

Water Corporation

Wastewater overflow management Swan and Canning rivers

Based on a report prepared for the Department of Environment on 28 October 2004 in response to a wastewater discharge into the Swan River from a corroded pressure main near the western bank of the river at Caversham on 16 October 2004.



Improving Perth's wastewater system: Trenchless sewer relining project in Cottesloe

Water Corporation
Wastewater overflow management

BACKGROUND

The Water Corporation takes wastewater spillages very seriously, recognising and acknowledging that they are unacceptable to the Western Australian public.

Western Australia's public sewerage systems are designed, maintained and operated in line with practices employed by the most modern water utilities in the world. These networks of gravity flow pipes, pumping stations and pressure pipes are designed for reliability. Generally, despite their huge geographic extent, they perform well with relatively few failures. Across the world, in order to protect the health of the public in the areas they serve, all of these systems rely on rivers, lakes and other low-lying environments for emergency overflow relief. Given the nature of the systems, the total elimination of all wastewater spills is not attainable but the likelihood of their occurrence must be closely and carefully managed.

Public concern, together with the Water Corporation's own aim of attaining high levels of sustainability in every aspect of its operations, has resulted in the Corporation adopting an aspirational target of zero waste water spills. The Corporation is committed to working towards this target to the best of its capabilities and resources.

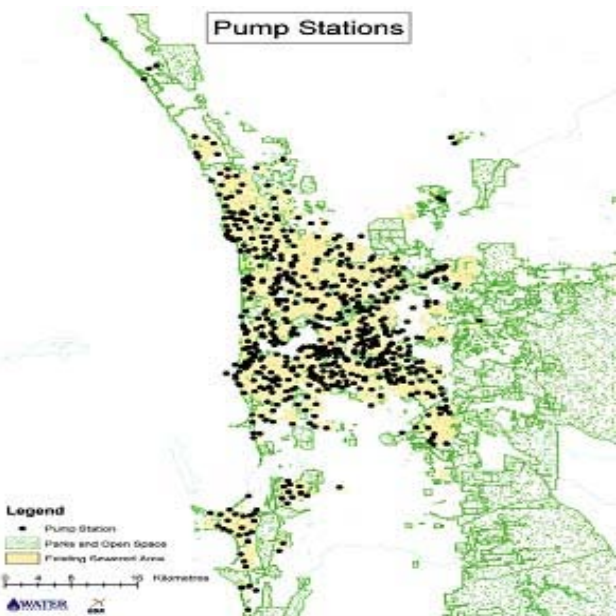
This paper is based on a report produced for the Department of Environment following the major spill from a corroded pressure main near the Swan River at Caversham on 16 October 2004. It sets out the background to the Corporation's initiatives to reduce discharges to the environment from its wastewater systems. It also details the plans in place to further enhance the level of protection currently in place and outlines the maintenance management philosophy employed by the Corporation for its wastewater assets.

The Water Corporation operates and maintains a large network of wastewater assets around the Swan and Canning rivers.

Wastewater networks rely mainly on gravity to transport the water. It is, therefore, inevitable that pumping stations and pressure mains are located low in the landscape, often near rivers and wetlands. This is standard practice around the world, however in Perth it has implications for the Swan and Canning rivers.

The Corporation recognises the importance of protecting the environment and community concerns with wastewater overflows and has been working to reduce the number of overflows across the whole State, and in particular to the Swan and Canning rivers.

In 1997, a working group chaired by the Department of Environmental Protection, and with membership from the Water Corporation, Swan River Trust and Water and Rivers Commission, assessed the impact of sewage spills on the river system and made a number of recommendations to Government.



THE RIVERWISE PROGRAM

In response to these recommendations the Corporation initiated a major program known as 'Riverwise'. This program resulted in \$15 million being spent on 36 Sewerage Pump Stations (SPS). This has been effective in halving the number of overflows to the Swan and Canning rivers.

