Sustainable Water Management Strategy
Bayside City Council

VOLUME 1

8 March 2011
Prepared by CPG Australia

Acknowledgements and Recognition

John Edwards	**Bayside City Council**
Stephen Thorpe	**Bayside City Council**
Naomi Paton	**Bayside City Council**
Damian Carr	**Bayside City Council**
Samantha Krull	**Bayside City Council**
Leanne Stray	**Bayside City Council**
Michael Brown	**Melbourne Water**
Justin Lewis	**South East Water Limited**

Issue Date	Revision No	Author	Checked	Approved
02/07/2010	1	Leigh Holmes	Jonathon McLean	Jonathon McLean
28/07/2010	2	Leigh Holmes	Jonathon McLean	Jonathon McLean
20/9/2010	3	Leigh Holmes	Jonathon McLean	Jonathon McLean
25/10/2010	4	Leigh Holmes	Jonathon McLean	Jonathon McLean
17/11/2010	5	Leigh Holmes	Jonathon McLean	Jonathon McLean
28/01/11	6	Leigh Holmes	Jonathon McLean	Jonathon McLean

Executive Summary

Background

CPG Australia has been engaged by Bayside City Council to develop a Sustainable Water Management Strategy (SWMS) to provide direction and targets for alternative water supply within the municipality. The Council provided a list of recreational and open space reserves which have been deemed high priority from a community and Council perspective.

Historically Melbourne has relied on a centralised water management approach to provide high quality water and the City of Bayside has relied on this centralised supply source to meet its demands for water. The legacy of this approach is that Council will continue to rely on the reticulated supply at least in the short term, while augmentation of the system through projects such as desalination will provide increased security of supply.

The drought experienced over the past decade is impacting upon the ability to access freshwater supplies. In addition, our communities are continuing to grow and this growth is placing an ever-increasing demand on our water supply systems. Coupled with the impacts of climate change, our water supplies are going to become even more scarce and valuable.

Within Melbourne this has resulted in moderate to severe water restrictions, impacting upon industry, residents, tourism and recreational activities and it is apparent that we will no longer be able to rely on the same water supplies to meet our needs and those of the environment as we have in the past. These severe water restrictions have recently been relaxed. The current restriction for sportsgrounds is now based on an annual volume of 3000 kilolitres per hectare.

This strategy identifies a total annual water demand (i.e. sustainable water budget) of around 455,000 kilolitres (kL) for sites directly managed by Council while larger leased assets have a demand of around 230,000 kilolitres. From 2001-01 to 2008-09 Bayside City Council reduced potable water consumption from 406,675 kilolitres to 135,488 kilolitres for assets that it directly managed however much of this reduction resulted from water restrictions. Council's data management and other key corporate process will be augmented to include all Council owned assets. Data for water use at leased sites will be included as a separate category as part of Councils water use profile. This will significantly change Council's water consumption and provide a more accurate indication of water use associated with Council assets. Council's leasing policy will include requirements for lessees to provide data about water consumption.

A diversity of water supplies should be utilised however this will vary geographically according to local circumstances and opportunities for accessing alternative water sources. For areas such as the Cheltenham precinct the current reliance on groundwater and limited access to stormwater is a major factor. Opportunities for storing ground water via Managed Aquifer Recharge will require further investigation with South East Water

as the lead agency. For other areas such as the Elsternwick Park, precinct level stormwater will be a major opportunity. Other areas with relatively smaller water use and suitable buildings will require rainwater harvesting while some areas with few options for alternative water use will require continuing reliance on the reticulated water system. Climate variability means that this will require review according to variation and the impact of climate change.

Bayside City Council has already developed a range of policy and strategy to respond to climate change, sustainability and water management. Through these strategies a range of sustainable water management projects have been implemented which will reduce potable water consumption by around 40,000kL through means of irrigation management, turf replacement and rainwater harvesting systems. Precinct level projects at Elsternwick Park, Sandringham Golf Course and Cheltenham Park are being developed and could reduce potable water consumption by around 200,000kL per year.

The SWMS establishes the framework to capture the existing City of Bayside water initiatives and provides recommendations for long term strategic direction to maintain parks, sportsgrounds and reserves. The framework is based on the “Water Sensitive Cities” concept which is emerging as a best practice approach for sustainable urban water management. This approach has evolved from initiatives such as development of the Clean Stormwater Planning Framework, which Council led on behalf of the Association of Bayside Municipalities. It was formally recognised with the establishment of the Centre for Water Sensitive Cities at Monash University. Stormwater harvesting has been identified as the most viable option both regionally and locally and is therefore considered the primary alternative water source for the City of Bayside. Broad targets have been established however options for specific locations will be based on local need and opportunities. For some areas stormwater may provide opportunities however other areas may still require water from the reticulated water system. The existing and future Council projects will help achieve a target of 55 – 85% by 2030 of water use from alternative water sources.

Strategy recommendations

The following is a summary of strategy recommendations and actions from the Sustainable Water Management Strategy. It is intended that these will inform the development of Bayside City Council’s key business planning and budgetary processes.

1. *Cities as Catchments Strategy*
   Reduce water consumption through efficiency improvements to achieve potable water consumption targets.

Actions

- Rationalise and optimise the actual areas required for irrigation at each site.
- Continue replacing cool season grass with warm season turf for sportsgrounds and high use open space areas.

2. *Cities as Catchments Strategy*
Improve data management for all Council assets so that data is complete, consistent, accurate and timely.

Actions

- Reframe and further develop Council's data bases for water use. The data base should include two categories: Council managed sites and leased sites.
- Undertake an audit to ensure all sites are metered. Consider the installation of sub-maters to separately record irrigation from other water uses.
- Identify Council department and officer to manage, update and co-ordinate the database.
- Council to work co-operatively with managers of leased sites to obtain their commitment to supply water use data.

3. *Cities as Catchments Strategy*
Pursue stormwater and rainwater harvesting for open space irrigation as the primary alternative water source in the City of Bayside.

Actions

- Complete and implement precinct level stormwater harvesting projects:
    - Elsternwick Park
    - Sandringham Golf Course

- Implement the design and construction of the following projects:
    - Cheltenham Park Precinct
    - Brighton Golf Course and Dendy Park
    - Boss James Reserve
    - Hurlingham Park and Landcox Park,
    - Chisholm Reserve
    - Basterfield Park.

- Develop a stormwater harvesting pre-feasibility and implementation plan for the following priority open space sites
    - Simpson Reserve
    - RJ Sillitoe Reserve
    - Donald MacDonald Reserve
    - Banksia Reserve
    - Beaumaris Reserve
    - Brighton Beach Oval
    - Billilla Historic Gardens
    - Tjilatjirrin Reserve
    - Brighton Library Gardens
    - Kamesburgh Gardens

- Green Point
- FL Yott Reserve Precinct

- Update and implement projects for the following waterMAP sites:
  - Trevor Barker Oval
  - Sandringham Family Leisure Centre
  - Brighton Golf Course and Dendy Park

- Pursue partnership opportunities with Melbourne Water and South East Water for delivery of the Avoca Street Retarding Basin stormwater harvesting project.

- Pursue funding opportunities at state and federal governments using the pre-feasibility study recommendations as the basis for obtaining financial contribution from within Council and other government agencies.

- Pursue the implementation of rainwater tanks where supply and demand can be met.

4. Cities as Catchments Strategy
Pursue regional opportunities and projects as longer-term alternative water sources

Actions

- Maintain regular liaison with water agencies to ensure awareness of regional directions and initiatives
- Continue to monitor and review other alternative water opportunities (e.g Class A recycled water) as long term options.
- Work with South East Water to identify potential Managed Aquifer Storage sites in the City of Bayside.
- Integrate Water Sensitive Urban Design (WSUD) principles into Council projects.

5. Cities as Ecosystem Services Initiative
Not pursue additional groundwater bore licences unless it incorporates Managed Aquifer Recharge

Actions

- Minimise Council's impact on the natural groundwater environment by limiting its extraction to three bore sites (which are existing) unless the proposed bore incorporates Managed Aquifer Recharge.
- Develop a communication plan within Council to explain the limit on the groundwater supply.

6. *Cities as Ecosystem Services Strategy*
Develop capacity for stormwater quality measurement and reporting.

Actions

- Work with Melbourne Water as a partner to develop City of Bayside wide stormwater quality targets.

7. *Cities as Ecosystem Services Strategy*
Assess the carbon footprint for projects to ensure consistency with Council's carbon neutrality goal.

Actions

- Assess and review projects carbon footprint and consider initiatives such as low embodied energy products, carbon offset plans, energy efficiency and alternate energy sources such as solar and wind.

8. *Cities as Ecosystem Services Strategy*
Protect water quality of existing water storages that are used for stormwater capture and storage.

Actions

- Assess the impact of stormwater capture on water quality and aquatic life prior to finalisation of project proposals.

9. *Cities as Water Sensitive Communities Strategy*
Adopt a sustainable irrigation rate and sustainable water budget to ensure recreational ovals are fit for purpose such that they are safe and provide an amenity for the community to enjoy.

Actions

- Council to adopt 5100 kilolitres/ha per annum as an irrigation standard for ovals (based on warm season grasses).
- Increase annual total water budget to 455,000 kilolitres for Council managed sites via alternative water sources.
- Continue monitoring, recording and reviewing open space conditions and irrigation regimes.

- Continue consultation with the community to ensure public well being, safety and aesthetic values of open spaces are being considered.
- Identify and prioritise facilities that require a very high reliability of supply. Establish a hierarchy of willingness-to-pay to justify the implementation of higher cost schemes.
- Develop community engagement and information program regarding Council's sustainable water management activities and achievements

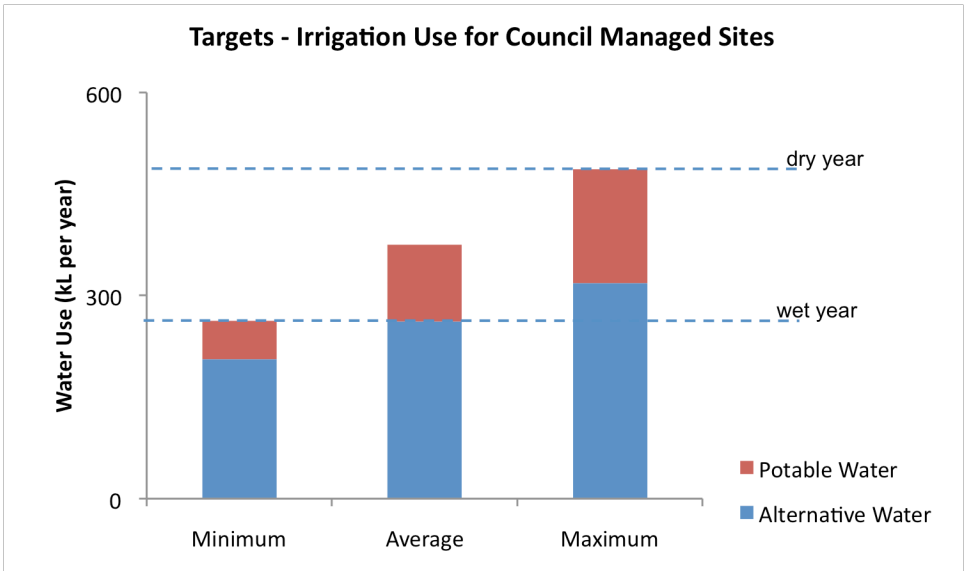
Targets for alternative water sources

Historically Council has almost entirely relied on Melbourne's water supply system (potable or drinking quality) for its water. Council's "Council Plan 2009-2010 – Revised 2010" has a strategy to reduce Council's reliance on potable water. Work from this strategy indicates that Council can source 55 - 85% of its water use from alternative water sources. The major alternative water source is stormwater harvesting. The target is expressed as a range as it represents the possible variation in supply and demand from one year to the next due to variations in climatic conditions. Council's water use for outdoor irrigation is closely linked to seasonal and annual rainfall. For example seasonal rainfall variations (e.g. a wet or dry year) has a significant impact on the potential supply of stormwater and temperature variations (e.g. a hot or mild summer) has an impact on the demand for irrigation.

Sustainable Water Targets for Council Managed Sites

Targets	Irrigation Use (kilolitres)	Other Water Use (kilolitres)	Target Date
Potable Water Use	57,000 – 169,000 (113,000)	50,000 – 60,000	2030
Alternative Water Sources	206,000 – 318,000 (262,000)	20,000 – 30,000	2030
Total	(375,000)	80,000	

Note: average figures shown in brackets



Sustainable Water Targets for Council Leased Sites

Targets	Water Use (kilolitres)	Target Date
Potable Water Use	59,500 – 130,500 (95,000)	2030
Alternative Water Sources	106,000 – 177,000 (141,500)	2030
Total	(236,500)	

Note: average figures shown in brackets

Contents – Volume 1

Tables

Figures

1 Introduction

1.1 Background

CPG has been engaged by Bayside City Council to develop a Sustainable Water Management Strategy (SWMS) to provide direction and targets for alternative water supply within the City of Bayside. The Council has provided a list of 25 recreational and open space reserves which have been deemed high priority from a community & Council perspective.

The City of Bayside covers an area along the coast of Port Philip Bay, from Elwood to Beaumaris, and is a leafy, mostly residential municipality with a population of 95,000 (as at June 2008). The land is mostly modified landscapes, however contains 305 hectares of land that is dedicated as open space, comprising all parks, sporting reserves, urban space and significant streetscapes. Elster Creek is the only waterway, while the coastal and marine environments also add to the diversity of the natural ecosystems. The City of Bayside has approximately 45,000 street trees and several remnant inland vegetation reserves.

The drought experienced over the past decade is impacting upon the ability to access freshwater supplies. In addition, our communities are continuing to grow and this growth is placing an ever-increasing demand on our water supply systems. Coupled with the impacts of climate change, our water supplies are going to become even more scarce and valuable.

Within Melbourne this has resulted in moderate to severe water restrictions, impacting upon industry, residents, tourism and recreational activities and it is apparent that we will no longer be able to rely on the same water supplies to meet our needs and those of the environment as we have in the past. In recent times restrictions have resulted in Council's reducing their irrigation to one in four ovals or in the case of Bayside City Council a modified approach of one quarter of the total pervious area/open space reserves.

"The changes observed in rainfall and run-off over the past 10 years, and 2006 in particular, require a change in the basis for water planning. Future rainfall patterns may be different from the past, although the precise pattern is unclear. We need to move away from relying on one major source of supply from our reservoirs to a portfolio of diverse water sources."[1]

There is a range of open space within the municipality, including golf courses, recreational sites, sports fields, heritage sites, parks and gardens. These are valuable assets for the community, and this strategy investigates the feasibility of irrigating these areas with alternative water supplies to reduce the reliance on potable water.

This strategy draws on policy and documentation on sustainable water management from national, state, local and community perspectives. It uses the notion of Water Sensitive Cities as a framework for understanding and developing a sustainable water management strategy for Council. One aim of the Water Sensitive City is to promote collaboration between organisations which establishes sharing of information, innovation and assists

[1] Our Water Our Future - The Next Stage of the Government's Water Plan

change. The SWMS will be used as a tool to further strengthen inter-governmental dialogue and enhance support for strategic projects.

1.2 Objectives

This SWMS will assist in securing Bayside City Council's water supply through demand management and alternative water supplies. Stormwater is the major opportunity within the City of Bayside, although other alternative water sources have been identified and assessed within this strategy. It will allow Council to secure a sustainable water supply without relying solely on centralised water supply systems and set an example for others in the community in achieving water conservation.

The Bayside City Council SWMS draws upon previous federal, state and local legislation, policies and documents such as Council's Sustainable Water Management Plan (2005), which will then establish a framework for reducing the reliance on potable water within the municipality. This SWMS aims to set long term strategic direction to maintain parks, sportsgrounds and reserves. Council staff identified 27 priority sites for the SWMS:

Table 1: Council Priority Sites

Site Description	Melways Reference	Reserve Area (ha)
Elsternwick Park/Elwood Park	67 D3 & C5	32.89
Dendy Park/Brighton golf course	77A2 & 76K2	63.50
Cheltenham Precinct	86 F2	89.87
Hurlingham Park/Landcox Park	67 J10	10.50
Basterfield Park/AW Oliver	77 C7 & B6	9.64
Brighton Beach Oval	76 D3	2.38
Xavier College Precinct	76 D3	3.00
Beaumaris Reserve	86 D6 & C5	19.84
Banksia Reserve	86 E7	4.74
Trevor Barker Beach Oval	77 F8	2.55
Billilla Historic Gardens	67 F12	1.66
Brighton Grammar School	67 D1 & E10	8.75
Simpson Reserve	77 A6	2.80
R J Sillitoe Reserve	77 A5	2.77
Boss James Reserve	77 A7	3.93
Castlefield Reserve	76 J5	2.64
R G Chisholm Reserve	76 K8	2.15
Donald MacDonald Reserve	86 B6	6.51
Green Point	76 C3	3.07
Kamesburgh Gardens	67 E7	2.54
Black Rock House	85 K5	0.38
Brighton Library Gardens	67 F10	1.39
Tjilatjirrin Reserve	77 A12	8.50
Sandringham Municipal Golf Links	86 C1 & D1	55.13
Royal Avenue Tennis Centre	76 J12	6.82
FL Yott Reserve Precinct	86 E8	3.29
Avoca St	77 C10	1.63

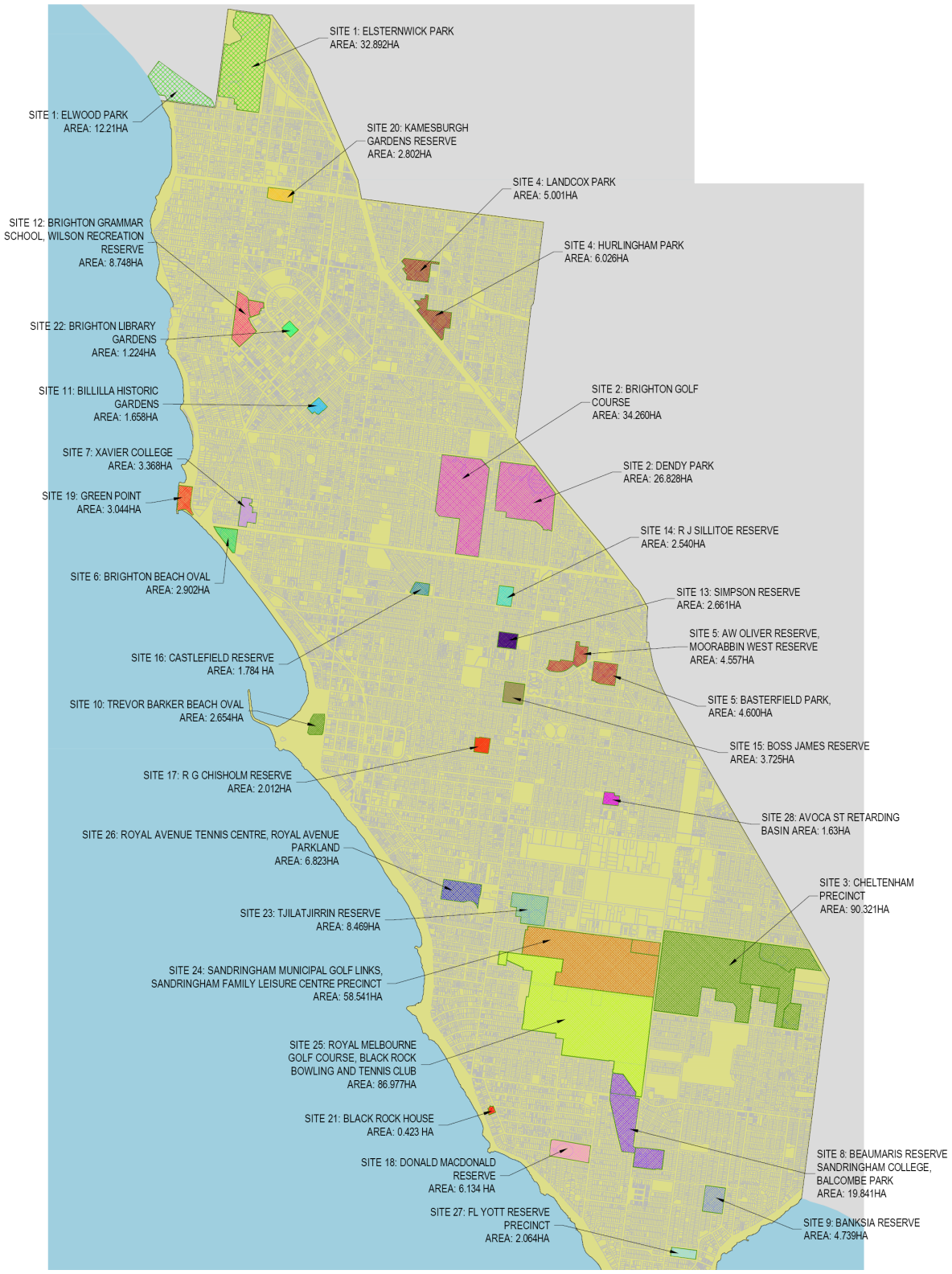


Figure 1: Map of Council Priority Open Space Sites

1.3 Scope of report

The scope of this report includes:

- Discussion of strategic context
- Review legislative requirements of each of the relevant authorities
- Identify local and state initiatives in which Bayside City Council could participate
- Establishing historic and future water demand
- Review availability and feasibility of alternative water sources
- Preliminary analysis of potential water substitution at 27 sites
- Development of water use targets for Bayside City Council
- Develop four concept plans/financial assessment from key SWMS priority sites.

