality Workshop with the Australian Institute of Landscape Architects and the Australian Parks and Leisure Institute	W&RC	
13	Arrange for 'Managing Urban Stormwater Quality' to form part of the curriculum for all Planning, Engineering, Environmental Science and Landscape Architect Courses at Western Australian Universities	W&RC	
14	Place 'A Manual for Managing Urban Stormwater Quality in Western Australia' on the Water and Rivers Commission website	W&RC	
15	Send the pamphlet outlining principles of 'Managing Urban Stormwater Quality in Western Australia' to local government, developers, planners and consultants who work in the Canning Catchment	W&RC	
16	Establish an interagency Stormwater Quality Coordinating Committee to: <ul style="list-style-type: none"> <li>• set policy</li> <li>• ensure inter-agency consultation</li> <li>• develop design criteria for drainage networks</li> <li>• determine water quality criteria for new and existing drainage networks</li> <li>• determine how to effectively enforce the water quality criteria</li> </ul>	W&RC	WC, WAMA, MfP, DEP
17	The Stormwater Quality Coordinating Committee should develop a Statement of Planning Policy that recognises and adopts WSUD	MfP	
18	Councils to include a provision in Town Planning Schemes that requires the developer to demonstrate that the principles of water sensitive urban design (WSUD) have been incorporated into the drainage design	CoA, CoG, CoC	
19	Require new developments to have best management practice drainage treatment systems to remove gross pollutants, sediment and debris at the source (e.g. continuous deflector separators) as conditions of approval	CoA, CoG, CoC	



*Stormwater detention basin*

# Section 4. Management programs

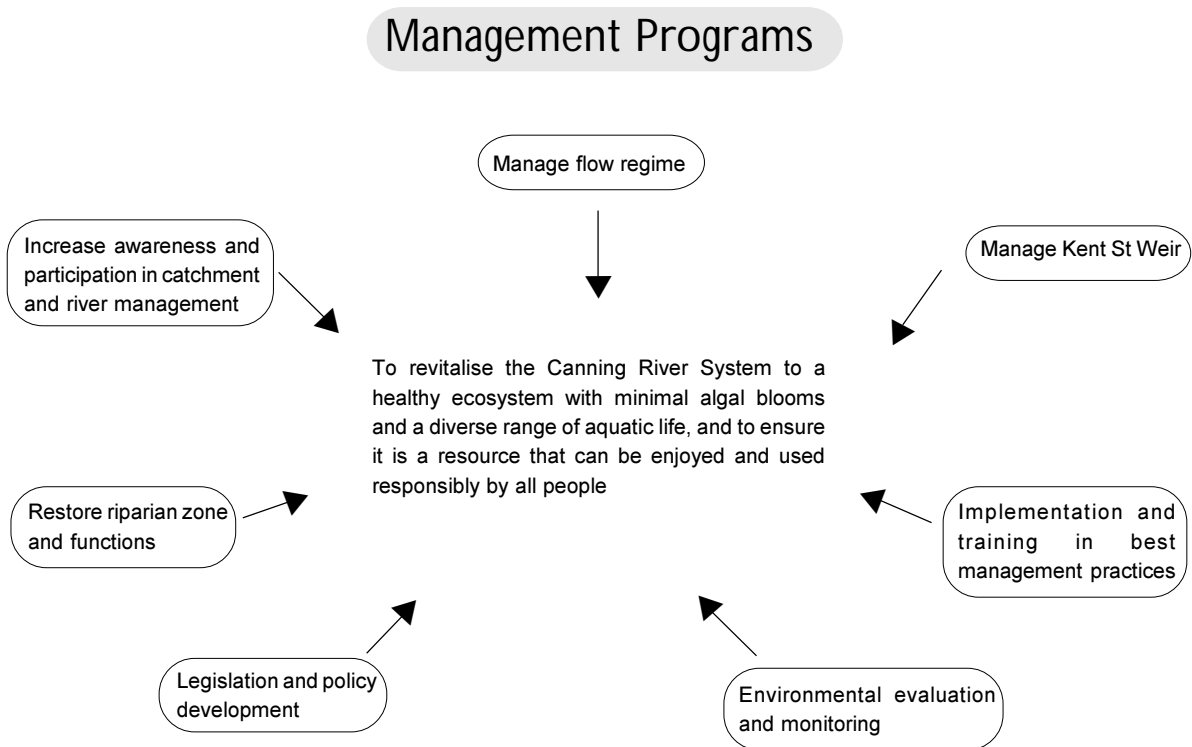
The recommendations listed in Section 3 have been grouped into seven management programs, that aim to achieve the vision of this plan. Grouping the recommendations into defined management programs will assist in their implementation by focusing the recommendation on a desired outcome.

