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Service activities relating to drinking water supply, wastewater and stormwater systems — Examples of good practices for stormwater management

PROOF/ÉPREUVE

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 224, *Service activities relating to drinking water supply, wastewater and stormwater systems*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

The objectives of stormwater management systems include effective control and management of flows; protection of water quality; preservation of water quantity; protection of the built, public and natural environments; water conservation and reuse; protection or enhancement of ecosystem health; protection or enhancement of public health, safety and welfare; protection or enhancement of social values; and facilitation of sustainable development and climate adaptation.

"Climate Change 2014: Synthesis Report: Summary for Policymakers, 2014, Intergovernmental Panel on Climate Change" gives us the warning that many global risks of climate change are concentrated in urban areas. It indicates that risks are amplified for those lacking essential infrastructure and services or living in poor-quality housing and exposed areas. The key risks, all of which are identified with high confidence, include those of severe ill-health and disrupted livelihoods for urban populations due to flooding from a range of sources including pluvial, fluvial, storm surges and coastal flooding.

Pursuant to the "World Urbanization Prospects: The 2011 Revision, 2011, United Nations", the world urban population is expected to increase by 72 per cent by 2050, from 3,6 billion in 2011 to 6,3 billion in 2050. i.e. the same size as the world's total population was in 2002. Virtually all of the expected growth in the world population will be concentrated in the urban areas of the less developed regions, which are deemed to be vulnerable to flooding. The report states that flooding is the most frequent and greatest hazard for the 633 largest cities or urban agglomerations analysed. Mud slides are often associated with severe weather conditions and flooding, particularly in rural areas and commonly will impact rural villages and small towns, or their associated transportation infrastructures.

Thus, climate change and urbanization with rapid growth in population in cities and surrounding areas are most likely to increase flooding and the risks associated with stormwater worldwide. Serious challenges for stormwater management are posed for an increasing number of stormwater utilities, which are responsible for the control of pluvial flooding that is caused by rainwater entering and surcharging stormwater systems or remaining on surfaces and flowing overland or into local depressions and topographic lows to create temporary ponds.

The immediate impacts of urban flooding can include loss of human life, damage to property, disruption of traffic and other services and deteriorations of limited freshwater resources, water ecosystems and hygienic living conditions. Effective stormwater management systems can enhance the resilience of communities by reducing the likelihood and severity of pluvial, fluvial and coastal flooding.

Planning methods for stormwater systems have been established in most developed countries but they do not always apply directly to other countries with different conditions. In order to help deliver the best solution to the targeted area, the framework and planning processes should be standardised, within a local institutional and regulatory context.

Urban stormwater management is usually the responsibility of municipal water and wastewater service providers. However, in some countries the urban stormwater system management is performed by separate entities especially established for this purpose. Sometimes these services are not financially supported from the municipal water and wastewater revenues but from stormwater levies applied to flood vulnerable properties concerned and created for that purpose or a local governing authority.

While it is largely and historically true that urban stormwater management has been the responsibility of municipal wastewater authorities, it is increasingly recognized that stormwater management may be best or additionally served through collaboration with other relevant stakeholders such as Forestry Commissions (for forested hill and mountain sides), Agricultural Commissions for upstream farming properties, river authorities or Port Commissions for the management of tidal surges on both marine and freshwater bodies or local governing authorities.

This document compiles examples of good practices in stormwater management.

These examples illustrate a wide range of measures including both asset and non-asset-related measures for various objectives relating to stormwater management.

Service activities relating to drinking water supply, wastewater and stormwater systems — Examples of good practices for stormwater management

1 Scope

This document provides examples of good practices in stormwater management related to ISO 24536 and information on standards and guidelines used in various countries.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Format and content of the examples provided in this document

Examples of stormwater management introduced here are classified by country and are described in Annex A. They are also classified according to the objectives in ISO 24536:2019, Table 1, and are shown in Table A.1. The examples were provided by country representatives and adapted to the format of this document. In addition, although various standards and guidelines are described in Annex B, Table B.1 and Table B.2, they are shown only as a name and a reference URL.

Table 1 illustrates the structure of the examples included in Annex A.

