



Our Heritage and Our Future: Health of the Swan Canning River System





VISION
of the
Office of the Auditor General
*Excellence in auditing for the
benefit of Western Australians*

MISSION
of the
Office of the Auditor General
*To improve public sector
performance and accountability
by reporting independently to
Parliament*

**Office of the Auditor General
Western Australia**

7th Floor Albert Facey House
469 Wellington Street, Perth

Mail to:
Perth BC, PO Box 8489
PERTH WA 6849

T: 08 6557 7500

F: 08 6557 7600

E: info@audit.wa.gov.au

W: www.audit.wa.gov.au

National Relay Service TTY: 13 36 77
(to assist persons with hearing and voice impairment)

On request this report may be made available in an
alternative format for those with visual impairment.

© 2014 Office of the Auditor General Western Australia. All
rights reserved. This material may be reproduced in whole or
in part provided the source is acknowledged.

*Acknowledgement: Cover photos one
and three are from the Swan River
Trust.*

ISBN: 978-1-922015-45-7

WESTERN AUSTRALIAN AUDITOR GENERAL'S REPORT

**Our Heritage and Our Future: Health of the
Swan Canning River System**

Report 16
August 2014



**THE PRESIDENT
LEGISLATIVE COUNCIL**

**THE SPEAKER
LEGISLATIVE ASSEMBLY**

OUR HERITAGE AND OUR FUTURE: HEALTH OF THE SWAN CANNING RIVER SYSTEM

This report has been prepared for submission to Parliament under the provisions of section 25 of the *Auditor General Act 2006*.

Performance audits are an integral part of the overall audit program. They seek to provide Parliament with assessments of the effectiveness and efficiency of public sector programs and activities, and identify opportunities for improved performance.

The information provided through this approach will, I am sure, assist Parliament in better evaluating agency performance and enhance parliamentary decision-making to the benefit of all Western Australians.

A handwritten signature in black ink, appearing to read 'C. Murphy'.

COLIN MURPHY
AUDITOR GENERAL
13 August 2014

Contents

- Auditor General’s Overview 4
- Executive Summary 5
 - Overview 5
 - Audit conclusion 6
 - Key findings 6
 - Recommendations 8
 - Agency responses 10
- What Did We Do? 12
- Background 13
 - The Swan Canning river system 13
 - A changing environment 14
 - Threats to river health 14
 - Managing the Swan and Canning rivers and their catchments 15
- What Did We Find? 17
 - Despite two decades of monitoring, planning and intervention, the health of the Swan Canning river system is not adequately protected 17
 - The Swan River Trust manages and funds programs to improve river health but crucial programs have had limited success 21
 - Actions to enhance river health are hampered by gaps in reporting, planning and monitoring 30
- Appendix 1: Agency Responsibilities for Riverpark Management 38

Auditor General's Overview

The Swan Canning river system provides an iconic backdrop to our city. Many of us enjoy its beauty and spend time on the water or along its foreshore. The rivers are an integral part of our history. They form part of the cultural heritage of the Aboriginal people who have lived in this area for millennia and are where Europeans first settled the Swan River colony.



The river system is now significantly challenged by the effects of human activity in the last 170 years. Various state governments have recognised the need for coordinated action to address these challenges. As a consequence, the Swan River Trust was created in 1989 to simplify river management and to coordinate activities which impact the Riverpark.

A key value of the river system is water quality. If this is poor then the rivers' social and economic values are reduced. Monitoring of the Swan and Canning rivers over almost 20 years shows that water quality in the middle and upper reaches is declining, while the lower estuary is in reasonable condition, but is still under threat.

To improve water quality, the Swan River Trust has been working with key stakeholders on a range of projects. For instance, the Swan River Trust works with local government and community groups to construct wetlands and drainage nutrient intervention works. These are designed to capture nutrients and pollutants before they enter the river system.

However, agency responsibilities for river management are complex and often overlap. The Swan River Trust must often negotiate and work with others to achieve results or change practices. This report identifies some key areas where more action is needed if the decline in river health is to be addressed. Appropriate fertiliser use, suitable disposal of chemicals and other contaminants, and better planning of urban developments are important strategies to improve river health.

Experience elsewhere shows that it is possible to improve the health of rivers in urban areas, but this requires concerted and coordinated effort by key stakeholders, and long-term action. More comprehensive and easily understood information about the river's condition would help galvanise support and action to address these issues. Incorporating agency commitments into a River Protection Strategy would provide direction and outcomes that can be monitored by Parliament and the community.

Success will depend upon state agencies, local governments and the private sector being aware of and acknowledging what needs to be done. State government agencies will need to meet their mandated roles.

I would like to acknowledge the many committed volunteers who have given their time to help protect the river. With their continued commitment, as well as that of government and private businesses, we can continue to enjoy the rivers and their surrounds into the future.

Executive summary

Overview

The Swan and Canning rivers flow through the heart of Perth. The rivers provide an important environmental and community resource. In 2004 the Western Australian Government declared the Swan River as the State's 'first heritage icon'.

The impacts of current and past land uses, shallow, slow-moving rivers and streams, combined with sandy soils and a drying climate have made the river system vulnerable to a range of environmental issues.

River health has been of concern from as early as 1880 when the Swan River was used as a 'depository for filth of every kind'. In the 1940s waste from a sewerage treatment plant and urban drains caused algal blooms and noxious odours. In response the State Government set up the Swan River Reference Committee to report to the Minister for Works on 'any matter which it considers detrimental or dangerous to the River or to the use of the River'.

Concern for the fate of the rivers saw the creation of the *Swan River Conservation Act 1958*. Thirty years later the *Swan River Trust Act 1988* established the Swan River Trust (the Trust) in 1989. The Trust was formed to simplify river management, which had become the responsibility of around 30 agencies and Local Government Authorities (LGAs).

The Trust is a state government agency responsible to the Minister for Environment. The Trust has an annual budget of \$18 million and employs around 60 professional and technical staff. The Department of Parks and Wildlife provides administrative support. The Trust works with over 40 state agencies and LGAs that have management responsibilities for the 72 km² of waterways, public land and adjoining river reserves that make up the Swan Canning Riverpark. Universities and community-based groups also contribute significant resources to Riverpark management.

The *Swan and Canning Rivers Management Act 2006* (the Act) provides for a more coordinated and collaborative approach to managing the river system. Under the Act the Trust is responsible to 'protect and enhance the ecological and community benefits and amenity' of the Swan and Canning Development Control Area (DCA) and Riverpark.

To achieve this the Trust must 'coordinate and promote the activities of other bodies that have functions in relation to the catchment area' where these may affect the Riverpark. The Act requires that the Trust prepare an overarching River Protection Strategy (RPS) to outline agency responsibilities for river management and report whether targets are met. All agencies must then work together towards achieving the agreed RPS objectives.

This performance audit examined whether the environmental health of the Swan Canning river system is adequately protected. We assessed whether the Trust has a good knowledge of the health status of the river system, and whether this knowledge is used to prioritise key threats and manage those key threats to protect and enhance the river system.

Audit conclusion

Despite a range of plans, strategies and actions, the Swan Canning river system is not adequately protected. Water quality in the middle and upper Swan and Canning rivers is declining, although some interventions are treating the symptoms of poor health. The lower estuary is in reasonable condition, but is still under threat.

The Trust has a difficult task to protect and enhance the rivers within a complex urban ecosystem and rural catchment. Often the Trust does not directly manage many of the broader scale threats affecting the rivers. Instead it must influence other agencies that are responsible for specific aspects of river management.

Long-term monitoring has provided useful information on trends in river health. However the Trust has not used this information to create a good understanding in the community and Parliament about the decline in the condition of the river.

The Trust's draft RPS has still not been approved seven years after the Act was passed. Further, the draft RPS and other Trust plans do not identify which threats impact most on water quality and the highest priority actions to address these. The Trust has also not set out what needs to be done to return the river to a healthy state and the resources needed to do this.

The Trust has funded local programs to rehabilitate areas next to the river. While these programs will have some impact on nutrients and pollutants flowing into the river, strategies to manage key threats to water quality have been less successful.

Key findings

The condition of the river is declining

- Long-term monitoring by the Department of Water (DoW) shows that water quality in the middle and upper sections of the Swan Canning river system is in moderate to poor condition and declining. This is due to decades of human impact in the catchment and urban areas, and the more recent changes in climate. Of particular concern is the influx of nutrients and organic matter from urban and rural areas. Nutrients have been recognised as a key threat since the 1990s.
- Our drying climate has meant less water flow into the river system and less nutrient run-off from agricultural areas. However, it has also meant less flushing in the upper rivers so that nutrient concentrations have remained high. More nutrients will flow into the river if rainfall levels increase to those experienced previously.
- The water quality in the lower estuary is in reasonable health but there is evidence that all is not well. Seagrass and prawn populations have declined and salinity and water temperature have increased. The lower estuary is subject to similar pressures as the middle and upper sections but the effects are less obvious due to the larger water body and regular flushing by tidal seawater.
- Experience elsewhere shows that it is possible to improve the health of rivers in urban areas. While many river systems still have to achieve their target health status there are two factors common to their success so far. These are the cooperation of key stakeholders and ensuring a long-term commitment to sustainable funding.

Some improvement strategies are working

- A number of direct actions are in place and proving helpful in combating the decline of the river system. These include:
 - collaboration with local governments and community groups has resulted in the construction of wetlands and drainage nutrient intervention works to remove nutrients and pollutants from stormwater, revegetation of bare drains to become 'living streams', and the use of soil 'amendments' to help retain phosphorus in the soil. Ideally these pollution sources should be minimised before they enter the drainage network
 - the Trust and DoW operate four oxygenation plants at a cost of \$1.5 million per year to reduce the effect of high nutrient levels in the river. These programs help prevent algal blooms and fish deaths.

Capacity to manage threats to the river is hampered

- Efforts in the last 20 years to manage key threats have been less successful. The reasons for this are varied but are closely linked to the dispersed and overlapping authority between state government agencies and LGAs. In most instances the Trust can only influence other agencies and organisations rather than act itself. As shown below, action to combat key sources of nutrients and pollutants has not been effective.
 - Urban drains are a year-round major source of pollutants from small to medium-sized industry, agriculture and from domestic sources. No single agency is responsible for overseeing Perth's urban stormwater and drainage system before it enters the river system. Many agencies could influence water quality in their sections of the drainage network, yet no agency is mandated to do so. Once water from local drains enters the river, the Trust and LGAs are left with the difficult task of managing the nutrients and pollutants it carries. Some actions have been taken to reduce these pollutants but these have been insufficient to make any significant difference. Preventing the pollution is generally regarded as more cost effective than treating the polluted river system.
 - Nutrient flow into the river from rural farms has long been recognised as a major source of pollutants. Efforts to date to reduce these nutrients have been largely unsuccessful. Recent strategies have involved visits by the Department of Agriculture and Food WA to a small number of farms in Ellen Brook to demonstrate to farmers that soil testing can often show that they can significantly reduce their use of phosphorus fertilisers. It can also lead to the use of low soluble phosphorus fertiliser, which is less harmful. But, achieving any meaningful change will require greater effort and may also require additional legislation.
 - Development of new urban areas will release significant nutrient loads and other contaminants from the soil and groundwater into the river system unless prevented. The Trust has a role in assessing or providing advice on development proposals and DoW advises on reducing nutrients entering the river system. But, better planning processes would ensure the Trust's advice is obtained for all developments that will significantly impact the rivers and at the most appropriate stage. As mentioned earlier, it is more cost effective to stop nutrients entering the river system than treating the polluted system.