The Corporation's overall approach is to ensure that all sewerage pump stations have several controls in place to limit the probability of overflows from mechanical and electrical failures, together with processes to limit the impact should these occur. These controls include:

- All components designed to Australian Standards.
- Extensive asset maintenance and assessment programs.
- Alarm monitoring / remote control / rapid response – 24 hours x 7 days.
- Back up equipment – pumps, fixed & mobile power plants and spares.
- Incident management plans for emergency responses.
- Emergency storage to allow contingency arrangements to be activated.
- Private tanker companies on call.
- Overflow points to water courses as a last resort (*recognising that other emergency discharge options pose a greater risk to human health*)

Sewerage pump stations adjacent to the Swan and Canning rivers have a higher level of protection than most other stations in the State.



BEYOND RIVERWISE

The cross-agency Riverwise Working Group formed the view that the hazards posed to public health and the ecology from periodic sewage overflows to the Swan and Canning Rivers are both temporary and localised. However, the Water Corporation has continued to plan and invest in infrastructure improvements to further reduce the likelihood of such incidents.



The Corporation electronically monitors its water and wastewater schemes 24 hours a day through the state-of-the-art SCADA monitoring system.

In July 2004 the Corporation completed a comprehensive review of its sewerage pumping system infrastructure and operations and maintenance practices across the State in order to reduce the number of overflows from its reticulation and sewerage pumping systems. In doing so it has produced:

- An assessment of current risks of overflow at all existing sewerage pumping stations across Western Australia.
- Principles to guide the Corporation's response to this comprehensive review at each of these sites.
- A 15-year program to retrofit the existing sewerage pumping stations and bring them up to the standards expected today.

The results of the review and their implementation represent the Corporation's response to the requirements set out in the draft *National Water Quality Management Strategy Guideline for Sewerage Systems - Sewerage System Overflows* and will also support the Code of Practice on Sewerage Overflows being developed by the Department of Environment.

Guidelines have been developed that provide direction on the measures to be put in place for large, medium and small sewerage pumping systems in highly sensitive, sensitive, moderately sensitive, and low sensitivity environments for the four most likely modes of failure – power failure, pressure main failure, total sewerage pumping station failure and alarm failures.

The guidelines have been formally endorsed by the Wastewater Management Framework Steering Committee which was established by the Water Corporation to assist it in the development of management strategies for the wastewater system. This committee comprises representatives from Department of Environment, Department of Health, World Wildlife Fund, Australia, Conservation Council of Western Australia, Economic Regulatory Authority and the Water Corporation.

These organisations have also agreed in principle to the timeframe as discussed below and will review the focus of the program for each coming year. It is recognised that some unexpected failures may occur during this implementation program and this is why the priorities are being agreed by all parties so that each agrees that the highest risks are being focused on first.

ASSESSING AND MANAGING RISK

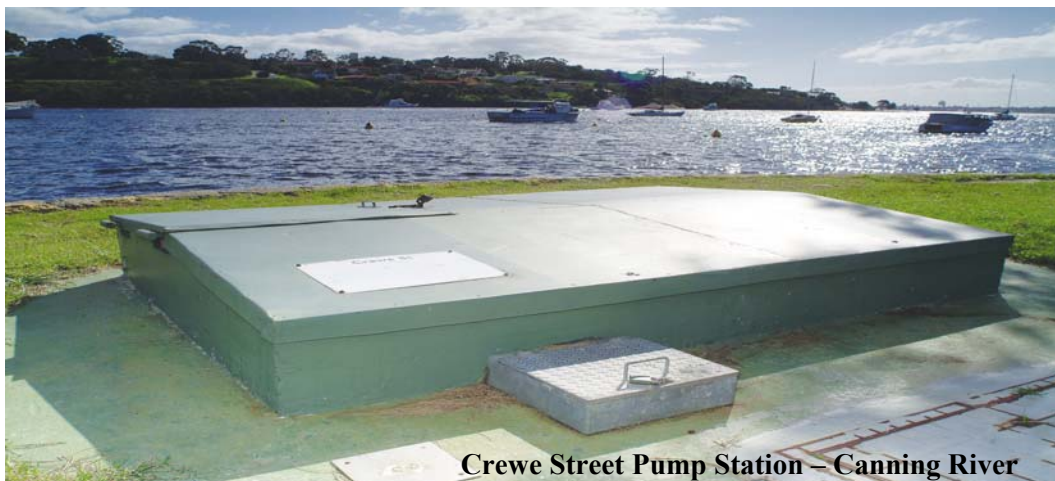
The Water Corporation has set itself a target of achieving a significant and rapid reduction in the number of overflows from its sewerage conveyance systems.