Table 1 — The structure of the examples

Section	Content
Background	Provides background information on the project, such as characteristics of the watershed, social background, issues and tasks.
Purpose	Provides a description of the project objectives, such as improvements to be achieved.
Project outline	Provides a description of the project.
Organization	Provides simply the identity of the organization offering its experience.

Annex A
(informative)

Examples of stormwater management

A.1 Introduction

There are many examples of good stormwater management practices that follow the procedures set by the ISO 24536. The examples have been classified according to the stormwater management objectives they were answering to.

Table A.1 — List of examples and their key objectives for stormwater management related to ISO 24536

Sub-clause	Title	Objectives according to ISO 24536								
		Effective control and management of flow volumes	Protection of water quality	Preservation of water quantity	Protection of the built, public and natural environments: infrastructure, property and resources	Water conservation and reuse	Protection or enhancement of ecosystem health	Protection or enhancement of public health, safety and welfare	Protection or enhancement of public social values	Facilitation of sustainable development and climate adaptation
A.2.1	Creation of a wetland in Mount Barker		X		X		X	X	X	
A.2.2	Stormwater harvesting and reuse in Murray Bridge			X		X				
A.3	Austria — Increasing storage capacity and implementing dynamic control in Vienna	X	X		X			X		
A.4.1	Improving sediment control through the implementation of a wetland in Hamilton		X				X		X	X
A.4.2	Planning effective stormwater management measures in Ottawa	X	X		X		X	X	X	
A.5	Denmark — Dynamic control in Kolding	X	X	X	X		X			
A.6.1	Disconnecting stormwater from the combined network in Killingworth and Longbenton, North Tyneside, England	X	X		X		X	X		X
A.6.2	River diversion and stormwater storage in Brunton Park, Gosforth, Newcastle, England	X			X		X	X		X
A.7	France — Real-time control of sewer systems for the reduction of combined sewer overflows in Biarritz	X	X		X					
A.8.1	Implementation of a real-time supervision for stormwater facilities operation and flood risk management in Nagoya	X			X					
A.8.2	Implementation of the stormwater management strategy of Niigata City	X								

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Table A.1 *(continued)*

Subclause	Title	Objectives according to ISO 24536								
		Effective control and management of flow volumes	Protection of water quality	Preservation of water quantity	Protection of the built, public and natural environments: infrastructure, property and resources	Water conservation and reuse	Protection or enhancement of ecosystem health	Protection or enhancement of public health, safety and welfare	Protection or enhancement of public social values	Facilitation of sustainable development and climate adaptation
A.8.3	X-band radar observation and forecast for stormwater and flood risk management in Osaka City	X			X					
A.8.4	Implementation of a flood risk protection strategy in Tokyo	X			X			X		
A.8.5	Source infiltration promotion in Yokohama	X			X					X
A.8.6	Implementation of the stormwater management strategy in Kitakyushu City	X								X
A.8.7	Implementation of an early flood warning system in Toyama City				X			X		
A.8.8	Stormwater storage tank and reuse in Hiroshima City's new stadium	X				X				X
A.8.9	Flood risk protection scheme in Fukuoka	X								X
A.8.10	CSO reduction and flood prevention in Kyoto	X	X		X				X	X

A.2 Australia

A.2.1 Creation of a wetland in Mt Barker

A.2.1.1 Background

A new Environmental Services Centre is planned for Mt Barker adjacent to a wastewater treatment plant, Mt Barker Creek and a high school.

The area has a long history of disturbance being a former abattoir, tannery and now informal council works storage area. Despite this disturbance, Lathan's snipe (an endangered migratory bird from Siberia) and many other bird species have been sighted along the flood plain area.

A.2.1.2 Purpose

As part of planning for the Environmental Services Centre, a wetland and surrounding landscape was built to achieve multiple objectives, including:

— creating habitat for the Lathan's snipe and other birds species;

— becoming a recreational asset with high amenity, providing links to a linear trail along Mt Barker Creek and connecting to the school and depot;

— rehabilitating vegetation and creating a seed bank for local provenance plants in a range of ecosystems;

— providing stormwater treatment for runoff generated by the new depot and car park;

— providing opportunities for education and awareness programs, both for the school and for a planned community environmental centre servicing community groups, schools and the general public.