Gaps in planning and reporting limit action to enhance river health

- There has never been comprehensive and easily understood reporting to Parliament and the public on the overall health status of the river system. DoW developed a draft report card on the health of the river in 2011 that would have provided this level of understanding but it has never been published. Without a good understanding of the condition of the river, necessary actions may not be given the priority they need.
- Seven years after the Act was passed, the Trust's RPS has not been approved. An approved RPS would establish goals and targets and specific commitments by individual agencies. The RPS is also a framework to monitor, evaluate, and report on the river systems' health and actions to improve it. We were advised the Minister did not approve the RPS in 2012 due to the imminent State election. It is now on hold pending the amalgamation of the Trust with the Department of Parks and Wildlife.
- The Trust has numerous plans and published reports which comment on threats to the river's health. The Trust's current plans typically outline what can be done in the next five years within existing resources. Yet it has not informed Government of what needs to be done to restore the condition of the river and an estimate of what this might cost. Local Water Quality Improvement Plans go some way towards outlining key threats and actions necessary to improve water quality, though actions are not prioritised or costed. An approved RPS would greatly enhance understanding about threats and enhance the capacity of the Trust to focus actions on the highest priority threats.
- DoW's water quality monitoring is robust and uses similar indicators to that used by other estuarine river managers throughout the world. It is sufficient to determine the status of the estuary and rivers and provide an understanding of the physical, and some biological, functions of the system. More consistent use of biological indicators, smaller-scale monitoring programs and flow gauges would deliver a more comprehensive understanding of the river system.

Recommendations

The Swan River Trust should:

- regularly inform Parliament and the community on the overall health of the river using a comprehensive, and easily understood report
- take necessary action to have the River Protection Strategy adopted
- prioritise key threats to the river's health and the most effective actions to address these
- ensure the indicators and monitoring used are sufficient to report to government on the status of the river, to better understand the changes that occur, and to provide effective management of the river system
- work with agencies and Local Government Authorities to clarify responsibility for managing and maintaining water quality in drains, rivers and tributaries throughout the Perth metropolitan area and the Swan Canning river system and identify the additional resources required to enable this to occur
- work with government, agencies, businesses and the community to effectively reduce contaminants in groundwater and stormwater from entering drains and the river system
- review the Fertiliser Action Plan and Fertiliser Partnership to ensure the most effective combination of strategies from both are implemented to prevent nutrients entering the river system
- work with planning entities, developers and other organisations associated with major developments and land use changes to ensure that its advice on how to minimise nutrient discharge into the drainage and river systems is provided when it is most needed
- work with the Department of Planning to improve role clarity in the administration of planning controls outside the Development Control Area
- improve dialogue with the Department of Planning on the requirements and appropriate interpretation of management guidelines to reduce the release of nutrient and other contaminants into the river system by new developments
- continue the high level of community involvement in protecting and enhancing the river system and in educating the public in ways they can assist.

Agency responses

Department of Water

The Swan Canning River is exposed to a range of stressors associated with the heavily urbanised Swan Coastal Plain catchment and agricultural areas, together with an increasing population and drying climate. The issues are complex and require leadership, coordination and prioritised management informed by good scientific research within available resources.

National and international best practice involving large complex river systems with overlapping responsibilities demonstrates that an essential element in addressing river health problems is an entity responsible to lead and coordinate action. In line with this model the *Swan and Canning Rivers Management Act 2006* (the Act) established the Trust as the responsible agency in the Swan and Canning Rivers. Best practice principles include management efforts coordinated through a strategy outlining actions required and corresponding responsibilities. The Act provides for this through the river protection strategy developed and led by the Trust.

Under the Act the Department of Water's (DoW) role (along with other agencies) is to comply with strategic documents made by the Trust and perform its other legislative functions with due regard to the Act. DoW's functions, enabled by other acts and regulations, include licensing the taking of water; priority groundwater investigations, water measurements and assessments; and providing advice under State Planning Policy 2.9 Water Resources.

DoW delivers an agreed program of scientific and monitoring work, directed and funded by the Trust under a memorandum of understanding (MoU), within available resources. Much of our recent research has focused on understanding the stressors and pressures on the system and in acquiring new data and knowledge to inform management actions. DoW has developed an estuary report card methodology for the Trust to consider, as part of the scientific and technical expertise provided under the MoU. As seagrass is an important indicator of river health, DoW has also developed seagrass assessment reports.

Significant progress has been made, such as successful operation of four oxygenation plants which have supported the Swan ecosystem while broad-scale management plans were developed. Algal blooms and fish kills have declined as a result. The oxygenation plants are an innovative solution, developed and implemented by leading DoW scientists in partnership with international experts from the United States of America and Germany.

The DoW will continue to use its water science expertise and water and land use planning advice to work closely with the Trust, developers, Department of Planning, WA Planning Commission, local governments and others to minimise nutrient discharge from existing and new urban developments and ensure water factors are fully considered early in land planning.

In November 2012 the Trust, Western Australian Local Government Association, DoW and the Water Corporation ratified an Agreement to progress strategic issues relating to urban drainage and water quality within the Swan Canning estuary catchment. One project focusses on improving urban drainage governance and managing the quantity and quality of drainage and flood water. Several projects aimed at improving information availability and collaboration have been progressed to date.

Swan River Trust

The Swan River Trust agrees with the Auditor General's broad conclusion that the Swan Canning river system continues to face a range of environmental pressures.

Many of the Auditor General's recommendations relate to actions that require ongoing, concerted and cooperative actions of a number of State government agencies and stakeholders. In this context it is important to note that the Government has legislation before the Parliament that will see the functions and staff of the Trust amalgamated with the Department of Parks and Wildlife. Many of the actions recommended by the Auditor General, including long-term, cross agency strategies such as the proposed River Protection Strategy, will be finalised and implemented by the amalgamated agency.

The Auditor General's report suggests that the Trust has not prioritised threats and required actions for the Swan and Canning rivers. This is not accepted as a reasonable conclusion. The report at several points notes that "nutrients have been recognised as a key threat ..." and refers to Swan River Trust sources to outline this and other threats to the river system. The Trust's existing strategies and website clearly outline the prioritised threats and the responses to those threats.

Given that the Auditor General accepts that nutrients are the key threat to be managed, it is reasonable and appropriate that the Trust has explicitly given priority to this issue through the Healthy Rivers Action Plan and the Swan Canning Water Quality Improvement Plan. This weighting of effort is further evidenced by the fact that more than 70 per cent of the Trust's annual budget is directed via its catchment to coast programs to reduce nutrients entering the river system and improve water quality. Notwithstanding, the Trust will consider further measures to highlight priority threats and actions.

The Trust welcomes and accepts the Auditor General's other key recommendations:

- Better use of reporting to Parliament and the community – the Trust intends to complete the work done on Report Cards following adoption of the River Protection Strategy.
- Coordinated management of drains – the Trust agrees this is a high priority and is actively working in partnership with Department of Water, Water Corporation and the WA Local Government Association to help refocus urban drainage legislation and prioritise management actions.
- Ensure indicators and monitoring programs are sufficient to report to government, to better understand changes that occur and provide for effective management – the work done to date will be enhanced and adopted as part of the River Protection Strategy implementation.
- Review the Fertiliser Partnership – the Trust is a partner in implementing the State Government's Fertiliser Partnership, led by the Department of Environmental Regulation. It would be appropriate to include progress in implementing the Fertiliser Partnership as part of reporting on the River Protection Strategy.
- Continue high level of community involvement – the Trust agrees this is a critical element of river management and will continue its efforts in this area.

What Did We Do?

Our objective was to determine whether the environmental health of the Swan Canning river system is adequately protected.

Specifically we asked:

- Does the Swan River Trust know what the environmental health status of the Swan Canning river system is?
- Are management strategies and plans being informed by information about the environmental health of the Swan Canning river system?
- Is the Swan River Trust effectively managing key threats to the environmental health of the Swan Canning river system?

We focused on the activities of the Trust and DoW to protect, manage and monitor the health of the Swan Canning river system over the last 20 years. The Swan and Canning Rivers Management Amendment Bill 2014 is before Parliament to amalgamate the Trust into the Department of Parks and Wildlife. Our audit focused on the Trust's activities, hence we refer to the Trust throughout this report.

In undertaking the audit we:

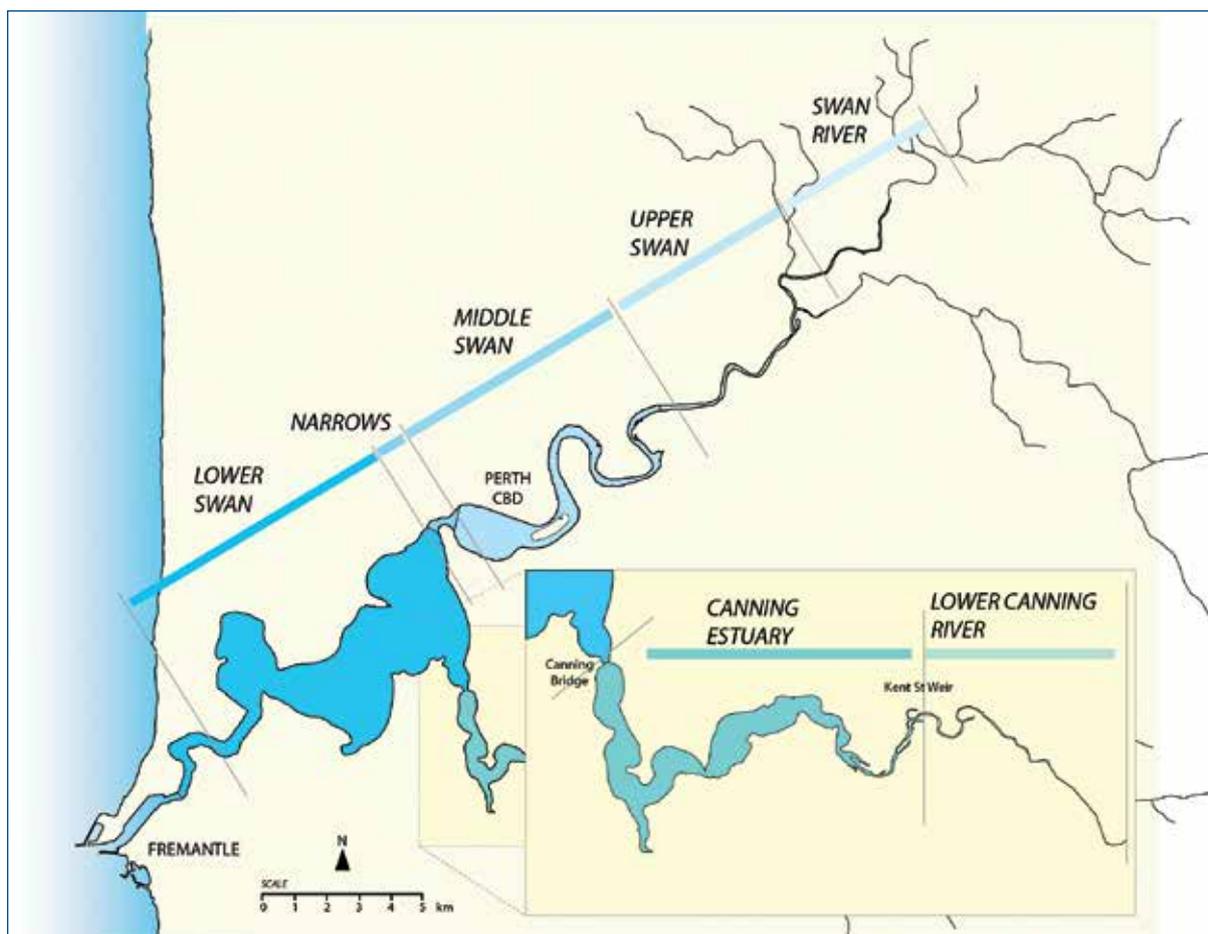
- reviewed plans, programs, strategies, policies, reports and other documents from the Trust
- reviewed reports and other documents from DoW, other agencies, LGAs, Western Australian Local Government Association (WALGA) and community groups
- reviewed water quality monitoring information from DoW
- interviewed stakeholders, community groups, universities and key agencies with a role in the management of the Swan Canning river system
- attended a meeting of the Marine Reserves and Parks Authority Audit Committee
- interviewed staff from three agencies and two universities involved in conducting research to better guide management of the river system
- conducted site visits to the Swan and Canning Rivers and Ellen Brook with LGAs and community groups.

