ICMPs IN A PARALLEL UNIVERSE:

The development & implementation of 10 Integrated Catchment Management Plans in Dunedin

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ABSTRACT (200 WORDS MAXIMUM)

This paper presents the pragmatic approach that Dunedin City Council Water and Waste Services is taking in response to outputs from a comprehensive 3 waters modelling project and the subsequent development (in parallel) of ten integrated catchment management plans (ICMPs) for stormwater management.

With the recent development of a robust strategy for long-term investment decisions, the challenge Dunedin City Council now faces is how to balance strategic commitments, model predictions, activity performance targets and ICMP recommendations in order to prioritise and plan capital expenditure. The motto 'why do I care' has been a useful question for staff to use when considering the ICMPs in parallel and attempting to prioritise issues and options against stated objectives, across ten catchments simultaneously; as opposed to working on a catchment by catchment basis.

The ICMPs are not only being used to inform capital and operational investment decisions over the next 50 years, but also form the basis for Dunedin City Council's application to renew its resource consents for stormwater discharge into the Otago Harbour. As such, there is the added challenge of translating this information into practical long-term consent conditions whilst ensuring the monitoring regime will provide meaningful results to gauge the success of ICMP implementation.

KEYWORDS

Integrated catchment management, 3 Waters, targets, prioritisation, interpretation, implementation, investment decisions, consent conditions.

PRESENTER PROFILE

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1 INTRODUCTION

Historically, stormwater management in Dunedin has attracted less focus than that of water supply and wastewater. However, the development and implementation of integrated catchment management plans (ICMPs) for stormwater management signals an emerging shift in focus by the Dunedin City Council (DCC). This has been driven through the need for an improved understanding of the stormwater network; how it responds to different built and natural variables; its connectivity to other piped networks; associated capital and operational needs and a requirement for more visibility and commitment to long-term strategic priorities and levels of service.

This paper discusses how ICMPs have been developed in Dunedin, their interpretation into meaningful actions, the approach to prioritisation of issues, subsequent programme coordination and lessons learned.

1.1 BACKGROUND

Dunedin City covers a geographic area of 3,350 square kilometres, making it the largest city in New Zealand by land area. Much of the city's 124,000 population live in the metropolitan area. Dunedin's population growth is relatively slow, but is subject to seasonal variation due to the high population of students and the arrival of summertime cruise ships.

The DCC owns and manages assets valued at $1.6 billion (gross replacement cost), across all three waters (water, wastewater and stormwater). Specifically, Dunedin's stormwater network comprises 363 km of pipes and 11 pumping stations. The gross replacement cost of the stormwater asset group is approximately $254 million (as at August 2010.) The majority of stormwater in Dunedin's metropolitan area drains to the Otago Harbour (upper/inner harbour area). The harbour is 40 km long and is considered an important area for recreation and tourism and is of great significance to local Iwi and Dunedin's community. The harbour has been heavily modified by reclamation, transport causeways and dredging.

Stormwater that discharges to the harbour does not meet permitted activity rules in the Otago Regional Plan: Coast and as is therefore considered a 'controlled' activity. Consequently, the Otago Regional Council (ORC) must grant consent, but may impose reasonable consent conditions that relate to the matters over which it has reserved control. These include: the location, volume, rate and nature of the discharge; treatment required (if any); duration of consent and information and monitoring requirements.

The majority of Dunedin's stormwater reticulation assets have an estimated useful life of 100 years. Theoretical life assumptions indicate approximately 10% of Dunedin's stormwater network (36 km) currently exceeds its remaining useful life and a further 3% will exceed its remaining useful life in the next 10 years, at a replacement cost in the region of $20m. The approved budget for stormwater network renewals for the next decade, however, is approximately $17m. This budget shortfall further emphasises that careful planning of capital investment is required to ensure that best value for money is obtained.

In a number of areas, the capacity of the stormwater network is of concern, with recorded flooding events following periods of prolonged or intense rainfall. Modelling work has estimated that parts of the network may only be providing low levels of service (1 in 2 year or 1 in 5 year), considerably less than the current design standard of 1 in 10 year. Inflow and infiltration may be exacerbating capacity issues and contributing to this problem. However, the modelling also indicates that the low level of service may not always cause significant flooding issues.

Although traditional engineering approaches to collecting and conveying stormwater currently represent the preferred method in Dunedin, the nature of stormwater lends itself to being both influenced and managed by a range of stakeholders. The issue of 'ownership' exacerbates existing problems with the network comprising of assets owned both privately and across a range of DCC departments. Although there are various tools available to guide the management of stormwater in

Dunedin (such as the Dunedin City District Plan, the Code of Subdivision and Development, the Trade Waste Bylaw, the Building Act and Building Code, Regional Plans, other watercourse guidelines and utilities codes etc) there is nothing entirely specific which would ensure a coordinated approach to stormwater management across the city.