Each of the proposed recommendations have been assigned against an organisation that is considered to have key responsibilities in a particular area. It will be the responsibility of each of these organisations to facilitate the implementation of specific recommendations contained within the plan, in consultation with key stakeholders. In order for the plan to be successfully implemented it will

require a coordinated approach with a number of organisations and groups working together in partnership to achieve the vision identified in the plan.

This section also outlines how the recommendation may be implemented and any costs associated with implementing the recommendation.

This plan is intended to guide certain aspects of river management in the Canning Catchment for the next five years. It is assumed that after this time the recommended actions and management programs will need to be revisited by the major stakeholders operating in the catchment at that time.



No.	Recommendation	Comments	Proposed organisation	Partner/s	Associated costs
<b>MANAGEMENT PROGRAM 1 — <i>Manage the flow regime</i></b>					
A1	The Canning River System should be maintained as permanently flowing waterway and the quantity released from the environmental release points should never be less than historically released		W&RC	WC	
A2	In consultation with stakeholders, develop and implement a trial release program at selected sites in the Canning River System during 2001-2002 and report on the results of this trial release		W&RC	WC	Salary costs
A4	Staff gauges (water level markers) need to be installed to calculate water levels and flow volumes during the trial release		W&RC	WC	
A5	Determine Environmental Water Provisions (EWPs) for the Canning River System following the process outlined in Figure 10		W&RC	WC	Salary costs
A6	Incorporate the EWPs into a water resource allocation plan for the Canning River System		W&RC		Salary costs
A7	Investigate the ability to provide a release from near the dam wall on Wungong Brook to maintain summer flows between the Wungong Dam and the release point at South Western Highway		W&RC	WC	Salary costs
A8	Investigate if additional environmental release points are required on the Southern-Wungong Rivers to attain recommended EWPs in all parts of the system. Evaluate the cost of additional releases		W&RC	WC	Salary costs
A9	Review the EWPs as required, taking into account results of the monitoring program		W&RC		
D3	Develop a long-term incentive scheme that encourages riparian and licensed users to use water from the main scheme supply		W&RC	WC	
<b>MANAGEMENT PROGRAM 2 — <i>Manage the Kent Street Weir</i></b>					
B1	Retain the function of the Kent Street Weir to maintain <ul style="list-style-type: none"> <li>• ecological values</li> <li>• social values</li> <li>• amenity</li> </ul>				
B2	Obtain an engineering estimate of the structural integrity and life expectancy of the weir and ability to withstand high flows and floods		W&RC		Consultant engineer
B3	Conduct a feasibility study on what the impacts would be if a toxic algal bloom and/or high organic loads were released into the lower Canning River		W&RC		
B4	Establish a water quality monitoring site immediately downstream of the Kent Street Weir		W&RC		Water quality analysis



