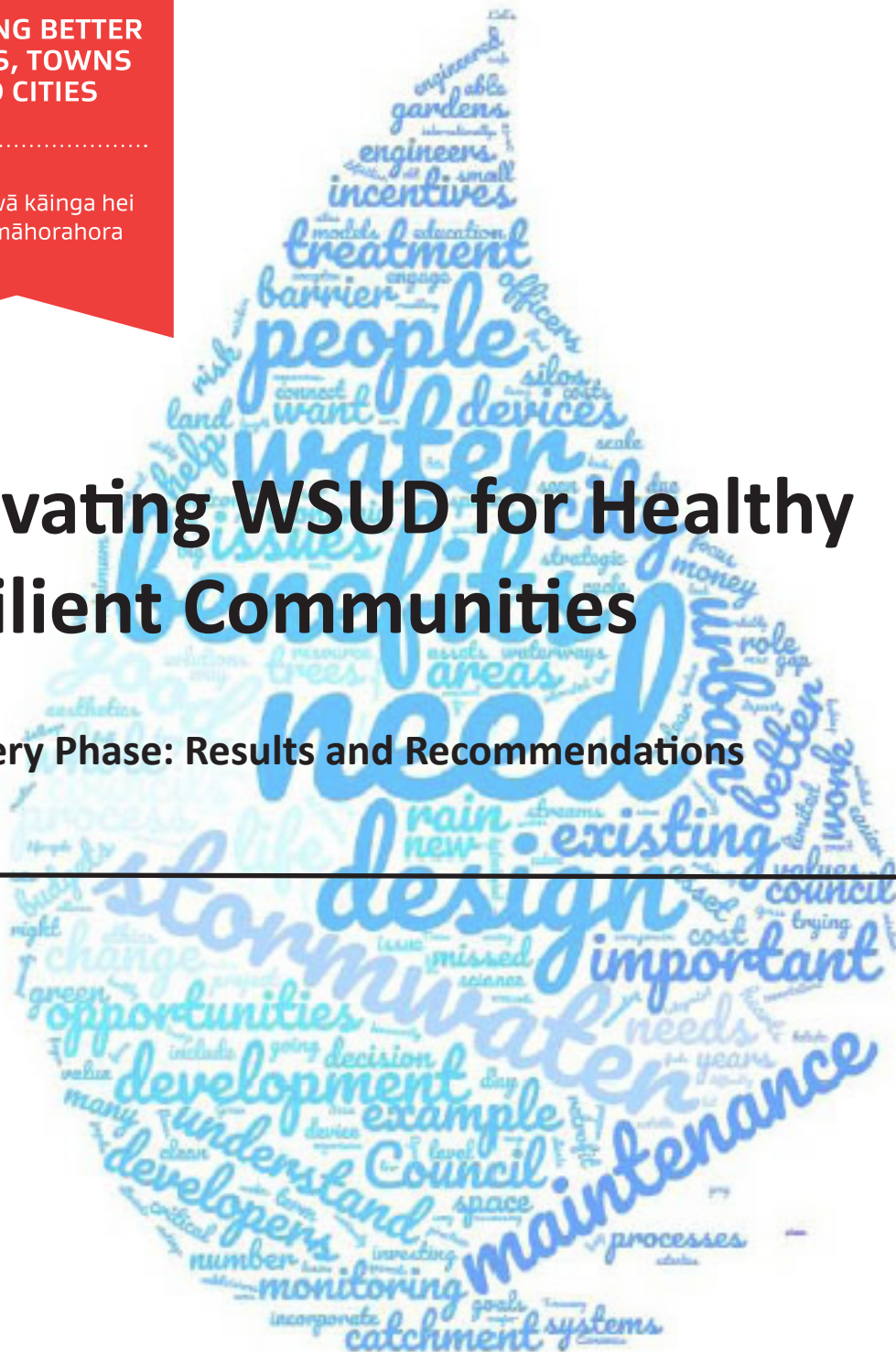


**BUILDING BETTER
HOMES, TOWNS
AND CITIES**

Ko ngā wā kāinga hei
whakamāhorahora

Activating WSUD for Healthy Resilient Communities

Discovery Phase: Results and Recommendations



Activating WSUD for Healthy Resilient Communities – Discovery Phase: Results and Recommendations

Funded by the Building Better Homes, Towns and Cities National Science Challenge

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Page 1 'word cloud' reflects statements made by workshop attendees in Auckland (Nov 2017) and Christchurch (Dec 2017) on the 'burning issues' associated with barriers to the uptake of WSUD.



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Executive Summary

The Building Better Homes Towns and Cities National Science Challenge (BBHTC) has commissioned the project, 'Activating Water Sensitive Urban Design (WSUD) for healthy, resilient communities'. The project aims to deliver research and enhance capability to address critical current barriers to the uptake of WSUD in New Zealand. There are three phases to the project. Phase 1 is the discovery phase, involving engagement with WSUD stakeholders to determine the project's subsequent research priorities. The **purpose of this report** is to describe the findings of Phase 1 and make recommendations for research activities in Phase 2 of the project. Collectively, the research activities in and beyond Phase 2 aim to produce evidence and tools to support the business case for, and implementation of, water sensitive urban design approaches in New Zealand.

Phase 1 involved two principal activities, both aimed at eliciting views from WSUD practitioners and other stakeholders to guide this research. The first was a short on-line survey, asking five questions about the barriers and activating factors associated with the uptake of WSUD. Seventy responses to the survey were received from participants across New Zealand, which also included information on respondents' field of expertise, sector and region. Secondly, two workshops were held, one in Auckland and one in Christchurch, allowing more detailed discussion of WSUD barriers. Each workshop was attended by more than 20 participants and included sessions on 'burning issues', a field walking tour of WSUD devices and an evaluation of where New Zealand cities lie on the pathway to adopting more water sensitive approaches. The results of the survey and workshops have been analysed to identify the relative frequency of 15 themes and the key messages within each of these themes.

The findings of Phase 1 demonstrate strong convergence between the outcomes of the survey and workshops, international experience and other New Zealand research in the area. The overall sentiment is that there is a need to review management of the urban water cycle in New Zealand. Specifically, the capacity of current approaches to meet the reasonably foreseeable future requirements for urban liveability in New Zealand. This capacity needs addressing across the entire value chain, from design through regulatory processes to implementation. Motivating factors include: the frequency and intensity of weather events associated with climate change; congestion and capacity issues with current urban water cycle interventions; and increasing sensitivity to Māori needs and aspirations, including as development partners.

WSUD as concept and practice has proven effective internationally but has not been widely taken up in the NZ/Aotearoa context. While similarities exist, there are important differences between the NZ/Aotearoa context and international examples. That "kiwi" context includes WSUD as a purely stormwater oriented approach as opposed to a component of an integrated three waters management strategy. In New Zealand WSUD economics are narrowly understood, and uncertainty promotes inertia which favours and entrenches status quo practice.

Phase 2 of the project will involve a series of short term (9 to 12 month) actions that can deliver on high priority 'quick wins' identified in Phase 1. Recommendations are made for three core research activities, three further discovery activities, and two activities involving the enhancement and dissemination of existing information sources.

The three "**core research**" activities proposed are titled:

- "Understanding the full lifecycle costs of WSUD",
- "Characterising, evaluating and demonstrating the full benefits of WSUD", and,
- "Guidance for operations-led design and construction of WSUD in Aotearoa/NZ"

“Understanding the full lifecycle costs of WSUD” will consist of a compilation of costs data that builds on well-progressed work in this space and addresses a high frequency theme in survey and workshop responses: the need for robust data on WSUD costs, especially maintenance costs.

“Characterising, evaluating and demonstrating the full benefits of WSUD” will develop a vision of what an Aotearoa/NZ version of WSUD actually is and could be, assemble and review information on benefits and evaluation methods and develop a co-ordinated long-term plan for monitoring and evaluating the delivery of these benefits, a key requirement for the building of a robust evidence base to support WSUD uptake.

“Guidance for operations-led design and construction of WSUD in Aotearoa/NZ” will review NZ regional design and maintenance practices, targeting demand from regions outside of those where uptake of WSUD is most progressed and brownfield/retrofit settings.

Activities characterised as “**further discovery**” are:

- “WSUD and Te Ao Māori: scoping exercise”,
- “Investigating WSUD barriers: roading and development sectors”, and,
- “Knowledge transfer: learning from the Australian experience”.

The “WSUD and Te Ao Māori: scoping exercise” will begin to address a major gap identified in Phase 1 – the need to develop an understanding of the extent to which WSUD does and could further deliver culturally-specific benefits.

“Investigating WSUD barriers: roading and development sectors” will address the remaining major gap identified in the discovery phase – the need to develop an understanding of the relative influence of other mandates in determining the actions of these sectors in respect of uptake of WSUD principles in their domains.

“Knowledge transfer: learning from the Australian experience” will harness the well advanced Australian experience to assist in the development of NZ/Aotearoa WSUD. While recognising the need for NZ -specific guidance, there is likely to be significant value in learning and reflecting on insights generated by our Australian peers and importing relevant international best practice to NZ.

Activities characterised as “**Enhancement and dissemination of existing information sources**” are:

- “WSUD success stories: awards evaluation protocol and website scoping exercise”, and,
- “Incentives: international options analysis for NZ/Aotearoa WSUD.”

“WSUD success stories: awards evaluation protocol and website scoping exercise” aims to help build capacity and provide a hub for the NZ/Aotearoa WSUD community.

“Incentives: international options analysis for NZ/Aotearoa WSUD” will build on existing work to collate and evaluate US/European approaches, conduct and disseminate critical analysis in order to create a high value contribution to the toolbox of enabling mechanisms for government and local authorities.

The range of activities proposed for Phase 2 aim to support innovation across the value chain and the governance contexts to grow a NZ/Aotearoa version of WSUD concepts, designs, and technology that addresses these emergent needs for burgeoning New Zealand urban environments. However, the research team recognise that for these Phase 2 ‘quick wins’ to bear fruit, a significant longer-term programme of research and implementation is required. As well as developing such a programme (as part of the Phase 2 outputs), the long-term goal of ‘Activating WSUD’ in New Zealand will benefit from close on-going collaboration with other relevant initiatives and research activities.

1. Introduction

1.1 Background

The Building Better Homes Towns and Cities National Science Challenge (BBHTC) is funding the 'Activating Water Sensitive Urban Design (WSUD) for healthy, resilient communities' research project. The project aims to deliver research and enhance capability to address critical current barriers to the uptake of WSUD in New Zealand.

WSUD is an alternative to conventional forms of urban development. It aims to integrate urban planning and water management in order to better manage, for example, water supply security, water quality in natural waterbodies, flood risk and amenity values of waterbodies^{1,2}. While different jurisdictions place emphasis on different aspects of WSUD³, the following concepts are particularly evident in a New Zealand 'understanding' of what WSUD comprises⁴.

Firstly, WSUD aims to limit stormwater runoff and contaminant generation at source by minimising the construction of impervious surfaces, such as roads and roofs. This can be achieved, for instance, by building clusters of multi-storey dwellings in order to retain relatively large areas of undeveloped green space. Secondly, WSUD aims to maintain the functioning of natural drainage systems, rather than replacing stream networks with piped systems. In combination, these practices aim to maintain characteristics of catchment hydrology, including infiltration, groundwater recharge and stream flow characteristics, similar to those that existed pre-development. Thirdly, WSUD uses green technologies to better manage stormwater in a way that complements its approach to land use planning. The use of permeable paving, for instance, helps to promote infiltration and reduce stormwater runoff. Bioretention systems, or raingardens, also provide for runoff control while providing treatment to improve stormwater quality via the removal of contaminants as stormwater infiltrates through an engineered soil media. Wetlands also provide stormwater treatment and runoff control, as well as providing habitat and amenity services. WSUD can also feature riparian planting, or the revegetation of stream banks, to improve stream habitat quality and connectivity.

In New Zealand, WSUD clearly has a strong focus on management of stormwater and receiving water bodies. While consideration of its potential role in the water supply and wastewater sectors and in relation to wider (including non-water) contributions to urban liveability have received little attention, a future-focused approach recognises these other opportunities and areas of impact. For instance, a WSUD approach can mean providing an alternative water supply to enhance drought resilience. It can also mean contributing to urban amenity and community health through WSUD providing multi-functional green spaces to recreate and seek shade. While acknowledging the current stormwater focus of WSUD in New Zealand practice, this research considers it important to recognise that a truly WSUD approach can include some or all of these wider potential role(s).

¹ Mouritz, M., M. Evangelisti, and T. McAlister. 2006. Water sensitive urban design. In: T. Wong, ed., Australian Runoff Quality. Engineers Australia, Sydney, Australia, pp. 5-1–5-22.

² Hoyer, J., W. Dickhaut, L. Kronawitter, and B. Weber. 2011 Water Sensitive Urban Design: Principles and Inspiration for Sustainable Stormwater Management in the City of the Future. Jovis, Berlin, Germany, p. 144.

³ Fletcher, T., W. Shuster, W. Hunt, R. Ashley, D. Butler, S. Arthur, S. Trowsdale, S. Barraud, A. Semadeni-Davies, J.-L. Bertrand-Krajewski, P. Mikkelsen, G. Rivard, M. Uhl, D. Dagenais, and V. Viklander. 2014. SUDS, LID, BMPs, WSUD and more – the evolution and application of terminology surrounding urban drainage. Urban Water Journal 12(7): 525-542.

⁴ For instance, in Auckland – see Lewis, M., J. James, E. Shaver, S. Blackburn, A. Leahy, R. Seyb, R. Simcock, P. Wihongi, E. Sides, and C. Coste. 2015. Water Sensitive Design for Stormwater, Auckland Council Guideline Document GD2015/004. Auckland Council, Auckland, New Zealand, p.193.

1.2 Project overview

There are three phases to the project. Phase 1 is the discovery phase, involving engagement with WSUD's community of practice to determine the project's subsequent research priorities. The **purpose of this report** is to describe the findings of Phase 1 and make recommendations for research activities in Phase 2 of the project.

Phase 2 activities comprise short term (9 to 12 month) research that can deliver on high priority 'quick wins' identified in Phase 1. In Phase 3 of the project, the research team will disseminate research findings from the 'quick win' activities as well as delivering a co-designed and prioritised longer-term plan for the continued delivery and implementation of WSUD research, beyond the life of this project.

1.3 Scope of discovery phase

The scope of the discovery phase of the project is to:

- Form an External Advisory Group (EAG) to provide guidance on the detailed design and delivery of the research⁵.
- Activate and engage a WSD community of practice via a survey and action research workshops, including WSUD case study field visits.
- Develop a prioritised research plan for Phase 2 of the project that responds to the needs expressed through the survey and workshops.

While no scope constraints were placed on the topics and issues that could emerge through the Phase 1 discovery activities, based on the prior experience of the research team it was anticipated that most would lie within one of two broad areas:

- Issues relating to the NZ value case for WSUD, for instance relating to fully recognising and evaluating the full costs and benefits of WSUD approaches; and
- Issues relating to implementation of WSUD, for instance relating to the design, maintenance and accountability for WSUD.

1.4 Report content

Section 2 of this report describes the methods employed in the discovery phase: a survey of WSUD practitioners; workshops in Auckland and Christchurch; and the analysis of the data collected from those sources. Section 3 summarises the results of that analysis, describing the relative frequency of various themes present in the survey and workshop responses and the key messages within each of those themes. These findings are compared with the results of other similar research conducted both in New Zealand and overseas.

Section 4 of the report sets out the range of potential research and other activities which respond to the key messages emerging from the survey and workshops, while Section 5 provides further detail on those activities which the research team recommends be pursued as part of Phase 2 of the project. Section 6 summarises a range of activities being pursued by other parties that have the potential to complement this research, while Section 7 sets out the next steps for the project following consideration of the EAG's feedback on the proposed activities set out in this report.

⁵ The EAG was established in late 2017 with membership from central government, a council, an iwi authority and industry.

2. Methods

2.1 Overview

Phase 1 focussed on two key data collection methodologies to elicit information on WSUD barriers from NZ WSUD stakeholders: a survey and workshops. This combination of methods was designed to be complementary. The survey aimed to capture information from a wide geographic and disciplinary range of respondents who would not all have the time or geographic proximity to attend the workshops. The workshops aimed to investigate barrier topics in more depth, and complemented the survey with two further activities: a walking tour of WSUD devices and a benchmarking assessment. This combination of activities constitutes an “expert elicitation” process which gave the workshop attendees (the ‘experts’) the opportunity to assess and update their survey responses⁶.

While the introduction to this report provides a description of how WSUD is generally understood in New Zealand, no definition of WSUD was provided in either the survey or the workshops. This was deliberate, allowing respondents to draw from their own experience of WSUD rather than constraining responses to fit within a specific definition.

The data collected via the survey and workshop was analysed to investigate the relative frequency of different themes and the key messages with each theme. This analysis provided the research team with an understanding of the leading barriers identified by WSUD stakeholders to inform potential areas of activity for Phase 2 of this project.

2.2 Survey

An on-line survey was conducted over the period 20 November to 21 December 2017⁷ using the SurveyMonkey® platform (Appendix 1). The survey targeted WSUD stakeholders, but was open to any party. Information was emailed to individuals and groups with an interest in WSUD as well as being posted on the project web site⁸ and circulated via on-line professional networking sites. Target groups included:

- Land developers (iwi, public and private);
- Design engineers, architects, landscape architects, urban planners;
- Professional institutes such as Engineering New Zealand (formerly IPENZ), Water New Zealand, Civil Contractors New Zealand, the NZ Institutes of Architects and Landscape Architects, NZ Planning institute, NZ Institute of Surveyors, Property Institute of NZ etc.)
- Tertiary education providers, particularly landscape, engineering and surveying schools;
- Construction and maintenance contractors;
- Iwi and urban Māori agencies;
- Central government (Ministry for the Environment, Treasury, New Zealand Transport Agency, Department of Conservation, Ministry of Health);
- Regional councils (planning, regulatory and operations);

⁶ McBride M.F., Burgman M.A. (2012) What Is Expert Knowledge, How Is Such Knowledge Gathered, and How Do We Use It to Address Questions in Landscape Ecology?. In: Perera A., Drew C., Johnson C. (eds) Expert Knowledge and Its Application in Landscape Ecology. Springer, New York, NY

⁷ The survey was re-opened in January 2018, allowing the ongoing collection of views on barriers to WSUD in parallel with research activities conducted during Phase 2 of the project.

⁸ <https://www.landcareresearch.co.nz/science/living/cities,-settlements-and-communities/water-sensitive-urban-design/survey>.

- City and district councils (planning, regulatory and operations, including parks); and
- Council controlled organisations (water, transport and development).

The objective of the survey was to harness the expertise of respondents to identify barriers, and activating factors for WSUD, as they understood it in their professional lives. Their contributions would form part of the analysis and prioritisation of the Phase 2 research topics.

The survey asked for responses to the following five questions:

1. What barriers to WSUD do you find in your work?
2. What barriers (listed above) have you most recently experienced in a WSUD project?
3. What would support you to more fully implement WSUD in your job?
4. What 'activating factors' were effective in your most recent experience or project?
5. We are running workshops around New Zealand. How do we make these of most value to you?

Examples of possible barriers and activating factors were given, but the survey indicated that responses were not limited to these examples. Respondents were asked to score the barriers and activating factors that they identified using a scale of 5 (high) to 1 (low)⁹.

Seventy responses were received to the survey. These responses are confidential, with respondent data on sector, area of expertise and location (see Appendix 2) sought solely to investigate the influence of these factors at an aggregate level. Ethics approval for the survey was given by internal ethics committee of Maanaki Whenua Landcare Research.

2.3 Workshops

Two one-day workshops for WSUD stakeholders were held, in Auckland on 30 November 2017 and in Christchurch on 12 December 2017.

The workshops built on and extended the survey information through giving participants the opportunity to discuss issues rather than provide responses in isolation. The workshop activities were designed to allow participants to consider issues associated with WSUD at a range of levels, from the practicalities of the design, construction and maintenance of WSUD devices (see (b) below) to the extent to which WSUD features in strategic thinking and planning (see (c) below).

As with the survey, invitations to the workshops targeted the groups listed above, but attendance was open to any party wishing to participate. Information about the workshops was emailed to known parties with an interest in WSUD as well as being posted on the project web site¹⁰ and circulated via on-line professional networking sites.

There were 21 attendees at the Auckland workshop, the majority from Auckland but including participants from other North Island regions (e.g. Hamilton, Porirua). There were 24 attendees at the Christchurch workshop, the majority from Christchurch but including participants from other South Island regions (e.g. Nelson, Dunedin) and Wellington. Taken together, the workshop attendees included many of NZ's most experienced WSUD practitioners from across industry, local government and the research sector.

⁹ A large proportion of responses were received without scores being assigned, resulting in the adoption of the analysis methods described in Section 2.3.

¹⁰ <https://www.landcareresearch.co.nz/science/living/cities,-settlements-and-communities/water-sensitive-urban-design/workshop>.

Below is a short synopsis of the three main activities conducted at the two workshops. Full minutes are included in Appendix 3.

(a) Burning issues

The first part of the workshop included an introduction session, during which attendees described their ‘burning issue’ associated with barriers to the uptake of WSUD and self-scored their level of involvement with WSUD. The interim results of the on-line survey were also presented.

(b) Walking tour

A walking tour of WSUD devices (in Albany and central Christchurch, respectively), during which the views of attendees on positive and negative aspects of the devices visited were elicited. By walking together and viewing WSUD devices, participants were able to share their ‘on the ground’ knowledge of design, construction and maintenance issues related to stormwater management, as well as learn from local examples (both good and bad).

(c) Benchmarking and barriers

The afternoon session included a benchmarking exercise adapted from methods developed by Australia’s Cooperative Research Centre (CRC) for Water Sensitive Cities¹¹. The purpose of the session was to assist participants in thinking about where their NZ city may fit within the “urban water transitions framework continuum” (Figure 1). Participants used the “advocating and contesting narratives” in the transitions dynamics framework supplied by the CRC for Water Sensitive Cities (pers comm. Briony Rogers, November 2017) to identify which phase of change their cities could be in (Figure 2). They also identified barriers to WSUD using a matrix (Figure 3, also developed by the CRC for Water Sensitive Cities). These group exercises assisted in generating discussion amongst the participants to further identify strategic and institutional barriers to the implementation of WSUD, and provided the research team with a “practitioner view” of those areas of further work that would be required to build a Strategic Transition Programme for New Zealand.

Participants’ statements made during each of these activities were recorded in notes taken by the research team, while attendees also provided further comments on a workshop evaluation form completed at the end of the day. The workshop outputs are reported on the project website¹² and in Appendix 3.

¹¹ Brown, R., Rogers, B. and Werbeloff, L. 2016. Moving toward Water Sensitive Cities: A guidance manual for strategists and policy makers. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

¹² <https://www.landcareresearch.co.nz/science/living/cities,-settlements-and-communities/water-sensitive-urban-design/presentations>.

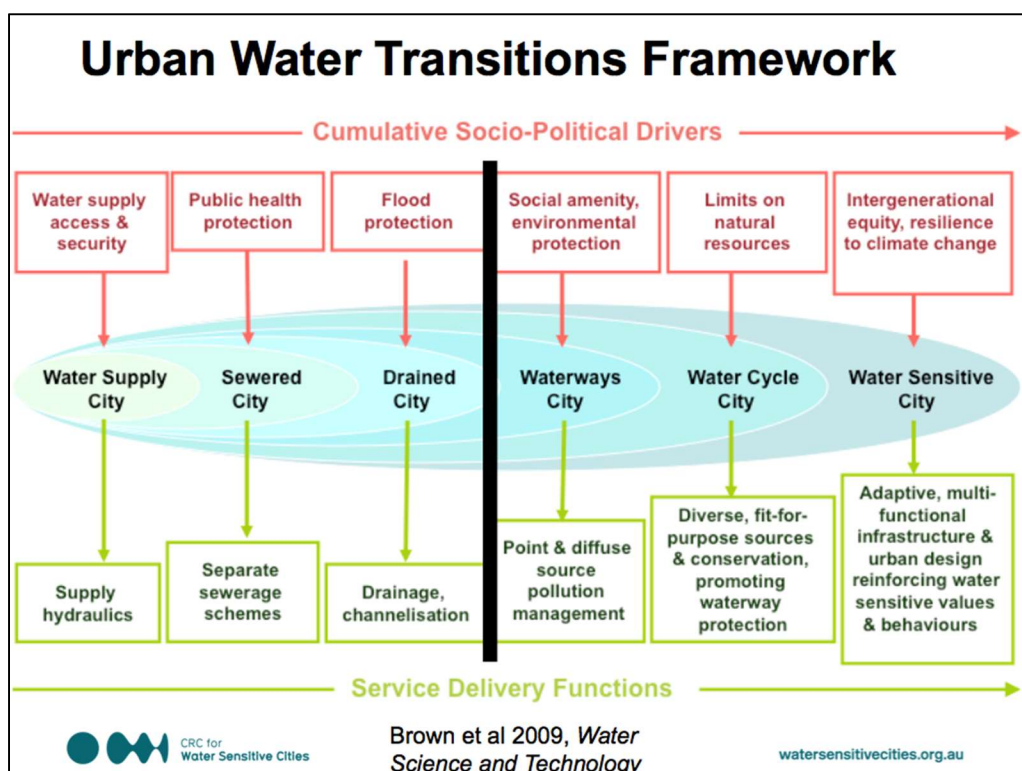


Figure 1: Urban Water Transitions Framework¹³.

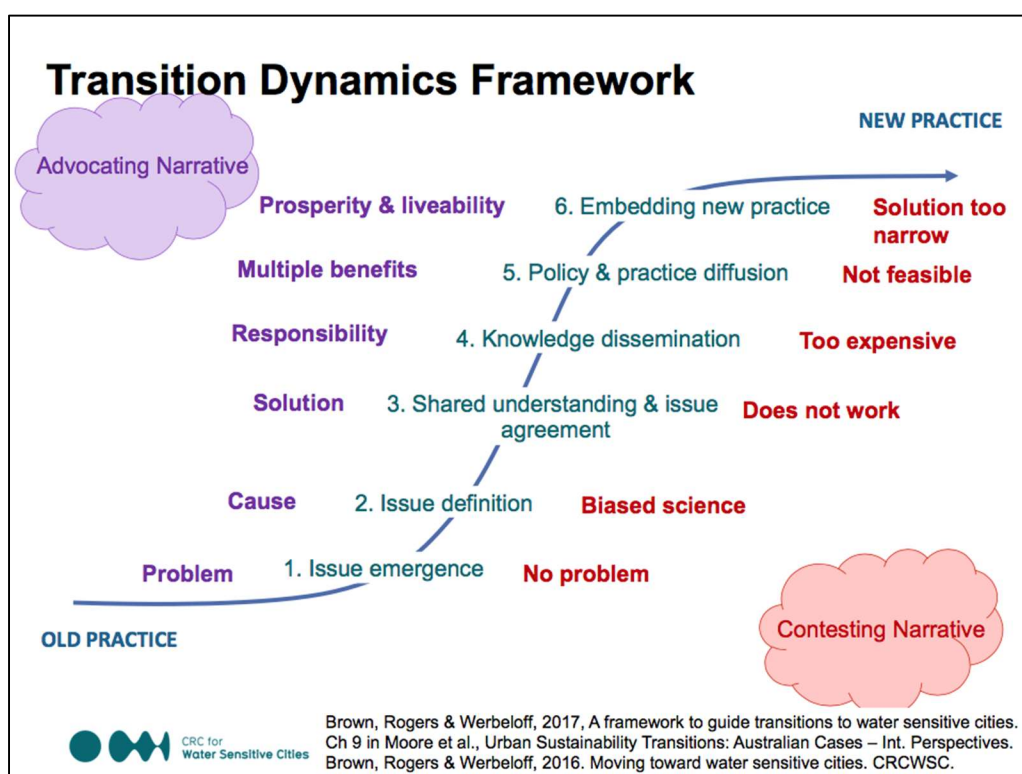


Figure 2: Transition Dynamics Framework – advocating and contesting narratives

¹³ Source: Brown, R.R., Keath, N., & Wong, T.H.F. (2009). Urban water management in cities: Historical, current and future regimes. *Water, Science and Technology: A Journal of the International Association on Water Pollution Research*, 59(5), 847–55.)