Each Corporation sewerage pump station in Western Australia has been assessed against a number of factors that determine the risk associated with an overflow. These factors are:

- Volume of wastewater to be managed.
- Environmental impact.
- Community concern.
- Health and amenity.
- Likelihood of failure.

More than 900 sewerage pumping stations have been placed in risk order to guide the planning, definition and design, and implementation of improvements.

As a part of this study the Corporation undertook a review of all sewerage pump stations adjacent to the Swan and Canning rivers and their tributaries. It has taken a conservative approach, identifying 133 SPS that are within 500 metres of the river, or within 1000 metres and near a drain leading to the river. The pumping stations near the Swan and Canning rivers, depending on their location, have been placed in the sensitive and highly sensitive categories. These are all being treated with priority, with the program representing a more stringent approach to risk when compared to the 110 pumping stations classified as Riverwise pumping stations in 1997.



Crewe Street Pump Station – Canning River

RISK AND ECONOMIC COST

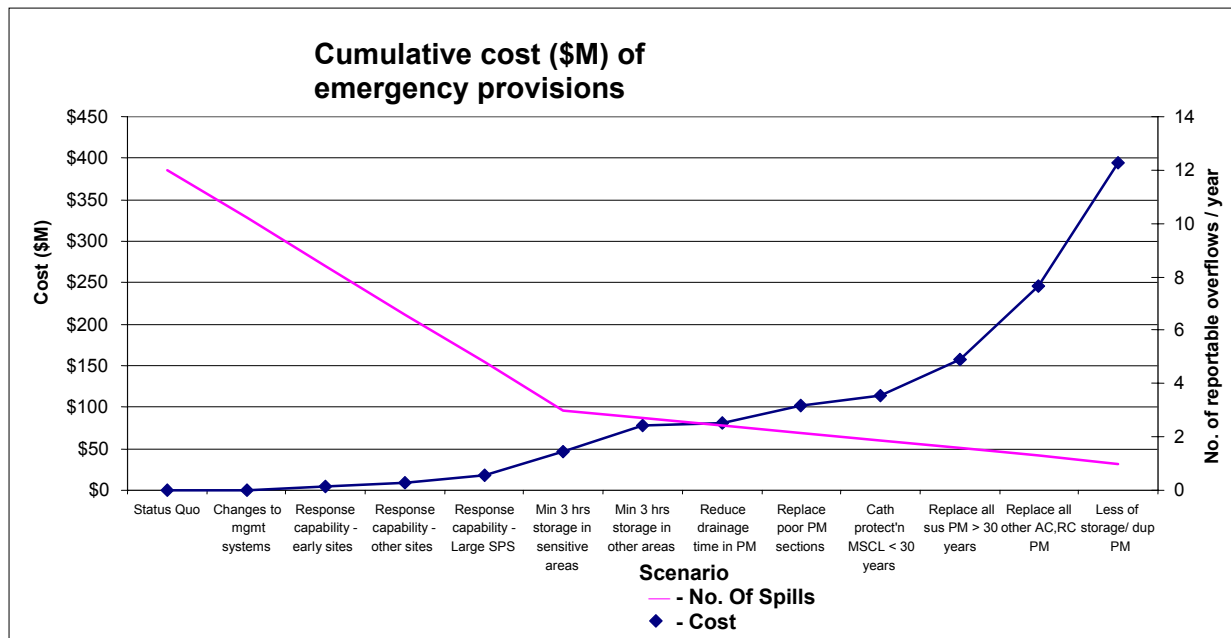
There will always be a chance of an overflow as the Corporation does not control all circumstances and cannot access all of its buried assets. The benefit of trying to eliminate all overflows must be weighed against the very significant associated cost.

The diagram below shows the cost required to reduce the risk of overflows from sewerage pumping systems (pump stations and pressure mains) across the State. It indicates that an exponential increase in expenditure is required to significantly reduce the probability of the last few overflows. The costs shown reflect the cost to retrofit existing systems with the necessary improvements.

The alternative of containing spills within the sewerage catchment poses greater risk to human health.’ (Sinclair Knight Merz – 1997 – for Swan River Trust)

The Corporation notes also the view of independent consultant Sinclair Knight Merz in relation to periodic incidents.