No.	Recommendation	Comments	Proposed organisation	Partner/s	Associated costs
<b>MANAGEMENT PROGRAM 3 — Implementation and training of best management practices</b>					
E5	Actively encourage participation in Agriculture WA property management workshops to promote BMPs for small landholdings		AgWA	W&RC, SRT, UCSWCT	
E7	Hold a training course for retail nursery staff to promote the guide outlined in recommendation E6	Liaise with TAFE to incorporate training into an existing unit. Negotiate with TAFE to obtain accreditation	W&RC		Salary costs
E8	Support the following recommendations of the Swan-Canning Industry Project: <ul style="list-style-type: none"> <li>develop a framework to facilitate local government management of local light industry pollution issues</li> <li>promote best management practice in pollution prevention as the preferred approach to managing environmental risks</li> <li>increase industry participation in the adoption of simplified environmental management systems as part of their operational processes</li> </ul>		W&RC	SRT, CoA, CoG, CoC	Salary costs, training courses,
E9	Develop and adopt a drainage and nutrient management plan or guidelines for all grassed public open space areas as a joint Council initiative. Where new areas of grassed public open space are being created, provide developers with these guidelines		CoA, CoG, CoC		Salary costs
E10	Promote the use of local native species in landscaping the land managed or to be managed by the local government authority		CoA, CoG, CoC		Salary costs
E11	Adopt and implement a policy of cleaning up leaves dropped by deciduous trees before they enter stormwater systems connected to the river and its tributaries		CoA, CoG, CoC		Salary costs
D1	Require land owners to evaluate what best management practices they could use before being re-issued licenses on the Wungong Brook-Southern River		W&RC		Salary costs
D2	Include water efficiency conditions on Surface Water Licences when licences are re-issued		W&RC		Salary costs
F6	Using the 'Middle Canning Catchment Strategy: Stages 1 and 2' and the 'Urban Water Management Project: South East Corridor' and the results from F4, develop a summary document that outlines: <ul style="list-style-type: none"> <li>priority drainage sub-catchments for retrofitting</li> <li>effective treatments to use in retrofitting taking the physical characteristics of the Canning Catchment into account</li> <li>costs associated with retrofitting options</li> </ul>	Refer to Busselton stormwater concept plan	W&RC	CoA, CoG, CoC	Salary costs Investigate funding opportunities

No.	Recommendation	Comments	Proposed organisation	Partner/s	Associated costs
<b>MANAGEMENT PROGRAM 3 — Implementation and training of best management practices (cont)</b>					
F8	Conduct a survey of local drainage maintenance and determine where maintenance practices, particularly sediment removal may require upgrading/revision		CoA, CoG, CoC		Salary costs
F9	Ensure dry street sweeping is conducted in preference to wet street sweeping. Street sweeping should be encouraged to occur in priority sub-catchments prior to the first flush to remove pollutant build up and prevent litter and debris from entering the waterways		CoA, CoG, CoC		
F10	Review design guidelines for new Water Corporation drains to ensure they are consistent with the 'Middle Canning Catchment Strategy: Stages 1 & 2', 'Urban Water Management Project: South East Corridor' and WRC Manual for Managing Urban Stormwater Quality in WA	This review should include batter slopes to reduce the erosion and slumping currently occurring	WC		Salary costs
G1	Encourage and support each local government authority in acquiring skills in river restoration and revegetation techniques		W&RC	SRT	
G4	Provide support and coaching to new and existing community volunteer groups. Assist groups in acquiring the technical skills and confidence they require to initiate and/or participate in river restoration works	Implement through workshops and hands-on training days	W&RC		Salary costs, workshops
G5	Organise a property planning course for riparian land owners that focuses on riparian management issues including: <ul style="list-style-type: none"> <li>• weed control and disposal techniques</li> <li>• river restoration principles</li> <li>• erosion control</li> </ul>		AgWA	UCSWCT, W&RC	Salary costs, workshops
I1	Organise a catchment-based workshop on urban stormwater quality and design specifically for the Canning Catchment. This will be a forum for local government staff, stormwater design and maintenance contractors /consultants, planning consultants, land owners, engineers and Water Corporation staff to workshop specific catchment issues		W&RC	CoA,CoG, CoC	Salary costs, consultants (subsidise with minimal fee for attending workshop) Investigate funding opportunities
I2	Seek formal accreditation for professionals attending the Urban Stormwater Quality Workshop with the Australian Institute of Landscape Architects and the Australian Parks and Leisure Institute	Already accredited with Royal Australian Planning Institute and Aust. Institute of Engineers	W&RC		
I3	Arrange for 'Managing Urban Stormwater Quality' to form part of the curriculum for all Planning, Engineering, Environmental Science and Landscape Architect Courses at Western Australian Universities		W&RC		Salary costs

