

Urban Waterways Renewal Project *FINAL REPORT*

A report prepared by The South East Regional Centre for Urban Landcare for the Department of Water.

January 2014



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Acknowledgements

SERCUL would like to dedicate the Urban Renewal Project sites in Armadale to the late Mr Ron Van Delft, City of Armadale Environmental Planner and Manager and to the late Mr Cam Clay, AGLG Chairman and SERCUL Treasurer. Their foresight and dedicated optimism for converting drains to living streams is now a reality in the Wungong and Southern River Catchments.

SERCUL would like to acknowledge and thank the officers within the Department of Water who have assisted us to make this project a complete success. From the beginning of urgently putting forward a preliminary project profile with a detailed budget in three days to the on ground design details the DoW officers have been very proactive and have provided thorough technical advice and excellent skills in WSUD and the monitoring program design and delivery.

Particular officers we would like to thank and acknowledge include; Sandra Henville (McKenzie), Ken McIntosh, Janine McDonald and Patricia Pedelty, who worked tirelessly with SERCUL staff to prepare the original project plan, budget and then get the agreements through the approval process. Thanks also to Bill Till, Agnidhar Bhandari, Jason Lette, Belinda Quinton and Kelly O'Neil for their continued support through the project design and delivery, assisting SERCUL and other team members to resolve planning and design challenges along the way.

We also thank and appreciate the Swan River Trust Officers who also added tremendous support and sought additional funding for the projects. Those officers include Mr Rod Hughes, Mark Cugley, Debbie Besch and Sonia Kelly.

Within the Water Corporation, we thank Tom Long, Meg Anklesaria, Bob Humphries, Geoff Hughes and Scott Davies for assisting us through the planning approval difficulties and also undertaking continued research support for seeking new methods of nutrient intervention and project works that show how they can restore drainage features within existing traditional stormwater management systems into natural drainage features like living streams and bioretention/biofiltration areas.

We appreciate the communication with the Australian Government Department of the Environment via Mr Manni Hernandez, who maintained an excellent contact point for us as we met reporting milestones throughout the project delivery.

The SERCUL organisation appreciates the effort that the SERCUL staff have endured during the development and implementation of this large scale landcare and water resource management project. The SERCUL officers involved throughout the project delivery were;

Julie Robert, Ana Terrazas, Brett Kuhlmann, Tom Atkinson, Glen Byleveld, Ditte Strelbel, Matt Grimby, Amy Warner, Amy Krupa, Melinda Snowball, Alice Atkinson, Monica Estrada, Daniel Millea, Tony Parelli, Saw Ta Pewh, Saw Ha Say Htoo, Wilson Orjuela, Sandy Wainwright, Jose Alcalá, Russell Gorton, Lee Ireland, Megan Crotty and Cory Fletcher.

A team of reliable, motivated and inspiring people, working with cooperative and professional partners has achieved a remarkable outcome in completing the Urban Waterway Renewal Projects with great success. The Urban Waterway Renewal project has created a fantastic guiding waterway management legacy in Perth being; eleven functioning urban drainage renewal demonstration sites available for any land manager or developer to view hopefully be inspired to recreate elsewhere.



Project Partners and Contributors

The overall project partners that supported SERCUL to develop and implement these projects included the Department of Water, Swan River Trust, Water Corporation, City of Canning, City of Gosnells, City of Armadale, South West Aboriginal Land and Sea Council, Department of Regulation, Armadale Gosnells Landcare Group, Local Schools, Conservation Volunteers Australia, Chevron, Western Australian Planning Commission, Bannister Creek Catchment Group, Community volunteers, Corporate Volunteer groups, Karl Karu, Dr Michael Klunzinger and Dr Judy Fisher.

SERCUL is very appreciative of the dedicated effort that all partners have contributed, to support the success of the Urban Waterway Renewal program. Such a large number of large scale projects occurring across an urban landscape had not occurred before and this program of projects has proven very successful from an integration of WSUD principles perspective and given an appropriate period

of time, we are very positive, that they will also have success at reducing nutrient flow.

We sincerely thank the financial project partners, who are recognised below, for their critical role in providing funding for the projects and hope we can inspire more investment into the renewal of urban waterways into the future.



Executive Summary

In 2006, the Australian Government's Coastal Catchment's Initiative identified the Swan Canning river system as a coastal "hot spot" due to its high nutrient levels. Through the Coastal Catchments Initiative the Australian Government provided funding to the Swan River Trust to develop the Swan Canning Water Quality Improvement Plan (WQIP). The focus of the WQIP is to reduce nitrogen and phosphorus in the Swan Canning river system. In 2007, the Australian Government committed \$4 million to the Perth metropolitan 'Urban Waterways Renewal' project under the Water for the Future – National Water Security Plan for Cities and Towns program. The "Urban Waterways Renewal Project" concept was developed by the South East Regional Centre for Urban Landcare (SERCUL) in partnership with multiple waterways managers and stakeholders.

During 2009, the Department of Water in partnership with the Swan River Trust, local government authorities in Canning, Gosnells and Armadale, Water Corporation and SERCUL commenced the implementation of the project with matching funding from existing programs and state and local governments.

This project has retrofitted 11 sections of existing local government drainage system within the Canning River catchments of Bannister Creek, Bickley Brook and Southern River. The development and implementation phase of the project has stimulated the capacity of the partnering organisations to create living streams and functioning wetland basins to meet improved water quality and ecosystem function within the Canning River Catchment.

The integrated planning and implementation methods used for this project has increased stakeholders understanding and knowledge of local hydrology, water sensitive urban design (WSUD) technologies and demonstrated how they can restore natural drainage features into every day stormwater system maintenance and upgrades throughout the urban landscape.

There are now 11 WSUD demonstration sites created, each carrying different features including;

conversion of drains into living streams, revegetated gently, sloped banks, natural aeration riffles and biofiltration systems, water treatment structures within riffles, revegetated floodplains and basins and recontoured water way channels within detention basins. The projects have also provided highly valuable monitoring data that can be used to calibrate models and predict the ability of retrofitted and/or ecologically renewed waterways to produce water quality improvements. In addition to improving water quality these projects have improved the visual amenity of the urban areas and restored natural habitats, improved biodiversity and reduced erosion.

This project has restored 3.3 kilometers of old urban drainage into living streams and biofiltration swales, installed over 424 400 plants, five gross pollution traps, created eight biofiltration systems in previously weed infested floodplains and old drainage basins, removed 18 hectares of weeds including WONS listed weeds, constructed 12 riffles, three with trial water treatment media structures, removed 4600m³ of sediment and rubbish and engaged over 1600 volunteers, volunteering 6953 hours (worth \$201 567).

The project was expanded and extended by State Agencies and Local Governments investing in the projects directly and indirectly.

The Swan River Trust invested \$860 000 of State NRM funding into the Southern River Catchment adding a new site in the Williams Road Main Drain and adding significant extensions to the Wungong River projects. The Water Corporation contributed \$90 000 cash for Water Quality Intervention and Monitoring and \$15 000 in-kind in researching and creating a nutrient intervention media that could be tested within the Bannister Creek Riffle structures to increase the reduction of nutrients.

It is estimated that the Local Governments and State Agencies have contributed at least \$950 000 of time, over the five year project development and implementation phases. Local Governments have made direct contributions of cash into the projects, as well as adding and improving nearby and interconnecting infrastructure, interconnecting drainage and also enabling the projects to occur through their council regulatory process.

Project Outcomes

Over 3 years 2010-2013

11 PROJECTS

4 million dollars in Australian Government investment
4.5 million dollars in State Government and other investment

9 PARTNERS

Common Wealth Government, Swan River Trust, Department of Water, Local Governments of Canning, Gosnells and Armadale, Water Corporation, Bannister Creek Catchment Group, Armadale Gosnells Landcare Group.

17 SITE TOURS

pre site selection, conferences, DoW, SRT, CW, SERCUL members

5 WORKSHOPS

site selection, living stream, riffle construction

13 ORAL AND POSTER PRESENTATIONS

Landcare awards, Murdoch Conference, SERA Conference, River Symposium, the Cockburn Wetlands Conference, Canning, SRT, Curtin workshops.

OVER 1200

people attending the workshops, presentation and tours

424 416 Plants Installed

1638 Volunteers

6953 Volunteer Hours

3.3kms of Foreshore & Living Stream Restoration

18 ha of Weed Control

8 Bioretention Basins

12 Rock Riffles Constructed

5 Sediment and Gross Pollutant Traps Installed

3 Biofiltration Swales

4600m³ Sediment and Rubbish Removed

8 Community Groups Engaged

10 Schools Engaged

The Swan Canning River Park

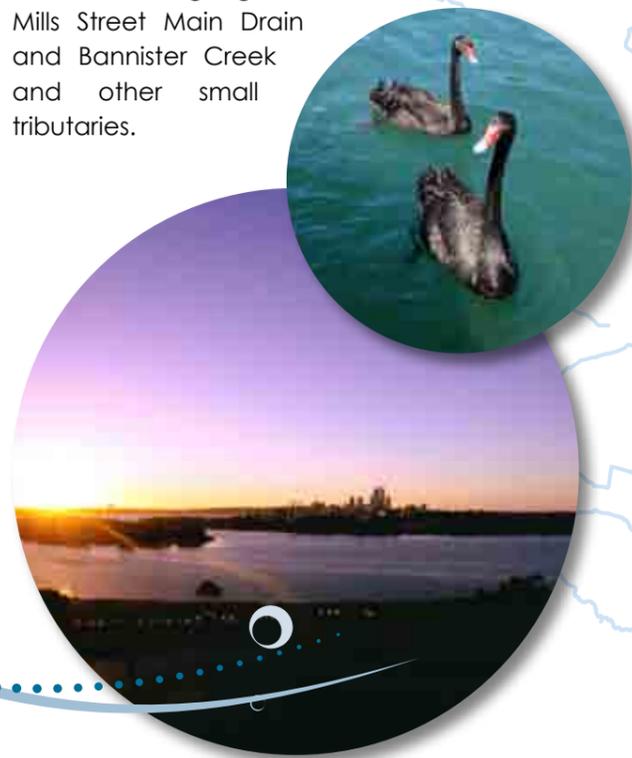
About SERCUL

The Swan Canning Catchment includes 2126 square kilometers in the South West of Western Australia and drains into the Swan and Canning rivers. The volume varies seasonally, but there are approximately 55 gegalitres of water in the Swan and Canning rivers. The Swan and Canning rivers are highly valued by the community. They are a key feature of Perth's recreation, social and cultural landscape.

The Swan River is about 67kms long. It starts when the Avon meets Wooroloo Brook in Walyunga National Park. Together, the Swan-Avon River is 280 kilometers long and flows from near Wickepin to the Indian Ocean at Fremantle. Swan River tributaries include the Helena River and Wooroloo, Susannah, Ellen, Bennett, Henley and Jane brooks, plus the Blackadder Creek and Bayswater and South

Belmont main drains and other small tributaries.

The Canning River is about 100kms long. It flows from about 10kms north-east of North Bannister in State Forest 22 in the Darling Scarp and enters the Swan River at Melville Water between the suburbs of Como and Applecross. Tributaries entering the Canning River include the Southern River, Churchman, Munday, Bickley, Yule and Wungong brooks, Mills Street Main Drain and Bannister Creek and other small tributaries.



The South East Regional Centre for Urban Landcare (SERCUL) was formed in 2003 as an independent Natural Resource Management body in Perth, Western Australia. SERCUL brings together the community, business and government to develop and implement projects that improve the health of our waterways and other ecosystems.

Our aim is to use integrated natural resource management to develop cultural change in how the community views and interacts with the environment while promoting and actively participating in, the improvement of the health of waterways and other ecosystems within the South Region.

SERCUL is a sub-regional body that operates in the metropolitan and peri-urban areas of the Swan Canning Catchment. The area covered takes in most of the southern and eastern suburbs of Perth and includes Dyarguu (the Canning River), the Southern-Wungong River and parts of Derbarl Yaragan (the Swan River).

The South Region is defined as consisting of those parts of the Cities of Armadale, Belmont, Canning, Cockburn, East Fremantle, Fremantle, Gosnells, Kwinana, Melville, Rockingham, South Perth, Shire of Kalamunda and Town of Victoria Park which fall within the boundary of the Natural Resource Management Region of the Swan Region. This is shown in the map below:



Figure 1: Division of the Swan NRM Region into five Sub regions

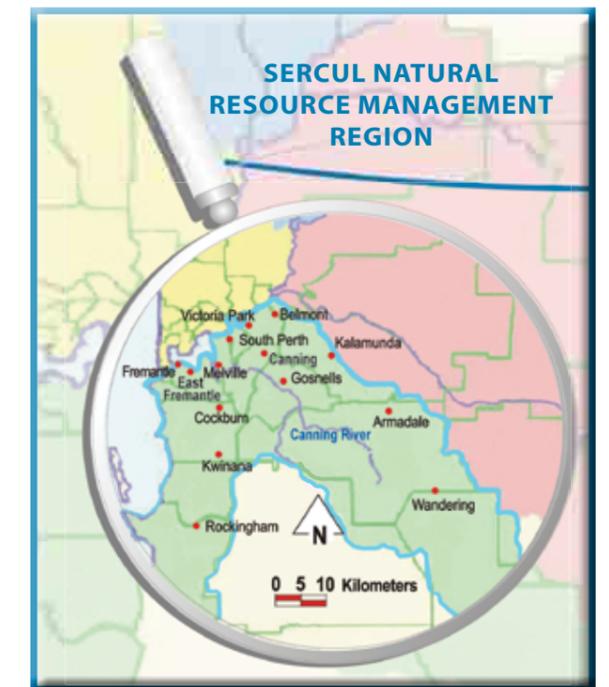


Figure 2: South Sub Region

UWR Project Background

In 2006, the Australian Government's Coastal Catchments Initiative identified the Swan Canning river system as a coastal 'hot spot' due to its high nutrient levels. Through this Initiative the Australian Government provided funding to the Swan River Trust to develop the Swan Canning Water Quality Improvement Plan (WQIP). The focus of the Swan Canning WQIP is to reduce nitrogen and phosphorus into the Swan Canning river system (SRT 2009).

The Swan Canning WQIP assessed thirty sub-catchments of the Swan Canning Catchment to identify the major sources of total nitrogen and total phosphorus inputs to the Swan Canning river system. Priority catchments were targeted with the intent of producing local WQIPs. In the Urban Waterways Renewal (UWR) project area, WQIPs had been released for Bickley Brook and Southern River Catchments in September 2009. A local WQIP for the Bannister Creek Catchment was planned for and completed in 2011. These WQIPs assisted State and Local Government authorities and communities

to prioritise management recommendations, identify resources and seek funding to improve water quality. The Urban Waterways Renewal project provided additional and necessary implementation dollars for these plans.

The 'Urban Waterways Renewal' project was funded by the Australian Government through Water for the Future – National Water Security Plan for Cities and Towns program. The detailed project brief was prepared by the South East Regional Centre for Urban Landcare (SERCUL) in partnership with the Department of Water, Water Corporation, Swan River Trust, and Local Government authorities in the cities of Canning, Gosnells and Armadale. The Australian Government funding provided \$4 million dollars for actions identified in the Swan Canning WQIP. The project partners matched this funding commitment through the expansion of existing projects and the development of new works programs and other State and Local Government water quality improvement strategies and plans.



Project Delivery

The Urban Waterway Renewal Projects were overseen by an integrated stakeholder management team who met on a six monthly basis to discuss future works, resolve challenges and receive project progress reports. A total of 9 meetings occurred with two occurring prior to the receipt of funding. The Department of Water chaired those meetings and ensured that the Australian Government Department of the Environment officer was available by telephone if unable to attend the meetings. The meetings were hosted in turn by the partnering Local Government Authorities.

Project Management Meetings were held, generally monthly, but also on site as needed. SERCUL facilitated those meetings, with venue support provided by the appropriate Local Government Authority. Minutes

and Actions from those meetings were distributed. These meetings managed the technical aspects of the projects including ensuring that appropriate procurement procedures were being followed. SERCUL followed the project delivery procurement procedures as were set out in the MOU's.

The Department of Water, Water Science Branch, managed the water quality monitoring and evaluation of the projects.

SERCUL provided budget reports to the management meetings and discussed any contingencies, project issues and on ground delivery timelines. SERCUL administered the MOU's, finances for the projects and have prepared the maintenance agreements for all projects. The project has been fully financially audited and a certificate of audit has been provided.

All projects have active maintenance plans in place.

Urban Waterway Renewal Management Committee
 6 monthly review meetings held
 with executive support provided by the Department of Water.
 All key stakeholders including the Australian Government representative present. Full presentations from SERCUL project managers at each meeting. Technical support provided by all stakeholders.

Department of Water
 Provision of Engineering advice & project design reviews to ensure that sub-projects met due process and the Stormwater Management and River Restoration Manual guidelines. Undertook the Water Quality Monitoring as per the plan.

South East Regional Centre for Urban Landcare Inc. (SERCUL)
Project Delivery Management Team
 SERCUL CEO, Overall Project Coordinator & Manager

City of Canning,
 Department of Water, Water Corporation, Swan River Trust
 SERCUL facilitated Monthly UWR Project Management Meetings hosted by the LGA.

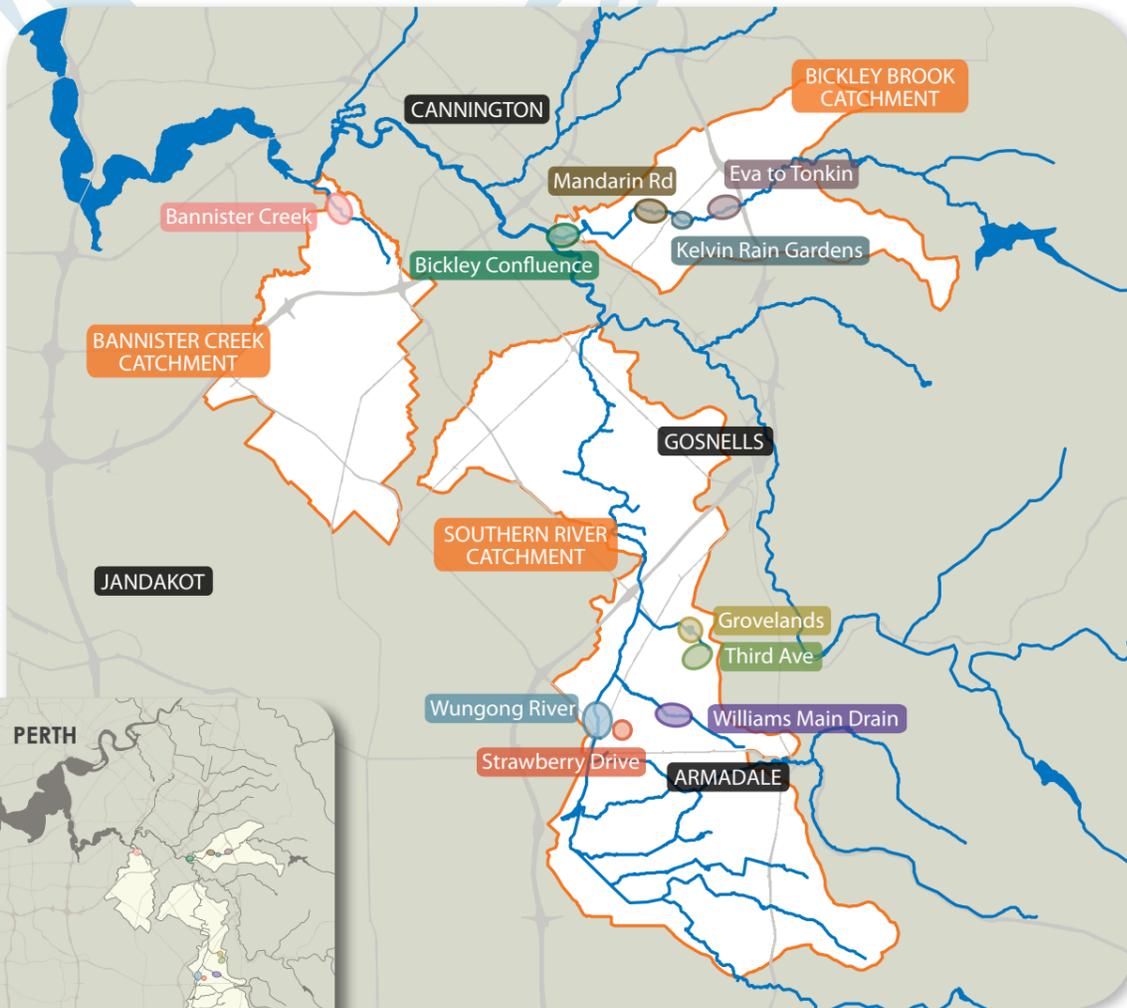
City of Gosnells,
 Department of Water, Water Corporation, Swan River Trust
 SERCUL facilitated Monthly UWR Project Management Meetings hosted by the LGA.