2 A Water Sensitive City Framework for Bayside

This Sustainable Water Management Strategy consolidates existing, proposed and future projects within Bayside City Council to achieve its targets for reducing potable water consumption while accessing alternative water sources. Clear targets, strategies and actions allow the various park and reserve master plans to better integrate and demonstrate a consistent approach.

The objectives of Council as presented in the Council Plan 2009-13 (Revised 2010) – including responding to the challenges of climate change, reducing reliance on potable water, providing accessible open space and conserving the natural environment – align well with the emerging concept of a Water Sensitive City, and it is this framework within which can build these values into the SWMS.

The main ideas of a Water Sensitive City can be arranged around three key pillars:

- Cities as catchments – accessing water through a diversity of sources at a diversity of supply scales;
- Cities providing ecosystem services –supplementing and supporting the function of the natural environment
- Cities comprising water sensitive communities.[2] – meeting social and economic needs while facilitating water sensitive behavior in the community

These pillars align with the more commonly used Triple Bottom Line (TBL) approach, which includes analysis of economic, environmental and social factors. Water Sensitive City pillars also address a broader suite of issues associated with improving the performance of our cities and communities in regards to water use and marine/riparian environments. In the following paragraphs the key ideas and relevance for each pillar are described to demonstrate the suitability of this framework for Bayside City Council.

The "Water Sensitive City" framework provides Bayside City Council with a "roadmap" for establishing sustainable water management policies and actions.

2.1 Cities As Catchments

Cities as Catchments – "accessing water through a diversity of sources at a diversity of supply scales".

We need to break the dependency of cities on favourable soil moisture conditions in water supply catchments for security of their water. To do this, alternative water sources can be utilised. These may include groundwater, urban stormwater, rainwater, recycled wastewater and desalinated water (expanded upon in Section 6). Ideally, an efficient portfolio of water sources will be used, providing security through diversity of source, and of centralised and decentralised infrastructure.

The range of various water sources can then be used to set a sustainable water budget for Council where a realistic water demand can be determined with the aim to utilise Council's own catchments and further reduce potable water consumption. Council's water

[2] http://www.watersensitivecities.org.au/?page_id=1706

budgets have often been set based on potable water, where as the cities as catchments approach is to set a budget based on various water sources.

Sustainable Water Management Strategies have or are being developed at a range of spatial scales across metropolitan Melbourne. Whist the Integrated Water Management philosophy is relatively consistent the differences are the focus and type of initiative.

Large, centralised infrastructure has been a focus at a State and National level (for example, desalination), leaving opportunities for the investigation of decentralised infrastructure at a local level, contributing to the overall resilience of the city as a whole. Within the City of Bayside there is an opportunity to also consider the concepts of centralised and decentralised infrastructure at a much smaller scale.

Also contributing to the cities as catchments pillar is South East Water who is currently preparing an Integrated Water Management (IWM) strategy for the south-east region in partnership with Southern Rural Water and Melbourne Water. The aim of this strategy is to collaboratively develop an IWM strategy that meets the needs of all water users across the whole water cycle for the south-east region of Melbourne. This will allow Council to potentially have a greater range of water sources options and be involved in decisions with environmental and social benefits for the community.

Within Council documents, strategies have been presented that align with this pillar. These include:

Council Plan 2009-10 (revised 2010) Strategies
4.2.1 We will achieve carbon neutrality for Council's operations by 2020
4.2.2 We will reduce Council's reliance on potable water

Council will consider the carbon footprint now and into the future of its water infrastructure, balancing the value of potable water substitution and improved environmental quality with the cost of implementing alternative water source schemes.

2.2 Cities Providing Ecosystem Services

Cities Providing Ecosystem Services – "supplementing and supporting the function of the natural environment".

Cities, as large and high density locations of infrastructure, buildings, vehicles and people, have a significant impact on the natural environment. We need to protect the environment from stormwater pollution and other waste water streams – a key objective of sustainable water resource management. Where negative impact has already been made, we also consider the rehabilitation of degraded urban waterways. In Bayside this is already happening with improvements being made to the Elster Creek. Ecosystem services will consist of a mixture of catchment-wide and on-site initiatives, improving waterway health and water quality.

Council strategies have placed a particular emphasis on the quality of the natural environment available within Bayside, including:

Council Plan 2009-13 (revised 2010) Strategies
4.1.1 We will conserve Bayside's natural environment
4.1.2 We will increase the extent of tree canopy of the municipality including the planting of more trees on public land
4.1.3 We will provide accessible open space that meets the needs of the Bayside community
4.1.4 We will develop a response to the challenges of climate change, especially in coastal locations

Council wishes to improve the quality of the open space and natural environment already present within the City of Bayside, for its intrinsic values and also to improve the open space experience of the local population.

Bayside City Council is taking leadership within the community, with proactive response to issues such as leading the development of Clean Stormwater Planning Framework and implementation of Amendment C44 to the City of Bayside Planning Scheme. The Clean Stormwater Planning Framework was developed by the Association of Bayside Municipalities and sets out how improvement to stormwater quality can be achieved in planning and development. Amendment C44 implements the Framework and Bayside City Council was the first Victorian Council to achieve this (refer to Appendix A for more detail). These initiatives provide commitment for investing in projects that contribute to ecosystem preservation, and assign value to the natural environment.

2.3 Cities Comprising Water Sensitive Communities -

Cities Comprising Water Sensitive Communities – "meeting social and economic needs while facilitating water sensitive behavior in the community".

Communities are beginning to demand a greater level of engagement around water management and environmental sustainability, and this is also the case for Bayside City Council [3]. This is driven by a growing awareness of the potential environmental impacts of climate change and human behaviours. At a local level, physical and mental well-being is associated with good open space[4].

Communities must be engaged in the management of their own open space. Water management negotiations and responsibilities must be distributed between state government, local government, communities and the private sector. A partnership philosophy is essential to facilitate the design and management supply approaches so that ownership and local knowledge is utilised.

In addition, Council has operational control over many of the open space assets, which are directly related to the community's health and wellbeing. This provision of assets and services by the Council not only contribute to the recreation, but also create opportunity in terms of water management. Additionally, although Council is impacted by external

[3] Bayside City Council 2008. Local Environmental Sustainability Priority Statement
[4] Parks Victoria 2002. Linking People and Spaces: A Strategy for Melbourne's Open Space Network

parties on water infrastructure, there are many opportunities to support initiatives across the municipality and community on a range of levels. One example is involvement in the delivery of the Victorian Government's shower head exchange throughout the community in partnership with South East Water. In recent years Council has also implemented several programs to assist the Bayside community to live more sustainably.

Council strategies have focussed heavily on improving consultation with the local community on many issues, including the environment:

Council Council Plan 2009-13 (revised 2010) Strategies
4.2.3 We will educate and engage our community in environmental sustainability
4.2.4 Through effective partnerships, Council will advocate to achieve positive environmental outcomes

Council is developing and open space strategy which involves engagement with the community.

3 Strategic context

Historical data shows an undeniable trend of decreased rainfall in Victoria across recent years. After over a decade of sustained drought conditions, strategies for supply and demand have become increasingly critical in Victoria. More detail on Climate Change impacts and rainfall data are shown in Section 4.

It is in this environment, compounded by the expected population growth, that all levels of government and the community are reviewing possibilities of alternative water sources. The Victorian scales of water management are broadly shown in Figure 2.

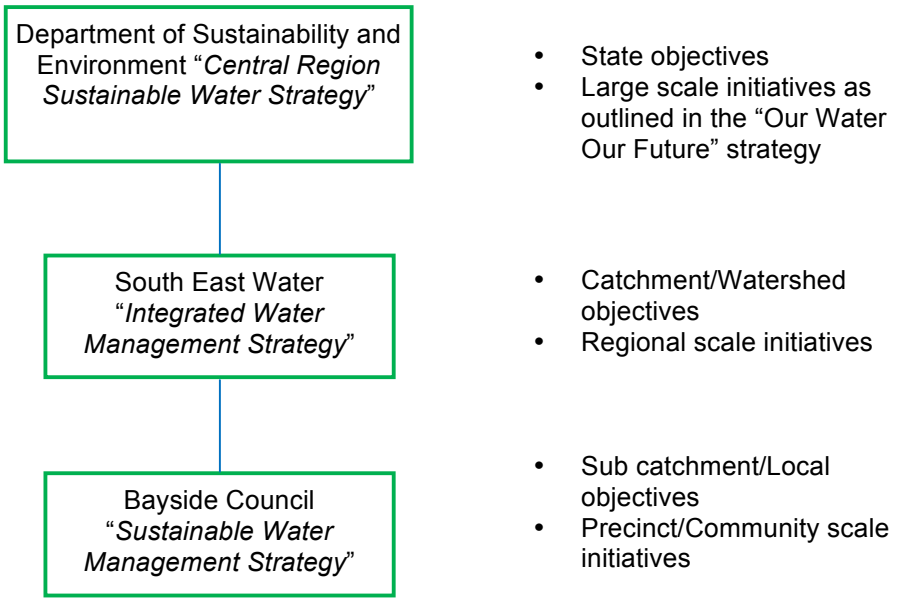


Figure 2: Scales of Water Management Strategies

"The duration and severity of the low flows of the last 11 years has required the Victorian Government, water businesses and water users to take additional measures to respond not only to the ongoing water shortage, but to the risk that the recent low flows will continue."[5]

Council operations are directly affected by the State and Federal Government, and any implementation needs to consider these policies and adhere to any regulations. Federal Government programs provide broader direction and funding opportunities. The Victorian government's Our Water Our Future Strategy is a key consideration. The provision of new water infrastructure such as desalination is a key consideration. Similarly it is expected that South East Water's Integrated Water Management Strategy will help identify regional water supply solutions. The management of water supplies relies upon availability as well as current and expected future water restrictions. Risk mitigation is a key driver for exploring alternative water sources, impacting economic, social and environmental values through the availability of Council open space.

[5] Victorian Water Accounts 2007-2008

There is a wide range of strategic context that impacts development of the SWMS for Council. A detailed investigation of many of the federal, state and local strategies has been carried out and a reference list of these documents can be found in Appendix A. A summary of the varied levels of stakeholders are illustrated in the table below:

Table 2: Overall Strategic Context

Level	Strategic Documents
Global	ICLEI Local Governments for Sustainability
National	Department of the Environment, Water Heritage and the Arts (DEWHA) Water for the Future Campaign
State	Our Water Our Future Parks Victoria - Linking People and Spaces Department of Sustainability and Environment Central Region Sustainable Water Strategy Port Phillip and Westernport Regional Catchment Strategy State Environment Protection Policy – Waters of Victoria Melbourne 2030 Victorian Planning Provisions Clause 56
Catchment/ Regional	Melbourne Water Corporation - Climate Change Study MWC – Water Supply and Demand Strategy 2006 - 2055 SEWL Integrated WMS Better Bays and Water Waterways A Water Quality Improvement Plan for Port Phillip Bay and Western Port
Local	Local Government SWMS
Community	Individual / Household Strategy

Bayside City Council has already developed a range of policy and strategy to respond to climate change, sustainability and water management. The Council places great importance on understanding, planning and managing water resources in a sustainable manner, and continues to act and plan in a proactive manner. All Council's existing documentation and strategies have been reviewed with the key strategies summarised in the table below.

Table 3: Bayside Strategic Context

Bayside Strategic Documents	Key Actions/Objective
Bayside Environmental Sustainability Framework	Provide environmentally sustainable sports facilities and open space Access alternative water sources such as stormwater, groundwater and recycled water
Council Plan 2009-2013 (updated 2010)	Provides Strategic direction for addressing challenges facing the municipality
Water Action Plan 2007-2009	A list of specific actions in regards to sustainable water management which aligns with the Council plan objectives
Sustainable Water Management Plan (2005)	The Sustainable Water Management Plan provides strategies and actions for the Bayside City Council and the Bayside community to reduce water consumption and improve water quality.
Sustainable Water Management Plan (2005)	The Sustainable Water Management Plan provides strategies and actions for the Bayside City Council and the Bayside community to reduce water consumption and improve water quality.

Clean Stormwater Planning Framework (2004)	The Clean Stormwater Project was initiated by the Association of Bayside Municipalities (ABM) to address the impacts of urban development on Port Phillip Bay. The project has delivered a simple and effective planning framework that will promote water wise stormwater management through the planning system to reduce the impacts of urban growth on Port Phillip Bay and other waterways. Bayside City Council was the pilot for implementing the framework.

Through these strategies a range of sustainable water management initiatives have been implemented and various other projects have been identified within the municipality to further develop through to implementation stage. Refer to Section 8 for all Bayside City Council's sustainable water management projects.

3.1 Summary

This SWMS aims are to integrate the various strategies from a state level through to local level regarding sustainable water management. As a result of multiple Council strategies many of the sustainable initiatives are similar and it is evident that Council is striving to become more sustainable with their use of water management whether it be by means of turf and irrigation management or use of alternative water sources.

It is also imperative that stand alone strategies do not contradict other Council strategies such as the regional soccer strategy and policies such as the C44 amendment (clause 22.10) are implemented with any new Council development to ensure consistency throughout the municipality.

To further enhance and simplify Council's strategies and policies this SWMS report will attempt to unite each of Council's initiatives and ensure a consistent sustainable water management approach is applied throughout the municipality.

4 Climate Change Impacts and Rainfall Data

4.1 Climate data

The precise effects of climate change within the City of Bayside are uncertain. What is certain is that there is already a demonstrated change in climate and based upon scientific research, it is expected that our climate will continue to change. Such changes that are likely to be experienced within the City of Bayside have been summarised in a 2006 report by CSIRO on climate change[6], which identified the following trends:

- Increased average and summer temperatures;
- Reduced rainfall;
- Reduced stream flows; and
- More extreme storm events.

This is reflected in the Victorian State Government's water plan strategy "Our Water Our Future (2007)" which quotes the Intergovernmental Panel on Climate Change's Fourth Assessment Report 2007 that "warming of the earth's climate is unequivocal". As a result Victoria is expected to become warmer and drier. There has been a decline in autumn/winter rainfall since 1950, especially since the mid 1990s within the state's southern areas. This appears to be due to a southward shift in weather systems due to natural variability, increase in greenhouse gases and ozone depletion. Changes observed over the past 10 years and 2006 in particular, will require a change in the basis for water planning. Figure 3 below shows the winter rainfall for 2006 across Victoria

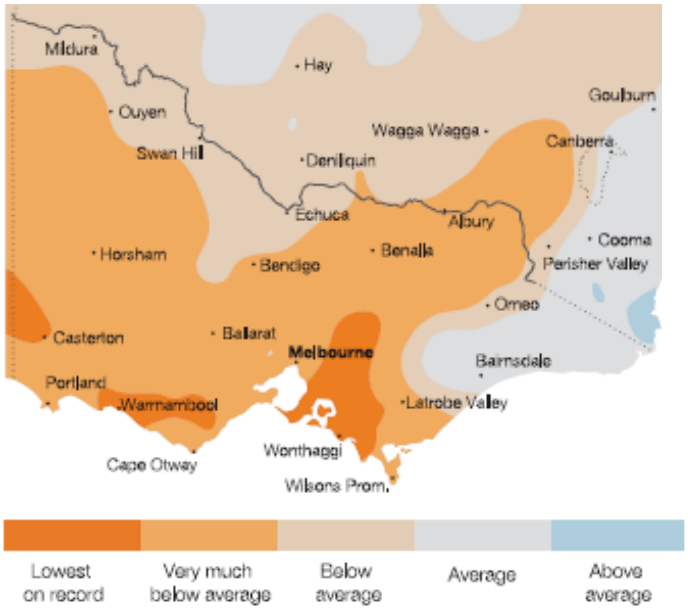


Figure 3: Victorian Rainfall – Winter 2006

Source: Our Water Our Future, The Stage of the Governments Water Plan, June 2007

[6] CSIRO, Climate Change Impacts on Australia and the Benefits of Early Action to Reduce Global Greenhouse Gas Emissions, February 2006

Winter 2006 rainfall was much lower than the long-term average and the inflows into Melbourne's water storages were the worst in recorded history (refer to Figure 4),

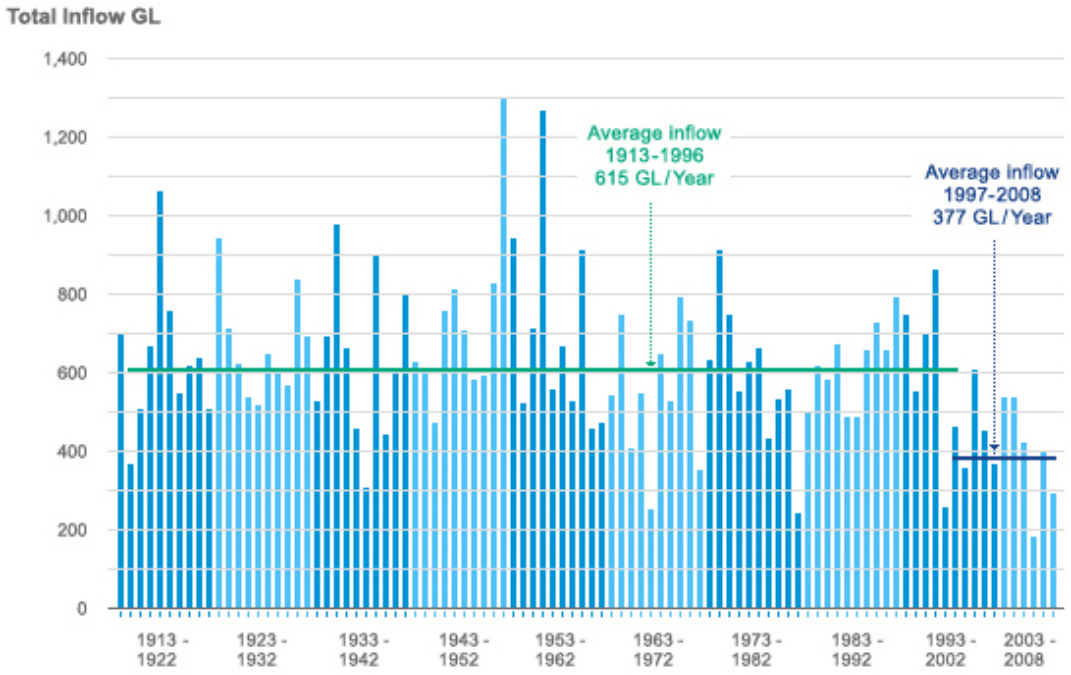


Figure 4: Melbourne storage inflows 1913-2008[7]

As a result of the "step change" in reduced inflows to our reservoirs over the last decade, future water supply cannot be guaranteed based upon the traditional approach of a single supply source. In order to meet continuing increases in demand for water the State Government is advocating several approaches to secure water for the future which includes conservation and efficiency, reuse and recycling, interconnections and augmentations. As these approaches will need to be implemented at a range of spatial scales (i.e. at catchment, regional and precinct levels) there is an important role to be played by Bayside City Council.

The State Government has committed significant investment in large scale projects (e.g. desalination plant, north-south pipeline) in order to secure more reliable water supplies to meet current and future needs within Victoria for the next twenty to 25 years. This investment will increase the price of potable water at a greater rate than the Consumer Price Index (CPI). As the price of water increases, together with current or possible future restrictions on external use all provide an incentive for the community to source alternative water supplies.

