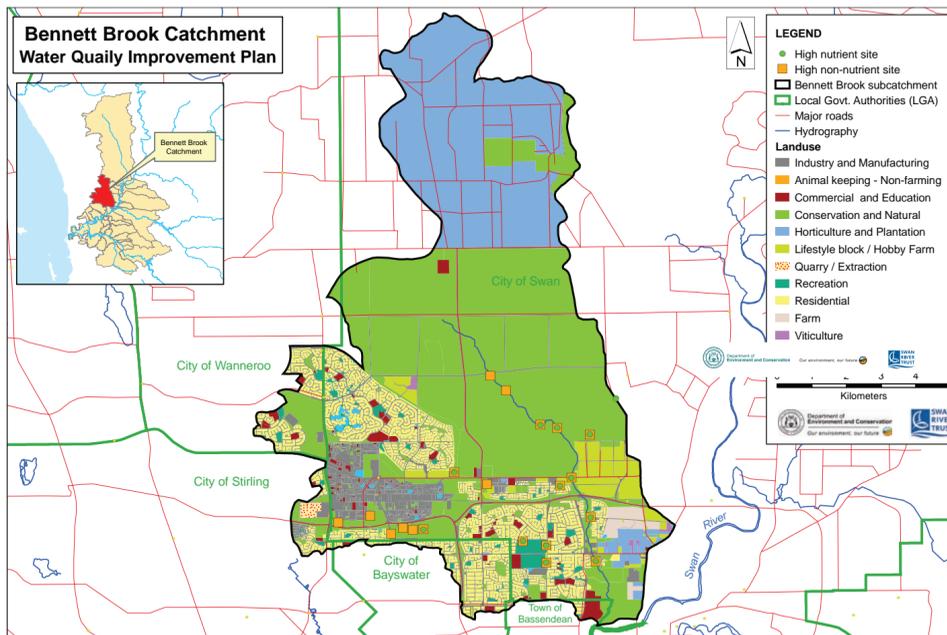


5. Monitoring and review

Strategy	Implementation	Lead organisations	Supporting partners	Timing
How do we measure our success?	<ul style="list-style-type: none"> Organise initial stakeholder meeting to determine Key Performance Indicators (KPIs) and annual reviews to assess progress on KPIs; identify funding opportunities; and determine objectives and actions for the next 12 months Seek funding and support to ensure ongoing implementation and monitoring of effectiveness of strategies and actions 	Trust, CoS	WC, DoP, DEC, PRNRM, DoW	Starting 2010

Maps



Coastal Catchments Initiative

In June 2006 the Swan Canning river system was identified as a hotspot for water quality issues as part of the Australian Government's Coastal Catchments Initiative (CCI). The Trust was responsible for preparing the regional Water Quality Improvement Plan for the Swan Canning river system.

The regional WQIP provides a roadmap for reducing

nutrient levels in the river system using scientific models and decision support tools prepared under this new initiative.

Integrating science and management actions, an accredited WQIP will underpin a long-term investment strategy to improve water quality in known hotspots such as the Swan Canning river system.



Planting day at Clarry Small project site, Bennett Brook, 2006



Quenda at Bennett Brook, picture courtesy of Whiteman Park



Bennett Brook

Partners

This WQIP was developed in consultation with the following stakeholders



ANZECC & ARMCANZ 2000, *Australian and New Zealand Guidelines for Freshwater and Marine Water Quality, Volume 1, The Guidelines*, Australian and New Zealand Environmental and Conservation Council and Agricultural and Resource Management Council of Australia and New Zealand.

For further information contact

City of Bayswater Ph 9272 0903 www.bayswater.wa.gov.au
 City of Swan Ph 9267 9267 www.swan.wa.gov.au
 Swan River Trust Ph 9278 0900 www.swanrivertrust.wa.gov.au *Caring for the Swan Canning Riverpark*

March 2011

Local Water Quality Improvement Plan Bennett Brook Catchment



Background

The Swan River Trust (Trust) works to reduce nutrients and other contaminants entering the Swan and Canning rivers.

The Trust has developed and is investing in local **Water Quality Improvement Plans (WQIPs)**. These will provide local councils and communities with a mechanism to prioritise recommendations and resources, and seek funding to improve water quality in catchments contributing the greatest amount of nutrients. These plans should be reviewed annually and assessed after five years. Under the Healthy Rivers Action Plan (HRAP), the Bennett Brook Catchment is identified as one of eight priority catchments in the Swan Canning river system.