Transition phase	Domains of change				
	Actors	Bridges	Knowledge	Projects	Tools
	Key networks of individuals	(Semi) Formalised organisations, structures, & processes for coordination & alignment	Research, science, & contextualised knowledge	Experiments, demonstrations, & focus projects	Legislative, policy, regulatory, & practice tools
1. Issue Emergence	Issue activists	N/A	Issue discovery	High profile scientific studies	N/A
2. Issue Definition	Science leaders	Science-industry	Cause-effect	Laboratory-based & scientific solution prototypes	N/A
3. Shared Understanding & Issue Agreement	Technical solution coalition	Science-industry-policy	Basic technological solutions	Minor scientific field demonstrations	Draft best-practice guidelines
4. Knowledge Dissemination	Informal policy coalition	Science-industry-policy-capacity building	Advanced technological solutions	Major scientific field demonstrations	Best-practice guidelines, targets
5. Policy & Practice Diffusion	Policy & decision coalition	Science-industry-policy-capacity building	Modelling solutions, capacity building	Numerous industry-led field experiments	Legislative amendments, market offsets, national best-practice guidelines, regulatory models
6. Embedding New Practice	Multi-agency coalition	Formalised institution	Next research agenda	Standard practice	Political mandate, coordinating authority, comprehensive regulatory models & tools

Figure 3: The six phases of the transitions dynamics framework and the five domains of change¹⁴

2.4 Analysis

The survey responses and workshop statements were reviewed to establish the extent to which common themes were present. Fifteen themes were identified, seven of which relate to the broad category of ‘WSUD value case’ and eight to that of ‘WSUD implementation’ (see Table 1). While these two broad categories were posed as a high-level organising framework in the original design of this research project (see Section 1.3), the 15 themes themselves emerged from the data collected via the survey and workshops. This set of 15 themes was adopted for the subsequent analysis of responses, according to the following approaches.

It is relevant to note that the 15 themes are not all mutually exclusive: many of them are closely linked and/or have a degree of overlap. For example:

- issues around maintenance of WSUD devices can be related to cost considerations (linking themes 3 and 10);
- issues around design can be related to a lack of guidance and local precedents (linking themes 2, 9 and 14):

¹⁴ Brown, R., Rogers, B. and Werbeloff, L. 2016. Moving toward Water Sensitive Cities: A guidance manual for strategists and policy makers. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

- issues around a reluctance to innovate can be related to organisational culture (linking themes 4 and 13); and

While noting these areas of linkage and overlap, none of the 15 themes is considered redundant (i.e. no two themes are exact duplicates), providing the necessary diversity to build a sound understanding of the range of issues faced by WSUD practitioners.

Table 1 – The 15 WSUD themes adopted for coding survey responses and workshop statements

Category	Theme	Examples of barriers
Value case	1. Knowledge of WSUD concepts, vision and benefits	Lack of awareness/buy-in to WSUD philosophy, including professional and community sectors.
	2. Precedents / evidence of WSUD performance and outcomes	Lack of NZ / local examples of WSUD delivering measurably better outcomes than conventional approaches.
	3. Economics	Perceived higher costs, lack of cost-benefit examples, lack of information around maintenance costs.
	4. Innovation stance	Institutional risk aversion to new methods.
	5. Māori cultural benefits	Business case failure to consider culturally-specific benefits of WSUD.
	6. Social, health and environmental co-benefits	Business case failure to consider amenity, health, climate adaptation and other co-benefits of WSUD.
	7. Political will / social licence	Lack of political leadership and/or community-led demand mandating the adoption of new development approaches. 'Like for like' replacement of infrastructure.
Implementation	8. Regulation, policy, planning, consenting and compliance	Ambiguity in regional and district plans, inflexible consenting processes preventing innovation. WSUD enabling development in inappropriate places (like wetlands, or in areas with highly sensitive receiving environments).
	9. Design and construction	Poorly designed and built systems leading to substandard performance or inactivation (e.g. no water entry or no ponding) or inevitable failure of WSUD devices.
	10. Maintenance	Maintenance poorly understood and delivered including lack of compliance monitoring and asset rejuvenation.
	11. Project lifecycle	Poor integration / hand-over between design/construction/operations. Responsibility for asset ownership and management unclear and/or poorly delivered.
	12. Funding and incentives	Lack of funding and/or incentives leads to continued adoption of business-as-usual approaches.
	13. Organisational culture	Poor collaboration between and within organisations, continuation of silo mentality in delivery of different functions.
	14. Capacity, training and guidelines	Lack of WSUD expertise or education for upskilling relevant professions, including construction and maintenance contractors.
	15. Competing mandates	WSUD trumped by infrastructural needs of other functions such as road safety and flood control.

2.4.1 Frequency of themes

Each survey response and workshop statement was coded to reflect which of the 15 themes were present. Any single response or statement could contain reference to more than one theme, and the coding reflected this. The coding was based on a simple ‘presence/absence’ assessment, reflecting the fact that the majority of the responses had not scored the relative importance of themes.

The counts of each theme were aggregated and plotted to show the frequency of themes:

- in the combined survey responses to ‘barrier’ and ‘activating factor’ questions, respectively, and disaggregated by sector, area of expertise and by region;
- in the combined workshop ‘burning issues’ and all statements, respectively, and disaggregated by workshop location.

The disaggregation of survey responses by sector, area of expertise and by region allowed investigation of the potential influence of strongly-represented groups on the overall results. The collection of information on respondent sector, expertise and region was also useful in indicating groups that were under-represented (or absent) from this exercise¹⁵.

It is likely that some of the workshop attendees also replied to the survey¹⁶, essentially creating a level of duplication in responses. In order to avoid potential double counting, there was no aggregation of the data from the two sources: the frequency the themes occurred was assessed separately for the survey and the workshops.

2.4.2 Analysis of statements

Statements (many of which were relevant to more than one theme, as noted above), were grouped and reviewed to elicit key messages relating to barriers and activating factors relevant to each of the 15 themes. Illustrative statements were selected to support a commentary on these key messages.

¹⁵ A factor that is reflected in the recommended Phase 2 activities presented in Section 5.

¹⁶ Although, because the survey responses were confidential, the data is not available to check the extent to which this occurred.

3. Results

3.1 Overview

This section summarises the results of the analysis of the survey and workshop data. Interested readers will find a further, comprehensive description and analysis of the results in Appendix 4 of this report. The summary presented here begins with a high-level characterisation of sentiment evident in the survey and workshop responses (Section 3.2). The relative frequency of the 15 constituent WSUD themes and the key messages within each theme are then described (Section 3.3). Section 3.4 summarises findings of other relevant research, while Section 3.5 draws on the preceding sections to describe the extent to which WSUD drivers and barriers in New Zealand differ from those experienced elsewhere.

3.2 Overall sentiment

There is a need to review management of the urban water cycle in New Zealand from the perspective of the capacity of current approaches to meet the reasonably foreseeable future requirements for urban liveability in New Zealand. This review of management must be across the entire value chain, from design through regulatory processes to implementation. Motivating factors include: the frequency and intensity of weather events associated with climate change; congestion and capacity issues with current urban water cycle interventions; and increasing incorporation of Māori values/aspirations through roles as development partners and in co-governance.

Those interventions emphasise water transport through pipe networks as a flood relief remedy, while water quality (and mauri) issues in receiving water bodies remain largely unaddressed. Source control of water quantity and water borne contaminant effects is often absent from greenfields situations, and retrofitting that capacity to existing urban areas is highly problematic (and expensive¹⁷). Fresh approaches are required. WSUD as concept and practice has proven effective internationally, but has not been widely taken up in the kiwi context. That kiwi context includes WSUD as a purely stormwater oriented approach as opposed to a component of an integrated three waters management strategy. Here, WSUD economics are not widely understood, and uncertainty promotes inertia which favours and entrenches status quo practice. Responses show potential for fruitful innovation across the value chain and the governance contexts to grow a local kiwi version of the WSUD concepts, designs, and technology that addresses these emergent needs for burgeoning New Zealand urban environments.

3.3 Themes and key messages

Table 2 provides a synthesis of the results of Phase 1, setting out the relative frequency with which each theme occurred (see Appendix 4, Section A4.1 for details) and the key messages elicited from respondents' statements (see Appendix 4, Section A4.2 and A4.3 for details). Relative frequency is expressed in qualitative terms (very frequent, frequent, less frequent and very low frequency) that reflect the number of times themes occurred in survey responses and workshop statements relative to other themes. The key messages generally reflect issues and views that were expressed in a number of responses on each of the fifteen themes. The themes are listed in order of relative frequency, noting specific sectors, areas of expertise or regions that gave more or less weight to the theme than arose from the aggregated results. Note that Table 2 places no particular emphasis on either the survey or workshop findings: both the relative frequencies and key messages are drawn from responses and statements provided through both mechanisms.

¹⁷ For example, the Auckland Central Interceptor project is reported as costing \$4.9 b.

Table 2 – Synthesis of results: the relative frequency and key messages of each of the 15 WSUD themes in survey responses and workshop statements (“Groups” means sectors, areas of expertise and regions)

Theme	Category		Relative frequency	Key messages
	Value case	Impleme- ntation		
#14. Capacity, training and guidelines		X	Almost universally a <u>very frequent</u> theme, other than in responses from planners/policy analysts.	<ul style="list-style-type: none"> Key sectors in the WSUD value chain, for instance construction and maintenance contractors, often lack the basic knowledge for successful implementation of WSUD. The value to be gained from capacity building and training that targets these key sectors is likely to be significant. There is a need for national definition, leadership and guidelines on WSUD.
#3. Economics	X		Almost universally a <u>very frequent</u> theme, other than in responses from operations staff.	<ul style="list-style-type: none"> Reliable information is needed on the full lifecycle costs of implementing WSUD. Maintenance costs are a specific knowledge gap. Reliable methods and information is required for assessing the full range of direct and indirect benefits. Cost and benefits should be assessed relative to those associated with conventional approaches.
#8. Regulation, policy, planning, consenting and compliance		X	A <u>frequent</u> theme overall and in responses from most groups, but very frequent in responses from local government, engineers, planners and at Auckland workshop.	<ul style="list-style-type: none"> There is a need for greater emphasis, transparency and consistency on WSUD in council plans and consenting processes A lack of cohesion between regional and local government regulations are a barrier to the implementation of WSUD.
#9. Design and construction		X	A <u>frequent</u> theme overall and in responses from most groups, but very frequent in responses from operations staff and at <u>Auckland</u> workshop.	<ul style="list-style-type: none"> Good examples of WSUD design and construction are needed as part of building the evidence base and building capacity. Design guidance is needed that reflects the range of NZs environments and both greenfield and brownfield settings.
#2. Precedents / evidence of WSUD performance and outcomes	X		A <u>frequent</u> theme overall and in responses from most groups, but very frequent in responses from local government, engineers and researchers.	<ul style="list-style-type: none"> There is a need for evidence from precedent implementation NZ exemplars. Recent/current WSUD developments provide opportunities for monitoring case studies. Evidence should include information on costs, device performance and the full range of environmental, social and cultural benefits.
#10. Maintenance		X	A <u>frequent</u> theme overall and in responses from most groups, but very frequent in responses from Auckland and regions outside the three main population centres.	<ul style="list-style-type: none"> Maintenance requirements are often poorly specified and hence appear as a burden, as a result of lack of a full lifecycle plan for WSUD installations. There is a paucity of reliable data on maintenance costs.
#1. Knowledge of WSUD concepts, vision and benefits	X		Almost universally a <u>frequent</u> theme, but very frequent in responses at Christchurch workshop.	<ul style="list-style-type: none"> WSUD concepts and wide-ranging benefits are not widely known among key groups that could be involved in its implementation, and across city communities in general. There is a lack of clarity on what WSUD is, including a misunderstanding that it is solely a set of stormwater treatment devices rather than a holistic design approach.
#13. Organisational culture		X	A <u>less frequent</u> theme overall and in responses from most groups, but frequent in responses from planners/policy analysts and researchers and at workshops.	<ul style="list-style-type: none"> WSUD is hampered by jurisdictional issues between regional and local government. Organisations fail to take an integrated, multi-disciplinary approach to WSUD and can feature departments or individuals with entrenched (anti-WSUD) perspectives on urban development and stormwater management. There is a need for WSUD champions.
#4. Innovation stance	X		A <u>less frequent</u> theme overall and in responses from most groups, but frequent in responses from planners and researchers.	<ul style="list-style-type: none"> There is reluctance to implement WSUD among all of the various sectors in the WSUD value / supply chain (designers, local authority practitioners, developers) The national conversation on water quality is an opportunity for more innovative approaches to feature more strongly.
#15. Competing mandates		X	A <u>less frequent</u> theme overall and in responses from most groups, but frequent in responses from planners	<ul style="list-style-type: none"> Organisations often fail to take an integrated, multi-disciplinary approach to WSUD Other considerations, both commercial (development yield) and public service (affordable housing, roading), often outweigh WSUD.
#12. Funding and incentives		X	A <u>less frequent</u> theme overall and in responses from most groups, but frequent in responses at workshops	<ul style="list-style-type: none"> There is a lack of regulatory or economic incentives promoting the uptake of WSUD in NZ. The implementation of WSUD is held back by funding constraints, for instance for monitoring to enable WSUD as unanticipated opportunities arise.
#6. Social, health and environmental co-benefits	X		<u>Very low frequency</u> overall and in responses from most groups, but frequent in responses at workshops	<ul style="list-style-type: none"> Consideration of WSUD’s wider social, health and environmental benefits and the opportunity costs of failure to implement WSUD is an important omission.
#5. Māori cultural benefits	X		<u>Very low frequency</u> overall and in responses from most groups, but frequent in responses from Auckland and other regions	<ul style="list-style-type: none"> The inclusion of cultural well-being as a WSUD outcome tends to be tokenistic. The building of the NZ WSUD evidence base should have a specific reference to Mātauranga Māori.
#7. Political will / social licence	X		<u>Very low frequency</u> overall and in responses from most groups, but frequent in responses from NGOs and at workshops	<ul style="list-style-type: none"> The potential for community-led demand to be an activating factor for WSUD is significant, as evidenced by the current national conversation on water quality There has been a lack of leadership from central government. There has been a lack of cohesion/clarity in how regional and local governments enable and/or deliver WSUD.
#11. Project lifecycle		X	<u>Very low frequency</u>	<ul style="list-style-type: none"> Lack of asset ownership results in device failure and a bad look for WSUD Better decision-making and management is required that takes account of the full lifecycle through planning, design, construction, handover, maintenance and operations, through to asset disposal/renewal.

While the order of priority based in relative frequency of themes appears reasonable, the researchers are mindful of the need to address the potential for self-selection bias in the research outcomes before adopting those priorities as a basis for establishing a research agenda.

Specification of the themes themselves was not based on any particular *a priori* considerations from the literature other than the knowledge and integration processes of the researchers. Preliminary outcomes of the survey were presented as these themes at the workshops¹⁸ with requests for comments from the attendees. The self-selection bias issue was raised at the time as a possible influence on the relative intensity of the themes. The set of themes was expanded in the final analysis from the ten presented to the workshops to the fifteen used in the final analysis to better address the value case and implementation division for better consistency with the research brief. Consistency was evident between barriers and activating factors. This was expected since problems/weaknesses often signal opportunities in SWOT analyses. Value chain knowledge and training, WSUD concepts, and design and economic considerations emerged as consistent priorities; these are reflected in the final outcomes in Table 2.

Many of the lesser ranked themes are intertwined with those higher on the list. For example: incentives are linked to regulation and policy; capacity and guidelines are associated with knowledge; economics and notions of cost benefit analysis relate to the wider indirect benefits that feature lower in the theme rankings. The cluster of themes located at the head of the list are therefore considered likely to signal fruitful avenues for further research.

Figure 4 describes the outcomes of the CRC benchmarking and barriers activity that was undertaken at the workshops. Participants identified barriers using the matrix developed by the CRC for Water Sensitive Cities to build a “Strategic Transition Programme” (Figure 3, Section 2.3). Those outcomes present an indicative summary of the results from the different group discussions.

It is apparent from Figure 4a that the Auckland community is slightly further advanced in its WSUD journey than Christchurch and other regions (Figure 4b). This is not wholly unexpected, since widespread recognition of the impacts of conventional development on receiving water bodies arose first in Auckland, as evidence by the fact that guidelines for stormwater management and WSUD (previously low impact design) have emanated from the Auckland region. Other contextual influences are also relevant: participants at the Christchurch workshop noted that progress initiated around a decade ago has been interrupted not only by the 2010-11 earthquakes, but also by subsequent local council internal re-organisations. While differences in WSUD uptake provide an opportunity to generalize learnings from Auckland to other New Zealand regions, they also reinforce the need to ensure that future research helps develop and disseminate knowledge and tools that are specific to those regions where WSUD uptake is less well progressed.

Research to support the wide-spread implementation of WSUD should focus on those areas/ boxes highlighted in yellow in Figure 4 (“we are partly doing this – some presence”) and red (“we are not doing this – gap in current transition phase”). Broadly, the feedback represented in Figure 9 signals a view that developing a shared understanding of WSUD and disseminating knowledge to assist with accelerated and wide-spread implementation is required. Champions require location applicable knowledge and support for projects and solutions. The tools and instruments required to assist the

¹⁸ https://www.landcareresearch.co.nz/_data/assets/pdf_file/0018/154305/wsud-workshop-christchurch-presentation.pdf

transitions are less well developed to effectively motivate uptake of WSUD knowledge to inform the emergence of a NZ variant of urban water sensitivity.

(a)

Transition phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
1. Issue emergence	Issue activists		Issue highlighted	Issue examined	
2. Issue definition	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	
3. Shared understanding & issue agreement	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
4. Knowledge dissemination	Influential champions	Building broad support	Solutions advanced	Solutions demonstrated at scale	Refined guidance and early policy
5. Policy and practice diffusion	Organisational champions	Expanding the community of practice	Capacity building	Widespread implementation and learning	Early regulation and targets
6. Embedding new practice	Multi-stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

(b)

Transition phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
1. Issue emergence	Issue activists		Issue highlighted	Issue examined	
2. Issue definition	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	
3. Shared understanding & issue agreement	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
4. Knowledge dissemination	Influential champions	Building broad support	Solutions advanced	Solutions demonstrated at scale	Refined guidance and early policy
5. Policy and practice diffusion	Organisational champions	Expanding the community of practice	Capacity building	Widespread implementation and learning	Early regulation and targets
6. Embedding new practice	Multi-stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

Key

- we are doing this (complete presence)
- we are partly doing this (some presence)
- we are not doing this (gap in current transition phase)

Figure 4 - Building a Strategic Transition Program: Where are we? – matrices from (a) Auckland and (b) Christchurch workshops.

3.4 Findings of other research

This section briefly summarises key findings from other research into barriers to the uptake of WSUD, both in New Zealand and overseas. This snapshot of wider research allows comparison with results of our survey and workshops, and helps identify similarities and differences between the WSUD experience in New Zealand and elsewhere (see Section 3.5).

A postgraduate research project at the University of Canterbury undertaken by Ms. Vicki Southwick¹⁹ is in progress. Entitled, “Increasing the uptake of water sensitive urban design at the building scale in Christchurch”, her project is closely aligned with this research²⁰. In a recent presentation she assessed the international literature in this area in support of her own outcomes.

Her findings include:

- Local barriers to progress include: not all technologies are equally well understood; absence of demonstration projects and locally relevant monitoring data; difficult transition to a new hydro-social contract; and, lack of early identification of options in building projects (Roy et al., 2008)²¹.
- Sometimes it takes a crisis to motivate the transition to water sensitive urban forms (Brown and Clarke, 2007²²).

Citing Geels et al., (2011)²³, Southwick notes that at least partly due to the interaction with complexities that arise from historical sources, the local, immediate, visible user benefits that WSUD approaches offer are opaque, and by implication require promotion and localisation.

Lastly, Southwick points to Mātauranga Māori as a fertile solution to the barriers and complexities she has observed:

“I am interested to explore the potential for the Maori concept of kaitiakitanga to be embedded more deeply in all New Zealanders. The strong cultural link to water and the importance of high quality waterways that exists in the Maori culture may offer an opportunity to support change that doesn’t exist in the UK for example. Can we all become kaitiaki of our waterways and prioritize our spending on WSUD features instead of copper cladding and granite worktops? Can a rainwater tank and permeable paving become the new social norm?”

Brockbank (2017)²⁴ concurs with Southwick’s observation, noting Auckland Council’s Healthy Waters initiative trialing a modified MauriOmeter²⁵ to complement traditional CBA and multi-criteria analysis.

¹⁹ Ms Southwick attended the Christchurch workshop.

²⁰ Noting that Vicky’s research is Christchurch based and that there are important differences in the transition process between Auckland and Christchurch as revealed in the benchmarking exercise (See Figure 9).

²¹ Roy, A. H., Wenger, S. J., Fletcher, T. D., Walsh, C. J., Ladson, A. R., Shuster, W. D., ... Brown, R. R. (2008). Impediments and solutions to sustainable, watershed-scale urban stormwater management: lessons from Australia and the United States. *Environmental Management*, 42(2), 344–359.

²² Brown, R., & Clarke, J. (2007). *Transition to Water Sensitive Urban Design: The Story of Melbourne, Australia* (No. 07/1). Facility for Advancing Water Biofiltration, Monash University, Clayton, Melbourne, Australia.)

²³ Geels, 2011 in: Perales-Momparler, S., Andrés-Doménech, I., Andreu, J., & Escuder-Bueno, I. (2015). A regenerative urban stormwater management methodology: the journey of a Mediterranean city. *Journal of Cleaner Production*, 109, 174–189.

²⁴ <http://www.stormwater360.co.nz/assets/Uploads/Just-Add-Mauri-LG-Dec18.pdf>

²⁵ www.mauriometer.com/

In the Low Impact Urban Design and Development (LIUDD) research project Landcare Research(NZ) conducted a series of workshops in 2009. The Introduction to the LIUDD workshop summaries identifies the barriers as 'largely socio-political' as found in Australia (Brown et al., 2009)²⁶, and refers to Eason et al (2009)²⁷ noting: 'Further, a critical element is the need to promote capacity building of practitioners, as well as within and across organizations.'

Amongst the outputs from the LIUDD programme Feeney and Lysnar (2006)²⁸ developed a thirteen point list of barriers to the uptake of LIUDD: thinking there isn't a problem; applying LIUDD in a piecemeal fashion; regulatory and institutional inertia; price/cost concerns isolated from benefits; practices not widely accepted; lack of technical and hydrological data; no holistic overview to make the compelling case for change; disconnected thinking; conflicting stakeholder needs and the threat of litigation; price concerns; planning and institutional impediments; lack of locally based design, ecological, engineering, economic and technical data; conventional approaches to profit maximization and lack of cost-benefit data on alternatives; and, lack of environmental, economic and social data to influence plans, practice, and policy.

Other New Zealand work of a more general nature includes Olorunkiya et al²⁹ who address the issue of risk aversion in maintaining the status quo against the uptake of LIUDD practices.

Internationally this New Zealand effort is supported by a wide literature. While not an exhaustive survey of the literature examining barriers to implementation it includes work by:

- Brown (2005)³⁰: Impediments to integrated urban stormwater management: the need for institutional reform,
- Hammitt (2010)³¹ examined barriers in Seattle, Washington, Minneapolis, Minnesota and Portland Oregon, finding "engineers and maintenance workers lack knowledge of ecology and gardening which are necessary to design and maintain GI facilities; ambiguity around maintenance responsibilities, resistance to changing current design and maintenance techniques. Residents lack awareness of stormwater management problems and how to address them at their homes/businesses".
- MWH (2012)³² examined sustainable drainage systems in the USA,

²⁶ R. R. Brown, N. Keath, T. H. F. Wong, 2009, Urban water management in cities: historical, current and future regimes, *Water Science and Technology*, 59 (5) 847-855; DOI: 10.2166/wst.2009.029.

²⁷ Eason CT, Dixon JE and van Roon MR. 2009 'A trans-disciplinary platform for urban eco-design. Pp 470-483 In 'Ecology of cities and Towns: A comparative approach. Eds MJ McDonnell, AK Hahs and JH Breuste. Cambridge University Press.

²⁸

https://www.landcareresearch.co.nz/publications/researchpubs/2006_03LIUDD_LandDevelopmentProcesses.pdf

²⁹ 11. Olorunkiya, J., Fassman, E., & Wilkinson, S. (2010). Risk as a Fundamental Barrier to Adoption of Low Impact Design Technologies. Paper presented at The New Zealand Society for Sustainability Engineering and Science (NZSSES) -Transition to Sustainability, Auckland, New Zealand

³⁰ 13. Brown RR (2005). Impediments to integrated urban stormwater management: the need for institutional reform. *Environmental Management* 36(3):455-468
<https://link.springer.com/article/10.1007/s00267-004-0217-4>

³¹ 14. Hammitt S 2010 Toward sustainable stormwater management: overcoming barriers to green infrastructure. M. City Planning Thesis. Massachusetts Institute of Technology.
<https://dspace.mit.edu/handle/1721.1/59735>

³² MWH 2012. An insight into the USA approach. Sustainable drainage systems in Portland and Seattle. Summary of a joint UK Water and Sewerage Company visit to the USA
<http://www.susdrain.org/resources/evidence.html>

- EPA 2012³³ present 12 case studies that identify barriers and solutions and help identify strategies for overcoming common problems for brownfield sites), and,
- Fletcher et al., (2014)³⁴ describe the evolution and application of terminology around urban drainage systems.

3.5 Contrasting contextual factors

The survey and workshop results and findings of previous research reveal some important contrasts between the WSUD context in New Zealand and overseas, although there are also clearly areas of common ground.

Two particularly important barriers common in both overseas literature and Aotearoa/ New Zealand are:

- Lack of awareness of the problem of existing ‘Business as Usual’ stormwater management – across the general public and among planners, landscape architects/architects and engineers; and
- Lack of coordination across departments in cities. This leads, among other things, to a failure to realise potential co-benefits of non-stormwater-focused projects, e.g. urban forestry programmes, park and other green-space upgrades.

Three WSUD-drivers that dominate overseas appear to be absent or much less important here:

- Severe water shortage or wastewater pollution affecting highly-valued ecosystems (lakes, poorly-drained estuaries) or species (salmon as ‘protected species’ in Washington State and Portland Oregon). This is partly a result of overseas cities generally having much larger areas of combined sewers and higher proportions of impervious surfaces;
- Co- benefits of WSUD regarded as relatively much more important, particularly shade/heat reduction, air quality improvement and ‘nature services’ to people; and
- Impervious surface charges or ‘rainwater taxes’ that drive improvements to ‘existing’ polluting areas.

Finally, two local drivers appear to be absent overseas

- Consideration of indigenous cultural values and approaches to water; and
- Legislative tensions, for example, between the RMA and the Building Act and reinsurance limitations (i.e., requiring replacement of ‘like with like’ drainage in post-earthquake Christchurch).

³³ EPA 2012. City Green: Innovative green infrastructure solutions for downtowns and infill locations. <https://www.epa.gov/smartgrowth/city-green-innovative-green-infrastructure-solutions-downtowns-and-infill-locations>

³⁴ Fletcher et al 2014. SUDS, LID, BMPsw, WSUD and more – the evolution and application of terminology surrounding urban drainage. Urban Water Journal 12(7):525-542
<http://www.tandfonline.com/doi/abs/10.1080/1573062X.2014.916314>

4. Response to discovery phase findings

Table 3 lists a range of responses to the discovery phase findings. It identifies which themes are addressed by each response and whether each response is either: (a) a ‘quick win’ that could be actioned as part of Phase 2 of this project; (b) a longer-term research activity; or (c) some other (non-research) action that involves implementation by WSUD stakeholders. In one way or another, the list presented in Table 3 responds to all of the key messages bullet-pointed in Table 2.

WSUD hasn’t been taken up consistently in New Zealand partly due to **inertia** that favours the status quo, partly **poor understanding**, and partly because social license to address urban water quality is only early emergent (through the Land and Water Forum requirement to manage urban freshwater). Progress in the uptake of WSUD is not consistent across NZ: some jurisdictions e.g. especially Auckland, are more well advanced than the regions generally. Even within Auckland, progress appears uneven, with some localities offering more successful implementations than others, perhaps an historical artefact of the amalgamation process. There was informal comment as to the particular influence of these “historical remnants” spanning events from earthquakes, to amalgamation, to organisational restructuring.