[7] Melbourne Water, available at www.melbournewater.com.au

4.1.1 Rainfall

Unlike in the tropics with a long wet season and long dry season, the City of Bayside tends to have rainfall events throughout the year. Due to the high natural variability associated with rainfall and its distribution there is really no such thing as an 'average year'. As a result it is important that any alternative water source strategies, particular stormwater harvesting, be based on historical data over a long period of time (ie years). As a result the water balance analysis for the City of Bayside requires continuous simulation modelling that will provide a closer representation of the range of conditions (e.g. dry periods) that is likely to occur into the future. This is particularly relevant for this SWMS, as the majority of water used is by Bayside City Council is for outdoor irrigation, which is significantly influenced by seasonal variations.

However due to climate change and variability the average rainfall for the City of Bayside has reduced by nearly 17% of the last decade compared with long term historical averages (refer to Figure 5). By 2100 the reduction in rainfall is predicted to be up to 35%. Less rainfall will impact upon the quality Bayside Council's open space, gardens and trees.

The Bureau of Meteorology has a rain gauge site at Dendy Park Bowling Club but this weather information is not available at the continuous recording detail required. However the Dendy Park Bowling Club rainfall gauge displays approximately similar rainfall totals between 1998 and 2007 compared with the Melbourne Regional Office Station, which has continuous recording data available. This station is located approximately 10km north from the City of Bayside and will provide sufficiently accurate rainfall data to conduct initial rain and stormwater capture assessments. It is therefore recommended that the Melbourne Regional Office rainfall period from 1998 to 2007 is used to determine the water balance for the City of Bayside, which will allow for the predicted reduction in rainfall and runoff due to climate change. This period of analysis is consistent with the recommendation in the DSE report (October 2006) "Sustainable Water Strategy Central Region".

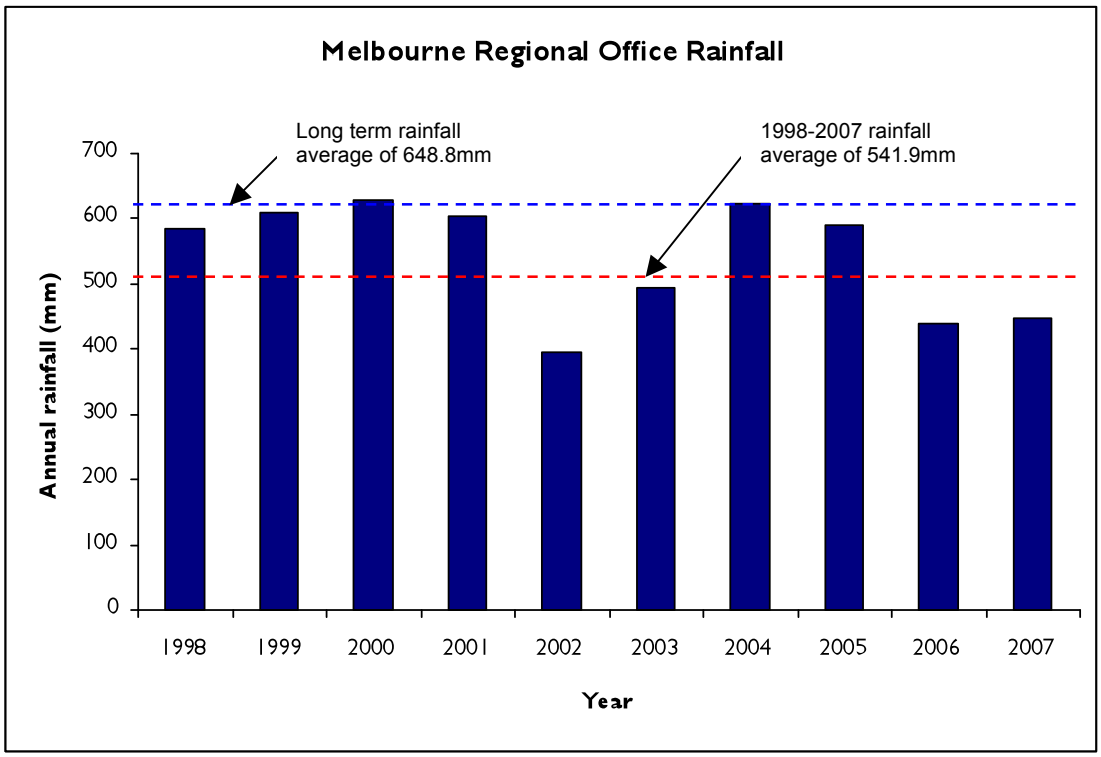


Figure 5: Melbourne Regional Office Rainfall 1998-2007[8]

4.1.2 Evapotranspiration

Evapotranspiration (ET) is the other climatic data set that is needed to understand your water balance as it defines the amount of water that is lost from a surface. It therefore influences the potential supply of stormwater available as well as the demand for irrigation water.

The water balance model MUSIC (Model for Stormwater Improvement Conceptualisation) uses average areal potential evapotranspiration data. This refers to the evapotranspiration that would take place, under the condition of unlimited water supply, from an area so large that the effects of any up-wind boundary transitions are negligible and local variations are integrated to an areal average. The average areal potential Evapotranspiration (ET) data used for the MUSIC modelling were supplied by the Bureau of Meteorology for the Melbourne Regional Office. The data is used in the form of daily averages for each month and is as follows:

Table 4: Melbourne Regional Office - Average Areal Potential ET

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
mm/day	4.84	4.29	3.23	2.33	1.29	1.33	1.29	1.45	2.33	3.39	4.5	4.35	1051mm

[8] Bureau of Metrology, available at www.bom.gov.au

Irrigation demand is usually estimated using Class A Pan Evaporation data. This is the physical measurement of water lost from the surface using a pan of specific dimensions (ie a Class A pan).

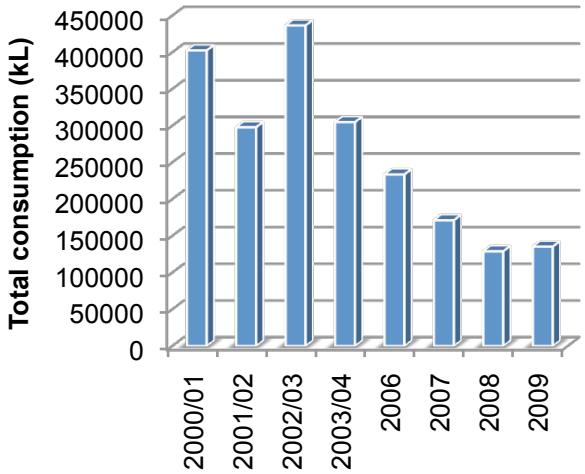
Table 5: Melbourne Regional Office – Class A Pan Evaporation

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
mm/day	5.8	5.3	3.9	2.5	1.6	1.1	1.2	1.7	2.5	3.5	4.4	5.2	1168mm

5 Water Demand

5.1 Bayside City Council Water Use

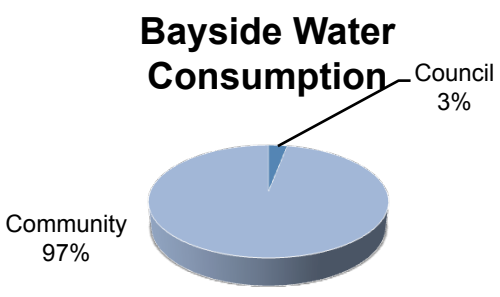
Historically Council has collected data and reported on water consumption for assets that it directly manages.

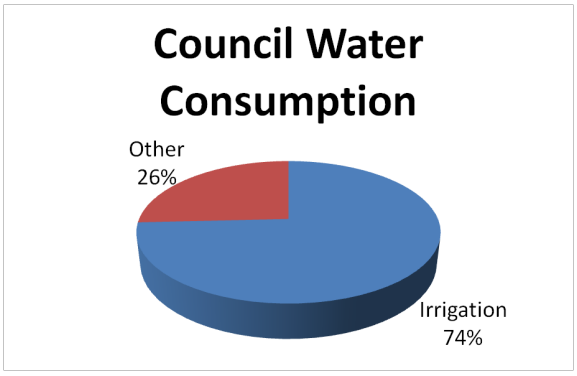


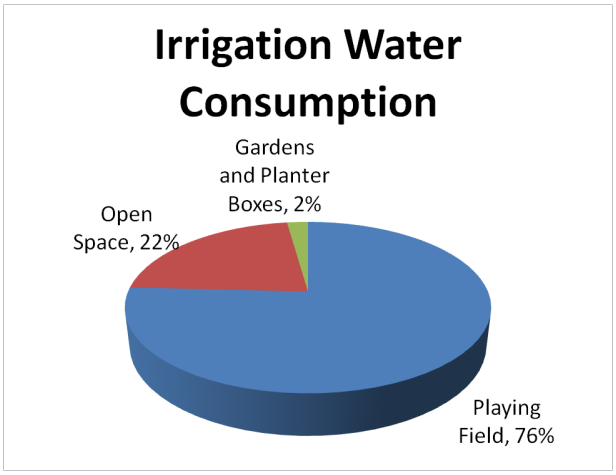
From 2000-01 to 2008-09 Bayside City Council reduced potable water consumption from 406,675 kilolitres to 135,488 kilolitres. This equates to 2008-09 being only 33% of that in 2000/2001 with the introduction of water restrictions in 2006 playing a pivotal role in this decreased water consumption. Council's water saving and substitution projects have also contributed to this reduction.

This reduction in water consumption has been to the detriment to many of Council's reserves as the quality of turf has degraded, which causes potential safety issues for sproting and recreational ovals.

It is estimated that Council facilities and operations constitute only 3% of the total water use across the total Bayside municipality. Based on 2008/2009 data, 74% of Council's water consumption is used for irrigation. Of this 74%, 76% is used for playing fields, 22% for open space and 2% for gardens and planter boxes.







Council has around 245 sites within the municipality that it does not directly manage. These sites include many leased sites such as golf courses, bowls clubs, scout halls etc. Brighton Golf Club is the only leased site that Council currently records water usage data. A complete list of all Council's leased sites has been included in Appendix B. The sites are managed by lessees and most of them pay for and manage their water use. This is a significant gap in Council's water consumption data. Some of these sites such as the golf courses are large users of water and Council is working actively with the lessees to reduce water consumption. As Council owns the sites it is seeking to collect data on water use through its leasing policy, which will require the provision of information about water use.

Data for water use at leased sites will be included as a separate category as part of Council's water use profile. This will enable more accurate reporting of Council's water consumption and provide a more complete indication of water use associated with all Council owned assets. It will require Council to identify an appropriate Council department and officer to update and coordinate this data base. An audit of all leased sites should also occur to ensure all the leased sites are metered. Council will need to continue working cooperatively with leased site managers on sustainable water use projects and obtaining data for reporting on water use.

Council provided a list of priority sites for water conservation and substitution projects. It is estimated that these sites comprise approximately 75% of Council's total water demand and most of Council's irrigation requirements. The SWMS includes these priority sites in calculations for setting Council's sustainable water targets. From these priority sites a number of leased sites have also been identified. The leased sites incorporated in this study are as follows:

- Elsternwick Golf Course (40,000 kilolitres annual demand)
- Cheltenham Golf Course (40,000 kilolitres annual demand)
- Sandringham Golf Course (80,000 kilolitres annual demand)
- Brighton Golf Course (70,000 kilolitres annual demand)
- Royal Avenue Tennis Club (4.2 kilolitres annual demand)
- FL Yott Reserve (2.3 kilolitres annual demand)

Further details of Councils sustainable water budget and optimum irrigation has been discussed in section 5.2.

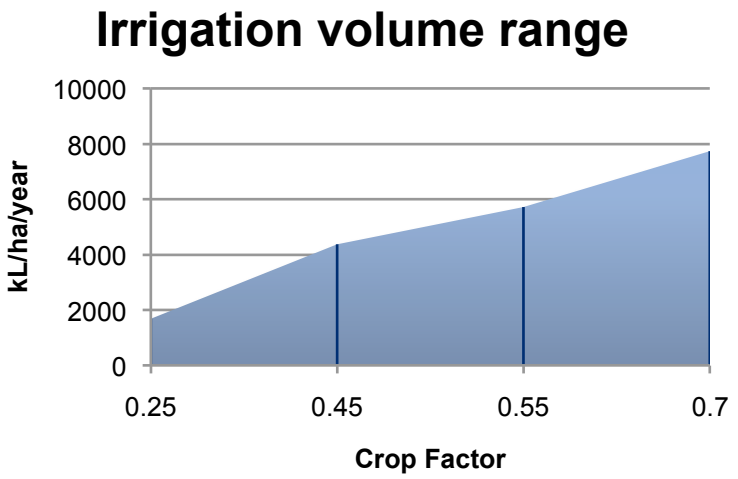
5.2 Optimum Irrigation rates

Council's total water use in recent years was significantly affected by severe water restrictions which have been relaxed. The current restrictions for sportsgrounds is now based on an annual volume of 3000 kilolitres/hectare. With the easing of restrictions and the potential for using alternative water sources, Bayside City Council will be required to adopt an optimum irrigation rate for all irrigated sites.

Council's strategy, as set out in the Council Plan 2009-13 (Revised 2010) is to 'reduce reliance on potable water' and access alternative water sources. When greater volumes of non-potable water sources become available then as part of the third pillar of a Water Sensitive City (cities comprising water sensitive communities) Bayside City Council will have access to more water *in total* (potable and non-potable) than has been used in the past to maintain the open space assets. This will help create a healthy and vibrant community and public realm. Ultimately it would be ideal to reduce potable use within the municipality to use only in food preparation and drinking.

At present many sports grounds are not receiving irrigation, or are being irrigated to a purely 'survival' level, which is not sustainable. Playing fields will need to be carefully managed to ensure that they are safe for players, and that the vegetation does not suffer. This is likely to require greater volumes of water and more carefully managed irrigation schedules than occurs at present.

The following graph indicates the total volume of water required per hectare of warm season grass in the City of Bayside each year under various "growth quality" regimes. A crop factor of 0.25 – equating to 'just acceptable' or 'survival' growth – results in an irrigation demand of around 1500 kilolitres (kL)/ha/year. At the other end of the scale, a crop factor of 0.7 corresponds to the upper limits of 'vigorous growth' for warm season grass and requires 7700 kilolitres/ha/year.



At present, Council documents suggest that irrigation rates are around 2000 – 3000 kL/ha/year, or just above survival rates (refer to Appendix C for Bayside City Council Sports Surface Changeover Table). Following discussions with Council it is recommended

that a crop factor of 0.55 be adopted, which corresponds with 'strong' growth, at approximately 5100kL/ha/year. This application rate will allow vegetation to remain healthy, retain full coverage of pitches, and withstand heavier use throughout the summer and winter seasons, which will ultimately improve the amenity value to the community.

A number of open space and playing field locations may not have been irrigated during the period of water restrictions. These locations can now be reconsidered in the light of potential alternative water sources. It is acknowledged that high quality open space is beneficial for the physical and mental well-being of the community. This is reinforced in Strategy 4.1 from "The Council Plan 2009-13 (Revised 2010)" which states that "we will provide accessible open space that meets the identified needs of the Bayside community". Council is developing an Open Space Strategy and the recommended water demand of 5100kL/ha/year identified in this SWMS should be referenced.

In conclusion it is recommended that the City of Bayside adopt an irrigation rate of 5100 kL/ha/year in order to establish a sustainable water budget for Council open spaces. Based upon a potential irrigated open space network of 140 hectares, Council's annual irrigation water demand budget is 455,000 kilolitres (excluding leased sites).

Cities as Water Sensitive Communities Strategy
Adopt a sustainable irrigation rate and sustainable water budget to ensure recreational ovals are fit for purpose such that they are safe and provide an amenity for the community to enjoy.

Actions

- Council to adopt 5100 kilolitres/ha per annum as an irrigation standard for ovals (based on warm season grasses).
- Increase annual total water budget to 455,000 kilolitres for Council managed sites via alternative water sources.
- Continue monitoring, recording and reviewing open space conditions and irrigation regimes.
- Continue consultation with the community to ensure public well being, safety and aesthetic values of open spaces are being considered.
- Identify and prioritise facilities that require a very high reliability of supply. Establish a hierarchy of willingness-to-pay to justify the implementation of higher cost schemes
- Develop community engagement and information program regarding Council's sustainable water management activities and achievements

.

6 Alternative water sources

6.1 Potential water sources

Source substitution is the use of alternative sources of water treated to a level appropriate for their end use. Alternate water sources of appropriate quality will reduce reliance on potable water for gardens, playing fields and facilities in the City of Bayside, while maintaining open space to acceptable levels. There are many possible alternative sources of water, although not all will be practical or safe for use due to the community/commercial nature of the facilities and potential public exposure. Potential end users within the municipality and acceptable sources of water are summarised below in and detailed in the following sections.

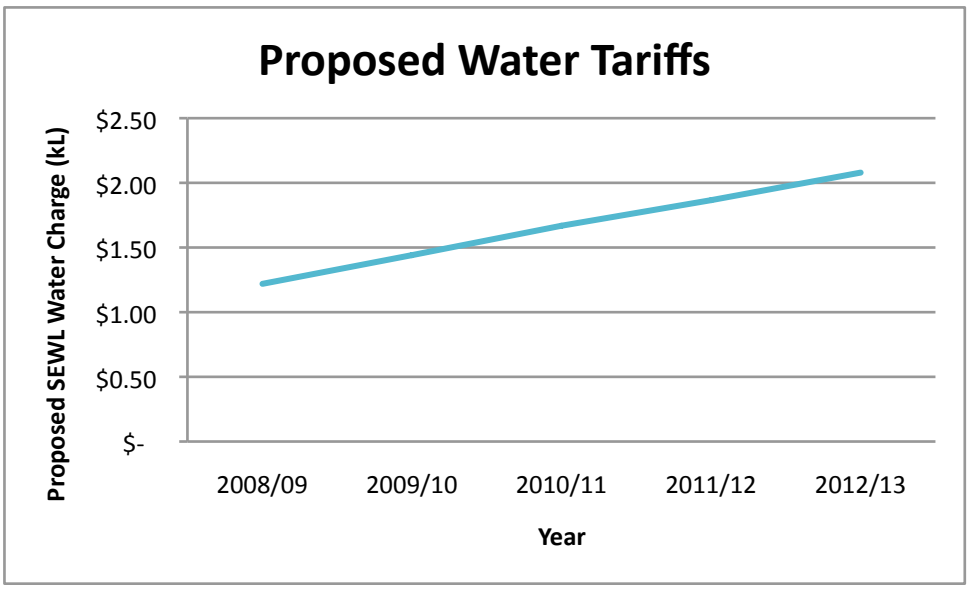
Table 6: Hierarchy of water use in the Bayside City Council

End Use	Allowable water quality	Comment
Drinking & kitchen use	Potable mains water	Where a reticulated drinking water supply is available, the Department of Health (DoH) recommends that rainwater is not used for drinking or food preparation, as the quality of rainwater is not as reliable as urban drinking water supplies. (DoH 2007) No other alternative water source is of sufficient quality for drinking and kitchen use.
Showers & basins	Treated rainwater	The Department of Health recommends that rainwater systems servicing commercial sites incorporate treatment to remove microbial hazards for uses with a moderate risk of ingestion. (DoH 2007)
Hot water	Untreated rainwater	Hot water services that heat and store water at 60˚C (consistent with the requirements in AS/NZS 3500 *National plumbing and drainage code*) will provide treatment for most microbial contaminants in rainwater, and so the use of untreated rainwater in these systems should be acceptable in most scenarios. (DoH 2007)
Toilets	Untreated rainwater/ Treated stormwater/ Recycled water (Class A)/ Greywater/ Groundwater	Harvested rainwater may be used without treatment for toilet flushing. Harvested stormwater should only be used for low risk uses. (DoH 2006). Recycled water and grey water treatment systems can provide water of a quality suitable for toilets.
Irrigation	Untreated rainwater/ Untreated stormwater / Recycled water (Class A)/ Greywater/ Groundwater	Harvested rainwater or stormwater may be used without treatment for irrigation, although treatment will reduce the level of sporting ground access control required. (DoH 2006) Recycled water can provide water of a suitable quality for open space irrigation if appropriately managed. Watering of vegetables for raw consumption may require further treatment or restriction due to increased human health risk.

6.2 Potable Water Costs

Whilst pricing in the water industry has moved towards a "user pays" philosophy, the water pricing arrangements still do not reflect the true or total cost for water. The pricing of water is based on a financial analysis rather than an economic analysis. As result environmental and social externalities (eg waterway health) are not fully accounted for in the water pricing index.