No.	Recommendation	Comments	Proposed organisation	Partner/s	Associated costs
<b>MANAGEMENT PROGRAM 4 — <i>Environmental evaluation and monitoring</i></b>					
A3	<p>Conduct an appropriate sampling program to measure the effectiveness of the trial release program. This program should sample for the following parameters:</p> <ul style="list-style-type: none"> <li>• water quality</li> <li>• erosion and sedimentation downstream of environmental release points</li> <li>• aquatic invertebrates</li> <li>• fish species populations and structure</li> </ul> <p>This monitoring program can form part of the ecological health monitoring program outlined in recommendation C2</p>	Seek external research grant	W&RC	WC	Salary costs Consultants Investigate funding opportunities
F2	Support a student project at a Western Australian University to monitor and report on the water quality and ecological health at this demonstration site and existing living stream sites in the Canning Catchment, including Bannister Creek and Southernwood Creek		W&RC	CCCG	Salary costs (support)
F4	<p>Identify drainage sub-catchments that contribute significant pollutant loads to the main river channel based on:</p> <ul style="list-style-type: none"> <li>• land use and land capability</li> <li>• modelling, Geographic Information System (GIS)</li> <li>• snapshot sampling</li> <li>• known erosion points</li> <li>• Involve a WA University</li> <li>• Identify and appropriately deal with any pollution point sources whilst obtaining this information</li> </ul>		CoA, CoG,	W&RC CoC	Salary costs, sampling
C2	<p>Develop and implement an ecological health monitoring program that includes:</p> <ul style="list-style-type: none"> <li>• community involvement in sampling</li> <li>• sampling of biological indicators</li> <li>• a suite of indicators that best monitor the ecological status and/or changes of the catchment</li> <li>• publication of these results in a public awareness campaign (refer to recommendation E1)</li> </ul>	<p>Links to sampling program required for trial release program (Recommendation A3)</p> <p>Involve community in survey sampling</p>	W&RC (Ribbons of Blue)	UCSWCT	Seek funding grant
H1	Map sedimentation and erosion 'hot spots' in the main river channel of the Canning, Southern and Wungong Rivers. Identify tributaries that contribute/have the potential to contribute high sediment loads to the rivers	River survey - identify origin of sediment where possible	W&RC		Salary costs
F5	Map local government drainage networks starting with priority sub-catchments		CoA, CoG, CoC		Salary costs

No.	Recommendation	Comments	Proposed organisation	Partner/s	Associated costs
<b>MANAGEMENT PROGRAM 5 — <i>Restore riparian zone</i></b>					
F1	Establish a 'living stream' demonstration site upstream of Kent Street Weir and assess the effectiveness of streamlining drains in urban catchments	Select a highly visual drain	W&RC WC	UCSWCT,	Salary costs, seek funding grant
F3	Implement the principles of living streams where appropriate as opposed to piping open drains		W&RC	UCSWCT	
G6	Support community projects that aim to re-establish woody debris in the rivers				
G7	Using the results of the foreshore assessment surveys; <ul style="list-style-type: none"> <li>• prioritise revegetation and weed removal works</li> <li>• develop a revegetation strategy for these priority areas</li> <li>• organise and conduct on-ground works</li> </ul>		W&RC	USCWCT	Investigate funding opportunities
H2	Establish a trial of removing a sediment deposit from a river pool in the main river channel of the Canning, Southern and Wungong Rivers and monitor the extent of sedimentation over time		W&RC	UCSWCT	Investigate funding opportunities
<b>MANAGEMENT PROGRAM 6 — <i>Increase awareness and participation in catchment and river management</i></b>					
A10	Increase public awareness through newsletters, pamphlets and catchment groups that developing environmental water provisions forms just one part of the overall river restoration program		W&RC		Salary costs
E1	Trial a 'clean up our river' campaign in the Canning Catchment. Begin with promotional material in the local papers. This should include: <ul style="list-style-type: none"> <li>• best management practices for a variety of landuses</li> <li>• ecological status report (refer to recommendation C2)</li> <li>• facts about river systems including historical information</li> <li>• a survey of community attitudes at the commencement and finish of the campaign</li> </ul>	Survey can link into existing SCCP survey	W&RC	UCSWCT, CCCG	Salary costs, advertising, consultant to conduct survey
E2	Promote the Swan River Action Program (Adult Awareness Program) in the Canning Catchment		SRT	UCSWCT, CCCG	
E3	Support effective existing community projects that focus on water quality protection and raise awareness of best management practices in residential areas		W&RC, WC		Salary costs (support)