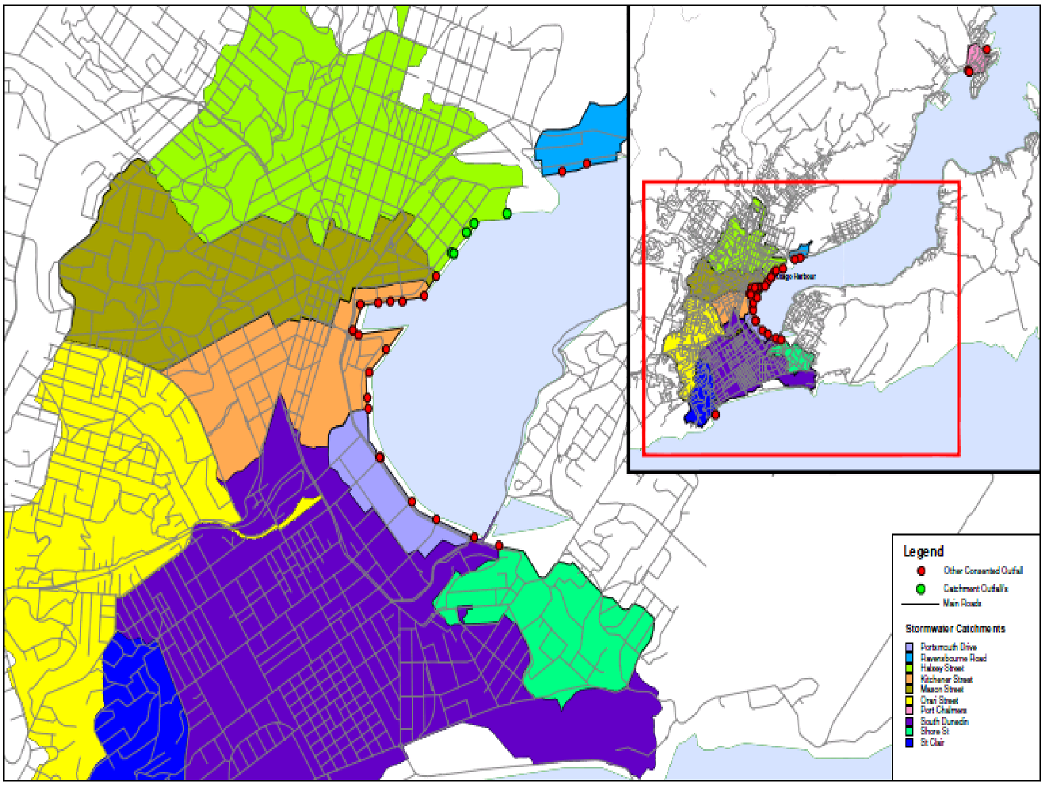
1.1.1 STORMWATER DISCHARGE CONSENTS

In 2002 the DCC lodged an application with the ORC to discharge stormwater to the Coastal Marine Area (CMA) and the Pacific Ocean. Whilst DCC provided all the information that was available at the time, the ORC considered that the information gaps generated enough uncertainty to require a request for additional information on various aspects relating to both stormwater quantity and quality. This caused delays in the consent process and at the end of 2007 the consents were granted, but with a consent term of only five years. The ORC considered that anything more than five years would further delay the process of reaching one of their key policy targets, which is to achieve contact recreation water quality by the end of 2011.

Altogether a total of 31 stormwater discharges have resource consent and each require that a stormwater catchment management plan be developed. However, it was considered impractical to develop 31 catchment management plans. As such, the number of ICMPs required was rationalised to 10 (Figure 1), with the catchment boundaries determined by considering topography, stormwater network and landuse. The development of these plans commenced in 2009 and is due to finish in 2011. Another catchment (Mosgiel) has since been included and is also programmed to finish in 2011, however this catchment does not discharge to the Otago Harbour.

The current consent conditions require a range of sampling and monitoring to be carried out on an annual basis. Along with stormwater discharges, other sampling and analysis includes: harbour sediment, cockles, spotties (small fish), octopi, as well as recording abundance and type of flora and fauna. Stormwater discharge sampling currently involves obtaining grab samples during the ‘first flush’ of a defined rainfall event. The event must be preceded by 72 hours of no measurable rainfall and measure at least 2.4mm in a 24 hour period. It is acknowledged that there are various issues with this approach and these will be discussed later within the context of the ICMP recommendations.