City of Armadale,
 Department of Water, Water Corporation, Swan River Trust
 SERCUL facilitated Monthly UWR Project Management Meetings hosted by the LGA.

SERCUL Project Planning and Implementation Team
 3 Project Managers
 Consulting Engineer/s & Waterway Designer
 Team of 6 other SERCUL NRM support officers sharing project roles as needed
 Volunteer Coordination, Community Groups & Volunteers

Project Locations

- 1 **Bannister Creek** - Living Stream
- 2 **Bickley Brook Confluence** - Living Stream
- 3 **Mandarin Road** - Living Stream
- 4 **Kelvin Road** - Biofiltration Systems
- 5 **Eva Street** - Living Stream
- 6 **Grovelands Reserve** - Treatment Basin
- 7 **Third Avenue & Seville Grove** - Bioretention System
- 8 **Wungong River** - Living Stream Biofiltration System
- 9 **Riverside Lane** - Living Stream Biofiltration System
- 10 **Strawberry Drive** - Treatment Basin
- 11 **Williams Road** - Swale Sediment Management System



Project Goals



Healthy Water

Healthy Water is water that provides a balance of sufficient nutrients and minerals for natural ecosystems and organisms to nourish healthy habitats. Urban waterways in Perth carry a complex mixture of chemicals, nutrients and biota as water crosses hardened surfaces into drains &/or through sandy soils into shallow interacting surface and groundwater systems.

The goal is to gather water quality data before, during and after restoration which will provide data on the physical, chemical, biological and aesthetic characteristics of the water before and after it moves through the restored habitat. The data is used to make smarter ecological restoration management decisions.



Healthy Habitats

Healthy habitats in waterways and wetlands provide the basic needs for natural organisms to thrive, breed and interact. Urban drains and basins in Perth have replaced or bypassed the natural tributaries and wetlands that supplied healthy water to the rivers.

This project goal will convert 10 sections of drainage or basin to a healthier habitat that improves the quality of water entering the receiving water body and/or river system.

The restored section/s will be representative of what can be done to improve existing drainage systems to perform ecological function as well as safely transport water across the urban landscape.



Educated Communities

Urban waterways are or can be a key part of the fabric of a suburban community. Improving the health of these waterways and basins provides the opportunity to involve and educate the local community symbiotically with the key planners and land managers.

The goal of these projects is to increase the natural capacity of the existing drainage managers and community groups to facilitate an ecologically sensitive change in how stormwater drainage systems are managed and retrofitted throughout the catchment.



Recreation & Wellbeing

Perth urban waterways provide an essential network of recreational space for both passive and physical human activities.

The project goal is to naturally and sensitively restore the urban waterway or basin so it retains its required drainage function while enhancing and managing the aesthetics and recreational access. The conversion of steep sided drains into streams with gently sloping banks enables a safer guided access and improves the public amenity of the waterway and basins.

Project partners will provide additional landscaping and passive recreational access.

UWR Timeline

2009

June 10, 2009
Stakeholders meeting to review proposed sites list

July 1, 2009
Projects proposal descriptions and budget completion

October 19, 2009
Photo monitoring commenced

November 11, 2009
Site selection tour with DoW and SRT managers

2010

June 8, 2010
Implementation Plan was agreed by DoW and Commonwealth Government

September 14, 2010
Living Stream Workshop

September 25, 2010
Canopy survey, Bannister Creek dryland planting commenced

October 6, 2010
MoU signed between DoW and SERCUL

October 20, 2010
Morning tea to mark project commencement



September 9, 2009
SERCUL and Local Government Authorities send project commitment letter to Department of Water (DoW)

March 1, 2010
Weed management commenced

October 10, 2010
Aquatic macroinvertebrates survey commenced

2011

December 14, 2010
City of Gosnells signed MoU with SERCUL

November 3, 2010
Vegetation monitoring commenced

February 10, 2011
City of Armadale signed MoU with SERCUL

July 22, 2011
Bimonthly bird survey commencement

June 1, 2011
Bannister Creek and Bickley Planting commenced



November 1, 2011
UWR finalist in WA Landcare Awards

May 27, 2011
City of Canning signed MoU with SERCUL

November 1, 2011
Hydrocarbon pads were installed at Kelmscott industrial area for "track and trace" project

October 26, 2011
Terrestrial Macro invertebrates survey commenced

October 1, 2011
Media strategy finalized

October 27, 2011
Acid sulphate soils sampling

November 10, 2011
Sites tour for SERCUL committee

November 27, 2011
Bannister Creek major works community consultation



2012

February 21, 2012
Earthworks commenced on Armadale project sites

February 17, 2012
Bannister Creek construction commenced

November 11, 2011
Freshwater mussel population baseline survey



October 30, 2012
Hydrocarbon pads were installed at Maddington industrial area for Track and Trace project

March 29, 2012
Senator Don Farrell's visit to mark earthworks commencing at Bannister Creek



April 16, 2012
Earthworks commenced on Bickley Brook sites

September 26, 2012
Lessons learned survey and Future projects workshop

October 10, 2012
UWR oral and poster presentation at River Symposium in Melbourne

2013

April 11, 2013
Riffle construction live workshop



May 23, 2013
Tour of UWR sites for DoW Managers

November 16, 2012
Swan River Trust and sub regional groups tour of project sites

November 25 - 29, 2012
UWR sites tours, oral and poster presentations at Murdoch University International Wetland Conference and Society of Ecological Restoration conference

July 9, 2013
Iron enriched woodchips installation at Bannister Creek

Ongoing maintenance over all project sites

Project Budget

SERCUL URBAN WATERWAY RENEWAL BUDGET 2010 – 2013 Australian Government Funds Only	Jan – Jun 2010	July – Dec 2010	Jan – Jun 2011	July – Dec 2011	Jan – Jun 2012	July – Dec 2012	Jan – Jun 2013	Total
City of Gosnells								
Project Management, Coordination and Reporting	\$42 600	\$42 600	\$27 000	\$27 000	\$27 000	\$23 400	\$23 400	\$213 000
Planning and Design	\$23 500	\$0	\$2 500	\$0	\$0	\$0	\$0	\$26 000
Construction	\$22 500	\$0	\$266 000	\$0	\$159 400	\$0	\$0	\$447 900
Restoration Activity (e.g. planting)	\$80 000	\$16 500	\$86 000	\$109 500	\$28 500	\$81 000	\$23 500	\$425 000
Administration	\$17 100	\$17 100	\$15 660	\$15 660	\$15 660	\$2 160	\$2 160	\$85 500
Sub Total	\$185 700	\$76 200	\$397 160	\$152 160	\$230 560	\$106 560	\$49 060	\$1 197 400
City of Armadale								
Project Management, Coordination and Reporting	\$0	\$36 250	\$21 750	\$21 750	\$21 750	\$21 750	\$21 750	\$145 000
Planning and Design	\$53 500	\$0	\$11 000	\$0	\$0	\$0	\$0	\$64 500
Construction	\$0	\$486 900	\$54 500	\$50 750	\$0	\$0	\$0	\$592 150
Restoration Activity (e.g. planting)	\$27 600	\$108 150	\$0	\$0	\$0	\$148 695	\$4 505	\$288 950
Administration	\$0	\$16 250	\$9 750	\$9 750	\$9 750	\$9 750	\$9 750	\$65 000
Sub Total	\$81 100	\$647 550	\$97 000	\$82 250	\$31 500	\$180 195	\$36 005	\$1 155 600
City of Canning								
Project Management, Coordination and Reporting	\$54 000	\$54 000	\$32 400	\$32 400	\$32 400	\$32 400	\$32 400	\$270 000
Planning and Design	\$35 000	\$0	\$0	\$0	\$0	\$0	\$0	\$35 000
Construction	\$80 000	\$34 000	\$0	\$355 000	\$0	\$0	\$0	\$469 000
Restoration Activity (e.g. planting)	\$55 000	\$55 000	\$0	\$75 000	\$35 000	\$95 000	\$15 000	\$330 000
Administration	\$16 500	\$16 500	\$9 900	\$9 900	\$9 900	\$9 900	\$9 900	\$82 500
Sub Total	\$240 500	\$159 500	\$42 300	\$472 300	\$77 300	\$137 300	\$57 300	\$1 186 500
SERCUL Total	\$507 300	\$883 250	\$536 460	\$706 710	\$339 360	\$424 055	\$142 365	\$3 539 500

Note: Funds provided to the Water Science Branch, Department of Water for project monitoring and evaluation: \$460 500



Project Monitoring

The projects have been monitored using a number of different parameters for measuring the effectiveness and success of the projects. The Water Quality Monitoring has been undertaken by the Aquatic Science division of the Department of Water.

SERCUL has undertaken their own monitoring program that is additional to and symbiotic with the Dept of Waters monitoring.

Most of SERCUL's monitoring work forms a baseline data set and this has included the following areas of monitoring;

- 1. In-stream Macroinvertebrates** - in 4 sites including a reference site. 8952 invertebrates were collected representing 39 Taxonomic groups.
- 2. Terrestrial Invertebrates** - includes a completed report with 440 photo plates of invertebrates from the Canning Catchment.
- 3. Reptiles** - recorded during invertebrate surveys across 5 sites.
- 4. Birds** - Aquatic and Terrestrial birds were monitored by volunteer bird enthusiasts and the records have been submitted to Birdlife Australia.
- 5. Mussels** - *Westralunio carteri* freshwater mussel populations were surveyed finding no live populations. Very large shells were found in the Bickley Brook which probably deceased after very high tidal surges of saline waters entered the confluence of the brook for the first time in 2009-10.

- 6. Vegetation** - including canopy cover and quadrats set up ready for repetition over time. 7 transects set up in Bannister Creek, 17 Transects set up within the Bickley Brook, 2 transects in the Souther River Catchment.

Most of the results of these studies are not reported in this document because the projects have not been in completion for long enough.

The Mussel study and Invertebrate study are available from the SERCUL website: www.sercul.org.au/publications

It is anticipated that all the sites will be resurveyed in 2015 if funding is available for the studies to be completed. SERCUL will make every attempt to gain this funding as these results are imperative to the evaluation of these projects and for future project development.



Bannister Creek Catchment

The aim of this project is to enable the final sections of Bannister Creek to be restored to perform as a living stream, maintaining its function of carrying stormwater from the surrounding industrial and urban catchment and to restore it to an attractive parkland area for recreational purposes.

The reach of Bannister Creek identified for the UWR living stream restoration project runs for 2km from Acacia Place weir in Lynwood to Hybanthus Road in Ferndale. This section of the creek offered the opportunity to install pollution treatment interventions in combination with river restoration techniques to improve water quality, parkland amenity and environmental values.

The project, in partnership with the City of Canning, used best practice in river restoration design and reconstruction of a drain into a living stream. River

restoration techniques used included the installation of three originally designed "treatment media holding structures" that were installed within three separate rocky riffles. Drain banks were reconfigured and shaped, massive weed barriers were removed to regain hydrological access to the natural floodplain and a 70 meter section of the waterway was redesigned into and through the natural floodplain to enable the paperbark plant communities to be reconnected to the waterway.

Final Figures

Total area of **WEED CONTROL**: 5.2ha

Total area of **RESTORATION**: 6ha

Total length of **CHANNEL MANAGED**: 1.2km

RIFFLE STRUCTURES installed: 5

Total number of **VOLUNTEER** participants: 583

Total number of **VOLUNTEER HOURS** contributed: 2677

Total value of **VOLUNTEER LABOUR** contributed: \$77 606

Total number of **PLANTS** installed: 131 147



BANNISTER CREEK LIVING STREAM

SECTION 1 - Acacia Place weir to Metcalfe Road

AIM

The aim of this project is to enable the final sections of Bannister Creek to be restored to perform as a living stream, maintaining its function of carrying stormwater from the surrounding industrial and urban catchment and to restore it to an attractive parkland area for recreational purposes.

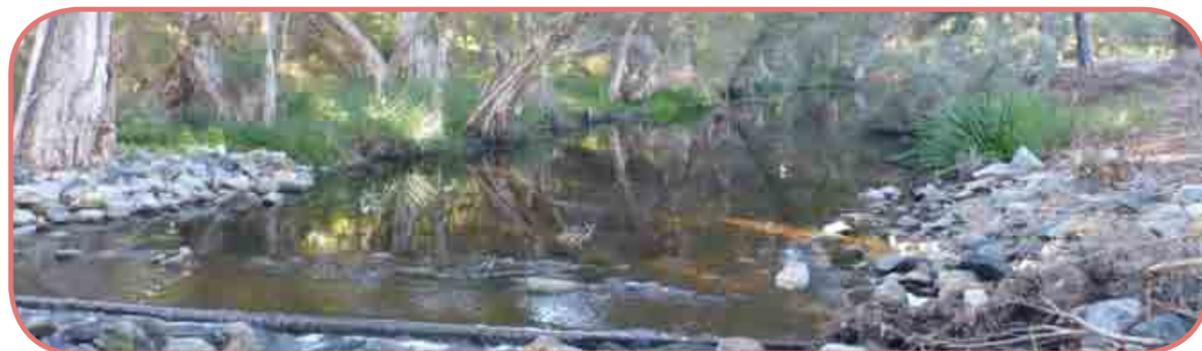
The renewal of this 300m long section has revitalised the creek and reconnected the waterway to its floodplain bringing life back to the creek. This section was heavily infested with blackberry in the 1990's and it has taken more than a decade to gain enough funding for a holistic repair. The waterway banks were heavily eroded and there was substantial sedimentation within the waterway which contained dense mats of weedy non-native plants.

Floodplain restoration commenced in 2011 with dense dryland and dampland slope planting and implementation of baseline water quality, vegetation, animal and insect surveying. The waterway restoration commenced in February 2012 with the construction of the first media treatment riffle 30-40 metres below the Acacia Place weir where the very steep 4-5m bank (west side of the creek) was retained with a triple level,

terraced, limestone wall. The floodplain terrace at the base of the terracing and the banks were densely revegetated.

The second and third treatment media riffle was built just 200m and 280m from the first to create a riffle pool sequence that has significantly reduced erosion and enabled the creek water to pass through the riffle and out onto the densely vegetated floodplain, stripping nutrients and providing vital water to the fringing dampland.

The weedy grasses on creek banks were replaced with natural vegetation and the City of Canning constructed a new pathway on the upper area to separate the natural revegetation from the grassed areas and also to provide a safe access path for the local community to enjoy the site.



Construction of **three riffle** pool sequences, preventing erosion, sedimentation, and enabling riverbed stabilisation. Each riffle contains a structure that can hold water treatment media to expedite the reduction of nutrients being transported to the river.

Reduced the export of nutrients and other pollutants by **planting 14 000** in stream plants and **29 000** along the waterway floodplain for the biofiltration of pollutants.

Stabilised **800m** of stream bank (both sides) and 800m of streambed to reduce erosion with 35 000 dampland/upland plants preventing re-sedimentation from bank erosion.

Removed **300 tons** of sediment from the waterway to increase stream bed integrity

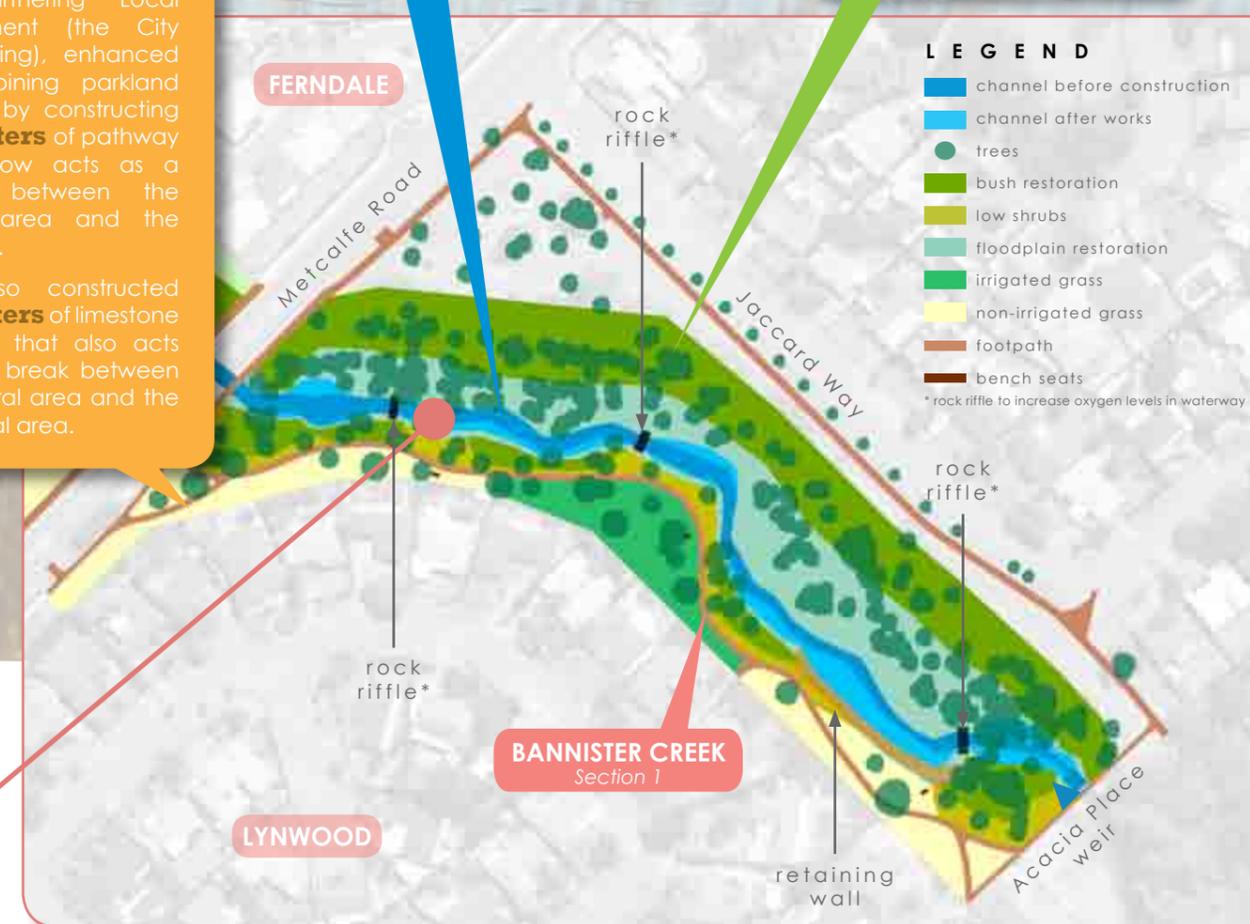
The partnering Local Government (the City of Canning), enhanced the adjoining parkland amenity by constructing **300 meters** of pathway which now acts as a division between the natural area and the parkland.