A design response was developed that addressed these criteria and was thoroughly tested during consultation with Birds SA, council, community groups and specialist ecologists.

The design also provides a range of ecological habitats for vegetation and bird species, encourages visitors yet provides secluded areas where birds will not be disturbed.

A.2.1.3 Outline

This project was developed to rehabilitate a degraded area on the banks of Mt Barker Creek as part of a planned council depot construction. The central component of the project is a constructed wetland which will protect the creek from increased pollutants, provide habitat for rare and endangered bird species and become a recreational node along the Mt Barker Creek linear path.

A broader objective of the project is to rehabilitate a range of ecological habitats surrounding the wetlands, including grasslands, wet and dry woodlands and riparian areas. Much of the impetus for the initiative is to improve habitat for a range of rare and endangered birds and therefore the design involved close consultation with Birds SA.

The design provides a range of ecological habitats for vegetation and bird species yet provides secluded areas where birds will not be disturbed.

Walking paths, viewing decks and a boardwalk encourage people to enjoy the wetland but manage their access and allow a variety of habitats to be created (riparian inundation, open grassland, tussock grassland and wet woodlands).

The 6 000 m^2 wetland was constructed in 2014 and an extensive search was performed to source local provenance plant species to use in the wetlands. A thorough mapping exercise was undertaken during planting to enable the wetland to serve as a seedbank for these rare local species into the future.

The wetland also provides best practice stormwater treatment for runoff from the (future) depot thus helping to protect Mt Barker Creek and ultimately the Bremer River from urban stormwater pollutants (see Figure A.1).

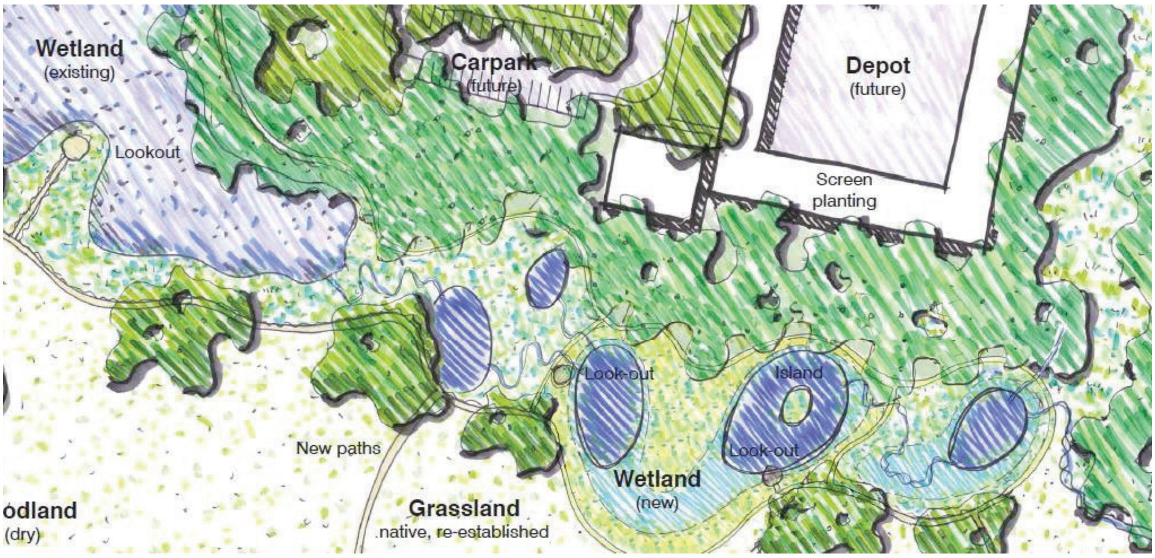

Figure A.1 — Future plan of Mt Barker Environment Services Centre wetlands

A.2.1.4 Organization

Mount Barker District Council

A.2.2 Stormwater harvesting and reuse in Murray Bridge

A.2.2.1 Background

Murray Bridge, South Australia, is situated on the banks of the River Murray and is one of the larger regional centres at the lower end of the Murray Darling Basin and an important hub for regional industries in the Lower Murrayland and Mallee Regions. Residential and industrial developments are a sign of the city's growing urban populations. Sustaining the city's many open spaces – parks, reserves and sporting facilities – is vital to the region and its local community.

