SUMMARY REPORT:

PERCEPTIONS OF INSTITUTIONAL DRIVERS AND BARRIERS TO SUSTAINABLE URBAN WATER MANAGEMENT IN AUSTRALIA

SURVEY RESULTS OF URBAN WATER PROFESSIONALS ACROSS BRISBANE, MELBOURNE AND PERTH






Rebekah Brown, Megan Farrelly and Nina Keath
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MONASH University
National Urban Water Governance Program

Summary Report: Perceptions of Institutional Drivers and Barriers to Sustainable Urban Water Management in Australia

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National Urban Water Governance Program

The *National Urban Water Governance Program* (the Program) is located at Monash University, Melbourne. The Program comprises a group of social research projects investigating the changing governance of traditional urban water management in Australia.

The Program is intended to facilitate progress towards achieving a 'Water Sensitive City', a long-term aim of Australia's National Water Initiative, by drawing from a number of social theories concerning institutional and technological change processes, and by undertaking comprehensive social research across three Australian cities: Brisbane, Melbourne and Perth.

Three key questions guiding the Program's research are:

1. What institutional factors are most important for enabling change towards a Water Sensitive City?
2. How can current reform processes be effectively informed and adapted to advance a Water Sensitive City?
3. What are the implications, and future roles, for professionals in the urban water sector?

The metropolitan regions of Brisbane, Melbourne and Perth were selected as case studies because they share similar drivers for re-examining their water management options (drought, waterway degradation, increasing populations). Collectively, the cities also represent a broad range of differing urban water governance structures and systems across Australian cities. This is in addition to differences in traditional water supply sources. Perth's supply is predominantly sourced from groundwater aquifers, whereas Melbourne and Brisbane's are sourced primarily from surface, freshwater systems.

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1. Overview

1.1 Introduction

Over the past few decades, Australian cities have been subject to significant urban water management challenges including growing populations, extended periods of drought, waterway degradation, and aging, degraded infrastructure (Birrell *et al.*, 2005; Engineers Australia, 2005; Howe *et al.*, 2005). Consequently, a growing number of water managers are re-examining traditional approaches and many argue for more sustainable urban water management (SUWM). Numerous definitions exist for SUWM and following a review of the literature, we consider that the six points below underpin the SUWM philosophy (Serageldin, 1995; Mouritz, 1996; Maksimović and Tejada-Guibert, 2001; Mitchell, 2006; Mostert, 2006):

1. All parts of the water cycle need to be considered as an integrated, inter-connected system, which includes protecting and restoring waterway health.
2. Multiple purposes for water use (human and environmental) need to be accepted, and flexible and multiple solutions need to co-exist.
3. Context matters; therefore all perspectives (environmental, social, cultural, political and institutional) need to be considered.
4. Public participation in planning and decision-making is vital.
5. Programs, projects and policies need to be considered over long-term timeframes guided by a common vision.
6. An interdisciplinary approach is required (e.g. engineers, environmental scientists, social researchers, economists, educators, urban designers and planners working cooperatively).

By defining SUWM we wish to be clear that this term is used in its broadest sense, and encompasses the many other idioms used in the industry such as 'total water cycle management', 'integrated urban water management', 'water sensitive urban design', 'integrated urban water cycle management' and 'integrated land and water management' (note that the terms 'total water cycle management' and 'water sensitive urban design' were adopted in the survey instrument).

Although the above points are reasonably well supported by the scientific community and the urban water sector, it is widely acknowledged in contemporary research that there are numerous barriers inhibiting the adoption of more sustainable practices and that the shift towards a Water Sensitive City[1] has, at best, been slow. Furthermore, a growing and diverse group of local and international commentators have identified that the majority of these barriers are social and institutional rather than purely technical (for example, Maksimović and Tejada-Guibert, 2001).

Climate change predictions show that future flooding and drought events in cities will be less predictable and more frequent (IPCC, 2007). As a result, cities will need to have the resilience to be able to adapt to both water rich and water poor conditions and the host of scenarios in between. To ensure that Australian cities (including urban waterways) are resilient to the effects of climate change and provide a secure water supply for a growing population, there is a strong need to focus on long-term planning and the development of flexible institutional infrastructure to cope with the increased uncertainty and variability in water conditions.

Part of the solution will be the development of a diverse water supply approach. For example, a recent report by the Prime Minister's Science, Engineering and Innovation Council Working Group on *Water for Cities: building resilience in a climate of uncertainty* (2007, pg 11) suggested that for a Water Sensitive City, a "share portfolio" of diverse water sources is required, supported by centralised and decentralised water infrastructure. In addition, improving the many highly degraded waterways of urban environments will be essential for improving their ecological resilience to the effects of climate change. Building on this, there appears to be a strong case for further implementing stormwater quality treatment technologies for both protecting waterways and providing a potential water supply source.

Water sector reform activity and current political attention on urban water management presents an important opportunity for implementing the necessary capacity building and change intervention strategies required to support SUWM and eventually realise Water Sensitive Australian Cities. Current attention to water issues is largely driven by the extended period of drought across Australia. As part of strategic planning and policy development for future urban water sector reforms, it is essential that the experiential knowledge and perspectives of professionals working in the sector help inform these processes. Therefore, this study provides insights into the factors that professionals working in the urban water sector perceive to be enabling and/or constraining the practice of SUWM.

[1] Clause 92 of the Australian Government's National Water Initiative outlines action directed at "innovation and capacity building to create water sensitive cities" (CoAG, 2004, pg 20).

1.2 What is Presented in this Summary Report?

This summary report provides an overview of two reports produced by the National Urban Water Governance Program, which detail the outcomes of an online questionnaire survey conducted over October and November in 2006. This report is the first stage in a broader program of research aimed at investigating and identifying the institutional factors most important for enabling a Water Sensitive City. While the analysis in this report is mostly descriptive, future reports will provide more detailed analysis. The purpose of the online questionnaire survey (referred to as 'the survey') was to provide reliable insights into the social and institutional drivers and barriers to SUWM as perceived by professionals operating in the urban water sector, across the cities of Brisbane, Melbourne and Perth. These cities were selected as case studies because they share similar drivers or circumstances for re-examining their water management options (drought, waterway degradation and increasing populations). However, the cities also represent different urban water governance structures and systems. These different institutional contexts (yet similar technological and human resource contexts) provide an important basis for a comparative assessment of the significance of perceived institutional drivers and barriers to SUWM.

It is hoped that this work will contribute to a better understanding of the factors that influence the uptake of technologies that enable diverse water sources and improved stormwater quality management. The two reports, which provide further detail than presented in this Summary Report are available at www.urbanwatergovernance.com, and include:

1. *Advancing the Adoption of Diverse Water Supplies in Australia: A Survey of Stakeholder Perceptions of Institutional Drivers and Barriers*, Report No. 07/04, National Urban Water Governance Program, Monash University, September 2007, ISBN 978-0-9804298-1-7.
2. *Advancing the Adoption of Urban Stormwater Quality Management in Australia: A Survey of Stakeholder Perceptions of Institutional Drivers and Barriers*, Report No. 07/05, National Urban Water Governance Program, Monash University, September 2007, ISBN 978-0-9804298-0-0.

Framed using the concept of 'receptivity' (explained in the next section), this summary report documents the overall receptivity of respondents to:

- augmenting conventional potable water supplies with diverse water sources (Table 1.1, Water Sources (A)),
- using diverse water sources in a fit-for-purpose context (Table 1.1, Water Uses (B)),
- adopting appropriate technologies to supply diverse water sources (Table 1.1, Diverse Water Source Technologies (C)),
- adopting appropriate technologies to improve stormwater quality and protect receiving waterways (Table 1.1, Stormwater Quality Treatment Technologies (D)).

Table 1.1: Urban Water Variables Tested in the Online Survey

Water Sources (A)*		**Water Uses (B)**		**Diverse Water Source Technologies (C)***		**Stormwater Quality Treatment Technologies (D)***
Rainwater	Sewage	Drinking	Indoor Household	Rainwater Tanks	On-site Greywater	Local Stormwater Quality Treatment Technologies
Greywater	Seawater	Outdoor Household	Public Open Space	Third-pipe Greenfield	Third-pipe Existing	Precinct Stormwater Quality Treatment Technologies
Stormwater	Groundwater	Environmental Flows	Industry	Indirect Potable Reuse	Direct Potable Reuse	Regional Stormwater Quality Treatment Technologies
New Dams	Water Trading					

(A)* Due to the wide variety of terms used in each city to describe different diverse water sources (such as recycled water, treated wastewater, non-drinking water) we refer to actual water sources that are treated to appropriate levels for fit-for-purpose uses.

(C)* While seawater and new dams were tested as Water Sources, they were not tested in the group of Diverse Water Source Technologies.

(D)* While stormwater was tested as a Water Source, the Stormwater Quality Treatment Technologies were tested from the perspective of improving stormwater quality for protecting receiving waterway health.

Furthermore, a summary is provided of professional perceptions regarding the key institutional factors enabling or constraining technology uptake. Table 1.2, on the following page, presents the twelve institutional factors that were tested. These factors were identified from the available scientific and practice based literature and considered amenable to quantitative testing.

Table 1.2: Social and Institutional Factors Tested that Influence the Uptake of SUWM Technologies

Community Perceptions	Social Amenity	Government Policy	Property Access Rights
Environmental Outcomes	Technical Feasibility & Performance	Management Arrangements & Responsibilities	Capital Costs
Public Health Outcomes	Professional Knowledge & Expertise	Regulation & Approvals Processes	Maintenance Costs

This report also documents the perceptions of professionals in the urban water sector regarding projected timeframes for development of diverse water source options, and organisational commitment to advancing SUWM practices. It is also important to note that a range of cross-tabulations and statistical correlation tests with respondent demographic data, such as disciplinary background, field of work, and length of time in the industry, were conducted during the analysis, with the results presented in the two main reports.

1.3 Receptivity Analysis

As discussed in the main reports, the concept of receptivity was used as the analytical framework for assessing and interpreting the professional community's overall readiness to implement a diverse water supply and waterway health protection approach. The aim of this analysis was to reliably inform current and future policy programs and capacity building initiatives across the sector. The concept of receptivity draws from research on 'innovation and technology transfer policy' studies and provides strategic guidance on the focus of 'change interventions' required for enabling the adoption of new technologies and practices (Jeffrey and Seaton, 2003/2004).

The concept of receptivity is based on the understanding that to mainstream new practices and technologies, it is important that policy programs are designed from the 'user's' or 'recipient's' perspective. For a new practice or technology to become mainstreamed, the recipient (whether an individual or an organisation) typically needs to have the following four receptivity attributes (Jeffrey and Seaton, 2003/2004; Brown and Keath, 2007):

- *Awareness:* acknowledgement that a problem needs to be addressed and that a range of possible solutions exist.
- *Association:* identification with enough associated benefits for their own current agenda that they will expend the necessary effort to utilise the technology or practice to address the problem.
- *Acquisition:* ready access to the necessary skills, resources and support to be able to address the problem.
- *Application:* exposure to an appropriate set of enabling incentives, such as regulatory and market incentives, to assist in implementing the new solution.

Based on the definitions above, Table 1.3 presents how the social and institutional factors tested in the survey (Table 1.2) can be aligned to awareness, association, acquisition and application. In addition, other factors were also tested including 'stakeholder commitment' (which represents the aggregate of all of the receptivity attributes), 'effectiveness of institutional arrangements' and 'projected implementation timeframes of sources and technologies'. The receptivity attribute 'awareness' was not tested because it was assumed that professionals in the sector already possessed an 'awareness' of the range of available water sources and technologies, due to their professional status.

Table 1.3: Receptivity Attributes Tested in the Survey

Awareness	Association	Acquisition	Application
Not Tested	Community Perceptions	Technical Feasibility & Performance	Capital Costs
	Environmental Outcomes	Professional Knowledge & Expertise	Maintenance Costs
	Public Health Outcomes	Government Policy	Projected Implementation Timeframes of Sources and Technologies
	Social Amenity	Management Arrangements & Responsibilities	Stakeholder Commitment
	Stakeholder Commitment	Regulation / Approvals Processes	
		Property Access Rights	
		Effectiveness of Institutional Arrangements	
		Stakeholder Commitment	

1.4 Who are the Survey Respondents?

The survey was aimed at capturing the insights of the broad spectrum of professionals operating within the urban water sector including, among others, planners, engineers, policy professionals, scientists, land developers and economists. In total, 1041 respondents completed the survey, with over 300 each from Perth and Brisbane, and over 400 from Melbourne.

This high participation rate attracted a reliable cross section of respondents from different stakeholder groups and those organisations with a significant water supply responsibility. For example, the highest response rates were from employees of the Melbourne group of water businesses[2] (39%), Brisbane City Council (37%), and the Water Corporation (33%) (Perth).

Figure 1.1 shows that many of the respondents were highly experienced (between 11 and 20+ years experience), although a considerable number of respondents in Brisbane and Perth had only up to one year of work experience in the urban water sector.