They also constructed **580 meters** of limestone pathway that also acts as a fire break between the natural area and the residential area.

Increased vegetative diversity by removing the feral grasses, weedy eucalypts and dense thickets of blackberry to improve the biodiversity of plant species.

Completed a baseline **aquatic and terrestrial invertebrate survey**.

Increased the habitat and biodiversity values by **planting 35000** upland and dampland local species



Treatment media trial - Iron enriched woodchips

Water Corporation (WC) developed and patented "nutrient filter chips", an iron-enriched woodchips media that aims to remove nutrients from water. In March 2012 the WC set up an off line (but within the Bannister Creek Catchment) upstream of our project site at the Whaleback Lake in Parkwood. The field trials indicated that the water could not flow properly. After completing further tests and rechecking chemistry, WC decided the problem was due to the coating material, not media size. WC ran a series of permutations using a variety of

adsorption agents and focused on the most effective agents, tweaking pH and coating thickness to maximise Phosphorus removal. In March 2013, SERCUL undertook a second trial with "new improved" nutrient filter chips and finally got approval from stakeholders to install them into the three riffle media holding structures in Bannister Creek in May 2013. Water Quality monitoring and evaluation is being continued on a regular basis post installation and the WC is funding this research. SERCUL will publish the results of this trial on completion



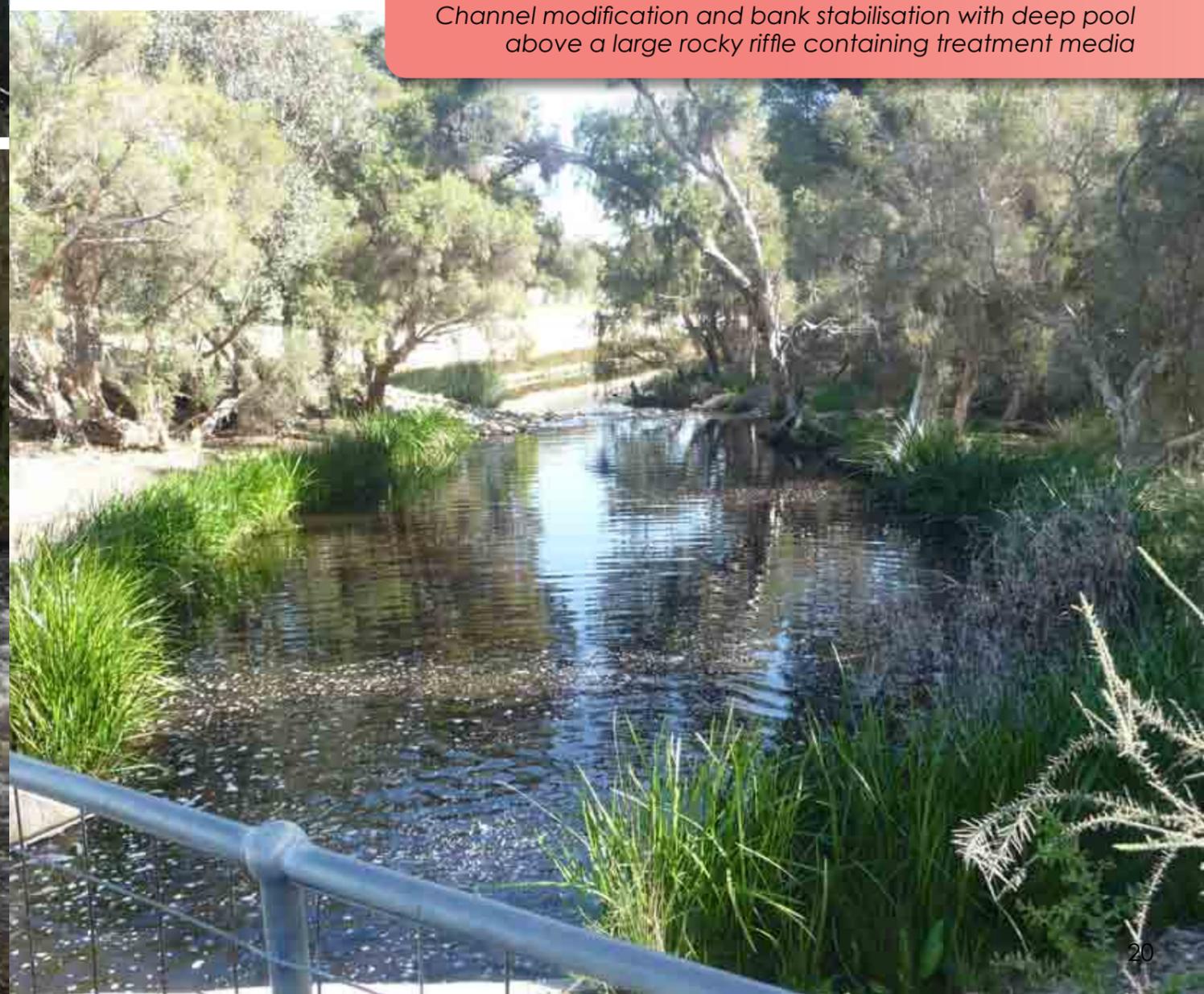
ACACIA WEIR

Before and after the construction of a limestone wall, riffle with treatment media and planting



ACACIA WEIR

Channel modification and bank stabilisation with deep pool above a large rocky riffle containing treatment media



BANNISTER CREEK LIVING STREAM

SECTION 2 - Metcalfe Road to Hybanthus Road

AIM

The aim of this project is to enable the final sections of Bannister Creek to be restored to perform as a living stream, maintaining its function of carrying stormwater from the surrounding industrial and urban catchment and to restore it to an attractive parkland area for recreational purposes.

The restoration of this 500m long section required the hand removal of an extremely dense understory of blackberry, morning glory, willows, ivy, giant reed (bamboo) and numerous other weeds, while protecting the vital native tree canopy. The City of Canning marked and numbered all canopy trees with an identification tag so we can make assessment post 5 years of works of the tree canopy change.

The learning from past works in this site by the local Bannister Creek Catchment Group and the City of Canning, enabled us to understand how to restore Blackberry and Arundo (giant reed) infested wetland sites that previously took 3-4 years of repeated treatment before planting can occur. The removal of 27 very large Chilean Willows, a 'Weed of National Significance', also enabled the widening of the fire protection zone while increasing accessibility by the public and improving stable vehicular access to the waterway reserve for the maintenance team.

After removal of woody weeds 70m of waterway was reconfigured to flow through the paperbark floodplain reconnecting the waterway to the floodplain and reducing the steep bank contact where erosion was occurring.

The entire 500m of waterway has been redesigned with stabilised and graduated slopes enhancing the interconnection of revegetated banks with the water. Sediment was removed and the riverbed stabilised with vegetation and installation of two rocky riffles creating a continuation of the riffle pool sequences.

An unexpected positive outcome has been the suspected drowning of many hectares of blackberry and weedy vine regrowth with the flooding of the previously dry floodplain. Some of these areas were not planned to be revegetated until we were sure that the blackberry and other weeds were under control, but it appears we may be able to commence revegetation much earlier. The success of the embankment revegetation in this section is outstanding, which is attracting a lot of positive local community attention. The project works has increased community passive recreation in the area.



Riffles

Two large and one small rocky bed riffles were constructed in this section of the Bannister Creek. These riffles can be adjusted, if necessary, to suit the needs of the waterway over time to ensure that the floodplains can operate with maximum ecosystem efficiency.

All the riffles installed act as a natural waterway obstruction but they do not block the migration of fish and other aquatic fauna. They enhance the habitat diversity of the waterway by encouraging the growth of biofilms (natural algae & microorganisms) and increasing aeration of flows. The formation of a riffle creates a pool directly above it which has the added benefit of providing a deeper water habitat and refuge for fauna breeding and feeding especially during the dry season.

Stabilised **600m** of stream bank (both sides) and **600m** of streambed to reduce erosion, increase vegetative stabilisation and improve the biodiversity of the entire waterway system.

Reduced the density and diversity of exotic flora by removing **5.2 hectares** of dense blackberry thickets entwined with multiple weedy vine species and removing 37 exotic trees including Chilean willows.

Increased the habitat and biodiversity values by planting of **33 000** native sedges and other local aquatic species.



- LEGEND**
- channel before construction
 - channel after works
 - trees
 - bush restoration
 - low shrubs
 - floodplain restoration
 - irrigated grass
 - non-irrigated grass
 - fire break
 - footpath
 - bench seats
- * rock riffle to increase oxygen levels in waterway

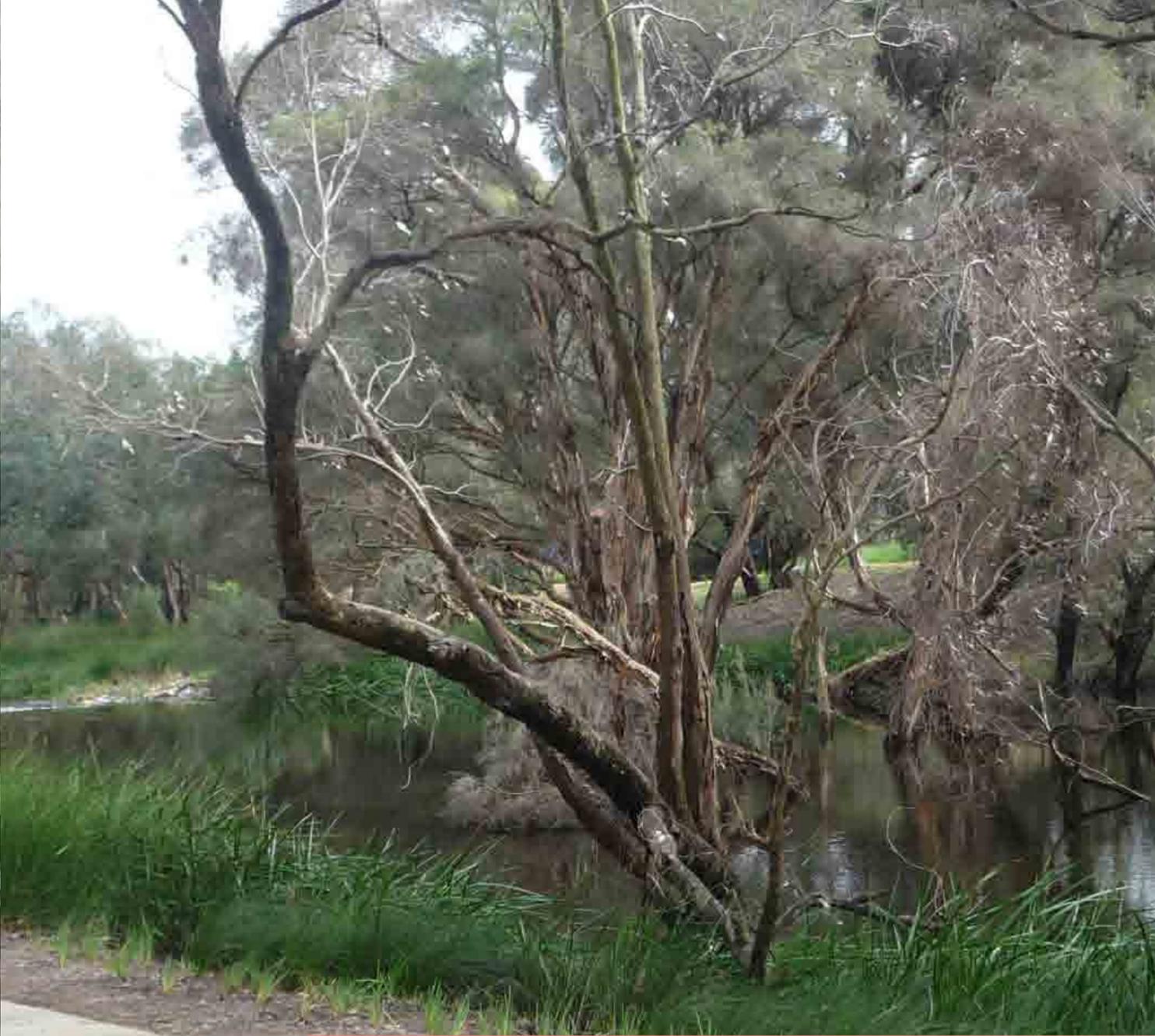
Involving one Senior High School with site assessments, weeding and planting.
Involved **379 volunteers**, **3176 volunteer hours** and **11** corporate days.

The **removal of weed** infested vegetation from the floodplains of this section of waterway re-opened up the floodplain to become part of the waterway. The revegetation of that floodplain has improved habitat while increasing the contact time between water and natural vegetation.
Installation of **three rocky riffles**, realignment of a 50m section of waterway to prevent erosion of a main sewer line has **reduced the channel velocity** thus increasing waterway stabilisation.



HYBANTHUS ROAD

Before and After removal of Blackberry and Morning Glory thickets, installation of a riffle and bank stabilisation with plants



METCALFE FLOODPLAIN

Major bank stabilisation, removal of floodplain weeds and creation of a naturally vegetated floodplain pool



Bickley Brook Catchment

The Bickley Brook has been as a significant contributor of nutrient, heavy metals, hydrocarbon and sediment to the Canning River. The Bickley Brook Water Quality Improvement Plan (WQIP) highlights the need to address a range of issues within the catchment.

The Bickley Brook is a natural stream that has been highly modified. The brook passes through the semi-rural suburb of Orange Grove then through the Maddington Kenwick industrial area before discharging into the Canning River. Once the brook enters the industrial precinct, much of the system is in the form of a trapezoidal drain with steep edges and limited space for ecological style interventions.

The UWR Bickley Brook projects to work on different aspects of the WQIP through the engagement of the local community, raising the awareness of the brooks connections to the Canning River and to commence the work required to enhance the environmental values of the Bickley Brook.

Final Figures

Total area of **WEED CONTROL**: 93 820m²

Total area of **RESTORATION**: 93 820m²

Total length of **CHANNEL MANAGED**: 1090m

RAIN GARDENS installed: 2

RIFFLE STRUCTURES installed: 4

Total number of **VOLUNTEER** participants: 334

Total number of **VOLUNTEER HOURS** contributed: 1471

Total value of **VOLUNTEER LABOUR** contributed: \$42 644

Total number of **PLANTS** installed: 107 119

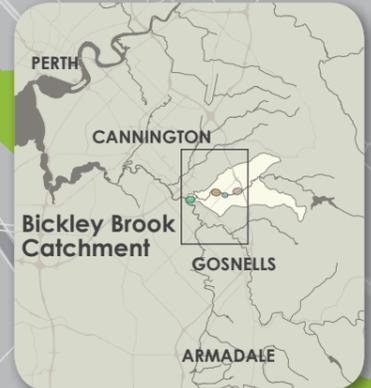


Project Areas



LEGEND

- Bickley UWRP subcatchment
- metropolitan drainage lines
- road centrelines
- Metropolitan Regional Scheme**
 - industrial
 - parks and recreation
 - regional roads
 - public purposes (high school)
 - railways
 - waterways



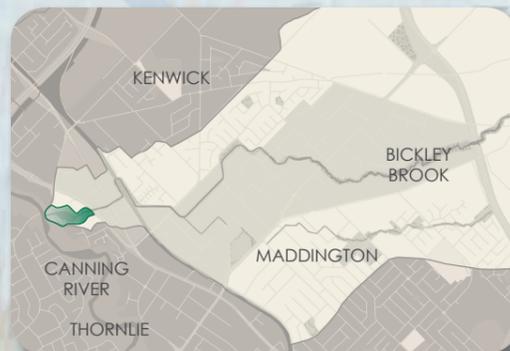
BICKLEY BROOK CONFLUENCE LIVING STREAM

AIM

The project aims to increase the natural system ability to retain and uptake nitrogen and phosphorus through the reconnection of the brook with its natural floodplain.

The Bickley Brook Confluence project encompasses approximately 8000m² of floodplain, located adjacent to the Royal St Bridge in Kenwick, which is within the 100 year flood levels of the Canning River. The main channel of the Bickley Brook had been straightened and trapezoidally excavated through its natural flood plain. This has resulted in the existing channel having steep eroding banks with limited connection to the surrounding floodplain.

Prior to works being undertaken this site was dominated by exotic vegetation. The over storey was a mix of exotic White Ash Tree (*Fraxinus americana*) and native Flooded Gum (*Eucalyptus rudis*), while the understorey was dominated by exotic species, being a mix of Blackberry (*Rubus fruticosus*) and Watsonia (*Watsonia bulbifera*).



The main objectives of this project were to re-establish a native vegetation complex and to reconnect the Bickley Brook with the floodplain. The connection with the floodplain was achieved via an extended flow path through a vegetated swale which returns back to the main channel and a high flow path to enhance water flow through existing damp depressions within the flood plain.



Acid sulphate soils in Bickley Brook

A preliminary investigation was carried out within the project area to determine the risk of exposing acid sulphate soils during the proposed earthworks.

The results of this assessment indicated that whilst the sediments were of low risk of Acid Sulphate Soil development, they were inherently of low pH, which ranges from 6.56 to 3.33. A component of organic acid was undoubtedly

present in the sediments but more detailed analysis was required to determine the causes and extent of the acidity. Additional soil and groundwater sampling were taken and results indicated that a low pH issue in the groundwater was localised to one area. This finding resulted in changes to the initial concept design for the site and excavated below the clay layer in this location was avoided.

With this site being located at the confluence of the Bickley Brook on the floodplains of the Canning River it is a fantastic location for interpretative education. It has been utilised in UWR site tours and catchment education.

The neighbours adjacent to this project area have become custodians of the site.