In addition, major subdivisions are planned at the Newbridge (Old Racecourse) site and Gifford Hill, which are proposed to include in excess of 3 000 dwellings, and will constitute a major proportion of the proposed expansion of Murray Bridge over the next 20 years. A challenge for Council is the provision of infrastructure that can appropriately manage the increases in stormwater runoff associated with infill and greenfield developments.

A.2.2.2 Purpose

The Murray Bridge stormwater management and reuse scheme was built to provide an alternative, secure and sustainable source of non-drinking water supply to the Rural City of Murray Bridge. The Scheme harvests stormwater from eight basins and wetlands across Murray Bridge and transports it to a lined lagoon at Gifford Hill for long-term storage. When needed for irrigation, raw stormwater is pumped from the lagoon to the new treatment plant on Old Swanport Road, from which the treated stormwater is transported via distribution pumps and pipelines to the city's irrigation system.

The scheme was delivered by the Rural City of Murray Bridge, in partnership with the Australian Government and two private contributors. The total budget of $14,23 million was supported through $7,115 million of funding from the Australian Government's National Urban Water and Desalination Plan, to match the co-contribution from Council and in-kind works from the Gifford Hill Joint Venture. The scheme was completed on time and within budget, and with an impeccable safety record.

The Australian Government funding agreement required the scheme to decrease reliance on the River Murray and reduce potable water demand by up to 172 ML annually.

A.2.2.3 Outline

A.2.2.3.1 Scheme overview

The Rural City of Murray Bridge (Council) has a current water allocation of 250 million litres/year from the River Murray, and this allocation is subject to restrictions depending on flow conditions in the river. Council's allocation was significantly restricted during the drought years of 2006 through to 2010, dropping as low as 45 million litres/year (18 %) in 2008/09. These restrictions resulted in significant "browning off" and degradation of Council's reserves and sporting fields.

In response to the drought, Council identified stormwater as a valuable, untapped resource that can provide a secure, sustainable and diverse water supply to meet the future needs of the community. A strategy was soon developed for how stormwater can be harvested and reused across Murray Bridge to prevent a repeat of the devastating impacts of the drought, reduce reliance on mains and River Murray water, improve amenity of the many parks and reserves, improve drainage performance and flood protection, and improve water quality.

A.2.2.3.2 Design

In 2014 the Rural City of Murray Bridge entered into an Early Contractor Involvement (ECI) process with construction and design partners to optimize the previous concept design of the scheme. The ECI process was facilitated by the scheme's project manager, with input from the scheme's Technical Advisor.

Due to a delay in the planned housing developments at the Old Racecourse (Newbridge) and Gifford Hill development sites, which were originally proposed to be the source of a significant portion of the harvestable volume of stormwater in the previous concept design, a comprehensive optioneering phase was undertaken to identify alternative harvesting sites that can meet or exceed the yield targets.

Through careful planning, design and management the yield (irrigation demand met) from the eight harvesting sites currently connected to the scheme is expected to be approximately 230 ML annually, based on average rainfall in Murray Bridge. The scheme has also made provision for the connection of future pump stations at the Newbridge (Old Racecourse) and Gifford Hill development sites. Once these pump stations are installed and the developments are completed, the total harvestable volume for the scheme may exceed 700 ML annually.

The ECI process also identified a parcel of vacant land on Old Swanport Rd that was ideally located to become the hub of the scheme (Figure A.2). Located between the existing and Rural Avenue Wetland and the Gifford Hill Lagoon, with existing power supply available from Old Swanport Rd and only a short drive to the Council Depot, the site was ideal for the construction of the new treatment plant.