This SWMS is a long-term strategy so a longer term approach is required, noting that long-term forecasts for Melbourne's Water plan indicate that additional augmentation beyond the Our Water Our Future projects (e.g desalination) will be required. It is important that the costs of any alternative water source be compared with the long-run cost of potable water, as opposed to the present cost. At present, potable water (non-residential, South East Water) costs around $1.85 per kilolitre and is set to rise to over $2.10 per kilolitre by 2013. A significant component of this price rise is the estimated cost of augmenting potable water supplies using desalination, which is a key component of the State Government's "Our Water Our Future" Water Plan.



This SWMS strategy has allowed for the "stepped" price increase of water up until 2013, with the price of water indexed by the Consumer Price Index (CPI) beyond 2013. The full effect on the price of water has not been forecast after 2013 due to uncertainties within the water market, particularly beyond about 2030. With water prices increasing, alternative water sources will only become more feasible and all levelised costs depicted in this strategy will reduce if further increase occurs after 2013.

6.3 Recycled Water – Centralised Supply

The closest recycled water source to the City of Bayside is the Eastern Treatment Plant (ETP) in Bangholme. At present the ETP produces Class C recycled water but from the end of 2012 will be able to deliver Class A recycled water, which will be appropriate for use in irrigation, including spray irrigation. With this in mind, recycled water will continue to be considered. The cost of recycled water must also consider transport costs (both financial and environmental), as it is assumed that it is unlikely a third pipe will be retrofitted and installed in the Bayside City Council area. This is also reinforced by the fact that South East Water's "Integrated Water Management" strategy has not earmarked recycled Class A supply for the Bayside region.

6.3.1 Recycled Water (Centralised Supply) Summary

It is recommended that Council pursue recycled water as a lower order alternative water supply due to prohibitive costs and carbon footprint impacts when transporting water from the Eastern Treatment Plant. Also uncertainty to whether a third pipe will be retrofitted and installed in the Bayside City Council area, however if South East Water decide to pursue this in the future then recycled water will become a high order alternative water source.

Cities as Catchments Strategy
Pursue regional opportunities and projects as longer-term alternative water sources

Actions

- Maintain regular liaison with water agencies to ensure awareness of regional directions and initiatives
- Continue to monitor and review other alternative water opportunities (e.g Class A recycled water) as long term options.
- Work with South East Water to identify potential Managed Aquifer Storage sites in the City of Bayside.
- Integrate Water Sensitive Urban Design (WSUD) principles into Council projects.

6.4 Sewer Mining – Decentralised Supply

A different recycled water option is to consider sewer mining. This decentralised method of utilising the waste water stream can be effective in areas with appropriate catchments but often has prohibitively high costs and increased carbon footprints due to infrastructure and energy requirements. Its attractiveness as an option will be dependent on the availability of stormwater and other alternative water sources.

Sewer mining refers to the collection of sewage from trunk, distribution and or reticulation sewers, which undergoes a treatment process to produce Class A recycled water, allowing for similar end uses as appropriately treated grey water. Traditionally the preference is to harness sewage from residential catchments only; this relates to the

constituents of residential sewage generally being more consistent. Commercial or industrial sewage can often contain contaminants that complicate the treatment process. In the case of the City of Bayside, Class A recycled water supplied through sewer mining could be reused for irrigation and toilet flushing purposes. Refer to Section 6.3.1 for strategy detail and actions.

6.4.1 Water quality and treatment requirements

In Victoria the regulatory authority, the Department of Health (DoH), requires a 7 log reduction in pathogens and a 6 log reduction in protozoa (compared with raw sewage) to meet the Class A standard. For example a 1 log reduction means a 90% removal and a 6 log reduction means a 99.9999% removal. Therefore the level of treatment required to achieve such high quality water is significant. The treatment process typically lends itself to a membrane and disinfection system potentially including reverse osmosis, UV disinfection and chlorination.

6.4.2 Available supply

A detailed analysis of local sewer catchments has not been conducted for the purposes of this SWMS. Generally speaking the sewer catchment area will closely follow that of the stormwater catchment area, therefore based on current water usage data from South East Water (SEWL) it is relatively easy to determine demands and daily sewer flows. Sewer has a reliable flow and is one of the main benefits of sewer mining, however the treatment requirements are rigorous and require high level of maintenance in comparison to other types of alternative water source schemes. The potential sewage volume generated within the City of Bayside municipality is approximately 5,500,000 kilolitres (kL) or 5.5 gigalitres (GL) per annum. Of this 4,500,000 kilolitres (kL) or 4.5 gigalitres (GL) is greywater.

6.4.3 Cost

Operating costs of a sewer mining plant will depend on the specific design of the infrastructure elements. However, on a per-kilolitre basis, operating costs are likely to be in the order of $0.50/kilolitres, excluding management costs. Capital costs, as a 'ball park' figure only, are likely to be in the order of over $1,000,000 (for a 50kL/day plant), resulting in a total per-kilolitre levelised cost of up to $6[9]. Such costs are expensive when compared with other alternative water source options such as rainwater and stormwater.

6.4.4 Sewer Mining (Decentralised Supply) Summary

It is recommended that Council pursue sewer mining as a lower order alternative water supply due to the prohibitive costs and high level of maintenance required to run and manage these schemes. As Council's policy is to becoming carbon neutral, this type of system does not fit well within this policy unless large quantities of green energy can be provided to the scheme. In determining the feasibility of such a scheme, it would be best done in collaboration with SEWL. Refer to Section 6.3.1 for strategy detail and actions.

[9] Marsden Jacob Associates 2007. *The economics of rainwater tanks and alternative water supply options*, report prepared for Nature Conservation Council of NSW, Australian Conservation Foundation and Environment Victoria, April 2007.

6.5 Groundwater

Southern Rural Water manages licences to take and use groundwater. It has a number of responsibilities in accordance with the *Water Act 1989* such as water allocations; including assessing applications according to policies, environmental sustainability, and impacts on Victoria's water resources.

Groundwater is a finite resource, and not a 'waste' stream in the manner of rainwater, stormwater or recycled water. While the financial cost of groundwater may be comparable or positive compared to other sources, the environmental cost places it in a separate category.

Groundwater supplies are separated into Groundwater Management Areas. These areas have a Permissible Annual Volume (PAV). Bayside lies within the Moorabbin Groundwater Management Area, which has a PAV of 4,305,000 kilolitres.

In Australia, the relatively short history of groundwater exploitation along the coast means that seawater intrusion has thus far only been noted in a few hotspots. While excessive groundwater abstraction is the principle cause of seawater (or saltwater) intrusion (SWI) in Australian coastal areas, reduced rainfall and low recharge to coastal freshwater aquifers can also lead to encroachment of seawater. Groundwater in the Moorabbin Groundwater Management Area is exhibiting some of these characteristics and is becoming more saline. The salinity is due to its close proximity to Port Phillip Bay and the use of the resource.

It is understood that Council currently has a licence for three groundwater bores where two are being used at this stage. Although Council's effect on groundwater is minimal, the non-porous surfaces around Bayside are contributing to a reduction in groundwater levels as flows of stormwater have increased. It is recommended that if Council pursue groundwater as an alternate water source it should only be done in conjunction with a Managed Aquifer Recharge (MAR) scheme.

Cities as Ecosystem Services Initiative
Not pursue additional groundwater bore licences unless it incorporates Managed Aquifer Recharge

Actions

- Minimise Council's impact on the natural groundwater environment by limiting its extraction to three bore sites (which are existing) unless the proposed bore incorporates Managed Aquifer Recharge.
- Develop a communication plan within Council to explain the limit on the groundwater supply.

MAR involves adding a water source (such as stormwater or recycled water) to underground aquifers under controlled conditions where it is stored and recovered at a later point in time. South East Water is currently preparing an integrated water management strategy for the Melbourne's South East Region and it has earmarked the Bayside region as a potential groundwater – MAR zone. Council should therefore review any groundwater source in conjunction with South East Water as the continual capital and maintenance cost of a groundwater – MAR system would more than likely be unfeasible from a municipal perspective. Figure 6 below shows all the current groundwater bores located in the Bayside region.

Figure 6: Groundwater bore locations in Bayside[10]

6.5.1 Water Quality and Available supply

The quality of groundwater is changing as a direct consequence of human activity such as the increase in impervious area. Groundwater is generally less prone to bacterial contamination as the soils and rocks act as a filtration system. However groundwater in the Moorabbin Groundwater Management Area is becoming more saline.

Excessive extraction of groundwater without MAR in coastal areas such as Bayside City Council can lead to salinisation of the aquifers through the infiltration of seawater. Salt

[10] Bayside Environmental Sustainability Framework, 2007

water intrusion is a major environmental threat, especially in areas where there is a history of over-use of coastal aquifers. Seawater intrusion can have major impacts on water quality in aquifers and can impact significantly on floodplain and wetland ecosystems.

The Groundwater Directory for Greater Melbourne, prepared by Sinclair Knight Merz as part of the Smart Water Fund, has a wealth of hydrogeological (groundwater) information available. An overview of the likely groundwater occurrence in the Bayside region is shown in Table 7:

Table 7: Likely Groundwater Occurrence

Region	Estimated Depth to Watertable	Common Salinity Range (mg/L TDS)	Range of Bore Yields (L/sec)	Groundwater uses based on salinity ranges
Bayside	At the surface Usually less than 10m	1000 to 3500	Up to 5, however usually less than 1	Irrigation, possible garden use, industrial water use

In the case of Bayside the quality of groundwater is considered relatively good and as depicted above can be used for irrigation purposes. In general minimal treatment if any would be required for the use of groundwater within the Bayside municipality. However site specific considerations are necessary as Council has some anecdotal evidence from sports clubs that the groundwater requires diluting because of salinity levels.

As mentioned in section 6.5 Council should only pursue groundwater in conjunction with MAR, however from the Groundwater Directory Managed Aquifer Recharge storage potential map, areas within the Bayside City Council have been ear marked as not suitable. Upon further feasibility studies detailed investigations will need to occur to ensure MAR is suitable for the required area.

6.5.2 Groundwater Summary

It is recommended that Council only pursue groundwater as an alternate water source if it is done in conjunction with a managed aquifer recharge scheme. This should be undertaken with South East Water as the lead agency. Investigations will be required to ensure MAR is suitable for the required area and water quality samples will be required to ensure the groundwater is fit for purpose.

6.6 Stormwater

Stormwater harvesting refers to the collection of rainfall runoff from impervious surfaces. Here, stormwater is collected from below ground drainage systems. Catchment collection has one main advantage over rainwater collection in that traditionally the area for runoff is larger and hence yields are increased. The disadvantage is that dependent on the type of land use within the catchment, a level of water treatment may be required to ensure water quality is acceptable for end use. This type of treatment typically involves a gross pollutant trap and filter followed by UV disinfection.

Figure 7: Installation of below ground tank at Hampton Primary School
(Source: Bayside City Council)

Stormwater and rainwater are likely to provide the best opportunities for harvesting alternative water sources. Council's reserves are located throughout the municipality and where local stormwater drains run in close proximity to a reserve, potential exists for stormwater diversion to supplement any surface flow volumes that may be harvested.

"Stormwater is a valuable water resource if it can be harvested, treated and stored efficiently. It can be particularly useful to substitute for supplies of drinking water for non-drinking purposes such as watering parks, gardens and sporting grounds." [11]

6.6.1 Water quality and treatment requirements

Stormwater from local (i.e. Council stormwater pipes) and external catchments (i.e. the Melbourne Water main drains) are available for use within the Bayside municipality. Potential volumes available and system requirements for each catchment type are discussed in Section 9. The use and required quality of stormwater is not specifically regulated in Victoria except for guidelines set by the "Central Region Sustainable Water Strategy" and the "Australian Guidelines for Water Recycling: Stormwater Harvesting and Reuse (2009)", see section 6.6.4.

Irrigation of open space reserves is deemed a relatively low risk use therefore stormwater harvesting is a potentially viable source for these applications.

While all stormwater catchments differ, Bayside City Council has predominantly an urban catchment. As such, there will be a potentially highly variable quality of stormwater harvested. Quality of stormwater from houses, businesses, parks, gardens and roads is

[11] Sustainable Water Strategy Central Region Discussion Paper

influenced by construction activity, the use of fertilisers, pesticides, septic tanks, industry and transport related activities. Table 8 outlines some stormwater quality issues that may be present in an urban catchment.

Table 8: Stormwater quality - Pollutant sources and impact

Quality Issue	Pollutant	Urban Source	Impact
Pathogens	Virus, Bacteria (Ecoli and Coliforms as indicators)	Animal faeces, septic tanks, sewer overflows, organic matter decay.	Public health, illness
Colour	Sediment Suspended Solids Dissolved Solids	Land surface erosion, pavement and vehicle wear, building / construction sites, spillage, illegal discharge, organic matter (leaves, grass), car washing, atmospheric deposition	Aesthetics, consumer acceptance, staining of assets, reduced effectiveness of UV disinfection
Metals	Lead, Zinc, Copper, Cadmium, Chromium, Nickel	Fertilisers, vehicle fuels and fluids, fuel combustion, vehicle wear, industrial and household chemicals, Industrial processes, paint, pesticides	Scaling of equipment, public health, soil degradation
Salinity	Chloride Sodium Calcium Total Dissolved Solids	Groundwater, industrial discharge	Degradation of machinery and equipment, restricted vegetation growth, soil degradation, leaf/ foliage burn
Oils and Other Toxicants	Hydrocarbons, Chlorobenzenes	Pesticides, herbicides spillage, illegal discharge, sewer overflows	Public health, aesthetics
Nutrients	Nitrogen, Phosphorus	Fertilisers, atmospheric deposition, erosion, fuel combustion, animal faeces, septic tanks	Algal growths causing clogging and scaling to machinery and irrigation equipment, leaf/ foliage burn
pH	various		Plant tolerance, soil chemistry, machinery corrosion

It is expected that in general, stormwater from the Bayside City Council catchments will conform to typical contaminant levels and be able to be safely managed through treatment and access restriction.

6.6.2 Treatment for Irrigation

The “Australian Guidelines for Water Recycling: Stormwater Harvesting and Reuse (2009)” provide the criteria for determining the need and extent of stormwater treatment for irrigation purposes. The criterion includes the type of management controls that are in place, the irrigation method and the type of irrigation system and equipment. The guidelines recommend that disinfection of harvested stormwater is undertaken where

unrestricted spray irrigation is to occur. Due to the potential turbidity of the stormwater, a filtration system such as a sand filter is normally a key pre-treatment component of the process to ensure that the reliability of the disinfection method. Table 9 indicates the level of treatment required based on irrigation method.

Table 9: Irrigation type and stormwater treatment required for public open space irrigation

Access control	Stormwater treatment criteria
Unrestricted spray irrigation	Disinfection to achieve: • >1.5 $\log_{10}$ reduction of viruses and bacteria • >0.8 $\log_{10}$ reduction of viruses and bacteria • *Escherichia col (E.coli)i* <10 colony forming units (CFU)/100mL (median) Turbidity to achieve: • <25 nephelometric turbidity units (NTU) (median) • 100 NTU (95th percentile) provided the disinfection system is designed for such water quality and that, during operation, the disinfection system can maintain an effective dose. Iron to achieve: • <9.6mg/L (median)
Restricted spray irrigation or unrestricted drip irrigation or unrestricted subsurface irrigation	No treatment required

Bayside City Council's open space reserves will potentially all be spray irrigated. If the decision is made to avoid treatment and instead conduct 'restricted spray irrigation', the *Australian Guidelines for Water Recycling* suggests methods for restriction to include:

- Clear delineation of the irrigation area, for example, using fencing or vegetative borders
- Signs, including words and pictures, on all designated entry points to the irrigation area, warning the public that the water in use is not for drinking and that the irrigated area must not be entered from the time irrigation begins until the irrigated area is dry
- A minimum 25m buffer from the irrigation scheme's wetted perimeter to the nearest point of public access and spray drift control using low-throw sprinklers (180˚ inward throw), vegetation screening or anemometer switching.

It is unlikely that the requirements for restricted irrigation will be met by Bayside City Council, therefore the SWMS has assumed that filtration to reduce turbidity followed by a disinfection process will be undertaken before the use of stormwater for irrigation.

Even in cases where treatment is considered unnecessary from a human health risk perspective, it may be beneficial to reduce phosphorus and iron concentrations to prolong the life of irrigation equipment.

6.6.3 Cost

The levelised cost of harvesting stormwater is in a similar order of magnitude to or less than that of rainwater harvesting. The cost intensity varies due to differences in catchment size and potential for larger collection volumes, along with more stringent treatment requirements. Local catchments may require diversion of existing drainage infrastructure, while pumping for treatment and storage will be required where mining a main drain. In general, the cost of stormwater reuse has been estimated to vary from $0.10-$1.50/kL[12].

6.6.4 Further consideration

The Victorian Government's Central Region Sustainable Water Strategy (refer to Appendix C), proposed the following guidelines regarding the harvesting of stormwater:

- If stormwater is flowing to the sea via a drain, all of the stormwater may be harvested
- If stormwater is flowing to a stream from an existing development, assume up to 50% of existing stormwater can be harvested for consumptive use and 50% is reserved for the environment. If there is a scheme to harvest more than 50% of the resource a study is required to assess the implications for the environment
- If stormwater is generated from a new development, all of it is available for consumption with the aim of the development having no impact on catchment run-off.

These guidelines were developed to address the difficult task of balancing the environmental flows required to sustain a waterway with potentially eroding and damaging storm surges, which are magnified in urban catchments with a high proportion of impervious surfaces. Capturing stormwater for reuse decreases these storm flows, reducing erosion and sedimentation. The diversion of stormwater from drainage infrastructure also reduces the pollutant load entering local waterways and Port Phillip Bay.

The majority of Bayside City Council's stormwater drains discharge directly to Port Phillip Bay. As a result the criteria contained within the first dot point above will for the majority of Bayside City Council's catchments.

In general, modelling of stormwater flows and potential capture and reuse is undertaken due to the seasonality of flows. In small catchments, flows will only occur during and immediately after a rain event. However, in the case of the large Melbourne Water catchments, sample results from Melbourne Water typically indicate flows in the drain at a much greater frequency. While there will still be instances of zero flow, the extent of the catchment and factors such as groundwater discharge and seepage into the drains means that some flows could be available for most of the year.

6.6.5 Stormwater Summary

Apart from rainwater, stormwater is likely to provide the best opportunity for harvesting alternative water sources. Council manages the majority of the urban drainage

[12] Marsden Jacob Associates 2007. *The economics of rainwater tanks and alternative water supply options*, report prepared for Nature Conservation Council of NSW, Australian Conservation Foundation and Environment Victoria, April 2007.

infrastructure in the City of Bayside and stormwater is a large potential alternative water source. The potential stormwater runoff volume generated within the City of Bayside municipality is 9,000,000 kilolitres (kL) or 9 gigalitres (GL) per annum. It is recommended that Council adopt stormwater harvesting as their preferred alternative water source.

Cities as Catchments Strategy
Pursue stormwater and rainwater harvesting for open space irrigation as the primary alternative water source in the City of Bayside.

Actions

- Complete and implement precinct level stormwater harvesting projects:
  - Elsternwick Park
  - Sandringham Golf Course

- Implement the design and construction of the following projects:
  - Brighton Golf Course and Dendy Park
  - Boss James Reserve
  - Hurlingham Park and Landcox Park,
  - Chisholm Reserve
  - Basterfield Park.

- Develop a stormwater harvesting pre-feasibility and implementation plan for the following priority open space sites
  - Simpson Reserve
  - RJ Sillitoe Reserve
  - Donald MacDonald Reserve
  - Banksia Reserve
  - Beaumaris Reserve
  - Brighton Beach Oval
  - Billilla Historic Gardens
  - Tjilatjirrin Reserve
  - righton Library Gardens
  - Kamesburgh Gardens
  - Green Point
  - FL Yott Reserve Precinct

- Update and implement projects for the following waterMAP sites:
  - Trevor Barker Oval
  - Sandringham Family Leisure Centre
  - Brighton Golf Course and Dendy Park

- Pursue partnership opportunities with Melbourne Water and South East Water for delivery of the Avoca Street Retarding Basin stormwater harvesting project.

- Pursue funding opportunities at state and federal governments using the pre-feasibility study recommendations as the basis for obtaining financial contribution from within Council and other government agencies.

- Pursue the implementation of rainwater tanks where supply and demand can be met.