‘The environmental damage resulting from sewerage overflows is relatively low and ecological damage will be short-term and recoverable. Thus sewerage overflow policy should be driven by protection of community health.’



Whilst the Corporation endeavours to plan for and operate the wastewater system so as to avoid any discharge to the environment, there is recognition of the following element.

‘Sewerage systems will have failures from time to time, regardless of the degree of protection provided. The ultimate repository of any overflow from sewer failures should be watercourses. The costs to the community of a zero – spill philosophy cannot be justified.’

FIVE-YEAR IMPROVEMENT PROGRAM

The Corporation has begun a \$98 million program in the metropolitan area over five years from 2004/2005. The program will:

Improve operational response at pump stations through the provision of fixed and mobile generators, improved Supervisory Control and Data Acquisition (SCADA) systems, provision of by-pass pumping capability and the establishment of higher inventories of critical spares.

- Duplicate pressure mains at river crossings.
- Protect and enhance mild steel cement-lined pressure mains through replacement of sections in poor condition, cathodic protection, where appropriate, and additional section valves to reduce draining time in the event of an emergency.
- Provide pump stations with increased emergency storage by retrofitting emergency storage in sensitive areas.
- Treat gravity sewers prone to blockages.

The program outlined above is aimed at rapidly increasing the Corporation's early warning and response capabilities and will address sewerage pumping systems in sensitive areas including those near the Swan and Canning rivers. Targeted remedial work and enhancement work on the older and larger mild steel cement-lined pressure mains is also scheduled for early attention with a focus on the Swan and Canning rivers.

This will be followed by work at sewerage pumping systems in other areas through the following 10 years.

Replacement and duplication of pressure mains will be based on formal asset condition assessments and growth triggers. The Corporation will each year involve the Wastewater Management Framework Steering Committee in the review of program priorities.

Within this program the Corporation has identified a number of improvements to the riverside sewerage pumping stations. 21 will be fitted with SCADA, 33 will have increased storage, 51 will be fitted with Generator Quick Connectors, 52 will be fitted with by-pass pumping branches and a set of mobile emergency equipment will be acquired for use at sewerage pumping stations across Perth as required.

EARLY IMPROVEMENTS

The work programmed for this year (2004/2005) on pressure mains near the river is as follows:

- Begin replacement of sections of pressure main with the potential to fail due to internal gas corrosion.
- Begin installation of cathodic protection on pressure mains with the potential to fail due to external corrosion. The actual targets will be determined as a result of an investigation currently under way.
- Installation of additional section valves to reduce the drainage time should a burst occur.
- Research and Development into a system to detect leakage from pressure mains. There is currently no known method of doing this in the water industry to sufficient accuracy. However, the Corporation believes it has located two potential products from the oil and gas industry and is currently in discussion with one of the suppliers to establish a trial to prove the concept. If successful, this will be applied to sensitive pressure mains.



Ready for action: Mobile generators can be easily transported to site when required.

Additionally, the Corporation has identified gravity sewers that are susceptible to overflow due to root intrusion and this year a preventive program began with an aim to reduce the number of overflows by 30-50% over the next two years.

MANAGEMENT OF THE WASTEWATER SYSTEM

The asset management methodology used by the Corporation as it relates to maintenance planning and execution can be broadly described in relation to Asset Condition Assessment (ACA), Asset Risk Assessment (ARA) and Maintenance Standards.

Asset Condition Assessment

Asset Condition Assessment (ACA) is a process with supporting information systems for use in managing the condition assessment of the Corporation's infrastructure assets. It was endorsed for implementation across the Corporation in July 2000. Implementation began in 2001/02 with priority given to the assessment of the highest risk and the oldest assets. Implementation of ACA is scheduled for completion in December 2005.

In 2003/04, the Water Corporation undertook approximately 20,000 asset condition assessments.

ACA is a tool for managing the process of condition assessment. It:

- Ensures that the condition of all infrastructure assets is routinely assessed.
- Provides a rating structure and the criteria against which this condition assessment is done.
- Provides a suite of standard inspection templates.
- Provides a first pass assessment and identifies the need for a second pass (more detailed - engineering based) assessment.
- Flags required treatments (first pass) that are then reviewed before being fed into the capital and maintenance planning processes.
- Provides a register of asset condition and stores condition history.
- Supports the management reporting of asset condition.