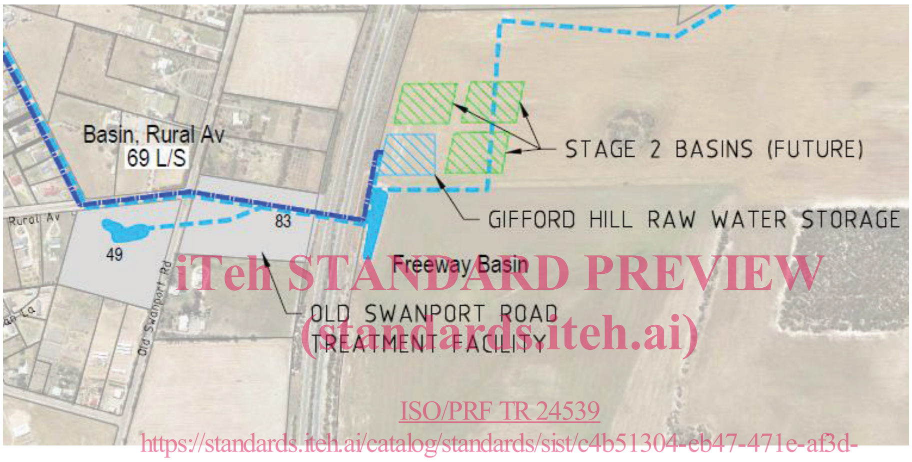

Figure A.2 — The 'hub' of the scheme; Rural Avenue Wetland, the treatment plant and Gifford Hill Lagoon

A route for the new pipelines along Rural Avenue, Prosperity Grove and Maurice Road was selected to provide a link between the treatment plant and the existing Council irrigation network on Adelaide Road. This route also enabled stormwater to be harvested from the existing Council wetlands and basins using parallel pipelines to reduce construction cost (i.e. one set of pipelines for harvesting, and another set of pipelines for distribution, within the same road reserve).

The planning and design of the scheme included consideration of opportunities for future expansion to include additional harvesting sites, increased demand for treated stormwater, and a possible link to a regional water diversification scheme that links Murray Bridge to the District Council of Mount Barker.

Examples of the "future-proofing" measures that were incorporated into the design include:

— The siting of the 110 ML storage lagoon on land that acts as a buffer to the SE Freeway at Gifford Hill, with surrounding land available for additional storage lagoons in the future (an ultimate storage of 440 ML is envisaged).

— The inclusion of a UV disinfection unit in the Old Swanport Road treatment plant to provide treated stormwater that is fit for purpose under an "unrestricted" irrigation regime. This provides flexibility for Council and third party water users to irrigate public open spaces 24 h a day. Provision was also made in the treatment plant for a second UV disinfection unit to be retrofitted in the future, should higher treatment flow rates be desirable.

— The treatment plant and treated water storage tank have been sized to accommodate Council's peak irrigation demand (night time, typically from 10 pm to 8 am) while also filling the tank shared by two other local organizations. There is further opportunity to operate the treatment plant during non-peak times (day time, 8 am to 10 pm) to service additional Council sites and other water users.

— The harvesting and distribution pipelines were sized to accommodate stormwater flows from the planned housing developments at the Old Racecourse (Newbridge) and Gifford Hill development sites, to enable simultaneous pumping from these sites together with the current harvesting sites. In particular the pipe crossings of the SE Freeway, which were installed using horizontal directional drilling (HDD) techniques, have significant redundancy to accommodate increase flows.

With the Council's unique stormwater drainage system consisting of a series of stormwater basins in localized depressions, it was also important that the harvesting and reuse strategy was able to improve the performance of the drainage system and level of flood protection to public and private infrastructure.

The basins do not naturally drain to the River Murray, but rather they rely on infiltration or pumps to dispose of stormwater. In the past, these basins have not always been able to cope during large rainfall events, resulting in flooding of roadways and in some instances, private property, as represented in Figure A.3. Floodplain modelling was therefore used to inform the selection of pump rates and to inform the scheme's control philosophy, to ensure that the improvements to drainage performance and flood protection were maximized.