A body of knowledge, customised to New Zealand conditions, disseminated to practitioners across the urban development value chain, and motivated by central government leadership is required to support local authorities creating mandatory adoption of source control across all urban landscapes. That body of knowledge should be available in functioning exemplars³⁵ that extend beyond the device scale to integrated urban designs and include the business cases for a range of incentivising adoption schemes. Noting that the outcomes presented in Figure 4 (Section 3.3) are a synthesis of views at the Auckland and Christchurch workshops, respectively, progress on the transitions journey is uneven: the greatest needs lie in communities with least experience and potentially least resources.

Table 3’s content first addresses the requirement to access the sectors whose views are not included or well represented to date in the discovery phase of this research. These include: Māori; the roading sector; and commercial and public property development enterprises. It is likely that the full innovation required to remedy perceived shortcomings of status quo urban freshwater management will only emerge following local governments’ introducing mandatory cost neutral WSUD regulation. However, at the outset, evidence of the effectiveness of WSUD practice and guidance in its initial implementation is required. A truly kiwi WUSD may then emerge as New Zealanders find ways to provide more effective and value creating urban forms that target urban freshwater quality and culturally-aligned practices. This research aims provide the basis for that progression.

³⁵ Not all the current implementations of WSUD in New Zealand could be considered to be technically effectively functioning examples integrated in catchment design appropriately. There is scope for a body of work to identify the incidence of these, offering potential improvements and alternatives to deficiencies.

Table 3 – Responses to the findings from the WSUD surveys and workshop

Response to findings from discovery phase	Theme															Description of responses, with rationale		
	Knowledge	Evidence	Economics	Innovation	Cultural	Co-benefits	Politics	Regulation	Design	Maintenance	Lifecycle	Incentives	Organisations	Capacity	Comp. mandates	Phase 2 quick wins	Longer-term research	Other (non-research)
(A) Targeted engagement with Māori stakeholder groups, leading to development of WSUD approaches that embrace and cater for Te Ao Māori	x	x			x									x		Required to address major gap in discovery phase – the need to develop an understanding of the extent to which WSUD does and could further deliver culturally-specific benefits. Engage with key Māori practitioners to scope a research and engagement plan for the development of guidance on Aotearoa-specific forms of WSUD and evaluation methods that incorporate mātauranga Māori.	Acting on the scope developed in Phase 2, engage, research and develop guidance for Aotearoa-specific forms of WSUD and evaluation methods that incorporate mātauranga Māori.	Multi-party implementation of guidance when consulting on, planning, designing and operating WSUD.
(B) Targeted engagement with roading and development (public and private) sectors	x			x					x	x	x		x	x	x	Required to address major gap identified in discovery phase – the need to develop an understanding of the relative influence of other mandates in determining the actions of these sectors. Audit relevant WSUD examples and review codes of practice. Present to roading and development sectors, respectively, as a means of initiating discussion and eliciting feedback at targeted workshops.	Acting on the findings from Phase 2, conduct targeted partner research e.g. on materials and methods, value chain analysis, commercial models.	Ongoing actions to raise WSUD profile. WSUD community to actively engage with these sectors via professional meetings etc. Establish champions from within these sectors.
(C) Recognise WSUD success stories: Establish and promote web-based database and awards systems for successful examples of NZ WSUD implementation.	x	x			x	x			x	x				x		Helps build capacity and provides hub for WSUD community. Can be initiated immediately, and added to over a longer time frame. Resurrect the LIUDD case study database and scope enhancements, for instance: linking to walking tour examples from the Phase 1 workshops; developing an awards system and linking to cost database.	Acting on the scope developed in Phase 2, build, populate and promote an enhanced NZ WSUD case study website.	Requires long-term ownership by identified parties in WSUD community to maintain, update and promote it.
(D) Update lifecycle cost databases and models, including data on maintenance and avoided costs. Model case studies including avoided costs.	x	x	x						x	x	x			x		Compilation of the database builds on well-progressed work in this space and addresses a high frequency theme. Through interrogation of existing costs database and the inclusion of data to address key gaps (maintenance costs, avoided costs), derive guidance on unit costs (e.g. dollar per square metre, dollar per kg sediment retained) of implementing WSUD relative to conventional approaches.	Using the updated database, model case studies including actual and planned WSUD developments to demonstrate cost differential when the full range of costs are considered (novel research). Regularly collate additional cost data and review models accordingly. Liaise with the NZ Asset Metadata Standards to determine protocols for collecting, storing and analysing acquisition and maintenance cost data as part of the public network asset data management standards for NZ.	Requires long-term updating of cost databases and could be linked to the WSUD “hub” above.

Response to findings from discovery phase	Theme															Description of responses, with rationale		
	Knowledge	Evidence	Economics	Innovation	Cultural	Co-benefits	Politics	Regulation	Design	Maintenance	Lifecycle	Incentives	Organisations	Capacity	Comp. mandates	Phase 2 quick wins	Longer-term research	Other (non-research)
(E) Develop and provide guidance on methods for CBA/CEA, including assessment of indirect benefits	x	x	x			x								x		Assembling and reviewing information on existing methods draws on well-developed familiarity of this topic area. Characterise the full range of benefits of Aotearoa/NZ WSUD and provide a critical analysis of the methods for assessing these benefits. Liaise with CRC for Water Sensitive Cities to gain insights from Australian research in this area.	Developing tools for implementing comprehensive CBA / CEA is a significant research undertaking, but a key part of a longer-term research programme.	
(F) Review effectiveness of WSUD-related plans and regulations.				x		x	x	x						x				Central/local government to review existing RMA plans to develop policy and planning guidance, including on NPS, regional plan and district plan cohesiveness. Implementation of best practice guidelines by councils. Regular review of effectiveness of provisions could be co-ordinated at central government level.
(G) Investigate and develop NZ/regional guidance on WSUD design, maintenance and lifecycle planning, including both greenfield and brownfield settings.	x							x	x	x	x			x		Reviews (documents and in the field) of NZ regional design and maintenance practices draws on well-developed familiarity of this topic area. Involves: (1) conducting field ‘training and assessment’ workshops in up to three regions (esp. where limited exposure to WSUD to date), to reveal and resolve specific local issues; and (2) Reviewing guidelines and practice in relation to role of WSUD in brownfields development and/or stormwater retrofits/upgrades.	A longer-term programme can extend the reviews to cover additional regions / contexts. Regular updates of design and maintenance ‘living document’ guidelines to enable practitioners to be informed of evolving best practice.	Multi-party implementation of guidance in planning, designing and maintaining WSUD.
(H) Review and provide guidance on potential options for incentivising uptake of WSUD and potential alternative funding mechanisms for WSUD implementation	x	x	x	x								x		x		Review of international incentives and funding mechanisms can build on previous work to collate and evaluate US/European approaches, with input from workshop participants involved in this work. Liaise with CRC for Water Sensitive Cities to gain insights from Australian research in this area.		Implementation by councils and/or central government.

Response to findings from discovery phase	Theme															Description of responses, with rationale		
	Knowledge	Evidence	Economics	Innovation	Cultural	Co-benefits	Politics	Regulation	Design	Maintenance	Lifecycle	Incentives	Organisations	Capacity	Comp. mandates	Phase 2 quick wins	Longer-term research	Other (non-research)
(I) Design and implement plan for long-term monitoring and evaluation of WSUD across multiple indicators.	x	x	x		x	x					x			x	x	Plan design only. Sets out a co-ordinated approach to gathering the essential evidence to support WSUD uptake. On-going engagement in phases 2/3 provide vehicle for multi-stakeholder input.	Implementation of the monitoring plan is likely to take years to decades, depending on indicators. Results should be regularly and reviewed reported, allowing revisions to programme over time.	Feeds into the review, revision and implementation of WSUD policy, plans, design, maintenance and guidance.
(J) Develop and apply software models and assessment tools to demonstrate the contrast in outcomes between WSUD and conventional approaches across multiple indicators.	x	x	x		x	x	x							x		Assemble summary / review of existing tools, building on well-progressed familiarity with this topic. Review international examples (e.g. SuDS tool, UK) and liaise with CRC for Water Sensitive Cities to gain insights from Australian research in this area.	Developing and applying models and tools for conducting assessments of WSUD outcomes is a key part of a longer-term research programme. Some tools are ready for application in case studies while others will emerge or evolve as the evidence base on WSUD improves.	
(K) Investigate and implement ways of promoting change toward more water sensitive practice among professionals and in and between organisations	x			x								x	x		x	Liaise with CRC for Water Sensitive Cities to gain insights from Australian research in this area. Scope methods (new research and/or knowledge transfer from Australia) for the development of guidance on activating change in NZ professions and organisations.	Acting on the scope developed in Phase 2, engage, research and develop guidance on activating change in relation to Aotearoa-specific forms of WSUD.	Relies on stakeholder organisations to implement this. Could involve establishing disciplinary champions and multi-disciplinary / organisational exemplars.
(L) Investigate and implement ways of promoting stronger support for water sensitive practice amongst decision-makers and broader society	x				x	x								x	x	Liaise with CRC for Water Sensitive Cities to gain insights from Australian research in this area. Scope methods (new research and/or knowledge transfer from Australia) for the development of guidance on activating a 'social licence' for WSUD.	Acting on the scope developed in Phase 2, engage, research and develop guidance on activating change in relation to Aotearoa-specific forms of WSUD.	Relies on the buy-in of politicians, communities and the market.

Figure 5 provides a check on the ways in which the responses listed in Table 3 aim to advance the cause of ‘activating WSUD’ in New Zealand. Based on the CRC for Water Sensitive Cities transition dynamics framework, the figure shows the extent to which Phase 2 ‘quick wins’ can contribute to progress being made in each of the five domains identified by the CRC. In summary, the activities proposed for Phase 2 have the potential to help:

- Connect WSUD champions (‘Champions’ domain);
- Develop a collective voice (‘Platforms for connecting’ domain);
- Advance WSUD solutions (‘Knowledge’ domain);
- Experiment with solutions (‘Projects and applications’ domain); and
- Provide refined guidance (‘Tools and instruments’ domain).

Response (see Table 3)	A, B, K	B, C, I, K, L	A, C, D, E, G, H, I, J, K, L, M	C, I, J	C, D, E, F, G, H, J
Transition phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
1. Issue emergence	Issue activists		Issue highlighted	Issue examined	
2. Issue definition	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	
3. Shared understanding & issue agreement	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
4. Knowledge dissemination	Influential champions	Building broad support	Solutions advanced	Solutions demonstrated at scale	Refined guidance and early policy
5. Policy and practice diffusion	Organisational champions	Expanding the community of practice	Capacity building	Widespread implementation and learning	Early regulation and targets
6. Embedding new practice	Multi- stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

Figure 5: How the ‘quick win’ responses to the findings of the discovery phase contribute to activating WSUD, based on the transitions dynamics framework developed by the CRC for Water Sensitive Cities³⁶. The arrows show the extent of progress in each of the CRC’s domains that the ‘quick wins’ listed in Table 3 can contribute to, with further progress relying on longer-term research and other non-research implementation activities.

³⁶ Brown, R., Rogers, B. and Werbeloff, L. 2016. Moving toward Water Sensitive Cities: A guidance manual for strategists and policy makers. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

5. Recommended activities for Phase 2

5.1 Introduction

This section sets out the package of recommended research and other activities for Phase 2 of this project, to be delivered over the 12 month period March 2018 to February 2019. Collectively, these activities aim to produce evidence and tools to support the business case for, and implementation of, WSUD approaches in New Zealand. All of the recommended activities aim to address a key knowledge gap or take up an opportunity to promote and/or progress WSUD identified through the findings of Phase 1 of this project. However, a number of other considerations have been taken into account. Inevitably, these include the available research budget and time for the delivery of project outputs. They also include consideration of whether each activity is (or could be) delivered by others and the extent to which it genuinely supports the needs of WSUD stakeholders.

The proposed activities include three core research activities (Section 5.2), three further discovery activities (Section 5.3) and two activities involving the enhancement and dissemination of existing information sources (Section 5.4). Each of these activities reflects one or more of the responses to Phase 1 listed in Table 3; in other words, some of those responses have been amalgamated to become part of a single, larger activity. Each activity is presented in the form of a summary table describing: the relevance / potential impact of the activity; the methods involved; the research team; the approximate budget size; anticipated outputs and possible end-users.

It should be noted that these budgets are intended to convey the relative level of effort required in relation to each activity, they have not been estimated in detail. Figure 6 shows the approximate split by activity of the total funding available for Phase 2 (approximately \$200,000). Subject to peer review and feedback from the EAG and science challenge leaders, the programme will be finalised and further, more detailed scoping of the methodology and budgets for each activity determined. The project team will also look for opportunities to co-fund some of these activities from other sources in order to increase the funding pool available.

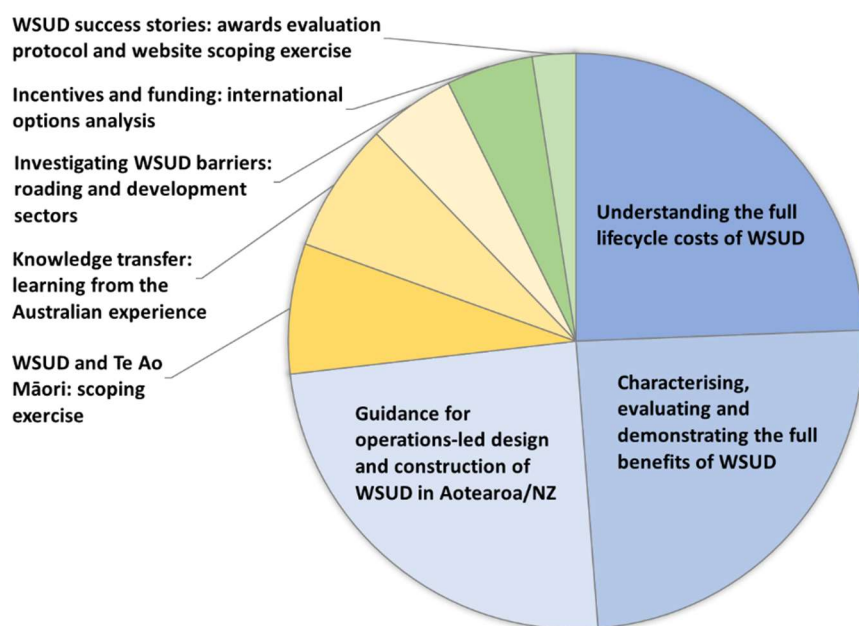


Figure 6 – Proposed activities for Phase 2, showing approximate split of effort between core research activities (blue segments), further discovery activities (yellow) and enhancement and dissemination of existing information sources (green).

5.2 Core research activities

Activity	Understanding the full lifecycle costs of WSUD (Table 3, (D))
Relevance / potential impact	Compilation of a costs database builds on well-progressed work in this space and addresses a high frequency theme, especially the need for robust data on WSUD maintenance costs.
Methods	Through interrogation of existing costs database and the inclusion of data to address key gaps (maintenance costs, costs of conventional development that are avoided by WSUD), derive guidance on unit costs (e.g. dollar per square metre, dollar per kg sediment retained) of implementing WSUD relative to conventional approaches.
Research team	Activating WSUD core research team (esp. Koru Environmental), supported by other WSUD practitioners as necessary. This is likely to include collaborating with Auckland Motorways Alliance, who we understand hold reliable data on maintenance costs.
Approximate budget size	\$50,000
Anticipated outputs	The collection of maintenance cost data has previously proved challenging, and many historical WSUD devices are maintenance deficient. The outputs will depend on the availability and quality of maintenance cost data. As a minimum, maintenance cost protocols, including types of activities and their frequency, will be developed. A report will be prepared which then addresses key gaps around maintenance costs, avoided costs, and the relationship between the life cycle cost (LCC) and load of contaminants removed by the device. Avoided costs will be documented according to the differing objective, geographic, site and legislative constraints. Depending on budget availability and the maintenance data collection process, the report will also tabulate or graph \$/device area LCCs, as well as \$/device area/ contaminant removed LCC. The report will also summarise any updated information on maintenance costs, activities and frequencies available in New Zealand (including data from the complementary activity on maintenance – see below) and assess the validity of data collected in Australia (linking to the discovery activity below). Other outputs include case studies contributing to a future WSUD website (see below). Costs around source control of contaminants from cars and building materials are considered outside the scope of this project, but could be identified as a project for investigation as part of the long-term research plan.
Potential end-users	Central, regional and local government; design engineers; developers; maintenance contractors; network operators; and planners.

Activity	Characterising, evaluating and demonstrating the full benefits of WSUD (Table 3, (E), (I), (J))
Relevance / potential impact	Assembling and reviewing information on benefits and evaluation methods and tools addresses a number of high frequency themes relevant to making the business case for WSUD. Developing a co-ordinated approach to monitoring and evaluating the delivery of these benefits is key to building a robust evidence base to support WSUD uptake.
Methods	(1) Develop a vision and understanding of what Aotearoa/NZ WSUD actually is and could be: aims and elements. This includes capturing perspectives from the 'Te Ao Maori' activity (see Section 5.3) as a critical and integral component of what makes for 'kiwi WSUD'. (2) Characterise the full range of benefits of this version of WSUD and provide a critical analysis of the methods for assessing and quantifying these benefits across the biophysical, economic, social and cultural domains (see also link in Section 5.4 below). (3) Scope a long-term plan for monitoring and evaluating WSUD across multiple indicators. On-going engagement with WSUD stakeholders during Phases 2/3 provide a vehicle for multi-stakeholder input into this activity and contribute to an activated WSUD community of practice.
Research team	Activating WSUD core research team (esp. Batstone Assoc. and NIWA).
Approximate budget size	\$50,000
Anticipated outputs	Guideline document detailing a vision and understanding of "Kiwi WSUD", along with a literature review of benefits and assessment methodologies. Research scoping document for long term monitoring of WSUD across multiple indicators. Dissemination via presentations and case studies on a future WSUD website (see below).
Potential end-users	Central, regional and local government; design engineers; developers; roading sector; planners; and politicians.

Activity	Guidance for operations-led design and construction of WSUD in Aotearoa/NZ (Table 3, (G))
Relevance / potential impact	Reviews (documents and in the field) of NZ regional design and operational practices (device inspection, maintenance and rejuvenation) draws on well-developed familiarity of this topic area and targets demand from regions outside of those where uptake of WSUD is most progressed (i.e. Auckland).
Methods	Focusing on functional and operational cost-related aspects of WSUD design, this will involve: (1) conducting field 'training and assessment' workshops in up to three regions (esp. where limited exposure to WSUD to date), to reveal and resolve specific local issues; and (2) Reviewing guidelines and practice in relation to role of WSUD in brownfields development and/or stormwater retrofits/upgrades. At least two 'Zero Additional Maintenance' devices developed in Australia and USA will be assessed for their relevance in New Zealand. Produce guidance material in relation to each of these focus areas. Investigate collaboration with other initiatives (e.g. WaterNZ 2019 Stormwater conference, MfE, IPENZ, Auckland Council) as platform for delivering workshops/training.
Research team	Activating WSUD core research team (esp. Landcare Research)
Approximate budget size	\$50,000
Anticipated outputs	Workshops in three regions. Data on operational (inspection, maintenance and rejuvenation) costs supplied to WSUD costs activity (see above). Report on operations-led design: principles and practice. Case studies contributing to a future WSUD website.
Potential end-users	Regional and local government; design engineers; developers; maintenance contractors and landscapers; network operators; and planners.

5.3 Further discovery activities

The following further discovery activities reflect key gaps in the data collected during Phase 1 of this project. The aim of these activities is to engage with these critical stakeholder groups in order to inform WSUD research and implementation activities that will be proposed as longer-term research activities beyond the life of this project.

Activity	WSUD and Te Ao Māori: scoping exercise* (Table 3, (A))
Relevance / potential impact	Required to address major gap in discovery phase – the need to develop an understanding of the extent to which WSUD does and could further deliver culturally-specific benefits.
Methods	Engage with key Māori practitioners to scope a research and engagement plan for the development of guidance on Aotearoa-specific forms of WSUD and evaluation methods that incorporate mātauranga Māori.
Research team	Activating WSUD core research team engaging with 2-4 leading Māori WSUD practitioners (inc. Troy Brockbank, Emily Afoa), including assessments of positive examples and missed opportunities associated with existing WSUD projects.
Approximate budget size	\$15,000
Anticipated outputs	A series of workshops with Māori practitioners which result in the development of a research and engagement plan (report) which scopes research to be implemented beyond the life of this project.
Potential end-users	Potential funders of future research; research team; Māori practitioners; central, regional and local government; wider WSUD stakeholders.

* See section 7.2 for a potential extension of this activity.

Activity	Investigating WSUD barriers: roading and development sectors (Table 3, (B))
Relevance / potential impact	Required to address major gap identified in discovery phase – the need to develop an understanding of the relative influence of other mandates in determining the actions of these sectors. This work should be afforded priority early on in Phase 2 because of its potential to feed into other research activities.
Methods	Audit relevant WSUD examples and review codes of practice. Present to roading and development sectors, respectively, as a means of initiating discussion and eliciting feedback at targeted workshops.
Research team	Activating WSUD core research team engaging with selected representatives from council/CCO roading departments, NZ Transport Agency, private developers and state housing sponsors.
Approximate budget size	\$10,000
Anticipated outputs	A series of workshops with these sectors, as well as a report which details potential barriers present in roading and other codes of practice. Can be used to scope further research to be conducted beyond the life of this project.
Potential end-users	Potential funders of future research; research team; central, regional and local government; network operators; developers; and design engineers.

Activity	Knowledge transfer: learning from the Australian experience (Table 3, (E), (H), (J), (K), (L))
Relevance / potential impact	The Australian CRC for Water Sensitive Cities has an approximate \$100M budget to deliver research that cuts across many of the themes identified in Phase 1. While recognising the need for NZ/Aotearoa-specific guidance, there is likely to be significant value to be gained by learning and reflecting on insights generated by our Australian peers and importing relevant international best practice to NZ. This is especially the case in relation to: the characterisation and assessment of WSUD benefits; planning a longer-term monitoring and evaluation programme; incentives; activating organisational change; and progressing the social licence for WSUD.
Methods	Take part in study visit to Monash University, Melbourne (host of CRC for Water Sensitive Cities). Workshop NZ areas of interest with leading researchers in relevant fields, and learn from current implementation practices by Melbourne Water and relevant local authorities. Scope methods (new research and/or knowledge transfer from Australia) for the development and dissemination of NZ-relevance guidance. Take opportunities to host key CRC investigators in New Zealand, for instance providing support to extend planned visits (e.g. conference attendance) to hold workshops and research meetings.
Research team	Activating WSUD core research team
Approximate budget size	\$15,000 (assuming a contribution from other non-challenge sources if combined with other travel/conferencing)
Anticipated outputs	Use of findings in reporting on the three Core Research Activities and other Discovery activities where relevant. Include specific sections on NZ/ Australian synergies, similarities and differences, and highlighting Australian lessons learnt from the transformation process and implementation of WSUD in Melbourne, Perth, Sydney and Adelaide.
Potential end-users	Potential funders of future research; research team; central, regional and local government, politicians, developers, planners.

5.4 Enhancement and dissemination of existing information sources

Activity	WSUD success (and near-success) stories: awards evaluation protocol and website scoping exercise (Table 3, (C))
Relevance / potential impact	Provides basis to identify, share and celebrate success stories. In longer term a website can help build capacity and provide a hub for WSUD community.
Methods	Develop an evaluation protocol or 'score card' that could provide the basis for a national WSUD awards scheme (via a WSUD assessment template developed from the findings of research described in Section 5.2). Review the (discontinued) LIUDD case study web-based database and scope enhancements, for instance: multi-benefit, cost and 'missed opportunities' evaluations of case studies; and links to walking tour examples from the Phase 1 workshops.
Research team	Activating WSUD core research team.
Approximate budget size	\$5,000
Anticipated outputs	Evaluation protocol and website scoping document for discussion with potential hosts (MFE, WaterNZ, regional council collective). Paper at WaterNZ Stormwater conference 2018.
Potential end-users	All WSUD stakeholders.

Activity	Incentives and funding: international options analysis for NZ/Aotearoa WSUD (Table 3, (H))
Relevance / potential impact	Relatively low effort but of high value for government/councils assembling tool box of enabling mechanisms.
Methods	Building on existing work to collate and evaluate US/European approaches, conduct and disseminate critical analysis with input from workshop participants currently and previously involved in this work.
Research team	Activating WSUD core research team (Koru Environmental, Batstone Assoc.) with input from practitioners such as Jan Heijs, Stu Farrant and Clare Feeney.
Approximate budget size	\$10,000
Anticipated outputs	A report, based on overseas experience, which summarises the available funding options and incentives which could be implemented in New Zealand.
Potential end-users	Central, regional and local government.

6. Complementary activities

The Activating WSUD research project is not happening in a vacuum. As well as learning from the on-going everyday experiences of WSUD practitioners via further formal and informal engagement throughout the life of the project, the research team recognises the value to be gained through close collaboration with a number of other initiatives. These include the following.

The **Urban Water Good Management Principles (GMP) working group** has been convened by the Ministry for the Environment (MFE) with the aim of collating, developing and disseminating information on GMPs for urban water management, with particular reference to assisting implementation of the NPS-FM in urban areas. The project is operating via six sub-groups, focusing on: policy framework; values for urban water; methods for mitigating priority pollutants; guidance/outreach; benefits, economic implications and incentives; and monitoring, evaluation and compliance. Clearly there are many areas of very similar interest and the Activating WSUD project team are engaging closely with the MFE project leaders³⁷ to consider alignment and avoid duplication. One activity, for instance, that the MFE-led project may be well placed to progress is the review of effectiveness of WSUD-related RMA plans and regulations (Table 3 (F)), given that the Urban Water GMP working group includes several council planners³⁸. Accordingly, we have not proposed to pursue that topic with the funding available to this project. We also anticipate that some of the outputs of the MFE working group will be available to feed into this project as we progress the Phase 2 activities. For instance, MFE is aiming to draft a series of high level urban water management ‘principles’ by May 2018. These are likely to be highly relevant to the visioning of ‘kiwi WSUD’ in our “Characterising, evaluating and demonstrating the full benefits of WSUD” activity and we will aim to avoid any duplication of effort in this space.

University research is a second area of complementary effort. A graduate student at the University of Canterbury, Vicky Southworth, is currently investigating barriers to the uptake of WSUD in the Christchurch rebuild (see Section 3.4.3). Vicky attended our Christchurch workshop and has shared her findings to date. Likewise, the Activating WSUD team will share the findings from our discovery phase (and subsequent) research with Vicky. Other opportunities for Masters projects may arise as part of our implementation of Phase 2 research activities and the project team will look encourage and be actively involved in these. We know already of two students who have expressed an interest in a WSUD-related masters’ topic through their exposure to this research at the Auckland and Christchurch workshops. There is also the potential to collaborate with one of our workshop participants, Troy Brockbank, in scoping a PhD topic that aligns with the further discovery activity ‘WSUD and Te Ao Māori: scoping exercise.’

A third very relevant activity is the award of a **Winston Churchill Fellowship** to one of our EAG members, Stu Farrant. Stu will be travelling to Europe and the US to gain insights into urban water management policy, technical innovations and funding mechanisms. Stu has confirmed his willingness to report back on his findings and the research team expects that these will be of significant value to many of the Phase 2 activities, as well as providing a mechanism for making connections with other overseas researchers and practitioners.

Finally, a number of potential **training opportunities** may arise during the lifespan of the current project. These opportunities, which include training hosted by councils and potentially at WaterNZ

³⁷ Two of the Activating WSUD team and several of the EAG are members of the Urban GMP working group, while the MFE project leader attended the Auckland Activating WSUD workshop.

³⁸ Noting the possible limitation that the Urban Water GMP project is relying on *pro bono* contributions from working group members to develop outputs.

conferences, could provide an additional way of disseminating the results of this research. Accordingly, it is important that the team continues to liaise closely with our contacts in the WSUD community of practice so that training can be delivered in a coordinated fashion.

7. Feedback on this report

7.1 International Peer Review

A draft version of this report was reviewed by Dr Briony Rogers of Monash University, one of the lead researchers at Australia's CRC for Water Sensitive Cities. Dr Rogers gave the report and its recommendations a favourable review and was strongly supportive of building closer research ties between our two sets of research activities. She commented that *"there appears to be good synergy between the proposed research activities with CRCWSC research, without any real duplication"* and provided some suggestions for material that would be useful for us to consider as we move into Phase 2. In addition, Dr Rogers made a number of suggestions for additions and some restructuring of the draft report to improve its clarity and impact. The research team acted upon almost all of these suggestions in preparing this final version of the report.