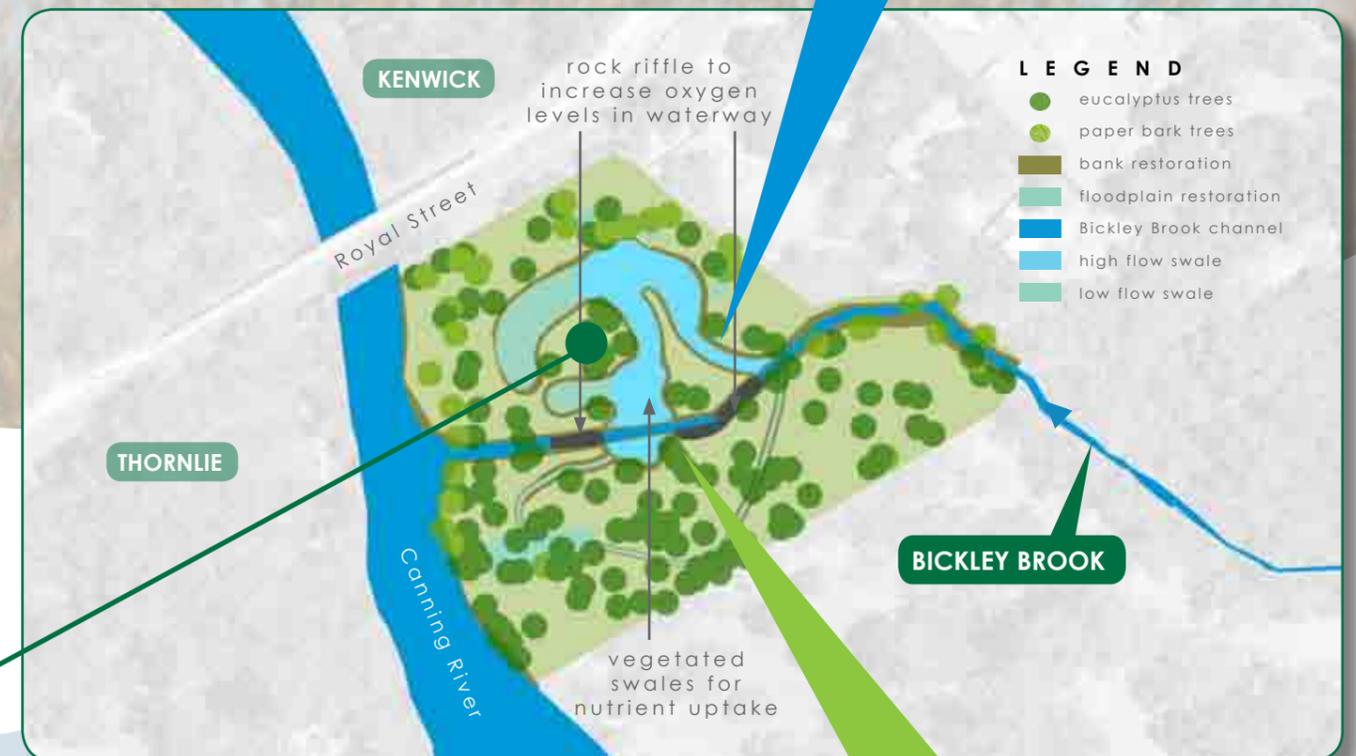
The site is highly visible from a dual use path on the opposite bank of the Canning River. **Signage** erected adjacent to the dual use path provides an opportunity for increased understanding of the project in the context of the catchment.

Reconnecting the channel to the flood plain through the construction of **two swales** allowing water to re-engage with the floodplain. The first swale carries low flows out into the flood plain and back to the main channel, extending the flow path of the water. The second swale increases the opportunity for high flows to move across the opposing floodplain to an existing damp land. Both of these vegetated swales increase the opportunity for the water travelling within the main channel to engage with the floodplain.

Increase of natural filtration through the establishment of native sedges along the main channel and through the floodplain swales.

Two rock riffles were constructed within the main channel primarily to divert water through the floodplain swales. These riffles also increase the dissolved oxygen levels within the water prior to its discharge to the Canning River.

Stabilised banks and the streambed reduced erosion within this section of the brook. A **log riffle** was also constructed within the low flow swale to reduce erosion while the vegetation established.



Weed control of 10 000m² through the removal of an exotic overstorey (White Ash Tree) and exotic understorey (Blackberry and Watsonia).

70 meters of waterway redesigned with the creation of low and high flow vegetated swales through the floodplain. The establishment of variable hydrological zones was one of the factors considered during the designing and construction of the swales. This enabled the re-establishment of varying ecological zones within the project area.

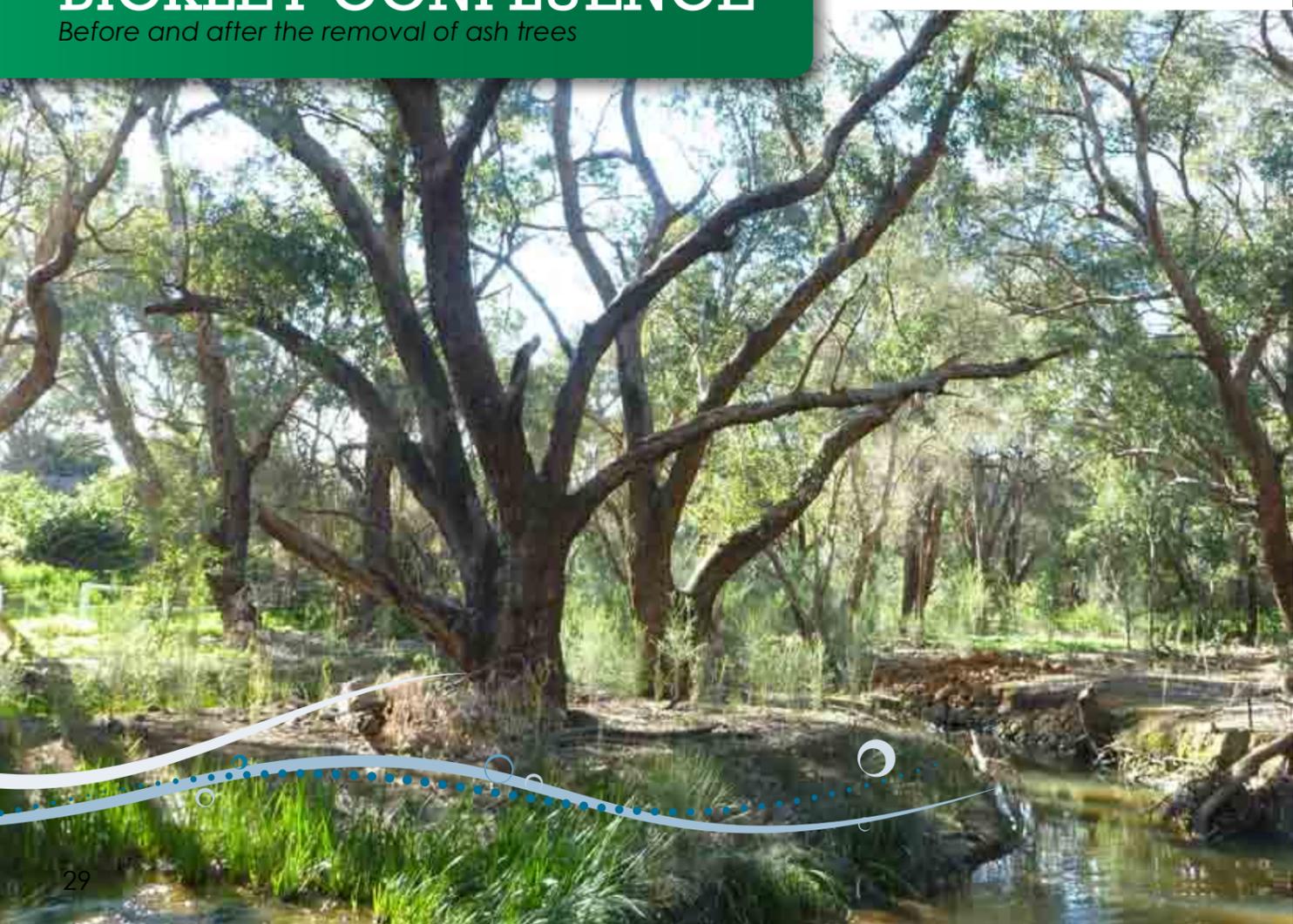
The enhancement of existing basins and damp depressions within the floodplain including an existing basin that received stormwater directly from the road drainage system.

Re-establishment of a native vegetation complex through the planting of **28 000** native sedge and floodplain species.



BICKLEY CONFLUENCE

Before and after the removal of ash trees



BICKLEY CONFLUENCE

Before and after planting and construction of swales



MANDARIN ROAD LIVING STREAM

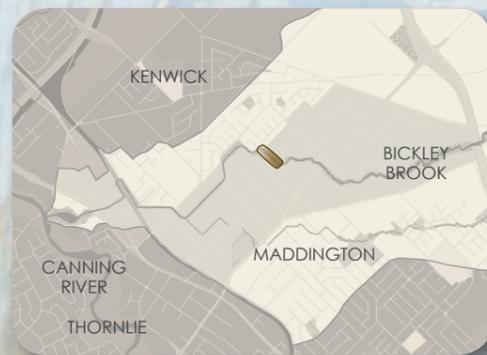
AIM

The project aim was to convert approximately 200 meters of urban drain into a living stream, increasing the natural system's ability to retain and uptake nitrogen and phosphorus. The reduction of contamination entering the stormwater system throughout the stormwater network was targeted by extending the contaminant investigations out into the subcatchments.

The location of this project was also chosen to raise the awareness of the Bickley Brook as a natural river system. The intent was to provide a visually impressive area with appropriate signage which also extended our water resource management education and engagement out into the local businesses.

This project site is located within the Maddington Industrial area. The Bickley Brook has been highly modified as it passes through this industrial area. Much of the brook is in the form of a steep sided, straight, trapezoidal drain. The Mandarin Road site was one of the few sites along this section of the brook with sufficient space available to enable access and opportunities for intervention. A large stormwater outfall pipe enters the brook at Mandarin Road. This outfall is a consistent source of hydrocarbon pollution entering the Bickley Brook.

When the project commenced the dumping of rubbish and the stock piling of soil, rubble and a range of other material was common practice along the banks of the brook.



The site provided an opportunity, within the available space, to return a highly degraded and weed infested section of the Bickley Brook into a living stream.



Hydrocarbon Track and Trace Program

From November 2012 to March 2013 the hydrocarbon Track and Trace project in the Maddington industrial area took place. The project was designed to assist in identifying sources of hydrocarbon pollution in the stormwater system of subcatchment for the Mandarin Road outfall. This outfall receives stormwater from a 45ha of industrial area and has been identified as a consistent source of hydrocarbon pollution entering Bickley Brook.

In partnership with the Swan River Trust and the City of Gosnells, SERCUL installed 33 hydrocarbon capture pads into the catchments stormwater network to track and trace potential sources

of hydrocarbon pollution. Monitoring took place by conducting three visual inspections and replacement of the pads and then rating the extent of discolouration following the storm events on November, December and March.

Once the three visual inspections were complete the average discolouration of pads was calculated for each stormwater pit and categorised into three levels of hydrocarbon pollution; high, moderate or low. The report from this program was provided to the project partners and the Department of Environment and Conservation's Pollution Response Unit.

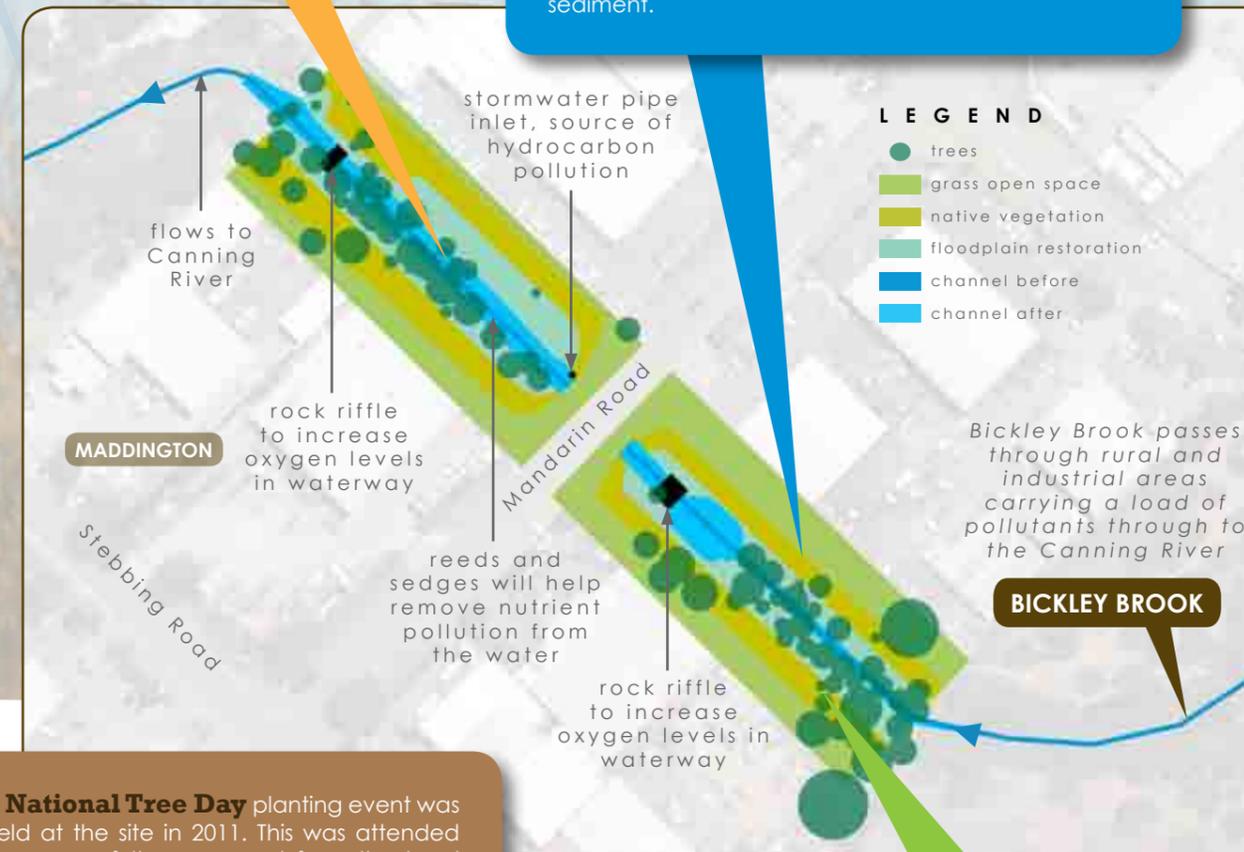
The removal of dumped rubbish and various stock piles from the banks of the brook along with the establishment of a native vegetation complex has significantly improved the **visual amenity** of the area.

Increase dissolved oxygen levels within the water through the construction of **two rock riffles**.

Reduce the velocity of water passing through this section through the creation of a **pool and riffle** sequence.

Reduce the export of nutrients through the establishment of **two biofiltration zones**. Native sedges were established within these zones and along the banks of the main channel.

Reduce sediment export from the site through the establishment of **two settling areas**. Access to these settling areas was established to allow annual maintenance and removal of the accumulated sediment.



A **National Tree Day** planting event was held at the site in 2011. This was attended by many of the personnel from the local businesses.

Onsite **discussions, letter drops and personnel engagement** with businesses in the area regarding the project activities.

Increasing the environmental awareness the **installation of signage**.

A **hydrocarbon track and trace survey** was conducted within the sub catchment of the Mandarin Road outfall to identify sources of hydrocarbon pollution.

A **riffle construction workshop** was held onsite, during the construction of one of the rock riffles. This was attended by 40 individuals coming from a two local government areas, one state agency, SERCUL staff and Conservation and Land Management students.

The removal of dumped rubbish from the site. The removal of stock piles of soil, rubble and various materials from the banks of the brook around the project area.

Removal of an exotic grass understorey and a variety of exotic weeds from an area of **4870 m²**.

Bank stabilisation to reduce erosion.

Removal of approximately **100m³** of accumulated sediment from the main channel.

Establishment of a native vegetation complex along a 200 meter stretch of the brook by planting of **18 000** native canopy, understorey and sedge species.



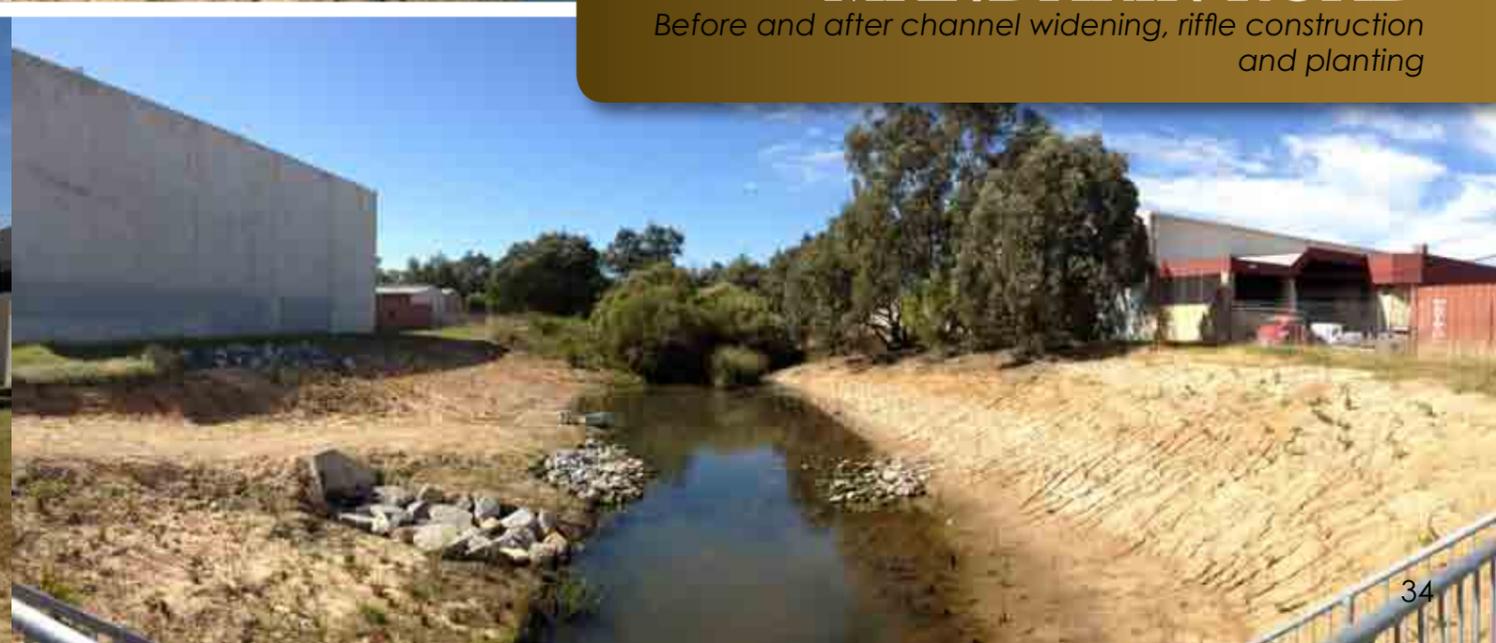
MANDARIN ROAD

Before and after channel widening, riffle construction and planting



MANDARIN ROAD

Before and after channel widening, riffle construction and planting



BICKLEY BROOK BIOFILTRATION SYSTEMS

AIM

The project initially proposed to replace approximately 200 metres of roadside urban/industrial open table drain in heavy clay soils on Myola South Place, Maddington, with a series of bio filtration systems or rain gardens to improve the quality of stormwater runoff from the roadway, which was ultimately delivered to Bickley Brook at the Myola South Place outfall.