As shown in Figure 1.2, a similar number of respondents in each city identified themselves as working in the fields of water

Figure 1.1: Respondents' Length of Experience in the Urban Water Sector

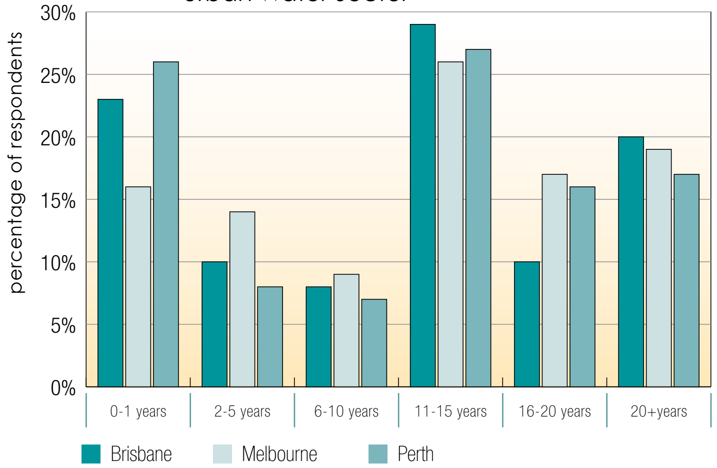
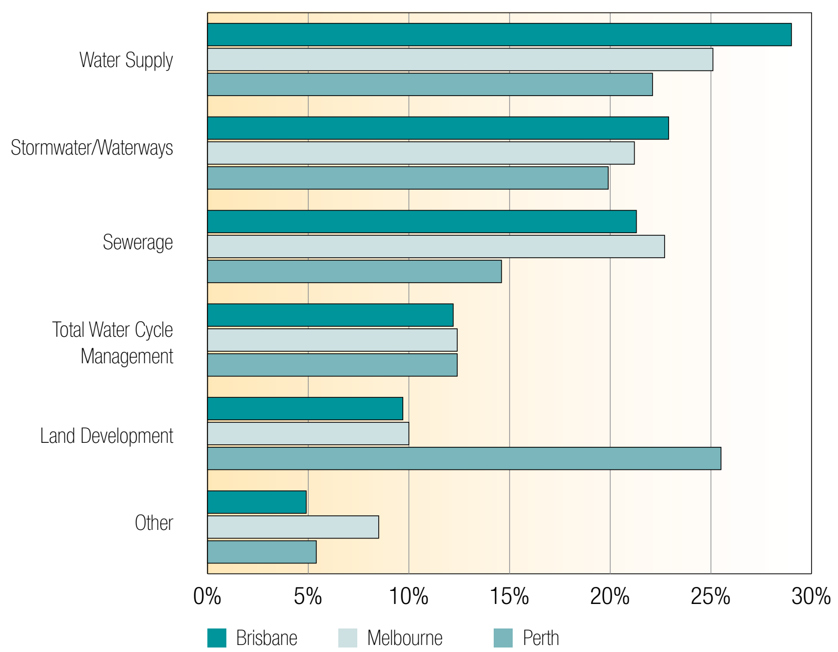


Figure 1.2: Respondents' Main Field of Work



[2] The Melbourne group of water businesses that participated in the survey include: Melbourne Water; South East Water; and Yarra Valley Water. City West Water did not participate in the survey.

supply, sewerage and stormwater. Of note, 12% of respondents within each city identified their main field of work as 'total water cycle management'. In Perth, approximately 26% of respondents indicated that they worked in land development, in comparison to approximately 10% in the other two cities, perhaps reflecting the high development growth rates in Perth.

As presented in Figure 1.3, over 60% of respondents in Brisbane and Melbourne, and over 50% of respondents in Perth had a background and/or training in engineering and science. Over 30% of respondents in Perth and over 20% of respondents in both Melbourne and Brisbane had background and/or training in business, planning, humanities or urban design/ architecture. Over 10% of respondents in each city had other disciplinary backgrounds (such as law, education and administration). Figure 1.4 shows that the majority of respondents across the three cities currently work in design/technical/ operations fields, followed by strategy/policy.

Figure 1.3: Respondents' Professional Background

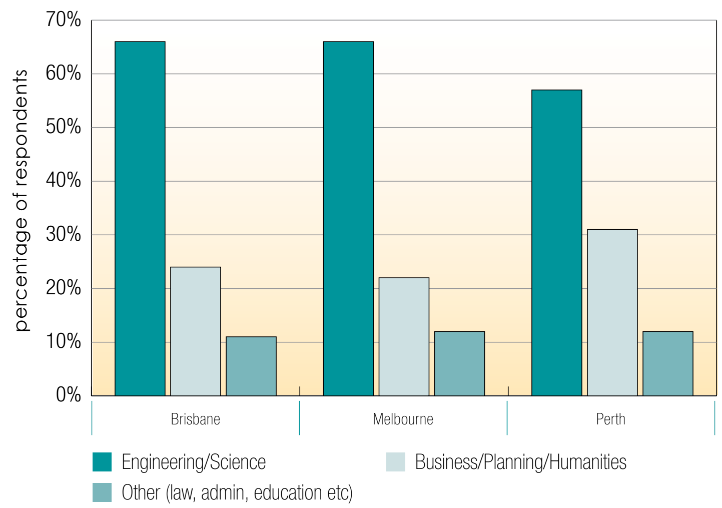
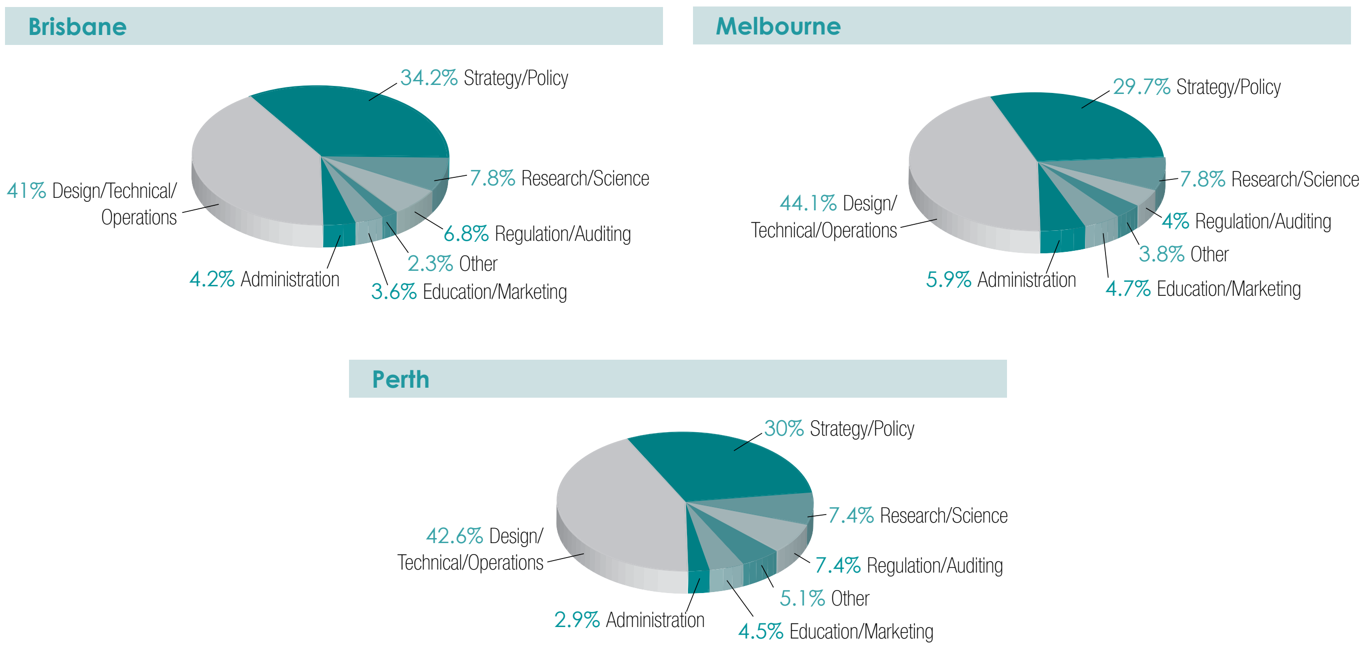


Figure 1.4: Respondents' Main Type of Work



2. Key Results

2.1 Receptivity to Diverse Water Sources and Uses

Survey respondents rated the importance of developing various water source options from 'very low' to 'very high' importance. Table 2.1 presents the distribution of the combined 'high' and 'very high' importance ratings for each of the water source options. As shown, rainwater received the highest level of support and new dams the least support in these high importance categories. On average, greywater, stormwater and sewage sources were rated as more important to develop than seawater, groundwater and water trading. Perth respondents were slightly more receptive to developing groundwater and seawater sources than respondents in the other cities, perhaps reflecting their current dependence on these sources. Brisbane respondents were slightly more receptive to new dams than respondents in Perth and Melbourne, which may reflect the proposal for the new Traveston Dam at the time of the survey. Melbourne respondents were, overall, more receptive to developing stormwater as a supply source.

Table 2.1: Perceived Importance of Developing Diverse Water Sources (high and very high importance ratings)

0-19%	20-39%	40-59%	60-79%	80-100%
New Dams	Seawater Groundwater	Water Trading	Greywater Stormwater Sewage	Rainwater

Survey respondents were also asked to nominate which uses they were receptive to for each of the water sources within a fit-for-purpose context. Responses were categorised between 'very low' and 'very high' receptivity so that the uses nominated by less than 20% of respondents were allocated a 'very low' rating, and the uses nominated by 80% or more of the respondents were allocated a 'very high' receptivity rating. As presented in Table 2.2, receptivity tended to decrease with increasing personal contact. For example, receptivity to sewage, was low for drinking and indoor household uses but high for public open space and industrial uses. Likewise, greywater received a very low rating for drinking but a high rating for outdoor household uses. Stormwater also received a very low rating for drinking and a low rating for indoor household uses but high ratings for public open space and environmental flows. Rainwater and groundwater received the highest receptivity rating (average) for drinking. Rainwater also received a high rating for indoor and outdoor household uses. Receptivity was highest for industrial uses with average to high ratings for all tested sources. Seawater received a low rating for all uses except for industrial uses, which was average. Groundwater received low to average ratings for all uses. In all three cities, the majority of respondents with an engineering/science background did not support the use of rainwater for drinking (particularly in Melbourne) and did not support using seawater for environmental flows. In Brisbane and Perth, respondents with planning/ humanities background were significantly more likely to support the use of stormwater than respondents with a background in engineering/science. However, engineers were more likely than planners to support the use of sewage as a supply source.

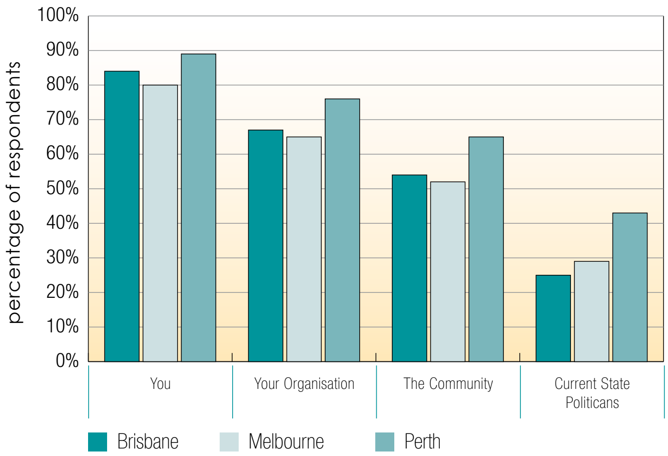
Table 2.2: Professional Receptivity to Diverse Water Source Uses

	VERY LOW n = 0-19%	LOW n = 20-39%	AVERAGE n = 40-59%	HIGH n = 60-79%	VERY HIGH n = 80-100%
DRINKING	Greywater Stormwater	Sewage Seawater	Rainwater Groundwater		
INDOOR HOUSEHOLD USE		Greywater Stormwater Sewage Seawater Groundwater		Rainwater	
OUTDOOR HOUSEHOLD USE		Seawater	Sewage Groundwater Stormwater	Rainwater Greywater	
PUBLIC OPEN SPACE		Seawater	Rainwater Greywater Groundwater	Stormwater Sewage	
ENVIRONMENTAL FLOWS		Greywater Seawater Groundwater	Rainwater Sewage	Stormwater	
INDUSTRY			Rainwater Greywater Seawater Groundwater Stormwater	Sewage	

2.2 Perceived Importance of Receiving Waterway Health

On average, over 80% of respondents across Brisbane, Melbourne and Perth indicated that they place a high or very high level of importance on protecting waterway health (Figure 2.1). However, respondents believed that protecting waterway health was less important to their organisation, the community and current state politicians respectively. This decreasing trend is common across the three cities.

Figure 2.1: Perceived Importance of Protecting Waterway Health (high and very high importance responses)



2.3 Overall Drivers and Barriers to SUWM Technologies

This section provides a broad summary of the perceived influence of the range of social and institutional factors outlined in Table 1.2 on SUWM technology adoption across the three cities[3]. The technologies tested have been grouped into four main types including:

- on-site technologies (rainwater tanks and greywater systems),
- third-pipe technologies (greenfield and existing),
- potable re-use schemes (indirect and direct),
- stormwater quality treatment technologies (local, precinct and regional).

The information presented in the Tables on the following page (Tables 2.3 to 2.6) represents broad trends around the likelihood of a factor being perceived as a driver or barrier across the three cities. Where perceptions varied within or between cities, they have been categorised as 'mixed views.' For example, Table 2.6 shows that there were mixed views about the 'technical feasibility and performance' of stormwater quality treatment technologies between the three cities. The city specific sections of the report demonstrate that in Perth (Section 5) this factor was believed to act as a barrier, whereas in Brisbane (Section 3), this factor was considered a driver. It is important to note that there were a number of respondents who identified some of the factors as neutral. City specific findings are reported in Tables 3.3, 4.3 and 5.3.

As shown in Tables 2.3 to 2.5, respondents in all three cities generally considered that there were few drivers for the adoption of diverse water source technologies. 'Environmental outcomes' were identified as the only outright driver for on-site and third-pipe technologies and there were no outright drivers identified for indirect and direct potable reuse schemes.