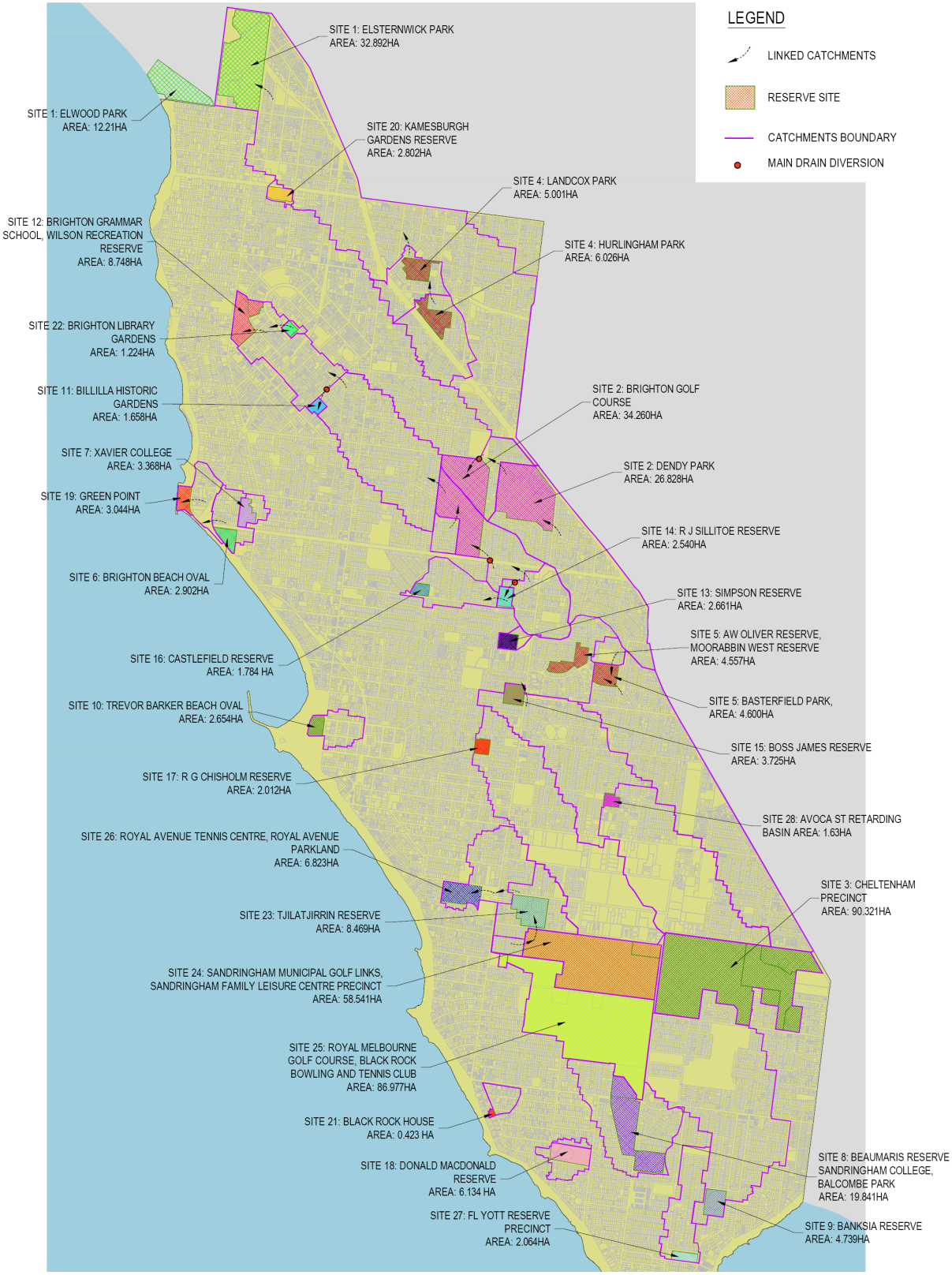


Figure 8: Map of Stormwater Catchments within City of Bayside

6.7 Rainwater

Rainwater harvesting refers to stormwater harnessed from roofs only; the water is captured and stored in a tank and then pumped for an appropriate end use. However this system can be limited in that end use requirements often require large roof areas and tank storage volumes for reliable yields. In comparison with other municipalities such as the City of Kingston, the City of Bayside does not have large commercial and industrial premises so opportunities are more limited.

6.7.1 Water quality and treatment requirements

As described earlier, Bayside City Council has already undertaken a preliminary rainwater harvesting assessment in order to understand the quantity of water able to be capture from municipal buildings. Rainwater harvested from roofs is assumed to be significantly less contaminated than harvested stormwater, provided that systems are appropriately maintained. As a result rainwater has more potential end uses. The quality and acceptable uses of rainwater are not subject to specific regulation in Victoria. However, the Department of Health has indicated that rainwater should not require treatment or disinfection if it is not being used for drinking and food preparation[13], although in some cases treatment is recommended, with potential uses detailed in Table 10.

[13] EPA Victoria 2007, *Rainwater use in and around the home*, available at www.epa.vic.gov.au

Table 10: Treatment and monitoring recommendations for rainwater

					Recommended minimum monitoring	
Use	**Risk of ingestion**	**Treatment**	**System inspection**	**Treatment process**	***E.coli***	**Chemicals**
Personal washing (showers, bath and hand basins)	Moderate	Recommended	Quarterly	Consult manufacturer or water treatment specialist.	Quarterly[1]	Every 3 years[2]
Swimming pool/spa	Moderate	See note[3]	Quarterly	N/A	N/A[4]	Every 3 years[2]
Laundry (trough and washing machine) Toilet flushing Garden watering and general outdoor use[5]	Low	Unlikely to be necessary[6] (unless hazard identification and risk assessment indicates that significant risks require management)	Quarterly	N/A	N/A[4]	N/A[7]
Garden watering (subsurface or drip irrigation)	Extremely low	Unnecessary[6]	Quarterly	N/A	N/A[4]	N/A[7]

Notes:
1. It may be appropriate to increase the frequency of *E.coli* monitoring if rainwater is used for susceptible groups, such as elderly, immune-suppressed or very young.
2. More frequent monitoring of chemicals may be appropriate if the initial sampling and risk assessment indicates that chemical concentrations are close to levels of health concern, or if treatment processes are being used to remove chemicals of health concern.
3. Swimming pool and spa water treatment processes, such as chlorination, should meet treatment needs in most cases (unless chemicals are assessed as being of concern).
4. *E.coli* monitoring is usually unnecessary if rainwater is untreated. However, if treatment such as disinfection is used then *E.coli* monitoring may be an appropriate indicator of treatment effectiveness.
5. Garden watering includes vegetable gardens. General outdoor use includes car washing, dust suppression, construction, wash down and filling water features and ponds.
6. Treatment is generally considered unnecessary from a human health risk perspective. In some circumstances it may be necessary to treat rainwater to remove chemical contaminants that may damage appliances or industrial systems.
7. Monitoring may be appropriate for chemical of aesthetic or physiochemical concern.

The SWMS utilises previous studies carried out for Council regarding the feasibility of rainwater harvesting. Rainwater harvesting is deemed a high priority in supplementing potable water for various demands such as those mentioned above although not limited to these demands. The Department of Health has stated that food businesses must use potable water for all food preparation activities[14]. Treatment of rainwater can be managed via the hot water service if it was deemed necessary to treat rainwater prior to use. From a practical economic view, hot water supplies involve separate plumbing systems, so it is relatively easy to incorporate the use of rainwater into the other facilities for this purpose, with minimal duplication of pipes or fittings.[15]

[14] Department of Health 2007, *Rainwater use in urban communities*, p.14, available at www.health.vic.gov.au
[15] enHeath 2004, *Guidance on the use of rainwater tanks*, available at www.health.vic.gov.au

6.7.2 Cost

The levelised cost of harvesting rainwater for reuse is situation specific, and dependent on the rainfall, volume of storage tank, availability of space, complexity of installation and level of demand among other factors. In general, the cost of rainwater reuse may vary from $2.15 - $12.30 per kilolitre (kL)[16].

6.7.3 Rainwater Summary

Rainwater is an effective way of utilising good quality alternative water. Rainwater tanks generally have a relatively small catchment and infrastructure and it is essential to ensure appropriate sizing and demand analysis has been carried out to maximise the benefit of rainwater tanks. Options in the City of Bayside are limited in comparison with other municipalities, because of the land use characteristics. For most uses other than consumption, rainwater requires no treatment and can offset potable water use for such things as internal use including toilet and shower. It is recommended that Council pursue rainwater tanks as their first preference where supply and demand can be met. Refer to Section 6.6.5 for strategy detail and actions.

[16] Marsden Jacob Associates 2007. *The economics of rainwater tanks and alternative water supply options*, report prepared for Nature Conservation Council of NSW, Australian Conservation Foundation and Environment Victoria, April 2007.

7 Bayside Opportunities Analysis

Bayside City Council provided a list of 27 priority sites as per Table 1, in order to assess their feasibility in securing alternative water sources within their own catchments. A preliminary feasibility study has been carried out to determine the opportunities within Bayside City Council.

7.1 Scope of Preliminary Feasibility Investigation

The scope of sites for this investigation is limited to the following:

- Review of alternative water use for open space irrigation only
- Council managed land
- Recognition of leased sites such as golf courses
- Excludes detailed analysis of those sites which already have a strategy developed for sustainable water management, e.g. Elsternwick Park, Dendy Park

7.2 Hierarchy of Alternate Water Use

Based on Section 6 a summary table has been produced to ascertain Council's priority and which alternative water source takes precedence. Obviously individual sites will have their own constraints and opportunities; hence an appropriate source will need to be selected on that basis.

Table 11: Hierarchy of Alternate Water Sources

Ranking	Alternate Water Source	End Use	Comments
1	Rainwater	Hot water, Shower, toilet, laundry, Irrigation	Good Quality, Low/medium costs, multiple uses, generally small yields
2	Stormwater	Toilet & Irrigation	Medium/high costs, low level treatment required, Large yields, low maintenance costs.
3*	Recycled Water	Toilet, laundry, Irrigation	Excellent Quality, high transport costs hence increased carbon footprint, medium/high costs, Transfer storages required.
4	Potable Water	All Uses	Excellent Quality, limited resource, increasing costs, Conserve for consumption purposes.
5	Groundwater/MAR	Irrigation	Low costs, relatively good quality, detriment to the environment if excess extraction occurs, finite resource
6	Sewer Mining	Irrigation	Energy & Maintenance intensive, High Costs

*Assumed no reticulation mains available within Bayside City Council

7.3 Water Sensitive Cities Approach

7.3.1 Cities as Catchments

The aim of the first pillar of a water sensitive city is to access a diversity of water sources. A preliminary investigation of each of the 27 sites listed in Table 1 was completed on the basis of topography, location, catchment, surrounding infrastructure and complexity. The analysis primarily focused on irrigation for open space reserves.

The rainwater harvesting catchments within each of these priority sites are relatively small and will generally not be able to generate the amount of water required to irrigate the likes of a small football field. Stormwater is the next priority and a more rigorous review of the potential yields was undertaken. Recycled water, reticulated water, groundwater and sewer mining are other options when stormwater cannot feasibly meet the requirements of the site.

Large water users such as the golf courses will potentially need a variety of sources to meet their high demands. For example Sandringham Golf course uses a combination of groundwater and stormwater, while Cheltenham Golf course primarily uses groundwater.

All Council owned sites were included in the analysis although it is recognised that Council has water sharing arrangements with other landowners such as schools. Each site's catchment was evaluated and then considered as either a "local scale" or "catchment scale" project in order to define the type of infrastructure where stormwater would be extracted from. The definition of the two spatial scales is as follows:

- Local scale is less than 60ha and harvesting is likely to be from council managed drains
- Catchment scale is greater than 60ha and harvesting is likely to be from Melbourne Water Corporation drains

7.3.2 Sustainable Water Budget - Alternate Water Analysis

Council wants to set sustainable water use targets that can be applied across the municipality, and are relevant to all open space, from significant regional sportsgrounds to local reserves. To move forward in developing targets that include relevant social, environmental and economic issues, we need to address the two key issues of scale and optimum water use.

<u>Optimum Water Use</u>

The sustainable water budget is the optimum level to achieve a healthy, safe and aesthetically pleasing open space environment.

The optimum irrigation application rate was discussed in Section 5. In terms of total irrigation area for the 27 priority sites (excluding leased sites) and based on an irrigation rate of 5100 kilolitres (kL)/ha/year the total annual irrigation demand is approximately 375,000 kilolitres.

The optimum water use on major leased sites is based on the demands estimated as part of precinct level sustainale water management plans. The Royal Avenue site and the FL Yott site were based on the sports change over table provided by Bayside Council in Appendix C. Based on this information, the leased sites total water budget is estimated to be 236,500kL per year.

Based on the above it is recommended to set the muncipal water budgets for the Council managed and leased sites to 455,000kL and 236,500kL per annum respectively. Refer to Section 5.2 for strategy detail and actions.Council's annual overall total water budget for sites that it manages and leases is 691,500kL. Council is working with lessees to obtain water consumption for other leased sites.

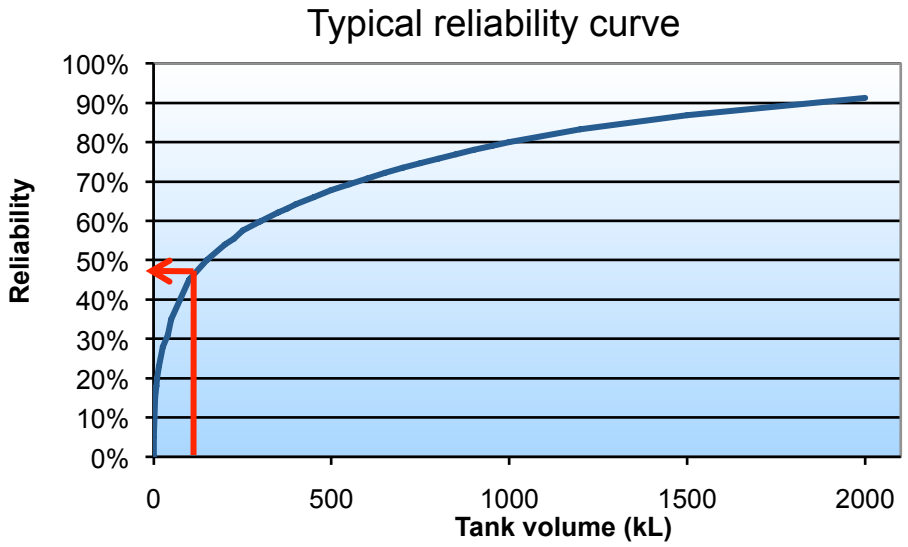
Water source opportunities – spatial scale

Issue: Does Council want to pursue source substitution opportunities at larger centralised sites, smaller/decentralised sites, or both?

In order to answer this issue it is necessary to determine the motivation and driver for source substitution. Is it:

1. The desire to 'drought proof' (i.e. high reliability of alternative water source) Council's largest and most highly-utilised Open Space/Playing Field assets?
2. To minimise the overall demand by the municipality for potable water?

Larger sites do provide the opportunity to substitute greater volumes of water, provided the catchment is available. However, depending on circumstances, smaller more localised schemes may provide more cost effective solutions if partial substitution is acceptable. In many harvesting schemes it is storage (underground or above ground tanks, or storage dams) that contributes to a large proportion of the cost. This is demonstrated by a "reliability curve". A reliability curve shows the reliability of supply of a harvesting system based on the storage volume selected; that is the percentage of the total demand of the area that can be supplied by stormwater. The shape of the curve shows that as storage sizes get larger, the gains in reliability diminish. This is due to the finite amount of water available for capture. Each reliability curve is unique, based on the characteristics of an individual project, including the total water demand, the annual rainfall, the size of the catchment area and the land use within the catchment. It can be seen that a small tank size may only provide partial substitution but can be very cost-effective and result in significant water saving. A number of small, cost-effective schemes could provide non-potable substitution options across a range of locations, totalling similar water savings as a larger, centralised scheme.



If Council is driven by the need to drought-proof larger facilities, a higher reliability of supply may be a requirement of any harvesting system. An 80-90% reliability of supply will mean that a site is effectively independent of the potable water supply. If reliability is also based on a strong growth rate, more sparse irrigation during dry periods will still maintain a surviving ground cover. As noted above, depending on specific site characteristics, such schemes may not be the most cost-effective available. Council will need to consider the priority of these sites and perhaps establish a hierarchy of willingness-to-pay to allow more significant but higher cost schemes to compare favourably with small-scale schemes achieving a low dollar per kilolitre figure. Refer to Section 5.2 for strategy detail and actions.

Alternate Water Analysis

The issues associated with spatial scale and optimum water use have been investigated and evaluated using the 27 Council sites identified in Table 1. The analysis of the results can be found in Appendix D, which identifies the most cost-effective opportunities for Council to pursue.

A summary of the alternative water source analysis have been quantified in Table 12 and Table 13. The basis of the stormwater harvesting analysis and proposed monthly irrigation regimes can be found in Appendix E and Appendix F.

Table 12 - Summary of Results (Council Managed)

Site Description	Sustainable Water Budget (kilolitres)	Potential Alternative Water Source Supply (kilolitres)
Other Council Managed Facilities	80,000[17]	20,000 - 30,000[18]
Open Space/Reserves	375,000	226,000 - 318,000
Total	455,000	246,000 – 348,000

Table 13: Summary of Results (Leased Sites)

Site Description	Sustainable Water Budget (kilolitres)	Potential Alternative Water Source Supply (kilolitres)
Leased/Private Sites	236500	106,000 -177,000

The potential alternative water source supply in Tables 12 and 13 are shown as a range. The range represents the possible variation in supply and demand from one year to the next due to variations in climatic conditions. For example seasonal rainfall variations (eg a wet or dry year) has a significant impact on the potential supply of stormwater and temperature variations (eg a hot or mild summer) has an impact on the demand for irrigation.

It is noted that some sites will be more complex than others and will need further development of concept/detailed designs to fully understand the constraints of each site. However this analysis enabled four priority sites to be identified, namely:

- R.G, Chisholm Reserve Stormwater Harvesting Project
- Baserfield Park and AW Oliver Reserve Stormwater Harvesting Project
- Hurlingham and Landcox Park Stormwater Harvesting Project
- Boss James Stormwater Harvesting Project

Further work and concept designs for these four priority sites have been prepared and costed. Further details on these projects can be found in Volume 2 of the “Sustainable Water Management Strategy”.

Refer to Section 6.6.5 for strategy detail and actions.

[17] Based on water consumption data provided by Bayside City Council
[18] Potential saving has been derived from the rainwater harvesting study carried out for Council

7.3.3 Demand Management

Council has already implemented a number of demand management measures. Some public reserves have been improved, with new subsurface drainage and more drought tolerant playing surfaces. The sustainable water budget has been determined upon the consideration of the following demand management measures:

- Decrease Irrigation areas or rationalise irrigation area
- Change turf to a synthetic turf
- Lower irrigation application rate

These initiatives should reduce the overall water demand through irrigation efficiency and reduced demand. Although the SWMS has assumed irrigation of warm season grasses to a moderate level, there is some potential to optimise the irrigation area and reduce supply in prolonged dry periods.

Cities as Catchments Strategy
Reduce water consumption through efficiency improvements to achieve potable water consumption targets.

Actions

- Rationalise and optimise the actual areas required for irrigation at each site.
- Continue replacing cool season grass with warm season turf for sportsgrounds and high use open space areas.

Some analysis regarding water savings has been quantified by Council with respect to potential replacement of natural sporting surfaces with synthetic surfaces (refer to Appendix C).

7.4 Cities as Ecosystems

Council has already actively implemented initiatives to improve ecosystem services through its leadership role in developing the Clean Stormwater Planning Framework and implementation of Amendment C44. This involves implementing Water Sensitive Urban Design (WSUD) treatments via the planning system to achieve improvement in the quality of stormwater that enters Port Phillip Bay. This strategy focuses primarily on ensuring that Council implements WSUD treatments in its own projects.

In addition to this SWMS it is recommended that Council create stormwater quality targets to incorporate a holistic approach to the water cycle. To date, there has not been the knowledge or system to establish a workable municipal wide stormwater quality target for Council to achieve. Whilst “best practice guideline targets” and Amendment C44 have been available and applied to individual projects, an overall implementation process to track progress and set goals has not been developed. Therefore the objective of the targets is to provide council with a communication and measurement tool that will enable WSUD to be integrated with capital works programs such as roads and open space.