The audit was conducted in accordance with Australian Auditing and Assurance Standards.

Background

The Swan Canning river system

The Swan Canning river system drains a catchment of 2 090 km², stretching from near Gingin in the north to Armadale in the south (see Figure 1). It includes the Swan and Canning 'estuaries', which are influenced by both marine tides and river flows, and the Swan and Canning 'rivers' and their tributaries. The Swan River flows from Walyunga National Park where it meets the Avon River (with a catchment of 126 000 km²), down to its mouth at Fremantle Harbour. The Canning River originates in the Darling Ranges, and joins the Swan River in Applecross, downstream from the Kent Street Weir.



Source: Department of Water

Figure 1: The Swan Canning river system

The Trust is directly responsible for the Development Control Area (DCA) and Riverpark. The DCA includes the waters of the Swan and Canning rivers and a thin strip of land fringing the rivers including adjoining parks and recreation reservations. The Riverpark is 72 km² of waterways, public land and adjoining river reserves of the Swan, Canning, Helena and Southern rivers.

The Swan Canning river system has 31 sub-catchments. These have a variety of urban, industrial and agricultural land uses. Urban development surrounds the lower estuary and middle reaches of the Swan and Canning rivers. Land uses in the upper estuary and river zones of the Swan River include cattle grazing, horticulture, light industry and urban settlements.

Historic land uses along the edge of the rivers have left a legacy of contaminated sites. These include rubbish tips and heavy industry, from wool scouring plants in Fremantle to a fertiliser factory and foundries in Bayswater and Bassendean.

A changing environment

Humans have permanently changed the Swan and Canning rivers and their catchments. The Swan River was mostly brackish before the rocky Fremantle bar was removed by early settlers in the 1890s and the area dredged to build the Fremantle Harbour. The lower reaches of the river system became a permanently open estuary that changed from fresh/brackish in winter and spring, to saline during summer and autumn. Our drying climate has caused the bottom waters of the middle and lower reaches of the river system to be saline for most of the year.

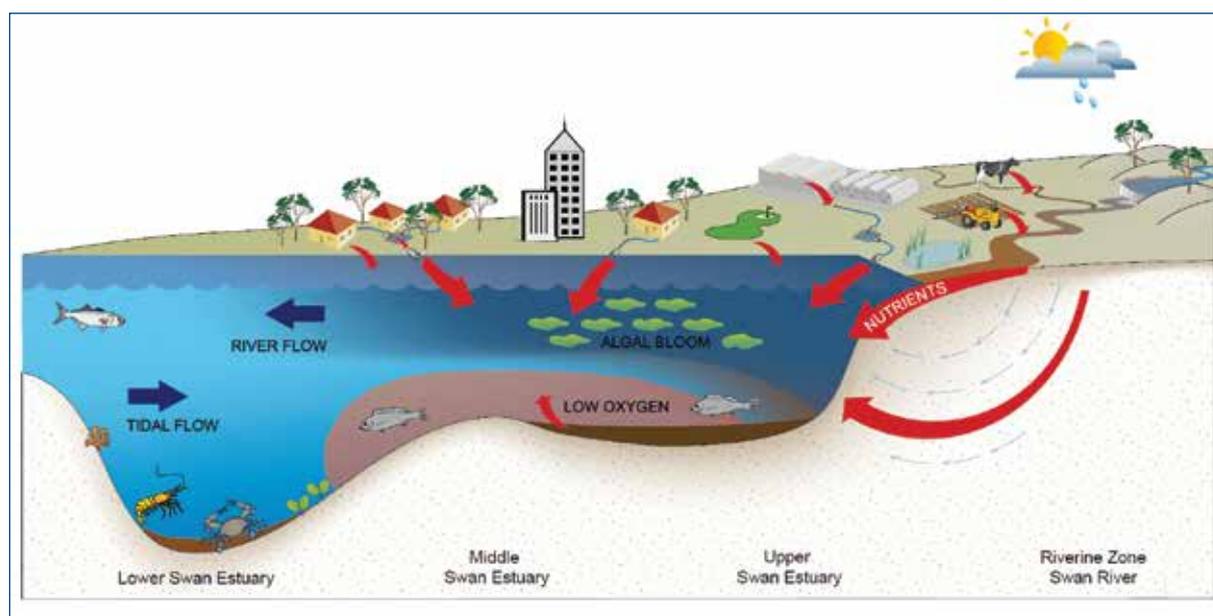
It is not possible to return the river system to its original condition. Instead, the Trust attempts to keep the rivers healthy and resilient in the face of growing pressures and demands of urban development, climate change, agriculture, industry and recreational and commercial use.

Threats to river health

There are many threats to the environmental health of the Swan Canning river system. In 1999 the Trust identified excessive nutrients (nitrogen, phosphorus and organic matter) as the primary cause of algal blooms in the rivers. Nutrients flow into the rivers from urban and rural catchments, and old landfill sites.

Excess nutrients fuel algal blooms, which die and fall to the river bed (see Figure 2). The algae are broken down by bacteria. This process removes oxygen from the water, which kills fish and can also result in the release of nutrients from the sediment. These extra nutrients and organic matter can in turn, help to fuel further algal blooms.

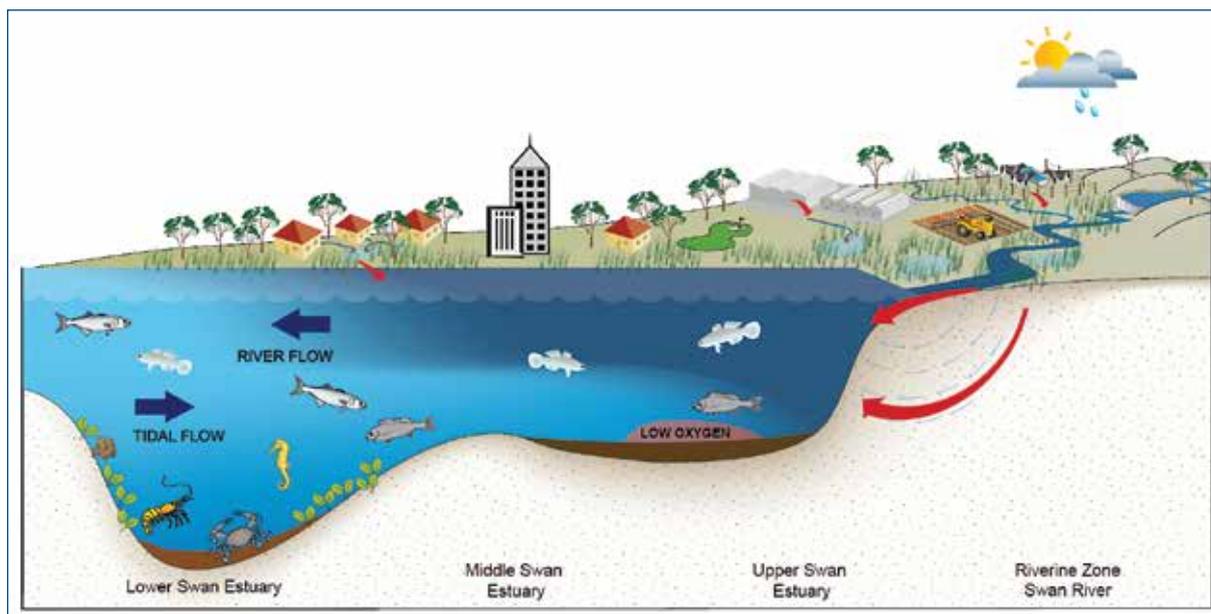
The low oxygen conditions commonly occur in the middle and upper Swan and Canning rivers, particularly in autumn when water flow increases and in the spring when river flow decreases. These conditions have become worse in recent years due to our declining rainfall.



Source: Healthy Rivers Action Plan, 2008, Swan River Trust

Figure 2: State of the Swan Canning river system in 2008

Reducing the nutrients that enter the rivers will reduce algal blooms and improve oxygen conditions. The result will be a healthier and more resilient river (see Figure 3).



Source: Healthy Rivers Action Plan, 2008, Swan River Trust

Figure 3: Desired state of the Swan Canning river system

The Trust and DoW have identified a number of other threats that affect the health of the Swan Canning river system. They include:

- erosion and sedimentation
- climate change
- changes in the quantity of water flowing through rivers and drains
- loss or degradation of salt marsh and shoreline vegetation
- non-nutrient contamination
- acidification
- a 'salt wedge' of water pushing upstream that does not mix with fresh surface water heading downstream.

Managing the Swan and Canning rivers and their catchments

The *Swan River Trust Act 1988* established the Trust in 1989 to simplify river management, which had become the responsibility of around 30 agencies and Local Government Authorities (LGA). The Trust was seen as a solution to an overlap of responsibilities and poor coordination, especially in relation to planning and development applications.

The *Swan and Canning Rivers Management Act 2006* came into effect in 2007. The Act outlined the Trust's responsibilities to provide a more coordinated and collaborative approach to managing the river system. These included to:

- establish the Swan Canning Riverpark and DCA
- protect and enhance the ecological and community benefit and amenity of the Riverpark and DCA

- prepare and implement a River Protection Strategy (RPS), which describes the responsibilities that agencies and LGAs have to protect and enhance the Riverpark
- advise the Minister for the Environment on development proposals in the DCA
- provide advice to LGAs and the Western Australian Planning Commission (WAPC) on town planning issues affecting the rivers
- promote community awareness of issues that affect the health of the river system and increase community involvement in river protection and restoration.

In fulfilling their role the Trust delivers programs in six areas:

- strategic programs to achieve collaborative and coordinated Riverpark management
- statutory planning to ensure land use planning protects the Riverpark
- Riverpark management to enhance community benefit and amenity
- environmental management to improve river system health and resilience
- community engagement
- business management.

DoW is responsible for managing and protecting rivers and estuaries in Western Australia (WA) under the *Water Agencies (Powers) Act 1984*. DoW has collaborated with the Trust to monitor water quality in the Swan Canning river system since 1995. DoW has also provided scientific and technical advice.

There are 15 agencies and 21 LGAs with a statutory requirement to manage specific aspects of the Riverpark (Appendix 1). In September 2013, the Minister for Environment announced the amalgamation of the Trust with the Department of Parks and Wildlife which is responsible for monitoring and maintaining the State's biodiversity. The Swan and Canning Rivers Management Amendment Bill 2014 was introduced into Parliament in May 2014.

What Did We Find?

Despite two decades of monitoring, planning and intervention, the health of the Swan Canning river system is not adequately protected

Assessing the ecological health of a river system requires analysis of a combination of measures of water quality and biological activity. To appropriately interpret and analyse the data, river managers also need to understand ecosystem processes and other changes which are occurring, such as declining rainfall.