Respondents broadly identified the same barriers to the adoption of all tested diverse water source technologies, which were 'public health outcomes', 'management arrangements and responsibilities', 'regulation and approvals processes', 'capital costs' and 'maintenance costs'. Third-pipe technologies were considered to have an additional barrer, which was 'property access rights', and potable re-use schemes had the additional barrier of 'community perceptions'. All other factors that were tested received mixed responses. The factors of 'professional knowledge and expertise' and 'technical feasibility and performance' were perceived by a similar proportion of Brisbane and Melbourne respondents as an equal driver, barrier and neutral influence. This perhaps reflects growing professional expertise and faith in these technologies.

[3] Note that desalination technology and new dams were not tested in this part of the survey.

2. Key Results

As shown in Table 2.6, stormwater quality treatment technologies were perceived to have more drivers than diverse water source technologies, including, 'community perceptions', 'environmental outcomes', 'public health outcomes' and 'social amenity'. However, 'public health outcomes' were considered neutral at local and precinct scales in Melbourne and Perth (see Sections 4 and 5). On the other hand, outright barriers were perceived to be 'management arrangements and responsibilities', 'regulation and approvals processes', 'capital costs' and 'maintenance costs'. There were mixed views about the influence of all other tested factors on the uptake of stormwater quality treatment technologies.

Table 2.3: Perceived Drivers and Barriers to On-site Technologies: Rainwater Tanks and Greywater Systems

BARRIER	MIXED VIEWS	DRIVER
Public health outcomes	Community perceptions	Environmental outcomes
Management arrangements & responsibilities	Technical feasibility & performance	
Regulation & approval processes	Professional knowledge & expertise	
Capital costs	Government policy	
Maintenance costs	Property access rights	

Table 2.4: Perceived Drivers and Barriers to Third-pipe Technologies

BARRIER	MIXED VIEWS	DRIVER
Public health outcomes	Community perceptions	Environmental outcomes
Management arrangements & responsibilities	Technical feasibility & performance	
Regulation & approval processes	Professional knowledge & expertise	
Capital costs	Government policy	
Maintenance costs		
Property access rights		

Table 2.5: Perceived Drivers and Barriers to Potable Reuse Schemes: Indirect and Direct

BARRIER	MIXED VIEWS	DRIVER
Community perceptions	Environmental outcomes	
Public health outcomes	Technical feasibility & performance	
Management arrangements & responsibilities	Professional knowledge & expertise	
Regulation & approval processes	Government policy	
Capital costs	Property access rights	
Maintenance costs		

Table 2.6: Perceived Drivers and Barriers to Stormwater Quality Treatment Technologies

BARRIER	MIXED VIEWS	DRIVER
Management arrangements & responsibilities	Technical feasibility & performance	Community perceptions
Regulation/approval processes	Professional knowledge & expertise	Environmental outcomes
Capital costs	Government policy	Public health outcomes
Maintenance costs	Property access rights	Social amenity

2.4 Projected Implementation Timeframes

Implementation of diverse water sources was largely predicted to occur over the next five years in each case study city, with ongoing development for at least up to 15 years. Over 40% of respondents in Brisbane and Melbourne considered that rainwater was 'already integral' to supplementing conventional water supplies, and approximately 30% of respondents across the three cities believed rainwater would continue to be developed over the next five years. For Perth, over 40% of respondents considered that seawater was already integral to the supply system, and almost 60% considered that groundwater was also integral to the existing supply system. It is noteworthy, given the recent decision to commission a desalination plant for Melbourne's water supply system, that at the time of this study in November 2006, few Melbourne respondents considered that seawater would be developed as a source within the next five years. Over 25% of Melbourne's respondents believed it would take 16 to 30 years to develop (further details are in the main report). Unlike Melbourne, Perth had already committed to seawater desalination prior to the administration of the online questionnaire survey, as had the Gold Coast, which was to contribute to Brisbane's water supplies.

For stormwater quality treatment technologies, respondents across the three cities generally predicted that the uptake of technologies in greenfield areas would be over the next five years. However, they predicted a longer uptake timeframe in existing areas. Gross pollutant traps were identified by a significant proportion of respondents as already integral to current practice.

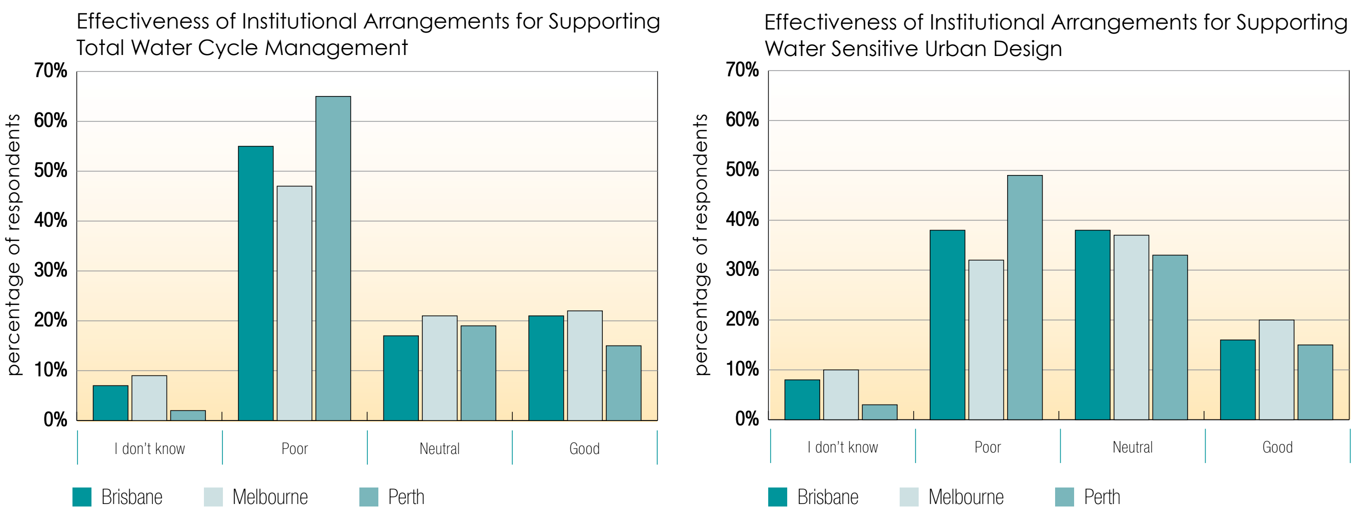
2.5 Perceived Effectiveness of Institutional Arrangements

Respondents were asked to rate the effectiveness of their institutional arrangements for promoting 'total water cycle management' (TWCM) and 'water sensitive urban design' (WSUD), as shown in Figure 2.2. Definitions of TWCM and WSUD were provided as follows:

- Total Water Cycle Management (TWCM) recognises that our water services – including water supply, sewerage and stormwater management – are interrelated and linked to the well-being of our catchments and receiving waterway environments (including surface and sub-surface). It involves making the most appropriate use of water from all stages of the water cycle that best deliver social, ecological and economic sustainability.
- Water Sensitive Urban Design (WSUD) evolved from its early association with stormwater management and aims to ensure that water is given due prominence within urban design processes. This is through the integration of total urban water cycle thinking in the detailed planning and design of the built form. In particular, WSUD reintroduces the aesthetic and intrinsic values of waterways back into the urban landscape.

In each case study city, respondents rated their institutional arrangements as 'poor' for enabling a TWCM approach, and between 'poor' to 'neutral' for WSUD. This perspective is reinforced by the predominantly institutional factors identified as preventing the implementation of SUWM technologies discussed in the previous section.

Figure 2.2: Perceived Effectiveness of Institutional Arrangements for Supporting Total Water Cycle Management and Water Sensitive Urban Design



Despite the many institutional barriers identified, respondents believed that organisations with a responsibility for urban water management were among the most committed to advancing the practice of TWCM. For organisations with a 'part' role, there was a high level of uncertainty amongst respondents as to the organisation's level of commitment. Despite the important role that local government and developers play in implementing WSUD practices, their perceived level of 'commitment' was low (excluding Brisbane City Council, which received a high commitment rating).

3. Key Brisbane Case Study Findings

This section provides a summary of the survey results specific to Brisbane. Overall, Brisbane respondents indicated that they were receptive to developing and using diverse water sources and protecting receiving waterway health. However, there were multiple institutional barriers perceived to be limiting the adoption of SUWM technologies.

3.1 Receptivity to Diverse Water Sources and Uses

As shown in Table 3.1, Brisbane respondents generally identified rainwater, stormwater, sewage and greywater as the most important options for supplementing conventional water supplies. They also believed that these options were important from the perspective of 'their organisation', 'the community' and 'state politicians'. As presented in the main reports, while professionals believed that state politicians placed a high priority on seawater and new dams, these were not considered the key priority by professionals themselves.

Table 3.1: Perceived Importance of Developing Diverse Water Sources in Brisbane (high and very high importance ratings)

0-19%	20-39%	40-59%	60-79%	80-100%
	New Dams Seawater Groundwater	Water Trading	Greywater Sewage	Rainwater Stormwater

As shown in Table 3.2, receptivity to diverse water source uses generally decreased with increasing personal contact, with the exception of rainwater, where receptivity tended to increase. Respondents demonstrated high receptivity to the adoption of rainwater for drinking, indoor household and outdoor household uses but average receptivity to using rainwater for public open space, environmental flows and industry. Respondents had very low receptivity to drinking greywater and low receptivity to drinking sewage, stormwater and seawater. There was also low receptivity to using greywater, stormwater, seawater and groundwater for indoor household uses. However, there was high receptivity to using stormwater and greywater for outdoor household uses and high receptivity to using stormwater and sewage for public open space. There was also high receptivity for using sewage for industry. Respondents demonstrated a low level of receptivity to using greywater or seawater for supplementing environmental flows, whereas they had a high level of receptivity to using stormwater. Overall, there was low receptivity to the use of seawater for all uses. In comparison to the other cities, there was an overall higher level of receptivity for using sewage for drinking and indoor household uses, however this was still 'low' to 'average'. The analysis revealed that the increasing levels of support for drinking sewage correlated with the respondents' seniority in their organisation. This may reflect the informal discussions in Brisbane at the time of the survey (and the now realised decision) to direct purified recycled wastewater to the Wivenhoe supply dam as an 'indirect potable reuse scheme'.

Table 3.2: Professional Receptivity to Diverse Water Source Uses in Brisbane

	VERY LOW n = 0-19%	LOW n = 20-39%	AVERAGE n = 40-59%	HIGH n = 60-79%	VERY HIGH n = 80-100%
DRINKING	Greywater	Sewage Stormwater Seawater	Groundwater	Rainwater	
INDOOR HOUSEHOLD USE		Greywater Stormwater Seawater Groundwater	Sewage	Rainwater	
OUTDOOR HOUSEHOLD USE		Seawater	Groundwater Sewage	Rainwater Stormwater Greywater	
PUBLIC OPEN SPACE		Seawater	Rainwater Greywater Groundwater	Stormwater Sewage	
ENVIRONMENTAL FLOWS		Greywater Seawater	Rainwater Sewage Groundwater	Stormwater	
INDUSTRY		Seawater	Rainwater Greywater Stormwater Groundwater	Sewage	

3.2 Perceptions of Drivers and Barriers to SUWM Technologies

Respondents were asked to rate how each of the social and institutional factors, listed in Table 1.2, influence the uptake of selected SUWM technologies. As shown on the following page in Table 3.3, factors were identified as barriers, drivers or neutral. Where factors attracted an evenly distributed rating across barrier and driver they are reported as 'mixed'.

As shown in Table 3.3, there were far more perceived barriers than drivers for the adoption of diverse water source technologies and, on the other hand, more perceived drivers for the adoption of stormwater quality treatment technologies:

- 'Community perceptions' were considered a barrier for greywater systems, third-pipe technologies in existing areas, and potable reuse schemes. There were mixed perspectives about their influence on third-pipe in greenfield areas, perhaps reflecting the very limited number of greenfield areas in Brisbane. Respondents believed that 'community perceptions' were a driver for stormwater quality treatment technologies at all scales and for rainwater tanks.
- 'Environmental outcomes' were consistently perceived as a driver across all the tested technology types, except for on-site greywater technologies, which received mixed responses.
- 'Public health outcomes' were perceived to be a barrier to the adoption of all tested diverse water source technologies except for rainwater tanks, which received a neutral response. On the other hand, 'public health outcomes' were perceived as a driver for stormwater quality treatment technologies at all scales.
- 'Social amenity' was considered a driver for all stormwater quality treatment technologies. This factor was not tested for diverse water source technologies.
- Respondents believed that 'technical feasibility and performance' and 'professional knowledge and expertise' were a driver for rainwater tanks, indirect potable reuse schemes and stormwater quality treatment technologies at all scales. However, these attributes were perceived as barriers to greywater and third-pipe technologies in existing areas. There were mixed perceptions about their influence in the application of third-pipes in greenfield areas, and direct potable reuse schemes, with responses evenly distributed across driver, barrier and neutral.