WQIPs trace nutrient and pollutant pathways through catchments from their source to the discharge point.

Bennett Brook Catchment Water Quality Improvement Plan

The Bennett Brook Catchment is located in the north east of the Perth metropolitan area and includes the local government authorities of the cities of Swan and Bayswater and Town of Bassendean. The catchment has an area of 217km². Just over half is covered by the Gngangara pine plantation and Whiteman Park.

Bennett Brook was once a natural creek system; however its tributaries to the west have been modified to deeply incised drains to allow development. Bennett Brook is fed primarily by groundwater seepage from the Gngangara Mound and also receives stormwater from the surrounding industrial, residential and rural areas. The water from these drains is discharged into the Swan River, upstream of Success Hill in Bassendean.

Increased groundwater pumping in the northern part of the catchment has lowered groundwater levels, consequently reducing flow into the brook. Conversely, the southern part of the catchment has elevated flow due to the construction of drainage networks and increased runoff from hard surfaces.

Outcomes

The Water Quality Improvement Plan will:

- identify water quality issues and hot spots;
- identify environmental values of water bodies and water quality objectives required to protect the values; and
- identify and commit to a set of cost-effective management measures to achieve and maintain those values and objectives.



Steps to develop a local WQIP

1. Existing activities

What are we doing to improve water quality?

Local WQIPs link to existing projects and programs in the catchment. They draw together activities contributing to improved water quality and target future investments for optimal water quality outcomes. Projects are based on partnerships with local government, community and shared stakeholders.

Examples of key existing programs in the Bennett Brook Catchment include:

Rehabilitation programs

Since 1998 rehabilitation works have occurred on a number of sites in the Bennett Brook Reserve through a range of collaborative partnerships. Rehabilitation of Lightning Swamp has been undertaken since 2000. The programs involve weed removal and revegetation with indigenous plant species.

Partners: Alcoa, City of Bayswater, Friends of Bennett Brook, Friends of Lightning Swamp, Perth Region NRM, Swan River Trust, Whiteman Park

Outcomes: Medium improvement in water quality

Water quality monitoring

A snapshot of water and sediment quality was initiated in 2002 and has since been conducted each year to help locate pollution hotspots throughout the catchment that may be contributing to contamination of Bennett Brook and the Swan River. In 2009, 24 sites along Bennett Brook were tested and parameters for nutrient and non-nutrients measured against the ANZECC water quality trigger values (for freshwater; 95% protection level guidelines for aquatic ecosystems; and recreational health).

Partners: City of Bayswater, City of Swan, Department of Water, Perth Region NRM, South East Regional Centre for Urban Landcare, Whiteman Park

Outcomes: Identify hotspots within the catchment

Pearl cichlid investigations

Studies on the biology of the pearl cichlid and its distribution in the Swan Canning Riverpark are continuing. Results from the study suggest that this feral freshwater fish has a current distribution from Altone Park lakes, through Lanuis Drain and into Bennett Brook as far downstream as Grogan Swamp. Although no pearl cichlids were caught in the Swan River or any of its other tributaries during the study, substantial numbers appear to be flushed from Altone Park Lakes to Bennett Brook following heavy rainfall.

The research also indicated that the pearl cichlid was breeding during much of the year and had established a self-sustaining population. The results of the study suggest that the potential for this species to spread throughout the Swan Canning Riverpark is high.

Partners: Murdoch University, Perth Region NRM and Swan River Trust

Outcomes: Low improvement in water quality and medium improvement in biodiversity

Gngangara Sustainability Strategy

The Gngangara Sustainability Strategy is a cross-government initiative working on an action plan to ensure the sustainable use of water for drinking and commercial purposes and protect the Gngangara Mound. Through the strategy a number of projects have been undertaken, including investigating opportunities to change pine harvest regimes to increase groundwater surface recharge.

Partners: CSIRO, Department of Agriculture and Food, Department of Environment and Conservation, Forest Products Commission, Department of Planning, Department of Water, Water Corporation

Outcomes: Medium improvement in water quality and biodiversity

Community Education And Awareness

There are a number of volunteer organisations that work with key stakeholders to coordinate and implement onground actions to improve wetland and catchment health. They consist of community members who work to raise awareness of the impacts of nutrients on waterways and protect the catchment's ecological values.