However, with respect to buried pipelines, and wastewater pressure mains in particular, the Corporation (and the water industry in general) has very limited capability for assessing the condition of these assets. In most situations, visual inspections are impractical.

Tests on samples of pipe actually removed from the pipeline (destructive testing) are used to make judgements about the condition of those parts of the buried asset that cannot be accessed directly. Another tool currently available to the industry for the assessment of the condition of internal linings is CCTV. This tool has broader application for assessment of clean water assets but its effectiveness is limited by the presence of slimes and films on the surface of wastewater pipelines.

Remotely controlled devices that travel along a pipe and measure pipe wall thickness are widely used in the oil and gas industry and provide reliable information on the condition of a pipeline. However, the most common types in use with oil and gas are not suitable for use in pipes with cement lining. There are also types that have been developed for the water industry, but they are limited to pipes of less than 400mm in diameter. There has been little uptake of the technology in the water industry in this country.

Asset Risk Assessment

The Asset Risk Assessment (ARA) process has been developed to provide the Corporation with quantified risk exposures that are associated with the infrastructure asset base.

The ARA process has been developed as a module in the Corporation's maintenance information system and is now used across the organisation. Where risks are identified as having major or significant risk exposures, treatment plans for these risks are prepared.

On completion of the treatment plans, the expected residual risk exposure is calculated. The concept of residual risk is important because, like all utilities (including power and gas), the Corporation's approach to asset management is risk-based.



Trenchless Technology: This flexible liner is fed through a platform which stands over a sewer access chamber.

Maintenance Standards

In 2003 the Water Corporation reviewed its existing maintenance plans and developed 17 'best-practice' Maintenance Standards for consistent application across the Corporation. These standards have been developed to cover major asset classes and are structured to achieve the following outcomes:

- Optimise whole of life cost.
- Ensure compliance with statutory requirements.
- Ensure that minimum levels of service are provided in terms of product quantity and quality.
- Optimise risk exposure (environment, public safety and employee safety).

The new standards are in the process of being implemented and will guide all maintenance activities across the Corporation. The Standards are subject to ongoing review and refinement.

Inspection and maintenance of pressure mains involves:

- Scheduled external inspection of valve pits, including section valves, scour valves and air valves that report on the condition of the pits; the condition of the valves; the condition of the fittings within the pits; the general condition of the pipework within the pits and the thickness of the metal in the pipework at selected points.
- Annual servicing of section valves and air valves. This involves operating the section valves over their full operating range and ensuring that the air valves are functional.

In addition to these maintenance activities, the Corporation has introduced Direct Current Voltage Gradient (DCVG) testing on selected pressure mains.

This approach to maintenance for mild steel cement-lined pressure mains is similar to practices used by the better Australian water utilities.

INTER AGENCY PROTOCOLS

Protocols are in place with the Department of Health, the Department of Environment and the Swan River Trust that aid in the protection of public health and the status of the river systems in the event of a discharge to the environment. These protocols have been agreed between the parties, are long standing and have been tested in practice.

Every endeavour is made to avoid the need to activate these arrangements. Nonetheless, they are an important element in the Corporation's contingency planning and this heightened state of preparedness maintained by all agencies contributes to the State's response capability.

CODE OF PRACTICE

The Department of Environment is currently finalising a Code of Practice for Wastewater Overflows. The Water Corporation is contributing to and co-operating with the department in establishing an agreed set of practices and targets for overflows. When this is complete, the criticality ranking of the sewerage pumping systems will be refined and any modification to practices included in the improvement program.

RESEARCH AND DEVELOPMENT

The Corporation constantly endeavours to find better ways to assess the condition of its assets, particularly its buried assets. The most promising at present appears to be Direct Current Voltage Gradient. This is being applied in the Perth Region to pressure mains near the Swan and Canning rivers.

Apart from knowing the condition of the assets so as to prevent a burst the most vulnerable areas are stopping the overflow as soon as possible and limiting the potential volume of discharge. The Corporation is putting in a number of conventional provisions, such as improved alarms and remote controls and seeking out new technologies to assist. In particular, in the past 12 months it has investigated leak detection equipment and line stopper to reduce the amount that must be drained from the main before a repair can be made.