However, after more detailed investigation by the City of Gosnells, relocation to a nearby site on Kelvin Road was proposed. Both sites were evaluated across a range of parameters and Kelvin Road was found to be the more advantageous site, given its lower capital and traffic management costs, significantly heavier industrial traffic volume and consequent stormwater pollutant load.

The Kelvin Road site is located 500 metres upstream of the monitoring site BICKBK07, which is identified in the report Bickley Brook Water Quality Monitoring and Evaluation: Summary and Directions 2006-2008 (SERCUL, 2010) as the 2nd highest priority site for the catchment with results including: Consistently high TSS, including the second highest reading in the catchment (96 mg/L); Total Nitrogen ranging from 0.82 to an extremely high 18 mg/L; Highest concentration of chromium (0.082 mg/L) of the entire catchment and high concentrations of aluminium (2 mg/L), copper (0.042 mg/L), lead (0.017 mg/L), iron (2.4 mg/L), nickel (0.023) and zinc (0.12 mg/L)



The design and construction of bespoke rain gardens of the required size and complexity, including monitoring and data logging equipment in a perfectly sealed and impervious system, proved very difficult and costs greatly exceeded initial estimates. As a result, the project scope was reduced to two rain gardens only. The specifications prescribed by the Facility for Advancing Water Biofiltration also proved difficult to match, particularly with regard to chemical properties and particle proportions of the required filter media.

The water quality data, site location, industrial land use and traffic data suggest that the Kelvin Road site is well situated to be a potential contributor to poor water quality in Bickley Brook. The project objective was to install three rain gardens that would intercept an anticipated high nutrient and other road runoff pollutant load prior to its delivery to Bickley Brook.



Data Monitoring

5 Octave ultrasonic water meters were installed at each inflow and the outflow pipes. Three were installed on rain garden two because it has two inflow pipes. The systems are telemetered using an Arad Dialog Cellular Unit which allows real time readings at 6 minute intervals so that the

data can be directly added into stormwater management models and used for future scientific research. Additional water quality measurements are scheduled to be undertaken by the Department of Water, who secured funds to continue monitoring this system until 2015.



Increased the habitat and biodiversity values by revegetating with **140** of local native species

Assessed the sustainability of rain garden vegetation with regard to survival during a Western Australian summer.



Filter Media

One of the main components, and challenging to source of the construction of the rain gardens, was the selection of the filter media. Gingin Loam (Loamy Sand) was chosen based on the Facility for Advancing Water Biofiltration (FAWB) design guidelines and research conducted at the University of Western Australia. Gingin Loam is a good contaminant removal when compared to other local soils; has appropriate particle size distribution (clay and silt fractions <3%); and appropriate hydraulic conductivity (180mm/hr) for a temperate climate.

Gingin Course Sand was used for the transition layer; which full fill FAWB guidelines of clean well graded course material (<4mm) containing less than 2% fines.

Based on FAWB design guidelines the submerged zone comprised 16 – 30 Silica Sand which is medium-to-course sand (0.25-1mm) with 5% Sugar Cane Mulch and 5% hardwood chips (approximately 6mm grading) by volume. However, a deep (600mm) submerged zone was chosen to help buffer against long summer drought.

Clean fine gravel of 2-5mm washed screenings was used for the drainage layer, as suggested by the FAWB guidelines.

Reduced the export of road runoff nutrients and other pollutants by directing stormwater through two rain gardens with different strata of filter media which help to slow the rate of stormwater entering the brook and assist in the removal of these pollutants.

Evaluated the efficiency of rain gardens in Perth urban environment by **installing 5 remote water meters** which allows real time readings at 6 minutes intervals; please refer to Department of Water monitoring report for results.



RAIN GARDENS

Before the installation of the rain garden



RAIN GARDENS

*After the construction of the rain garden
planting of native sedges*

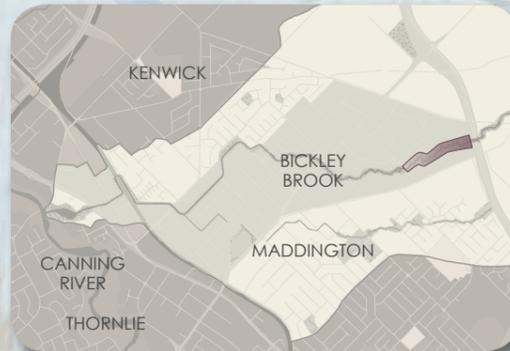
EVA STREET LIVING STREAM

AIM

The project aims to increase the natural system's ability to retain and uptake nitrogen and phosphorus through the reestablishment of a healthy habitat. The intent of the project is to restore a natural vegetation complex throughout this section of the Bickley Brook.

The site is located along the Bickley Brook between Eva Street and Tonkin Hwy within Maddington. This section of the Bickley Brook is one of the few stretches of the brook that retain the meanders of a natural waterway. Much of the site was however, dominated by an exotic understory of *Watsonia* (*Watsonia bulbifera*) and Couch Grass (*Cynodon dactylon*). Morning Glory (*Ipomoea indica*), Blue Periwinkle (*Vinca major*) and Giant Reed (*Arundo donax*) were also well established. Although most of the site was highly degraded, this reach of the brook encompassed a conservation category wetland and pockets of vegetation remained with highly diverse natural assemblages.

When the project commenced, access into this section of the brook was limited. The dumping of



concrete, rubble, waste material and a range of other rubbish items was evident throughout the project site. A number of illegal outfalls were identified entering the brook and property boundary encroachment into the reserve was identified as a significant issue to be addressed.



Sediment Removal

Sediment is the loose sand, clay, silt and other soil particles that settle at the bottom of a waterway. Sediment can come from soil erosion or from the decomposition of plants and animals. Wind and water help carry these particles into rivers, lakes and brooks.

Sediment pollution in our river systems is increasing. Sediment entering the Canning River through stormwater drains degrades the quality of water for recreation, wildlife and the land surrounding in the following ways:

- Sediment fills up storm drains and catch basins to carry water away from roads and homes, which increases the potential for flooding.
- Water polluted with sediment becomes cloudy, preventing animals from seeing food.

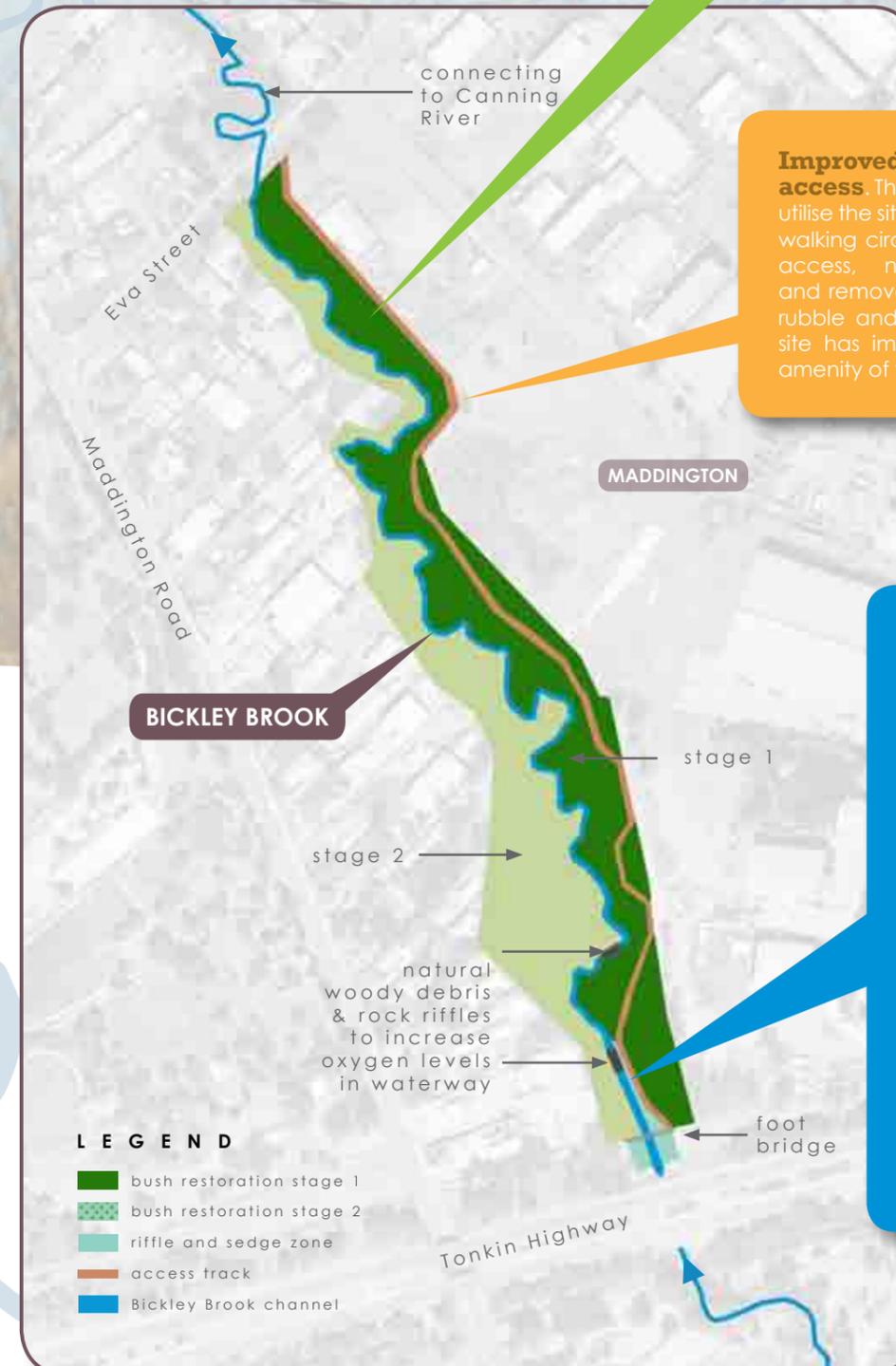
- Murky water prevents natural vegetation from growing in water.
- Sediment in stream beds disrupts the natural food chain by destroying the habitat where the smallest stream organisms live and causing massive declines in fish populations.
- Sediment can clog fish gills, reducing resistance to disease, lowering growth rates, and affecting fish egg and larvae development.
- Nutrients transported by sediment can activate blue-green algae that release toxins and can make swimmers sick.
- Sediment deposits in rivers can alter the flow of water and reduce water depth, which makes navigation and recreational use more difficult.



Control of **Watsonia, Morning Glory, Blue Periwinkle, Giant Reed, Paterson's Curse, exotic grasses** and a variety of other weeds throughout the site.

Removal of dumped rubble, concrete and waste material.

The reestablishment of a native vegetation complex by planting **38 000 native plants**.



LEGEND

- bush restoration stage 1
- bush restoration stage 2
- rifle and sedge zone
- access track
- Bickley Brook channel

Improved amenity and access. The local community utilise the site as part of a local walking circuit. The improved access, native restoration and removal of dumped soil, rubble and rubbish from the site has improved the visual amenity of the area.

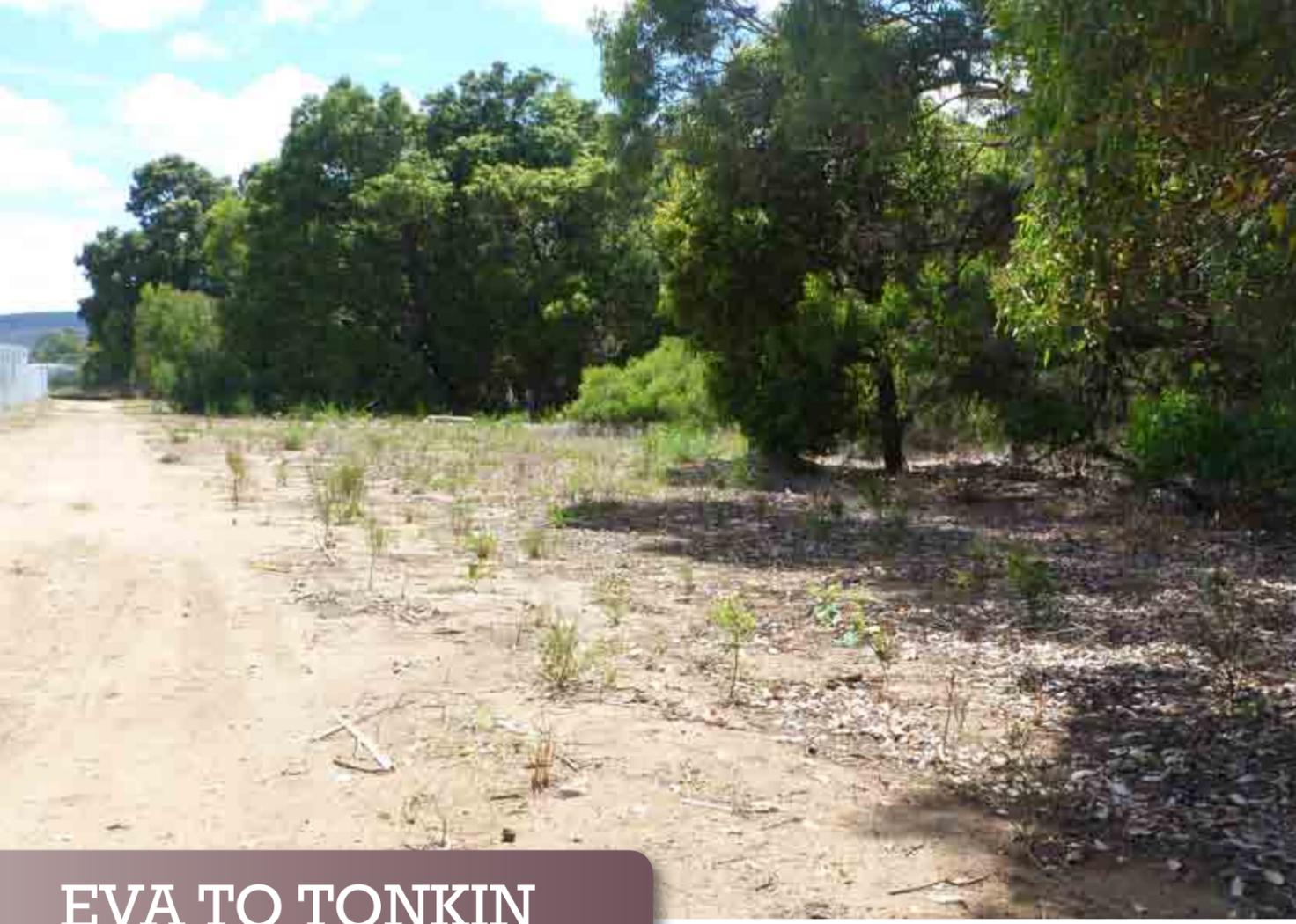
Stabilisation of sections of eroding bank along **750 meters of channel**.

Securing of naturally formed **log riffles** to enhance the dissolved oxygen levels within the water.

Establishment of **native sedges** along the banks of the brook.

Removal of rubbish from the waterway.

Through the partnership with the City of Gosnells the compliance issues of illegal stormwater outfalls and boundary encroachment are being addressed.



EVA TO TONKIN

Before and after planting



EVA TO TONKIN

Friends of Denmark volunteers planting day

Southern River Catchment

The Southern River Catchment has been identified as a significant contributor of nutrient and pollutants to the Canning River. Clearing of native vegetation has caused severe weed infestations, erosion and degradation of the Wungong and Southern River.

The Southern River Catchment includes Southern River and its tributaries, Forrestdale Main Drain, Wungong River and Neerigen Brook. The catchment covers an area of ~150km² is characterised by low lying areas and high groundwater. The Wungong River only receives runoff downstream of the Wungong River dam wall in the Darling Scarp. Many of the catchments wetlands in the catchment have been drained and large areas of the catchment is under increasing pressure from urban development. The catchment is one of the Perth metropolitan areas fastest developing areas.

The Cities of Armadale and Gosnells have worked with catchment management groups

since 1998 to develop the Upper Canning Southern Wungong Catchment Management Team (now the Armadale Gosnells Landcare Group (AGLG)) (Local Water Quality Improvement Plan, Southern River Catchment, Sept 2009, Swan River Trust. Three sites within the Southern River catchment received additional funding through the Swan River Trust and State NRM office through delivery of the Southern River Water Quality Improvement Plan.

The selected sites offer the opportunity to install pollution treatment interventions in combination with river restoration techniques to improve water quality and environmental values within this catchment.

Final Figures

Total area of **WEED CONTROL**: 82 100m²

Total area of **RESTORATION**: 105 605m²

Total length of **CHANNEL MANAGED**: 1675m

RIFFLE STRUCTURES installed: 7

Total number of **VOLUNTEER** participants: 721

Total number of **VOLUNTEER HOURS** contributed: 2805

Total value of **VOLUNTEER LABOUR** contributed: \$81 317

Total number of **PLANTS** installed: 186 150



Project Areas



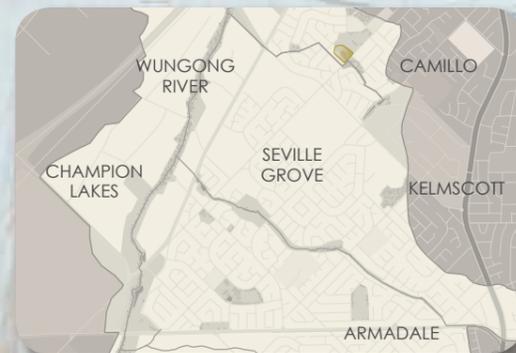
GROVELANDS RESERVE TREATMENT BASIN

AIM

The project aims to reduce nitrogen and phosphorus entering the Wungong River, as well as having additional benefit of significantly improving the aesthetics and biodiversity values of the reserve.

This project converted an existing compensation basin into a bioretention basin. By re-shaping and revegetating the basin with native vegetation, the sites ability to retain and uptake nutrients was increased and its natural diversity enhanced.

Grovelands basin is located on Westfield road, in the suburb of Camillo, within the City of Armadale, WA. The basin operates as a detention area for high flow stormwater events that flow into the Wungong River near the Champion Drive outlet. The basin remains dry most of the year and is mostly bare sand with only some weed grass species and non-native Eucalypt species providing very limited canopy cover. The basins harsh site conditions provided very little opportunity for improving habitat or water quality and also created an unsightly corner of an otherwise attractive public open space.



Soil Amendment trial

Soil fertility testing indicated that the soil was deficient in organic matter, nutrients and trace elements and was also highly water repellent. These conditions would restrict plant growth and indicated that the soil needed amendment to ensure successful revegetation of the site. Careful selection of a suitable soil amendment was required to protect surface and groundwater quality whilst improving soil conditions for revegetation.

Two products were tested onsite by dividing the basin into two halves and applying an amendment to each site. Both amendments were customized green waste composts from separate vendors. For legal reasons the supplier details cannot be provided in

this document. Both products were rotary hoed into the surface to approximately 150mm. The sites were both revegetated with the same native plants species diversity and density. Basic measures of plant survival, health and vigour are now being assessed to determine which amendment was the most effective.