No.	Recommendation	Comments	Proposed organisation	Partner/s	Associated costs
<b>MANAGEMENT PROGRAM 6 — Increase awareness and participation in catchment and river management (cont)</b>					
E4	Distribute small property manual 'The land is in your hands' to all ratepayers in special rural and rural areas	Make copies available at saddlery stores, stockfeeders, real estate agents, newsagents	AgWA, W&RC	CoA, CoG, CoC	AgWA to supply 5000 copies, Project Officer to distribute
E6	Develop and promote a user-friendly chart that recommends the most effective types of fertilisers and mulches to use in the Canning Catchment, based on soil types	Work with Nursery Industry Association so that guide is available in local nurseries and retail outlets. Develop guide with TAFE colleges	W&RC	CCCG, AgWA	Salary costs, printing
D4	Clearly define the riparian right entitlement and promote this through a leaflet for riparian land owners that includes best management practices for irrigation and up to date information on licensing and water reforms		W&RC		Salary costs, printing
F7	Engage Keep Australia Beautiful to conduct an annual litter audit of priority sub-catchments on Tidy WA Day by: <ul style="list-style-type: none"> <li>noting and analysing litter and debris entering the stormwater system</li> <li>publicising the results through recommendation E1</li> </ul>		W&RC		
C1	Improve the social focus of the Canning River System by encouraging appropriate community events, facilities and recreational opportunities along the banks of the river	First initiative - Canning River Festival	W&RC, CoA, CoG, CoC	UCSWCT, CCCG	
C3	Support community projects that are designed to achieve on-ground management and community participation in river management		W&RC, SRT		
G2	Request that Job Description Forms for Horticultural Officers and/or Parks and Gardens staff include rehabilitation skills and an interest in environmental issues as desirable criteria		CoA, CoG, CoC		
G3	Include Horticultural Officers, Parks and Garden staff and/or Environmental Officers from each LGA on the Swan Catchment Centre's 'Environmental Educators Network' list, so that they are informed of upcoming events and training workshops on natural resource management		W&RC		



No.	Recommendation	Comments	Proposed organisation	Partner/s	Associated costs
<b>MANAGEMENT PROGRAM 6 — Increase awareness and participation in catchment and river management (cont)</b>					
14	Place 'A Manual for Managing Urban Stormwater Quality in Western Australia' on the Water and Rivers Commission website	Interactive website	W&RC		
15	Send the pamphlet outlining principles of 'Managing Urban Stormwater Quality in Western Australia' to local government, developers, planners and consultants who work in the Canning Catchment		W&RC		Postage
<b>MANAGEMENT PROGRAM 7 — Legislation and policy development</b>					
16	Establish an interagency Stormwater Quality Coordinating Committee to: <ul style="list-style-type: none"> <li>• set policy</li> <li>• ensure interagency consultation</li> <li>• develop design criteria for drainage networks</li> <li>• determine water quality criteria for new and existing drainage networks</li> <li>• determine how to effectively enforce the water quality criteria</li> </ul>		W&RC	WC, WAMA, MfP, DEP	Salary costs
17	The Stormwater Quality Coordinating Committee should develop a Statement of Planning Policy that recognises and adopts WSUD		MfP		Salary costs
18	Councils to include a provision in Town Planning Schemes that requires the developer to demonstrate that the principles of water sensitive urban design (WSUD) have been incorporated into the drainage design		CoA, CoG, CoC		Salary costs
19	Require new developments to have best management practice drainage treatment systems to remove gross pollutants, sediment and debris at the source (e.g. continuous deflector separators) as conditions of approval Interim condition before I8 is implemented		CoA, CoG, CoC		Salary costs

## Section 5. References

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# Section 6. Appendices

## Appendix 1

### Water requirements of individual ecological values

#### Ecological water requirements of macroinvertebrates

Macroinvertebrates are an important component of the river's ecological structure. They break down organic matter and debris, consume algae and are a food source for other organisms.