Table 3.3: Respondent Assessment of Drivers and Barriers to SUWM Technologies in Brisbane

Social & Institutional Factors Tested	On-site Technologies		Third-pipe Technologies		Potable Reuse Schemes		Stormwater Quality Treatment Technologies		
	Raintank	Greywater	Greenfield	Existing	Indirect	Direct	Local	Precinct	Regional
Community Perceptions	Driver	Barrier	Mixed	Barrier	Barrier	Barrier	Driver (N = 31%)	Driver (N = 26%)	Driver (N = 25%)
Environmental Outcomes	Driver (N = 25%)	Mixed	Driver (N = 25%)	Driver (N = 25%)	Driver	Driver	Driver	Driver	Driver
Public Health Outcomes	Neutral	Barrier	Barrier (N = 27%)	Barrier (N = 27%)	Barrier	Barrier	Driver (N = 33%)	Driver (N = 33%)	Driver (N = 32%)
Social Amenity	Not Tested						Driver	Driver	Driver
Technical Feasibility & Performance	Driver (N = 36%)	Barrier	Mixed	Barrier	Driver (N = 26%)	Mixed	Driver (N = 29%)	Driver (N = 28%)	Driver (N = 25%)
Professional Knowledge & Expertise	Driver	Barrier (N = 27%)	Mixed	Barrier (N = 35%)	Driver	Mixed	Driver (N = 26%)	Driver (N = 25%)	Driver
Government Policy*	Driver	Barrier (N = 26%)	Mixed	Barrier (N = 27%)	Mixed	Barrier	Driver (? = 26%)	Driver (? = 27%)	Driver (? = 26%)
Management Arrangements & Responsibilities	Neutral	Barrier (N = 36%)	Barrier (N = 29%)	Barrier (N = 30%)	Barrier (N = 36%)	Barrier (N = 28%)	Barrier	Barrier	Barrier (N = 31%)
Regulation / Approvals Processes	Barrier (N = 33%)	Barrier	Neutral	Barrier	Barrier	Barrier	Barrier	Barrier	Barrier
Property Access Rights	Neutral	Neutral	Barrier	Barrier (N = 25%)	Neutral	Neutral	Neutral	Neutral	Barrier (N = 35%)
Capital Costs	Neutral	Barrier (N = 40%)	Barrier	Barrier	Barrier (N = 26%)	Barrier	Barrier	Barrier	Barrier
Maintenance Costs	Neutral	Barrier	Barrier	Barrier	Barrier (N = 38%)	Barrier (N = 29%)	Barrier	Barrier	Barrier

Barrier	Factor generally prevents the uptake of the technology
Mixed	Factor attracted an evenly distributed rating of preventing and encouraging the uptake of the technology
Driver	Factor generally encourages the uptake of the technology
Neutral	Factor neither prevents nor encourages the uptake of the technology

It is important to note that these receptivity indicators (i.e. driver, barrier, mixed and neutral) represent the overall trend of the aggregated results as detailed in the two main reports. Where the barrier or driver has comparatively less strength because of the proportion of respondents who selected 'neutral' or 'I don't know', we have included that percentage under the indicator in the table:

? = percentage of respondents who selected 'I don't know?'

N = percentage of respondents that identified the indicator as 'neutral'.

* Refers only to Brisbane City Council Policy

As shown in Figure 2.2, over 50% of the respondents believed that their institutional framework was ineffective for enabling a total water cycle management approach. This is supported by the types of perceived barriers to the implementation of the tested technologies highlighted in Table 3.3:

- 'Brisbane City Council' policies were considered to support rainwater tanks and all of the stormwater quality treatment technologies; limit greywater systems, third-pipes in existing areas, and direct potable reuse; and equally prevent and encourage the adoption of third-pipe technologies in greenfield areas and indirect potable re-use.
- With the exception of rainwater tanks, 'management arrangements and responsibilities' were perceived as an outright barrier to the adoption of all tested technology types.
- 'Regulation and approvals processes' were considered barriers to the adoption of all technology types, except third-pipe technologies in greenfield, which received a neutral response.
- 'Capital' and 'maintenance' costs were considered to be barriers to advancing the implementation of all tested technologies with the exception of rainwater tanks, which attracted a neutral response (This may reflect the significant government subsidies for rainwater tanks).

3.3 Projected Implementation Timeframes

As shown in Figure 3.1, over 40% of Brisbane respondents believed that rainwater was already an integral component of their water supply system and almost 50% of respondents suggested that rainwater will continue to develop for the next five years. Respondents also believed that all other diverse water source options would be developed over the next five years. For seawater, sewage, stormwater, water trading, groundwater, greywater and new dams, respondents believed that there will be ongoing development for up to 15 years. Some respondents considered that seawater and groundwater will continue to be developed over the next 30 years (Figure 3.1).

Figure 3.1: Envisaged Timeframes for the Implementation of Diverse Water Sources in Brisbane

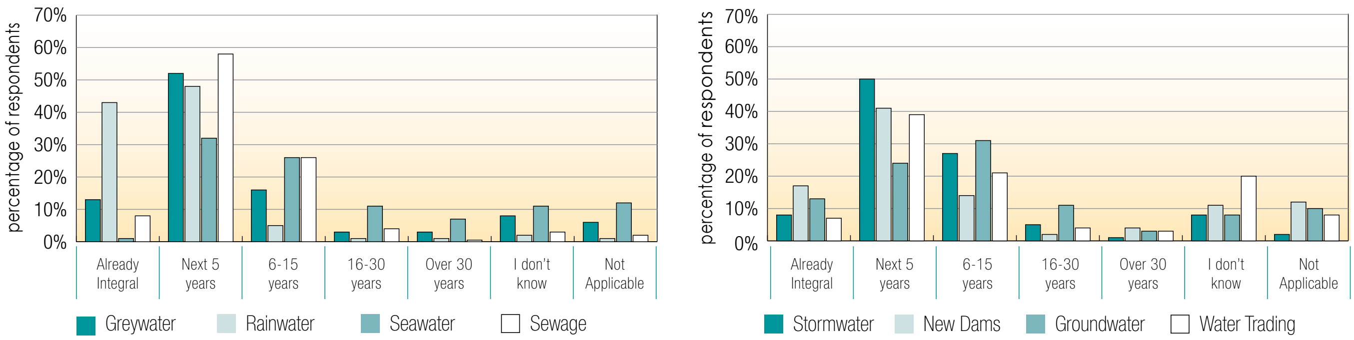
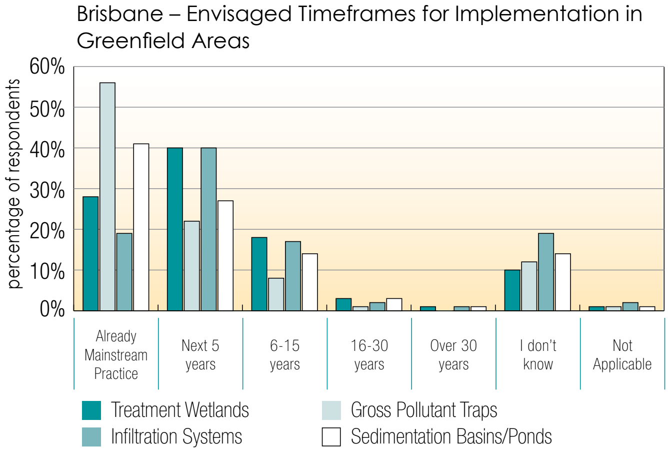
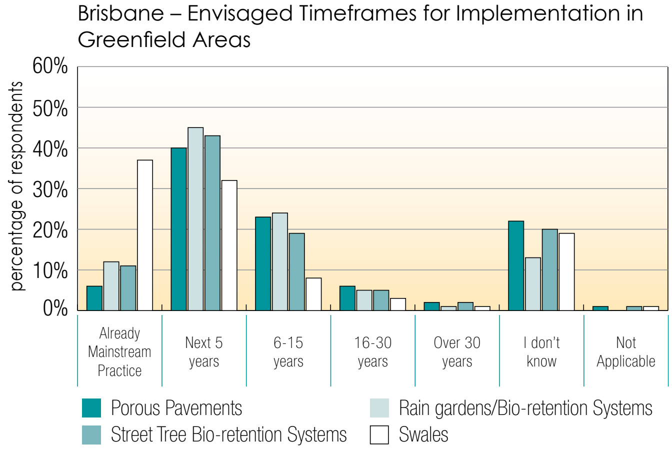
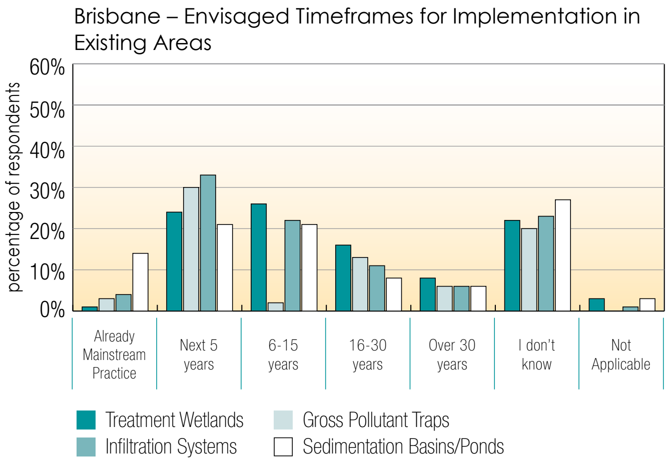


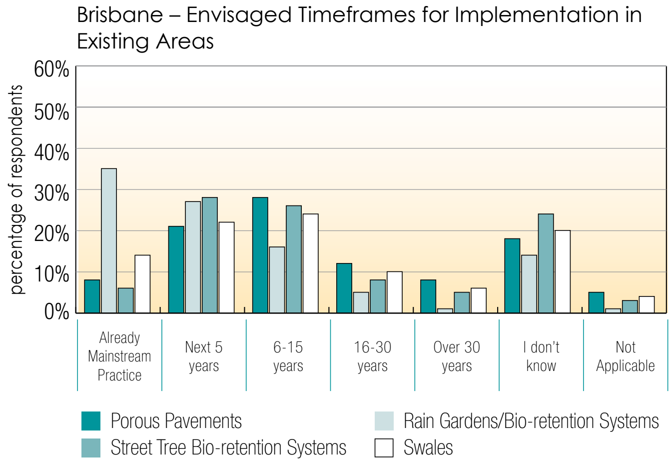
Figure 3.2 highlights that Brisbane respondents believed that gross pollutant traps, sedimentation basins/ponds and swales were already mainstream practice in greenfield and existing sites. Respondents believed that other stormwater quality treatment technologies could become mainstream practice in greenfield areas over the next five years but that it could take up to 15 years (and possibly longer) in existing sites. Many respondents were unsure how long it would take to implement these technologies.

Figure 3.2: Envisaged Timeframes for the Implementation of Stormwater Quality Treatment Technologies in Brisbane









3.4 Stakeholder Commitment

Organisations with a major responsibility for urban water management were generally perceived to have higher levels of commitment to TWCM than other organisations. However, not one organisation was considered 'fully committed' by a majority of respondents. Brisbane respondents clearly identified the Moreton Bay Waterways and Catchments Partnership as the most 'fully committed' to a TWCM approach (32%), followed by the Queensland Water Commission (23%), South East Queensland Water (22%) and Brisbane City Council (21%). All other organisations, as shown in Figure 3.3, were perceived to have lower levels of commitment to TWCM.

By combining the 'fully committed' with the next category of commitment, 'organisation/sector and internal champions committed', as shown in Figure 3.4 Brisbane City Council is rated as the organisation leading on TWCM (54%), closely followed by Moreton Bay Waterways and Catchments Partnership (50%).

There were a number of organisations that received substantial 'I don't know' responses, particularly the Queensland Competition Authority (57%), Department of Main Roads (43%), Queensland Health (39%), Department of Local Government, Planning, Sports and Recreation (38%), and the Office of Urban Management (37%).

Figure 3.3: Perceived Level of Organisational Commitment to Advancing Total Water Cycle Management in Brisbane

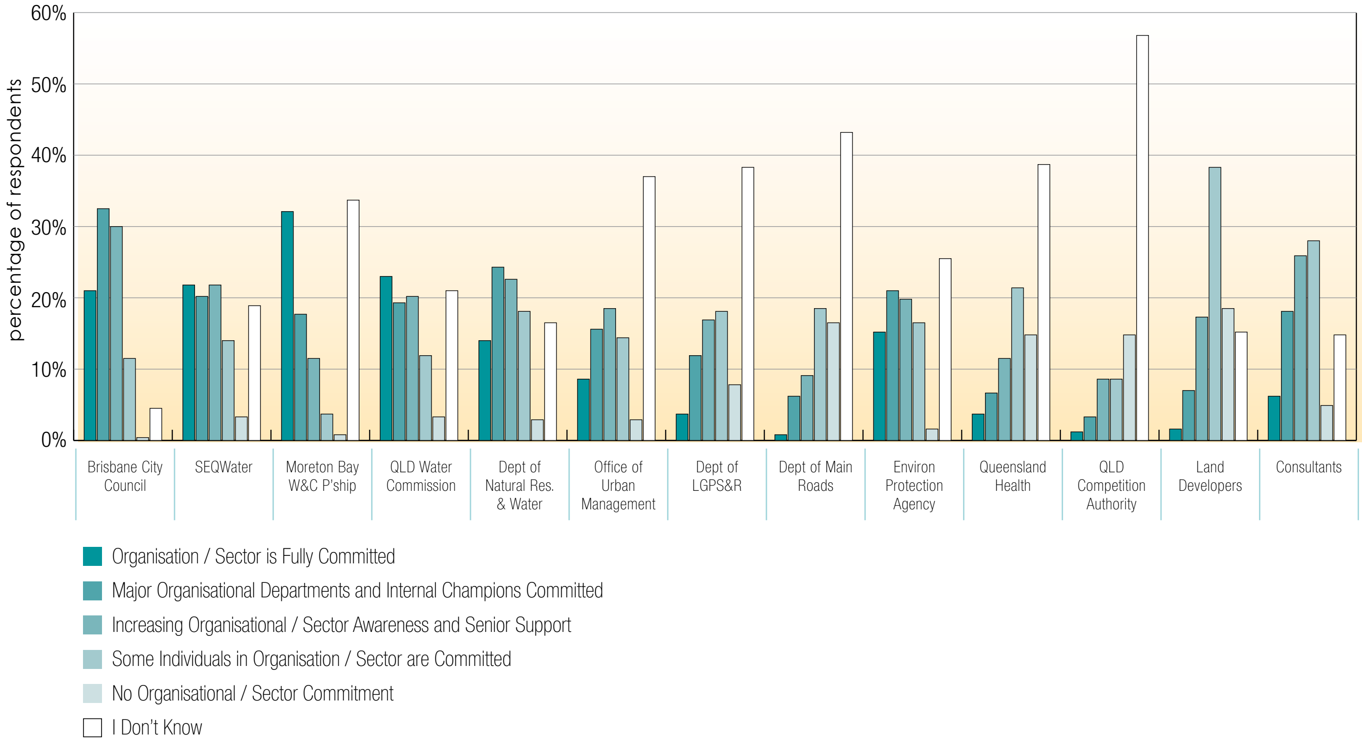
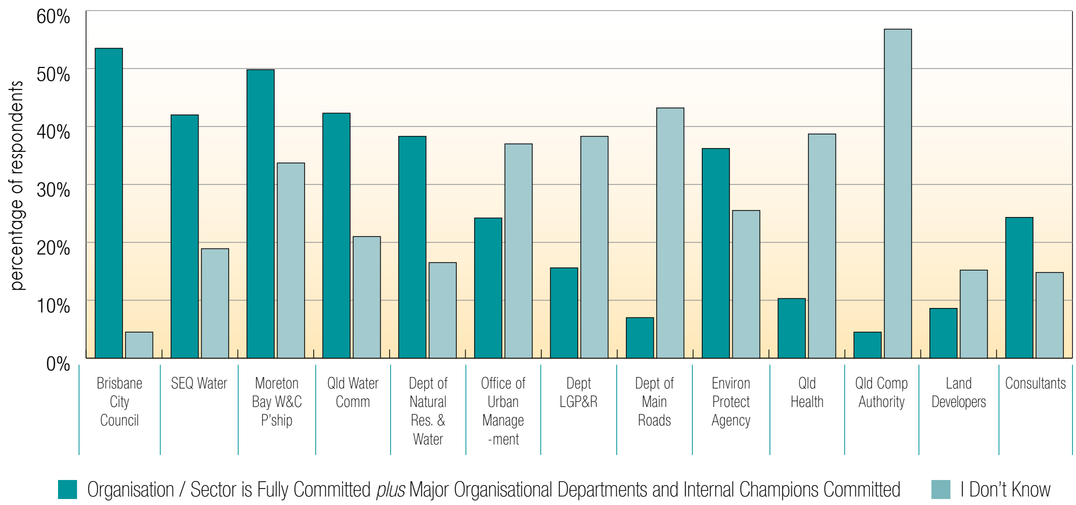