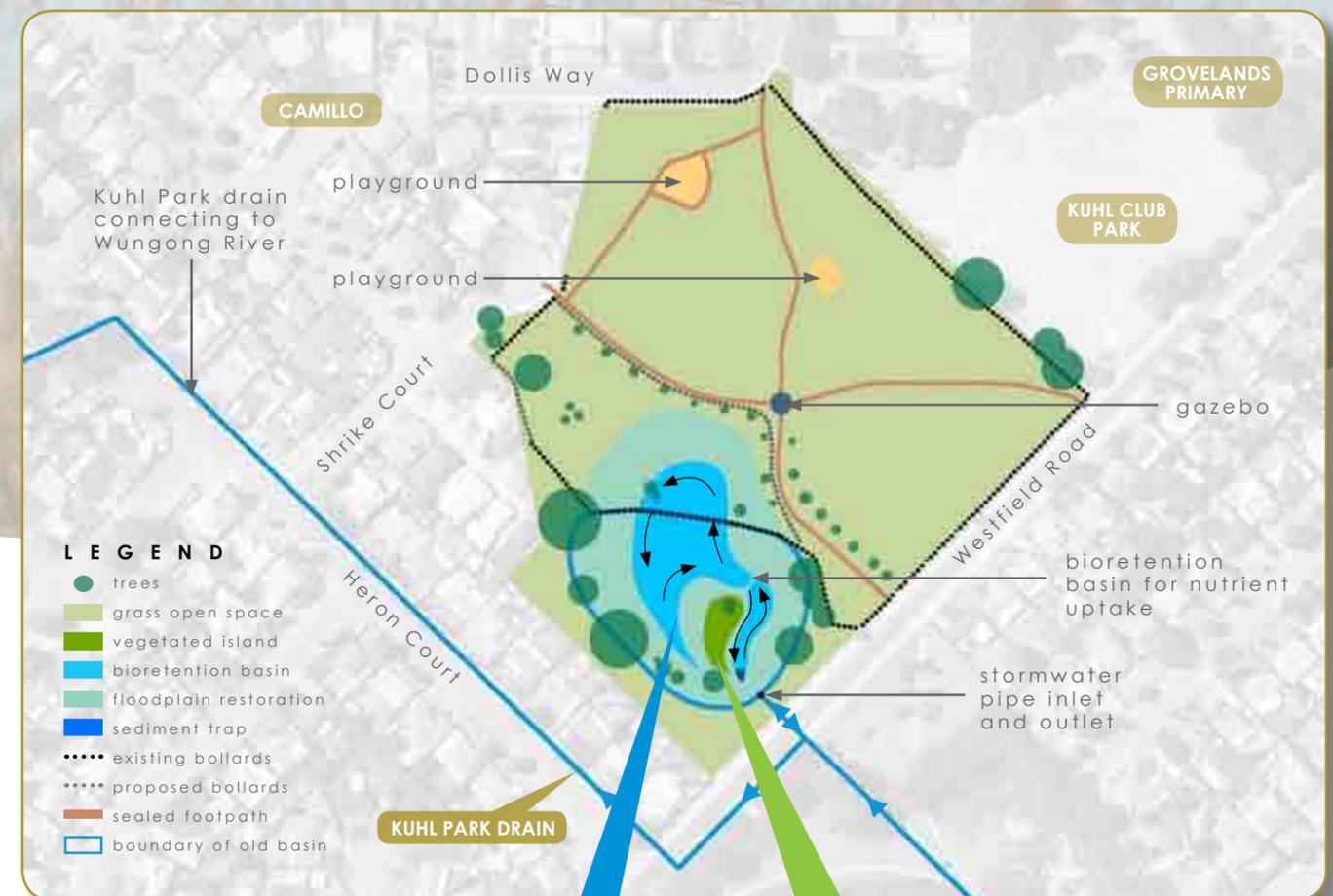
Both products were effective in improving soil conditions, plant vigour and health. Both products were composed of highly composted green waste with low nutrient levels and trace elements. The most successful product had additional rock mineral components, a small percentage of spongelite and increased trace elements including Calcium and Potassium.



Revegetation of the main basin area and construction of a mulched native garden zone on the Westfield road verge improved the aesthetic values of the reserve.



Involving Armadale Gosnells Landcare Group, Conservation Volunteers Australia and Big Help mob in planting day with 170 volunteers.



Reduced the export of nutrients by **reshaping the basin** to increase surface water flow path, increased groundwater recharge and plant water interaction through revegetation of flow path. Nutrient uptake and revegetation success was improved through the application of **250m³ of soil improver**. A **rubbish trap** was installed on the inlet structure to trap floating debris and sediment.



Created habitat and improved natural diversity by **removing weeds from 7800m²** and replacing with **27 000 native trees, shrubs, herbs and sedges**





GROVELANDS

Big Mob volunteers and after the removal of weedy topsoil and addition of re-mediated soil



GROVELANDS

Planting day with Big Mob volunteers



THIRD AVENUE AND SEVILLE GROVE BASINS

AIM

This project aimed to improve surface water quality, natural diversity and the visual amenity of the reserve. Additionally, the project aimed to increase awareness within the highly industrialized catchment of the detrimental impact that poor stormwater management and unauthorized discharges were having on water quality being discharged to the Wungong River.

Third Avenue and Seville Grove basins site is located on Gillam Drive, in the Kelmscott Industrial Area, within the City of Armadale, WA. Third Ave. basin receives stormwater from the Kelmscott Industrial Area. Seville basin adjoins Third Ave. basin and receives additional inlets from Seville Grove shopping centre and Kelmscott Industrial Area and part residential catchment. The stormwater entering both basins has high levels of total nitrogen, phosphorus and hydrocarbons. Gross pollutants are also an ongoing maintenance issue for the basins. Hard rubbish collected in stormwater run-off from road reserves accumulates in the basin and is transported directly to the Wungong River or to Kuhl Park basin. The rubbish and debris blocks infrastructure and increases flood risk.

This project included the re shaping of two compensation basins to extend the existing surface water low flow path and utilized a combination of amended soil and revegetation to reduce the outflow of nutrient contaminants from ground and surface waters. A gross pollutant trap was installed to reduce rubbish export from the basin. The City of Armadale installed a hydrocarbon capture device at the Inlet to Third Ave basin. Additionally, a Track and Trace hydrocarbons investigation took place in the Kelmscott industrial area to identify potential sources of oil entering the network.



Two compensation basins were converted to bioretention basins by:

- Redirecting surface flow to increase flow path by 300 metres which increased retention time and plant water nutrient uptake
- Installation of two subsurface biofiltration beds along the redirected low flow path
- Application of over 130m³ of amended topsoil to improve revegetation success and facilitate denitrification
- Installation of a Gross Pollutant Trap

Track and Trace Hydrocarbons Project

SERCUL commenced a survey of the Kelmscott industrial precinct in 2011 to identify potential sources of hydrocarbon contamination that had been observed entering the project site from the Kelmscott Industrial Area. The survey provided a case study for pollution monitoring using the hydrocarbon capture pads which has since been successfully replicated in the Maddington Industrial area.

The survey involved the attachment of hydrocarbon capture pads to stormwater grates and routine inspection. The suspended pads float on passing storm water and absorb hydrocarbons from its surface without obstructing flow. As they absorb hydrocarbons the pads discolour and upon inspection they provide a quick visual indication of the presence and absence of hydrocarbons. The pads were inspected following storm events and rated on the extent of their discolouration.

The ranked storm water pits were then mapped to prioritise sub catchments within the industrial Area that required further investigation.

This information was then provided to pollution response authorities who investigated the sub catchments that had been suspected of discharging hydrocarbons. 62 businesses within the Kelmscott Industrial Area were surveyed and provided information notifying operators of there legal obligations to stormwater management in the area.



Engaged 2 local business and 2 school groups in planting days and caring for the water way and remnant vegetation.

Engaged Peth Petroleum Services to deliver a Spill Prevention and Control training day for 13 City of Armadale and SERCUL staff

Undertook a Track and Trace survey

Created habitat and improved the natural diversity by planting 22 000 local native plants and reduce the density of weeds over 20 000m²

Interpretive signage and native garden beds were installed to improve aesthetics and attract local residents to understand the projects aim.





THIRD ROAD

Before removal of weeds and construction of an extended stormwater biofilter



THIRD ROAD

Installation of a biofiltration base to an existing stormwater basin



WUNGONG RIVER BIORETENTION BASIN

AIM

The project aimed to reduce the quantity of nitrogen entering the Wungong River redirecting stormwater through a treatment system to reduce contaminants and increase dissolved oxygen levels.

The Wungong River forms part of the Southern River Catchment in the metro area of Perth. The Wungong River project site extends approximately 200mtrs north of Lake road along the east bank of the Wungong River.

This site provided an opportunity to convert a closed piped system into an open system that mimics a more natural flow path for surface water across the site. The modifications created habitat for native fauna and provided treatment to improve surface water quality through biofiltration. A new manhole fitted with a diversion baffle directs low flows into a vegetated surface flow wetland constructed on the eastern floodplain of the Wungong River. The water passes through the open wetland and then through a gated weir into a vegetated subsurface flow wetland to create anaerobic conditions suitable for denitrification.



Create wildlife habitat and improve the natural diversity by planting **26 900 local native plants** and **removal of weeds from 380m** of Wungong River Foreshore

Improved the aesthetic of the area adjacent to the river by **converting grassland into native vegetation.**

Future **Wungong River Heritage trail** to be constructed will incorporate interpretative and interactive exhibits, sculpture and signage to improve locals understanding of the Wungong Rivers significance.

Reduce the export of nitrogen and phosphorus entering the Wungong River by construction a **bioretention system** and increasing the surface water flow path to increase nutrient uptake by vegetation.

Improve the oxygenation of water by installing a slowdown **drain rock chute** on the outlet.

Improve the quality of water infiltrating to groundwater near the Wungong River by using **190m³ of amended topsoil.**

This drain is just for rain...

The stormwater outlet which is redirected through the constructed basin collects stormwater from the adjacent residential catchment and a small portion of Lake Road reserve. Prior crossing Lake Rd the stormwater pipe passes sewerage pump station. When the sewerage pump station system fails and overflows it flows into a subsurface tank which then overflows into the passing stormwater pipe, transporting

raw sewerage directly into the Wungong River.

To provide some additional protection for the Wungong River and the constructed basin the design included a weir and gate valve which can be manually closed in the event of a pollution event to prevent contamination of the filter bed and river.

Outstanding work going past the funding agreement

As a result of the projects success the City of Armadale have adopted the approach and design elements illustrated through these projects and have engage SERCUL in two new projects opposite the existing Wungong and Riverside Lane sites that treat stormwater runoff from the Forrestdale Business park and have allow restoration of both banks of the Wungong River.

Supported the formation of the **City of Armadale's Bush Crew** to manage Natural areas within the council including the Urban Waterway renewal sites

Engaged the Armadale Gosnells Landcare Group to deliver the revegetation plan and include other local community groups including the Friends of Palomino Reserve and Forestdale Lake



WUNGONG RIVER

Construction of a major biofiltration living stream



WUNGONG RIVER

Wungong River



RIVERSIDE LANE FORESHORE AND FLOODPLAIN RESTORATION

AIM

This project aims to reduce the quantity of nutrients entering the Wungong River by removing sections of pipe that feed into the river and redirecting the polluted stormwater into a biofiltration basin. The project also aims to improve the aesthetic and biodiversity values of the foreshore and floodplain which was previously a rough mown paddock by removing illegal dumping of rubbish and revegetating with local native plant species.

The site is part of the Wungong River floodplain located between Riverside Lane and the eastern foreshore of the Wungong River, in Seville Grove. The site is situated on a stormwater pipe inlet which dissects the Wungong Rivers floodplain and transports stormwater with high levels of nitrogen and low dissolved oxygen directly into the river which can adversely affect aquatic life.

The project removed a section of the existing stormwater concrete pipe and created a biofiltration basin to reconnect the river with its floodplain. The modifications reinstated a more natural flow path that would have existed before the Wungong River was engineered as a drainage channel. Filtration media composed of coarse cracked pea gravel lines the base flow channel of the basin and the batters were lined with 50mm of amended topsoil to increase nutrient retention through elevated carbon levels and made plant available to improve revegetation success.

The basin was designed to follow the natural contours of the existing floodplain and utilise low points in the banks of Wungong River to create high flow inlets which deliberately reconnect the river with its floodplain.

The basin and floodplain was densely planted with native sedges and groundcovers. Dominant tree species such as Melaleuca raphiophylla and Eucalyptus rudis were planted to provide a canopy and more accurately reflect the natural assemblage expected along the Wungong River.



Raise community awareness by hosting 2012 **National Tree Day event** and numerous community planting days.

Hosted a Schools Open day with the Swan River Trust and Armadale Gosnells Landcare Group where **80 students** were given opportunities to engage with the Wungong River, gain an understanding of its ecological significance and how our actions impact on its health.



Improve sites aesthetics by converting a rough mown paddock into an **ecological corridor** and creating a **heritage walk trail** through the site.

Created wildlife habitat and improved the natural diversity by planting **54 000 local native plants** and **removing exotic flora** from the river foreshore and floodplain over 2.4 hectares or 415m of Wungong River Foreshore.

Removal of over 150m³ of sediment, weed material and rubbish from the Wungong river including 4WD vehicle.

Improved water quality entering the Wungong River by creating a billabong to intercept and treat polluted stormwater through an **open and subsurface wetland**.

Over **230m³ of amended topsoil** was applied to the newly constructed billabong before revegetation.



The Wungong Heritage Trail

The Wungong River is a registered site of significance to Noongar heritage. As the proposed project site works involved excavation and potential disturbance of any buried artefacts the site was assessed through a comprehensive archaeological survey and an ethnographic survey to develop a Cultural Heritage Management Plan for the site.

The archaeological survey found no artefacts or cultural material during the investigation. Site monitors were engaged to supervise earthworks and ensure no cultural material was damaged during the creation of the wetland.

The ethnographic survey involved a site inspection and consultations with thirty-six

individuals drawn from nine families/groups who claim heritage interests in the area. No concerns or objections were raised by the participants in relation to the project and some individuals expressed an interest in being involved in the project.

The City of Armadale in partnership with SERCUL developed a plan to construct a heritage trail through the project sites. The trail will allow users to safely access the site and provide interactive displays that will explain the natural and cultural significance of the site. The trail will protect restoration works by delineating them from turfed areas used for more active recreation.





RIVERSIDE LANE

Car body found in the Wungong River



RIVERSIDE LANE

Before and after the construction of the wetland



STRAWBERRY DRIVE BASIN

AIM

The project aimed to convert a compensation basin into a constructed and enable water to be treated before it is conveyed to the Wungong River.

The project site is on Strawberry Drive between Lisbon Way and Fortunella Grove in Seville Grove, Armadale. The Strawberry Drive project site is on Matthew Stott reserve vested in the City of Armadale for public recreation and drainage. It is located next to Willandra Primary School and a residential area.

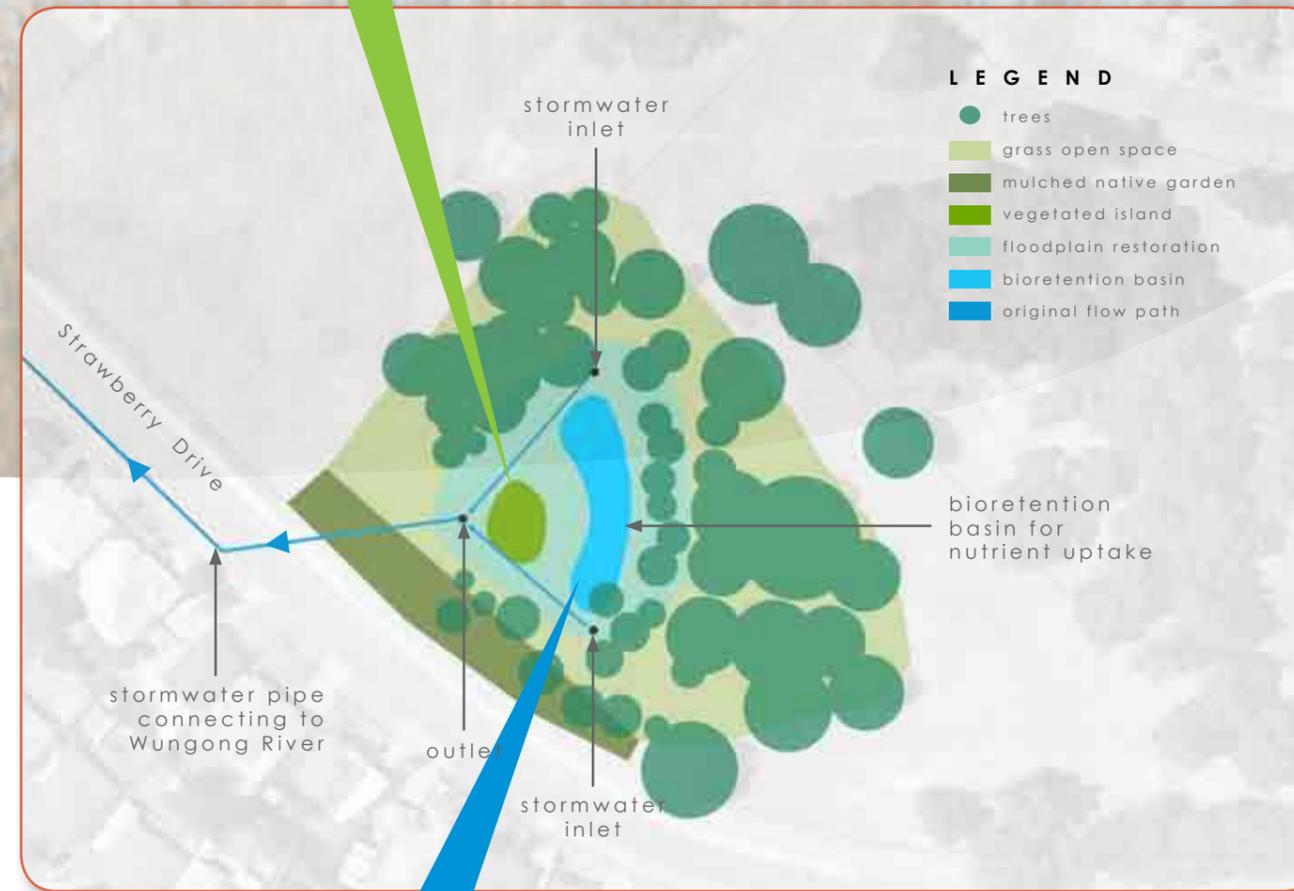
This compensation basin was re-shaped and revegetated to form a constructed wetland. The project involved rubbish and weed removal followed by revegetation using local native plants.



Created wildlife habitat and improved the natural diversity by planting **17 350 native plants** and **reducing the density of exotic flora**.

Improved the visual amenity by constructing a **mulched native garden** on the verge of Strawberry drive and develop a landscape plan with the City of Armadale.

The City of Armadale installed a **sealed path** to allow controlled access to the site and delineate it from turfed public open space.