Many species of macroinvertebrates have life cycles that are dependent on either oxygen-rich water in riffles and/or flows at certain times of the year. There are two main features of flow regimes that influence macroinvertebrate community structure: seasonality and predicability/persistence.

- Seasonality is important because low flows in summer result in higher water temperatures that are needed for reproduction and growth of macroinvertebrates (Humphries *et al.*, 1998). However the problems associated with low flow or no flow include desiccation, de-oxygenation of the water column and accumulation of leaf leachates and pollutants that may have an adverse impact on macroinvertebrates (Storey *et al.*, 2000).
- Predicability/persistence is important, as some species are susceptible to high and variable flows. These species can synchronise their life cycles so that the sensitive life stages (e.g. the larvae of crustaceans or pupating life stages) occur during the dry season. As a consequence unusually high flow volumes during the summer may adversely affect these particular species (Storey *et al.*, 2000).

Riffle zones are important to macroinvertebrate communities. To maintain macroinvertebrate communities in the Canning River, flow needs to be maintained over the top of these riffles.

#### Ecological water requirements of fish

Previous studies have found seven native species and five introduced species of fish in the Canning River System. For all native species found in the Canning River System, there is a need for permanent water.

#### Summary of freshwater fish found in the Canning River System (Storey *et al.*, 2000)

Species	Recorded in 2001	Previously recorded
<i>Galaxias occidentalis</i> (Western minnow)	✓	✓
<i>Edelia vittata</i> (Western pygmy perch)	✓	✓
<i>Bostockia porosa</i> (Nightfish)	✓	✓
<i>Tandanus bostocki</i> Freshwater cobbler	✓	✓
<i>Pseudogobius olorum</i> (Swan River goby, Blue spot goby)	✓	✓
<i>Afurcagobius suppositus</i> (Big headed goby)	✓	✓
<i>Leptatherina wallacei</i> (Swan River hardyhead)	✓	✓
<hr/>		
* <i>Gambusia holbrooki</i> (Mosquitofish)	✓	✓
* <i>Phalloceros caudimaculatus</i> (One-spot livebearer)	✓	✓
* <i>Oncorhynchus mykiss</i> (Rainbow trout)		✓
* <i>Salmo trutta</i> (Brown trout)		✓
* <i>Carassius auratus</i> (Goldfish)	✓	✓

\* *Introduced species*

Each species has its own requirements for flow and/or water levels to assist with breeding, migration and habitat. Knowing the species present in the Canning makes it easier to determine the flow/water levels required and the timing of these.

Species found in the Canning River System require sufficient water levels/flows for (Storey *et al.*, 2000):

#### **Predictable winter/spring flooding must be maintained to ensure breeding success and strong recruitment in western minnow, pygmy perch and nightfish**

Western minnow, pygmy perch and nightfish need fringing vegetation to be flooded so they can spawn. They also require the stimulus of fast flowing waters in tributaries for successful spawning. If water levels fall too soon or fluctuate greatly, eggs laid in inundated areas may be left to dry and desiccate. Flooded vegetation and shallow, flooded off-river areas also provide sheltered nursery areas for growing juveniles.

### **Sufficient water levels to maintain diversity of habitats and migration upstream or downstream**

There are obstacles present in the Canning River System, such as 'V notch' weirs that obstruct the migration of fish. Water levels need to be sufficient in spring to flood these obstacles and allow migratory fish to traverse them. The other option is to install broad-crested weirs or 'fish ladders' that still measure flow but allow migration of aquatic fauna.

### **Predictable flow pattern for the maintenance of Freshwater Cobbler 'nests' and recruitment of estuarine species**

Freshwater Cobbler build 'nests' in pools or areas with slow flow for the female to lay her eggs. Unseasonal or unpredictable high flows during the breeding months of November to January can dislodge these 'nests' and affect breeding success of the Cobbler. Very low flows can also cause harm by exposing these 'nests', leading to desiccation.