DoW has monitored water quality in the Swan Canning river system using standardised and repeatable methods since 1995. Such long-term data sets are invaluable, and have become particularly important as agencies try to interpret the consequences of more recent changes, such as our drying climate. The data describes the way in which the river system functions and the significant changes that have taken place since monitoring began.

The next two sections outline the key indicators that demonstrate the declining health of the river, particularly in the middle and upper estuary.

The health of the middle and upper estuary is declining

DoW's long-term water quality monitoring shows that the health of the middle and upper sections of the river system has declined gradually over the past 18 years. All the indicators of river health require improvements to reach the Trust's targets outlined in the draft RPS for the desired state of the Riverpark.

The middle and upper sections are the narrower reaches of the Swan and Canning rivers and their many tributaries. DoW found that the water quality in these areas was in moderate to poor condition due to excessive nutrients and low oxygen conditions. Biological activity was measured although not over the same timeframe or as consistently. Most indicators show a decline in river health.

Some of the indicators that show the decline in the health of the river since 1995 include:

- salinity levels have increased in the Swan estuary and river
- water temperature has increased at a higher rate than sea surface temperature
- oxygen levels are low in the Swan river
- water turbidity (cloudiness due to suspended solids) has increased
- phytoplankton and chlorophyll-a levels (signs of algal activity) are high
- nutrient (nitrogen and phosphorus) levels are high
- fish deaths were recorded above the Trust's target (of less than 10 000 deaths per year) in four of the last 10 years.

Some water quality indicators have improved but this may be due to reduced rainfall rather than management interventions:

- monitoring shows that nutrient levels have improved in some areas since 1995, however overall nutrient levels remain above ANZECC¹ guidelines and the Trust's targets. DoW reported that the most likely reason is reduced rainfall bringing fewer nutrients into the river system. More nutrients will flow into the river if rainfall levels increase to those experienced previously
- algal activity has decreased in the lower Canning River where the Trust has oxygenation plants and has distributed phosphorus-binding clay into the river (discussed further at page 22). The reduced nutrient levels in the river may also be partly responsible for the decrease in algal activity
- Murdoch University's Fish Community Index shows the abundance of fish as fair to good. The index has been stable for the last four years.

Indicators in the lower estuary show that it is in reasonable health but still under threat

The water quality in the lower estuary does not show obvious signs of pollution from excess nutrients and, in comparison to the middle and upper river system, is in reasonable health. However, monitoring since 1995 has provided evidence that all is not well. Management action is required to treat the symptoms and either manage or adapt to threats to river health.

The pressures in the lower estuary are similar to those in the middle and upper estuary but the effects are less obvious due to the larger water body and regular flushing by marine water. The lower estuary will remain under threat unless the key threats are addressed.

The lower estuary is the most used section of the river system. Changes are evident with increased salinity levels and water temperature and a range of indicators which show declining health including:

- seagrass distribution and abundance has declined by almost one-third since the 1980s
- prawn populations have declined since the 1970s
- natural foreshore areas are degraded and are in need of rehabilitation and stabilisation
- introduced species such as feral fish, the *Batillaria* snail and aquatic plants are present and have the potential to alter the ecosystem.

Indicators of stable or improving health in the lower estuary include:

- nutrient concentrations have declined. The decline is most likely due to reduced rainfall
- the frequency and intensity of algal blooms has declined
- a Fish Community Index score grade shows the abundance of fish as fair to good and it has been stable for the last four years.

Black swans have become more abundant, dolphins are still seen in the river, fish are regularly caught and water-based activities such as swimming and kayaking remain popular. These signs of good health in the lower estuary may result in the community mistakenly thinking that the entire river system is healthy.

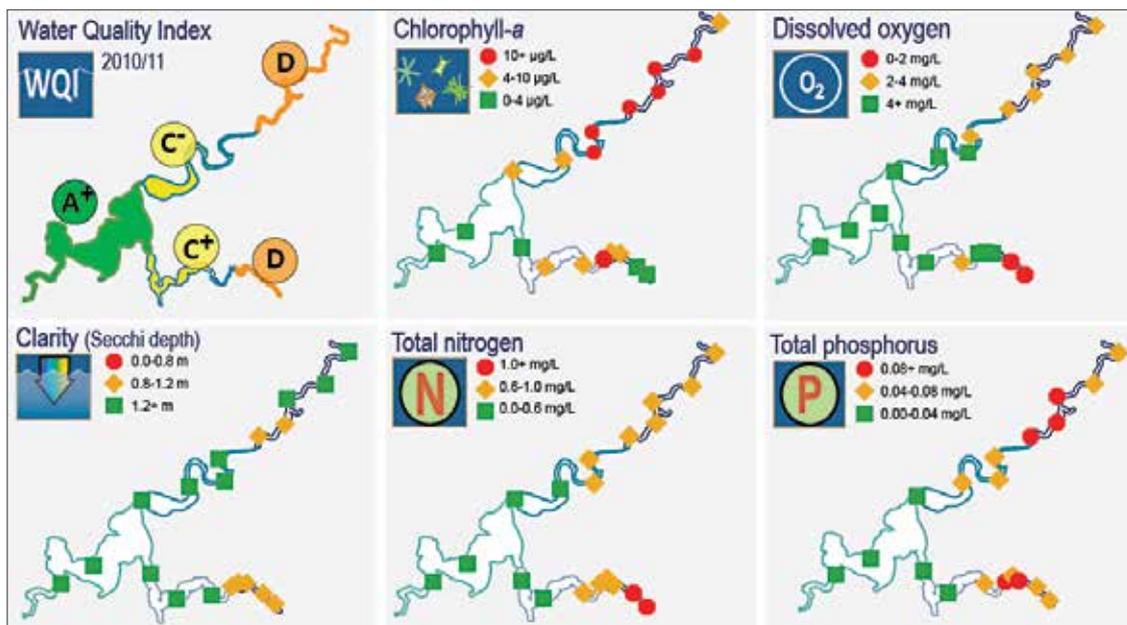
¹ Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Volume 1, the Guidelines. Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ).

Water Quality in the Swan and Canning River System

DoW measures a suite of water quality indicators in the Swan Canning river system and has combined five of these indicators to create a Water Quality Index.

Monitoring sites were chosen to cover a broad area of the river system and are monitored fortnightly. They provide statistically independent samples and give a picture of the larger scale processes (environmental flows, climate change) and finer scale incidents (rainfall events, storm surges, point source pollution) occurring within the river system.

A snapshot of the Water Quality Index from monitoring in 2010-11 shows that the lower Swan region was in good health with an A⁺ grade. However the middle and upper Swan and lower and upper Canning were assessed as moderate to poor with grades of C⁻ and D due to excessive nutrients and low oxygen conditions.



Source: Department of Water

Figure 4: Water quality index grades and indicators in 2010-11

Annual medians for each site summarise the results for each of the indicators.

DoW's long term monitoring from 1995 to 2013 shows similar results to the 2010-11 data. Over this longer timeframe there are significant trends in the five key indicators:

- increases in chlorophyll-a in the middle and upper Swan and Canning rivers cause increased algal growth and low oxygen. Median chlorophyll-a concentrations in the middle and upper Swan River have increased to 12-15 ug/L, which is well above the ANZECC water quality guidelines level of 3 ug/L
- decreases in dissolved oxygen occur in the middle and upper rivers. At 4 mg/L plants and animals become stressed and below 2 mg/L plants and animals cannot survive
- decreases in water clarity in some areas of the upper Canning and middle Swan reduces the amount of light that penetrates the water column to provide sunlight for plants to photosynthesise, produce oxygen and grow
- total nitrogen levels are above the ANZECC guidelines of 0.75 mg/L in the middle and upper Swan and Canning rivers
- total phosphorus levels are above the ANZECC guidelines of 0.03 mg/L in the middle and upper Swan and Canning rivers.

Case Study – Seagrasses

Seagrasses are regarded as a foundation species of the lower Swan estuary, providing habitat for fish and prawn stocks, acting as water filters, stabilising sediments and playing an important role in nutrient cycling and food webs. Once destroyed, seagrass systems do not always recover.

There has been a decline in the area of seagrass beds in the Swan River from 600 to 400 hectares over the last 30 years. Possible reasons for this decline include:

- changing rainfall patterns
- excess nutrients and organic matter in the sediments that can become toxic to seagrass
- effects of introduced snails and macroalgae blooms.

Introduced snails disturb the roots of seagrass and provide a surface for macroalgae to attach to and keep increasing (Figure 5). Snails have been found in densities of up to 2 000 snails per square metre and are likely to have contributed to the decline of seagrass in the Swan River.



Source: Department of Water

Figure 5: Introduced Australian mud whelk snails and mats of macroalgae choke seagrass beds in the lower Swan estuary

The Swan River Trust manages and funds programs to improve river health but crucial programs have had limited success

The Trust has put considerable effort into a range of activities to either prevent nutrients from entering the river system or to treat waterways to remove nutrients. These efforts are usually targeted in the Riverpark and the DCA where the Trust has more control.

However, most of the nutrients and pollutants entering the river system are from agricultural areas, industry, urban development and contaminated sites located in catchment areas that are outside of the Riverpark and the DCA. In these areas the Trust can only influence land uses.

The Trust's capacity to influence the broad range of stakeholders with control of these areas is problematic. The range of other stakeholders includes 15 state government agencies, 21 LGAs (Appendix 1) and thousands of private businesses and individual land owners. Not surprisingly, these stakeholders have objectives and a focus that is quite different to that of the Trust.

As discussed below, some small scale programs have contributed to improving the condition of the rivers but the Trust has had little success in addressing the broader scale issues that would likely lead to measurable improvement in river health.

The Trust has delivered local programs to protect, manage and enhance the river system

The Trust has established long standing relationships with some agencies, LGAs, research institutions, natural resource management groups, and community organisations and provides funding to them. All these stakeholders make valuable contributions to management of the river system. They monitor, rehabilitate and perform other activities to reduce pollutants entering the river system, restore foreshores and ensure the rivers and adjacent reserves are suitable for community use.

The Trust has implemented a series of plans over the last 15 years. Monitoring and evaluation of the plans and programs have shown that nearly all local scale actions under the direct control of the Trust were implemented or resulted in ongoing actions.

In 1999 the Trust launched the Swan Canning Cleanup Program Action Plan to tackle an increase in algal blooms. This was followed by the Healthy Rivers Action Plan (HRAP) in 2008, with a similar goal to protect the river system by improving water quality over a five year period.

The HRAP implemented eight programs to protect the environmental health and community benefit of the Swan Canning river system by improving water quality. The programs aimed to:

- reduce nutrients and contaminants
- minimise sediment loads entering the rivers
- increase oxygen levels in the rivers
- protect and rehabilitate foreshores.

The Swan Canning Water Quality Improvement Plan (WQIP) was produced by the Trust in 2009 to reduce nitrogen and phosphorus input from catchments. Local WQIPs were developed from 2008 to 2012 to provide practical solutions to reduce nutrients in ten of the priority sub-catchments. Projects included constructed wetlands and drainage nutrient intervention works to remove nutrients from stormwater, revegetation of bare drains to become 'living streams', and the use of soil 'amendments' to help retain phosphorus in the soil.

Since 1999 the Trust and DoW have introduced a number of interventions in the middle and upper sections of the River. The interventions mostly treat symptoms of poor health, but not the causes:

- the Trust and DoW run four oxygenation plants as 'life support systems' in the Swan River at Caversham and Guildford, and along the Canning River upstream from the Kent Street Weir. These provide a vital source of oxygen to the water column so that plants and animals are able to survive, and algal blooms, noxious odours and fish deaths are reduced
- phosphorus absorbing clay has been applied in some areas. The clay slurry settles as a thin layer along the bottom of a water body where it binds to any phosphate, effectively locking it away
- nutrient stripping wetlands and drainage nutrient intervention works have been used to improve water quality. They filter sediments, dissolved nutrients and other pollutants from stormwater runoff before the water is released into natural wetlands, drainage lines, rivers or streams.