Figure 3.4: Perceived Level of Organisational Commitment to Advancing Total Water Cycle Management in Brisbane: Top Two Ratings.



4. Key Melbourne Case Study Findings

This section provides an overview of the survey results specific to Melbourne. Overall, the Melbourne respondents were receptive to pursuing and using diverse water supplies and protecting waterway health. However, there remain many institutional barriers perceived to be preventing the adoption of SUWM technologies.

4.1 Receptivity to Diverse Water Sources and Uses

As shown in Table 4.1, Melbourne respondents generally considered rainwater, stormwater, greywater and sewage as the most important options for supplementing conventional supplies. As presented in the main reports, they also believed that these sources were important to 'their organisation', 'the community' and 'state politicians'. However, 'the community' were perceived to be less receptive to the development of sewage and stormwater.

Table 4.1: Perceived Importance of Developing Diverse Water Sources in Melbourne (high and very high importance ratings)

0-19%	20-39%	40-59%	60-79%	80-100%
New Dams	Seawater Groundwater	Water Trading	Greywater Sewage	Rainwater Stormwater

As shown in Table 4.2, receptivity to using diverse sources generally decreased with increasing personal contact. Respondents demonstrated very low to average receptivity to drinking all tested sources with the highest receptivity being for rainwater and the lowest being for greywater, stormwater and sewage. There was low receptivity to using greywater, sewage, seawater and groundwater for indoor household uses but high receptivity to using rainwater. There was high receptivity for using rainwater, greywater and stormwater for outdoor household use and high receptivity for stormwater and sewage for public open space. Respondents demonstrated very low receptivity to using seawater and low receptivity to greywater and groundwater for supplementing environmental flows; whereas there was high receptivity to using rainwater and stormwater. There was a high level of receptivity to using stormwater and sewage for industry and low receptivity to using greywater and seawater. Melbourne respondents generally had low to very low levels of receptivity to using seawater for all uses tested. Respondents had high receptivity to the use of stormwater for all outdoor uses including household, public open space, environmental flows and industry but very low receptivity for the use of stormwater for drinking.

Table 4.2: Professional Receptivity to Diverse Water Source Uses in Melbourne

	VERY LOW n = 0-19%	LOW n = 20-39%	AVERAGE n = 40-59%	HIGH n = 60-79%	VERY HIGH n = 80-100%
DRINKING	Greywater Stormwater Sewage	Seawater Groundwater	Rainwater		
INDOOR HOUSEHOLD USE		Greywater Sewage Seawater Groundwater	Stormwater	Rainwater	
OUTDOOR HOUSEHOLD USE		Seawater	Sewage Groundwater	Rainwater Greywater Stormwater	
PUBLIC OPEN SPACE		Seawater	Rainwater Greywater Groundwater	Stormwater Sewage	
ENVIRONMENTAL FLOWS	Seawater	Greywater Groundwater	Sewage	Rainwater Stormwater	
INDUSTRY		Greywater Seawater	Rainwater Groundwater	Stormwater Sewage	

4.2 Perceptions of Drivers and Barriers to SUWM Technologies

Respondents were asked to rate how each of the social and institutional factors listed in Table 1.2 influence the uptake of selected SUWM technologies. As shown in Table 4.3, factors were identified as barriers, drivers or neutral. Where factors attracted an evenly distributed rating across barrier and driver they are reported as 'mixed'.

Table 4.3 demonstrates that overall, there were twice the number of perceived barriers to the uptake of SUWM technologies than drivers and these drivers were predominantly related to the uptake of stormwater quality treatment technologies:

- 'Community perceptions' were identified as a driver for rainwater tanks, third-pipe systems in greenfield areas and stormwater treatment technologies. They were considered to be a barrier to greywater systems and potable reuse schemes and there were mixed views about their influence on third-pipe technologies in existing areas.
- 'Environmental outcomes' were the only consistently perceived driver for all tested technologies.
- 'Public health outcomes' were perceived as a barrier for greywater systems, third-pipe technologies and indirect/direct potable reuse but considered to have neutral influence on rainwater tanks and stormwater treatment technologies at the local and precinct scales. At the regional scale, 'public health outcomes' were considered a driver for stormwater treatment technologies.
- 'Social amenity' was considered a driver for all stormwater quality treatment technologies. This factor was not tested for diverse water source technologies.
- Respondents believed that 'technical feasibility and performance' and 'professional knowledge and expertise' had a neutral influence on rainwater tank adoption; were barriers for the uptake of greywater systems, and third-pipe technologies in existing areas; and, were drivers for precinct and regional stormwater quality treatment technologies. There were 'mixed' views about their influence on potable reuse schemes; third-pipe greenfield technologies and local scale stormwater quality treatment technologies.

Table 4.3: Respondent Assessment of Drivers and Barriers to SUWM Technologies in Melbourne

Social & Institutional Factors Tested	On-site Technologies		Third-pipe Technologies		Potable Reuse Schemes		Stormwater Quality Treatment Technologies		
	Raintank	Greywater	Greenfield	Existing	Indirect	Direct	Local	Precinct	Regional
Community Perceptions	Driver	Barrier	Driver	Mixed	Barrier	Barrier	Driver	Driver	Driver
Environmental Outcomes	Driver	Driver	Driver	Driver	Driver	Driver	Driver	Driver	Driver
Public Health Outcomes	Neutral	Barrier	Barrier (? = 35%)	Barrier (N = 32%)	Barrier	Barrier	Neutral	Neutral	Driver
Social Amenity	Not Tested						Driver	Driver	Driver
Technical Feasibility & Performance	Neutral	Barrier	Mixed	Barrier (N = 25%)	Mixed	Mixed	Mixed	Driver (N = 31%)	Driver (N = 29%)
Professional Knowledge & Expertise	Neutral	Barrier	Mixed	Barrier (N = 36%)	Mixed	Mixed	Mixed	Driver (N = 28%)	Driver (N = 28%)
Government Policy	Driver	Barrier (N = 30%)	Driver	Barrier (N = 33%)	Barrier	Neutral (? = 25%)	Mixed	Mixed	Driver
Management Arrangements & Responsibilities	Neutral	Barrier (N = 34%)	Barrier (N = 30%)	Barrier (N = 32%)	Barrier (N = 31%)	Barrier (N = 31%)	Barrier (N = 31%)	Barrier (N = 30%)	Barrier (N = 29%)
Regulation / Approvals Processes	Barrier (N = 39%)	Barrier	Neutral	Barrier (N = 26%)	Barrier	Barrier	Barrier (N = 33%)	Barrier (N = 32%)	Barrier (N = 33%)
Property Access Rights	Neutral	Neutral	Barrier	Barrier	Neutral	Neutral	Neutral	Neutral	Neutral
Capital Costs	Neutral	Barrier (N = 35%)	Barrier	Barrier (N = 31%)	Barrier (N = 25%)	Barrier	Barrier	Barrier	Barrier
Maintenance Costs	Neutral	Barrier	Barrier (N = 28%)	Barrier	Barrier (N = 34%)	Barrier (N = 29%)	Barrier	Barrier	Barrier

Barrier	Factor generally prevents the uptake of the technology
Mixed	Factor attracted an evenly distributed rating of preventing and encouraging the uptake of the technology
Driver	Factor generally encourages the uptake of the technology
Neutral	Factor neither prevents nor encourages the uptake of the technology

It is important to note that these receptivity indicators (i.e. driver, barrier, mixed and neutral) represent the overall trend of the aggregated results as detailed in the two main reports. Where the barrier or driver has comparatively less strength because of the proportion of respondents who selected 'neutral' or 'I don't know', we have included that percentage under the indicator in the table:

? = percentage of respondents who selected 'I don't know?'

N = percentage of respondents that identified the indicator as 'neutral'.

The majority of Melbourne respondents considered their institutional arrangements to be ineffective for promoting a total water cycle management approach (see Figure 2.2) and believed that their state politicians do not place a high level of importance on improving waterway health (see Figure 2.1). These views were further emphasised by the following findings:

- 'Government policy' was considered a driver for the adoption of rainwater tanks, third-pipe systems in greenfield areas and regional scale stormwater quality treatment technologies. However, 'government policy' was perceived as constraining the adoption of greywater systems, third-pipe technologies in existing areas and indirect potable reuse schemes. Although 'government policy' was considered to have a neutral influence on direct potable reuse, a quarter of all respondents suggested they did not know how 'government policy' influenced this technology. There were mixed views about the influence of 'government policy' on the implementation of stormwater treatment technologies at local and precinct scales.
- 'Management arrangements and responsibilities' were considered to be a barrier to the adoption of all technology types except rainwater tanks, which had a neutral response.
- 'Regulation and approvals processes' were considered a barrier to the adoption of all technology types, except third-pipe systems in greenfield areas, which had a neutral response.
- 'Property access rights' were considered a barrier to the adoption of third-pipe technologies.
- Both 'capital' and 'maintenance' costs were perceived to be barriers to the adoption of all technology types with the exception of rainwater tanks, where cost was believed to have a neutral influence (This may reflect the significant government subsidies for rainwater tanks).

4.3 Projected Implementation Timeframes

As shown in Figure 4.1, over 40% of respondents considered that rainwater was 'already integral' to conventional water supplies and a similar number suggested that rainwater would continue to be developed over the next five years. Melbourne respondents believed that, over the next five years, greywater, sewage, stormwater and water trading would be further developed to supplement conventional water supplies. Ongoing development over the next 6-15 years was expected for greywater, seawater, sewage and stormwater. Groundwater was perceived by almost 30% of respondents to be 'not applicable' and others believed groundwater would not be developed until the longer-term. Further, 28% of Melbourne respondents placed the development of seawater at 6-15 years in the future, 19% at 16-30 years, and 17% at 30 years.