Estuarine species are also influenced by river flow. Unpredictable or unseasonal flow will lead to a reduction in suitable habitat for juveniles of migratory marine species such as the commercially fished sea and yelloweye mullet, perth herring, western school prawn and crabs.

### **Flows to discourage the recruitment of introduced Mosquitofish.**

Pusey *et al.* (1989) noted that natural winter flows in unregulated systems reduced the population density of Mosquitofish to low levels. The Mosquitofish is a poor swimmer and large flushing winter flows have the potential to affect the successful recruitment of this aquatic pest.

During spring increased flows are required for:

- fish migration (drowning out of obstructions)
- flooding of fringing vegetation to allow some species to attach eggs, and
- to flood shallow off-river areas to allow them to be used as nursery areas for larval/juvenile species' (Storey *et al.*, 2000).

### **Ecological water requirements of fringing vegetation**

The ecological water requirements of fringing vegetation are the conditions necessary to maintain the health and vigour of plant species and enable them to regenerate (Pen, 1999) and the water levels required to recharge isolated shallow aquifers in the floodplain.

Most species of fringing vegetation are not as susceptible to low flows as macroinvertebrates and fish, however they do need sufficient flow to keep the riparian zone moist. The other aspect of flow that is important to fringing vegetation is flooding (inundation). Many fringing species require inundation of the floodplain to stimulate germination and ensure seedling survival. A lack of floodplain flows over a number of years can lead to a loss of seedling recruitment and opens up the understorey to weed invasion. It is evident this has occurred in the Canning River.

### **Ecological water requirements for channel maintenance**

In-stream flows influence channel form and morphology by scouring out river pools, scouring sediment from riffles and maintaining stream width and depth. Erratic and high winter flows are often required to maintain existing (or active) channel dimensions, and prevent the accumulation of sediment on organic debris in river pools (Storey *et al.*, 2000).

The construction of Canning Dam and the diversion of many scarp tributaries that used to flow into the Canning River System has dramatically reduced river power (Storey *et al.*, 2000) and therefore the magnitude of in-stream flows.

### **Ecological water requirements of waterbirds**

Permanent pools in coastal plain reaches of the Canning River provide refuges for waterbirds, particularly in the summer months (Storey *et al.*, 2000) providing a suitable habitat and food source. Many waterbirds are opportunistic breeders that depend on flooding of shallow floodplains and wetlands for a certain duration within which to complete their breeding cycle (Good, date unknown).

### **Ecological water requirements for ecological processes and energy flows**

High flows are important to ecosystem functioning (e.g. primary production, nutrient spiralling and decomposition). Without high flow or flood events, the productivity of a river system will be affected.

The floodplain contains carbon (leaf litter, debris, terrestrial insects) which is an important source of energy to river systems. It is important that the floodplain is inundated to maintain these riparian linkages with the river channel.

## Appendix 2

### Process used to identify Ecological Water Requirements (EWRs) of the Canning River System

To identify the ecological water requirements the following process was used:

1. Community/stakeholder workshop (December 1999) and consultation with catchment groups to assist in identifying the important ecological values of the river system.
2. Analysis of flow data to determine historical flow rates in comparison to the existing flow rates.
3. Selection of sites (four on the Canning, one on the Southern River and one on Wungong Brook) to conduct field surveys.
4. A survey of channel dimensions and flow rates at selected sites.
5. Qualitative field and literature surveys of fish and macroinvertebrate fauna to determine species presence in the Canning River System.
6. Qualitative field survey of fringing vegetation using the rapid assessment methodology of Pen and Scott (1995).
7. Using the above information, determination of the monthly flows or water levels estimated to maintain the identified ecological values (see Table 1) at a low level of risk (minimum water requirements).

To determine the flow regime needed to maintain these ecological values, the 'holistic approach' developed by Davies *et al.* (1998), was used.