The lower Canning River is a good example of a successful local program to restore a degraded section of river. The Kent Street Weir area has been transformed by oxygenation of the water and treatment with phosphorus-binding clay, drains revegetated to living streams, wetlands improved to provide habitat for birds and fish, and drainage nutrient intervention works constructed to reduce pollutants in stormwater (see Figure 6).



Figure 6: Rehabilitated wetland area beside the Kent Street Weir in Cannington

The City of Canning, South East Regional Centre for Urban Landcare and the Trust have worked together to transform a bare, odorous swamp into a thriving wetland community.

The Trust funds agencies and universities to conduct research related to river management. For example, Murdoch University has developed a Fish Community Index and DoW and Edith Cowan University have examined factors affecting seagrass health.

The Trust also distributes funds to enhance the Riverpark through a variety of programs. The Riverbank program aims to rehabilitate foreshores. The Swan River Trust and Alcoa Landcare Program has run for more than 15 years. Over 1 000 projects have been funded to protect and enhance bushland, waterways, wetlands and groundwater within the Swan Canning catchment.

Community support

Community groups help the Trust to protect the Swan Canning river system. Volunteers work to stabilise eroded foreshores, reduce harmful nutrients and contaminants from entering our rivers and ground water, reduce the spread of invasive species and create habitat for native animals by planting native vegetation and weeding.



Source: Swan River Trust

Figure 7: Community volunteers plant sedges along the Swan Estuary foreshore

Responsibility for the water quality in urban drains leading into the river system is unclear

No single agency is responsible for overseeing the quality of water in Perth's urban stormwater and drainage system before it enters the river. Many agencies could influence water quality in their sections of the drainage network, yet no agency is mandated to do so. LGAs and the Trust are left with the challenging task of improving the quality of water from drains as they enter the Swan Canning river system.

Stormwater carries point source pollutants from industrial and commercial premises, old septic tanks and intensive agricultural enterprises such as piggeries, poultry farms and market gardens. Drainage channels also collect diffuse sources of pollution from agriculture (fertiliser, pesticides, faeces, soil erosion), urban development, contaminated industrial sites, landfill sites, and urban pollution from vehicles, gardens, domestic animals and accidental spills.

The relative impact of urban drains as a source of nutrients and contaminants has increased. Nutrients from agricultural activities in the Avon and Ellen Brook catchments were two of the greatest sources of nutrients flowing into the river system but as annual river flows have declined by up to 50 per cent due to lower rainfall, so has the associated flow of nutrients. Targeting nutrient reduction in urban drains will therefore have greater impact on improving river health than in the past.

Drainage management is fragmented. The Water Corporation manages 828 kilometres of main drains in the metropolitan area (20 per cent of drainage infrastructure) to prevent flooding. LGAs manage local drains (80 per cent). A small number of drains are privately owned. One length of drain can be managed by multiple organisations.

These drains may cross multiple LGA boundaries and the location of subsurface drains are not always known, making management of the water within the drains an even more complex task.

The responsibilities for the quality of water within the drains overlap:

- the Water Corporation provides drainage services, which may include the management of water quality
- DoW conserves, protects and manages water resources and is responsible for developing the Arterial Drainage Strategy
- the Trust is responsible under the Act to protect, manage and enhance the Swan Canning river system
- LGAs are currently exempt from drainage licensing yet they manage the infrastructure and outputs from local drains
- the Department of Environment Regulation is responsible for licensing point source discharges, investigating illegal discharges and conducting investigations into major environmental incidents.

Without direct control over catchment land uses and discharges, drainage managers have a difficult task to treat the symptoms of poor water quality. Collaboration between agencies and LGAs remains essential to manage water quality within the urban drainage system. An agreement on urban drainage in the Swan Canning catchment was signed by the Trust, DoW, Water Corporation and WA Local Government Association (WALGA) in 2012 to find ways for the agencies to work together to improve water quality in both the river system and the urban drainage network.

The Trust, LGAs and community groups have set up projects that make small-scale improvements to the quality of stormwater and groundwater as it enters the Swan and Canning rivers and their tributaries. Under guidance from the Trust, 15 of the 21 LGAs that manage foreshore areas have engaged regularly with the Trust to install nutrient stripping wetlands or drainage nutrient intervention works to improve water quality. The remaining six LGAs tend to have less river frontage or low priority foreshores.

Community involvement and education is also important. Everyone can contribute to river health by keeping pollutants out of the urban drainage system.

There has been little consistent action to address pollution entering urban drains

Urban drains flow all year and are a major source of pollution from small to medium-sized industry, agriculture and domestic sources. Small industry audits by LGAs to identify and reduce point sources of pollution have achieved good results but have only been conducted intermittently. Difficulties in imposing penalties and finding the source of the pollution have also hampered actions to address this threat.

Hydrocarbons and detergents, organic chemicals (solvents, degreasers), alkalis, acids and non-organic chemicals (metals) make their way into the river system through stormwater drains. Small business owners tend to use existing waste treatment options. They can change business premises regularly and are often reluctant to invest in additional waste treatment infrastructure that best suits their business type.

The Trust is able to use River Protection Notices (RPN) as an enforcement tool under the Act but has not done so, mainly due to difficulties in pinpointing sources of contaminants entering the river system. Even those that stem from point sources are difficult to trace. A person issued with an RPN must comply with the requirements of the notice within such time as is specified in the notice. The Act provides a \$50 000 penalty for non-compliance.

The Trust can also issue infringements for the unauthorised discharge of potentially environmentally harmful materials under the *Environmental Protection (Unauthorised Discharges) Regulations 2004*, but only within the DCA. The Department of Environment Regulation is responsible for ensuring businesses comply with environmental legislation throughout the catchment.

One alternate approach trialled to reduce pollution has been audits conducted by LGAs of small to medium-sized industry. These audits provide a useful tool to educate small business owners.

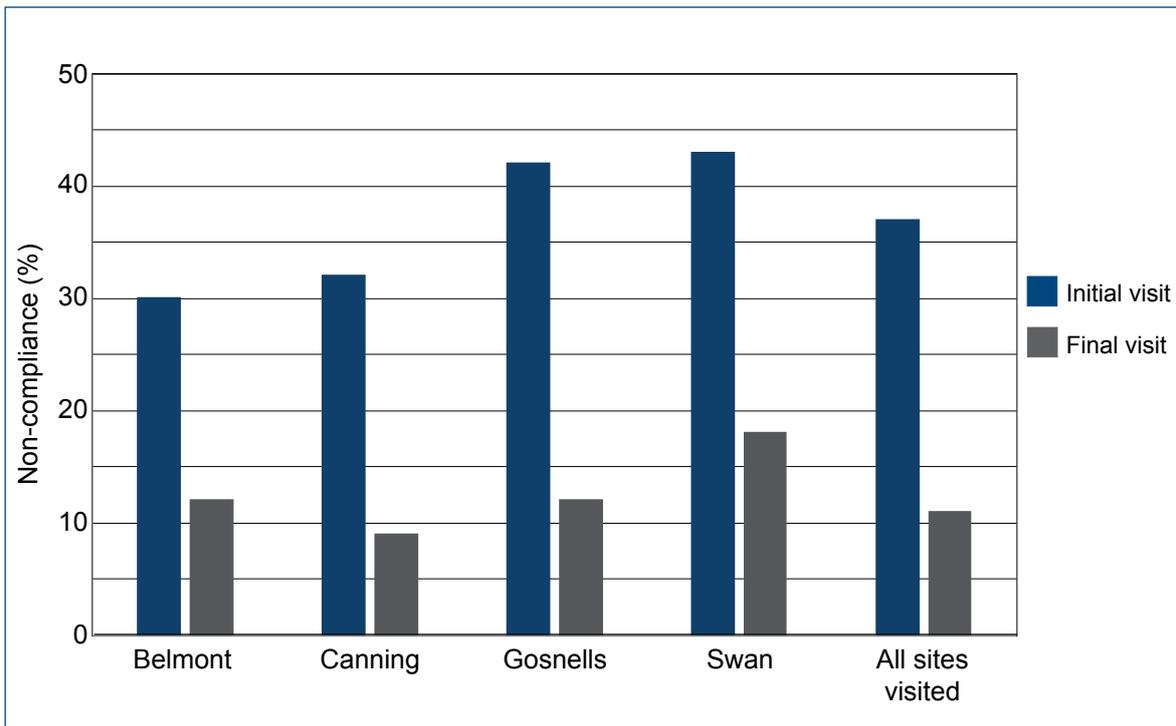
The Trust funded the Perth Region Natural Resource Management (NRM) group and South East Regional Centre for Urban Landcare to conduct short term projects to audit and educate small to medium-sized industry to identify and reduce nutrient and contaminant sources to the Swan and Canning rivers (see Figure 8). One of the 21 LGAs with river management responsibility, the City of Bayswater, has worked regularly with small industry for the last 20 years, using site visits to educate business owners on waste treatment.

Case Study – Perth Region NRM light industry audit and education program

The Program focused on minimising the discharge of contaminants from small to medium-sized light industrial enterprises in the catchments of the Swan and Canning rivers.

Perth NRM staff visited 1 118 separate businesses. The businesses were chosen as they serviced or cleaned vehicles or equipment on-site, stored liquids or were bulk transport operators. Businesses that failed to meet standards, or were at risk of causing pollution, were given recommendations and information to improve their current business practices to become compliant with waste management regulations.

Re-assessments of the 728 non-compliant businesses identified in the first audit showed significant improvements across all LGA areas (see Figure 8).



Source: Perth NRM Light Industry Audit and Education Program (2011)

Figure 8: Small business rates of non-compliance with pollution regulations – initial and final visit

The Fertiliser Action Plan has not achieved a key goal to phase out highly soluble phosphorus fertilisers on the Swan Coastal Plain

Phosphorus is one of the most necessary nutrients used in agriculture but it is also one of the key threats to the river system. Phosphorus seeps into groundwater or is lost via stormwater runoff that leads into waterways, causing the excess nutrients that create algal blooms and fish deaths. Various steps have been taken to reduce the level of phosphorus leaching into the river system but so far these have had limited effect.

The actions taken over the last seven years have centred on encouraging the use of 'low-soluble' phosphorus fertiliser and reducing the amount of phosphorus fertilisers used.

Low water-soluble phosphate pasture fertilisers were specifically developed to reduce the risk of fertiliser leaching into groundwater. Their use on farms in environmentally sensitive areas of WA is not mandated. It is voluntary only. In contrast, the amount of phosphorus in domestic use fertilisers has been limited by the *Environmental Protection (Packaged Fertiliser) Regulations 2010*.