These targets need to be based on rigorous analysis of land use, rainfall and pollutant loads. It is envisaged that the setting of robust water quality targets will guide water quality improvements to Bayside's receiving waters, build capacity within Council, and educate and inform the community. It will also:

- Support strategic and capital planning outcomes regarding water quality;
- Inform and support financial planning to achieve water quality targets;
- Provide a framework and driver for 'cultural' adoption of Water Sensitive Urban Design (WSUD) across the organisation;
- Integrate WSUD into general capital works projects
- Capture the additional stormwater quality benefits associated with stormwater harvesting projects;
- Identify appropriate targets based on catchment land use;
- Monitor and report on water quality improvements over time;
- Enable prioritisation of precincts for WSUD projects

As part of its Living Rivers capacity building program Melbourne is working with local government to develop these targets. It is recommended that Bayside Council liaise and work with Melbourne Water to establish municipal based stormwater quality targets for Bayside.

Cities as Ecosystem Services Strategy
Develop capacity for stormwater quality measurement and reporting.

Actions

- Work with Melbourne Water as a partner to develop City of Bayside wide stormwater quality targets.

7.4.1 Energy and Carbon Impacts

The largest current water harvesting project in the municipality is the Elsternwick Park scheme drawing stormwater from the Elster Creek. It is proposed that this scheme be enlarged to draw up to 100,000 kilolitres annually for carting to other locations. This is an example of a potential centralised scheme. Given that Council has set itself a target of carbon neutrality by 2020, the environmental impact of committing to trucking water from Elsternwick Park to other reserves must be considered. It is questionable whether this is deemed sustainable long-term behaviour. A similar question is raised by the use of recycled Class A water. The carting of water creates a need for balance storages, and raises logistical questions during the high water demand months of summer.

It is recommended that Council minimise the transport of alternative water to ensure consistency with their carbon neutrality plan. Council should consider reviewing each project to minimise its own carbon footprint through initiatives such as low embodied energy products, carbon offset plans, energy efficiency and alternate energy sources such as solar and wind.

Cities as Ecosystem Services Strategy
Assess the carbon footprint for projects to ensure consistency with Council's carbon neutrality goal.

Actions

- Assess and review projects carbon footprint and consider initiatives such as low embodied energy products, carbon offset plans, energy efficiency and alternate energy sources such as solar and wind.

Cities as Ecosystem Services Strategy
Protect water quality of existing water storages that are used for stormwater capture and storage.

Actions

- Assess the impact of stormwater capture on water quality and aquatic life prior to finalisation of project proposals.

7.5 Cities Comprising Water Sensitive Communities

Recreational reserves play a vital role with community and their well being, therefore it is important for Council to ensure the amenity and safety of these spaces is paramount within the parameters of sustainable water use. Alternative water supplies will allow Council to irrigate open spaces to a higher standard, which would equate to the standard of irrigation prior to the introduction of water restrictions.

As part of the SWMS and as per section 5 Council shall adopt a sustainable irrigation rate of 5100 kilolitres (kL)/ha/year. It should be noted that this figure is based on a "strong growth rate" for warm season grasses, however each site has its own unique characteristics, therefore monitoring of each site is essential to ensure appropriate irrigation regimes are being maintained. Community and user input is an important consideration. Refer to Section 5.2 for strategy detail and actions.

8 Bayside City Council Sustainable Water Management Projects

8.1 Current and Completed Projects

Council has implemented a suite of projects over the last five years to reduce its reliance on potable water and improve the quality of water that enters Port Phillip Bay. A range of open space reserves have been improved, with new subsurface drainage, more drought tolerant playing surfaces and other such initiatives such as rainwater harvesting tanks. Appendix G provides a list of current and completed recreational reserve improvement projects which Council have initiated to improve water consumption within the municipality. These projects expect to reduce the Council's potable demand by 40,000 kilolitres (kL) per annum.

Council has also developed a series of larger precinct level projects to further its sustainable water management. These projects focus on high water consumption facilities and will substantially reduce reliance on potable water while reducing the impact of stormwater pollution. They have potential to access around 200,000 kilolitres of stormwater from Council projects which is around 45% of Council's water budget (refer to the water budget in Section 10). It is recognised that localised assessment of water supply options are required for addressing site specific needs and water supply opportunities. Some sites may still require water from the centralised water supply system.

8.2 Dendy Park/Brighton Golf Club Water Management Strategy

The Study involved a review of existing Brighton Golf Course and Dendy Park water supply, development of alternative non potable water supply to supplement potable water use and identify opportunities and selection of a preferred scheme for development of a concept design. Annual water demand for Dendy Park is 13,870 kilolitres and the annual demand for Brighton Golf course is 70,000 kilolitres. Stormwater diversion was identified as the most viable alternative water supply option on the basis of water supply volume. This project is estimated to access 54,000 kilolitres of stormwater.

8.3 Elsternwick Park Sustainable Water Management Strategy

The project involves harvesting stormwater from the Elster Canal, treatment in a wetland and storage of the treated water in the existing lake. The treated water will be pumped to irrigate sporting ovals in both Elwood Park and Elsternwick Park and will be used on the Elsternwick Park Public Golf Course. The treated water stored in the existing lake will be also be used as a filling station for tree watering. The project is estimated to access up to 100,000 KL of stormwater and will be implemented over the next three years

8.4 Sandringham Golf Club Course Stormwater Harvesting Project

Bayside City Council undertook a Water Reuse Assessment at Sandringham Golf Links, an 18 hole golf course owned by Bayside City Council. The study comprised a review of the existing golf course water supply, development of alternative non potable water supply opportunities.

Stormwater will be harvested from the industrial catchment north of Tulip Street via an existing 1200mm diameter Council drain and pumped approximately 800 metres to the existing dam on the Sandringham Public Golf Course. The dam capacity will also be expanded to meet irrigation demands. It is estimated that the project will access up to 44,000 kilolitres a year of stormwater.

8.5 Cheltenham Precinct Water Management Strategy

The Strategy covers the Cheltenham Course and several facilities (soccer, cricket, football and dog training) in the south side of Park Road between Reserve and Charman Roads. The purpose of the strategy is to identify alternative sources of non-potable water supply options to supplement potable water use in the precinct. Work has been completed for the first phase which involves preliminary investigation and options analysis. The estimated potential for stormwater is up to 20,000 kilolitres per year.

8.6 Rainwater Harvesting

Rainwater harvesting provides opportunities for accessing alternative water supplies, however the potential is significantly less that stormwater harvesting due to smaller volumes associated with rainwater harvesting. A rainwater harvesting study was also carried out for Council where it looked at municipal buildings within Bayside (128 in total) and the potential yield achievable off each of these buildings. The net result was a potential saving of approximately 30,000 kilolitres. Refer to Table 14 below for recently installed rainwater harvesting tanks.

Table 14: Rainwater Harvesting Tanks Installed

Site Description	Tanks (No.)	Total Capacity (kilolitres)
Peterson Reserve	2	48
Tjiltjirrin Reserve	1 (u/g)	10
Sandringham Bowls Club	3	95
Beaumaris Bowls Club		90
Simpsons Reserve	1	55
Shipston Reserve	1	56
Banksia Reserve	2	86
Beaumaris Reserve	NA	56
Castlefield Reserve	1	56
Turf table Tanks – Harvest Pavilion roof water		
Shipston Reserve	1	≈ 12
Dendy Park	2	≈ 12
Sillitoe Reserve	1	≈ 12
Cheltenham Recreational Reserve	1	≈ 12

8.7 Avoca Street Retarding Basin

The Avoca Street Retarding Basin is a collaborative project between Melbourne Water and South East Water (SEWL). The project was initially identified through Melbourne

Water as part of their program to utilise retarding basin spaces and retarding basin functionalities more effectively. Melbourne Water initiated a pre-feasibility assessment for an understanding of the potential for a stormwater harvesting system. Through this process SEWL and Melbourne Water have engaged with Council to maximise the potential and form a collaborative alliance. At this stage the supply and demands require further analysis, however it is envisaged that seven potential private clients would utilise this stormwater including the Sandringham Golf Course. The project was recently submitted as part of the Stormwater and Urban Water Conservation Fund (SURF). Council will continue to work with water agencies on options for developing the site. It is expected the system can yield between 50,000 – 100,000 kilolitres of stormwater per annum. Refer to Section 6.6.5 for strategy detail and actions.

8.8 South East Water waterMAP projects

Council has also prepared water management action plans for three sites as part of South East Water's waterMAP Program. The waterMAP (Water Management Action Plan) program has been developed to encourage non-residential water use customers to be as efficient as possible with water

Under the waterMAP program, all non-residential property occupiers/users of over 10 million litres of potable water per year must develop a water management action plan (waterMAP) to demonstrate how they will use water more efficiently in the future. Council has developed plans for the following sites*:*

Sandringham Family Leisure Centre

The Sandringham Family Leisure Centre is Council's largest water user other than for irrigation because of its pool. A water efficiency audit was completed in 2008. Water consumption declined from around 10,000 kilolitres in 2007-08 to around 8,853 kilolitres in 2008-09 due to measures such as the installation of water efficient fittings and installation of a tank for re-use of backwash water. Installation of further tanks is being considered.

Trevor Barker Oval and Dendy Park

Dendy Park used up 26,000 kilolitres per year prior to commencement of water restrictions. Trevor Baker Beach Oval used 11,000 kilolitres per year. Council estimates these sportsgrounds use approximately 95% for irrigation with pavilion and other miscellaneous use accounting for the other 5%.

Actions at each site include installing efficient shower heads in pavilions, conversion of grass species to warm season turf types (this is an ongoing program), use of water crystals to enhance water retention within the soil (this is about to be implemented at Dendy Park across 6 hectares), installation of tanks to capture water from pavilions. Full reconstruction of Trevor Barker Oval is becoming an increasingly recognised action due to poor initial construction, poor drainage and poor overall shape. The oval would be fully reconstructed with warm season turf. Currently it has a mixture and warm and cool season grasses being dominated by cool. This will be a nominated action in the 2010/2011 Water Map plan. Refer to Section 6.6.5 for strategy detail and actions.

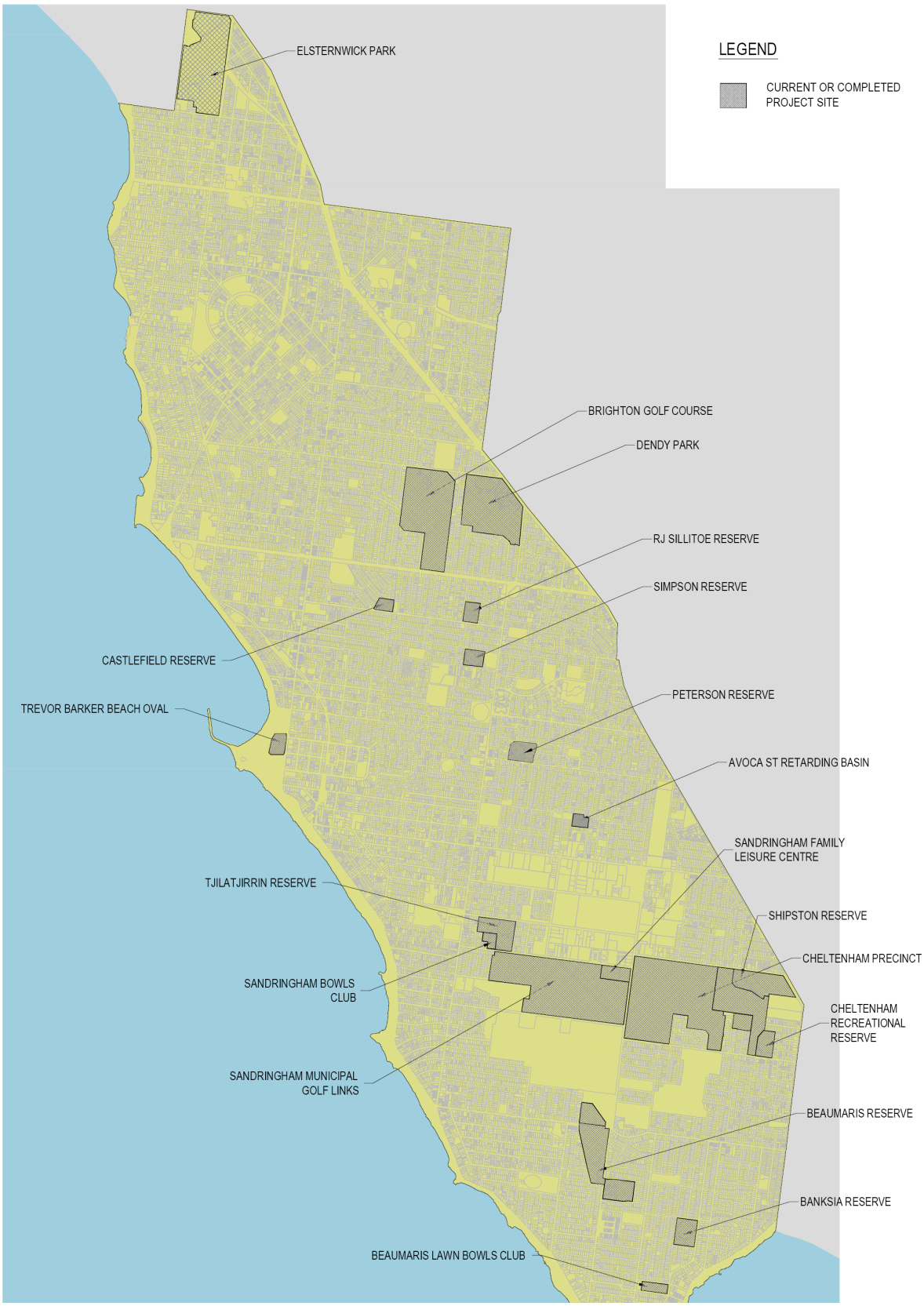

LEGEND
CURRENT OR COMPLETED PROJECT SITE
ELSTERNWICK PARK
BRIGHTON GOLF COURSE
DENDY PARK
RJ SILLITOE RESERVE
SIMPSON RESERVE
CASTLEFIELD RESERVE
TREVOR BARKER BEACH OVAL
PETERSON RESERVE
AVOCA ST RETARDING BASIN
SANDRINGHAM FAMILY LEISURE CENTRE
TJILATJIRRIN RESERVE
SHIPSTON RESERVE
CHELTENHAM PRECINCT
SANDRINGHAM BOWLS CLUB
CHELTENHAM RECREATIONAL RESERVE
SANDRINGHAM MUNICIPAL GOLF LINKS
BEAUMARIS RESERVE
BANKSIA RESERVE
BEAUMARIS LAWN BOWLS CLUB

Figure 9: Map of Current and Completed Sustainable Water Management Projects

8.9 Future Projects.

Further work completed for the Sustainable Water Management Plan has identified four additional projects for accessing stormwater:

- R.G, Chisholm Reserve Stormwater Harvesting Project
- Baserfield Park and AW Oliver Reserve Stormwater Harvesting Project
- Hurlingham and Landcox Park Stormwater Harvesting Project
- Boss James Stormwater Harvesting Project

R.G, Chisholm Reserve Stormwater Harvesting Project

R G Chisholm Reserve is located on the intersection of Duncan Street and Alfreda Street Sandringham. The reserve is taken up mainly by a 1.2 hectare (ha) oval that is used as a recreational open space and for cricket during the warmer months.

An existing main stormwater drain flows past the reserve down Alfreda Street from which, a diversion is proposed to harvest the stormwater. The drain has a primarily residential total catchment area of 132.8 hectares from which stormwater is to be harvested from using a diversion pit, pump station, treatment facility and 154 kilolitre tank. The irrigation demand for the R G Chisholm Reserve is 4,400 kilolitres per year.

Baserfield Park and AW Oliver Reserve Stormwater Harvesting Project

Basterfield Park and AW Oliver Park are two parks approximately 120 metres apart located either side of Widdop Crescent to the west of the Nepean Highway in Hampton East. The total area for irrigation is approximately 6.6ha which results in irrigation demand of 24,300 kilolitres per year. A large stormwater main drain runs through Basterfield Park with a catchment of 164.4 hectares. It is proposed to divert this drain at a rate of 50 litres per second to the existing pond within Basterfield Park. The existing pond has an existing groundwater recharge facility with a limited capacity. A storage depth of 0.5 metres was adopted in the concept design, which equates to a volume of 2700 kilolitres. From the analysis an 80% reliability can be achieved which equates to 19,500 kilolitres per annum of harvested stormwater.

Hurlingham and Landcox Park Stormwater Harvesting Project

Hurlingham Park and Landcox Park are two separate park areas located east of Nepean Highway in Brighton. The catchment is primarily residential and the combined catchment area of the two sites is 48.1 hectares excluding the open space areas. The ornamental lake within Landcox Park provides an opportunity to utilise this space as additional stormwater storage. The demand of both sites has been calculated to be 25,000 kilolitres per year based on the total area of both reserves. It is noted that the existing liner within the lake may not be sealed and therefore as part of these works investigation of the lakes liner will need to be carried out. An existing diversion is already setup on the western drain however as part of these works, upgrade to this infrastructure will be required. A storage depth of 0.5 metres was adopted in the concept design which equates to a volume of 1500 kilolitres. From the analysis a 70% reliability can be achieved which equates to 17,500 kilolitres per annum of harvested stormwater.

Boss James Stormwater Harvesting Project

Boss James Reserve is located on the western side of the intersection of Bluff Road and Wickham Road in Hampton. An existing main stormwater drain flows past the reserve from which, a diversion is proposed to harvest the stormwater. The drain has a total catchment area of 200 hectares, however an existing upstream retarding basin with a proposed stormwater harvesting system exists. This reduces the actual harvestable catchment to a primarily residential catchment of 85.3 hectares.

The irrigation demand calculated for the site is 7,320 kilolitres per year and the stormwater harvesting system will involve a 40 litres per second diversion pit, pump station, treatment facility and 260 kilolitre tank. The annual stormwater harvesting supply is expected to be approximately 5,800 kilolitres per year.

The potential cumulative savings for the four projects is around 47,000 kilolitres a year. Bayside City Council has also set out a list of sustainable water projects which have been highlighted for further development. These projects identify a variety of different sustainable water techniques such as turf replacement, new automated irrigation systems and rainwater harvesting tanks. Refer to Appendix H for a list of these future projects. Refer to Section 6.6.5 for strategy detail and actions.

There is also potential for all future projects to seek state and federal funding opportunities. A list of funds has been included in Appendix I.

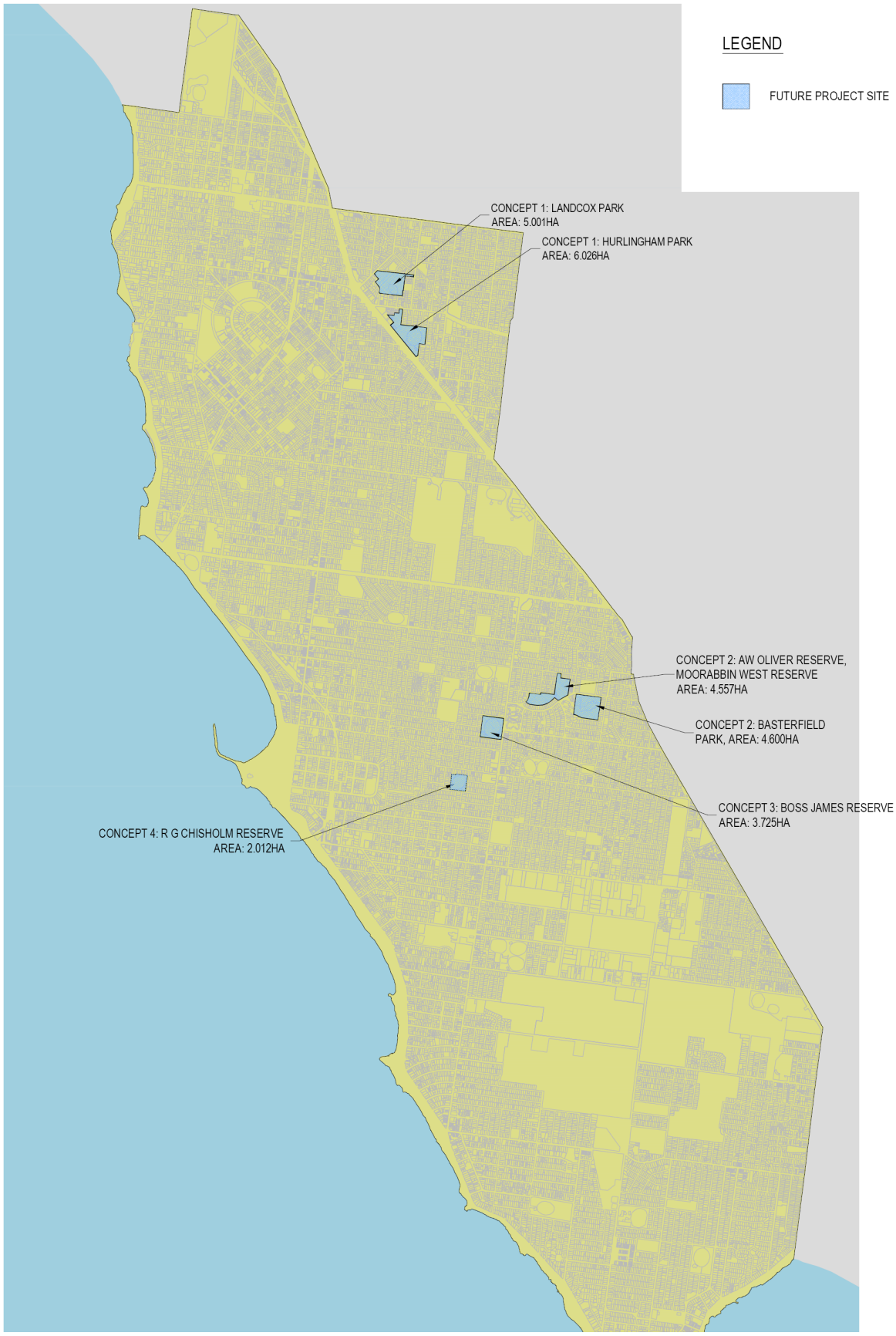


Figure 10: Map of Future Sustainable Water Management Projects

9 Financial analysis

For each of the 27 open space sites (refer to Table 1) investigated, financial modelling was undertaken to determine a levelised cost. This indicates the cost, per kilolitre of water provided, of the whole treatment and delivery system over a particular life span compared to the present value of water. This allows for comparison of systems on the basis of value for money.