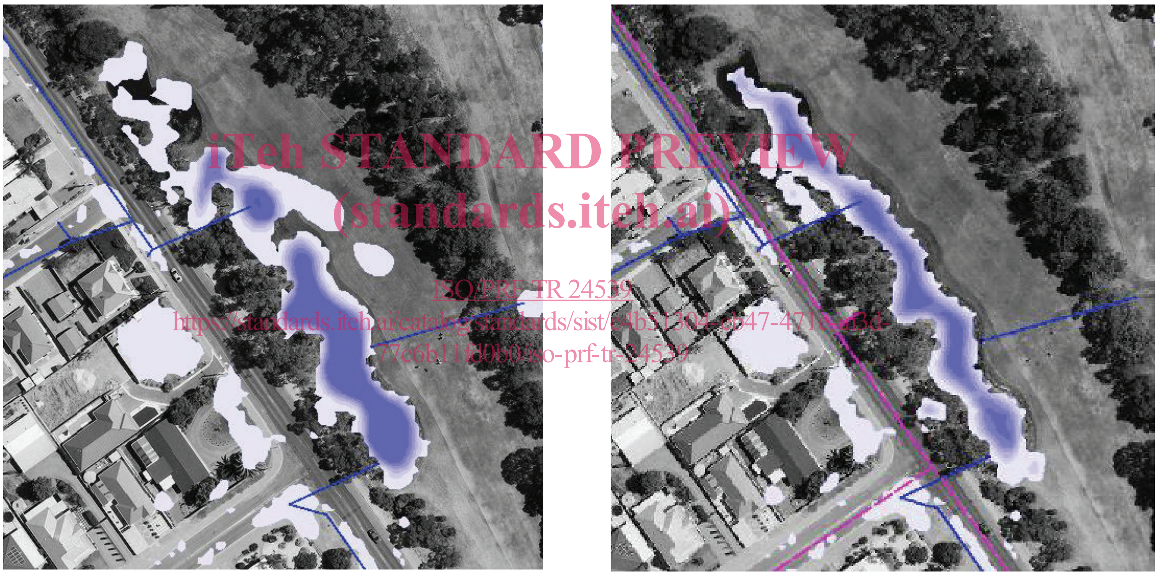

Figure A.3 — Before and after floodplain maps for golf course basin, 5-year average recurrence interval

The planning and design of the scheme also placed strong emphasis on the future operation and maintenance by Council staff. The scheme has a central Supervisory Control and Data Acquisition (SCADA) system located at the Old Swanport Road treatment plant that is connected to all sites via fibre optic cable or mobile phone based telemetry systems. The SCADA system enables Council staff to remotely monitor the harvesting and distribution infrastructure for the purpose of automated control, using their personal computers and/or tablet devices. In addition, critical alarms are alerted to the operators via an SMS service.

Many of the new pumps utilize variable speed drive functionality to provide operational flexibility, reduce wear on the mechanical components of the system, and to maintain system pressure as required. Under standard operating conditions all harvesting sites will pump simultaneously to the Gifford Hill Lagoon at pre-determined flowrates, in order to maximize the harvestable volume that is generated by small and frequent rainfall events.

In anticipation of and during large rainfall events, Council staff can use the new control system to remotely monitor the water levels in the basins and adjust pump rates and sequencing to manage flood risk in real time. For example, Council will have the flexibility to reduce the pump rate at one site, to enable a higher pump rate to be achieved at another site that is considered to be at greater risk of flooding.

While the scheme has been designed to operate automatically with minimal operator intervention, manual and local modes have also been provided on all equipment to facilitate testing and operation in unusual circumstances

Other notable operation and maintenance provisions include:

— Lifting mechanisms in the treatment plant to enable the safe and practical maintenance of pump sets and filters.

— Two solar powered pump stations that can easily be converted to mains power supply if higher flowrates are required in the future (i.e. after the ultimate development scenario is reached).

— Control manholes with isolation valves at each of the harvesting sites, to provide safe inspection and access of submersible pumps.

— The selection of submersible pumps stations with pumps capable of being removed from the pump station without entry in to the pump sump, providing a safe means of pump inspection by the elimination of confined space entry.