Reduced the nutrient levels exiting the basin by **reshaping the basin** to increase its capacity and retention time of storm water.

Application of a **soil amendment** and **revegetation** also increased the opportunity for nutrient uptake by vegetation.

Raised community awareness of the basins connection to the Wungong River and the impact of storm water contamination by installing a **sign**, providing local residents with **flyers** detailing the project and having Willandra Primary school involved in **two planting days**.

Weed Management

A weed is any plant that requires some form of action to reduce its effect on the environment, human health and amenity. Weeds are also known as invasive plants and are among the most serious threats to Australia's natural environment because they are causing damage to natural landscapes, agricultural lands, waterways and coastal areas.

A weed can be an exotic species or a native species that colonises and persists in an ecosystem in which it did not previously exist. Weeds typically produce large numbers of seeds, assisting their spread and they are

often excellent at surviving and reproducing in disturbed environments.

The first step in weed prevention, and the most cost-effective means of managing weeds, is to prevent potential weeds entering a project site. When a weed has taken hold, early detection and eradication are critical steps to reduce their impact. Priority weeds at Strawberry Drive site include Perennial Veldt grass (*Ehrharta calycina*), African Lovegrass (*Eragrostis curvula*), and Bulrush (*Typha orientalis*). These invasive weeds can increase the potential fire risk if not controlled effectively.



STRAWBERRY DRIVE

Biofiltration system installation into a simple stormwater basin



STRAWBERRY DRIVE

Soil amendment application



WILLIAMS RD MAIN DRAIN PROJECT – Biofilter and Bank Stabilisation

AIM

This project aimed to reduce the volume of sediment and gross pollutants exported from site.

The Williams Rd Main Drain (WRMD) has been identified as a significant contributor of nitrogen and sediment to the Wungong River system, which forms part of the Southern River Catchment.

The high flow rates and steep banks exhibited by WRMD have caused erosion, sedimentation, gross pollutant and nutrient export into the Wungong River. The project adopted the principles of water sensitive urban design utilising a treatment train approach to reduce the volume of sediment and gross pollutants exported from site. Erosion control measures and modification to the existing open channel stabilised banks and reduced the surface water flow rate. A biofiltration swale was installed as a secondary treatment to filter nutrients resulting in lower pollutant levels being flushed into the Wungong River.



Local residents highlighted the importance of the retention and improvement of Marri woodland park during site works.

As a main thoroughfare for local residents and students the woodland is highly valued and resident expressed their appreciation of its improvement by their involvement in planting days and feedback to site managers.

Invasive grasses were removed from Marri woodland remnants to improve biodiversity and reduce fire risk.

Increased habitat by the installation of **25 000 plants**



Williams Road Main Drain

WRMD receives large volumes of stormwater (> 14m³/sec) over short periods of time causing severe bank erosion and sedimentation in downstream reaches of the drain. As a result, the base of the drain has been scoured to reveal laterite bedrock and clay conglomerate. These features combined with steep banks reduce the area available to revegetate and encourage bio filtration through

plant water interaction. These features also limited plant species selection for revegetation too dry land species that can tolerate part to full inundation.

These features limited the use of soft structures and vegetation to stabilize banks therefore hard structural controls such as rock riffles were required to slow water flow and increase dissolved oxygen.

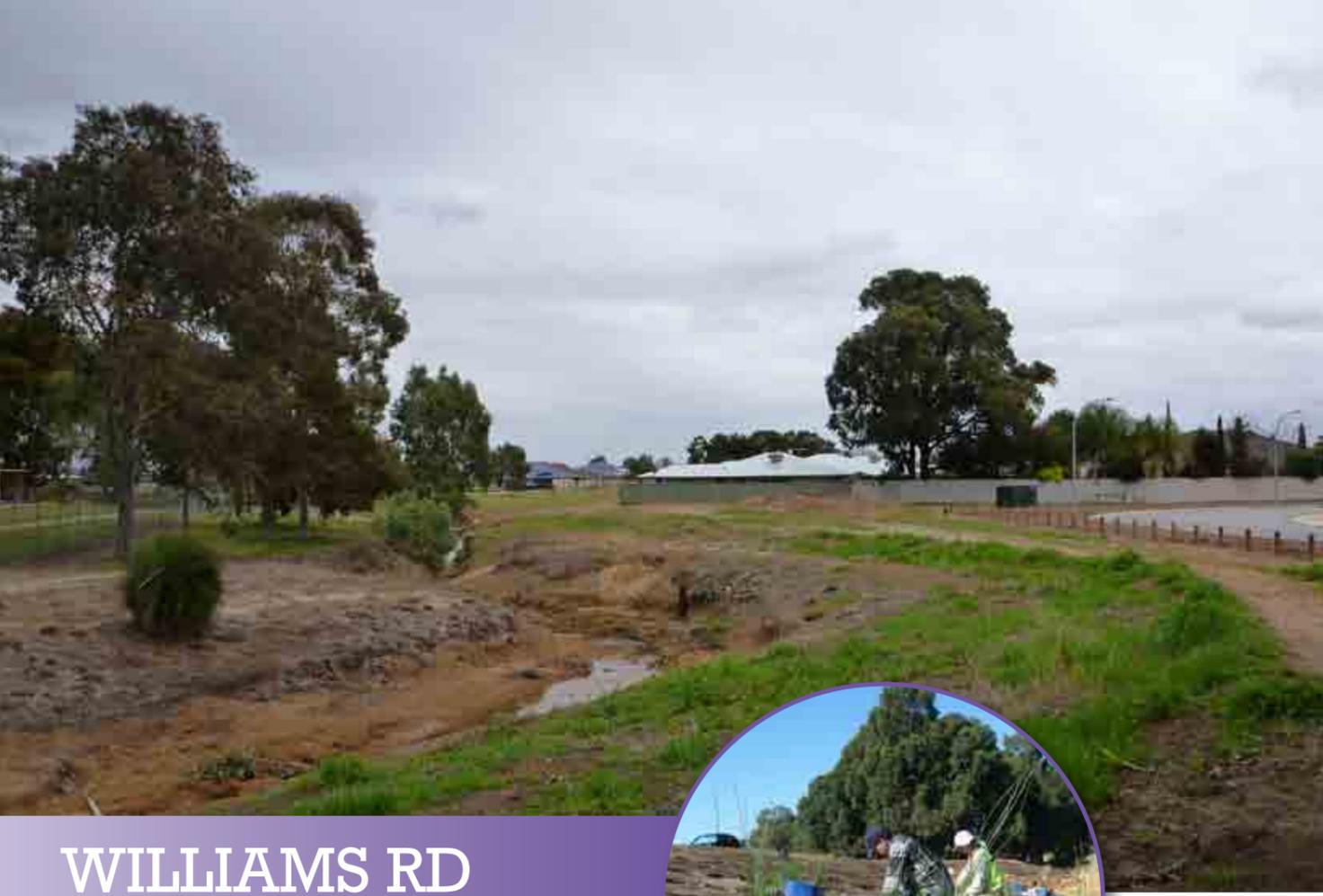
Reducing the flow velocity through the site was achieved by **widening the main channel, reducing and stabilising bank slopes** and creating a **high flow bypass** which has reduced erosion and sedimentation of the Wungong River

Installation of **4 rock riffles** and creation of a **sediment trap** has allowed trapping of coarse sediment and gross pollutants

Removal of over **1200m³** sediment and rubbish

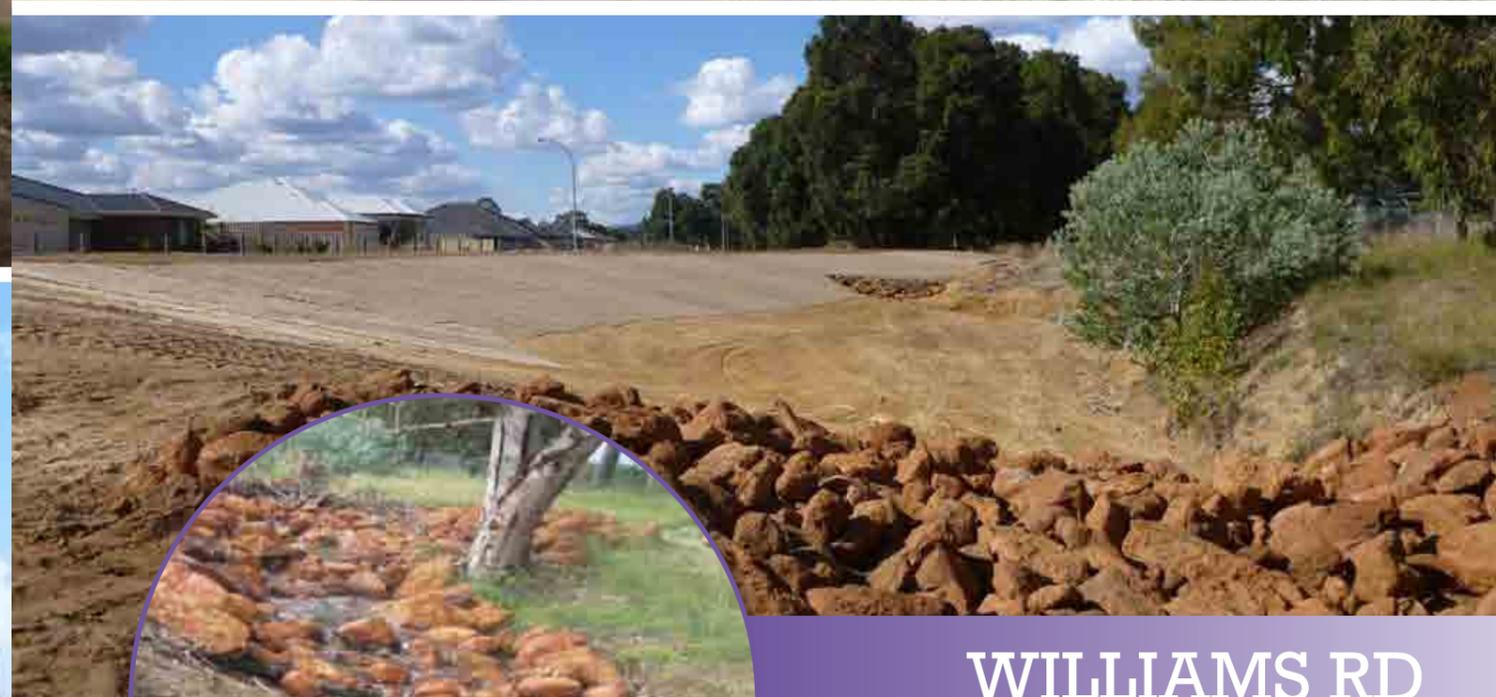
Installation of a **biofiltration swale** to provide secondary treatment to surface water.

Cecil Andrews High School has adopted the site in collaboration with locals residents and Polytechnic TAFE students, coordinating **National Tree Day** and **Clean Up Australia day** events.



WILLIAMS RD

Before and after channel widening, riffle construction and planting



WILLIAMS RD

Before and after planting channel widening and rock riffle construction



Final Budget Chart

SERCUL URBAN WATERWAY RENEWAL FINAL INCOME & EXPENSE CHART 2010 -2013	Admin	Overall Project Mgt	Bannister Creek	Bickley Brook Confluence	Eva -Tonkin St, Bickley Brook	Mandarin Rd Bickley Brook	Kelvin Rd (Myola) Biofiltration
Income - UWR Projects including State, Business and Commonwealth Funds							
Administration	261,500	0	0	0	0	0	0
Construction	0	0	469,000	80,000	181,900	93,000	93,000
Monitoring	0	0	0	0	0	0	0
Planning & Design	0	0	35,000	6,000	14,000	6,000	0
Plant installation	0	0	50,000	10,000	0	15,000	0
Plants	0	0	105,000	40,000	95,000	65,000	0
Project Management Armadale	0	225,000	0	0	0	0	0
Project Management Canning	0	270,000	0	0	0	0	0
Project Management Gosnells	0	213,000	0	0	0	0	0
Weed Control & maintenance	0	0	175,000	50,000	120,000	30,000	0
UWR plant reimbursement.	0	0	0	0	0	4,082	0
Water Corporation Research	0	0	90,000	0	0	0	0
Total Income	261,500	708,000	924,000	186,000	410,900	213,082	93,000
Expense - UWR Projects including State, Business and Commonwealth Funds							
Administration	252,798	0	0	0	0	0	0
Construction	0	0	469,000	80,000	181,101	93,000	93,000
Monitoring	0	0	0	0	0	0	0
Planning & Design	0	0	35,000	19,709	14,000	6,000	0
Plant installation	0	0	50,000	7,695	11,898	15,000	0
Plants	0	0	105,000	33,589	83,901	69,082	0
Project Management Armadale	0	225,000	0	0	0	0	0
Project Management Canning	0	270,000	0	0	0	0	0
Project Management Gosnells	0	213,000	0	0	0	0	0
Weed Control & maintenance	0	0	175,000	45,006	120,000	30,000	0
Total Urban Renewal Projects.	252,798	708,000	834,000	186,000	410,900	213,082	93,000
Water Corporation Research	0	0	45,301	0	0	0	0
Total Expense	252,798	708,000	879,301	186,000	410,900	213,082	93,000
Net Ordinary Income	8,702	0	44,699	0	0	0	0
Asset purchases-Computers	8,413	0	0	0	0	0	0
Asset Purchases - Plant & Equip	289	0	0	0	0	0	0
Total Other Expense	8,702	0	0	0	0	0	0
Net Other Income	(8,702)	0	0	0	0	0	0
Net Income	0	0	44,699	0	0	0	0

Final Budget Chart - cont.

SERCUL URBAN WATERWAY RENEWAL FINAL INCOME & EXPENSE CHART 2010 -2013	Grovelands Reserve	Wungong River - Riverside Lane	Seville & Third Bioretention	Strawberry Drive	Williams Rd Swale	Wungong River	SERCUL Urban Water Renewal Total
Income - UWR Projects including State, Business and Commonwealth Funds							
Administration	0	0	0	0	15,000	0	276,500
Construction	49,500	122,750	478,000	0	153,000	66,500	1,786,650
Monitoring	0	0	0	0	13,000	0	13,000
Planning & Design	15,500	46,000	30,000	0	34,000	18,000	204,500
Plant installation	0	25,000	0	0	28,000	16,000	144,000
Plants	50,000	101,477	91,300	35,000	25,500	50,000	658,277
Project Management Armadale	0	0	0	0	64,500	0	289,500
Project Management Canning	0	0	0	0	0	0	270,000
Project Management Gosnells	0	0	0	0	0	0	213,000
Weed Control & maintenance	0	40,505	0	0	62,000	15,000	492,505
UWR plant reimbursement.	0	0	0	0	0	0	4,082
Water Corporation Research	0	0	0	0	0	0	90,000
Total Income	115,000	335,732	599,300	35,000	395,000	165,500	4,442,014
Expense - UWR Projects including State and Commonwealth Funds							
Administration	0	0	0	0	15,000	0	267,798
Construction	49,500	123,676	478,000	210	153,000	66,065	1,786,553
Monitoring	0	0	0	0	12,387	0	12,387
Planning & Design	14,810	42,836	17,485	2,383	34,000	17,091	203,314
Plant installation	212	25,609	2,891	546	28,000	16,648	158,499
Plants	50,000	104,160	97,843	30,447	26,113	49,895	650,031
Project Management Armadale	0	0	0	0	64,500	0	289,500
Project Management Canning	0	0	0	0	0	0	270,000
Project Management Gosnells	0	0	0	0	0	0	213,000
Weed Control & maintenance	478	39,450	3,082	1,413	62,000	15,801	492,230
Total Urban Renewal Projects.	115,000	335,732	599,300	35,000	395,000	165,500	4,343,312
Water Corporation Research	0	0	0	0	0	0	45,301
Total Expense	115,000	335,732	599,300	35,000	395,000	165,500	4,388,612
Net Ordinary Income	0	0	0	0	0	0	53,401
Asset purchases-Computers	0	0	0	0	0	0	8,413
Asset Purchases - Plant & Equip	0	0	0	0	0	0	289
Total Other Expense	0	0	0	0	0	0	0
Net Other Income	0	0	0	0	0	0	0
Net Income	0	0	0	0	0	0	44,699

Project Maintenance Planning

Bannister Creek Catchment

The Bannister Creek Urban Waterways Renewal Project Maintenance plan MOU was completed and signed off by all land managers in November 2012. The plan is for 5 years and will expire in June 2018. The actions within this maintenance plan will become part of a new Bannister Creek Park Management Plan (2014).

Maintenance Overview

The project establishment phase will continue to be conducted by SERCUL in conjunction with the City of Canning and the Bannister Creek Catchment Group (BCCG). The establishment phase of this project ended 30th of June 2013. Upon completion there is a requirement for ongoing maintenance of the project site to fully enable the establishment of the restoration work and maintain the sites values.

Management Responsibilities

Bannister Creek forms part of the Water Corporations drainage infrastructure network, referred to as the Bannister Creek Main Drain. The Water Corporation is responsible for the conveyance of water for flood mitigation in accordance with its Operating Licence. This may involve inspection of the riffle structures, the removal of significant debris and the removal of accumulated sediments.

The Water Corporation reserves the right to remove or modify any installed works, if at some future date they are considered to be compromising the asset's prime purpose. The reason for decommissioning or modification to any works includes, but is not restricted to, hydraulic capacity of the drain, modifications to channel, public liability, employee safety, operability and maintainability of the main drainage assets.

The project site is in Bannister Creek Park, managed by the City of Canning. The reserve is vested for public recreation and has designated

conservation and recreational purposes zones. The Bannister Creek Park Management Plan 1999 outlines the management objectives for the reserve which will remain consistent with the new plan. The City will be responsible for the ongoing maintenance of the project site in accordance with the maintenance plan and the Bannister Creek Park Management Plan.

SERCUL and the Bannister Creek Catchment Group will be responsible for the restoration and establishment phase of the project. They will work with the City of Canning to manage the project site beyond the completion of the UWR project funding.

Weed control and Restoration

Weed control within the project site will occur throughout the project establishment and maintenance phase.

SERCUL and the Bannister Creek Catchment Group will work with the City to ensure the establishment of the restoration within the project site meet plant diversity targets. This may include the need to obtain further funding for restoration via grant applications as well as be included in annual City budget allocations.

Other major management items

Gross Litter: The City will be responsible for the removal of waste within the reserve and the Water Corporation responsible for waste removal in the creek. Other infrastructure may be necessary upstream to protect the waterways from gross litter intrusion.

Riffle structures & trials: Access paths will be maintained to all riffles structures for the replacement of the treatment media, monitoring and maintenance. The management responsibilities for all treatment media falls to the organisation who has undertaken the trial. The results of any trials will be made available to all stakeholders.



Project Maintenance Planning

Bickley Brook Catchment

The Urban Waterways Renewal Projects within the Bickley Catchment all have individual maintenance plans in the form of MOU's. This is due to the differing land managers requirements and timing of project completion.

Maintenance Overview

The Bickley Brook Confluence Maintenance MOU was completed and signed off in June 2012. The plan is for 5 years and expires end of June 2018. Maintenance of the site will ensure that the revegetation establishes into a sustainable ecosystem which adds to the function of the newly established stormwater quality management system in place on site.