7.2 External Advisory Group (EAG)

The project's EAG met on 22 February 2018 to discuss the research team's recommended activities for Phase 2³⁹. The EAG's feedback was very positive and they endorsed the project team's recommendations, subject to a number of suggested minor enhancements. These suggestions are reflected in the final description of activities presented in Section 5.2 of this report.

A more substantial suggestion made by several EAG members, and endorsed by the group as a whole, was to elevate the status of the 'Te Ao Māori' further discovery activity so that it becomes a core research activity for the project, but without reducing the funding allocation proposed for the other core activities. This suggestion reflects a view that understanding and embracing the perspective and values of Māori is fundamental to the development of 'kiwi WSUD' and an integral part of many of the other research activities planned for Phase 2.

The team's response to this feedback thus far has been to re-allocate some of the funding from other non-core activities to the proposed 'Te Ao Māori' scoping exercise. We suggest that this scoping exercise be considered as part 1 of a longer-term project. With additional funding, part 2 of this project would involve implementation of the outcomes of the scoping exercise. This would likely comprise a wide-ranging programme delivered by Māori researchers engaging with urban Māori and iwi, employing mātauranga Māori to develop and demonstrate a version of WSUD that truly embodies kaitiakitanga principles. We would welcome an opportunity to discuss options with the challenge leaders for securing additional funding to allow this more substantial research activity to begin within the life of the current project.

A second strong call from the EAG was for the establishment of a national entity that would take responsibility for leading and promoting the implementation of WSUD across New Zealand. While establishing (and funding) such an entity is outside the scope of the current project, it has some relevance to our activities. Such an entity would be the obvious host for a WSUD website, could co-ordinate the development of national guidelines, run an awards system, and lead the implementation of a long-term research strategy.

³⁹ Other than Julian Williams, who was unable to attend the meeting but who provided feedback in an email of 22 Feb 2018.

8. Next Steps

This report signals the completion of Phase 1 of this project. It describes a prioritised research plan which responds to the needs and barriers expressed through the workshop and survey and which has the backing of our EAG and international reviewer. The next steps of the project are as follows:

- Provide this research plan to the National Science Challenge (NSC) for funding approval for Phase 2 of the project;
- Subject to NSC approval, conduct the Phase 2 research projects over the period March 2018-February 2019; and
- Conduct Phase 3 of the project (to June 2019), disseminating the research findings through further workshops, research reports, guidance material and the WSUD website. These outputs include a co-designed and prioritised longer-term plan for the continued delivery and implementation of WSUD research, beyond the life of this project.

9. Acknowledgements

The research team gratefully acknowledges:

- Our many contacts in the WSUD community of practice, for their generous donated time to attend our workshops at short notice and at the busiest time of year;
- Our EAG, also for their generous donated time to guide this research and commitment to helping progress WSUD in Aotearoa/NZ;
- Briony Rogers, of the CRC for Water Sensitive Cities, for generously providing material to guide the workshop activities and for peer review of this report; and
- Clare Feeney, for her excellent facilitation of the workshops, co-ordination of the EAG and on-going generous contributions of ideas to help this research along; and
- Polly Holland, for her analysis and presentation of results from the survey and workshops, when the rest of the research team was on holiday.

Appendix 1 – On-line survey



You want WSUD? Help break the barriers

Make a practical difference to help deliver effective Water Sensitive Urban Design

Please help us make a practical difference to help deliver effective Water Sensitive Urban Design (WSUD) across New Zealand. Your input will help us prioritise which barriers to WSUD to explore in our research, which is funded through National Science Challenge 11 (<http://www.buildingbetter.nz/>).

Answering the following five questions will help us identify and prioritise over \$200,000 of research over 9 months from March 2018 and inform a longer-term national research and information transfer strategy.

Our key hypothesis is that relative to prevailing forms of urban development, WSUD performs more strongly under a comprehensive assessment of wider benefits.

Taking part in the survey is completely voluntary.

Your responses will be kept confidential and anonymous, and digital data will be stored in a secure manner. Our reporting will not include your name or organisation, however we would like to use some of your comments, so please take care what you write does not contain names or identifying details. The data may be used for successive workshops and research reports, as we plan ongoing engagement over the project duration.

This study has received ethics approval through Manaaki Whenua Landcare Research, a crown-owned research institute. If you have questions please email WSUD@landcareresearch.co.nz

Filling in answers to the questions below indicates your consent to participate in this survey.

Thank you for participating and helping influence what WSUD research we focus on.

1. Barriers to WSUD

What barriers to WSUD do you find in your work? You might consider areas such as maintenance, implementation, cost/economics, evidence on environmental outcomes and benefits, capacity issues, policy/consenting.

Please list as many barriers as you like, and score each of them using a scale where 5 = high (serious and/or common) barrier; 1 = low (= unimportant and/or rare) barrier

1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	

2. What barriers (listed above) have you most recently experienced in a WSUD project?

1.	
2.	
3.	
4.	

3. Activating WSUD

What would support you to more fully implement WSUD in your job? Examples may be in areas such as maintenance, implementation, cost/economics, environmental outcomes and benefits, capacity (training, suitable products) or policy/consenting or guidance.

Please list these 'activating factors', and score each using a scale where 5 = high (effective and/or would be often used); 1 = low (least effective and/or infrequently used)

•	<input type="text"/>
•	<input type="text"/>
•	<input type="text"/>
•	<input type="text"/>
•	<input type="text"/>
•	<input type="text"/>

4. What 'activating factors' were effective in your most recent experience or project?

•	<input type="text"/>
•	<input type="text"/>
•	<input type="text"/>
•	<input type="text"/>

5. We are running workshops around New Zealand. How do we make these of most value to you?

You might consider WSUD tours, actions to facilitate peer to peer connection, discussing volunteered case study sites, placing WSUD sites or cities along a gradient, coffee, forming a Facebook site with updates on the research, CPD points, etc. What would you like to gain from participating in a WSUD workshop?

•	<input type="text"/>
•	<input type="text"/>
•	<input type="text"/>
•	<input type="text"/>

Next



You want WSUD? Help break the barriers

Thank you for your input – it's vital for our research and for making our findings relevant to you.

Thank you also for the following information – it helps us balance coverage across the WSUD sectors.

More information on this research project is at www.landcareresearch.co.nz/WSUD. But please only look AFTER completing the survey (as we don't want to influence your survey responses).

6. What is your age?

- | | |
|---|---|
| <input type="checkbox"/> under 30 years | <input type="checkbox"/> 46 to 60 years |
| <input type="checkbox"/> 30 to 45 years | <input type="checkbox"/> over 60 years |

7. Which of the following describes your role(s)?

Tick all that apply.

- | | |
|---|---|
| <input type="checkbox"/> private sector / consultant / independent practitioner | <input type="checkbox"/> local or regional government / unitary authority |
| <input type="checkbox"/> developer | <input type="checkbox"/> central government agency |
| <input type="checkbox"/> iwi / maori agency | <input type="checkbox"/> council controlled organisation |
| <input type="checkbox"/> non government organisation | |

Other (please specify)

8. Which of the following describes your area of expertise(s)?

Tick all that apply.

- | | |
|--|---|
| <input type="checkbox"/> engineer | <input type="checkbox"/> iwi / community / local governance |
| <input type="checkbox"/> architect / landscape architect | <input type="checkbox"/> place maker |
| <input type="checkbox"/> operations - construction | <input type="checkbox"/> planner / policy analyst |
| <input type="checkbox"/> operations - maintenance | <input type="checkbox"/> researcher |

Other (please specify)

9. Which region are you based in?

Tick all that apply.

- | | |
|--|--|
| <input type="checkbox"/> Northland | <input type="checkbox"/> Manawatu / Wanganui |
| <input type="checkbox"/> Auckland | <input type="checkbox"/> Wellington |
| <input type="checkbox"/> Waikato | <input type="checkbox"/> Nelson / Tasman / Marlborough |
| <input type="checkbox"/> Bay of Plenty | <input type="checkbox"/> West Coast |
| <input type="checkbox"/> Taranaki | <input type="checkbox"/> Canterbury |
| <input type="checkbox"/> Gisborne | <input type="checkbox"/> Otago |
| <input type="checkbox"/> Hawke's Bay | <input type="checkbox"/> Southland |

Other (please specify)

10. If you want to receive more information on the workshops, please put your email address in the box below and we will send information specific to your region.

Email Address

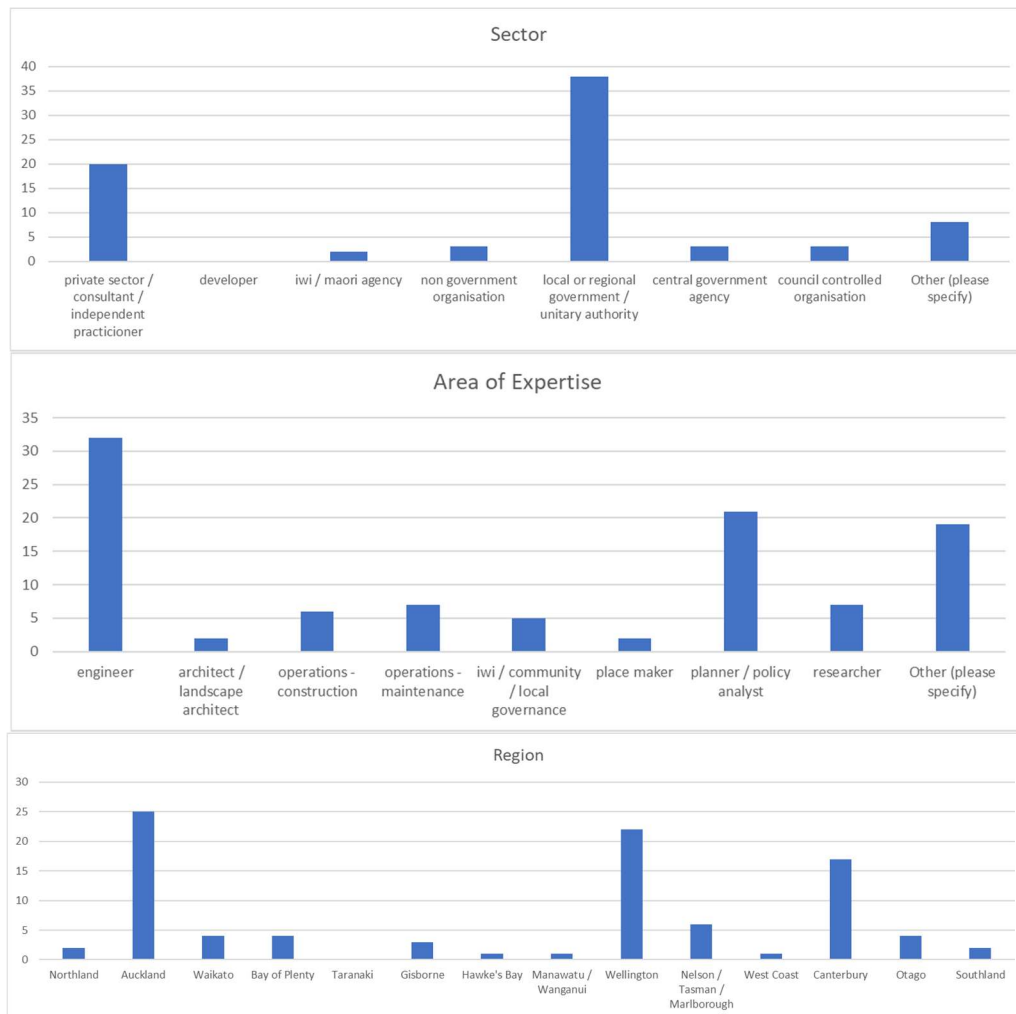
Phone Number

Prev

Done

Appendix 2 – Survey response data

Number of survey responses received by sector, area of expertise and region.



Appendix 3 – Workshop minutes

ACTIVATING WATER SENSITIVE URBAN DESIGN IN NEW ZEALAND

Barriers Workshop

Venue: Auckland

Date: 30 November 2017

Time: 9am – 3pm

Attendees

ORGANISATION	CONTACT NAME
ACH Consulting	Linda Norman
AR & Associates	Andrés Roa (Apologies)
AR Associates	Andrew Nel (Apologies)
AR Associates	Rowan Carter
Auckland Council	Gretel Roberts
Auckland Motorway Alliance	Peter Mitchell
Boffa Miskell	Benjamin Loh
CKL	Zeb Worth
Hamilton City Council	Andrea Phillips
Land and Water Forum	Andrew Schollum (Apologies)
Ministry for the Environment	Sarah Boone
Morphum	Emily Afoa
Morphum	Caleb Clarke
MWH Stantec	Hannah Andrew
Natural Habitats	Hayden Sefonte
Natural Habitats	Mel R.
Ngati Manuhiri	Fiona McKenzie
Ngati Manuhiri	Fiona McKenzie
Opus	Suman Khareedi (Apologies)
Porirua City Council	Torrey McDonnell
Stormwater360	Troy Brockbank
Todd Property	Neil Donnelly
University of Auckland	Marjorie van Roon
University of Auckland	Sam Trowsdale
Waikato Regional Council	Matthew Davis
Woods	Pranil Waden

Project Team

ORGANISATION	CONTACT NAME	EMAIL ADDRESS
Manaaki Whenua Landcare Research	Robyn Simcock	SimcockR@landcareresearch.co.nz
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Environmental Communications Ltd (EAG/ Facilitator)	Clare Feeney	clare@clarefeeney.com

Workshop Notes – Summary of Key Comments

A copy of the notes taken on the whiteboard are included in Appendix B.

Burning Issues

- Would love to see WSUD easier to get through the Council process, so that designs are not bespoke designs but standard approach to stormwater management.
- Similar to the above barrier. It's about getting around the regulatory process, and understanding and getting it right through from the planning stage through council processes.
- My networking outcome customer needs requires resilience and value for money assets/ outcomes, but the toolbox is very limited and lacking in good tools, including good decision making based on CBA over the life-cycle of the device. We need safe, reliably functional and resilient WSUD assets. We have a weak fluffy definition of WSUD and if it is not clearly defined you can't set goals and outcomes and then define risk.
- There is a clear differentiation in standards between new development and existing development issues and trying to alleviate existing issues whilst setting high standards for new – difficult to justify WSUD needs and what we do. This leads to a knowledge gap relating to macro-benefits.
- We understand the benefits around water quantity and quality, but better quantification of the other benefits is needed so other benefits can be maximised and WSUD can be a whole package (economic – real estate, environmental benefits, as well as social and aesthetic benefits).
- Politics of these experiments of water sensitive cities – is something to be explored and understood by looking differently at how we make decisions.

- We know economic, social and environmental well beings and benefits, but cultural well-being is being used as a token. We don't fully understand these benefits and we need to promote and raise cultural values both nationally and internationally.
- We can't separate stormwater from leaking wastewater, streams, oceans. Grass roots level – we can design all we want amongst ourselves, but until the community looks at what we're designing as an asset, it has a very short length of life in the ground. Community engagement (incl. landscape architects is key) – need to create the value by changing perception.
- Key barrier is whole life cycle cost benefit analysis to support good decision making - and support from Treasury. Drilling into those social, amenity and cultural values and putting a quantifiable number to justify that. Identifying tipping points / critical leverage points for behavior change. Where do people make the decision to go for grey water approaches vs WSUD.
- There is a lack of integration between typical urban design thinking (places and spaces) and WSUD thinking at the urban design level. [strategic growth alliance]
- It is important to quantify the wider benefits to get some of these devices over the line. Also missed opportunities through lack of understanding by those who do urban planning for development areas, and those in the regulatory process?
- There is a disparity between what is approved by Council and then what is actually installed (through push-back after consenting, for example during 'cost/value engineering'). Try and get more of these types of devices over the line and from a developer point of view it would be good to have more information around perception of cost, benefits and maintenance. Can then "sell" this to the clients.
- Opex is poorly understood – reflected by types of procurement models for long term maintenance. It is helpful to distinguish between cyclic, periodic, reactive, improvement and renewal maintenance through the life of a device (useful data is available on wetland maintenance in Auckland). NPV is useful when assessing whether to retrofit or do nothing for an existing asset, whereas CBA is useful when considering a new asset.
- Barriers at the 'back-end' of the development cycle – 4 different designs for rain gardens. Where is the specification or generic standard that people are following? E.g. rain garden media is a problem. Green infrastructure is generally outsourced at construction and there is lack of knowledge or care around this.
- Doing LTPs, we need to know are we investing in the right things by doing WSUD activities; compared with investing in better technologies?

It's about building on cultural and social values and ethics, but land ethics seems to trump things a lot – setting a line to keep people with standards, but is that line suitable since we are still getting adverse effects. NPS FM can help with this, but will

the community have the kaitiaki to spend that money? How do we get a 'land stewardship ethic' rather than a 'minimum compliance to just get over the regulatory line' approach?

- We need to work out why there is such sporadic intermittent uptake and why? What can we do about it?
- Is planting big trees in bioretention systems a problem and how stable they are in the long term. Also around maintenance as AT are reluctant to maintain tree pits.
- Need to better understand opportunities around WSUD to incorporate into Council planning processes and target setting for the NPS-FM.
- There is no way for developers to 'show off' their good environmental work and market it (no incentives). Maybe we need to include it in the green star rating system. We need developers to be able to appropriate the benefits created by adopting WSUD, including being recognized as market leaders

General Discussion (morning session)

- Are the devices being over-engineered as some sources of pollution may become obsolete? For example if Cu and Zn sources are eliminated, then different designs may be effective.
- Devices are quite flexible and can also be designed to assist with air quality. Overengineering may not be a negative outcome.
- Is there a lack of understanding around the value of implementing WS work in existing areas?
- The criteria for how benefits of WSUD are quantified depends on the people or customers that are influenced by the outcomes. What industry members think is desirable may be different to the average person. Customer outcome needs are specific to different areas. WSUD is either priceless or worthless depending on the point of view (tree hugger or concrete manufacturer).
- It is surprising that maintenance and the consenting process scored so low in the survey results. This is a large piece of the picture that is not represented.
- How much does the composition of survey respondents influence the survey results? Maintenance may not be presented as a large barrier because the respondents are not involved in that side of the process.
- The survey reflects the dominant disciplines charged with making decisions in urban spaces, which are usually very deterministic and technical. The results reflect the audience (eg scientists, economists) and how decisions are made.

- Whilst it is important to learn from international research, we should ensure that our research is focused in a New Zealand specific context. For example, elements such as labour costs that may contribute to the success of WSUD in Singapore may not be transportable to New Zealand.
- Outcomes could be improved if WSUD was part of the initial vision. Architects often see WS solutions as a burden. There is an opportunity to spread the WSUD message with Auckland architects who invite guest speakers on a monthly basis.
- There could be value in educating the public on what these devices are and how they work. Signage could be a method of achieving this.

Site Walk Over

- How effective are these devices and could they be having adverse effects? Is the hoggin at site 1 impermeable or is it causing sediment runoff? The grassed area (site 3) doesn't work because it is impervious in the winter due to impermeable clay and lack of slope, and is rock-hard when dry in the summer. The unshaded rock-lined device could be a source of temperature pollution. Rain gardens may not be functioning properly because the inlets are in the wrong place and may not be receiving much load at all.
- It is easier to manage devices when they are in defined areas because they can be expensive to put in and after a certain length of time you need to perform renewals.
- There is no standardization. People put devices in to meet regulations but if there is no follow up this may be harmful in the long run.
- There are practical maintenance issues with many of these devices. For example the central medians with single traffic lanes on each side means they are dangerous to maintain or road closures are required. This creates potential for a negative legacy. Material and maintenance should be considered in the design phase. For example, use of deciduous trees require more maintenance, and use of the photo-degrading or brittle plastic caps (which were often now broken) in the tree pits.
- Although we want to encourage everyone to do the best, rather than the minimum, regulations may go against incentivizing uptake.
- Urban developments are showing interest in having orchards in green spaces and fruit trees in rain gardens. However, there is confusion over the safety of eating from trees that may have treated stormwater due to the safety risks of bioaccumulation. Most orchard species also generally need relatively fertile soils (and raingardens should not be fertilized); others may require fungicide sprays (which are often copper based – and copper is a major stormwater contaminant)
- There are landscape features amongst the WSUD devices in Albany that some consider to be lost opportunities. Missed opportunities also occur when designs focus too heavily on technical compliance.

- Councils and planners must accommodate for engineers who prefer traditional approaches. For example, certain councils won't allow curb cutting and prefer catch-pits for ease of construction, transport and removal.
- Auckland has the ugliest stormwater devices.
- Devices such as the rock-lined detention area could benefit from planting around the devices for aesthetic and ecological reasons.
- If you leave the implementation of these devices to the market you'll get a continuation of the old approaches.
- People are disconnected from the water. The waterways are fenced so you walk past them and see them, but you can't connect with the water.
- There are socio-economic implications of WSUD. Who gets the benefits? Devices are more likely to be present in more affluent neighborhoods.

Site Walk Debrief

- We need a more holistic approach because these assets are part of multiple disciplines. There is a lack of flexibility and clarity around who is responsible for devices because they cross multiple jurisdictions within council (eg parks, Stormwater, roading authorities). This limits their design and implementation. How do they know they have these assets?
- Safety, design, engineering and risks need to be addressed right throughout life cycles.
- Devices would benefit from incorporation into the planning stages. Many devices appear to be an afterthought. These areas have potential to provide more social and cultural values.
- We should be trying to upskill and inform local people by exploring pathways of community involvement and fostering an understanding of water. Possible methods for this include community involvement in the development process, increasing amenity values and signage.
- People want to be more connected with water. For so long water has gone into pipes and removed from sight. It is important to educate people that rain and runoff are part of the hydrological cycle and it should be brought to the surface. Education around this will help to address health and safety issues. Why are stormwater assets fenced off and perceived as bad?

- What are the regulations or implications of minimal fencing and allowing for interaction? The level of fencing around waterways is overwhelming. This is also a missed opportunity for enhancing amenity value.
- Our communities need places to sit by the water and connect to water. There was a stone on site that said water was the life giving source of all things, but we didn't feel connected to the water because it was all fenced off and concrete. A review of current practice for integrating safety with stormwater (requirement or not of fencing/ barriers) and benefits of including places to sit near water to establish connectivity and observation of water, kaitiakitanga may be useful. What are the actual ecological outcomes and are they beneficial? For example, should we be encouraging fish and wildlife into these ponds? Perhaps not if they are hazardous, shouldn't encourage habitat value. Should we promote fish passage into stormwater ponds and wetlands? What is the impact on wildlife in these areas, e.g., pukeko.
- Best practice should consider the implications of construction and maintenance periods.
- 'Safety in Design' applied for roading design uses a life cycle model that could be useful for WSUD
- It could be worthwhile to explore the costs of doing this poorly. Some examples we saw are better than others, and there were varying levels of maintenance. Is a poorly managed device better or worse than a pipe? Poor application is inevitable. For example, a developer did not want ponds as he was aware of a site where ponds had dead ducks
- Maintenance is an issue and there is very little data available to inform this. At every stage of the process things can go wrong, so we need construction checklists that are well known. This should be done with ecologists as well.
- There is danger that if devices are not maintained well people will say "wetlands are bad, please build a pipe".
- Performance and conditions failure are two separate allocations of money.
- Decision makers need to know the costs of these processes. Is there currently any data to inform these budgets?
- Quick wins could include:
 - WSUD signoff checklists /inspection guides, rating and reporting systems – these have been developed both locally and internationally (CiRIA)
- In a recent subdivision, Auckland Council demanded roadside bioretention was planted in (non-native) *Lomandra*, not oioi (*Apodasmia similis*) on the basis that the oioi required trimming

- There is massive value for money in using the right people. It is easier to teach certain people particular skills than others. For example, construction workers aren't going to know about different types of plants. 'I can teach a wetland plant specialist how to assess inlets and outlets, but I can't teach a gumboot chap what a weed species is'.
- How do you get people more interested in developing these assets? When the existing assets are poorly maintained it has the opposite effect because it turns people off. How can we look at existing infrastructure and can we improve/maintain this to a higher level to build developer interest?
- What are the customer objectives and are they being reflected? Devices that look bad may be very functional.
- Public perceptions of WSUD can be influenced by the narrative that we give to people and public engagement. We could be educating to show that although these things may not be 'beautiful', they are what will allow your kids to swim in rivers.
- So many little things that came out today – the importance of proper compaction of soil, need for better distribution of flow into raingardens and wetlands – if there is no agreement or standard in this room, how will the broader industry get it right?
- It would be great to get national design guidelines. There is a desire to seek best practice and codify these elements. If we had national guidance you could inform decision makers.
- There is concern that standardization will lead to a loss of adaptability.
- Albany is not a good example of WSUD. Whilst it has a number of devices, the overall landscape reflects traditional approaches to development.

Afternoon session on Barriers and Transitioning

Appendix A includes a summary of the results of the activity group session. Some of the key points raised during the discussion include:

- Although there are some examples of multifunctional value, there is a general lack of cohesion in devices.
- It is almost as if cities are going through the cycles multiple times. For example, initially saying 'ponds are awesome' then acknowledging the downfalls and going to wetlands or raingardens or back to the start.
- An 'aspirational' vision doesn't need to be a realistic goal as long as it represents the right objectives.
- Benchmarking is useful and constructive for understanding our WSUD trajectory. Recognize that you don't have to fall within a single category. Decision making is not solely based on benchmarking.

- We need to acknowledge that there is also value in these devices as they can start the WSUD conversation (i.e. over and above just the technical value of the device itself).
- We do have individual champions but they may not be very influential or at the organization level. Many elements are in progress or simply aspirational. There is a key gap between policy and practice.
- How connected are individual champions to developers, stakeholders and each other?
- Need to showcase benefits and involve champions in networking and sharing of ideas. Different stakeholders have different interests.
- In cases where solutions have been developed, the sources of impact need to more in deeply researched.
- We have agreement that there is a problem and the current state of our receiving water quality is not acceptable. We are starting to build capacity as we build new solutions. This involves experimenting.
- Uptake needs to be driven by the community not industry. Build communities where WSUD devices are focal points, have continuity and community connectedness.
- Barriers can be opportunities. For example, the reduced use of plastic bags in supermarkets. This even creates a new market for selling bags rather than giving them away. When people saw the impact of plastic on wildlife, ‘mum and dad’ drove removal of plastic bags from supermarkets; what do we learn from this when considering impacts of Stormwater?
- We need to understand the intention behind WSUD from all levels (e.g. community through to developers). WSUD should have a clear design intention rather than be about a tick box checklist. We need to change the perception that maintenance is a burden by making it accounted for at the start of the design process.
- Do we need different guidelines in each region or is New Zealand small enough to have an overarching source of knowledge transfer?
- We need to broaden the discussion so that we are all walking in the same direction.
- It would be useful to have school-scale and school-suitable WSUD retrofit packages with educational resources – seeing surface rain and rainfall is part of reforming our relationship with land and water (moving from drained to water sensitive city)
- The biggest barrier is a lack of cohesion and multidisciplinary input. There is no “big picture”. Within the council alone there are lots of threads and competing

requirements which comes back to silos of professions and departments within government and industry. This can be partly attributed to funding models. For example, Watercare are incentivized to maintain and build wastewater assets, but stormwater is a public good. The Watercare model would not work for WSUD because that would incentivize more infrastructure which will create more issues. Stormwater falls through the cracks because it has no monetary value (no monetary cost or benefit) and this leads to a lack of ownership and associated problems.

Closing

The research team thanked all the attendees for their time and participation at the workshop.



National
Science
Challenges

BUILDING BETTER
HOMES, TOWNS
AND CITIES

Ko ngā wā kāinga hei
whakamāhorahora



*Batstone
Associates*



Thanks also to the following people for their assistance:

- Clare Feeney, The Sustainability Strategist, for facilitating the workshop.
- Briony Rogers, Monash University, and the CRC for Water Sensitive Cities, for sharing their research information with us and allowing us to use it in the workshop.