— A concrete ramp at the Gifford Hill Lagoon to provide boat access in the event that chlorine dosing is required, or small machine access in the event that the lagoon needs to be cleaned out.

— Provision for portable diesel powered pumps to be fitted at the harvesting sites, to enable basins to be pumped out even if short-term power failure were to occur.

— Design of the treatment plant shed roof to accommodate a future solar array, when battery storage technology is sufficiently advanced.

A.2.2.3.3 Control devices information

The central Supervisory Control and Data Acquisition (SCADA) system enables all harvesting sites to pump simultaneously to the Gifford Hill Lagoon at pre-determined flowrates to maximize the harvestable volume generated by small and frequent rainfall events. In anticipation of, and during, large rainfall events, Council staff can remotely monitor the water levels in the basins and adjust pump rates and sequencing to manage flood risk in real time.

A.2.2.3.4 Environmental management

As part of the construction program a project specific Environmental Management Plan (EMP) was developed with site specific criteria. The EMP detailed methodology included procedures for the prevention of contaminated water entering watercourses and the stormwater system.

Site-specific sections of the EMP detailed how to deal with the discovery and presence of local fauna and flora during the construction phase. Specifically this involved relocation of frogs, yabbies and other fauna to adjacent areas of the site that were not subject to construction works.

Consideration was also given to the discharge of backwash water from the treatment plant. This water is used to flush the treatment plant vessels during operation and is then transferred to a harvesting site for reuse, thereby reducing any disposal or wastage of this water. The selection of an ultraviolet disinfection system for the treatment of the distribution water also has an environmental benefit by eliminating both the storage and use of significant quantities of hazardous chemicals.

In order to minimize the impact of the project to trees and shrubs, the pipeline alignment and construction techniques were developed to focus on trimming of trees in order to reduce the number of trees removed.

A.2.2.3.5 Community and stakeholder engagement

The construction of this project included a dedicated community and stakeholder engagement plan and team. The team liaised with residents and stakeholders through the design and construction process with the following outcomes being achieved.

— The pipe alignment was adjusted to minimize disruption and impacts on businesses and the community in general. An example of this is the realignment of the pipeline along Adelaide Rd. The pipe was realigned to pass through a carpark rather than crossing one of the busiest intersections in Murray Bridge. Local businesses were consulted and the realigned pipe was constructed in without disruption to customer access to the businesses.

— Project introduction letters were distributed by letter drop to the general community, with follow-up communication to affected community members by specific information drops.

— Where the construction works directly impacted on community members, specific one-on-one communication was undertaken.

— Due to the important and significant indigenous history at Murray Bridge, the Ngarrindjeri people as the traditional owners of the land were consulted and involved throughout the construction process to ensure that the works caused no damage to items of significance.

— The construction program was developed to take into account concerns of the local community. Examples of this include:

  — Pipe construction along Maurice Rd was completed as night works to minimize the impact to traffic on this busy road.

  — Access to materials and pipe construction in the vicinity of the Racecourse was programmed to avoid disrupting events and training schedules.

  — Construction within the Golf Course involved timing of the works prior to major events and the utilization of track mats to prevent damage to the course during works.

— Extensive consultation was undertaken with state government agencies during the design and approvals phase, including:

  — South Australian Murray-Darling Basin Natural Resources Management Board;

  — Department of Environment, Water and Natural Resources;

  — Environmental Protection Authority;

  — Department for Health and Ageing;

  — Department of Planning, Transport and Infrastructure;

  — Office of the Technical Regulator.

Indigenous participation was also a strong focus of the project, as Murray Bridge and its surrounding region has numerous sites of cultural and spiritual significance of the traditional owners of this land, the Ngarrindjeri people. An important part of the Early Contractor Involvement process was the Council project team's collaboration with the Ngarrindjeri Regional Authority to ensure that the selection of project sites and design of the proposed works was sensitive to the cultural and spiritual significance of these lands to the Ngarrindjeri people.

Council's partnership with the Ngarrindjeri Regional Authority continued through the design and construction stages of the project, involving cultural heritage assessments of the project sites and monitoring of earth disturbing activities to ensure that risks to cultural heritage were appropriately managed (Figure A.4).