The Children's Groundwater Festival, held annually at Whiteman Park since 2001, provides the opportunity for teachers and students to learn more about water, sustainability and other environmental topics.

Partners: Bassendean Preservation Group, City of Bayswater, City of Swan, Department of Water, Friends of Bennett Brook Reserve, Friends of Lightning Swamp, Perth Region NRM, Swan River Trust, Water Corporation, Whiteman Park

Outcomes: Medium improvement in water quality and biodiversity

2. Condition

What are the water quality and quantity issues in the Bennett Brook Catchment?

High levels of nitrogen, phosphorus and non-nutrient contaminants

Water quality is monitored fortnightly by the Department of Water (DoW) on behalf of the Trust and reported through Nutrient Report Cards on the Trust website (www.swanrivertrust.wa.gov.au). These reports provide information across a seven-year period on concentrations, nutrient fractions and seasonal variation. This data indicates that total phosphorus (TP) has generally been at low levels in

this catchment but total nitrogen (TN) continues to be an issue.

A snapshot of water and sediment quality in the Bennett Brook Catchment has been conducted annually from 2002-2009. Samples were taken on various occasions from 25 sites and analysed for TN and TP. A summary of the results is shown below:

Nutrient	HRAP targets	Exceed HRAP targets	Range	Median	Mean
Total nitrogen	1.0mg/L	11 sites	0.15 – 4.3mg/L	0.81mg/L	1.046mg/L
Total phosphorus	0.1mg/L	3 sites	0.0025 – 0.6mg/L	0.026mg/L	0.06mg/L

Bennett Brook Catchment: main sources* of nutrients

Nitrogen		Phosphorus	
Residential	32.1%	Residential	40.9%
Septic	21.1%	Farm	16.1%
Farm	16.5%	Recreation	13.2%
Recreation	11.1%	Horticulture	11%
Horticulture	7%	Septic	8.1%
Hobby farm	6.3%	Offices, commercial, education	6.4%

* based on Swan Canning Water Quality Improvement Plan modelling

Water quality issues	Pollutant indicators	Pollutants/issues of concern
Contaminants <ul style="list-style-type: none"> Moderate nitrogen levels High levels of non-nutrient contaminants Potential remobilisation of pollutants from sediments Possible acid-sulphate soils 	Contaminants <ul style="list-style-type: none"> High nutrient and non-nutrient pollutant concentrations pH variations High colour, suspended solids and turbidity 	Nutrients <ul style="list-style-type: none"> Total nitrogen Non-nutrients <ul style="list-style-type: none"> Heavy metals: aluminium, chromium, copper, iron and zinc Pollution events Sediment Gross pollutants Solvents Surfactants
Biotic <ul style="list-style-type: none"> Nuisance growth of aquatic plants Infrequent algal blooms in wetlands 	Biotic <ul style="list-style-type: none"> Infrequent algal blooms Absence of desirable aquatic plants and animals, loss of biodiversity Turbidity 	

Maintaining seasonal flow variability

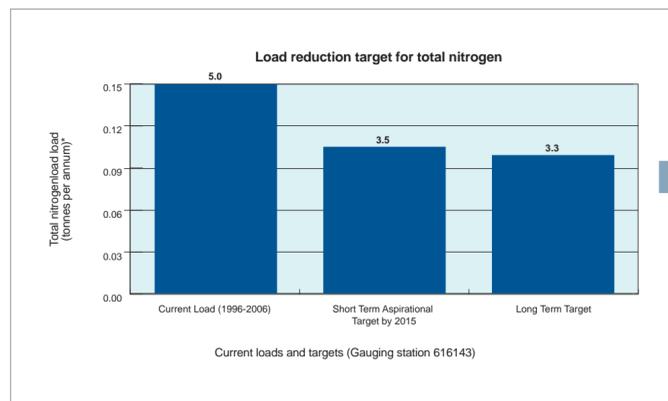
The amount of water entering Bennett Brook from the catchment is important to maintain environmental and recreational values in the brook. Data collected at DoW gauging station 616143 from 1997-2006

indicated the annual flow for Bennett Brook ranged from 2.5 to 10.1 gigalitres per year. With climate change this variability is likely to continue.