Costs for different harvesting schemes can vary considerably based on catchment area, complexity of site, water demand, topography, storage area availability, environmental benefits and community value.

The financial models incorporated estimates of capital expenses, along with maintenance and operational costs over a period of 20 years. As systems are site specific each of the 27 sites requires a detailed assessment of infrastructure required, therefore the SWMS has incorporated a range of indicative costs ranging from low, medium to high which can be directly related to site complexity. Each system has estimated an indicative mechanical/electrical cost, civil cost and infrastructure cost.

The value of water savings was based on the current cost of water and the forecast increase in the retail water price over the coming 3 years, based on the Melbourne Metropolitan Water Price Review 2009. Should the cost of water increase further, alternative options will become more attractive.

When considering the results of the financial analysis, it is worthwhile to compare the cost of alternative water supply scenarios with the marginal cost of augmenting potable water supplies. The Long Run Marginal Cost (LRMC) of augmenting potable water supplies for Melbourne can be approximated using desalination, which is a key component of the Government's "Our Water Our Future" water plan. This has been estimated at around $2.50 per kilolitre (kL). Local water supply scenarios with levelised costs similar to this LRMC range can therefore be considered to be relatively cost effective.

The average levelised cost has been documented in the results table in Appendix D for each of the 27 sites. Based on this analysis it is recommended that Council investigate implementing strategies with a levelised cost of up to $4.00/kL as a first priority. Refer to Section 6.6.5 for strategy detail and actions. Whilst the figure is somewhat subjective it was selected as an initial guide for considering the feasibility of projects upon the basis that Council would be willing to pay beyond the equivalent basic price for potable water in order to account for externalities and the true cost of water. Council has already committed to the fact that the environment has a value, through initiatives such as the C44 Amendment, therefore a figure of $4.00/kL for alternative water sources appears a reasonable starting point to account for environmental and social impacts as well as the possible long term future price increases of water.

Depending on the environmental and community benefits for alternative schemes Council may elect to invest in high cost schemes to ensure a drought proof open space/reserve area.

9.1 Scheme Externalities

An externality arises when the actions of one individual or organization creates impact on another (either positively or negatively) without compensation. To efficiently manage the utilisation of water resources in a sustainable manner requires a shift towards a more holistic approach whereby externalities such as community cost and environmental cost are fully included in analysis of proposed actions.

The reuse of harvested stormwater effectively removes this volume and its associated pollutants from the drainage system. The environmental benefits of this action are multiple, including a reduction in peak and total stormwater flows that contribute to erosion and sedimentation in local waterways, as well as removing a proportion of the nutrient loading from the system, reducing waterway pollution and other threats such as algal blooms. This benefit is recognised in the form of a stormwater quality offset rate, based on the total nitrogen reduction from the stormwater output of a catchment. All externalities should be included in detailed stormwater harvesting scheme designs.

In this analysis the social or community costs and benefits of harvesting stormwater for reuse has also not been quantified. However, benefits have been identified stemming from the ability for ongoing use of open space reserves in the face of tightening restrictions and altered rainfall patterns. The opportunity costs of not implementing alternative water use schemes include the loss of amenity for the community, as well as the significant costs associated with rebuilding open space at a later date that have been irreparably damaged by drought, will effect Council and ratepayers.

10 Targets

Council requires the SWMS to set sustainable water use targets that can be applied across the municipality, and are relevant to all open space, from significant regional sportsgrounds to local reserves.

Historically Melbourne has relied on a centralised water management to provide high quality water and the City of Bayside has relied on it for water. The legacy of this approach is that Council will continue to rely on the reticulated supply at least in the short term, while augmentation of the system through projects such as desalination will provide increased security of supply.

The traditional approach of water management is unsustainable in the long term. We cannot solely depend on our centralised Melbourne supply system; continue to degrade our waterways and be driven by a pricing regime that fails to account for the full impact of environmental externalities.

Climate change and degradation of waterways is changing our thinking and this SWMS has identified potential alternate water sources which can be used to reduce the reliance and vulnerability of the potable water system.

The Water Sensitive Cities Framework has been used to develop targets for alternative and potable water use. The targets therefore address the three pillars associated with the Water Sensitive Cities Framework:

- accessing water through a diversity of sources at a diversity of supply scales
- supplementing and supporting the function of the natural environment
- meeting social and economic needs while facilitating water sensitive behavior in the community

The targets cover both Council operated and leased assets and may require review once data from all leased properties is acquired. In developing the targets two key issues play an important role namely, scale and optimum water use.

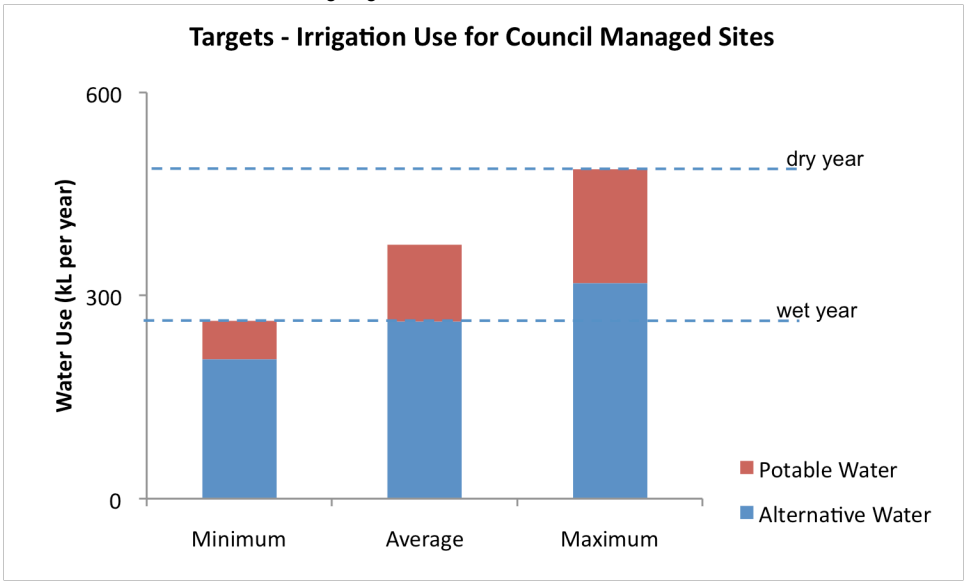
Based upon the water balance analysis for the City of Bayside there is potential for Council to source 55 - 85% of its water use from alternative water sources. The major alternative water source is stormwater harvesting.

Table 15: Sustainable Water Targets for Council Managed Sites

Targets	Irrigation Use (kilolitres)	Other Water Use (kilolitres)	Target Date
Potable Water Use	57,000 – 169,000 (113,000)	50,000 – 60,000	2030
Alternative Water Sources	206,000 – 318,000 (262,000)	20,000 – 30,000	2030

Total	(375,000)	80,000

Note: average figures shown in brackets



Although Council currently does not have access to data from many leased sites it has collected sufficient data to establish preliminary targets. Council has collected water consumption data for a number of its high water consuming leased sites as part of its project development and implementation activities, which provide preliminary data for developing targets for potable water consumption. Over time Council will further develop its database and understanding of consumption at Council owned and operated sites and leased sites.

Cities as Catchments Strategy
Improve data management for all Council assets so that data is complete, consistent, accurate and timely.

Actions

- Reframe and further develop Council's data bases for water use. The data base should include two categories: Council managed sites and leased sites.
- Undertake an audit to ensure all sites are metered. Consider the installation of sub-maters to separately record irrigation from other water uses.
- Identify Council department and officer to manage, update and co-ordinate the database.
- Council to work co-operatively with managers of leased sites to obtain their commitment

Table 16: Sustainable Water Targets for Council Leased Sites

Targets	Water Use (kilolitres)	Target Date
Potable Water Use	59,500 – 130,500 (95,000)	2030
Alternative Water Sources	106,000 – 177,000 (141,500)	2030

Total	(236,500)

Note: average figures shown in brackets

10.1 Data management

Rather than creating a new database to capture water consumption data, existing databases can be augmented to suit Council's needs. The two relevant databases are the "Assets Management Database" and the "Authority".

Council's asset management database can be augmented to incorporate leasing arrangements (i.e. all tenants, responsibility for payment of outgoings, lease timeframes) and metering information. Council currently does not collect data from lessees regarding their water use however Council's leasing policy will require the provision of data from lessees. In terms of capturing consumption data, Council's systems could be changed to ensure that water consumption data is entered into "Authority". If necessary specific attributes within "Authority" can be augmented, or processes put in place to ensure that water consumption data can be captured.

Council will also work with South East Water to improve water consumption data. South East Water provides data on water consumption to council. This database could be augmented to incorporate leased and Council owned and operated facilities. This will require working with lessees to obtain data for leased sites. Council has revised its leasing policy, which now includes a requirement for obtaining water consumption data.

There are also gaps in metering of sites with water use.

Refer to Section 10 for strategy detail and actions.

10.2 Implementation

The implementation of projects will require forward financial planning and scheduling of projects. This will be determined by budget priorities, access to funding opportunities and the establishment of effective partnerships with government and user groups. It will also be influenced by weather patterns and climate change. Council is developing a longer-term capital works plan so that it can plan for and schedule projects. A target of 20 years to achieve an uptake of 262,000 kilolitres (kL) for Council managed sites has been set. This target (see Figure 7) has been based on increasing Council's alternative water use to 262,000 kilolitres, which is 70% of the potential yields for Council managed sites. Upon accepting this strategic direction a review of this timeframe will be required annually to ensure target dates are being met.

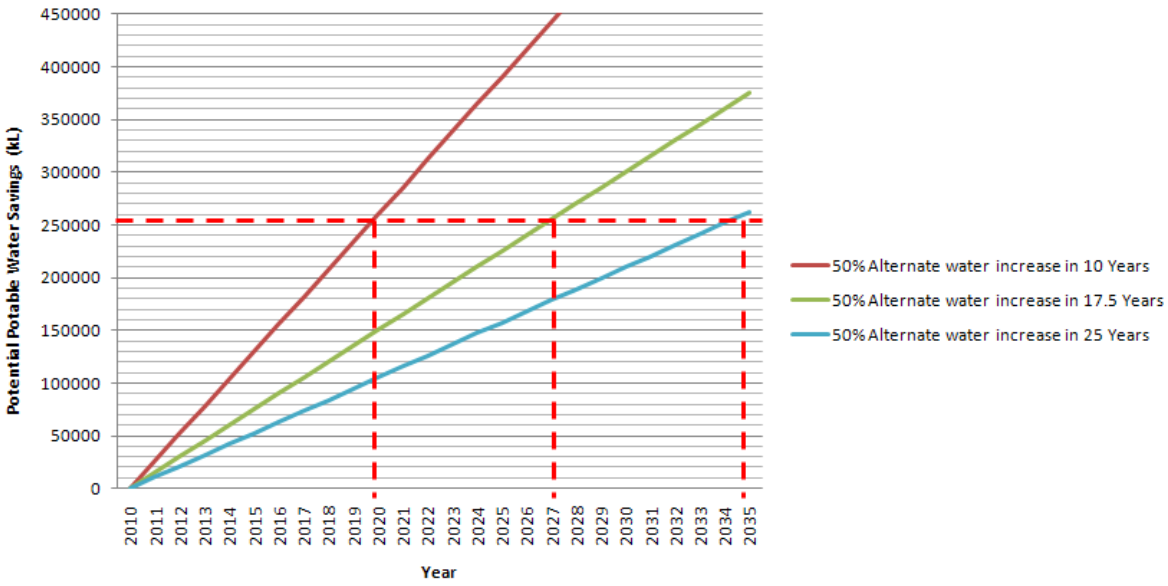


Figure 11: Adaptation of alternate water over time (Council Managed Sites)

11 Conclusion

This report has used the Water Sensitive City concept to develop a strategy for sustainable water management and much like the TBL principle, a Water Sensitive City can be arranged around three key pillars which is based around broader suite of issues associated with improving the performance of our cities and communities in regards to water use and marine/riparian environments as follows:

- Cities as catchments (economical)
- Cities providing ecosystem services (environmental)
- Cities comprising water sensitive communities (social)

Bayside City Council has significant opportunity to utilise stormwater as an alternative water source for open space irrigation.

The use of locally sourced water is the main driver for Council by creating less reliance on potable water system, increasing irrigation use via alternative water substitution to a more sustainable level while considering the environment and community. Due to water restrictions many of Council's open spaces have been degrading over time which is to a detriment to the community.

The following is a summary of the strategies and actions from the document. They are presented under the framework that is provided by the three pillars of the Water Sensitive Cities concept.

1. *Cities as Catchments Strategy*
   Reduce water consumption through efficiency improvements to achieve potable water consumption targets.

Actions

- Rationalise and optimise the actual areas required for irrigation at each site.
- Continue replacing cool season grass with warm season turf for sportsgrounds and high use open space areas.

2. *Cities as Catchments Strategy*
   Improve data management for all Council assets so that data is complete, consistent, accurate and timely.

Actions

- Reframe and further develop Council's data bases for water use. The data base should include two categories: Council managed sites and leased sites.
- Undertake an audit to ensure all sites are metered. Consider the installation of sub-maters to separately record irrigation from other water uses.

- Identify Council department and officer to manage, update and co-ordinate the database.
- Council to work co-operatively with managers of leased sites to obtain their commitment to supply water use data.

3. Cities as Catchments Strategy
Pursue stormwater and rainwater harvesting for open space irrigation as the primary alternative water source in the City of Bayside.

Actions

- Complete and implement precinct level stormwater harvesting projects:
  - Elsternwick Park
  - Sandringham Golf Course

- Implement the design and construction of the following projects:
  - Brighton Golf Course and Dendy Park
  - Boss James Reserve
  - Hurlingham Park and Landcox Park,
  - Chisholm Reserve
  - Basterfield Park.

- Develop a stormwater harvesting pre-feasibility and implementation plan for the following priority open space sites
  - Simpson Reserve
  - RJ Sillitoe Reserve
  - Donald MacDonald Reserve
  - Banksia Reserve
  - Beaumaris Reserve
  - Brighton Beach Oval
  - Billilla Historic Gardens
  - Tjilatjirrin Reserve
  - Brighton Library Gardens
  - Kamesburgh Gardens
  - Green Point
  - FL Yott Reserve Precinct

- Update and implement projects for the following waterMAP sites:
  - Trevor Barker Oval
  - Sandringham Family Leisure Centre
  - Brighton Golf Course and Dendy Park

- Pursue partnership opportunities with Melbourne Water and South East Water for delivery of the Avoca Street Retarding Basin stormwater harvesting project.

- Pursue funding opportunities at state and federal governments using the pre-feasibility study recommendations as the basis for obtaining financial contribution from within Council and other government agencies.

- Pursue the implementation of rainwater tanks where supply and demand can be met.

4. Cities as Catchments Strategy
Pursue regional opportunities and projects as longer-term alternative water sources

Actions

- Maintain regular liaison with water agencies to ensure awareness of regional directions and initiatives
- Continue to monitor and review other alternative water opportunities (e.g Class A recycled water) as long term options.
- Work with South East Water to identify potential Managed Aquifer Storage sites in the City of Bayside.
- Integrate Water Sensitive Urban Design (WSUD) principles into Council projects.

5. Cities as Ecosystem Services Initiative
Not pursue additional groundwater bore licences unless it incorporates Managed Aquifer Recharge

Actions

- Minimise Council's impact on the natural groundwater environment by limiting its extraction to three bore sites (which are existing) unless the proposed bore incorporates Managed Aquifer Recharge.
- Develop a communication plan within Council to explain the limit on the groundwater supply.

6. Cities as Ecosystem Services Strategy
Develop capacity for stormwater quality measurement and reporting.

Actions

- Work with Melbourne Water as a partner to develop City of Bayside wide stormwater quality targets.

7. *Cities as Ecosystem Services Strategy*
   Assess the carbon footprint for projects to ensure consistency with Council's carbon neutrality goal.

Actions

- Assess and review projects carbon footprint and consider initiatives such as low embodied energy products, carbon offset plans, energy efficiency and alternate energy sources such as solar and wind.

8. *Cities as Water Sensitive Communities Strategy*
   Adopt a sustainable irrigation rate and sustainable water budget to ensure recreational ovals are fit for purpose such that they are safe and provide an amenity for the community to enjoy.

Actions

- Council to adopt 5100 kilolitres/ha per annum as an irrigation standard for ovals (based on warm season grasses).
- Increase annual total water budget to 455,000 kilolitres for Council managed sites via alternative water sources.
- Continue monitoring, recording and reviewing open space conditions and irrigation regimes.
- Continue consultation with the community to ensure public well being, safety and aesthetic values of open spaces are being considered.
- Identify and prioritise facilities that require a very high reliability of supply. Establish a hierarchy of willingness-to-pay to justify the implementation of higher cost schemes.
- Develop community engagement and information program regarding Council's sustainable water management activities and achievements

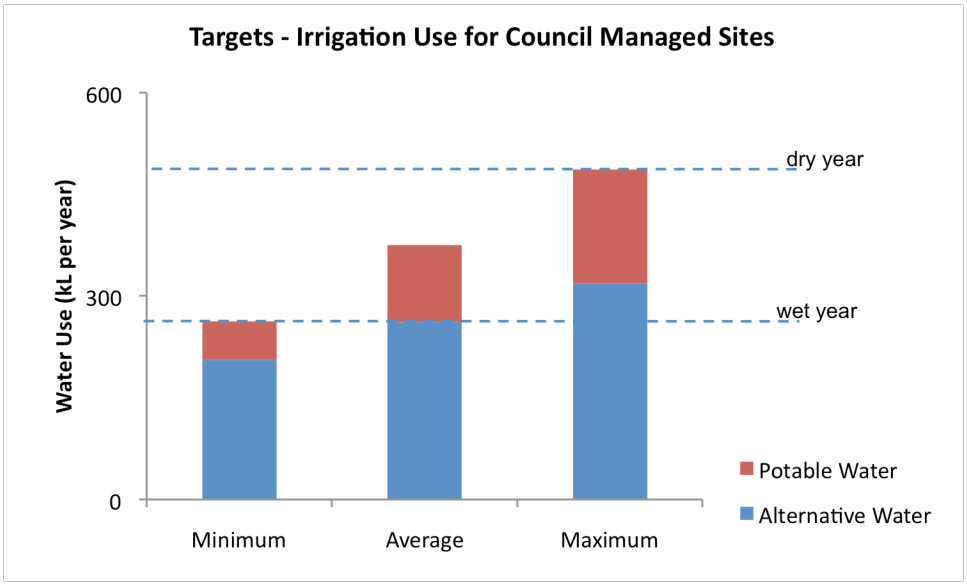
Targets

Council to source 55 - 85% of its water use from alternative water sources. The major alternative water source is stormwater harvesting. The target is expressed as a range as it represents the possible variation in supply and demand from one year to the next due to variations in climatic conditions. For example seasonal rainfall variations (e.g. a wet or dry year) has a significant impact on the potential supply of stormwater and temperature variations (e.g. a hot or mild summer) has an impact on the demand for irrigation.