Figure 4.1: Envisaged Timeframes for the Implementation of Diverse Water Sources in Melbourne

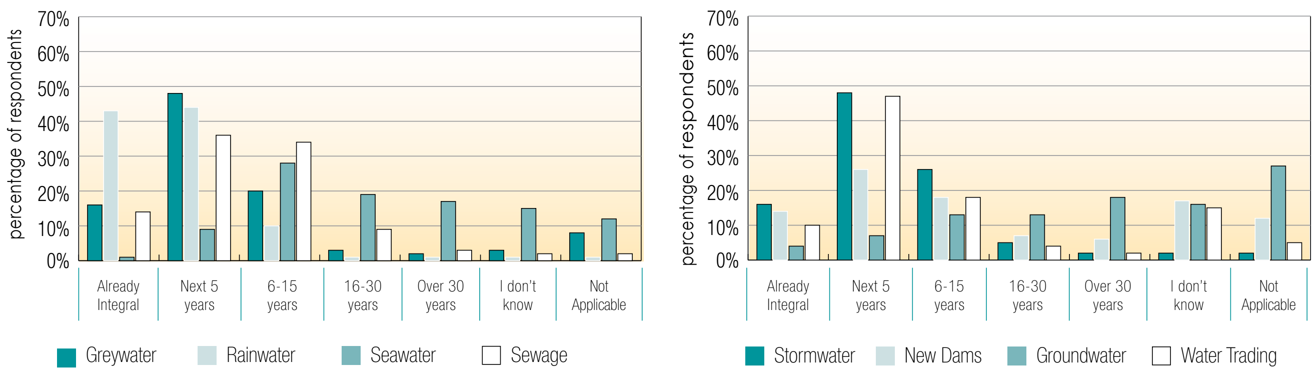
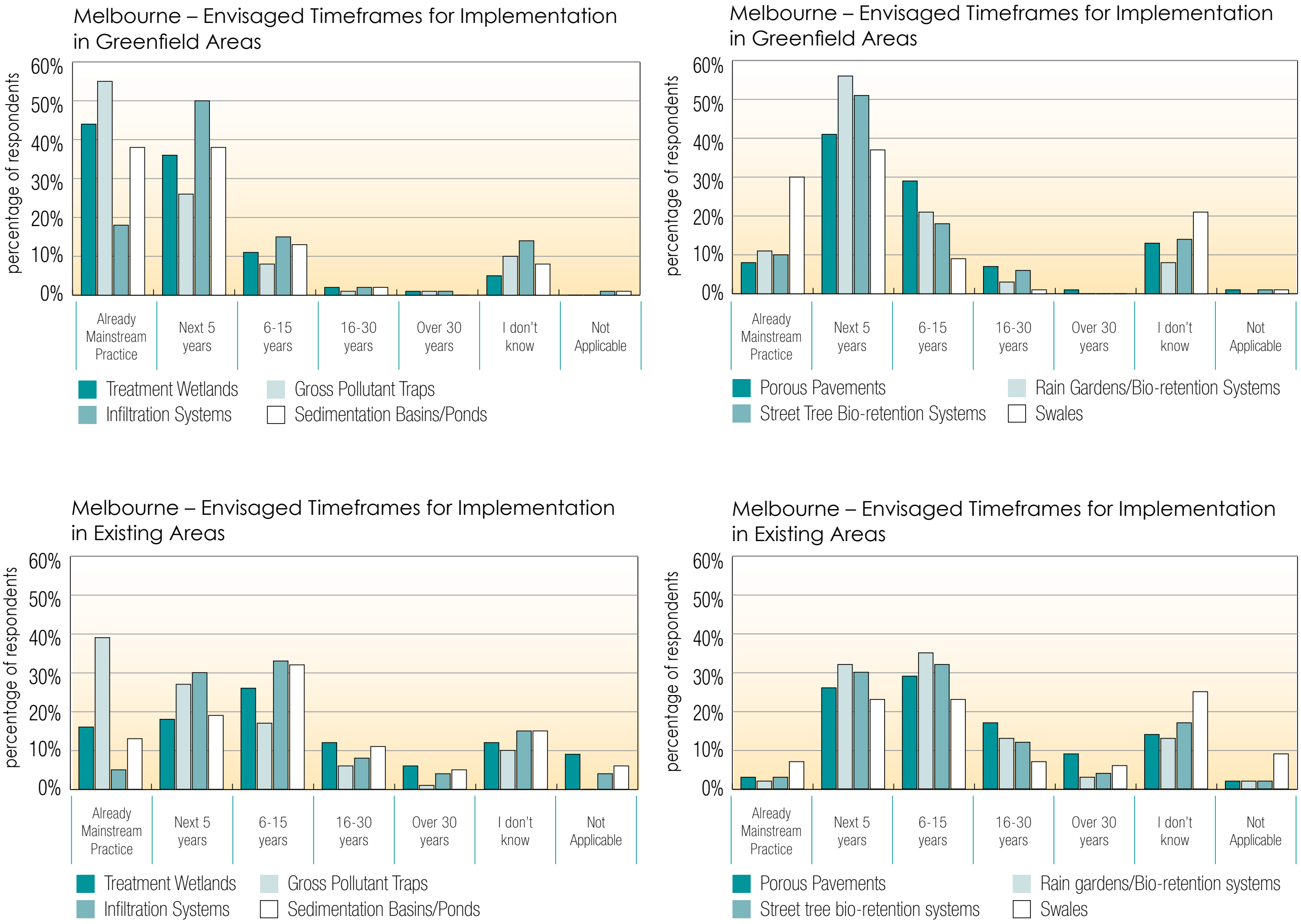


Figure 4.2, on the following page, presents the projected timeframes for stormwater treatment technologies. Melbourne professionals believed that the majority of stormwater quality treatment technologies would be adopted over the next five years in greenfield sites and over the next 15 years in existing areas. However, treatment wetlands, gross pollutant traps, sedimentation basins and swales were generally considered to be 'already mainstream' in greenfield and existing developments in comparison to other technologies. There were relatively high 'I don't know' responses for many of the technologies.

Figure 4.2: Envisaged Timeframes for the Implementation of Stormwater Quality Treatment Technologies in Melbourne



4.4 Stakeholder Commitment

Generally, organisations with a major responsibility in urban water management received the highest rating for commitment to TWCM, yet there was no single standout organisation in Melbourne. However, 21% of respondents perceived Melbourne Water and Sustainability Victoria as being 'fully committed' to advancing TWCM in Melbourne (Figure 4.3). Other organisations which were rated as 'fully committed' included South East Water (18%), the Department of Sustainability and Environment (17%), Yarra Valley Water (14%) and the Environment Protection Authority (12%). As demonstrated in Figure 4.3, the other organisations tested were perceived to have relatively low levels of commitment to TWCM.

By combining the top two commitment ratings, Melbourne Water was clearly rated (60%) as the most 'committed' organisation to advancing TWCM in Melbourne (see Figure 4.4). The next most 'committed' organisations were perceived to be the Department of Sustainability and Environment (46%), Sustainability Victoria (44%) then South East Water and Yarra Valley Water (at 40% and 39% respectively). Other organisations with only a 'part' role in urban water management in Melbourne had low perceived commitment ratings, but also a high number of 'I don't know' responses. For example, as demonstrated in Figure 4.4, the State-based regulators of health (Department of Human Services) and the economy (Essential Services Commission) received high 'I don't know' responses (42% and 52% respectively).

Figure 4.3: Perceived Level of Organisational Commitment to Advancing Total Water Cycle Management in Melbourne

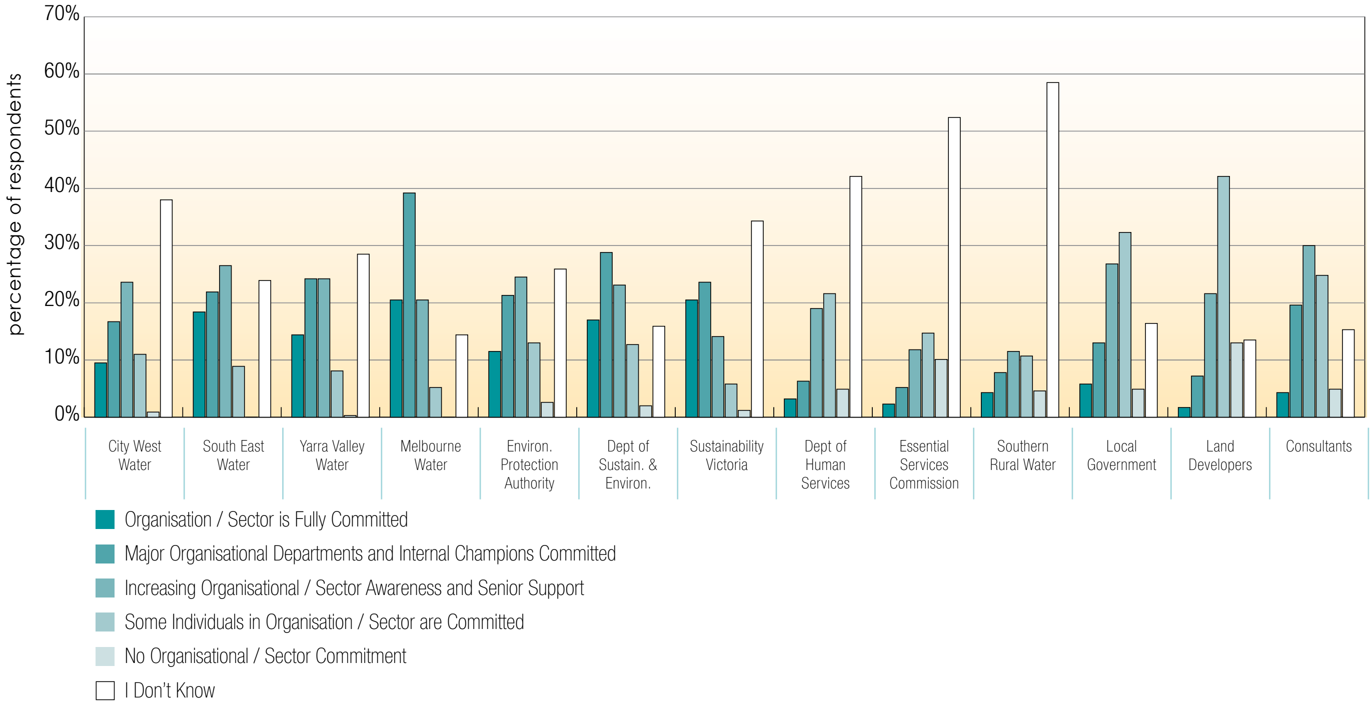
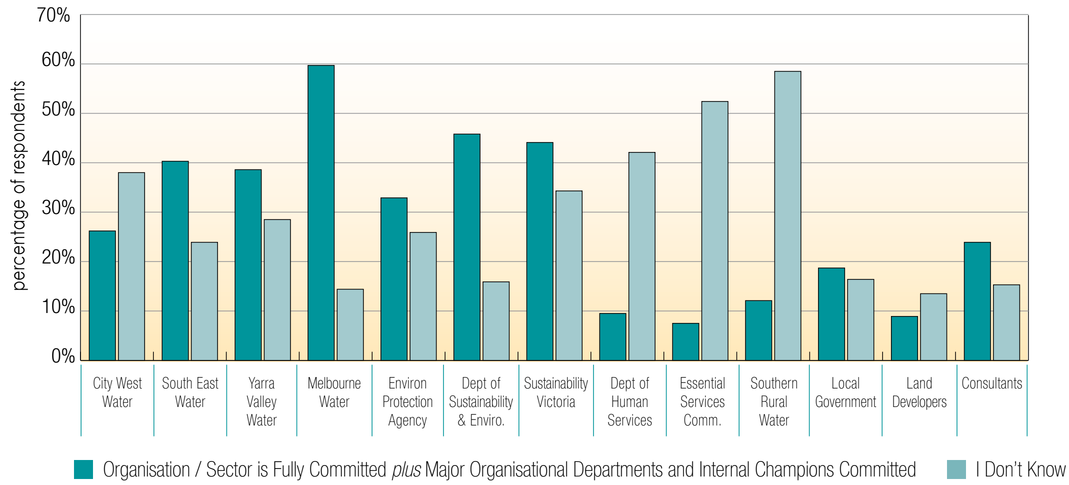


Figure 4.4: Perceived Level of Organisational Commitment to Advancing Total Water Cycle Management in Melbourne: Top Two Ratings



5. Key Perth Case Study Findings

This section provides an overview of the survey results specific to Perth. Overall, Perth respondents were receptive to adopting and using diverse water supplies and improving the quality of receiving waterways. However, professionals operating in Perth's urban water sector identified numerous institutional barriers, which they believed prevented the development of a diverse water source approach. Also, more barriers were identified for implementing stormwater treatment technologies than in either Brisbane or Melbourne.

5.1 Receptivity to Diverse Water Sources and Uses

As shown in Table 5.1, Perth respondents had the highest level of support for the development of rainwater, greywater, stormwater and sewage. They also believed that 'their organisation', 'the community' and 'state politicians' supported the development of these diverse water sources. They demonstrated the lowest level of support for new dams as well as relatively low support for further development of groundwater sourced from the superficial aquifer.

Table 5.1: Perceived Importance of Developing Diverse Water Sources in Perth (high and very high importance ratings)

0-19%	20-39%	40-59%	60-79%	80-100%
New Dams	Groundwater (superficial aquifer)	Water Trading Seawater Groundwater (confined aquifer)	Rainwater Greywater Stormwater Sewage	

As shown in Table 5.2, receptivity to diverse water source uses generally decreased with increasing personal contact, except for rainwater for which receptivity increased with increasing personal contact. Perth respondents demonstrated a high level of receptivity to using rainwater for drinking and indoor household use and low receptivity for its use for public open space and industry. There was very low receptivity to the use of greywater, stormwater and sewage for drinking and low receptivity to these sources for indoor household use. There was also low receptivity for the use of seawater for indoor household use. For outdoor household use, respondents demonstrated low receptivity to seawater and high receptivity to greywater use. Respondents identified high receptivity to the use of sewage and stormwater for public open space and and low receptivity to the use of rainwater and seawater. For environmental flows there was low to average receptivity for all sources, and for industry there was low receptivity for rainwater and groundwater and high receptivity for sewage.

Table 5.2: Professional Receptivity to Diverse Water Source Uses in Perth

	VERY LOW n = 0-19%	LOW n = 20-39%	AVERAGE n = 40-59%	HIGH n = 60-79%	VERY HIGH n = 80-100%
DRINKING	Greywater Stormwater Sewage		Seawater Groundwater	Rainwater	
INDOOR HOUSEHOLD USE		Greywater Stormwater Sewage Seawater	Groundwater	Rainwater	
OUTDOOR HOUSEHOLD USE		Seawater	Rainwater Stormwater Sewage Groundwater	Greywater	
PUBLIC OPEN SPACE		Rainwater Seawater	Greywater Groundwater	Stormwater Sewage	
ENVIRONMENTAL FLOWS		Greywater Sewage Seawater Groundwater	Rainwater Stormwater		
INDUSTRY		Rainwater Groundwater	Greywater Stormwater Seawater	Sewage	

5.2 Perceptions of Drivers and Barriers to SUWM Technologies

Respondents were asked to rate how each of the social and institutional factors listed in Table 1.2 influence the uptake of the selected SUWM technologies. As shown in Table 5.3, factors were identified as barriers, drivers or neutral. Where factors attracted an evenly distributed rating across barrier and driver, they are reported as 'mixed'.