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Appendix A: Summary of Afternoon Activity Group Session

Activity 1 - Benchmarking

Workshop 1 (Auckland and Hamilton)

	GRP 1	GRP 2	GRP 3	GRP 5	GRP 6	GRP 7
Water Supply City	98%	Existing Dev	Rural and existing Dev	Existing Dev		Existing Dev
Sewered City	85% - 90%				Some	
Drained City	75% - 80%				Most	
Waterways City	10% - 15%	Greenfields	New and some parts of Auckland	Te Papa Wetland	A little	Greenfields
Water Cycle City	1% - 10%					
Water Sensitive City	0.1%					

TDF Narrative (workshop 1)	GRP 1	General public is between issue emergence and issue definition (1 and 2); Professionals tend to be between Shared understanding + issue agreement and Knowledge dissemination (3 and 4); maybe also some policy + practice diffusion
	GRP 2	We are at the issue definition stage (2).
	GRP 3	Depends on perspectives and backgrounds, but potentially between the shared understanding + issue agreement and policy dissemination stage (3 and 4)
	GRP 4	Between issue emergence and shared understanding (2 and 3)
	GRP 5	General public is between issue emergence and issue definition (1 and 2); Professionals tend to be between knowledge dissemination and policy + practice diffusion (4 and 5); maybe also some policy + practice diffusion
	GRP 6	Issue emergence (1)

Additional Comments:

Water Cycle city is very isolated (only Long Bay).

Waterways City = Flat Bush (2005).

Existing areas never go far enough - new areas are further along the city spectrum.

Well along the spectrum with respect to Socio-Political Drivers, but lagging behind badly in service delivery.
Predominantly drained cities with pockets of sewerage, but also pockets of waterways cities.
Opportunities to enhance/ move forward to water cycle city.
Water Sensitive City is aspirational.
Wider Albany area shows variance between waterways, water cycle and water sensitive cities.
Some examples of multifunctional structures (e.g. Lake and path, rain gardens, landscape amenity).
Lack of cohesion in treatment areas.
Some examples on integrating amenity within treatment devices.
Different cities are at different levels of the advocating vs contesting narrative and may need to go through the cycle more than once.

Activity 3 - Barriers
Local government political model (10 year LTCP so not long term 50 year planning)
CCO model - Watercare model set up as a funding model by volumetric charge on wastewater and water supply, but not stormwater
Justify investing ratepayer in Water
Wellington water type.
Whilst there is some regional and community buy-in, take-up is not good at the individual level (nor is understanding)
Need to educate individuals, builders
Lack of guidance on specs, plants, etc.
Contractors need to be skilled up and need to create an 'auditing' framework
Community stewardship and continuity
Barriers should be seen as opportunities
Need an additional column in the Transition Dynamics Framework which is about Asset Management and Operations

Activity 3: Building a Strategic Transition Program: Where are we?

The matrix presented below is indicative only, and represents a summary of the results from the different group discussions. The green and yellow box (technical guidance) highlights that an equal number of groups said that "we are doing this" and said "we are partly doing this".

we are doing this
we are partly doing this
we are not doing this

Transition phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
1. Issue emergence	Issue activists		Issue highlighted	Issue examined	
2. Issue definition	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	
3. Shared understanding & issue agreement	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
4. Knowledge dissemination	Influential champions	Building broad support	Solutions advanced	Solutions demonstrated at scale	Refined guidance and early policy
5. Policy and practice diffusion	Organisational champions	Expanding the community of practice	Capacity building	Widespread implementation and learning	Early regulation and targets
6. Embedding new practice	Multi-stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

Appendix B: Whiteboard Notes

Burning issues

- Make it easier for WSUD to get through council processes
- Understanding the regulatory process
- Resilient whole of life value for financial asset
- Lack of tools and lack of good tools
- NPS kit – will the community want to spend the \$?
- WSUD definition is weak and fluffy, so we can't develop any KPIs or indicators
- Different standards for new developments vs existing issues – capex and opex – not the same level of commitment to existing areas of the city. Knowledge gap with respect to macro-benefits
- The Sustainable Society – values, ethics are not winning – benefits/rules – where to draw the line with respect to development
- Water quality and water quantity are understood – need more quantification of other benefits e.g. numbers on amenity/social/real estate benefits to help sell the benefits / procurement models for big contracts
- Understanding the politics of experiments with WSUD – explore and develop different ways of looking
- Knowledge of economic/social/environmental benefits but only token for cultural benefits – nationally and internationally; bridge engineering to Te Ao Maori
- All waters not just stormwater flow to the oceans
- Grass-roots design/community asset – short life in the ground leads to need to engage community early on in the piece to generate value
- Preserve te mana o te wai – life cycle assessment, cost/benefit analysis and social, cultural and amenity values quantifiable + tipping points for changes in practice
- Whole catchment, lack of integration between urban design thinking “places and spaces” vs urban design is never linked to results in the receiving environment
- Quantifying wide range of benefits to get WSUD over the line / missed opportunities – business as usual not working
- Disparity between what council approves vs what is built on the ground > more council cohesion needed / how to get more devices over the line depends on perceptions of benefits and cost – and the benefits with respect to durability / O&M (operation and maintenance) LCA (life cycle assessment)
- Give us the business case so we can give that to our clients
- At the back end of the project cycle we see 4 completely different rain garden designs: no standard specs
- Contracts > cost engineering
- Huge \$ in 10-year plan/infrastructure strategy – what is the right spend for local authorities under the LGA for O&M?
- Must have (= BAU) vs nice to have (=WSUD) – how to address WSUD in the district plan review?
- How to change sporadic uptake
- O&M vs design
- Strategic growth alliance

Benchmarking against the urban water transitions framework

Hannah's team

#1: Albany example

- Wider scale = waterways-water cycle-water sensitive city
- Some multifunctional structures e.g. the lake and rain gardens but general feel of lack of multifunctional infrastructure
- Lack of coherent plan

#2: State of change New Zealand is in: NZ cities are all different. Going through the transition cycle multiple times e.g. first with ponds, how with rain gardens

Sam's team

- #1: Useful conceptual model of post-industrial development – simplifies a very complex process to help us think
- #2: Water sensitivity is an aspirational goal, not one that can be achieved [Sue I: it's not a continuum; different places are in different stages]
 - We are trying to be more water sensitive. Peter M: a vision can be aspirational but it helps > the right values in decisions
 - Sam T: value of this is in recognising multiple values about and beyond devices

Matthew Davis' team

- #1: The CRC model is a useful categorisation of the trajectory/multiple values even though our cities have different pockets
 - The team worked with Panmure and Porirua: mostly they are drained cities, except for some floodable areas, with some water cycle elements
- #2: NZ is in between issue definition and the next stage (between stages 3 and 3)

Peter Mitchell's team

- #1: the first three are still high/ 2nd three are <50% / 10% / <1% - leads to lots of opportunities for growth
- #2: NZ is in between issue definition and the next stage (between stages 3 and 3)

Sarah's group

- #1: Central Wellington/Waitangi Park/Te Aro: upper catchment not always drained; lower catchment is more a water way city
- #2: NZ: Marjorie van Roon: look at different sectors of the population in different places e.g. WSUD professionals can be between 2 and 5 simultaneously while the rest of the population is around 1

Barriers activity

Sarah's group

- Filled in boxes – what we're doing, sort of doing, little or nothing
- Different parts of the same organisation can be in different phases
- 5. Policy and practice diffusion – policy is a long way behind practice, so split these two

Hannah's group

- similar to Sarah's group – lots of question marks
- issues/organisational champions – yes – connected champions – connected with each other, but..... how connected to developers and councils?
- Answers not really Yes/No

Chris's group – Linda

- Not whole-hearted agreement
- Column 1 pretty good but not multiple stakeholders/community outrage at polluted waters is the beginnings of a community voice
- Challenges grow our capacity / last column > no collective council policy: depends who you talk to
- How can we help developers build communities based on water sensitive design – connected communities
- Until Mums & Dads understand and really want this, it won't happen – like supermarket plastic bags
- Can we reframe barriers as opportunities? Sam T has a student working on this
- How we unpack barriers

Emily/Jonathan/Matthew Davis group

- Didn't use the grid – just chatted, trying to understand the real intention behind WSUD
- Now = tick-boxes to get consent – needs to reflect waters sensitive aspiration
- Designing for whole of life is better than the professionals all working separately at different stages
- Might with help buy-in by public.
- A lot around knowledge transfer New Zealand is small enough to share knowledge and skills – champions, networking, site visits to see what does and doesn't work
- Share success stories across multi-disciplinary sectors and with the community > all walking in the same direction in our different professions

Robyn's group

- Waxed philosophical about the general issue < lack of multi-disciplinary input < lack of cohesion within and between councils and with the wider sector and professional groups.
- Everyone's siloed even at central government level – no-one's looking at the bigger picture. Partly funding e.g. Watercare and other utilities vs stormwater and land uses leads to less WSUD due to reliance on the capex/asset model. Integrated thinking leads to coherent design and flood plain avoidance.

Wrap-up

From what we saw and talked about today, what topics could the research team most usefully focus on?

- Devices cross multiple jurisdictions within and beyond councils – who is responsible? Who co-ordinates?
- Who "owns" the water – e.g. AT – discharges can only be treated in the road reserve, limiting options. Straight to pipes becomes a community issue/integrate so we can be more connected to water
- Devices are present because they are tacked on because the development is not WSUD at the start. Better design leads to fewer devices. Eliminate don't treat the problem > bigger common areas and plant choice not just from the biofiltration palette
- Pathways for community involvement to lead to better public understanding of goals < innovations they see
- "adopt a device" < O&M
- engage at the design level and grass roots e.g. rain gardens demo at school: kids tell their parents and understand water
- lack of interpretive signage / reconnect with what nature does in the water cycle. Very few children drown in natural water. Fencing cuts us off from the water
- is there a barrier to using fruit trees?
- Fencing around ponds: what are the options for ponds with no fencing? Gradient of batters, stormwater health and safety
- Education of customers around wetlands/native fish? Or water quality of artificial surfaces – toxics going for phytoremediation – plant palette + disposal options and costs
- What are the costs of doing this poorly? Financial and cost to society – is a bad device better or worse than a good pipe?
- In councils there are many stages of consenting: need construction checklists to keep the process smooth
- Maintenance: hard to find data to identify O&M costs
- Peter M: for \$1k/year they do 3 inspections, rate device performance and condition and maintain or renew it accordingly. These things come from different budgets – but how much money is needed? What is the useful life of an asset?
- Contractors need plant (vegetation) skills – refer to Peter M's 4 Rs, including risk and the cost of using the wrong people

- What is the business/value case for developers and others? Cost of poor O&M to communities and investors
- Value case of community vs performance – e.g. for good erosion and sediment control, link to fishing – join the dots
- What is WSUD all about? Different customer values
- More information on things to think about in design and construction and effects on O&M
- Role of “safety in design” – Peter M – and LCA
- National design guideline: is this feasible? Or would it stifle WSUD?

ACTIVATING WATER SENSITIVE URBAN DESIGN IN NEW ZEALAND

Barriers Workshop

Venue: Christchurch

Date: 12 December 2017

Time: 9am – 3pm

Attendees

ORGANISATION	CONTACT NAME
Avon-Otakaro Network	Evan Smith
Christchurch CC	Clive Appleton
Christchurch CC	Boyd Barber
Christchurch CC	Peter Wehrmann
Christchurch CC	David Boothway
Christchurch CC (EAG)	Paul Dickenson
CTN Consulting	Peter Christensen
Dunedin CC	Warren Biggs
Environment Canterbury	Jenny Walters
Environment Canterbury	Nick Moody
Fulton Hogan	Kenedy Evans
Landcare Research	Colin Meurk
Metro Green	Paul Malcom
Morphum	jan Heijs
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Workshop Notes – Summary of Key Comments

A copy of the notes taken on the whiteboard are included in Appendix B.

Burning Issues

- We want to see more of this type of stormwater treatment design throughout our existing city because we have a huge challenge with trying to retrofit stormwater treatment within existing (brownfield) areas. Greenfields development is easier to deal with.
- How do we start doing integrated holistic designs? The main barrier is urban and landscape design. We see fragmented small developments which each do their own thing and do not take a whole of catchment approach.
- Frustrated with the “show pony” examples around the city. Councils like to create and construct projects which show how good they are, but they are so isolated. The isolation and small scale implementation means receiving water benefits are insignificant. Very little maintenance and monitoring ever undertaken so we are not able to fully quantify the benefits. Economics are not done well by engineers so we can’t sell WSUD through the economic benefits. Lastly we need to change the minds and hearts of professionals – we’ve (engineers) been trained to drain wetlands, pipe stormwater, etc. so we need to change this mindset, especially in brownfields/retrofit (WSUD is easy to apply in greenfields).
- The uptake of WSUD in NZ is minimal. The issues are not technical but rather institutional and regulatory. We don’t have the rules to support or force uptake of WSUD. There are some science gaps but they are not the major issue. There are a lot of myths around the economics and aesthetics. There is resistance within specific parts of councils, for example roading engineers are very uncooperative and unresponsive to WSUD ideas.
- There needs to be more transparency around the costings of WSUD – capital (establishment), maintenance costs through to whole of life costs.
- WSUD is pretty new (30-40 years old) and NZ is not taking it seriously. Its more than just following about TP10 and chucking in individual treatment devices. There needs to be a lot more effort around monitoring, design, construction and particularly compliance that checks devices are operating before and after signoff on behalf of the regulators and more information around costing. It takes at least 5 years before rain gardens and other practices are fully operational, so we need to start monitoring.
- Can WSUD help us comply with the Land and Water Regional Plan Guidelines via Network Discharge Consents? Zinc is our problem. Retrofitting is the most difficult area for WSUD.

- Despite knowledge around WSUD, we still see standard engineered (kerb and channel with pipes) solutions going in – there is a gap between the science and the implementation by consultants, developers and councils. There are too many missed opportunities through the development (including commercial) process. For example, national ‘big box’ business chains that have very high impervious surfaces such as supermarkets, building stores, retail.
- The difficulty that council officers have is that different departments in local authorities aren’t collaborating on a number of different issues. There are a lot of silos within council.
- Let’s be positive: it is exciting to see the changes which have happened over the last few years as we have had a number of rain gardens installed across Christchurch city. These installations have varying degrees of success, but at least they’re there. There is also less kerbing around landscaping so land is connected to the stormwater network, providing at least some degree of Stormwater treatment and passive ‘self-watering’ of landscaping . Very large wetlands have also been put in (up to the size of Hagley Park), innovations such as foresting infiltration basins and Christchurch has NZ’s largest ‘Stormfilter’ system. We are starting to reverse the trends of negative effects of urban landuse. Key frustration is funding - healthy waterways is a council priority and a strategic outcome, but budgets are less than desirable, especially operational spending and push back on maintenance and this leads to frustration by the officers and the community.
- We are concerned about zinc levels in stormwater, retrofitting devices at factories / industrial areas and the challenges in that space. As a city and citizens of Christchurch we point the finger at the rural areas, and we need to look at what we as a city are doing and the impacts the city is causing. Council should lead by example.
- Biodiversity and biosecurity should be more fully considered in terms of their role in placemaking as part of WSUD. These issues are often treated as ‘green fluff’ and sometimes subsumed by dubious hydrological models which are risk averse and highlight constraints which go beyond what is likely to happen. In Christchurch city (Avon) this resulted in removal of taller native shrub groundcovers and flaxes – and replacement with mown grass. Part of the issue is that the profession of ecology is also subsumed and not involved in the conception from design through to implementation. Ecology is often excluded by landscape architects. This is due to the silo-type of environment that we all work in.
- How can we activate WSUD principles in a more tangible way that allows people to engage with it and experience it? We need to expand on best practice and to combine systems to include aesthetics and people, not just function.
- We need to have coordinated budgets: there is a lot of good will between people in councils but this is not enough – goals, budgets and timings do not coexist. WSUD crosses silos. We need to monitor what we do. All the additional green space is

wonderful, but sometimes our actions may be making things worse. For example, there is a huge focus on flood mitigation but not a focus on day to day flows or supporting base flows. Are we keeping up with some of the modern pollutants such as plastics and temperature – what impact is that having on the environment? Stormwater is still considered a nuisance and problem by many, but water is so critical to life and it should be seen as a resource – and therefore needs to be respected.

- NGOs and community groups are very important as they are interested in the whole catchment, but they also sit between the decision-makers and professionals to try and elicit collaboration at that scale. NGOs are a voice for the community which try to bring councils and communities together, and work across the silos. Potentially 50% of the stormwater remediation/ treatment will be infrastructure-based, but 50% will be due to the community, connecting them with water to support better water quality. As a result, community education, awareness and public perceptions are very important. Information is just not out there for people and there are no incentives to do better. Incentives are very under-utilised. Make water issues fun and tangible for people which allows them to connect with their streams.
- We need community led involvement on the ground if we're going to make a difference. Education is key and we need to take communities on the WSUD journey with us. We need clearer messaging beyond 'show pony' projects – to show how nature can take a role in protecting / restoring water
- Holistic catchment management is key. How can we bring things together in a catchment and engage with communities at the same time? We need to understand where we are but also have a clear pathway to where we want to go. How do we influence existing businesses to do something more? Grants or incentives are needed, as is behavioural change.
- How can we make WSUD sexy? Council officers ability to influence good urban design outcomes is very low because they only get to have input late on in the project design process when consents are applied for.
- Since education is important, what can the university's role be in all of this? We help change hearts and minds in students, so they see Stormwater beyond water quality and flow. What opportunities can we make from the WSUD? What research can be done as part of these barriers? Funding of WSUD research in general and for performance monitoring is a barrier as it is very limited but needed to improve design.
- Due to all the media rhetoric it feels like people are really starting to connect with their waterways and we are on the cusp of changing things, but the technical capacity really lets us down both in the consulting world and in approvals. Landscaping and engineering are not listening nor understanding to each other, and no one is thinking about the ecological outcomes. Many stormwater systems are over engineered resulting in inflated/additional cost without necessarily improving amenity or ecology. Councils sometimes don't understand those subtle nuances. In New Zealand the national psyche seems to be content with just reaching minimum guidelines to get a

‘pass’. There is little will by developers to create fantastic urban spaces, rather most just want to meet the standards set by councils. This contrasts with some developers in Australia. The economics of WSUD is very important – e.g., increased section prices (Australian subdivisions)

- Infrastructure design defaults to hard engineering solutions and we have a lot of missed opportunities. Additionally, in the project space there is a lot of time and money pressure to get through consenting and design processes and high risk aversion. There are no incentives.
- We need to use stormwater as a resource, e.g. to (passively) water trees in tree pits. Trees can be successfully grown in city hard paved areas, but we’re not seeing it here and many of the trees are dying. Why not use stormwater to help grow trees?
- Why have we not seen building WSUD features (such as rain tanks) being incorporated into the Christchurch rebuild.
- The language that we use is really important. We need to bring to life the word “environment” and incorporate the biological component. Perhaps by changing to ‘ecology’, as this evokes living. Environment can have dead connotations, e.g., ‘clean water’ ‘clean air’.

General Discussion (morning session)

- We encourage the research team to look holistically at WSUD. Stormwater treatment is vital, but it is the ambulance at the bottom of the cliff. We need other people involved in this, but unfortunately no roading engineers or developers here. We need to be able to influence the roading engineers and architects.
- Need to look at our roads from a six values approach. We need to try and stop contaminants at source, especially in relation to building products, to try and stop them needing to be treated in the first place.
- Christchurch City Council wants to launch a million dollar community water partnership where everyone takes responsibility for their own water. Community behavior change and social networking is important for activating WSUD.
- It’s not just about treatment - we need to be talking about restoring the whole natural water cycle. But we do acknowledge that this is difficult to do within the resource consenting process.
- We need to make sure that the roading engineers and developers also take the survey. Why don’t they ‘do’ WSUD? Because they don’t have to. NZ needs to get tougher on developers and work out how we can convince developers that this is the way to go. Perhaps the NPS-FM will trigger that. We also need to influence architects not to use exposed copper

- National psyche thing – really complicated around numbers. In Australia developers just get it and they have simplified targets but majority of good developers go way beyond that. This is because they don't have to go through any consenting hurdles. We've burrowed down into a hole of complexity and technical numbers and a consenting regime which stifles innovation.
- We need to introduce a word like 'legibility' which describes the ability to 'read the landscape' and tells us about our history (geological, social, ecological, topographical = streams/wetlands/ terraces). People have a fundamental need to understand where they come from and where they're going to.
- We need a good process which brings people together and stops them working in their silos.
- Implementation of WSUD is very disjointed and non-linear in its functionality (we are not creating green corridors) and this should be picked up on. An example is the East Frame that we will see on the WSUD walk – this arm of green is disjointed, not connected (for land-based native species at ground-level), not ecological. This contrasts with the Northern Corridor design and build project that is bringing WSUD and ecology together – and going for 'bronze green road' status, a first in New Zealand.
- Collaboration is easier through a design and build approach. The CNC team is going to try for a green roads certification (bronze) which hasn't been achieved yet in NZ.

Site Walk Over

- Site 2 raingarden: The inclusion of the old kerb as a heritage feature was noted. However the relatively high level of the raingarden to the kerb & channel invert effectively means this will rarely operate as an effective raingarden. The use of the wood mulch also indicates this raingarden is considered not to pond as this type of mulch has a high propensity to float when youthful and dried out (if wetted/ slightly decomposed or mixed with some compost it would not tend to float). This is an example of significant additional cost (installation of the scruffy dome and associated piping) without much benefit, and also finished levels that don't allow even ponding of water across the surface. The wooden dividing board is probably unnecessary if the levels were changed. The planting repeats the use of large European/Northern hemisphere trees rather than equivalent 'noble' native trees (totara, beech, kahikatea, etc.) which means the potential for supporting native wildlife (birds, invertebrates) is unrealized and the rich, unique history remains hidden.
- Site 4 gardens: This is a lost opportunity – a broad, linear garden that could have been designed as a functioning raingarden, despite needing to be shallower due to depth of the existing pipe network. Examples like these can be relatively costly to build but provide little/no functional benefit thus contributing to the perception of WSUD as a high cost nice-to-have. In this kind of retrofitting project it is generally the case that green technology is installed in conjunction with piped systems, unless soils are

sufficiently permeable to allow full infiltration of stormwater. This doubling up also contributes to the high cost nice-to-have perception of WSUD.

- Site 7 raingarden: noted that the cut-away section of the kerb (inlet) was currently deliberately and very effectively blocked (with concrete) until plants have become established. When the inlet was open, inflow of water and sediment meant that the area was a bog and getting compacted (specialized raingarden media have not been used) However, relative levels of road-edge channel and raingarden mean that most stormwater is likely to be conveyed along the gutter, rather than into the raingarden. Note low (100-400 mm) native and non-native plantings, with a lack of trees or taller vegetation. Is there really likely to be a traffic visibility issue here? Have native *Dianella* (turuturu) been substituted with Australian *Dianella*? Most of the plants appear to be landscaping cultivars, not local eco-sourced species – and this reduces the ecological value of the plantings.
- Worcester St: Originally planned as a higher profile, ‘prettier’ space within this area of redevelopment but hasn’t really delivered on that. The axis forms a major cycle route and greenway across the city and where it intersected with the greenframe was initially envisioned as a ‘shared space’, so it connected with parks with no visual separation of cars and people. Another example of gardens that are not functioning raingardens. Noted that cost of maintaining these sorts of gardens unlikely to differ much from maintaining functioning raingardens, justifying incorporating WSUD devices rather than just landscaping. Also noted that the linear park bisected by Worcester St does not provide a green corridor for ground-based fauna – it’s too disconnected. The area has low ecological value although a few native totara are in adjacent hoggin surface (sensible to reduce maintenance associated with deciduous leaves). Also connectivity is low with vertical concrete surface, absence of (daylighted) water / swales connecting with nearby Avon, instead lots of mown grass and paving. Contrast with Waitangi park in Wellington or Wynyard Quarter in Auckland that use very high component of locally-relevant and much taller groundcover plant species, including tree canopy, reflecting local ecosystems.
- Site 9 Armagh raingarden/grass swale: best design of any of the examples on the walk because no kerb, a small but effective drop that prevents sediment buildup and ensure road runoff enters along its entire length. However, odd to include a grass swale, lined by trees along invert which over time may impact on the conveyance function of the swale. The trees are planted into the mown grass (which is mown much shorter than the 100 mm height usually specified for swales) and the base of every tree has bark that has been physically damaged (by weed-whackers?), creating opportunities for fungus to enter, so shortening tree life. The landscaping on the opposite side of the road is a very good example of what raingarden groundcover should target, with a variety of native shrub and herbaceous species and established tree cover - again, this landscaping is lower than the footpath, so can receive some stormwater runoff, helping achieve some treatment and reducing plant stress.
- Site 12. Margaret Mahy and Avon River with noble tree plantings into mown lawn and provision of access to the water’s edge providing connectivity to the River. Along the

river native sedges (*Carex secta*) self-established when the Council stopped mowing right down to the waters edge, and these provide refuges and habitat; unfortunately non-native 'male' ferns also established. Across the river is an important area of native trees that were planted by early Christchurch settlers, showing casing their growth and potential contribution to the landscape – it includes southern rata, totara, beech and cabbage trees. Later, 'golden' totara were planted slightly downstream – again – a wasted opportunity to provide for native birds, as the *Podocarpus totara* 'Aurea' do not fruit.

Site Walk Debrief

- Proposal to create an updated version of the site walkover with commentary as a result of the workshop was supported.
- There should be signage around the devices so that people understand what the rain gardens are for and why they're there.
- Portland has produced guidance for the public on how to disconnect impervious surfaces and deal with stormwater on your own site, effectively build your own raingarden.
- Given Christchurch is in the process of installing raingardens throughout the redeveloped areas monitoring should start right now – to build the local evidence base.
- The extent of raingardens/WSUD has been limited because SKIRT's mandate was to get the city horizontal infrastructure (drainage, roads, water supply) functioning under funding for a 'like for like' condition (i.e. pre-earthquake, not modern)
- Jan Heijs provided a summary of his previous work on developing an impervious surface tax in Europe: Germany developed a 'concrete tax' and the money was put into subsidies for creating rain gardens (funded from the tax on impervious surfaces). Expected uptake of about 50% over a few years, but uptake was actually around 90% within the first year. A proposal was together for a similar system in NSCC but not submitted to Councillors. It is important that the tax \$/m² is high enough to assist with behavior change, as is the subsidy.
- Los Angeles asked the public to vote on whether or not they were in favour of an impervious surface tax. 80% voted in favour. The program focused on why it is needed and made it about protecting the bay.
- Ecological and landscape literacy: need to get people to look deeper than the surface. Can we afford to keep building these fancy ideas and systems? Signage on drains help people understand where the water goes.
- We need to be able to step back and learn from our mistakes – we should be honest about our mistakes so that we don't have more lost opportunities.

- For the next site walk we need to actually reach the river!
- We need to encourage the multi-use of space, especially around roads and park areas, and co-creation of designs.
- The site walkover focused on rain gardens but what other NZ devices have been demonstrated successfully elsewhere?

Afternoon session on Barriers and Transitioning

Appendix A includes a summary of the results of the activity group session.

Final Session:

- Any holistic solution to activate WSUD is going to have to work for everyone as we all have the same aspiration but we are all in different positions and have different perspectives in terms of barriers to achieve this. Need to remember that because Christchurch is built on a swamp there is a long-standing cultural imperative to drain, and get water away.
- It is not so much about convergence but about inclusiveness and accommodating diversity. We also can't forget the role of random events which creates action and motivation. Especially droughts and floods - 'a lot of rain focuses political will'.
- Political environment is a barrier. We're working in a political environment so we need to get backing from the general public to get them to push politicians to do more.
- About 20% of Christchurch has protection from flooding (basins, wetlands) and 80% will be unprotected; with retrofitting needed into roads and public spaces. The Waterways Enhancement Programme started by focusing on restoring waterways, and got to a stage where it was decided that easements were needed in areas where public land areas for flood management were inadequate, so budget was moved into protection and buying land in SW Christchurch (meaning restoration was put on the back burner).
- We need to make a greater effort to make WSUD about every day activities (e.g. wash your car on the grass) – we need to make people aware that they have “water” choices.
- Nationally we are finally waking up to our 'water issues' – community desire to talk and look after environmenta, including taking action themselves is increasing – hence potential backing of WSUD from general public. However, local government are at the mercy of budgets with strong push-back on rates rises
- We need to recognize the value of iwi input into this discussion and recognize that iwi groups are allies of WSUD.