The plans and strategies to reduce the amount of phosphorus from fertiliser use in agricultural areas have been:

- the Fertiliser Action Plan (2007) was prepared by the Joint Fertiliser Working Party, whose members included the Environmental Protection Agency, the Trust, DoW, Department of Agriculture and Food WA (DAFWA), and the fertiliser industry. Its aim was to 'phase-out the use of highly water soluble phosphorus fertilisers'. The plan recommended:
 - a 'State Environment Policy be developed to provide a regulatory framework with commitment from the relevant state agencies, for implementation of the Fertiliser Action Plan'. This was not done
 - key strategies to develop and demonstrate new fertiliser products, encourage their voluntary uptake and conduct nutrient management planning from the regional down to individual farm scale. These actions were introduced and now form part of the current Fertiliser Partnership
- the Trust's Healthy Rivers Action Plan (2008-2013) sought to implement the Fertiliser Action Plan by phasing out highly water-soluble phosphate fertilisers in sensitive catchments. This was not done
- the Fertiliser Partnership (2012-2016) between government, the fertiliser industry, fertiliser user groups, and peak non-government organisations aims to reduce nutrients from fertilisers entering waterways and wetlands on the Swan Coastal plain by 50 per cent
 - one of the strategies of the Partnership is to develop and promote fertiliser with a low phosphorus content in the metropolitan area. The focus on low phosphorus fertiliser instead of 'low water-soluble' phosphorus as recommended in the Fertiliser Action Plan was made despite recognition of the greater benefit that low soluble fertiliser has for the river system in environmentally sensitive areas. Low soluble fertiliser allows farmers to continue to use similar amounts of phosphorus, but less would dissolve in the waterways to fuel algal blooms
 - the Partnership focuses more on encouraging the farming community to reduce the amount of fertiliser used. There is up to three years of phosphorus stored in the soils in intensive pastoral areas such as Ellen Brook, and an average of five years of stored phosphorus in wheatbelt soils. Pastures can use this stored phosphorus and do not always require phosphate fertilisers to be applied every year. Routine soil testing and mapping levels of nutrients in farm soils helps farmers know how much fertiliser to apply, based on knowledge of what they have available
- DAFWA has funding to December 2015 to visit another 100 farms to conduct soil tests and provide advice on fertiliser use. These farms are spread over the Swan Coastal Plain, from Ellen Brook in the north to the Scott River and Wilson Inlet in the south. The wide geographic focus has targeted coastal pasture grazing areas where there has been less frequent and less intense soil testing than in cropping areas of the Avon River catchment.

Unless farmers are persuaded or required to change their approaches to fertiliser use, current fertiliser management practices will continue – to the detriment of the river system.

Part of the argument to persuade farmers should be that better and less fertiliser use will save them money. DAFWA has estimated that the direct cost to south-west farmers of unnecessary phosphorus application is \$400 million per year.

If adopted, a combination of strategies from both the Fertiliser Action Plan and the Fertiliser Partnership to prevent phosphorus entering the river system could lessen the need for more expensive technologies, such as constructed wetlands, nutrient interception and groundwater treatment, to be used after nutrients have entered the waterways. But, DAFWA has advised that improved fertiliser management will still result in unacceptable leakage and is insufficient to turn around water quality problems alone.

The impact of urban development is increasing and requires additional effort to minimise impact on water quality

Urban development in the catchment of the Swan and Canning rivers causes significant harm to the river system. Development can lead to nutrients and other contaminants being released from the soil and groundwater to flow into the river system. Managing urban development in a way that limits the release of nutrients into the drainage network is far more effective than extracting them from the river system.

The *State Planning Policy 2.10* recognises this risk and requires that ‘...developments must maintain or improve water quality’.

The Metropolitan Region Scheme (MRS) and the Act provides the Trust with a statutory role to assess and determine, or provide advice on a range of development proposals. The MRS is one of the town planning schemes for land use in the Perth metropolitan area. The Trust’s advice is also sought under local town planning schemes and the Central Perth and Midland Redevelopment Schemes, administered by the Metropolitan Redevelopment Authority.

The Trust provides binding advice to the Western Australian Planning Commission (WAPC) for developments that are on land within the DCA or abutting the waters of the DCA. It also provides non-binding advice to the WAPC, local government and developers on land abutting the DCA or likely to affect waters in the DCA. During 2012-13, the Trust assessed and provided advice on or determined 323 proposals. Of those, 78 were referred to the Trust by the WAPC.

The Trust does not always have the opportunity to provide site specific advice to developers at the right time. The planning process is complex, involves many levels of approval, and agencies, LGAs and developers often differ in the way they engage with the Trust. This affects the Trust’s ability to assess or provide advice for development proposals that may affect water quality in the river system. To support efficient and environmentally responsible development the Trust must provide the right advice at the right stage of development planning. However, this requires developers, other agencies and LGAs to approach the Trust and accept the advice given.

We identified a number of development planning issues that can affect water quality in the river system:

- the Trust’s advice is not always sought for developments outside the DCA but which may affect the waters of the DCA. The WAPC and LGAs can go directly to the Trust to request advice on development proposals in the catchment, but there are occasions when the Trust is not consulted. The WAPC advised that it is mindful of the need to minimise the impact of proposals on the DCA and takes a risk based approach when considering the Trust’s involvement. Developments that could have a significant impact on nutrient levels in the river system may therefore progress without sufficient advice on appropriate drainage

- variation in the levels of planning that exist across the metropolitan region can mean that the planning process is not always orderly. For example, subdivisions can be approved by the WAPC before LGAs have completed the Structure Plans, though the WAPC has advised that these approvals are provided based on its risk assessment of the level of impact. These plans ensure developments are well integrated. When this occurs the Trust loses opportunities to provide coordinated and suitable drainage solutions within local government areas
- current legislation does not recognise nutrients as groundwater pollutants. This makes enforcement of water quality standards difficult as the nutrients only become pollutants when they enter the river system. In addition, any monitoring of developers' compliance with these standards is minimal
- in 2008 the WAPC produced its Better Urban Water Management (BUWM) guidelines to facilitate better management and use of our urban water resources at each stage of the planning system. One of the objectives is to maintain and, where possible, enhance water quality, which includes to:
 - minimise waterborne sediment loading
 - protect riparian vegetation
 - minimise the export of pollutants such as phosphorus and nitrogen to surface or groundwater
 - prevent groundwater acidification processes
 - minimise the export and impact of pollution from sewerage.

The BUWM guidelines need to be applied differently at each development site. Eight strategic development planning proposals received by the Trust in 2012-13 had the potential to impact on water quality in the Swan Canning river system. Only one of those provided the correct level of information and proposed best management practices outlined in the BUWM.

The BUWM guidelines provide a strong framework for integrating water management within the planning system. However, the implementation of BUWM often requires that the Trust deliver advice on a case-by-case basis due to differences in soil types and natural features at each development site. The Trust must negotiate with LGAs and agencies involved in the planning process to ensure BUWM guidelines will be implemented to achieve the best possible outcomes. The WAPC has sometimes approved developments based on its assessment of risk while Trust officers are still in the process of negotiating the best site-specific solution for urban water management.

- there are no statutory powers associated with BUWM guidelines and minimal enforcement or follow up on implementation. This is one reason why the Trust's timely input in the development planning and approvals process is so important.

Coordinated and orderly delivery of the planning approvals process is required to ensure the Trust is able to provide the 'right advice at the right time'. Improved arrangements between the Trust, WAPC, LGAs and other agencies and organisations involved in the planning of urban development is needed to ensure water quality standards are being met.

Actions to enhance river health are hampered by gaps in reporting, planning and monitoring

The Act requires that the Trust prepare an overarching RPS and use this framework to monitor and report on the extent that ecological and community benefit and amenity targets are met. The Trust has spent considerable effort in preparing plans and developing strategies. However, the capacity for these strategies to make a difference has been hampered by limited public knowledge of the true condition of the river and no approved RPS.

Improving the health of the Swan Canning river system is achievable, but as experiences elsewhere show, rapid solutions are unlikely. Two common themes that link success stories are long-term commitment to sustainable funding and commitment from businesses, concerned citizens and government agencies.

The following sections outline the issues that prevent the Trust from effectively engaging other agencies and stakeholders in river management.

The need to tackle the declining health of the river system would be helped by better high-level public reporting

There is limited public reporting in an easily understandable format about the current health of the river system and the problems it faces. Without easily understood information, Parliament, some river managers and the community can be limited in their capacity to make informed decisions about the need and priorities for protecting the river.

The Act states that the community should have access to reliable and relevant information. The Trust provides a range of scientific, policy and planning documents and expends considerable effort in programs to engage the community. However, much of this information is disaggregated and in a form that favours a level of scientific knowledge. The lack of a simple tool to report on the health of the river system has not helped public awareness and left some river management agencies and many in the community with little understanding of the serious decline in the rivers' condition.

The need for a high level form of public reporting has been recognised for some time. In 1999 the Trust recommended producing a 'State of the Swan Canning System' report – but this did not proceed. DoW has produced standardised annual sub-catchment 'nutrient reports' since 1999, however these only describe nutrient levels. They do not include any other measures of water quality or biological indicators.

'Report Cards' are widely recognised and often used to provide a simple summary of environmental health. In 2011, DoW produced a report card and estuary health score that gave a simple but comprehensive picture of the health of the Swan Canning River. However, this report card has never been publicly released.

Report Cards have been used successfully in Australia and internationally to report annually on trends in the health of water bodies. One example is Chesapeake Bay in the USA (see Figure 9). Other examples include:

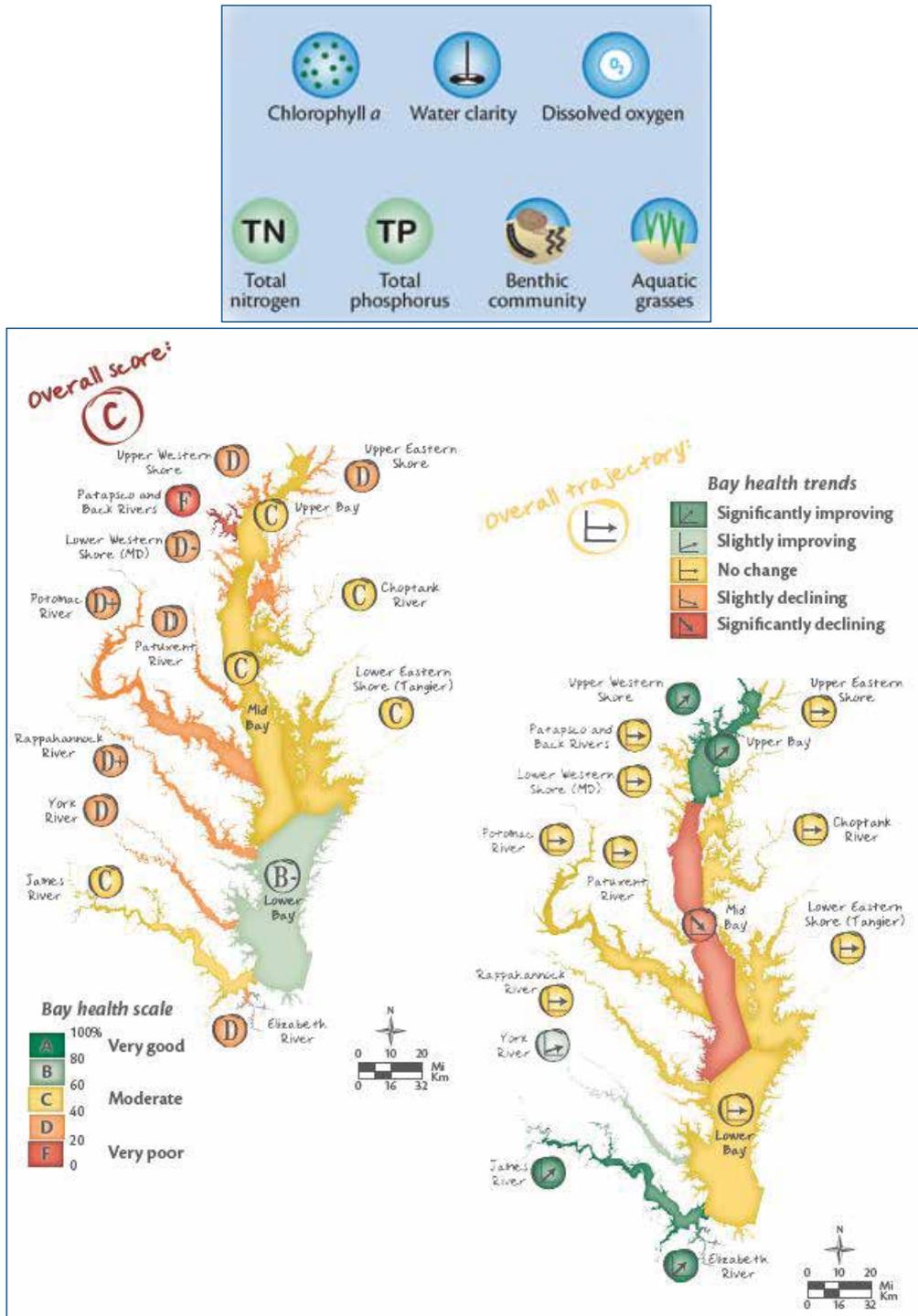
- Cockburn Sound Management Council reports annually on the state of the Sound to the Minister for Environment, Parliament, the Environmental Protection Authority and publicly. The report comments on whether the environmental values and objectives established for the Sound are met. The report cards tabled in Parliament are used to trigger management action
- South East Queensland Healthy Waterways Ecosystem Health Monitoring Program is used to advise councils and land managers on areas of declining health. The report cards and associated monitoring is also used to evaluate the effectiveness of management strategies to protect and improve rivers and estuaries
- European Commission's *Water Framework Directive 2000* sets measures of river health that all European Union countries must report on: chemical composition of the water, phytoplankton, other aquatic flora, benthic invertebrate fauna, and fish fauna. Where actions taken by a member state are not sufficient to achieve targets, the member state must take additional action to do so.