Sustainable Water Targets for Council Managed Sites

Targets	Irrigation Use (kilolitres)	Other Water Use (kilolitres)	Target Date
Potable Water Use	57,000 – 169,000 (113,000)	50,000 – 60,000	2030
Alternative Water Sources	206,000 – 318,000 (262,000)	20,000 – 30,000	2030
Total	(375,000)	80,000	

Note: average figures shown in brackets



Sustainable Water Targets for Council Leased Sites

Targets	Water Use (kilolitres)	Target Date
Potable Water Use	59,500 – 130,500 (95,000)	2030
Alternative Water Sources	106,000 – 177,000 (141,500)	2030
Total	(236,500)	

Note: average figures shown in brackets

Glossary

CPG	CPG Australia Pty Ltd
CRSWS	Central Region Sustainable Water Strategy
DSE	Department of Sustainability & Environment
EPA	Environmental Protection Agency
ETP	Eastern Treatment Plant
ICLEI	Local Governments for Sustainability (founded in 1990 as the 'International Council for Local Environmental Initiatives')
IPCC	Inter-governmental Panel on Climate Change
MW	Melbourne Water
SEWL	South East Water Ltd
SWI	Seawater Intrusion
SWMS	Sustainable Water Management Strategy
Levelised Cost	Levelised cost is the price at which water can be supplied from a specific source to break even. It is an economic assessment of the cost of water system including all the costs over its lifetime: initial investment, operations and maintenance, cost of fuel, cost of capital, and is useful in comparing costs from different water supply sources.
LRMC	The Long Term Marginal Cost is the long term measure of the costs of increasing the production output by one additional unit (eg one kilolitre)
kL	Kilolitre. One kilolitre equals 1000 litres.
ML	Megalitre. One megalitre equals 1000 kilolitres or 1,000,000 litres.
GL	Gigalitre. One gigalitre equals 1000 megalitres or 1,000,000,000 litres.
ha	Hectare. One hectare equals 10,000 square metres.

Appendix A: Strategic Context Analysis

For further information regarding the strategic documents from federal government, state government and the other relevant authorities in relation to this sustainable water management strategy, refer to the website links below.

Federal Government

- The Department of Sustainability, Environment, Water, Population and Communities

  http://www.environment.gov.au/

State Government

- Our Water Our Future
  www.ourwater.vic.gov.au/

- Linking People and Spaces: A Strategy for Melbourne's Open Space Network
  www.parkweb.vic.gov.au/resources07/07_2056.pdf

- Central Region Sustainable Water Strategy
  http://www.dse.vic.gov.au/CA256F310024B628/0/390774F960736D1CCA25709F0015522A/$File/Sustainable_Water_Central_Region.pdf

- Port Phillip and Westernport Regional Catchment Strategy
  http://www.ppwcma.vic.gov.au/publications_plans.htm

- State Environment Protection Policy – Waters of Victoria
  http://www.epa.vic.gov.au/water/EPA/wov.asp

- Melbourne 2030
  http://www.dse.vic.gov.au/melbourne2030online/

- Victoria Planning Provisions Clause 56
  http://www.dse.vic.gov.au/planningschemes/

- Water Authority – Melbourne Water
  www.melbournewater.com.au

- Water Authority – South East Water
  www.sewl.com.au

City of Bayside

- C44 Planning Amendment
  www.bayside.vic.gov.au

Appendix B: List of Council Leased Sites

Leased Premise Address	Premises Details
76-82 Bamfield Street Scout Hall	1st Sandringham
Fern Street Scout Hall, 152 Bluff Rd Tricks Reserve	1st Black Rock
Holloway Road Scout Hall	5th Sandringham
Sandringham Beach Park Sparks Street Scout Hall	1st Beaumaris Sea Scouts - bluestone
149- 221 Thomas Street Scout Hall Bayside District Hall	Bayside District Scouts
Bodley Street Scout Hall Yott Reserve	1st Beaumaris Sea Scouts
Martin St Guide Hall Yott Reserve	Beaumaris Girl Guides
Keating Street Scout Hall McDonald Reserve 54 Fourth St	1st Beaumaris Sea Scouts
Sandringham Beach Park near Reserve Road	Scout & Guide Sailing Centre
2-4 Willis Street Hampton	1st Hampton Scouts
Fern Street Black Rock 152 bluff Rd Tricks reserve	Girl Guides Victoria
71- 73 Ludstone Street Scout Hall Castlefield Reserve	2nd Hampton Scouts
44-70 Whyte Street Brighton	2nd Brighton Group of the Boy Scouts' Association
228 Dendy Street Scout Hall	2nd Brighton East (fromerly 9th Brighton)
Holloway's Bend near Gould Street Brighton	11th Brighton Sea Scouts
Hurlingham Park Francis Street Brighton	4th & 6th Brighton Scouts
76-78 Wells Road Beaumaris	8th Mordialloc Scouts
Highett Grove / Graham Road Highett	
Glebe Avenue Cheltenham	
737 Weatherall Road Cheltenham Part Cheltenham Reserve	4th Cheltenham Scout Hall & Guide Hall
Chelt Park Cheltenham behind Cheltenham railway station carpark	1st & 3rd Cheltenham Scouts
1 Livingston Street Highett	part of Livingston St Complex
3 Livingston Street Highett	Livingston St complex
Glamis Ave Reserve Thomas Street Hampton	

Leased Premise Address	Premises Details
26 Grandview Rd Beaumaris	
152 Bluff Road Black Rock fern street	Also Known Fern Street, Black Rock
59 - 61 Sandringham Road Sandringham	
12 Willis Street Hampton	
3 Beaumont Street Sandringham	
24 Grandview Avenue Beaumaris	
1 Palmer Avenue East Brighton	Sub-leases part of Council building (as per Annexure A) Council operates 4 year old Kindergarten
62 Wells Road Beaumaris	Kindergarten
28 Olympic Avenue Cheltenham	
17-19 Gordon St Beaumaris	
17-19 Gordon St Beaumaris	Part of the building at 19 Gordon st, Beaum comprising the MC&H Centre as outlined on attached plan in lease
145a Cochrane Street, Brighton	Kindergarten
145a Cochrane Street, Brighton	Playroom
212 Dendy Street, BRIGHTON VIC 3186	
1 Livingston Street Highett	Part of "Highett Childrens Centre"
Chalmers Ave (Waltham St), 18 Abbott Street Sandringham	
14 Service Street Hampton	
2 Karrakatta St Black Rock	
84 - 98 Reserve Road Beaumaris	(Cnr Cloris Ave)
Livingston Street Highett	
4/82 Dalgetty Road, Beaumaris	
1/51 Haldane Street, Beaumaris	
1 Sandringham Road, Sandringham	
Durrant Street Brighton	

Leased Premise Address	Premises Details
Bodley Street Beaumaris	Olive Philips' Kindergarten Inc.
Cnr Myrtle Rd & Sargood St Hampton	Trustees Hampton Community Kindergarten
33 Kingston Street Hampton	Helen Paul Kindergarten Inc.
66 Grange Road Community Pre School	
53-55 Bluff Road Black Rock	
232 Dendy Street, Brighton	(former Btn Golf Course Residence) Sublease to Lighthouse Foundation
79 North Rd Brighton Kamesburgh Gardens	Kamesburgh Gardens Known as the Day Care Centre
79 North Rd Brighton	Anzac Hostel (Kamesburgh Gardens)
Boxall st Brighton	Courth house Boxall st
Wilson Street Brighton	Part Brighton Town Hall (Part of the Bayside Arts and Cultural Centre)
Bayside Waste & Recycling Centre	144 Talinga Road Cheltenham
Bayside Waste & Recycling Centre	144 Talinga Road Cheltenham
2D Bricker St, Cheltenham	SES, Photo copy only
Sandringham Beach Park Black Rock Yacht Club	
Sandringham Beach Park near Georgiana Street Sandringham Anglers Club	
Sandringham Beach Park near Georgiana Street Sandringham Anglers Club	
Sandringham Beach Park opposite Balcombe Road Black Rock Life Saving Club	
Sandringham Beach - Jetty Rd	Part of carpark only
Sandringham Beach Park Reserve Road vicinity Beaumaris Life Saving Club	
Hampton Life Saving Club Sandringham Beach Park near Small Street Hampton	
Sandringham Beach Park Bay Road vicinity Sandringham Life Saving Club	
Sandringham Beach Park Small Street vicinity Half Moon Bay Life Saving Club	
Sandringham Beach Park Jetty Road	
Sandringham Beach Park Coral Avenue	
Part Sandringham Beach Park opposite Mildura Street Sandringham	
Part Sandringham Beach Park opposite Mildura Street Sandringham	

Leased Premise Address	Premises Details
Fairway Hostel	
Beaumaris Community Centre Reserve Road Beaumaris	(Cloris Street)
14-18 Willis Street Hampton	Hampton Community Centre,
197 Bluff Road Sandringham	Southern Family Life Centre,
505 Bluff Road Sandringham	Castlefield Community Centre
505 Bluff Road Sandringham	Castlefield Community Centre
Rear 52 Middle Crescent Brighton	Rear 52 Middle Cres (Council owns title at the rear)
Part of Brighton Town Hall	
104 Bay Street Brighton	Part Higinbotham Hall
104 Bay Street Brighton	Part Higinbotham Hall
104 Bay Street Brighton	Higinbotham Hall
93 Outer Crescent Brighton	
Wilson Street, Brighton	Part Brighton Town Hall,
26 Halifax Street Brighton	Billilla
26 Halifax Street Brighton	Billilla
26 Halifax Street Brighton	Billilla
26 Halifax Street Brighton	Billilla
82 Wells Road Beaumaris	Stan Hawken Hall
78 North Road Kamesburgh	
Cnr Abbott & Waltham Streets Sandringham	Part premises (Sandringham Library)
Francis St Brighton Hurlingham park	Part of Hurlingham Park
Brighton Foreshore - Dendys Crown Special Survey 253 St Kilda Street Brighton	
North Road Pavilion Foreshore Reserve End North Road Brighton	
Middle Brighton Baths Esplanade Brighton	Baths, Resaurant & café
Middle Brighton Baths (Sea baths) Esplanade Brighton	
43 Nancy St Cheltenham East	43 Nancy St Cheltenham East

Leased Premise Address	Premises Details
Ricketts Point Tea House Beach Rd, Beaumaris	
Sandringham Beach Park Boat House Sites 211 / 212 Half Moon Bay Kiosk	Cerbrus Restaurant & Kiosk
Sandringham Beach Park Boat House Sites 211 / 212 Half Moon Bay Kiosk	Cerbrus Restaurant (outdoor area)
Part Beach Oval Sandringham Trevor Barker Oval	A0003390U of The Foreshore, Hampton 3188
Brighton Foreshore opposite Keith Court	
Boatshed 36 - Sandringham Harbour	BoatShed
Boatshed 35 - Sandringham Harbour	BoatShed
Tulip Street, Sandringham	Bowling Club
Between Martin & Bodley Streets Beaumaris	Bowling Club
Cnr. Fewster & Earlsfield Roads Hampton	Bowling Club
Elsternwick Park 170 Glenhuntly Road Brighton	Bowling Club
Brighton Beach Recreational Reserve South Road Brighton Beach	Bowling Club
Part Dendy Park Breen Drive East Brighton	Bowls Club
Highett Grove Highett	Bowls Club
Reserve Road Beaumaris	Tennis Club
Banksia Reserve, Cnr. Tramway Parade & Cromb Avenue, Beaumaris Known as 68 Oak Street Banksia Reserve on Insurance register	Tennis Club
Royal Avenue Tennis Courts Sandringham	Royal Avenue Tennis Courts
Bodley Street Tennis Centre Yott Reserve Bodley Street Beaumaris	Bodley Street Tennis
Civic Centre Gardens Wilson Street Brighton	Tennis Club
Breen Dv, Dendy Park	Deny Park Tennis Club
Elsternwick Park Tennis Centre Cnr Glenhuntly Rd & St Kilda St Elsternwick	Elsternwick Park Tennis Centre
Hurlingham Park Tennis Club Off Francis Street East Brighton	Tennis Club
Basterfield Park 2ADane Road Highett	

Leased Premise Address	Premises Details
Boardwalk Area Middle Brighton Baths	
Sandringham Dressing Sheds	
Hampton Dressing Sheds	
33 Victor Ave, Cheltenham	Cheltenham Golf Club Cheltenham Public Park and Moorabbin Cricket Reserve-
Boatshed 37 - Sandringham Harbour	
Dendy Street East Brighton	Brighton Golf Course
Glenhuntly Road Elsternwick	Elsternwick Park Golf Course
Part Cheltenham Recreation Reserve 135 - 137 Weatherall Road Cheltenham	Neil Hamilton Pavillion
Sandringham Athletics Track Part Glamis Avenue Reserve Glamis Avenue Hampton	Sandringham Athletics Club Part Glamis Avenue Reserve, (bound by plan in Annexure B).
32 Waltham Street Sandringham	Land rear 32 Waltham Street Sandringham
Bridge & Kyarra St Hampton	Land Cnr Bridge & Kyarra St Hampton
319 Reserve Road Cheltenham	Council Dwelling 319 Reserve Road Cheltenham
Cnr Carpenter & William Sts Brighton	Splay Corner Cnr Carpenter & William Sts Brighton
Part of 144 Talinga Road Cheltenham (Council Depot)	
Part of 144 Talinga Road Cheltenham (Council Depot)	144 Talinga Road Cheltenham
Part of 144 Talinga Road Cheltenham (Council Depot)	144 Talinga Road Cheltenham
Bodley Street Beaumaris	
Cnr Myrtle Rd & Sargood St Hampton	
33 Kingston Street Hampton	
66 Grange Road Community Pre School	
53-55 Bluff Road Black Rock	
26 Grandview Rd Beaumaris	
Fern Street Black Rock Also known as 152 Bluff Road	

Leased Premise Address	Premises Details
Corner Tibrockney & Eddie Streets Highett	Highett Tennis Club Inc
Cnr Wangara & George Street Sandringham	Café
Cheltenham Rd Sandringham	Sandringham Golf Course
Sandringham Family Leisure Centre Tulip Street Sandringham	Aquatic Pool
Sandringham Family Leisure Centre Tulip Street Sandringham	Aquatic Café
Sandringham Family Leisure Centre Tulip Street Sandringham	Gym, Shop & Creche
Sandringham Family Leisure Centre Tulip Street Sandringham	Sandringham Leisure Centre Sports Medicine Centre
150 Tulip Street Sandringham	
Cnr Wangara Rd & George St Cheltenham	Golf Driving Range

Leased Premise Address	Premises Details
59 - 61 Sandringham Road Sandringham	
1 Palmer Avenue East Brighton Sub-leases part of Council building (as per Annexure A) Council operates 4 year old Kindergarten	
62 Wells Road Beaumaris	
28 Olympic Avenue Cheltenham	
17-19 Gordon St Beaumaris	
Cnr Wangara Rd & George St Cheltenham	
Elsternwick Park	
Elsternwick Park	Rooms 1 & 2 & Storeroom Southern Pavilion Head Street Brighton
Dendy Street East Brighton	Brighton Municipal Golf Links Pavilion (old pavilion located on Brighton Golf Course)

SPORTS SURFACES - CHANGEOVER COSTS/ BENEFITS

Sport	Current Surface	New surface	Current Water Usage	Expected Water Usage	Savings	Financial Cost Changeover
Tennis	Red Porous (En tout cas)	Waterless (acrylic- non cushioned)	219k to 329k litres per court per year	Nil	219k to 329k litres per court per year	$26k to $35k per court
Tennis	Red Porous (En tout cas)	Waterless (SFAG)	219k to 329k litres per court per year	Nil	219k to 329k litres per court per year	$30k - $39k per court
Tennis	Red Porous (En tout cas)	Waterless (acrylic- semi cushioned)	219k to 329k litres per court per year	Nil	219k to 329k litres per court per year	$39k - $53K per court
Tennis	Red Porous (En tout cas)	Waterless (Synthetic clay)	219k to 329k litres per court per year	Nil	219k to 329k litres per court per year	$36K to $49K per court
General Sportsground - 1 ha	Cool Season Grass (Maintenance) per ha	Warm Season Grass(Maintenance) per ha - Sodding	3.8 megalitres per ha per year	2 megalitres per ha per year	1.8 megalitres per ha per year	$95K per ha - sodding
General Sportsground - 1 ha	Cool Season Grass (Survival) per ha	Warm Season Grass(Survival) per ha- sodding	2.9 megalitres per ha per year	.5 megalitres per ha per year	2.4 megalitres per ha per year	$95K per ha - sodding
General Sportsground - 1 ha	Cool Season Grass (Maintenance) per ha	Warm Season Grass(Maintenance) per ha- sprigging	3.8 megalitres per ha per year	2 megalitres per ha per year	1.8 megalitres per ha per year	$20k per ha- sprigging
General Sportsground - 1 ha	Cool Season Grass (Survival) per ha	Warm Season Grass(Survival) per ha- sprigging	2.9 megalitres per ha per year	.5 megaltires per ha per year	2.4 megalitres per ha per year	$20k per ha- sprigging
Soccer - .8 ha	Cool Season Grass (Maintenance)	Warm Season Grass(Maintenance)	3 megalitires per pitch per year	1.6 megalitres per pitch per year	1.4 megalitires per pitch per year	$16k per pitch (Sprigging)
Soccer - .8 ha	Cool Season Grass (Survival)	Warm Season Grass(Survival)	2.3 megalitres per pitch per year	.4 megalitires per pitch per year	1.9 megalitres per pitch per year	$16k per pitch (Sprigging)
Soccer - .8 ha	Cool Season Grass (Maintenance)	Warm Season Grass(Maintenance) - Sodding	3 megalitires per pitch per year	1.6 megalitres per pitch per year	1.4 megalitires per pitch per year	$75K per pitch (Sodding)
Soccer - .8 ha	Cool Season Grass (Survival)	Warm Season Grass(Survival)- Sodding	2.3 megalitres per pitch per year	.4 megalitires per pitch per year	1.9 megalitres per pitch per year	$75K per pitch (Sodding)
Soccer - .8 ha	Cool Season Grass (Maintenance)	Synthetic	3 megalitires per pitch per year	Nil	3 megalitires per pitch per year	$600k-$700k per senior pitch
Soccer - .8 ha	Cool Season Grass (Survival)	Synthetic	2.3 megalitres per pitch per year	Nil	2.3 megalitres per pitch per year	$600k-$700k per senior pitch
Football/ Cricket - 1.5 ha	Cool Season Grass (Maintenance)	Warm Season Grass (Maintenance)	5.7 megalitres per ground per year	3 megalitres per ground per year	2.7 megalitres per ground per year	$30 k per ground (Sprigging)
Football/ Cricket - 1.5 ha	Cool Season Grass (Survival)	Warm Season Grass (Survival)	4.35 megalitres per ground per year	.75 megalitres per ground per year	3.6 megalitres per ground per year	$30 k per ground (Sprigging)
Football/ Cricket - 1.5 ha	Cool Season Grass (Maintenance)	Warm Season Grass (Maintenance)	5.7 megalitres per ground per year	3 megalitres per ground per year	2.7 megalitres per ground per year	$140 k per ground (sodding)
Football/ Cricket - 1.5 ha	Cool Season Grass (Survival)	Warm Season Grass (Survival)	4.35 megalitres per ground per year	.75 megalitres per ground per year	3.6 megalitres per ground per year	$140 k per ground (sodding)
Lawn Bowls	Turf (Natural) Green	Synthetic (Sandfilled) Green	500k litres per green per year	200k litres per green per year	300k litres per green per year	$150 k per 8 lane green
Lawn Bowls	Turf (Natural) Green	Synthetic (Carpet) Green	500k litres per green per year	100k litres per green per year	400k litres per green per year	$190k per 8 lane green

Sources: SportsTurf - David McGeary; ABS - Douglas Golder; Tennis Victoria - Melanie Orr

Appendix D – Alternate Water Analysis Results