As shown on the following page in Table 5.3, Perth professionals identified far more barriers than drivers for the adoption of SUWM technologies with slightly more drivers identified for the adoption of stormwater quality treatment technologies:

- 'Community perceptions' were perceived to act as a driver for all stormwater treatment technologies and for rainwater tanks, however, they were also believed to be a barrier to the adoption of third-pipe technologies in existing areas and potable reuse schemes. There were mixed views about the influence of 'community perceptions' on third-pipe technologies in greenfield areas.
- 'Environmental outcomes' were perceived as a driver for the adoption of all technologies except potable reuse schemes, which received mixed views.
- 'Public health outcomes' were considered a barrier to the adoption of all tested diverse water source technologies in Perth. They were considered a driver for stormwater treatment technologies at the regional scale and neutral influence at either the local or precinct scale.
- 'Social amenity' was considered a driver for all stormwater quality treatment technologies. This factor was not tested for diverse water source technologies.
- 'Technical feasibility and performance' was considered to prevent the uptake of all tested technologies.
- 'Professional knowledge and expertise' was generally perceived as a barrier, although there were mixed views about the impact on regional and precinct scale stormwater quality treatment technologies and neutral views for rainwater tanks.

5. Key Perth Case Study Findings

Table 5.3: Respondent Assessment of Drivers and Barriers to SUWM Technologies in Perth

Social & Institutional Factors Tested	On-site Technologies		Third-pipe Technologies		Potable Reuse Schemes		Stormwater Quality Treatment Technologies		
	Raintank	Greywater	Greenfield	Existing	Indirect	Direct	Local	Precinct	Regional
Community Perceptions	Driver (N = 27%)	Barrier	Mixed	Barrier (N = 25%)	Barrier	Barrier	Driver (N = 28%)	Driver (N = 28%)	Driver
Environmental Outcomes	Driver (N = 28%)	Driver	Driver	Driver	Mixed	Mixed	Driver	Driver	Driver
Public Health Outcomes	Barrier (N = 29%)	Barrier	Barrier (N = 26%)	Barrier (N = 29%)	Barrier	Barrier	Neutral	Neutral	Driver (N = 35%)
Social Amenity	Not Tested						Driver	Driver	Driver (N = 28%)
Technical Feasibility & Performance	Barrier (N = 39%)	Barrier	Barrier (N = 29%)	Barrier (N = 27%)	Barrier	Barrier (N = 27%)	Barrier (N = 32%)	Barrier (N = 29%)	Barrier (N = 27%)
Professional Knowledge & Expertise	Neutral	Barrier	Barrier (N = 28%)	Barrier (N = 31%)	Barrier	Barrier	Barrier	Mixed	Mixed
Government Policy	Mixed	Barrier	Barrier (N = 27%)	Barrier	Barrier	Neutral	Barrier (N = 29%)	Barrier (N = 26%)	Barrier (N = 27%)
Management Arrangements & Responsibilities	Neutral	Barrier (N = 29%)	Barrier	Barrier	Barrier	Barrier	Barrier	Barrier	Barrier
Regulation / Approvals Processes	Neutral	Barrier	Neutral	Barrier	Barrier	Barrier	Barrier (N = 27%)	Barrier (N = 27%)	Barrier (N = 26%)
Property Access Rights	Neutral	Neutral	Barrier	Barrier (N = 34%)	Neutral	Neutral	Neutral	Neutral	Neutral
Capital Costs	Barrier	Barrier	Barrier	Barrier	Barrier	Barrier	Barrier	Barrier	Barrier
Maintenance Costs	Barrier	Barrier	Barrier	Barrier	Barrier (N = 28%)	Barrier	Barrier	Barrier	Barrier

Barrier	Factor generally prevents the uptake of the technology
Mixed	Factor attracted an evenly distributed rating of preventing and encouraging the uptake of the technology
Driver	Factor generally encourages the uptake of the technology
Neutral	Factor neither prevents nor encourages the uptake of the technology

It is important to note that these receptivity indicators (i.e. driver, barrier, mixed and neutral) represent the overall trend of the aggregated results as detailed in the two main reports. Where the barrier or driver has comparatively less strength because of the proportion of respondents who selected 'neutral' or 'I don't know', we have included that percentage under the indicator in the table:

? = percentage of respondents who selected 'I don't know?'

N = percentage of respondents that identified the indicator as 'neutral'.

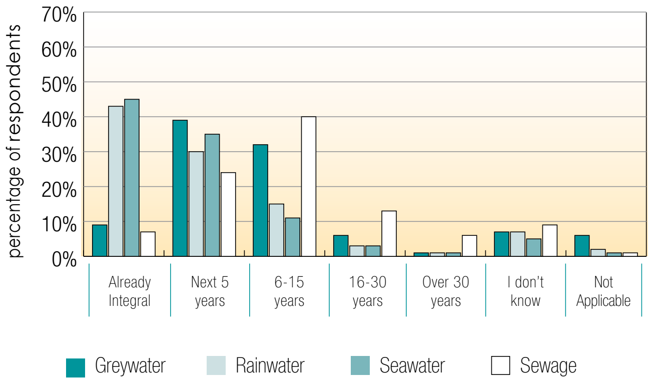
As shown in Figure 2.2, 65% of Perth respondents considered their institutional framework to be ineffective for promoting the adoption of TWCM practices and 50% considered institutional arrangements constrained the adoption of WSUD. Further emphasising this point were other perceived institutional barriers:

- 'Government policy' was considered a barrier to the majority of tested technologies, despite being mixed for rainwater tanks and neutral for direct potable reuse.
- 'Management arrangements and responsibilities' were considered a barrier to all tested technologies with the exception of rainwater, which received a neutral response.
- 'Regulation approvals processes' were considered a barrier to all tested technologies except for rainwater tanks or third-pipe technologies in greenfield areas, where they were not perceived to be an influencing factor.
- 'Property access rights' were believed to limit the adoption of third-pipe technologies in greenfield and existing areas.
- Both 'capital' and 'maintenance' costs were considered barriers to the uptake of all technologies tested.

5.3 Projected Implementation Timeframes

Respondents were asked to predict implementation timeframes for the development of specific water sources and stormwater treatment technologies. As shown in Figure 5.1, over 40% of respondents in Perth considered rainwater and seawater as already integral to conventional water supplies and almost 60% indicated that new dams and groundwater (confined and superficial) were also already integral. Respondents believed that most development would be over the next 5 years and the next 6 to 15 years in comparison with respondents from the other cities, who predicted longer development timeframes. Perth respondents also had fewer 'I don't know' responses in comparison to Brisbane and Melbourne.

Figure 5.1: Envisaged Timeframes for the Implementation of Diverse Water Sources in Perth



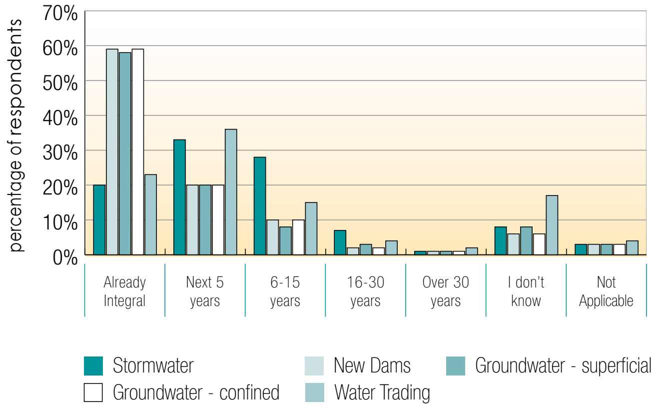
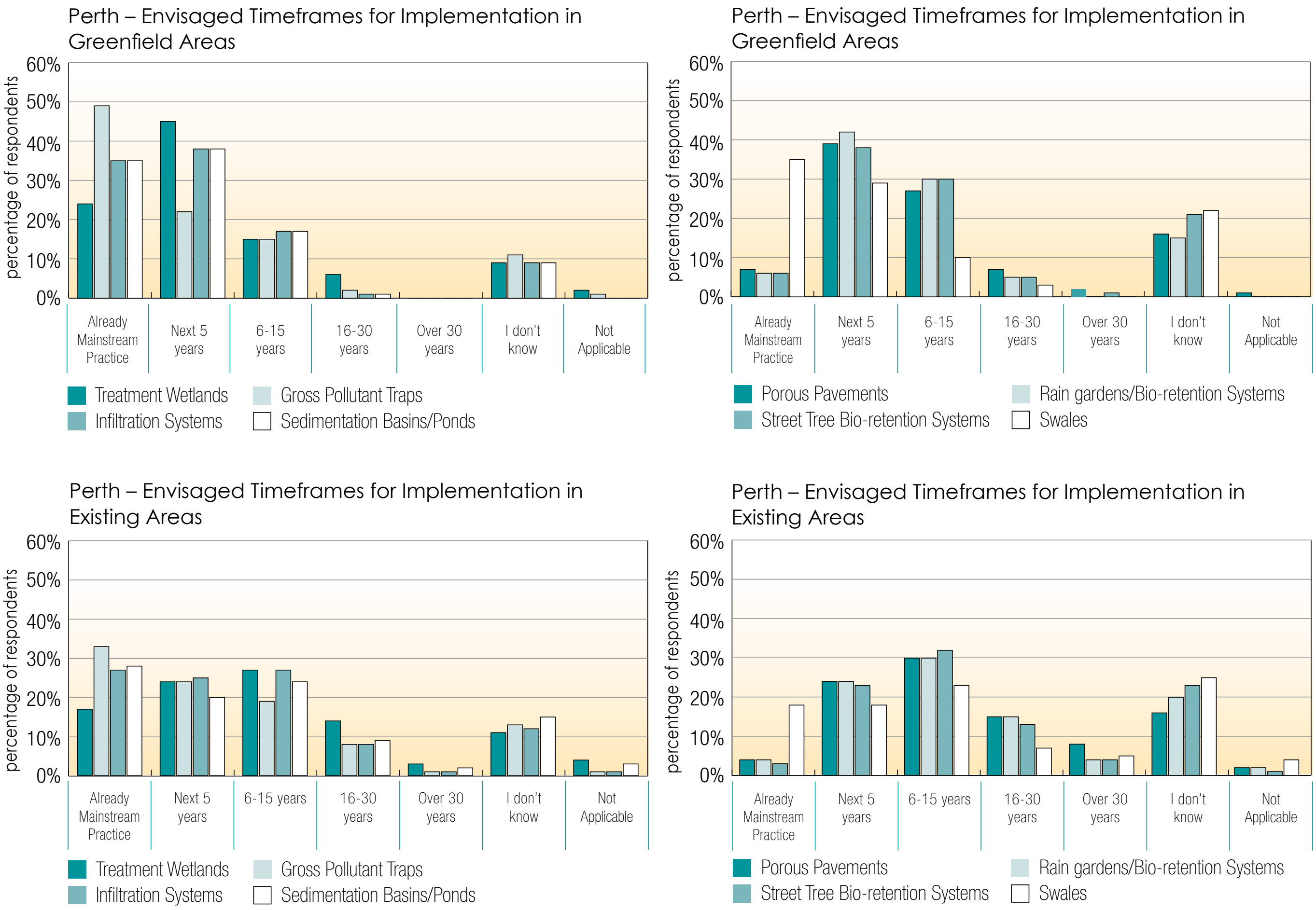


Figure 5.2, on the following page, presents the predicted timeframes for the implementation of stormwater quality treatment technologies in greenfield and existing areas of Perth. Overall, 49% of respondents considered gross pollutant traps as mainstream in greenfield areas and 35% also perceived infiltration systems, sedimentation basins and 'swales' were mainstream in greenfield areas. Gross pollutant traps were considered by 33% of respondents in Perth to be mainstream in existing areas. Overall, the majority of treatment technologies were envisaged to be developed over the next five years with ongoing development for up to 15 years for greenfield areas. For existing areas, technology application was considered to be concentrated over the next 6-15 years and up to 30 years. There were relatively high 'I don't know' responses for many of the technologies.

Figure 5.2: Envisaged Timeframes for the Implementation of Stormwater Quality Treatment Technologies in Perth



5.4 Stakeholder Commitment

Respondents clearly identified that the most 'committed' organisation to advancing total water cycle management in Perth was the Water Corporation (22%). As with Brisbane and Melbourne, respondents considered organisations with a major responsibility for urban water management as more committed than organisations with a 'part' role. The next most 'fully committed' organisations include the Environmental Protection Authority, Swan River Trust and the Department of Water (between 10-12%) (Figure 5.3).

Through combining the top two commitment ratings, a clearer picture emerges as demonstrated in Figure 5.4. The Water Corporation (49%) remains the 'most committed', closely followed by the Department of Water (45%), Environmental Protection Authority (37%) and the Department of Environment and Conservation (37%) and the Swan River Trust (36%). Again, in a similar manner to Brisbane and Melbourne, the economic and health regulators attracted large 'I don't know' responses to their overall commitment to advancing TWCM.