The Trust funds many foreshore restoration, drainage nutrient intervention and water quality monitoring projects carried out by LGAs and community groups. With greater knowledge of the threats and management actions required, LGAs might be persuaded to do more to address the causes of poor water quality.

Case Study – Chesapeake Bay Report Card

Report cards are used to report annually on whether the health of river catchments and estuaries of Chesapeake Bay are declining or improving. Regional river managers use the report cards to target management activities.

The Chesapeake Bay Report Cards combine five water quality indicators and two biotic indicators to produce a Bay Health Index. The Index provides a score and overall grade of Bay health. Trends in Bay health have also been calculated using data collected since 1986. This shows how the health of each region within the Bay has changed over time.



Source: University of Maryland Center for Environmental Science

Figure 9: Chesapeake Bay Report Card

Indicators of health include measures of water quality and biological parameters.

The Trust developed a draft River Protection Strategy but it has still not been approved by the Minister

A draft RPS that was completed by the Trust in 2012 is yet to be approved by the Minister. The RPS draws the Trust's plans, programs and strategies together to create a broader scale monitoring, evaluation, and reporting framework to accompany the highly complex task of river management. Once adopted, it will outline agency responsibilities for river management in accordance with the Act.

Production of an RPS is required under the Act. However the draft RPS has still not been approved seven years after the Act was passed. Following research in 2007 and 2008 the Trust sought input from stakeholders before drafting an RPS. Public comment was then sought. A final draft was produced in 2012, and approved by the Trust's Board. All relevant agencies signed off on the draft RPS between October 2012 and June 2013.

The draft RPS was submitted to the Minister twice in August 2012 and August 2013 but Ministerial approval to release was not provided on either occasion. The Trust advised that the RPS was placed on hold due to a state election and more recently until matters relating to a merger of the Trust with the Department of Parks and Wildlife are finalised.

In the absence of an approved RPS the Trust has advised that it was already using other mechanisms to confirm agency commitment. For instance, the Trust has collaborated with DoW since 2008 through a Memorandum of Understanding to monitor water quality and manage oxygenation plants. In 2012 the Trust, DoW, the Water Corporation and WALGA signed the Urban Drainage Partnership Agreement to develop and implement cooperative strategic and operational programs for specific areas of river management.

A ministerially approved RPS will add authority and buy-in to the type of actions referred to above. It will provide a public reporting mechanism to show the community what each agency and stakeholder has committed to, whether it has been done, and how the health of the system is tracking. Without the approval, the necessary buy-in and accountability from all relevant agencies is unlikely.

The Trust has not clearly prioritised actions to address key threats and generate the greatest improvements in river health

The Trust's draft RPS and most of its other plans do not prioritise the key threats facing the river system and the actions that will most improve its health in the long-term. This reduces the Trust's ability to influence agencies and stakeholders to undertake these actions and to leverage and focus resources to do so.

Without a list of key threats and management actions that will generate the greatest improvements in river health, the total cost to implement the RPS and protect the Swan Canning river system is unknown. Local Water Quality Improvement Plans go some way towards outlining key threats and actions necessary to improve water quality in 10 of the 31 sub-catchments, though actions are not prioritised or costed.

The Trust's mandate requires it to spread its expertise widely, from offering development planning advice through to funding foreshore rehabilitation projects. As with all agencies, the Trust is expected to focus its resources on where it can benefit the river most. Outlined on the next page is a summary of how the Trust's funding is spent (see Table 1).

Business Services	Consolidated Fund (\$)	Burswood Levy (\$)	Other External (\$)	Totals (\$)
Statutory Planning	1 032 000	-	110 000	1 142 000
River System Management	4 138 000	2 174 000	1 966 000	8 278 000
Riverpark Management	2 364 000	1 088 000	110 000	3 562 000
Strategic Programs	720 000	-	-	720 000
Communications	903 000	325 000	120 000	1 348 000
Business Management	2 862 000	319 000	-	3 181 000
Budget Total	12 019 000	3 906 000	2 306 000	18 231 000

Source: Swan River Trust

Table 1: Swan River Trust's budgeted expenditure 2013-14

A total of \$6.2 million of external funds are received from the Burswood Levy, State Natural Resource Management Program, Commonwealth Government, Metropolitan Redevelopment Authority and WA Fish Foundation.

The Trust estimates that key organisations contribute \$72 million a year towards river management. This does not include the valuable contribution made by volunteers, community groups and private enterprise.

WALGA has estimated that the total investment required to manage Riverpark assets and deliver projects outlined in the draft RPS, is more than \$930 million over five years. Water quality monitoring, community education and other catchment-wide management actions to address key threats not included in WALGA's estimate would bring the total budget for river management to over \$1 billion for the same five-year period.

Monitoring of water quality and the river's health status is reasonable

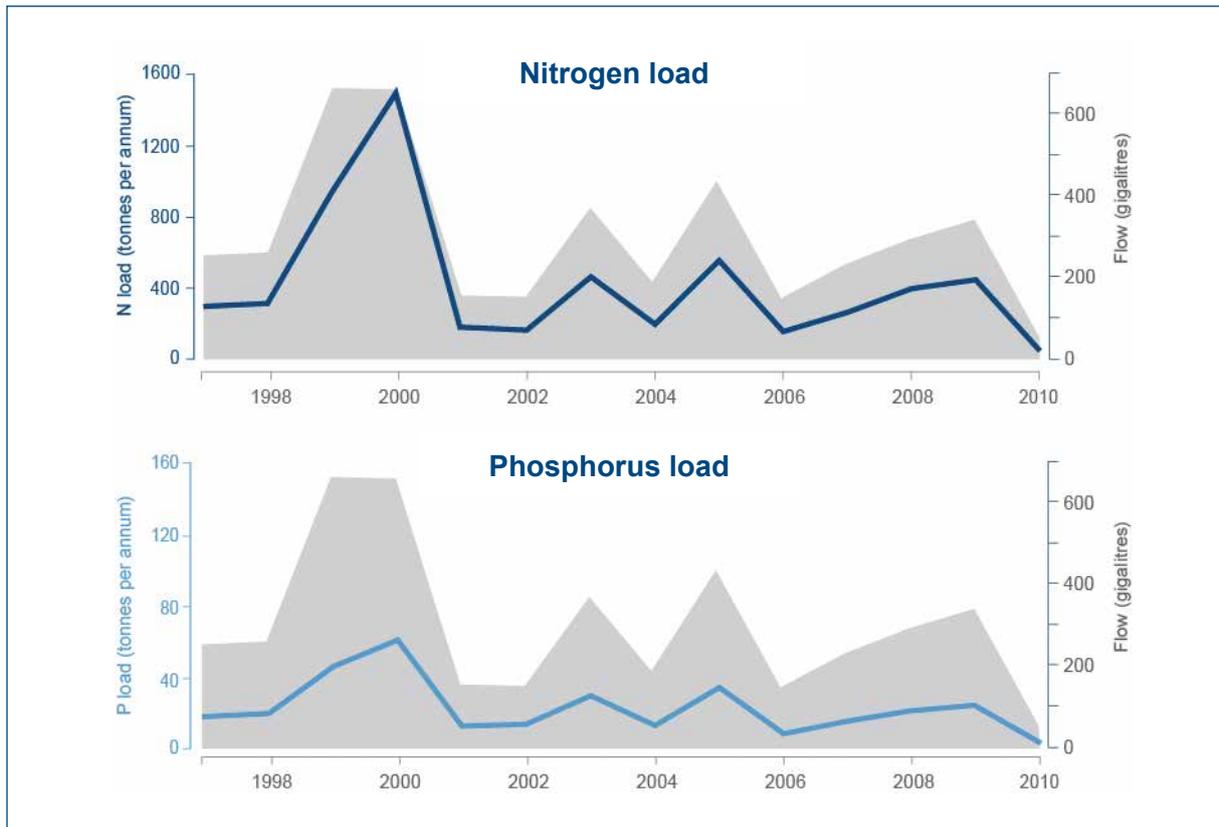
Water quality monitoring is robust but indicators of the overall health of the river system could be improved. More consistent use of biological indicators, smaller-scale monitoring programs and flow gauges would deliver a more comprehensive understanding of the river system.

DoW's water quality monitoring program uses similar indicators to that used by other estuarine river managers throughout the world. It conducts the bulk of the broad scale water quality monitoring in 25 of the 31 sub-catchments. This is sufficient to determine the status of the estuary and rivers and provide an understanding of the physical, and some biological, functions of the system. LGAs, community groups and property developers also conduct water quality monitoring projects, which are often focused on specific areas and for shorter time periods.

However there are some areas where improvements to the current monitoring program would provide better information on changes occurring in the river system and their underlying causes. The audit identified areas for improvement.

- A number of localised programs undertaken with short-term grants from various funding sources have not continued, despite recognition that they make a necessary contribution to understanding water quality in the river system. The programs include monitoring in some key sub-catchments, and for estuarine contaminants.