The Bickley Brook Mandarin Rd Project Maintenance MOU was completed in June 2013 and signed in July 2013. Maintenance of this site specifically pertains to improving surrounding landuse stormwater management and ensuring the revegetation and riffle structures continue function to improve water quality. Mycelx hydrocarbon detection and removal pads will be managed by SERCUL and the City of Gosnells. Sediment will be removed from the forebays created for that purpose by the Water Corporation as is required.

The Eva - Tonkin project maintenance MOU is in the final stages of being completed. Some final revegetation works are yet to be completed due to some additional weed and land management issues taking longer to resolve than expected. Plants are purchased and on hold awaiting appropriate seasonal changes for planting to occur.

Kelvin Rd (Myola) Rain Garden Trial UWR project will be fully maintained by the City of Gosnells (CoG) in collaboration with the Department of Water Aquatic Science Branch who have been implementing the water quality monitoring for this site. Plant establishment and sustainability forms part of the project thus the maintenance will be determined by the success/failure of species and replacement of plant species will remain the responsibility of the land manager. Trial results will be shared with all project stakeholders.



Management Responsibilities

All project sites, except the Rain Garden site, are within the Water Corporation management area as a Main Drain. The maintenance plan proposes no change to the Water Corporation's current management area, scope or focus. Any maintenance requirements beyond this scope, associated with the project works (including erosion repairs to the swale drains which may result from high flows) will need to be accepted by the land manager.

Overall - Weed control and Restoration

Ongoing weed management is required by the CoG to ensure the success of each site's redevelopment and revegetation. This responsibility is expected to reduce as the revegetation starts to dominate the landscape. SERCUL meet with CoG quarterly to discuss shared management opportunities with community.

Overall - Major management items

Gross Litter: The recent history at the Bickley Brook sites indicate that there is a range of gross litter items which enter the Bickley Brook reserve areas and it can travel downstream into the project areas. There is a potential for rubbish entering the site to impede the flow of water within the system and/or to reduce the aesthetic value of project areas. Catchment wide gross litter management and regular litter removal programs form part of the maintenance plans.

Project Maintenance Planning

Southern River Catchment

The Southern River Catchment has seven Urban Waterways Renewal Project sites. The 10 year maintenance plans formed part of the construction plans which were all approved prior to the commencement of the projects.

The City of Armadale and Water Corporation reserves the right to remove or modify any installed works, if at some future date they are considered to be compromising the asset's prime purpose. The reasons for decommissioning or modification to any works includes, but is not restricted to, hydraulic capacity of the drain, water quality, modifications to channel, public liability, employee safety, operability and maintainability of the main drainage assets and reserve.

SERCUL will provide technical advice for maintenance plan reviews.

PROJECT SPECIFIC MAINTENANCE

Grovelands Reserve treatment Basin - Bioretention upgrade; Site maintenance is the responsibility of the City of Armadale.

The City of Armadale will manage and maintain:

- Remnant vegetation
- Turf management and rubbish removal
- Revegetation zone weed control and rubbish removal
- The Water Corporation will manage and maintain:
- Main drainage infrastructure including removal of invasive weeds, refuse from main drainage structures
- Erosion repair resulting from high drain flows and sediment removal;
- Vandalism repair to drainage structures

Third and Seville Rd Basin Upgrade

The City of Armadale will manage and maintain:

- Remnant vegetation
- Turf management
- Weed control and rubbish removal
- Hard structure maintenance including drainage infrastructure, signage and safety barriers

Wungong River Restoration Bioretention Project

Site maintenance is the responsibility of the City of Armadale and the Water Corporation in the event of a pollution incident.

The City of Armadale will manage and maintain:

- Remnant vegetation
- Turf management and rubbish removal
- Revegetation zone weed control and rubbish removal

The Water Corporation;

In the event of a pollution incident causing contamination of the site as a result of the Lake Road pump station discharging to the Wungong River the Water Corporation will be responsible for site clean-up and remediation works including removal of contaminated water and solids and repair of any damaged infrastructure.

Wungong River Restoration Project

Site : Riverside Lane

The site is managed by the City of Armadale under the 'Wungong River Champion Drive to Armadale Road Management Plan 2010 to 2015' City of Armadale 2010.

The City of Armadale will manage and maintain:

- Remnant vegetation
- Turf management and rubbish removal
- Revegetation zone weed control and rubbish removal

Strawberry Drive Biofiltration Basin

The City of Armadale will manage and maintain:

- Remnant vegetation
- Revegetation zone weed control and rubbish removal

Williams Road Main Drain Upgrade

The City of Armadale will manage and maintain:

- Remnant vegetation in section 1
- Turf management and rubbish removal section 2
- Swale weed control and rubbish removal
- Irrigation - the Water Corporation will manage and maintain:
- Main drainage infrastructure including removal of invasive weeds, refuse from open water and main drainage structures
- Erosion repair resulting from high drain flows;
- Vandalism repair to drainage structures



Project Challenges

The project generally progressed well, but some challenges were highlighted during the project planning and implementation. Most challenges have been resolved, meaning new project delivery planning processes have been put in place or are in the process of being trialled.

The biggest challenge for SERCUL was the short timeline for project delivery once the funding was received, 2½ years. Typically large urban waterway restoration projects in Perth also incorporate large numbers of land managers and stakeholders whom all need to be consulted in an integrated manner. Project design and planning approvals took much longer to achieve than was expected and issues associated with planning design approvals being held up due to the high level of approvals being processed by developers became evident.

Mass removal of weeds was a challenge but met well with a much more economic method of removing blackberry in wetland floodplains with very little chemical required post removal. The blackberry and other vines that extended high into the paperbarks and eucalypts was manually cut down with skilled brush cutter operators. The mass waste was left to break down and cover the ground, reducing other weed growth. 12-18 mths later the floodplain was flooded with backwater after riffle construction. Extremely low levels of blackberry and other weeds have regrown, demonstrating a possible new methodology for removing intense blackberry invasion.

The collection of valuable ecological data prior to the projects being constructed has proven valuable but the short project delivery time frame has once again meant that collection of post project delivery results will mostly occur outside the project timeline. For quantifiable water quality improvement to be measured in new biofiltration and living streams projects, the revegetation needs to be at least two to three years post planting. SERCUL and other partners will need to seek funding for collecting and collating data that will demonstrate the effectiveness of these projects over time.

The cost of hydrological modelling and surveying (predevelopment and as constructed survey) engineering was

underestimated in the original budget and consumed all contingency funds.

Working with three different Local Government Authorities having differing approaches to stormwater and waterway restoration and project delivery was challenging within the same project framework. Regular project management meetings and on ground reviews solved these issues, with three very different styles of project delivery. One local authority was completely engaged with direct involvement in the on ground delivery and team involvement in design. Another authority was involved in design approval only and project overview on a very regular basis with project delivery managed by SERCUL. The third local authority was also involved in project overview and design approval but preferred that SERCUL outsourced the project delivery to preferred contractors, however they were engaged in supporting the SERCUL project manager by providing back up supervision and waste management.

The complexities surrounding the delivery of numerous projects across the urban landscape was a challenge but was well achieved with support from all land managers and project delivery teams. The expectations of these projects being achieved within a very tight time frame was met and the community have been a tremendous support in providing extra assistance in volunteering labour and providing technical monitoring expertise.



Lessons Learned

The purpose of the “lessons learned” is to provide information to help improve the performance of future projects by identifying the project’s successes, failures, challenges and missed opportunities and to help us avoid repeating problems of the past.

SERCUL undertook a survey of all persons involved in the projects and the lessons below reflect SERCUL’s interpretation of the survey results.

LESSON 1

That highly experienced community landcare organisations, like SERCUL, can cost effectively and efficiently coordinate and deliver such urban renewal projects on time, in partnership with multiple stakeholders, flexing and responding to changes along the way.

Project Benefit: 11 UWR projects completed and available as demonstration sites.

LESSON 2

The most efficient & cost effective method for delivery of large Urban Waterway renewal projects is with collaborative partnerships driven by community with direct involvement at the Local Government Authority level.

Project Benefit: The Land Manager learns how to implement and maintain ecosensitive stormwater management systems at the local level and can therefore continue to do so in other sites.

LESSON 3

Be aware that when changes are made by executive management, within government agencies that affect the managers and their team’s ability to participate in providing technical expertise out into the community, there can be an indirect financial impact imposed on projects that rely on and need that assistance, despite there being a signed agreement in place.

Project Impost: 50-75% increase in the cost of planning design and as constructed surveying plans.

LESSON 4

Make sure that when project agreements are signed within Government Agencies and Land Managers at the highest level, that the officers at the management and project delivery level are given a copy and understand the implications of the signed agreement.

Project Impost: Significant delay in planning approvals and thus project delivery timelines are extended which increases project management costs.

LESSON 5

That urban drainage reform in Perth has a long way to go. The fractured and super multi-stakeholder management of waterways in Perth makes the planning and delivery of water sensitive urban design restoration much more complex and more expensive than is necessary.

Project Impost: Increase in the cost of management of waterways in an ecosensitive and sustainable manner.

LESSON 6

That the planning approvals process for restoration improvement works within drains and waterways in Perth can take from 18 -24 months.

Project Impost & Response: Increase in cost of project. A better and more coordinated approach is urgently needed if funding can be attracted so works can meet tight funding time frames.

LESSON 7

Having waterways ecosystem monitoring data sets available to inform project design and feed into restoration evaluation methodologies.

Project Benefit: Collection of data sets from these projects made available for public use.

LESSON 8

The reporting framework used worked well, as did the management meeting structures. However, key agency and project management staff will change.

Project Response: Ensure the project management system is detailed enough to record all activities completed and those impending. Handover notes need to be up to date and be very thorough.

LESSON 10

Collection and collation of project data and activity records is a high priority and should be reported on monthly by the most senior project manager.

Project Benefit: all other project managers keep their records up to date so the project record keeping system functions and data is made readily available.

LESSON 11

Funding allocation for promotion of completed UWR projects is valid and that thorough reporting takes much more time than was predicted.

Project Response: Ensure the project budget has allocated adequate reporting and promotion funds from the beginning and that an evaluation framework is agreed to prior to the commencement of the project.

Media Moments & Site Signage

Renewal project begins

By Kate Murphy



The first phase of the urban waters renewal project began on Thursday where volunteers planted more than 96,000 seedlings across 11 sites on the Swan Canning riverpark.

The project involves 11 subprojects across Bannister Creek, Bickley brook and Southern River to reduce nutrient loads and pollutants flowing into the Swan and Canning Rivers.

Water Minister Bill Marmion said actions to reduce nutrients flowing into the riverpark included revegetating targeted areas, retrofitting old drains and restoring natural drainage features to filter out nutrients before they entered the waterways.

“When completed, the urban waterways renewal project will assist us in achieving the overall target established in the Swan Canning water quality improvement plan of reducing the nutrient load by 120 tonnes per year and the phosphorus load by 12 tonnes per year,” he said.

Mr Marmion said excessive nutrient loads were the main cause of algal blooms which were destructive to river ecosystems and could also be harmful to humans.

A total of \$4.5 million was provided by State Govern-

ment initiatives, Water Corporation and the cities of Armadale, Gosnells and Canning.

An additional \$4 million was provided under a national partnership agreement between the State and Federal governments under the water for the future - national security plan for cities and towns.

The South East Regional Centre for Urban Landcare (SERCUL) was delivering the works and chief executive Julie Robert said it had been preparing and planning for the project for more than 18 months. She said the earthworks were likely to go on for another 2-3 months.

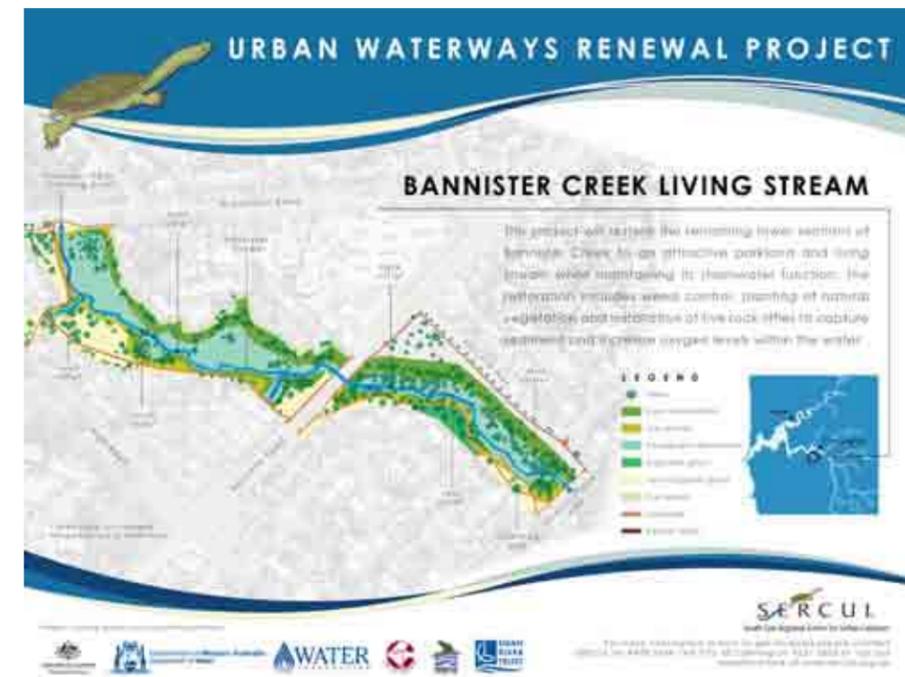
“There will be lots of volunteers involved, we’ll have schools and corporate groups helping out,” she said. “It seems that we are getting a lot of interest in being able to help to put the plants in the ground.”

Parliamentary Secretary for Sustainability and Urban Water Senator Don Farrell launched the construction phase on Thursday and said establishing native plants throughout the catchment would improve water quality by intercepting and drawing nutrients out of the water and also improving habitats.

“In addition to improving water quality, these projects will enhance the environmental qualities of urban areas and restore natural habitats, improve biodiversity and reduce erosion,” he said.

\$8.5mn riverpark project underway

Federal funds flow into Bannister Creek



Appendices available

All Appendices to this document, listed below, are made available on the following website: www.sercul.org.au/publications.

Macroinvertebrate study - "Does habitat restoration increase macroinvertebrate diversity of urban streams in Perth, Western Australia?" B. Clark - October 2011 (Honours Thesis) The University of Western Australia.

Baseline Assessment of Freshwater Mussel Populations within the Urban Waterways Renewal Project - MW Klunzinger, D Strebler, SJ Beatty, DL Morgan & AJ Lymbery, Centre for Fisheries & Fisheries Research Murdoch University December 2011

Bannister Creek UWR Construction Management Plan, B. Kuhlmann - January 2012 SERCUL. Bannister Creek UWR Maintenance Plan - B. Kuhlmann - November 2012 SERCUL.

Macroinvertebrate and Herpetofauna Inventory Survey. (Post Blackberry Removal and Partial Understorey Restoration of Bannister Creek October — November 2012 - David Knowles, Spineless Wonders Terrestrial Invertebrates.

Bickley Brook Confluence Living Stream Construction Management Plan. B. Kuhlmann - January 2012

Bickley Brook Confluence Living Stream Maintenance Plan. B. Kuhlmann - June 2012

Geochemical Characterisation of the Shallow Sediment Profile at the Bickley Brook Site (Confluence) Dave Oldmeadow, Ron Watkins. Curtin University of Technology - Report 6/11 October 2011

Bickley Brook Mandarin Rd Living Stream Construction Management Plan. B. Kuhlmann - May 2011

Bickley Brook Mandarin Rd Living Stream Maintenance Plan. B. Kuhlmann - November 2012

Hydraulic Investigation of the Bickley Brook Drain at Mandarin Road Crossing Maddington, Department of Water - August 2012

Bickley Brook Eva - Tonkin Revegetation and Maintenance Plan. B. Kuhlmann - July 2011

Bickley Brook Rain Gardens Final Designs. City of Gosnells

Southern River Catchment Urban Water Renewal Project sites Construction, Maintenance & Management plans -

Glen Byleveld;

Wungong River Restoration Project Site : Riverside Lane - January 2012

Third and Seville Rd Basin Upgrade- Biofiltration and Living Streams, - October 2012

Wungong River Restoration Project Site 8 : Bioretention Basin - August 2012

Grovelands reserve, Kuhl Park Basin Upgrade, Compensation to Bioretention - April 2012

Strawberry Drive Treatment Basin Urban Waterways Renewal - April 2012

Williams Road Main Drain Bioretention Upgrade: - January 2012

Geochemical Characterisation of the Shallow Sediment Profile at the Wungong River floodplain - Riverside Lane, Dave Oldmeadow, Ron Watkins. Curtin University of Technology - Report 8/11 October 2011

Cultural Heritage Management Plan, Wungong River - Living Streams Project, prepared by Heritage Advice Australia Pty Ltd 13/12/2011.

Project Audit and Financial Project Report - SERCUL - August 2013.



Thank you

SERCUL would like to thank all the contributors to the 11 Urban Waterway Renewal Projects and especially thank the Australian Government and State Government agencies, for believing that SERCUL and the three Local Governments could make these projects such a success.

We will continue to care for our waterways and return them into functioning ecosystems that will return life back into our communities.

"We must begin thinking like a river if we are to leave a legacy of beauty and life for future generations." — David Brower



Australian Government
Department of the Environment

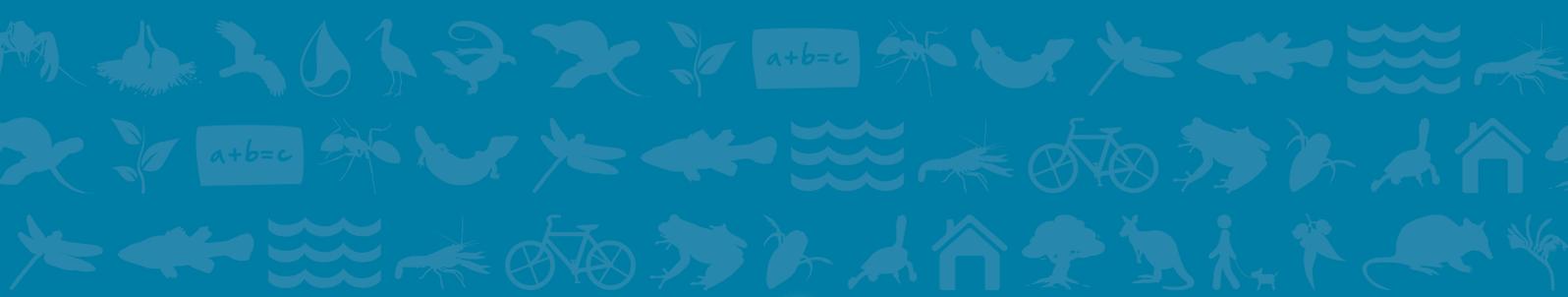


Government of Western Australia
Department of Water



STATE NRM OFFICE
Natural Resource Management in Western Australia






SERCUL

South East Regional Centre for Urban Landcare
69 Horley Road
Beckenham WA 6107
T | 9458 5664
F | 9458 5661
W | www.sercul.org.au