- There are a lack of events like this in Christchurch – everyone agreed to share email addresses. Also noted that information on the Canterbury Stormwater Forum activities (approximately quarterly) would be useful to send.
- We would like to see a guide book on the different types of stormwater treatment devices as a one-stop place and resource for people.
- Information from MfE and other similar groups is not being filtered down to the people working at the ground level. MfE could provide direction that is specified and clear that creates clarity and cuts out ambiguity on the need for a change in Stormwater management – e.g. maybe direction on source control (building materials, tyres, brake pads)
- Information on the ‘need’ for stormwater management is lacking to drive source control – for example understanding the impacts of copper and zinc.
- Mike Hannah offered to use the LinkedIn Stormwater Group page to share information about the Activating WSUD in NZ project.

Closing

The research team thanked all the attendees for their time and participation at the workshop.

National
Science
Challenges

BUILDING BETTER
HOMES, TOWNS
AND CITIES

Ko ngā wā kāinga hei
whakamāhorahora



Batstone
Associates



Thanks

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- Clare Feeney, The Sustainability Strategist, for facilitating the workshop.
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www.watersensitivecities.org.au

Appendix A: Summary of Afternoon Activity Group Session

Activity 1 - Benchmarking							
Workshop 2 (Christchurch)							
	GRP A (NEL)	GRP B (WLT)	GRP C (Chch)	GRP D (Chch)	GRP E (Chch)	GRP F (Chch)	GRP G (Chch)
Water Supply City	100%	100%			Just to the right of the black line	Waterways city	
Sewered City	100%	100%	Old city				
Drained City	80%	100%		60%			75%
Waterways City	70%	10%	Greenfields new development	40%			25%
Water Cycle City	10%	0%					
Water Sensitive City	0%	0%					

TDF Narrative (workshop 2)	GRP A	Where you are in the change spectrum can be role specific. Generally in the shared understanding & agreement phase (3). Tasman
	GRP B	Issue emergence (1). Wellington [note: could also be at different levels for different issues, i.e. quantity quality issues]
	GRP C	Between issue definition and shared understanding and issue agreement (2 and 3). Christchurch
	GRP E	Between shared understanding and issue agreement and knowledge dissemination (3 and 4). Christchurch
	GRP F	Between issue definition and shared understanding and issue agreement (2 and 3). Christchurch
	GRP G	Around policy and practice diffusion (5).

Additional Comments:

Waterways city - need to charge for water. Need to understand drivers for change to WSC.

The political will to accept impacts is limited and there is a lack of general public understanding therefore currently at start of shift to issue emergence (Wellington).

In Christchurch there are still many drains with no treatment.

Christchurch: until we meter water, a water cycle city would not be achievable.

If Christchurch were to develop to it's full extent, it would be 20% treated and 80% untreated.

In terms of the transition dynamics framework: where we are on the spectrum depends on if we're talking about the public or people in the industry.

Public are only at issue emergence whilst the industry is at shared understanding and issue agreement.

The Christchurch rebuild means we are now looking more to WSUD.

Christchurch has gone backwards in terms of it's WSUD implementation - previously had the wet waterways guidance, but now replacing "like for like".

Lack of funding as budgets move from rebuilding functional services to vertical infrastructure.

We need financial incentives to put in WSUD.

The Christchurch rebuild initially focused on restoring functionality through the replacement of horizontal infrastructure (roads and pipes). The 'like for like' approach adopted was a lost opportunity to adopt more progressive WSUD approaches. The rebuild has now moved from functionality to attractiveness, with a focus on vertical infrastructure. But there is a \$1B shortfall to deliver on aspirations.

The publication of Christchurch City's Waterways Guide several years ago shows that 'hearts are in it' in Christchurch. But the city has lost ground since then.

The council had a programme of actively buying up tributary land for 'restoration' and then focused this on SW Christchurch, given the development planned in that part of the city. However no actual restoration took place on this land.

Earthquakes and internal restructuring has contributed to the lack of progress.

Christchurch aspires to managing its waterways for the '6 values', even if not there yet.

What sort of % of the population pushing for transformation would be a critical mass?

Wellington and Dunedin are lagging behind, at the 'issue emergence' step.

Activity 3: Building a Strategic Transition Program: Where are we?

The matrix presented below is indicative only, and represents a summary of the results from the different group discussions.

we are doing this
we are partly doing this
we are not doing this

Transition phase	Champions	Platforms for connecting	Knowledge	Projects and applications	Tools and instruments
1. Issue emergence	Issue activists		Issue highlighted	Issue examined	
2. Issue definition	Individual champions	Sharing concerns and ideas	Causes and impacts examined	Solutions explored	
3. Shared understanding & issue agreement	Connected champions	Developing a collective voice	Solutions developed	Solutions experimented with	Preliminary practical guidance
4. Knowledge dissemination	Influential champions	Building broad support	Solutions advanced	Solutions demonstrated at scale	Refined guidance and early policy
5. Policy and practice diffusion	Organisational champions	Expanding the community of practice	Capacity building	Widespread implementation and learning	Early regulation and targets
6. Embedding new practice	Multi-stakeholder networks	Guiding consistent application	Monitoring and evaluation	Standardisation and refinement	Comprehensive policy and regulation

Activity 3 - Barriers
Transition Dynamics Framework: Matrix
We have connected champions and are developing a connected voice. Working on examining causes and impacts and exploring solutions. We have preliminary practical guidance. (Tasman)
We have some individual champions and are starting to share concerns and ideas. We are experimenting with solutions and are refining guidance and early policy (Wellington)
We have connected champions and are developing a collective voice. Solutions are advanced and demonstrated at scale, and we are refining guidance and early policy. (Christchurch)
We have some individual champions and are starting to share concerns and ideas. We are examining the impacts and causes and are exploring solutions. (Christchurch)
There is a lack of collaborative networks and a lack of knowledge and accessible information. There is also a lack of consensus (diversity of opinions)
We have individual champions and today we are sharing concerns and ideas. We have some solutions demonstrated at scale and preliminary practical guidance. (Christchurch)
We have individual champions and we are starting to develop a collective voice. We are developing solutions and experimenting with them, and are refining guidance and policy. (Christchurch)

Barriers
Council structures lead to silos and non-sharing.
There is resistance to WSUD and people do not see a problem (they're in denial)
We need smaller councils which are less layered and more direct connections to councillors and like minded colleagues. This would make it easier to develop supportive groups, but harder to develop knowledge and applications.
People don't want to pay for services, for houses and for cleaner rivers
We have a legacy of living in a swamp and therefore a drainage mentality.
Political resistance to implementing measurable numbers in global stormwater consents due to costs and responsibility.
Cost of increased rates is a barrier.
Politics - getting agreement from council and govt is difficult.
Getting government, councils and the public to take responsibility for the issue is problematic.
Budget restrictions and funding.
Insufficient incentives to implement WSUD (generally no water shortages)
Likely to increase the cost of housing which is already too expensive.
Legislation impacting on councils as are the regional plans. Not many regions have RPs with sufficient water quality standards. Canterbury WQ standards are unachievable as written.
Majority of the people (public) don't understand the link between urban contaminants and water quality.
Council departments are focussed on a few single issues = silos (e.g. Building consents dept only administers the Building Act Requirements.
More leadership from government would help.

No-one is painting the big picture at national/ international level (e.g. as David Attenborough is doing for polar bears).
Too many levels of administration/ government which allows issues and solutions to be 'watered down' at each level.
Councils and governments are risk adverse.
WSUD concepts should be bought into the universities.
We need to find money and financing to implement solutions.
Councils and regional councils are trying to deal with point and diffuse pollution, but they are resource constrained and behaviour change constrained.
We need involvement from local iwi.
Prejudice from professionals that WSUD can't be community led.
There is a lack of resourcing/ funding for community-led WSUD.
Lack of platforms for connecting around WSUD in Christchurch.
Lack of clear messaging about what is best practice.
Lack of proven effectiveness - need more monitoring.
Budgets are needed for general opportunistic WSUD philosophy rather than specific line item upgrades/ projects (e.g. xxxx street upgrade).
Councils need to be able to take advantage of WSUD opportunities but detailed design consenting approach prevents this.
We need financial incentives to put in WSUD.
Too many restructures in councils over the past few years has led to fragmentation and loss of institutional knowledge.
Organisations can't "pool" budgets further reinforcing the silo mentality.
Solutions demonstrated and implemented are often not desirable or good examples of WSUD practices.
In Christchurch there has been a return to silos with 'forced' widespread application of not very good solutions. No targets are set and no measurement against commitments made.
Key barriers are a lack of rules and lack of political will (compare actions on microbeads and copper).
Existing power structures within council are a barrier.
Examples of WSUD are isolated or often hybrids with conventional systems (not true WSUD)
Ambiguity in central, regional and local government roles.
Unclear role of MfE – good intent but not realizing true potential to do something more useful for NZ, given the relatively small size of the country.

WSUD Narrative for NZ
Mana whenua are able to access and enjoy customary food areas and species (mahinga kai)

Appendix B: Whiteboard Notes

Burning issues

- More design in Chch but retrofit a challenge (4)
- Integrated holistic design – needs to be catchment-wide – whole landscape not small isolated fragments (5)
- Long range (out to 50 years) planner: isolated WSUD “show ponies” are insignificant for creating change. Lack of maintenance and monitoring > no case for benefits to sell. Engineers don’t do economics so it’s hard to sell the financial and other benefits of WSUD. Need to change hearts and minds away from drains & pipes mindset and change to a positive game. Easy to do WSUD in greenfields, difficult in brownfields (5)
- Frustration is with minimal uptake: institutional and regulatory issues more serious than technical issues. The science gap is not major compared with this. Myths around the economics and functions of devices. Uncooperative parts of councils pose a barrier (e.g. roading engineers) (6)
- Lack of transparency with respect to costings – e.g. capex, establishment and maintenance costs (2-3)
- WSUD now 30-40 years old but still not taken seriously. Still device-focused. Need more effort as commented above – design, cost, regulation (5-6)
- Retrofitting WSUD. Waimakariri District Council currently going through network discharge consents – how to comply with Regional Land and Water Guidelines? Zinc an issue (2-3)
- Gap between WSUD (proven) and standard infrastructure codes for kerb and channel etc > reluctance of developers and their consultants + councils: still have difficulties, unclear etc. Frustrating to see opportunities missed to install WSUD upfront especially on commercial sites e.g. gas stations (WSUD operations = 5-6; WSUD design = 2-3)
- Difficulty departments in TLAs in collaborating with each other and the community and environment – lots of silos (3)
- Taking a positive perspective: extremely excited with change in the last few years e.g. raingardens in Chch – landscape connected to stormwater networks. New Zealand’s largest storm filter (2nd biggest in the world?) being install – a huge wetland the size of Hagley Park, in the Heathcote catchment. Seeing a reverse in trends of problems with urbanisation. Frustrated with funding of Healthy Waterways – not enough money, especially for operational spending (5)
- Zinc in stormwater, retrofitting WSUD devices on factory sites. Canterbury more focused on rural than urban water quality. Chch can lead by example (2)
- B&B (biodiversity and biosecurity) and their role in placemaking. Biodiversity is treated as green fluff and subsumed into very risk-averse hydrological / hydraulic models that are not ground-truthed. Ecologists are not included from project inception and design – no collaborative learning process (3)
- Sees opportunity: how to activate WSUD principles in a tangible way so people experience it and expand on best practice. Systems function, ecology. Aesthetics, and people (1)
- Lack of co-ordinated budgets: - there is goodwill on council but money, timing and priorities don’t always overlap. Monitoring – lots of new green space but is the water quality better or worse as a result? We are doing a lot of flood mitigation, but what are the effects on baseflows, that happen 97% of the time? Keeping up with modern pollutants e.g. plastics, temperature. Stormwater is still considered a nuisance but water is critical to life! (4)
- The current devolved model of water management means NGOs play a big role – they see the whole catchment but sit between the community and many siloed council professionals, and bring the two together. 50% of WSUD will come from community groups. Education, awareness, perceptions will lead to a big shift towards more sustainable behaviour in the way that we changed behaviours around recycling. Water is fun as well as functional (1, but more if a holistic view is considered part of WSUD)
- Role of community-led initiatives is to bring people along with us. Water quality and biodiversity effects on streams that are downstream of urban areas (4)

- Holistic catchment management – how to bring things together in a catchment. Where are we compared with where we want to be – lack of a clear pathway for the one to the other, so how to get funding? Grants? (5, with respect to behaviour change)
- How to make WSUD sexy? People, places, water. (5, for passion; 1 for ability to influence, because opportunities get ruled out before developments come to council)
- How can the UoC change the hearts and minds of new engineers beyond water quality and quantity to wards the big picture? Role of research and lack of \$ for performance monitoring to improve technical designs (4)
- Agree with all the above but we are on the cusp – people are starting to connect with their waterways but the technical capability and interdisciplinary understanding lets us down. The national psyche is oriented towards doing the bare minimum. (5)
- Infrastructure design defaults to hard solutions, leading to missed opportunities. We are also very risk-averse. (2-3)
- Also positive but some frustrations – NZ is behind
- Thesis on building scale devices e.g. rain tanks – why are we not doing it?

How involved have you been in WSUD over the last few years, on a scale of 1-5

Hardly at all		Sometimes		Extensively	
1	2	3	4	5	6
2	1	2	4	6	1
1	2-3		4	5-6	
	3			1	

Debrief of walking tour

- Signage/interpretation would raise community awareness
- Portland Oregon has videos e.g. how to do a rain garden
- Incentivisation gives the best results forgetting stormwater out of combined sewers: eg
 - for downspout disconnect
 - depave to reduce impervious area
 - treebate
 - green roofs allow extra floors in buildings
 - industry training
- concrete tax – his report said one city got a 90% uptake of a depaving incentive in the first year. The\$/m2 needs to be enough to change behaviour
- LA County “Proposition O” – 80% of people were in favour because it helped the harbour – people like it!
- Ecological land landscape legibility and literacy – look deeper than the superficial (see “Interpretation”, above). Very natural stuff often looks “untidy” and “broken” – we need a culture shift with respect to what we see and how we see it
- Bring to light the patterns of water movement across the landscape – e.g. fish on stormwater inlets
- Video/walk – honestly – learn from mistakes/show the river in all weathers
- Parks people are fine with below grade recreation areas – even roading engineers are OK if we rewrite the specs
- Co-creating WSUD – be here now!
- Website – before and after shots, GIS-based/searchable
- Focus today was on raingardens – what other opportunities are there?

Wrap-up

- Everyone has their own position – where they come from/where they're at – even though they may have the same vision, therefore activating WSUD needs to work for everyone, whatever position they're in
- Convergence + diversity – not everyone will converge on values, so how do we work towards a valuable outcome?
- Role of external events > moments of opportunity > new ways of looking at things/tipping point
- Political environment – e.g. marine plastics a known issue 20 years ago. Water quality is the same therefore we need to leverage off the political environment and community. Money talks to politicians, therefore bring in the community to give confidence to elected representatives
- More effort to bring it down to everyday activities: bike vs car/wash car on lawn/on road
- Importance of iwi involvement – voice of iwi must be strong
- Importance of political will > need for community support to sustain the political motivation

Appendix 4 – Analysis of survey and workshop responses

A4.1 Frequency of themes

A4.1.1 All responses

Figure A4-1 presents the number of times each of the 15 WSUD themes was referred to in survey responses and workshop statements from all participants.

The number of times that themes were referenced in survey responses fell in the ranges: 2 – 60 in relation to barriers in general; 1 – 35 in relation to recently experienced barriers; 1 – 59 in relation to activating factors in general and 1 – 16 in relation to recently experienced activating factors.

Economics was the most frequently occurring theme in survey responses on barriers in general (60) and recently experienced barriers (32). Other relatively frequent themes in relation to barriers were: regulation (51, 24)⁴⁰; capacity, training and guidelines (42,19); knowledge of WSUD (39,22); design and construction (38, 25); maintenance (37; 15); and precedents / evidence (34, 19). Competing mandates (28, 25), organisational culture (25, 17) and innovation stance (21, 15) were relatively frequent themes in responses on recently experienced barriers, but less so in relation to barriers overall. The five themes occurring the least frequently were: project lifecycle (21, 8); political will / social licence (16, 8); funding and incentives (15, 8); co-benefits (10, 3) and Māori cultural benefits (2,1).

Capacity, training and guidelines was the most frequently occurring theme in survey responses on activating factors in general (59, 13) while regulation was the most frequently occurring theme in relation to recently experienced activating factors⁴¹ (31, 16). Precedents / evidence (47, 11) and political will / social licence (24, 10) completed the top four ranked themes in both sets of responses. Other relatively frequent activating factor themes, especially in general responses, were economics (22, 3); knowledge (22, 7); maintenance (15, 3) and funding and incentives (15, 2). Design and construction (10, 6) and organisational culture (12, 6) were relatively frequent themes in responses on recently experienced activating factors.

The number of times that themes were referenced in workshop burning issues statements fell in the range 2 – 12, while the number of times themes were referenced in all workshop statements was in the range 11 – 47.

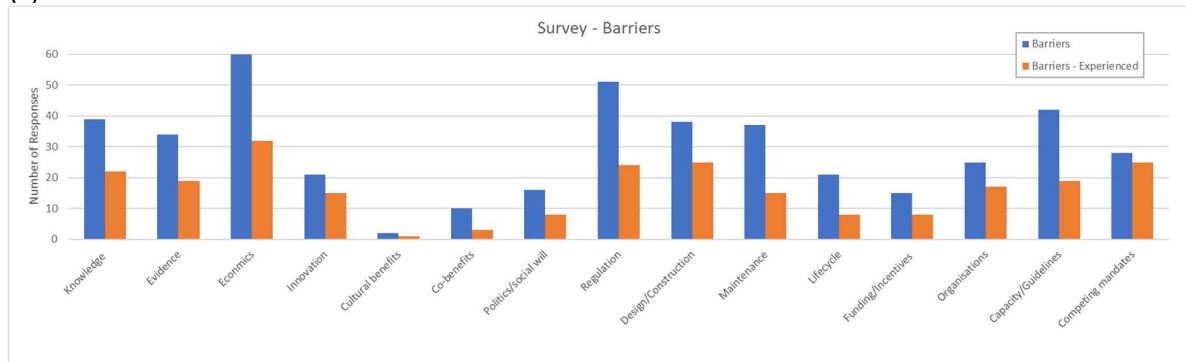
Similarly, to the survey responses on barriers, the most frequent burning issue themes included: regulation (12); knowledge of WSUD (11); economics (10); and design and construction (10). A notable difference, however, was the high frequency of the co-benefits theme (12). This latter theme also featured relatively highly in all workshop statements (40). Two other leading themes, political will and social licence (45, 9)⁴² and organisational culture (46, 9) were also more highly ranked in the workshop statements (all and burning issues) than in the survey responses on barriers. Funding and incentives (28, 6) also occurred relatively more frequently than in survey responses on barriers. Themes that were ranked lower in workshop statements than in survey responses on barriers included: maintenance (19, 5); capacity, training and guidelines (32, 5) and competing mandates (22, 4).

⁴⁰ (no. of counts relating to barriers in general, no. of counts relating to recently experienced barriers)

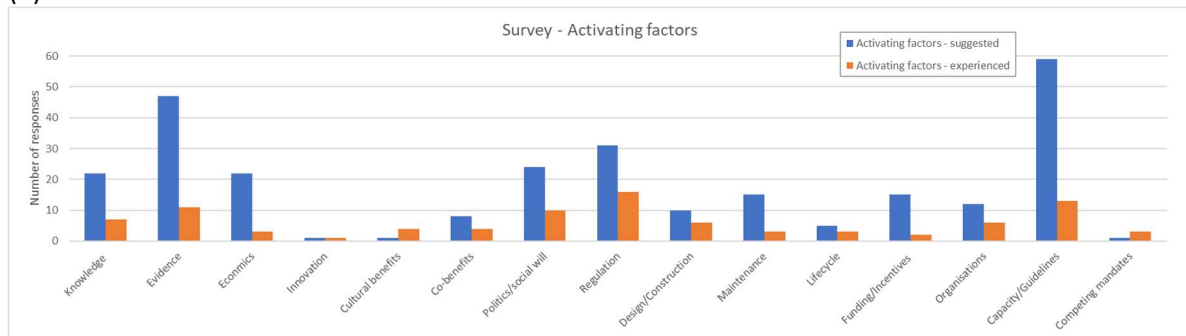
⁴¹ 'Activating factors' are, "the things that lead to use of WSUD instead of BAU (business as usual)"

⁴² (no. of counts relating to burning issues, no. of counts relating to burning issues)

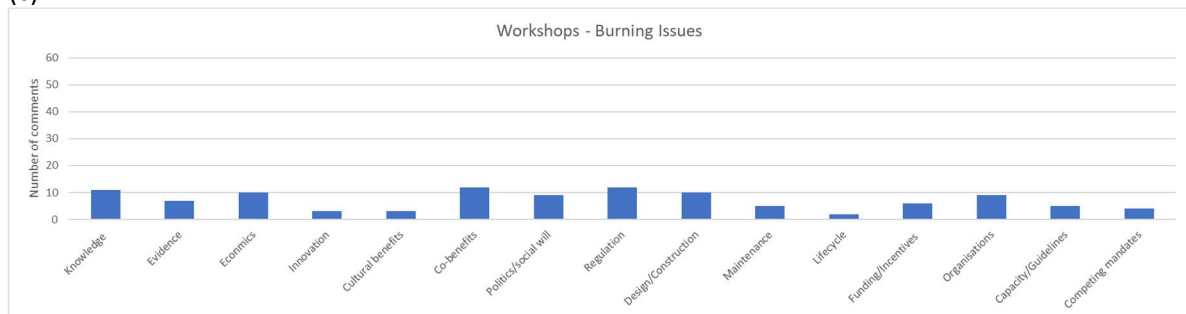
(a)



(b)



(c)



(d)

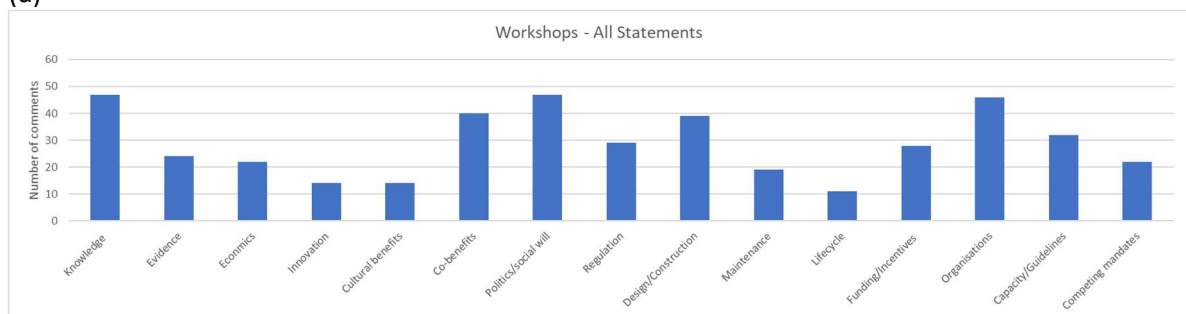


Figure A4-1 – Number of times each theme was referred to in survey responses on: (a) barriers and (b) activating factors; and in (c) workshop burning issues (d) all workshop statements.

A4.1.2 By sector

Figure A4-2 presents the number of times each of the 15 WSUD themes was referred to in survey responses from the local government (range 0 – 35) and private consultancy (range 0 – 25) sectors, while Figure A4-3 presents the equivalent information for all other sectors (range 0-9). Note that the y-axis scales on the two figures differ.

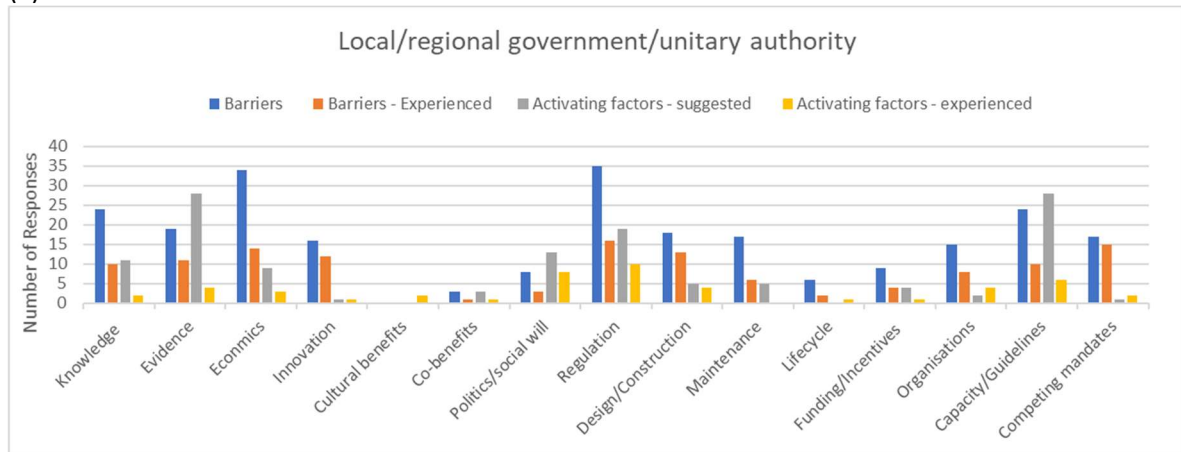
The relative frequency of themes in responses from the local government sector was very similar to the overall survey results, reflecting the fact that this was the largest sector represented in the survey. The regulation (35) and economics (34) themes occurred the most frequently in responses on barriers in general, while precedents and evidence (28) and capacity, training and guidelines (28) occurred the most frequently in responses on activating factors in general. In both cases, these leading themes occurred markedly more frequently than the third and lower ranked themes. In relation to recently experienced barriers, innovation stance⁴³ (12) featured in a relatively high number of responses, compared with its ranking in the overall survey results.

The relative frequency of themes in responses from the private consultancy sector was also generally similar to the overall survey results. Economics (22) occurred the most frequently in responses on barriers in general, while capacity, training and guidelines (25) occurred the most frequently in responses on activating factors in general. In both cases, these leading themes occurred markedly more frequently than the second and lower ranked themes. In relation to recently experienced barriers, precedents / evidence (1) featured in a relatively low number of responses, compared with its ranking in the overall survey results.

Leading themes in the responses of other sectors were: political will and social licence (central government agencies); design and construction (NGOs); competing mandates (council controlled organisations); and capacity, training and guidelines (central government agencies).

⁴³ The term “innovation stance” refers to organizations’ openness (or inversely, resistance) to fresh approaches, technologies. The reader should refer to Section A4.2.4 presenting quotes from survey and workshops.

(a)



(b)

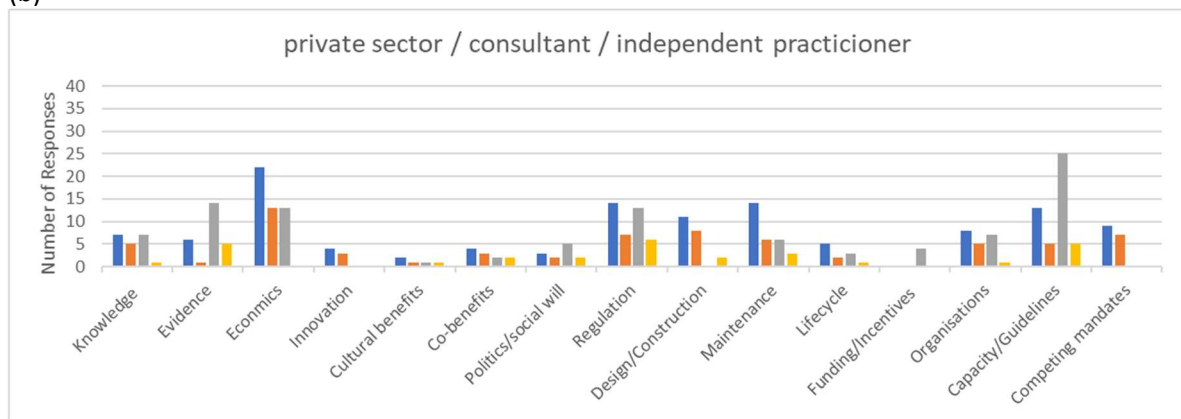


Figure A4-2 – Number of times each theme was referred to in survey responses from the (a) local government; and (b) consultancy sectors.