The Corporation's research shows that no other water utility in Australia or overseas is using technologies that can detect small leaks in pressure mains. However, as noted earlier in this report, its research has identified two promising solutions in the oil and gas industry and negotiations are under way with the supplier of one to set up a trial of the product. If this is successful it can be applied to other sites. Due to its cost, it is likely to be limited only to pressure mains in sensitive areas.

Effects of overflows on the Swan-Canning river system

The occasional wastewater overflow that enters the Swan-Canning river system is usually very small in volume compared with the volume of the receiving waterway. This means that any overflow into the river system is rapidly diluted. Also, wastewater is 99.97 per cent water (because most of it comes from showers, baths and washing machines).

As a precautionary measure in response to a wastewater overflow into the river system, the Department of Health may restrict access to an area larger than the immediate area affected. Following Department of Health advice, health-warning signs are erected where needed.

After a wastewater overflow, the Department of Health takes water quality tests for bacterial contamination. Once the sampling results show that the water quality is safe, the closed area is opened for the public to swim and for recreation. The sampling process usually takes about two days to complete.

The load from nutrients like nitrogen and phosphorus entering the Swan-Canning river system from wastewater overflows is very small compared with the total load of nutrients entering every day from the catchment. Only 0.004 per cent of nitrogen load and 0.009 per cent of phosphorus in the river system over the past 12 years has come from wastewater overflows.

Wastewater overflows contribute an insignificant amount of toxicants, such as heavy metals, to the river system and slightly reduce the levels of dissolved oxygen in the water, but not enough to harm the organisms that live there.

As the frequency of wastewater overflows entering the river system is low, each overflow is, in effect, an isolated incident. The rapid dilution and dispersion and the low amounts of contaminants entering the river system in overflows makes cumulative effects unlikely.

Approximate nutrient loads in the past 12 years (to 31 January 2004)

Sewer Overflows into the
Swan-Canning river system (4,829 kL)

❖ Nitrogen = 289kg

❖ Phosphorus = 72kg

Other Sources

❖ Nitrogen about 7,920,000kg

❖ Phosphorus about 771,000kg

100 Kilolitres of wastewater contains about 6kg of nitrogen and 1.5kg of phosphorus

REGULATORY FRAMEWORK

The Corporation is licensed by the Economic Regulation Authority to deliver services pursuant to the provisions of the Water Services Licensing Act 1995. The Corporation is the sole provider of wastewater services in the Perth metropolitan area.

The Operating Licence held by the Water Corporation requires (inter alia) that the Corporation shall:

- Provide for and maintain an asset management system.
- Notify the Economic Regulation Authority (ERA) of any significant change to the asset management system.
- Ensure that the asset management system sets out the measures to be taken by the Corporation for the proper maintenance of assets used in the provision of water services and for the undertaking maintenance and operation of water service works.
- Ensure the asset management system includes Asset Management Plans for all of its assets which shall fully describe the assets and their role in the Corporations business and provide details of management actions planned for the operations and maintenance of these assets.
- Provide the ERA with a report on the effectiveness of the asset management system conducted by an independent expert who has received the prior written approval of the ERA.
- Provide such independent reports every two years. Each report covers the effectiveness as at 30 June and must be provided to the ERA by 31 December following the audit period.

The Corporation has fully complied with this requirement.

The most recently completed report was provided by Meritec Pty Limited in December 2002. The review findings noted that *‘overall Meritec believes the Corporation could be categorised as demonstrating current best practice in asset management in the water industry in Australasia’*

The 2004 audit is currently (October 2004) being undertaken by Maunsell Australia Pty Ltd and the review findings will be available in December 2004.

SUMMARY

This paper was produced following the major spill from a corroded pressure main near the Swan River at Caversham on 16 October 2004.

The paper details the very significant progress the Corporation has made through the “Riverwise” program launched in 1997 to reduce discharges to the riverine environments of the Swan and Canning rivers.

The paper also provides details of the further risk assessments that have been completed on all wastewater assets across the State and the actions and plans in place to further enhance the level of protection for these assets.