Figure 5.3: Perceived Level of Organisational Commitment to Advancing Total Water Cycle Management in Perth

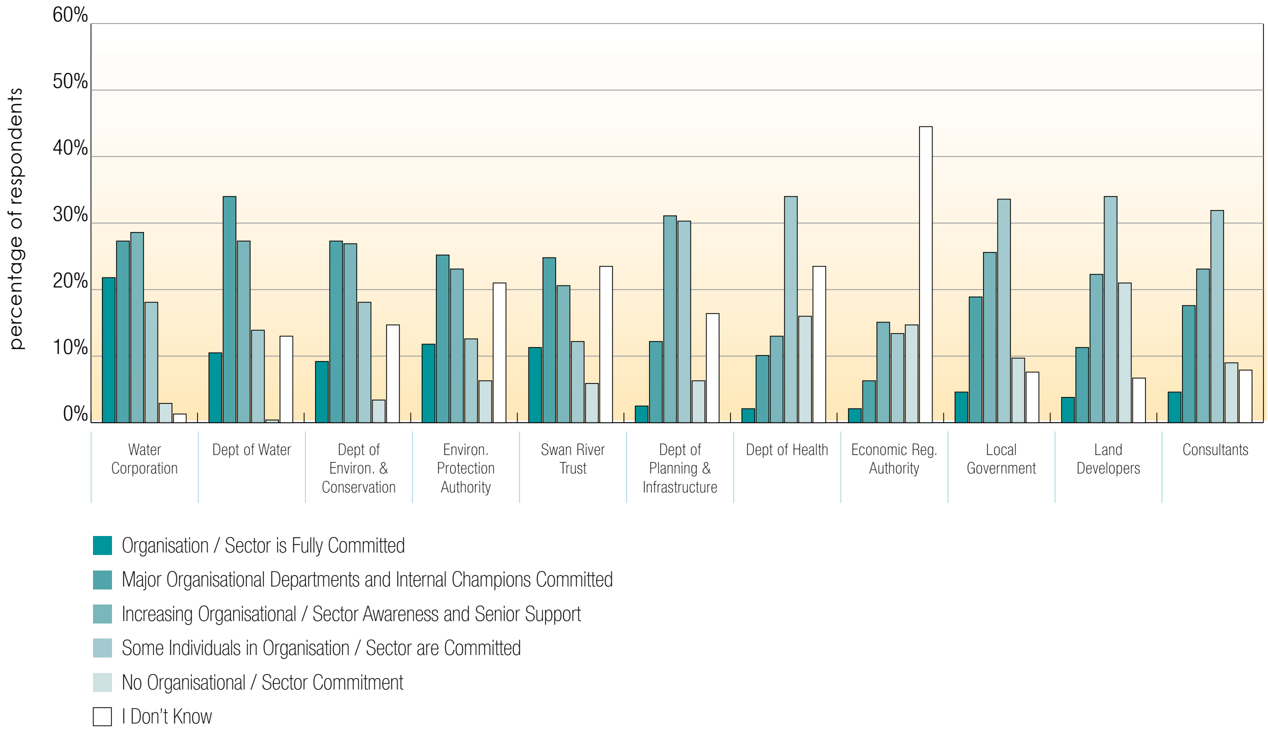
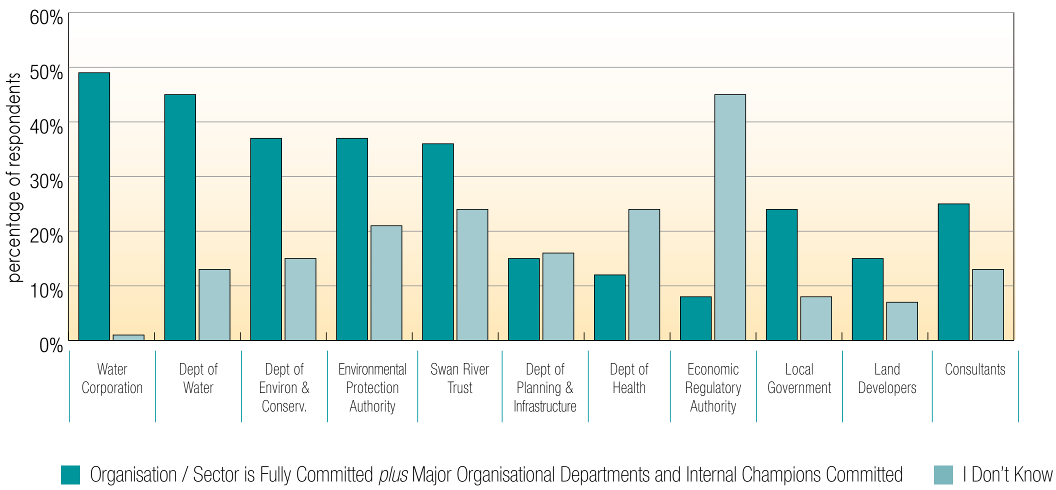


Figure 5.4: Perceived level of Organisational Commitment to Advancing Total Water Cycle Management in Perth: Top Two Ratings.



6. Advancing SUWM:
Future Receptivity Development Needs

As presented in the main reports, the survey findings were analysed to assess the receptivity or overall readiness of professionals in the urban water sector to develop diverse water supplies and to protect waterway health. The aim was to reliably inform the design of future policy programs and capacity building initiatives to better match the issues as perceived by practitioners. This section provides an assessment of the receptivity attributes including association, acquisition and application and the 'key' recommendations for improving the sector's receptivity to SUWM. Section 1.3 provides an overview of the concept of receptivity.

6.1 Perceived Benefits: Association

Despite reasonably strong support for developing diverse water sources for addressing the current water supply problem, respondents identified a range of barriers to the implementation of technologies that deliver a diverse water supply approach. The only clear driver for these technologies was the perception of improved environmental outcomes. 'Public health outcomes' and 'community perceptions' of these supply technologies were generally perceived as a barrier, and the professional community in the urban water sector clearly held a number of reservations in regard to supporting these technologies.

However, the level of association or perception of benefits with the stormwater quality treatment technologies is overall clear and strong; respondents do not face the same level of association tension as with the diverse water supply technologies. Comparatively, respondents see reasonably strong alignment and support for stormwater quality treatment technologies. 'Community perceptions', 'environmental outcomes', 'public health outcomes' and 'social amenity' were generally perceived as drivers and therefore reinforce a strong association (or perception of benefits), yet respondents believe that state politicians do not set priorities for these factors. Given the stronger overall association for stormwater quality treatment technologies it would also suggest that developing stormwater as a source may be a pertinent focus for the future.

Key Recommendation: Addressing Association
While there is broad recognition of the environmental benefits from pursuing diverse water sources and technologies within the professional community, clearly many professionals still perceive a significant risk to public health. This may also account for the perception that the 'technical feasibility and performance' of these diverse water source technologies (except rainwater tanks) is questionable. This is a fundamental association tension that needs to be addressed if a diverse water supply approach is to be realised. While there were low levels of support for drinking many of the listed diverse water sources, there was much higher support for their other non-consumptive purposes. The concern with risk to public health needs to be further investigated within the professional community with regards to whether this equally applies to the future 'fit-for-purpose' use scenario as it does with the contemporary convention of centralised, single-pipe, potable water supply. An independent scientific review is required to establish the known and envisaged 'risks' to public health in relation to each of these, and this information needs to be widely disseminated for broader public discussion with the professional community and others. It is important that any risk profiling is done in context and in comparison to other relevant examples, such as, how do the public health risks compare with other community interactions and responsibilities, such as managing household swimming pools?

6.2 Skills and Resources: Acquisition

Given the tension between the perception of 'poor public health outcomes' from diverse water sources despite overall positive perceptions of 'environmental outcomes', it is inevitable that there will be low acquisition capacity. Therefore, it is not surprising that respondents rated a significant majority of the acquisition variables (skills, systems and resources) as barriers, with a few exceptions. This suggests that the urban water industry is struggling to develop the requisite human resource capacity and institutional infrastructure to promote and successfully implement diverse water supply technologies. This would indicate that it is more likely that centralised options such as desalination, new dams and water trading will be favoured in future decision-making (without also prioritising the more decentralised technologies) unless there are sufficient interventions targeted at improving skills, resources, and systems to address the acquisition barriers identified.

For stormwater quality treatment technology implementation in the Brisbane and Melbourne case studies, there are fewer perceived acquisition barriers, particularly in relation to feasibility, expertise and government policy. In Perth, however, all of the tested acquisition factors were perceived as barriers. This is perhaps a reflection of Perth's more complex groundwater-dominated drainage system, which may exacerbate the perceived barriers in Perth.

Key Recommendation: Addressing Acquisition
The survey results demonstrate that there is a clear need for professional capacity building (knowledge and skills training) for the diverse water source technologies, and equivalent capacity building for stormwater quality treatment technologies in Perth. This should be in the form of technical and scientific training, alongside policy and institutional learning programs. Professional capacity building programs should focus on exposing professionals to the best available science and the

facilitation of informative training sessions that encourage industry professionals to raise concerns and ask questions that can inform the development of targeted policy mechanisms and encourage further proactive implementation. Such training programs would help address the perceived 'technical feasibility and performance' issues in relation to the diverse water source technologies. Also, such processes could stimulate new and/or improve current research agendas.

It is also essential that well designed demonstration projects around each of the technologies are supported for learning purposes and that these projects involve the government, developers, community groups, universities and research institutions. This would require the demonstration project to have a dedicated capacity building program design and budget at project inception. Learning programs would not only focus on important operational issues, but also focus on institutional learning where lessons for policy makers, technology/science experts, and the construction/maintenance professionals are captured and reinforced for the benefit of the broader sector. These programs would assist government officials in gaining knowledge about enabling proactive and equitable distribution of responsibilities and how to reward innovation and leadership in the sector. In addition, such programs may also support an improved understanding of how to use regulatory powers to stimulate sound and proactive SUWM practices.

6.3 Incentives for Implementation: Application

With a mixed level of association, and poor acquisition capacity, it is expected that application receptivity (perceptions of enabling frameworks for implementation) would be low. This is reflected by a majority of respondents believing that their current institutional arrangements are generally ineffective for enabling TWCM and WSUD. This is also substantiated by 'management arrangements' and 'regulation / approvals processes' being broadly perceived as outright barriers across technology types in the three cities. These results clearly indicate that there is a critical lag between best SUWM thinking and current practice.

While there is a lack of a central database for determining current implementation rates of these diverse water sources and stormwater quality treatment technologies in each city, a proportion of the respondents believed some of the technologies would be developed over the next 5 years and 6 to 16 years. This suggests that professionals in the urban water sector expect that the requisite improvement in skills, systems and resources will be achieved. However, there remains a major concern that with the current high rates of population growth and development in each of the cities, there will be significant lost opportunities for advancing the SUWM approach, which may further reinforce the traditional approach.

Key Recommendation: Addressing Application

It is important that policy-makers focus on addressing the association and acquisition issues reported here, as overcoming these limitations is essential to realising application and therefore enabling strong receptivity for the practice of SUWM. To address application issues, it is critical that policy-makers and strategists work in partnership with technologists and local planners to understand the priorities of the day-to-day systems that shape decisions, and create opportunities to innovate, at the project scale through to policy development. Adaptive governance, involving 'learning-by-doing' experiments, where the government leads by underwriting the risk and/or providing market-based incentives for professional and broader institutional learning is needed to enable the shift towards SUWM.

6.4 Stakeholder Commitment: Need for a Common Vision

There was a common trend across the three cities where organisations with the primary responsibility for water received a higher perceived organisational commitment rating, and local government (except Brisbane City Council) and developers received a lower overall rating. Across the three cities, only three organisations attracted a high commitment rating (over 50%); therefore the significant majority of organisations were perceived to not have the requisite commitment to advancing SUWM. However, a substantial proportion of respondents rated organisations with a broader charter than water with a high number of 'I don't know' responses. This is notable given that SUWM requires a multi-sectoral and inter-organisational approach.

Key Recommendation: Need for a Vision

Given the high level of perceived variability in stakeholder commitment, it is recommended that all Australian cities lead on facilitating an envisaging process for a sustainable water future as part of creating a Water Sensitive City. The survey results of such varying levels of commitment indicate that perhaps key stakeholders do not share a common vision of SUWM and lack a shared understanding of the different stakeholder roles in contributing to this vision. This envisaging needs to have dedicated policy resources, and involve key urban water leaders and other sustainability leaders from each of the major stakeholder groups. The vision timeframe needs to be far enough into the future so that participants do not become constrained by the decisions and cultures of today - it is likely that 30 to 50 years into the future would be appropriate. This can then be used for backcasting and strategic scenario analysis. It is important to note that the process of creating the vision is almost as important as the vision itself, as it will have valuable capacity building and institutional learning benefits.

7. Next Steps for the National Urban Water Governance Program

This report is the first stage in a broader program of research aimed at addressing the key research question of what are the institutional factors most important for enabling a Water Sensitive City. The purpose of this report is to disseminate the interim findings to the Australian water sector. These results will contribute to a detailed cross case analysis of the three case study cities (Brisbane, Melbourne and Perth) also drawing upon qualitative data from over 250 in-depth interviews with urban water professionals. City based case reports and a cross case analysis report will be released in 2008.

The Program team is currently working with partner organisations to address the recommendations of this research and other projects. In addition to the research currently underway, the next two major research projects include:

- Institutional Learning Research – this research project is focused on identifying new policy and institutional learning mechanisms that should be introduced as an integral part of the establishment and operation of SUWM projects. Such mechanisms would assist in building professional capacity, enhancing opportunities for innovation and addressing equitable distribution of risk amongst stakeholders, which together will expedite the practice of SUWM.
- Envisaging Water Sensitive Cities – this involves the Program team interacting with policy-makers, strategists and others to encourage cities to facilitate an envisaging process of desired sustainable water futures. This will contribute to overcoming the breadth of the social and institutional barriers identified in relation to the lack of a common water management focus among stakeholders, which is further compounded by a lack of agreement (and sometimes confusion) over what SUWM is, and how it could be fast-tracked. The Program's research, along with other technical and physical environmental research, would critically underpin this future activity.

It is hoped that the Program's research will contribute to the current and future sectoral reform activity in Australia, as well as inform the design needs of institutional capacity building programs and interventions. There is sufficient evidence to support informed dialogue, and action, on how we can best facilitate the social, institutional and bio-physical processes for realising Water Sensitive Cities in Australia.

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