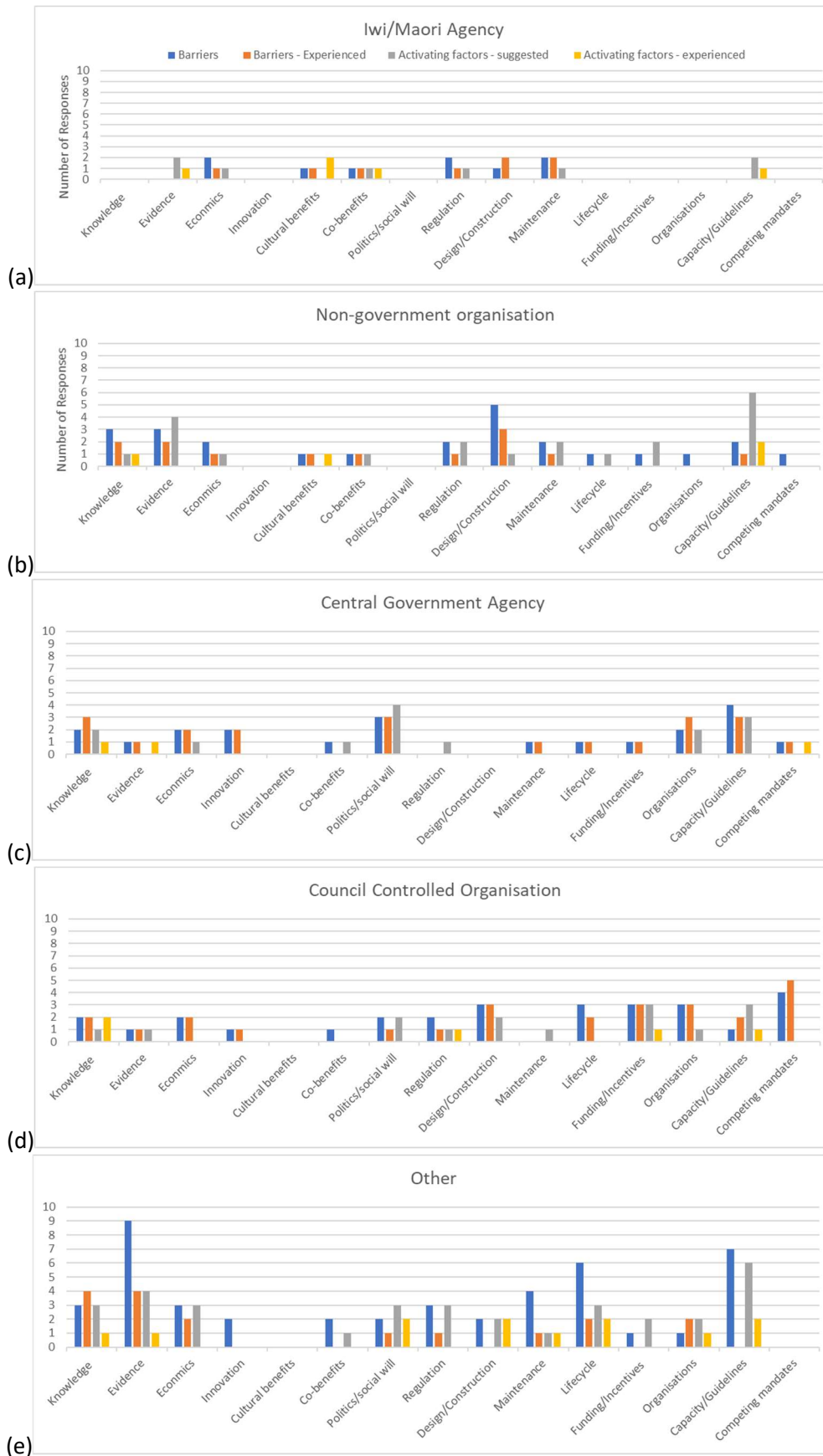


Figure A4-3 – Number of times each theme was referred to in survey responses from: (a) iwi/Maori agencies; (b) non-government organisations; (c) central government agencies; (d) council controlled organisations and (e) other sectors.

A4.1.3 By area of expertise

Figure A4-4 presents the number of times each of the 15 WSUD themes was referred to in survey responses from the following areas of expertise: engineers (range 0 – 29); planners/policy analysts (range 0 – 19); researchers (range 0 – 13); and other (range 0 – 18). Figure A4-5 presents equivalent information for: operations – construction (range 0 – 6); operations - maintenance (range 0 – 9); architects/landscape architects (range 0 – 3); local governance/iwi/community (range 0 – 6); and placemakers (range 0 – 4). Note that the y-axis scales on the two figures differ.

The relative frequency of themes in responses from engineers was generally similar to the overall survey results, with capacity, training and guidelines (27), economics (26) and regulation (25) the most frequent themes relating to barriers. All three themes were also highly ranked in relation to activating factors, with capacity (29) again top. As in the overall results, precedents and evidence (19) featured as the second most frequent activating factor.

Regulation (19) was the leading theme in responses relating to barriers from planners/policy analysts. Organisational culture (15), competing mandates (12) and innovation stance (10) featured more strongly than in the overall results, while the reverse was true for capacity (10), design and construction (6) and maintenance (5). The relative frequency of themes in responses on activating factors was broadly in line with the overall results.

The leading theme in responses from researchers relating to both barriers and activating factors was capacity and guidelines (9, 13). Precedents and evidence (6, 9) also featured strongly in both sets of responses. Innovation stance (6) appeared relatively frequently in responses on barriers, compared with the overall results, while the frequency of economics was relatively low. A relatively high number of responses on activating factors referred to organisational culture (6), compared with the overall results.

Design and construction (6) was the leading theme in responses relating to barriers from the operations – construction group. Two themes did not appear in any responses on barriers: precedents and evidence, and funding and incentives. However, consistent with the overall survey results, precedents and evidence (6) was the top ranked theme in responses on activating factors, along with capacity, training and guidelines (6). The themes of innovation stance; co-benefits; and funding and incentives did not appear in any of this group's responses on activating factors.

Design and construction (9, 4)⁴⁴ and capacity, training and guidelines (7, 6) were the top two ranked themes in responses from the operations – maintenance group. The project lifecycle theme (4, 3) also featured relatively strongly compared with the overall results. There were no responses at all relating to funding and incentives, while none of the following themes appeared in relation to responses on activating factors: knowledge; innovation; co-benefits; and organisational culture.

Capacity, training and guidelines was the leading theme in responses from three other groups: architects/landscape architects; local governance/iwi/community; and placemakers.

⁴⁴ (no. of counts relating to barriers in general, no. of counts relating to activating factors in general)

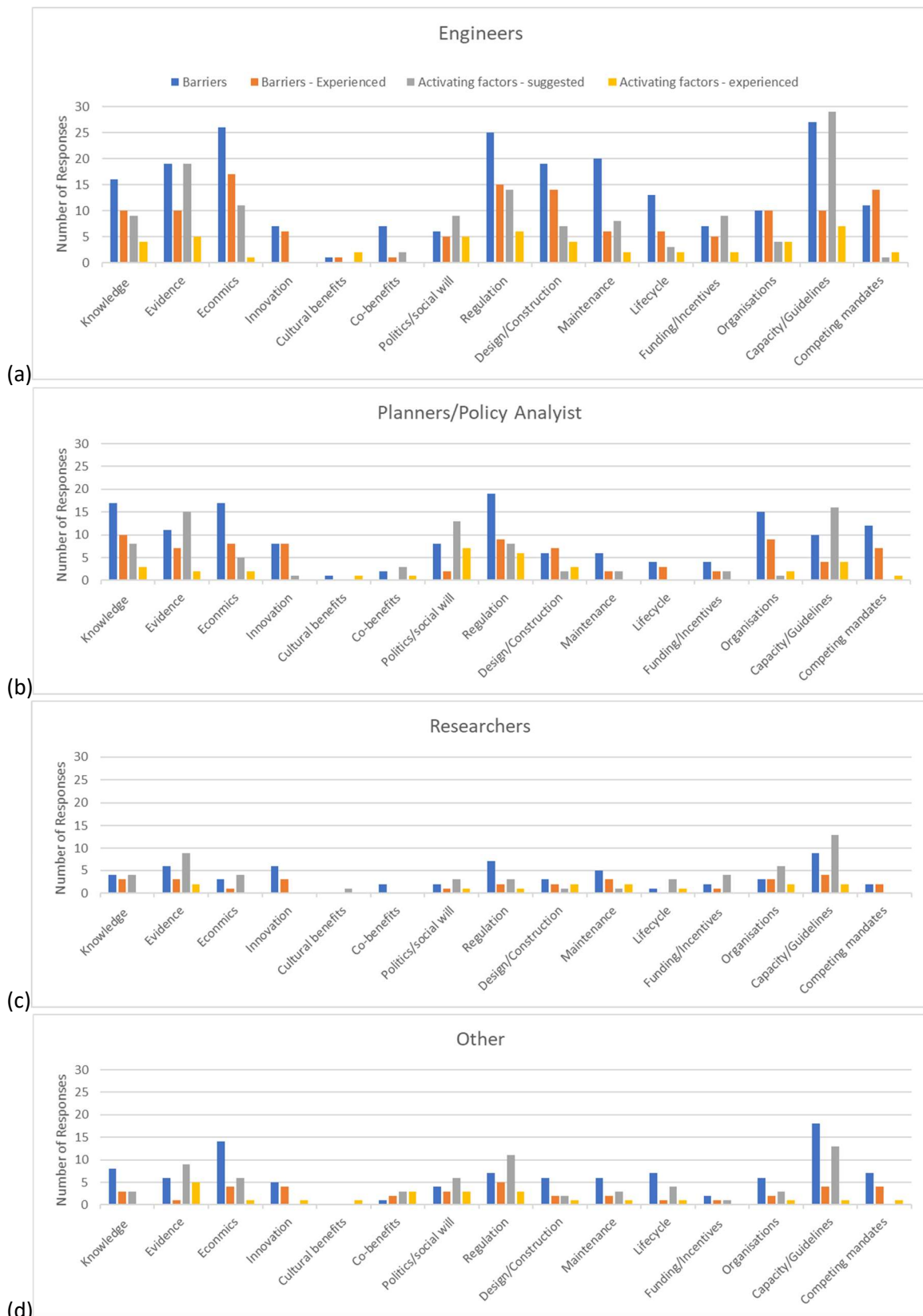


Figure A4-4 – Number of times each theme was referred to in survey responses from (a) engineers; (b) planners/policy analysts; (c) researchers; and (d) others.

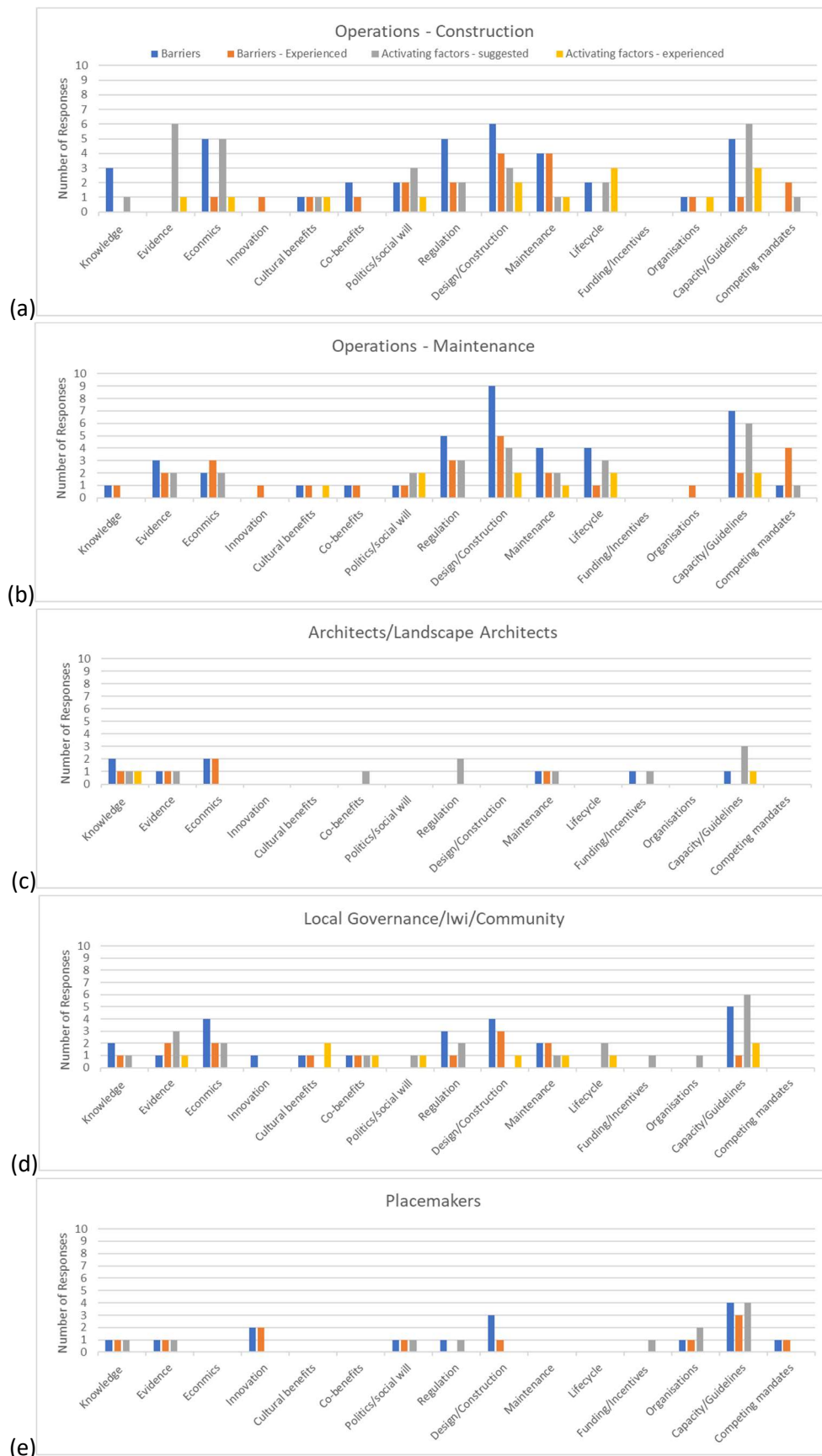


Figure A4-5 – Number of times each theme was referred to in survey responses from: (a) operations – construction; (b) operations – maintenance; (c) architects/landscape architects; (d) local governance/iwi/community; and (e) placemakers.

A4.1.4 By region

Figure A4-6 presents the number of times each of the 15 WSUD themes was referred to in survey responses from respondents in Auckland (range 0 – 22), Canterbury (range 0 – 17), Wellington (range 0 – 22), and all other regions combined (range 0 – 33). Figure A4-7 presents the number of times each theme appeared in statements made at the Auckland (range 0 – 25) and Christchurch (range 0 – 32) workshops.

The relative frequency of themes in survey responses relating to barriers from Auckland was generally similar to the overall survey results, although maintenance (22) and project lifecycle (11) both featured more strongly than in the national results. In responses relating to recent activating factors, references to Māori cultural benefits (3) were relatively more frequent than in the overall results⁴⁵. Regulation was the leading burning issue (8) at the Auckland workshop, while design and construction (25) was the leading theme in all statements made at the workshop. As with the survey responses, maintenance (14) and project lifecycle (10) featured more strongly in Auckland workshop statements than overall⁴⁶.

The relative frequency of themes in survey responses relating to barriers from Canterbury was also similar to the overall survey results, although innovation stance (5) featured more strongly in responses relating to recently experienced barriers than in the national results. In responses relating to recent activating factors, references to regulation (1) were very infrequent compared with the overall results. The themes of innovation stance and project lifecycle did not appear in any of the responses on activating factors. WSUD knowledge (8) and organisation culture (7) were the leading burning issues at the Christchurch workshop. Along with political will and social licence (29), WSUD knowledge (30) and organisation culture (32) were also the most frequently occurring themes in all statements at the Christchurch workshop⁴⁷.

A notable difference in the survey responses from Wellington, compared with the overall results, was the relatively low frequency of references to capacity, training and guidelines (3) in responses on barriers. In contrast, this was the top ranked theme in responses on activating factors (17), as was the case nationally. None of the Wellington responses on activating factors referred to innovation stance or competing mandates.

In the combined results from all other regions, maintenance (18) and co-benefits (15) featured more strongly than in the overall responses on barriers. In contrast, responses on barriers referring to precedents and evidence (5) were relatively infrequent. Cultural benefits (7) and co-benefits (6) featured strongly in the other region responses relating to recent activating factors. None of the responses from other regions on activating factors referred to innovation stance.

⁴⁵ Two leading Māori WSUD practitioners were present at the Auckland workshop.

⁴⁶ Auckland workshop attendees brought with them the combined experience of tens of years and a great number of WSUD projects.

⁴⁷ It is noted that the Christchurch earthquake and the nature of the consequent rebuild may have been influenced by the insurance industry policy of replacing “like with like”.

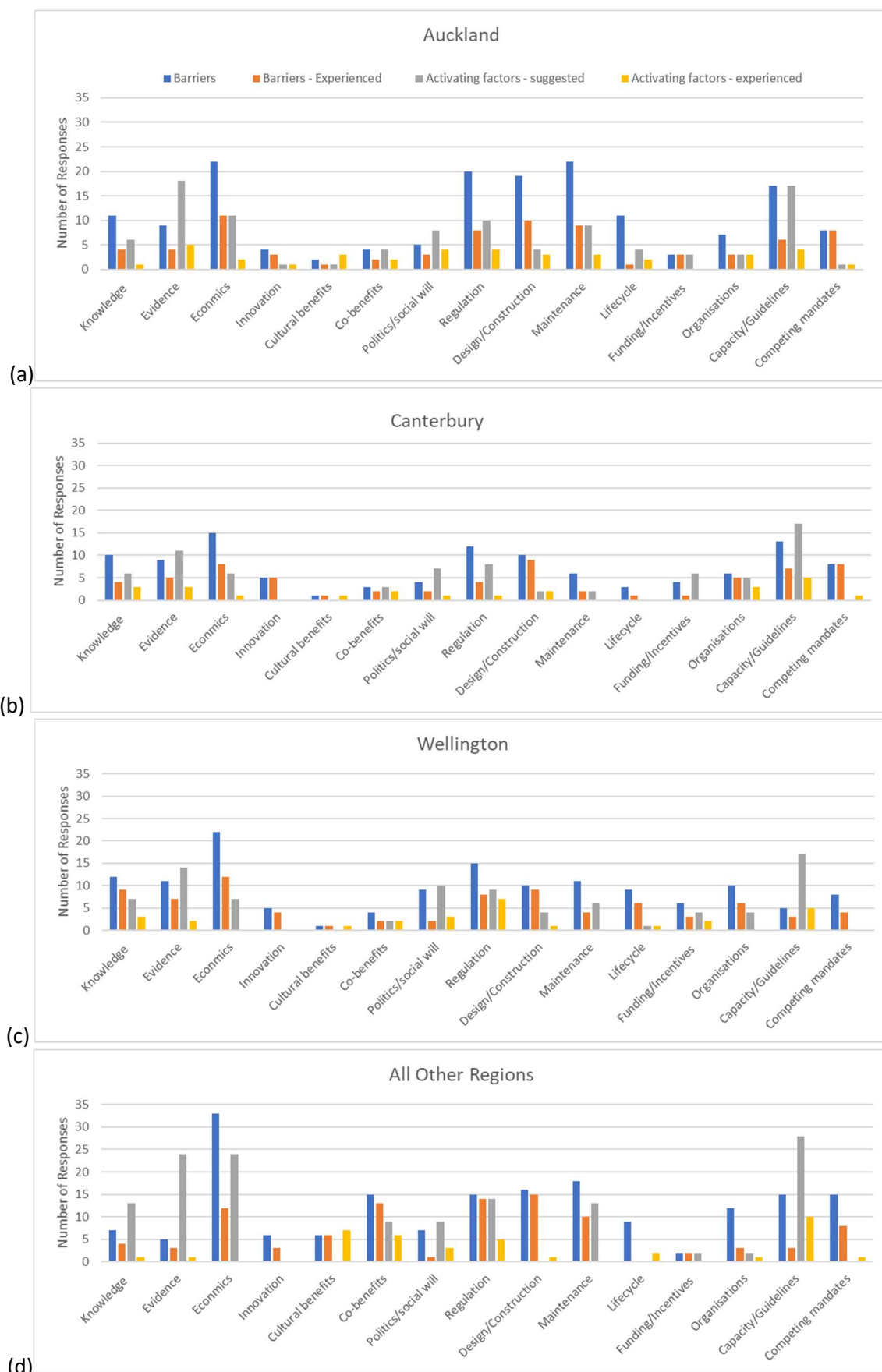


Figure A4-6 – Number of times each theme was referred to in survey responses from respondents in (a) Auckland; (b) Wellington; (c) Canterbury; and (d) all other regions.

(a)



(b)



Figure A4-7 – Number of times each theme was referred to at the Auckland and Christchurch workshops in (a) burning issues (b) all statements.

A4.2 Analysis of statements relating to value case themes

A4.2.1 Knowledge of WSUD concepts, vision and benefits

The knowledge and practice of WSUD lies at the intersection of barriers and activating factors.

The sub-themes that are contained in this Knowledge theme are: What is WSUD? Why is WSUD important? There are core (direct) and extended attributes to WSUD: what is the importance of the indirect outcomes? How can the knowledge that constitutes WSUD be applied? Who are the audiences?

There is a lack of clarity as to what WSUD is, and the associated capacity and effectiveness in the urban development process:

“Can WSUD help us comply with the Land and Water Regional Plan Guidelines via Network Discharge Consents? Zinc is our problem. Retrofitting is the most difficult area for WSUD.”

This definition was offered:

“The creation of a (body of) multifunctional assets that respect and utilizes the many roles of water in the environment and improves storm water quality’.

In that specification WSUD is cast in its stormwater mitigation role through receiving waterbody quality. In the follow-on to that response, with reference to flooding mitigation and the space afforded to WSUD in current stormwater management practice in NZ:

“There is much more focus on the rare infrequent damage/nuisance consequence of flooding which gets better funding.”

The implication here is that WSUD is the poor cousin to practices in the stormwater managers’ toolbox that focus on flood mitigation, and that one reason for this is due to lack of clarity as to what WSUD is and what it can do, and why is it required.

WSUD knowledge extends beyond the knowledge of device design and specification to a key aspect that lies in the knowledge of how to make assessments of catchments to deliver effective implementation:

“We need to introduce a word like ‘legibility’ which describes the ability to ‘read the landscape’ and tells us about our history (geological, social, ecological, topographical = streams/wetlands/ terraces). People have a fundamental need to understand where they come from and where they’re going to.”

“Lack of expertise / knowledge on WSUD options available for particular local conditions e.g. steep Wellington sites”

WSUD knowledge includes the technical requirements for effective devices integrated in urban catchment design. By extension, poor construction leads to indifferent performance which in turn impedes application of the philosophy:

“Effective construction. Often poorly constructed by undertrained or uninformed contractors. More market incentive needed to promote contractors to specifically implement constructed WSUD and other environmental solutions. Whole market mechanism being missed and the WSUD push is solely being led by regulators and scientists.”

“The misperception that WSUD is only about water quality and does not belong in a discussion about urban built form.”

The body of knowledge that constitutes WSUD includes benefits that its practices and philosophy deliver that extend beyond the immediate stormwater role into wider socio-economic considerations. This aspect is poorly understood and under-appreciated. This part of WSUD knowledge is an important avenue for uptake. In this lies the additional challenge to make the whole life cycle assessment transparent.

“Key barrier is whole life cycle cost benefit analysis to support good decision making - and support from Treasury. Drilling into those social, amenity and cultural values and putting a quantifiable number to justify that.”

The comment also makes an important point about the potential non-linearity of the WSUD uptake process and opportunities for intervention.

Identifying tipping points / critical leverage points for behaviour change. Where do people make the decision to go for grey water approaches vs WSUD.”

WSUD is a holistic urban development strategy that addresses a broad spectrum of urban development issues across the span of the entire social-ecological system.

“The focus is mostly on mitigation of environmental effects. Really important but there's so much more. WSUD is not just a collection of water treatment devices.”

An important aspect of the WSUD knowledge cache is the language in which it is framed:

“The language that we use is really important. We need to bring to life the word “environment” and incorporate the biological component. Perhaps by changing to ‘ecology’, as this evokes living. Environment can have dead connotations, e.g., ‘clean water’ ‘clean air’.”

Knowledge that is accessible across cultures in the community is important:

“Our communities need places to sit by the water and connect to water. There was a stone on site that said water was the life-giving source of all things, but we didn’t feel connected to the water because it was all fenced off and concrete. A review of current practice for integrating safety with storm water (requirement or not of fencing/ barriers) and benefits of including places to sit near water to establish connectivity and observation of water, kaitiakitanga may be useful. What are the actual ecological outcomes and are they beneficial? For example, should we be encouraging fish and wildlife into these ponds? Perhaps not if they are hazardous, shouldn’t encourage habitat value. Should we promote fish passage into stormwater ponds and wetlands? What is the impact on wildlife in these areas, e.g., pukeko.”⁴⁸

Overall, a holistic synthesis for a NZ/Aotearoa WSUD paradigm that provides the underpinning resources to resolve barriers has been encouraged;

“We encourage the research team to look holistically at WSUD. Stormwater treatment is vital, but it is the ambulance at the bottom of the cliff.”

The same response continues to note the inherent self-selection bias in the research response to date and offers sources of comment to alleviate that:

⁴⁸ This comment emerged during a field walk component of the workshop process.

“We need other people involved in this, but unfortunately no roading engineers or developers here. We need to be able to influence the roading engineers and architects.”

While the final comment in this section begins by addressing budgetary considerations, it also contains wider messages, the last with wider span, and allusions for the potential of WSUD to extend to “new” urban contaminants:

“We need to have coordinated budgets: there is a lot of good will between people in councils, but this is not enough – goals, budgets and timings do not coexist. WSUD crosses silos. We need to monitor what we do. All the additional green space is wonderful, but sometimes our actions may be making things worse. For example, there is a huge focus on flood mitigation but not a focus on day to day flows or supporting base flows. Are we keeping up with some of the modern pollutants such as plastics and temperature – what impact is that having on the environment? Stormwater is still considered a nuisance and problem by many, but water is so critical to life and it should be a resource – and therefore needs to be respected.”

A4.2.2 Precedents / evidence of WSUD performance and outcomes

There is a clear call across the survey and workshops for some system of evidence provision that includes actual precedent implementation examples and meets the information needs described in A4.2.1. This evidence needs to extend to the catchment scale and span design to maintenance costs and whole life cycle approaches. The following excerpts provide evidence of this

“WSUD is pretty new (30-40 years old) and NZ is not taking it seriously. Its more than just following about TP10 and chucking in individual treatment devices. There needs to be a lot more effort around monitoring, design, construction and particularly compliance that checks devices are operating before and after signoff on behalf of the regulators and more information around costing. It takes at least 5 years before rain gardens and other practices are fully operational, so we need to start monitoring.”

Additionally, there is no visible national champion(s) “shouting from the roof tops” of the need, and the directions to potential solutions:

“No-one is painting the big picture at national/ international level (e.g. as David Attenborough is doing for polar bears).”

Beyond the champion, the limitations of the currently deployed urban water cycle intervention tool box in NZ/Aotearoa are recognised.

“My networking outcome customer needs requires resilience and value for money assets/ outcomes, but the toolbox is very limited and lacking in good tools, including good decision making based on CBA over the life-cycle of the device.”

In this person’s view what is required:

“We need safe, reliably functional and resilient WSUD assets.” “We have a weak fluffy definition of WSUD and if it is not clearly defined you can’t set goals and outcomes and then define risk.”

From a design perspective one implementation problem is identified as “minimum threshold design style”. Remedies are offered that include education at a number of levels, design guidance, and new valuation / assessment conventions.

“Need more understanding of WSUD design intent and to avoid minimum threshold design style. This could be done through public and industry education, more clear design guidance including practical examples of what does and does not work and understanding how to value multifunctional systems.”

Aligned with the last comment is the contribution that activities such as monitoring existing and new implementations should be afforded priority:

“Given XXXX is in the process of installing raingardens throughout the redeveloped areas monitoring should start right now – to build the local evidence base.”