3. Values, objectives and targets

What water quality improvements would we like to achieve in the Bennett Brook Catchment?

Values	Objectives	Targets
River flow (RF) Flows in the Bennett Brook Catchment protect environmental values in the system and contribute to Environmental Water Requirements for the Swan River	<ul style="list-style-type: none"> Mimic natural inundation and drying patterns which protect wetlands and floodplains Minimise the effect of extraction on water quality by mimicking the natural frequency, duration and seasonal flow 	River Flow Flow quantity sufficient to maintain environmental values An environmental water requirements study is necessary to quantify target Nutrients The aim is to reduce average TN and TP loads by 30% by 2015 as a short-term aspirational target. Predictive modelling from the Swan Canning WQIP has demonstrated that no reduction is required for total phosphorus but in the longer term a reduction of 32% is required for total nitrogen Non-nutrients The target for non-nutrient contaminants is to meet ANZECC guidelines for environmental health at all sites
Aquatic ecosystem health (AH) Bennett Brook is a natural tributary valuable for biodiversity conservation, waterbird habitat and native fish breeding Bennett Brook Reserve provides habitat for the endangered southern brown bandicoot	<ul style="list-style-type: none"> To enhance and protect aquatic ecosystem health, recreation and aesthetics, and cultural and spiritual values it is necessary to improve water quality objectives The target to do this is to improve water quality by a 30% reduction in TN annual loads and maintain TP levels below HRAP targets by 2015 	
Recreation and aesthetics (RA) Bennett Brook has recreational and aesthetic value, both in its natural state and as part of urban development Whiteman Park is a valued amenity and provides multiple uses for a range of passive and active recreation		
Cultural and spiritual (CS) The land and waterways surrounding Bennett Brook are of Aboriginal significance The Bennett Brook area was commonly used for camping and Success Hill was used for conducting intertribal gatherings and ceremonies		



Total phosphorus

*Annual load: 0.29 tonnes (no load reduction required)
 Based on Swan Canning WQIP modelling data and long term HRAP concentration targets being met

* Based on average annual flow data from 1997-2006 and applies to annual river discharge loads similar to 1997-2006

** Short term aspirational target to achieve 30% reduction on annual load by 2015

4. Implementation

How do we achieve the water quality targets?

The Bennett Brook Catchment WQIP aims to reduce nutrient loads entering the Swan River through nutrient intervention and new management practices. By using a treatment train approach, a combined set of management actions are applied along nutrient pathways to minimise nutrient and non-nutrient contaminant losses to waterways.

The lead organisations and supporting partners will implement this WQIP in the constraints of existing budgets and resource levels. They are committed to working together to actively seek new resource opportunities.