This approach focuses on determining the flow regime required to maintain the ecology and ecological processes of the river, rather than protecting a few important species. The aim of establishing EWRs for the Canning River System is to enhance the key ecological values to enable the river to function as an ecologically healthy system.

After determining the water requirements of each ecological value, channel surveys are undertaken. The channel surveys reveal the dimensions of the river channel and the quantity of water required to meet the EWRs (i.e. inundate the floodplain, scour out sediment and maintain channel width and depth).

Channel surveys were conducted at the following locations:

#### Canning River

- Orlando Street, Kelmscott (Canning River Release No. 4)
- Harry Hunter Drive, Gosnells (WRC gauging station S616027)
- Manning Avenue, Martin (Canning River Release No. 5)
- Albany Highway Bridge, Gosnells (Canning River Release No. 6)

#### Southern Wungong

- South Western Highway Bridge, Wungong (Wungong Brook Release No. 2)
- Anaconda Drive, Gosnells (WRC gauging station S616092)



## Appendix 3 Ecological Water Requirements Workshop

Held at Kelmscott Hall

9<sup>th</sup> December, 1999 (7:30pm to 9:30pm)

Workshop coordinated by Lucy Sands (Water and Rivers Commission ) and Drs Andrew Storey & Peter Davies (Department of Zoology, UWA)

The aim of the workshop was to inform the public of this plan and a specific aspect of that plan, the study on ecological water requirements (EWRs). The workshop was attended by approximately 25 people, mostly riparian landowners.

As part of this workshop, participants were asked to express their main concerns for the river, and to list what they believed to be important values of the river system (Part A).

Issues listed related to EWRs, EWPs and general catchment management. Participants were then asked to vote on what they considered to be the most important issue (Part B).

### Part A. Issues raised at EWR's workshop for the Canning River System

- Drains – there is a lack of infiltration at source and dispersal of runoff
- Sediment in pools, need to identify sources (i.e. drains, agriculture, urban developments, industry)
- Too much water too fast
- What fringing vegetation needs to be put back after weed removal?
- Exotic fish species - first half of century it was goldfish now its Koi who are eating juvenile crustaceans
- No big marron or freshwater cobbler in river
- Weeds need to be removed i.e. arum lily, blackberry, watsonia

- Diversion of Kangaroo Gully has removed/reduced pools and reduced floodplain flows. This has reduced habitat diversity
- Tributaries and creeks have been engineered into drains
- Waterbird breeding – low flows have resulted in deaths at certain times of year
- Pollution and poor water quality from industrial areas
- Channel choked by sediment and weeds – channel difficult to access
- Protection of existing natural vegetation
- Leaching from sanitary disposal site- point source pollution
- Declining recreational opportunities/amenity
- Loss of social focus
- Historically there was more water in the river for recreation
- Roley Pool – sedimentation
- Natural springs have been lost to private abstraction
- Loss of flushing flows
- In-stream habitat – logs causing pools and habitat
- There is increased incision of the river channel
- Costs – who is going to pay for restoration and cleaning it up?
- Conflicts over river front access and ownership
- Weirs/barriers – to flow and fish
- Private abstraction – some inappropriate management practices, inefficient use of water
- Security in future land uses and riparian rights
- Illegal abstraction
- Evaporation from private dams – not shaded, this water used to flow down shaded channel

### Part B. Issues voted-on by workshop participants

Issue	Votes
Weeds need to be removed i.e. arum lily, blackberry, watsonia	9
Security in future land uses and riparian rights	7
No big marron or freshwater cobbler in river	6
Sediment in pools, need to identify sources (ie. drains, agriculture, urban developments, industry?)	6
Private abstraction – some inappropriate management practices, inefficient use of water	6
Channel choked by sediment and weeds – channel difficult to access	3
Natural springs have been lost to private abstraction	2
Loss of flushing flows	2
Illegal abstraction	2
Drains – there is a lack of infiltration at source and dispersal of runoff	1
Tributaries and creeks have been engineered into drains	1
Waterbird breeding – low flows have resulted in deaths at certain times of year	1
Pollution and poor water quality from industrial areas	1
Costs – who is going to pay for restoration and cleaning up?	1