Amongst comments around evidence and precedents in activating factors are:

“Evidence of environmental outcomes and benefits.”

“Availability of instructive exemplars.”

Application of benchmarking approaches to the use of those instructive exemplars reflects international experience:

“Benchmarking (use CRC method) would help showing current state and pathways to resolve barriers”

Exemplars can promote market forces and create demand pull:

“Try and get more of these types of devices over the line and from a developer point of view it would be good to have more information around perception of cost, benefits and maintenance. Can then “sell” this to the clients.”

The wider aspects of exemplars are noted:

“There is a need for more education and transparency around the whole life costs of WSUD including capital, establishment and maintenance.”

Exemplars should extend to a wide range of devices:

“The site walkover focused on rain gardens but what other NZ devices have been demonstrated successfully elsewhere?”

Exemplars should also include not just design but evidence of performance:

“Lack of proven effectiveness - need more monitoring.”

Cautionary comments were also made that existing implementations may not offer sound evidence of the efficacy of WSUD:

“Solutions demonstrated and implemented are often not desirable or good examples of WSUD practices”.

“Precedent - poorly maintained examples put people off.”

“Examples of WSUD are isolated or often hybrids with conventional systems (not true WSUD)”

Amongst the activating factor responses:

“Easy access to information/evidence on benefits to provide developers or decision makers.”

“Evidence on environmental outcomes in instream water quality and aquatic community’s health”

“Evidence/data for optimising design (i.e. creating a site-specific, contaminant-specific system)”

“Case studies, local examples.”

“evidence base of tangible outcomes”

“WSUD case studies detailing aspects that can complement /meet Maori cultural values”

A4.2.3 Economics

The following statement, sums up the need for economic information that will add to WSUD knowledge and compliment the exemplars /evidence requirements outlined above.

“Good, justifiable information on the cost and non-cost benefits of WSUD”

Because WSUD costs and benefits span many domains within the urban social ecological system there are problems in developing comprehensive cost benefit analyses. The direct and indirect costs, and benefits are poorly understood beyond academic and research communities. There is a strong connection between the evidential theme in this research and the economics considerations.

There is a real need for:

“Robust economic appraisals”.

“Cost/benefit analysis of WSUD projects as compared to 'conventional' models for earthworks/subdivision models, and, Proof of sustainable cost based on cost/benefit analysis”

The last point addresses a key failing of many economic analyses: correct specification of the counterfactual-, i.e. the economic performance and effectiveness of conventional models in addressing the revised requirements of the NPS_FM as applied to urban environments.

“Make the costs of not doing WSUD and the benefits of doing it more tangible to people - can we tie to real, measured water quality and ecosystem health improvements.”

Leadership from central government on economic assessments an overall performance assessment is required:

“Better Business Case (Treasury edition)”

“The toolbox is very limited and lacking in good tools, including good decision making based on CBA over the life-cycle of the device.”

“Try to get it out of the “fluffy” design space and clarify benefits in terms of cost/ economics/ property value. What is the increase in liveability worth in money?”

While the benefit assessment side of the ledger is challenging, incorporating costs – the correct cost assessment is also an issue:

“The real costs of business as usual piping/stormwater management needs to be realised, including both acute and chronic impacts on waterways.”

“Understanding life cycle costs better.”

“A lack of understanding of the lifecycle cost of WSUD due to a paucity of maintenance cost data.”

The perception that WSUD is expensive and is a barrier to uptake:

“Large cost (both CAPEX & OPEX) to install WSUD practices. Also, the large amount of space required to install WSUD and green infrastructure.”

“Real whole of life costs.”

Maintenance costs feature prominently in discussion of WSUD costs:

“A lack of understanding of the lifecycle cost of WSUD due to a paucity of maintenance cost data.”

A4.2.4 Innovation stance

The willingness of the various actors in the WSUD value / supply chain, designers, to local authority practitioners, to construction and development, to take up the WSUD innovations is highly variable.

“The uptake of WSUD in NZ is minimal. The issues are not technical but rather institutional and regulatory. We don’t have the rules to support or force uptake of WSUD. There are some science gaps, but they are not the major issue. There are a lot of myths around the economics and aesthetics. There is resistance within specific parts of councils, for example roading engineers are very uncooperative and unresponsive to WSUD ideas”.

It is not simply uptake, but active resistance in some instances:

“There is resistance to WSUD and people do not see a problem (they're in denial).”

Part of the resistance is systemic and relates to governance and regulatory issues:

“National psyche thing – really complicated around numbers. In Australia developers just get it and they have simplified targets but majority of good developers go way beyond that. This is because they don’t have to go through any consenting hurdles. We’ve burrowed down into a hole of complexity and technical numbers and a consenting regime which stifles innovation.” (emphasis added)

Downstream of consenting processes the outcomes are lost opportunities, and by implication transactions costs such as lock-in:

“Infrastructure design defaults to hard engineering solutions and we have a lot of missed opportunities. Additionally, in the project space there is a lot of time and money pressure to get through consenting and design processes and high-risk aversion. There are no incentives.”

A part of the problem lies in the information sets that providers operate from – physical to ecological:

“Because WSUD is a more ecological approach - relying on plants surviving, soil treating water etc. rather than a purely technical approach it is quite a mind shift for those managing the systems.”

Resistance to the WSUD innovations are not the sole domain of local body and generational perspectives:

“Ancient “traditional engineering” views in house and in consultants in XXXX and unwillingness to fund anything “out of the ordinary””

“Individual resistance to learn/change/adopt. Four years after implementation the SW Code of Practice is still ignored by many Development Engineers. They keep on using their old, withdrawn district plans. And this is an engineering guideline – how much stronger must the resistance be, if a soft and less engineered approach is promoted?”

A portion of the resistance is perceived as inertial and protecting commercial returns:

“Developer resistance to what they are used to and the perception that it will reduce their yields.”

“Flexibility: Project Managers are expected to deliver to budget within a predetermined time. WSUD more complex, more variable, some opportunities don't present themselves until well into detailed design.”

However, responses were not wholly negative, even optimistic:

“We have agreement that there is a problem and the current state of our receiving water quality is not acceptable. We are starting to build capacity as we build new solutions. This involves experimenting. Barriers should be opportunities.”

A4.2.5 Māori and cultural benefits

Assessment of the wider co-benefits in the socio-cultural space in the social ecological system is challenging to undertake and to integrate with economic and biophysical considerations:

“We know economic, social and environmental well beings and benefits, but cultural well-being is being used as a token. We don't fully understand these benefits and we need to promote and raise cultural values both nationally and internationally”.

“Economic and environmental values well understood and well documented. However social and cultural are barely considered.”

“A review of current practice for integrating safety with stormwater (requirement or not of fencing/ barriers) and benefits of including places to sit near water to establish connectivity and observation of water, kaitiakitanga may be useful. What are the actual ecological outcomes and are they beneficial?”

The role of Maori in contemporary New Zealand can be a significant activating factor:

“Iwi Pressure, Engagement with tangata whenua.”

Building the evidential exemplar phase should have a specific Mātauranga Māori reference:

“WSUD case studies detailing aspects that can complement /meet Maori cultural values.”

“Implement Te Ao Maori into mainstream WSUD using education and training on Te Ao Maori and tikanga and early communication with Mana Whenua”

A4.2.6 Social, health and environmental co-benefits

Consideration of the wider social, health and environmental (ecosystem services benefits and opportunity costs of failure to implement WSUD is an important omission:

“Development yield (developer profit) is given more weight than social and environmental outcomes.”

“Better understanding of costs and benefits - especially across the multiple benefits / ecosystem services”

An activating factor described by one respondent lies in:

“(Integrating) the value ascribed to the environment / receiving environment where the subdivision was to be developed. This gave greater weight to the relevant objectives and policies in the statutory documents considered during consenting.”

In the same vein, around the means to incorporate wider benefits in benefit-cost assessments:

“Better quantify spectrum of benefits - freshwater system health, coastal waters, climate change/natural hazard resilience, recreation and health, biodiversity, urban form and character.”

“We understand the benefits around water quantity and quality, but better quantification of the other benefits is needed so other benefits can be maximised and WSUD can be a whole package (economic – real estate, environmental benefits, as well as social and aesthetic benefits).”

There is evidence that social license for change is emerging, and that in turn requires technical and assessment innovations:

“Due to all the media rhetoric it feels like people are really starting to connect with their waterways and we are on the cusp of changing things, but the technical capacity really lets us down both in the consulting world and in approvals.”

Silo thinking doesn't help integrating wider benefits into the decision mix, and in particular neglect of ecological considerations is distortionary as existing approaches fail to deliver on (new) ecological goals:

“Landscaping and engineering are not listening nor understanding to each other, and no one is thinking about the ecological outcomes. Many stormwater systems are over engineered resulting in inflated/additional cost without necessarily improving amenity or ecology. Councils sometimes don't understand those subtle nuances.”

There is a reluctance to embrace the complexity that a wider assessment of costs and benefits would require:

“In New Zealand the national psyche seems to be content with just reaching minimum guidelines to get a ‘pass’. There is little will by developers to create fantastic urban spaces, rather most just want to meet the standards set by councils. This contrasts with some developers in Australia. The economics of WSUD is very important – e.g., increased section prices (Australian subdivisions).”

The research team recognise the absence of developers, construction professionals (including architects and roading engineers), and social housing agents as a significant contribution to self-selection bias and potentially fruitful direction for further research activity.

A4.2.7 Political will / social licence

The contribution of community lead demand for WSUD, either in housing markets or through the ballot box is held to be significant:

“...recognised degrading stream and estuarine WQ situation has activated the community to ask council to start 'cleaning' these issues.”

“Nationally we are finally waking up to our ‘water issues’ – community desire to talk and look after environmental, including taking action themselves is increasing – hence potential backing of WSUD from general public. However, local government are at the mercy of budgets with strong push-back on rates rises.”

“Urban Communities want dry environments, not rain forest type environments.”

“There is a lack of political will and we need to raise awareness of adverse effects of not activating WSUD.”

The relationship between central and local governments in respect of innovation in urban infrastructure provision attracted comment:

“Central government social housing has failed to lead the way in WSUD.”

“Failure of the RMA to be an effective planning decision making piece of legislation. Planning decisions are always a trade-off which yields poor results. There is a failure to align market, environment and social outcomes in the RMA. This trade-off means the effectiveness of all measures is compromised (WSUD or other). Often, costly additions such as WSUD are not perceived as worthwhile. To achieve WSUD we therefore need to aim much higher to get anywhere near achieving the benefits from WSUD.”

“New ministers represent an opportunity if they can be persuaded to consider the legacy of getting the scale of housing proposed wrong v right.”

The tension between central and local government continues between local and regional authorities:

“Requirement to consider WSUD sits at the policy level of regional plans but does not come down into the rule framework at the regional level well.”

“I think an aspect of this is the problem with jurisdictional issues between TAs and Regional Councils. By this I mean that issues concerning streams and water quality are dealt with through Regional Council's plans and the actual building on land (so building consents) are issued by TAs. Stormwater sits in between these two things, and I don't think it is well managed in terms of anyone having the 'whole picture' of integrating the details of the land development and connecting these to the water quality outcomes. Spatial zoning probably doesn't help as well as a separate thing which informs land use from another perspective.”

Leadership has been recognised as a contributor to barriers an opportunity for activating factors:

“Lack of managerial influence in Councils by CEO's and the like.”

“Voice of development industry having ear of politicians and claiming WSUD will increase costs.”

“I consider the ability for local government, consultants, planners and constructors to become market leaders in WSUD/WSC is paramount to changing relationships with water through design.”

“Community stewardship and continuity.”

“Need champions, guidance, networks and regulation.”

“We should be trying to upskill and inform local people by exploring pathways of community involvement and fostering an understanding of water. Possible methods for this include community involvement in the development process, increasing amenity values and signage.”

A4.3 Analysis of statements relating to implementation themes

A4.3.1 Regulation, policy, planning, consenting and compliance

Within the local government and engineering professions there is a lack recognition that business as usual is unlikely to meet the demands of ratepayers to achieve central government policy in respect of freshwater quality in urban contexts that are rapidly growing in changing climates forecast to produce more frequent and severe weather events. Presented as a barrier to WSUD uptake, this comment succinctly captures that position:

“WSUD, or change from traditional storm water management approach, isn't required”

However, the recognition that traditional approaches do not address water quality issues in receiving waterbodies does motivate consideration of innovation, particularly in relation to regulatory incentives:

“There are not enough rules regarding zinc and stopping stormwater pollution at the source.”

“Lack of regulatory requirements or incentives”

“Difficulty of retrofitting - consenting processes”

There are varying perspectives on ways forward:

“A robust and transparent decision-making process that is mapped out to carefully take account of the lifecycle through planning, design, construction, handover, maintenance and operations, through to asset disposal/renewal.”

The influence of the National Policy Statement for Freshwater Management (NPS-FM) on local authority decision making requires re-evaluation of how WSUD can contribute to the “new” set of responsibilities:

“Need to better understand opportunities around WSUD to incorporate into Council planning processes and target setting for the NPS-FM.”

“Appropriate rules in the Regional Plans to ensure WSUD is required when consenting new subdivisions e.g. To ensure the on-going stormwater discharges post development will meet the objectives and policies of the relevant statutory documents - NPSFM, RPS, Regional Plans. The developer required to meet WSUD requirements thus less issues when retrospectively adding WSUD to developed catchments “

“Framework of RMA provisions needs to be injected in to RPS, Regional Plans (land use, diversion, damming, discharge, earthworks etc) and District Plans (land use, earthworks and development controls) - difficult to achieve comprehensive whole /holistic framework - has to integrate with other (sometimes competing) demands.”

In some circles, there can be a degree of manoeuvring to get around regulatory requirements:

“Policy is these devices are not always required. But when it is compulsory, but there are physical or hydraulic restraints, we have seen engineers try to fit a BPO solution, where a different practice, providing full treatment should have been considered as a BPO.”

The three-tier system of governance in NZ is unhelpful:

“Jurisdictional boundaries between regional and district councils in terms of who is responsible for water quality (regional) and who is responsible for the design of new subdivisions (district).”

The effectiveness of existing processes in achieving WSUD implementation has been noted, with a solution to address the rebuttal:

“There is a disparity between what is approved by Council and then what is actually installed (through push-back after consenting, for example during ‘cost/value engineering’). Try and get more of these types of devices over the line and from a developer point of view it would be good to have

more information around perception of cost, benefits and maintenance. Can then “sell” this to the clients.”

A4.3.2 Design and construction

Knowledge around design and construction practice – i.e. the current state of play in technical specification and implementation is offered as a fertile field for improving WSUD uptake:

Reported in other sections, and explicitly noted on the walking tours sections of the workshops, as examples don’t seem to promote design and construction innovation:

“Badly designed/constructed/maintained examples, (are) held as reasons why it doesn't work”

Further response evidence in this theme may be found in Section A4.2.1 which addresses WSUD knowledge. Activating factors to feed into this design and construction issue included

the integration of design and construction into the decision process:

“A robust and transparent decision-making process that is mapped out to carefully take account of the lifecycle through planning, design, construction, handover, maintenance and operations, through to asset disposal/renewal”

Because NZ has differing geographies from internationally reported exemplars, there is a gap as to how WSUD could look and function in the NZ/Aotearoa context:

“The realistic and effective how and what does it look like in XXXX. All the examples from overseas have been from cities on flat locations. None in steep landscapes with thin, clay soils.”

Not only how it might look, but a thorough appreciation of the intent:

“We need to understand the intention behind WSUD from all levels (e.g. community through to developers). WSUD should have a clear design intention rather than be about a tick box checklist. We need to change the perception that maintenance is a burden by making it accounted for at the start of the design process.”

Funding for performance monitoring is likely to be an activating factor in this space:

“Funding to translate performance monitoring information into improved design guidance”

The greenfields/brownfields retrofit issue is raised again (see the previous section on retrofitting and consenting process) with specific reference to design, and by implication innovation research specifically addressing retrofitting WSUD:

“Information about what the feasibility of WSUD retrofit design looks like to understand what the potential for trialling retrofitted systems could be”

“Can WSUD help us comply with the Land and Water Regional Plan Guidelines via Network Discharge Consents? Zinc is our problem. Retrofitting is the most difficult area for WSUD.”

“Engineers been trained to drain wetlands, pipe stormwater, etc. so we need to change this mindset, especially in brownfields/retrofit (WSUD is easy to apply in greenfields).”

A4.3.3 Maintenance

One of the key emergent topics around barriers and activation factors lies in the maintenance issue.

This occurs across several themes:

“We need to understand the intention behind WSUD from all levels (e.g. community through to developers). WSUD should have a clear design intention rather than be about a tick box checklist. We need to change the perception that maintenance is a burden by making it accounted for at the start of the design process.”

“Maintenance costs are a barrier.”

“A lack of understanding of the lifecycle cost of WSUD due to a paucity of maintenance cost data.”

“Maintenance requires dedication, whereas those with the responsibility prefer a functional approach, such as herbicide spraying etc.”

“Training on design and maintenance”

“Agreement as to whether maintenance is a parks or infrastructure responsibility”

A4.3.4 Project lifecycle

WSUD is a strategy that has lifecycle considerations that contribute in various ways to understanding the lack of uptake in NZ. Again, the lifecycle concept spans several themes that emerged in the research.

The first considered here could equally well fit in the maintenance theme section above. It is not a technical issue as such, it is however a property rights issue:

“lack of asset ownership resulting in orphaned assets that look bad, and don’t perform reliably meaning they don’t meet customer or network outcome needs.”

From the exemplar, evidential perspective what happens post construction can have consequential implications:

“Some asset management is weak resulting in poor data for making good informed decisions about the whole of life value of some asset types.”

Amongst the activating factors:

“A robust and transparent decision-making process that is mapped out to carefully take account of the lifecycle through planning, design, construction, handover, maintenance and operations, through to asset disposal/renewal.”

“Understanding from design to construction and how if this is not built right can have massive consequences.”

“Devices would benefit from incorporation into the planning stages. Many devices appear to be an afterthought. These areas have potential to provide more social and cultural values.”

“We need a more holistic approach because these assets are part of multiple disciplines. There is a lack of flexibility and clarity around who is responsible for devices because they cross multiple jurisdictions within council (e.g. parks, Stormwater, roading authorities). This limits their design and implementation. How do they know they have these assets?”

The last response reported in this section offers a way to develop WSUD understanding by roading engineers, and by implications other competing mandates:

‘Safety in Design’ applied for roading design uses a life cycle model that could be useful for WSUD.”

A4.3.5 Funding and incentives

A factor that constitutes barriers for WSUD uptake and an avenue for resolution of slow uptake of WSUD in NZ is that of incentive generally, and regulation as a subset.

Amongst the barriers:

“Lack of regulatory requirements or incentives”

“Lack of incentive to retrofitting”

The potential for flow-on effects into other themes is captured by this comment:

“if there was a requirement to do WSUD there would be guidance, specifications, training and funding to make WSUD happen and work.”

“There is no way for developers to 'show off' their good environmental work and market it (no incentives). Maybe we need to include it in the green star rating system. We need developers to be able to appropriate the benefits created by adopting WSUD, including being recognized as market leaders.”

Budgetary considerations have been included in this theme section, but they have application across the balance of the themes. In these comments in this thread the perverse incentive of funding constraints is addressed:

“Let’s be positive: We are starting to reverse the trends of negative effects of urban land use. Key frustration is funding - healthy waterways is a council priority and a strategic outcome, but budgets are less than desirable, especially operational spending and push back on maintenance and this leads to frustration by the officers and the community.”

“Budgets are needed for general opportunistic WSUD philosophy rather than specific line item upgrades/ projects (e.g. xxxx street upgrade).”

“It is difficult to get funding for performance monitoring. Although different organisations are chipping in a bit, we could get a lot of research done for small financial contributions from organisations that would benefit.”

Addressing missing incentives as both a barrier and an avenue for resolution the following comment opens a field of action that is complimented by the subsequent offering:

“Missing incentives. A targeted rate on impervious areas would start a thinking process how much impervious is really required and how this can be offset on site by using WSD.”

“XXX provided a summary of previous work on developing an impervious surface tax in Europe: Germany developed a ‘concrete tax’ and the money was put into subsidies for creating rain gardens (funded from the tax on impervious surfaces). Expected uptake of about 50% over a few years, but uptake was actually around 90% within the first year. A proposal was together for a similar system in XXXX but not submitted to Councillors. It is important that the tax \$/m2 is high enough to assist with behaviour change, as is the subsidy.”

A4.3.6 Organisational culture

Organisational culture can frame attitudes to innovation uptake if WSUD is considered a disruptive innovation. The context that organisations are embedded in influences the culture and the response to the disruption:

“Requirement to consider WSUD sits at the policy level of regional plans but does not come down into the rule framework at the regional level well. I think an aspect of this is the problem with jurisdictional issues between TAs and Regional Councils. By this I mean that issues concerning streams and water quality are dealt with through Regional Council's plans and the actual building on land (so building consents) are issued by TAs. Stormwater sits in between these two things, and I don't think it is well managed in terms of anyone having the 'whole picture' of integrating the details of the land development and connecting these to the water quality outcomes. Spatial zoning probably doesn't help as well as a separate thing which informs land use from another perspective. “

More simply, “who owns the water quality problem”, as a contribution to the scope of an organisation’s mandate:

“Jurisdictional boundaries between regional and district councils in terms of who is responsible for water quality (regional) and who is responsible for the design of new subdivisions (district).”

“Role: Which asset owner role in local government is meant to provide WSUD outcomes?”

“The uptake of WSUD in NZ is minimal. The issues are not technical but rather institutional and regulatory. We don't have the rules to support or force uptake of WSUD.”

Several comments attribute barriers within organisations to WSUD uptake to specific roles in the organisations”

“Middle & Senior management”

An activating response might lie in:

“Having ecological expertise as a QBL requirement on boards and executives (as for business, sociology and culture.”

For some entrenched views amongst the three waters sector of the engineering profession itself is seen as a barrier as evidenced by this comment:

“Ancient "traditional engineering" views in house and in consultants in XXXX”

Other aspects included:

“WSUD Multi discipline design time soon mounts up. Coordinating different design staff availability sometimes complex.”

“Corporate/institutional culture dis-incentivising innovation.”

“Division/uncertainty of ownership between roading, parks and stormwater “

“Individual resistance to learn/change/adopt. Four years after implementation the SW Code of Practice is still ignored by many Development Engineers. They keep on using their old, withdrawn district plans. And this is an engineering guideline – how much stronger must the resistance be, if a soft and less engineered approach is promoted?”

“Council departments are focussed on a few single issues = silos (e.g. Building consents dept. only administers the Building Act Requirements cf cultural/Māori requirements)”

“The biggest barrier is a lack of cohesion and multidisciplinary input. There is no “big picture”. Within the council alone there are lots of threads and competing requirements which comes back to silos of professions and departments within government and industry. This can be partly attributed to

funding models. For example, CCO are incentivized to maintain and build wastewater assets, but stormwater is a public good. The CCO model would not work for WSUD because that. Because WSUD is a more ecological approach - relying on plants surviving, soil treating water etc. rather than a purely technical approach it is quite a mind shift for those managing the systems. Would incentivize more infrastructure which will create more issues. Stormwater falls through the cracks because it has no monetary value (no monetary cost or benefit) and this leads to a lack of ownership and associated problems.”

“There are some science gaps, but they are not the major issue. There are a lot of myths around the economics and aesthetics. There is resistance within specific parts of councils, for example roading engineers are very uncooperative and unresponsive to WSUD ideas”

The resolution of organisational culture issues is summarised by:

“Need champions, guidance, networks and regulation.”

These statements on organisational culture clearly have implications beyond the scope of this research. They call for a new, high level, rallying and enabling value proposition at each stage of the WSUD value chain. An overarching vision, goal, or principle that cuts across disciplinary, sectoral and departmental lines to generate cohesion and unity in strategic thinking and service delivery alike.

A4.3.7 Capacity, training and guidelines

This section should be considered alongside comments that feature in the knowledge section (Section A4.2.1). The first response featured here offers a conciliatory explanation for entrenched views, and an educational approach to alleviating barriers:

“Because WSUD is a more ecological approach - relying on plants surviving, soil treating water etc. rather than a purely technical approach, it is quite a mind shift for those managing the systems”.

Other areas for consideration under the ambit of capacity, training, and guidelines include:

“Maintenance contractor lacking knowledge of WSUD - can lead to deficiencies in the devices and expensive renewal (not to mention bad reputation for WSUD).”

“Very weak knowledge and appreciation of the variety of monitoring and maintenance activities needed throughout an asset lifecycle (cyclic, periodic, reactive, renewal, improvement, asset disposal).”

“A lack of understanding of basic principles in hydraulic design, soil science, and plant selection.”

“Contractors need to be skilled up and need to create an 'auditing' framework.”

Who gets trained and how capacity might be improved:

“There is massive value for money in using the right people. It is easier to teach certain people skills than others.”

This comment about a barrier – poor construction knowledge – links capacity and training issues to markets, incentives, and the lack of demand pull for WSUD:

“Effective construction. Often poorly constructed by undertrained or uninformed contractors. More market incentive needed to promote contractors to specifically implement constructed WSUD and other environmental solutions. Whole market mechanism being missed and the WSUD push is solely being led by regulators and scientists.”

Activating factors offered include:

“Training on design and maintenance.”

“A better knowledge of users, regulators and contractors about how to design it, build it and operate it and why it is important.”

These could be achieved through:

“Set up some nation-wide working group with 'a status' that is responsible has the mandate to provide the above. Question is whether this should be WaterNZ or IPENZ because WSUD goes much wider.”

“A nationally or regionally recognised guideline document which provides information on effective solutions and designs”–

“Quick wins would include: WSUD signoff checklists /inspection guides, rating and reporting systems – these have been developed both locally and internationally (CiRIA⁴⁹).”

A role for central government is seen:

“Information from MfE and other similar groups is not being filtered down to the people working at the ground level. MfE could provide direction that is specified and clear that creates clarity and cuts out ambiguity on the need for a change in Stormwater management – e.g. maybe direction on source control (building materials, tyres, brake pads).”

Last,

“Auckland case studies are available on their council website.”

A4.3.8 Competing mandates

There is perception that lack of cohesion and integration arising out of “path dependence” consequences of solutions to earlier challenges presents considerable barriers. Those factors create competing mandates, as described by the first comment in this section (this has been repeated from an earlier section. Note also the closing comments to Section A4.3.6)

“The biggest barrier is a lack of cohesion and multidisciplinary input. There is no “big picture”. Within the council alone there are lots of threads and competing requirements which comes back to silos of professions and departments within government and industry. This can be partly attributed to funding models. For example, CCO are incentivized to maintain and build wastewater assets, but stormwater is a public good. The CCO model would not work for WSUD because that would incentivize more infrastructure which will create more issues. Stormwater falls through the cracks because it has no monetary value (no monetary cost or benefit) and this leads to a lack of ownership and associated problems.”

There is a perspective that there are zero-sum game type trade-offs between WSUD and other decision factors:

“Development yield (developer profit) is given more weight than social and environmental outcomes: (WSUD is) Repressed by previous regime focus on numbers of houses v long term value & sustainable benefits.”

⁴⁹ CiRIA is the UK construction industry research and information association. <https://www.ciria.org/>

“Biodiversity and biosecurity should be more fully considered in terms of their role in placemaking as part of WSUD. These issues are often treated as ‘green fluff’ and sometimes subsumed by dubious hydrological models which are risk averse and highlight constraints which go beyond what is likely to happen. In XXX this resulted in removal of taller native shrub groundcovers and flaxes – and replacement with mown grass. Part of the issue is that the profession of ecology is also subsumed and not involved in the conception from design through to implementation. Ecology is often excluded by landscape architects. This is due to the silo-type of environment that we all work in.”

Further activating factors in response include:

“How do we start doing integrated holistic designs? The main barrier is urban and landscape design. We see fragmented small developments which each do their own thing and do not take a whole of catchment approach.”

“Integrating WSUD across design disciplines (landscape design, urban Design, roading...)”

“Framework of RMA provisions needs to be injected in to RPS, Regional Plans (land use, diversion, damming, discharge, earthworks etc) and District Plans (land use, earthworks and development controls) - difficult to achieve comprehensive whole /holistic framework - has to integrate with other (sometimes competing) demands.”