- Seagrasses, fish, sedimentary invertebrates and foreshore assessments are widely used elsewhere as indicators of environmental health. Indicators of biological health take time to develop and have yet to be used in the Swan Canning river system. The Trust contributed funds to DoW to expand seagrass surveys for use as an indicator of environmental health and Murdoch University to develop a Fish Community Index. However the results of these monitoring programs have only been published as scientific reports and not used for management purposes.
- Measures of contaminants in fish, invertebrate communities, sediment condition, abundance of introduced species and dolphin health are other possible indicators that are still poorly understood despite recognition that monitoring these indicators is also important.
- The use of additional indicators is particularly important in the lower Swan Estuary where DoW only sample water quality regularly at two sites. The information is used to produce the Water Quality Index. Finer scale indicators, such as seagrass and fish distribution and abundance are required to make a more comprehensive assessment of estuary status.
- In 2008 the Trust conducted a detailed foreshore assessment focusing on protecting human value and infrastructure, but it has not been repeated due to resource constraints. Since 2002, more than \$22 million has been invested to rehabilitate over 350 km of foreshore in the Riverpark. With the increased risk of extreme weather events and higher tides due to our changing climate, the priority areas identified back in 2008 may have changed or previously good quality areas may now be in need of rehabilitation. Re-assessment in the near future would add assurance.
- Reductions in nutrient loads are needed under average flow conditions to achieve the targets set by the Trust, but understanding the cause of changes in nutrient concentrations is complex. A lack of tools to adequately measure the effectiveness of management actions means that even if actions such as nutrient stripping wetlands are working to remove nutrients, there is no data to show that they are doing as intended.
- Both nutrient concentrations and loads within the river system have declined in some areas of the river system in recent years. These broader scale decreases are most likely due to reduced rainfall, rather than any changes in land use or management actions. In lower rainfall years nutrient loads decrease but in relatively higher, or more average, rainfall years, nutrient loads increase (see Figure 10). In the upper Swan nutrient concentrations remain high due to a lack of flushing.
- DoW has used the Water Corporations' flow gauges to measure stream flow and so calculate nutrient loads. The program was temporarily stopped in 2012 to upgrade the system. Since that time some flow gauges have been unavailable, which has caused a loss of critical data. The Water Corporation advised that it was unaware the data was being used by other agencies. The Corporation is in the process of re-establishing the flow monitoring program.
- While data collected by LGAs and community groups is consistent with DoW's sampling procedures some developers' programs do not follow specific guidelines or do not include quality control measures. This means that the data cannot be added to DoW's Water Information Reporting database and used to better understand the nature of the river and changes that are occurring.



Source: Department of Water

Figure 10: Nutrient loads in the Swan and Canning rivers are strongly correlated with river flows

River health can be improved with collaboration and long-term commitment

Experiences elsewhere in Australia and internationally have shown that the health of urban river systems can be improved. Improvements have been rapid where point sources of pollution can be targeted but can take years where pollution comes from diffuse sources. A combination of strong coordination, cross-boundary cooperation, broad partnerships, leading edge science and research, education and outreach, and long-term funding have been key components of many of these river restoration projects. Examples of where river systems have been improved include the River Thames and Chesapeake Bay.

London's River Thames was honoured at the International 'Riversymposium' in 2010 for its recovery from a 'biologically dead river' in the 1950s to a thriving waterway today. The chemical quality of the rivers within the River Thames Basin catchment has improved from 53 per cent in 1990 to 80 per cent in 2008 and is now classed as 'good' to 'very good'. Otter have returned to the river and fish are increasing. From 2005 to 2010 over 390 habitat enhancement projects were completed and 70 km of the Thames and tributary rivers were restored or enhanced.

The main drivers for improvement of the River Thames were:

- tighter regulation of polluting industries
- major investment at sewage treatment works to stop point source pollution
- work with catchment farmers, businesses and water companies to reduce pollution and improve water quality
- firm plans and costed actions for further improvements
- high level of community involvement.

The Chesapeake Bay is an estuary in the United States lying inland from the Atlantic Ocean. Over 150 rivers and streams flow into the Bay's drainage basin, which covers parts of six states and the District of Columbia.

The major pollutant to the Bay is excess nutrients from agriculture, urban runoff, vehicle emissions and many other sources. In 2000, Bay Program partners signed a comprehensive agreement that set a clear vision and strategy to guide restoration efforts through to 2010. The agreement established 102 goals to reduce pollution, restore habitats, protect living resources, promote sound land use practices and engage the public in Bay restoration.

In 2010, the US Environmental Protection Authority established the Chesapeake Bay 'Total Maximum Daily Load'. It sets limits on the amount of nutrients and sediment that can enter the Bay and its tidal rivers to meet water quality goals. Each of the seven Bay jurisdictions is creating a Watershed Implementation Plan that spells out detailed, specific steps the jurisdiction will take to meet the 2025 targets. The Bay jurisdictions will use their two-year milestones to track and assess progress toward completing the restoration actions detailed in the Watershed Implementation Plan.

The Chesapeake Bay health index has improved from 39 per cent and a D+ in 2006 to 45 per cent and a C in 2013. One hundred per cent represents pristine condition. When an index of 70 per cent is reached the bay is considered 'saved'. There is still a long way to go before the system is regarded as healthy.

The main drivers for continued efforts to restore Chesapeake Bay are regarded as:

- partnerships from a range of agencies and organisations
- program partners using their own resources to implement restoration activities
- cutting edge scientific research has advanced ecosystem restoration efforts
- established indicators and goals for reaching environmental restoration targets.

In all examples of river restoration examined there were no quick fixes. Long-term action beyond political timeframes is essential, as are the resources to achieve targets. A cooperative approach is needed to fully address the extent, complexity, and sources of threats, particularly where river catchments span numerous jurisdictional boundaries.

Appendix 1: Agency Responsibilities for Riverpark Management

The draft River Protection Strategy outlined agency and Local Government Authority responsibilities for river management.

Department of Agriculture and Food WA (DAFWA)	Department of Environment Regulation (DER)
Department of Fisheries (DoF)	Department of Aboriginal Affairs (DAA)
Department of Health (DoH)	Department of Planning (DoP)
Department of Parks and Wildlife (DPaW)	Department of Transport (DoT)
Heritage Council of WA (HC)	Department of Sport and Recreation (DSR)
Main Roads WA (MRWA)	National Trust of Australia (NT)
Swan River Trust (SRT)	Tourism WA (TWA)
Water Corporation (WC)	Local Government Authorities (LGA)

Issue	Lead Agency	Agency Responsibility			
		Monitoring, sampling and research	Education	Compliance and enforcement	Planning
Algal blooms	SRT, DoH	SRT, DoW, DoH	SRT, DoW, DoH, LGA	DoH	SRT, DoW, DoH
Biodiversity	DoF, DPaW, SRT, LGA, DoP	DPaW, SRT, LGA	DPaW, SRT	DPaW, SRT, DoT, DoF, LGA	DPaW, SRT, DoW, DAA, DoP, LGA
Boating	DoT, SRT, LGA, DER	DoT, SRT, LGA	DoT, SRT, LGA	DoT, SRT, LGA, DER	DoT, SRT, LGA, DoH
Contaminated sites	DER	DER, SRT, DoW, DoH	DER	DER	DER
Development applications	SRT, DER, LGA, DoP, DoT	SRT, LGA	SRT, DER, DoP, LGA	SRT, DER, DoP, LGA, DoT, NT, HC	SRT, DSR, NT, HC, DoT, DoP, LGA, DAFWA, WAPC
Drainage	WC, DoW, LGA	WC, DoW, LGA, SRT, DAFWA, DER	DoW, WC, DER, SRT, LGA	DoW, WC, SRT, LGA, DAFWA, DER	DoW, WC, SRT, LGA, DAFWA, MRWA, DER, DoP
Dredging	SRT, DoT	SRT, DoH, DER, DoW	SRT	SRT	SRT, DoP, DER, DoW, DAA, DoH, DoT
Environmental flow	DoW, WC	DoW, WC, SRT, LGA	SRT, DPaW, WC	DoW	DoW, WC, SRT, DPaW, DoH

Issue	Lead Agency	Agency Responsibility			
		Monitoring, sampling and research	Education	Compliance and enforcement	Planning
Fertiliser use	DAFWA	DAFWA	DAFWA, SRT		DAFWA
Fish kills	SRT	SRT, DoF, DER, DPaW, DoW, DAFWA, DoH	SRT, DPaW, DoH, DoW	SRT, DER	SRT, DoF, DAFWA, DoW
Fishing	DoF	DoF, DPaW, DoW	DoF, DPaW, DoH, TWA	DoF, DPaW, SRT	DoF, DPaW, DoW, SRT, TWA
Foreshore erosion	SRT, LGA	SRT, LGA, DPaW, MRWA	SRT, LGA, DPaW	SRT, LGA, DPaW, MRWA	LGA, DoP, DAA, DoW
Human health issues	DoH, DSR	DoH, DSR	DoH, LGA, SRT, DSR	DoH, LGA, SRT, DoT, DER	DoT, DoW, DoH, DER, SRT
Introduced species	LGA, DAFWA, DoF	DAFWA, DoF	DAFWA, DoF, SRT, LGA	DAFWA, DoF	DAFWA, DoF
Litter	SRT, LGA, DER	SRT, LGA, WC, DoW	SRT, DPaW, DER, LGA	SRT, WC, DPaW, DER, LGA, DoT	LGA, DoW, DPaW, DER, WC
Non-nutrient pollution	SRT, DER, LGA	SRT, DER, LGA, DoW, DoH	SRT, DER, DoH, DoW	SRT, DER, LGA, DoW, DoH	DoW, DoH, DoP
Sedimentation	DoT, SRT, DER	DoT, SRT, WC, DoW, LGA	LGA, DoW	SRT, WC, DoW, LGA	DoT, SRT, WC, DoW, DAFWA, LGA, WALGA, MRWA, HC
Sewage spills	DER, SRT, DoH, WC	DER, SRT, DoH, WC, DoW, LGA	SRT, DoH, WC	DER, SRT, DoH,	SRT, DoH, WC, DoW, DoP
Swimming	SRT, LGA, DoH	SRT, LGA, DoH	SRT, LGA, DoH, TWA	SRT, LGA, DoH, DoT	SRT, LGA, DoH, DSR, DER, DoT, DoP, TWA
Tourism activities	SRT, TWA	TWA, DPaW, DoT, SRT, DoF	TWA, DSR, LGA, NT, HC	DPaW, SRT, DoT, DoF	DPaW, DoT, LGA, TWA, DSR, DPaW, DoF, NT, HC, DAA
Yacht clubs and marinas	DoT, LGA	DoT, SRT	DoT, LGA	DoT, LGA, SRT	DoT, SRT, LGA

Source: Draft River Protection Strategy, Swan River Trust

Auditor General's Reports

REPORT NUMBER	2014 REPORTS	DATE TABLED
15	Working with Children Checks	30 June 2014
14	Information Systems Audit Report	30 June 2014
13	Royalties for Regions - are benefits being realised?	25 June 2014
12	Government Funded Advertising	25 June 2014
11	Licensing and Regulation of Psychiatric Hostels	25 June 2014
10	Universal Child Health Checks Follow-Up	18 June 2014
9	Governance of Public Sector Boards	18 June 2014
8	Moving On: The Transition of Year 7 to Secondary School	14 May 2014
7	The Implementation and Initial Outcomes of the Suicide Prevention Strategy	7 May 2014
6	Audit Results Report – Annual 2013 Assurance Audits (Universities and state training providers – Other audits completed since 1 November 2013)	7 May 2014
5	Across Government Benchmarking Audits – Controls Over Purchasing Cards – Debtor Management – Timely Payment of Invoices	1 April 2014
4	Behaviour Management in Schools	19 March 2014
3	Opinion on ministerial decision not to provide information to Parliament about funding for some tourism events	18 March 2014
2	Charging Card Administration Fees	12 March 2014
1	Water Corporation: Management of Water Pipes	19 February 2014



Office of the Auditor General
Serving the Public Interest

**Office of the Auditor General
Western Australia**

7th Floor Albert Facey House
469 Wellington Street, Perth

Mail to:
Perth BC, PO Box 8489
PERTH WA 6849

T: 08 6557 7500

F: 08 6557 7600

E: info@audit.wa.gov.au

W: www.audit.wa.gov.au



Follow us on Twitter [@OAG_WA](https://twitter.com/OAG_WA)



Download QR Code Scanner app
and scan code to access more
information about our Office