Treatment train approach	Management strategies	Implementation	Lead organisations	Supporting partners	Timing
1. Prevention Land use and planning	1.1 Application of Water Sensitive Urban Design (WSUD)	<ul style="list-style-type: none"> Ensure the planning process for retrofitting incorporates WSUD principles as stated in the Stormwater Management Manual for Western Australia (AH) Develop and implement a condition for development approvals for industrial buildings / areas to incorporate wastewater treatment systems (AH) ** Ensure WSUD is incorporated into all relevant planning proposals consistent with the requirements of Better Urban Water Management, State Planning Policy 2.9 Water Resources and local environmental conditions (AH) 	City of Swan (CoS), City of Bayswater (CoB), Town of Bassendean (ToB)	Department of Water, Perth Region NRM (PRNRM)	Starting 2010-11
	1.2 Improving wetland health	<ul style="list-style-type: none"> Develop a Stormwater Management Plan to assess water quantity and quality discharging into Lightning Swamp and identify threats to wetland hydrology (AH, CS) ** 	CoB, CoS	Department of Environment and Conservation (DEC), Swan River Trust (Trust)	Starting 2010-11
	1.3 Sustainable landscaping	<ul style="list-style-type: none"> Implement sustainable landscaping as part of future retrofitting in public open space and local government authority 	CoS, CoB, ToB	DoW	Starting 2010-11
	1.4. Monitoring water quality in the catchment	<ul style="list-style-type: none"> Continue to monitor existing groundwater bores and investigate future groundwater monitoring to determine groundwater levels and contribution from the groundwater system (AH, RF) Based on a review of historical land use data, identify sites currently contributing to nutrient and non-nutrient load (AH)** Conduct intensive water quality sampling in the Malaga industrial area to isolate sources of contaminants (AH) 	CoS, CoB, ToB, Developers	DoW, Whiteman Park (WP)	Starting 2010-11
		<ul style="list-style-type: none"> Seek funding to expand, review and continue the water quality monitoring program (AH) 	Trust, PRNRM	Universities	Ongoing
2. Minimisation Efficiency in nutrient use	2.1 Reduce output by land managers	<ul style="list-style-type: none"> Encourage land managers to investigate fertilisers and soil amendments to determine effectiveness in reducing nutrient run off and groundwater contamination (AH) 	Trust	DoW, WP, CoS, CoB, SERCUL	Starting 2010-11
	2.2 Reduce community output	<ul style="list-style-type: none"> Educate the community on sustainable landscaping practices (AH, CS, RA) Develop and implement a community education program for new developments (AH, CS) ** 	Trust	DoW, WP, CoS, CoB, South East Regional Centre for Urban Landcare (SERCUL)	Ongoing
	2.3 Reduce nutrient and non-nutrient input from industry	<ul style="list-style-type: none"> Regulate industry input through the application of the Unauthorised Discharge Regulations (AH) 	DEC	DoW, WP, CoS, CoB, South East Regional Centre for Urban Landcare (SERCUL)	Ongoing
3. Reduction Source control	3.1 Undertake soil investigation	<ul style="list-style-type: none"> Conduct an Acid Sulphate Soils (ASS) analysis at the headwaters of Bennett Brook and develop an ASS management plan if appropriate(AH) ** 	DEC	Trust, PRNRM, DEC	Starting 2010-11
	3.2 Reduce nutrient and non-nutrient input from industry *	<ul style="list-style-type: none"> Implement an education program for small to medium businesses to prevent inappropriate disposal of wastes (AH) Encourage adoption of best management practices for specific industries (AH) Develop and implement an audit program for small to medium businesses in the Malaga industrial area (AH) 	PRNRM, DEC	Trust, PRNRM, DEC	Ongoing
	3.3 Other relevant programs	<ul style="list-style-type: none"> Implement strategies to prevent shopping trolleys ending up in Bennett Brook (AH, CS, RA) ** 	CoS	CoS, CoB, ToB	Friends of Bennett Brook Reserve (FoBBR), shopping centres
4. Amelioration Conveyance and transmission	4.1 Apply best management practices for nutrient management	<ul style="list-style-type: none"> Identify and prioritise parks for retrofitting potential (AH, RA) ** Identify and prioritise compensation basins and drains for revegetation to reduce erosion and nutrient and non-nutrient Where practical create vegetated buffer zones/verges and implement WSUD principles between waterways and turf in council reserves to help prevent herbicides, fertilisers and grass clippings entering waterways (AH, RA) ** Manage aquatic invasive species in drains and compensation basins to prevent spread to wetlands and waterbodies (AH) Seek funding to continue the rehabilitation of Bennett Brook Reserve to stabilise the banks and reduce sediment loads (AH, CS, RA) 	CoS, CoB, ToB	PRNRM	Starting 2010-11
		<ul style="list-style-type: none"> Identify and prioritise parks for retrofitting potential (AH, RA) ** 	CoS, CoB, ToB	FoBBR, FoLS, WC	Ongoing
		<ul style="list-style-type: none"> Manage aquatic invasive species in drains and compensation basins to prevent spread to wetlands and waterbodies (AH) 	Trust, WC	CoB, CoS, ToB, Main Roads WA	Ongoing
		<ul style="list-style-type: none"> Seek funding to continue the rehabilitation of Bennett Brook Reserve to stabilise the banks and reduce sediment loads (AH, CS, RA) 	WP	FoBBR	Ongoing
5. Treatment - Reuse - Disposal	5.1 Full connection to infill sewerage	<ul style="list-style-type: none"> Increase management and maintenance of infrastructure to reduce the incidence of sewage spills to the environment (AH) Full connection of existing residential areas where a sewerage scheme is available 	WC		Ongoing

*new management strategy

**new management actions

(AH) = aquatic ecosystem health. Links to values for the catchment in Section 3