Figure 1: Stormwater Catchments



The ORC has not yet required consents for all stormwater discharges to urban streams in Dunedin. As such, the principal consideration for DCC's ICMPs is the discharge of contaminants into the CMA. However, there are strong indications that a policy relating to urban freshwater quality will be introduced in the near future. The content and structure of the ICMPs will, at a minimum, cover the long-term management plan requirements set out in the existing short-term consent conditions, but also include freshwater stream assessments as part of the baseline catchment information in preparation for potential future freshwater discharge consent requirements.

1.2 STRATEGIC DIRECTION

Within the timeframe of the initial stormwater discharge consent process, a comprehensive 3 Waters Strategy Project (water, stormwater and wastewater), driven by DCC Water and Waste Services (WWS), had commenced (2006). This project was one of the key initiatives in a business improvement plan for WWS. In conjunction with project partners Opus International Consultants and URS New Zealand, three distinct project phases were undertaken:

Phase 1 - Development of strategic level hydraulic models to allow the identification of capital and operational investment needs at a macro level.

Phase 2 - Further development of the hydraulic models to determine capital and operational needs at a catchment or zonal level. (A linked 1 and 2-dimensional hydrological and hydraulic model of each catchment and stormwater network was developed).

Phase 3 - Implementation of capital and operational works programmes to realise the required level of service improvements.

At the start of this project, however, an over-arching long-term strategic direction for the 'three waters' was lacking. Although the DCC stormwater Activity Management Plan (AMP) set out committed service levels, delivery methods, asset management techniques and funding, there was still a need for a robust review and understanding of existing issues, future challenges and community preferences; and specific acknowledgment of the benefits of an integrated approach across all three waters.

This review commenced in 2009 and in 2010 an over-arching strategy was adopted. The strategy itself is published under the title of '3 Waters Strategic Direction Statement 2010-2060' (3WSDS) and outlines the principles, priorities and planning assumptions that underpin decisions regarding three-waters infrastructure planning and service delivery in Dunedin for the next 50 years.

Within the 3WSDS, there are several key priority areas clearly linked to stormwater management that the DCC has committed to. These include:

- Improving the quality of discharges to minimise the impact on the environment;
- Ensuring that, as a minimum, key service levels are maintained into the future;
- Limiting cost increases to current affordability where practicable; and
- Adopting an integrated approach to management of the three waters and embracing the concept of kaitiakitaka (guardianship, care and wise management).

An important aspect of the 3WSDS is that it recognises the lifespan of three-waters infrastructure, highlighting that decisions made today have a long term impact on affordability, service delivery and community values – beyond current Council planning and election cycles. The 3 Waters Strategy Project reflected this 'long-term' requirement through the modelling and analysis of various influences over a 50 year period. Altogether, fourteen scenarios were analysed for stormwater, representing 2010, 2030 and 2060 time horizons in order to replicate the stormwater system performance and predict flood extents during different scenarios. The simulations included changes in land use (and therefore imperviousness), various rainfall events (1 in 2 yr through to 1 in 100 yr ARI rainfall events), various tidal boundaries (mean high water spring and extreme high tide), and climate change. The outputs from the 3 Waters Strategy Project have provided significant technical input and a good platform for the development of ICMPs.

2 ICMP DEVELOPMENT

2.1 CATCHMENT PRIORITISATION

In order to coordinate development of the ten ICMPs, a high-level evaluation and prioritisation of the original city catchments was carried out via Quadruple Bottom Line (QBL) assessment. The four QBL categories (representing economic, social, cultural and environmental 'wellbeings') and 12 related indicators were defined and weighted in consultation with several WWS staff members to ensure that the indicators considered to be most important had a greater impact on the final score than indicators that were considered less important (URS NZ Ltd, 2008).

Using the 12 indicators and 4 well-beings, the catchments' assets were gauged. A final weighted score and ranking of the catchments was derived through scoring each of them against the indicators on a scale of zero to five (zero representing 'no issue' and five, a 'significant issue') (URS NZ Ltd, 2008). Refer to Table 1.

Of the catchments assessed, 'South Dunedin' scored highest and became the main Phase 1 project deliverable for stormwater. This was used as a 'pilot' catchment, with the intention that any issues faced during model build, hydraulic analysis, issues identification and overall ICMP content and structure would be worked through and ironed out to provide a clear direction for the Phase 2 ICMP deliverables.

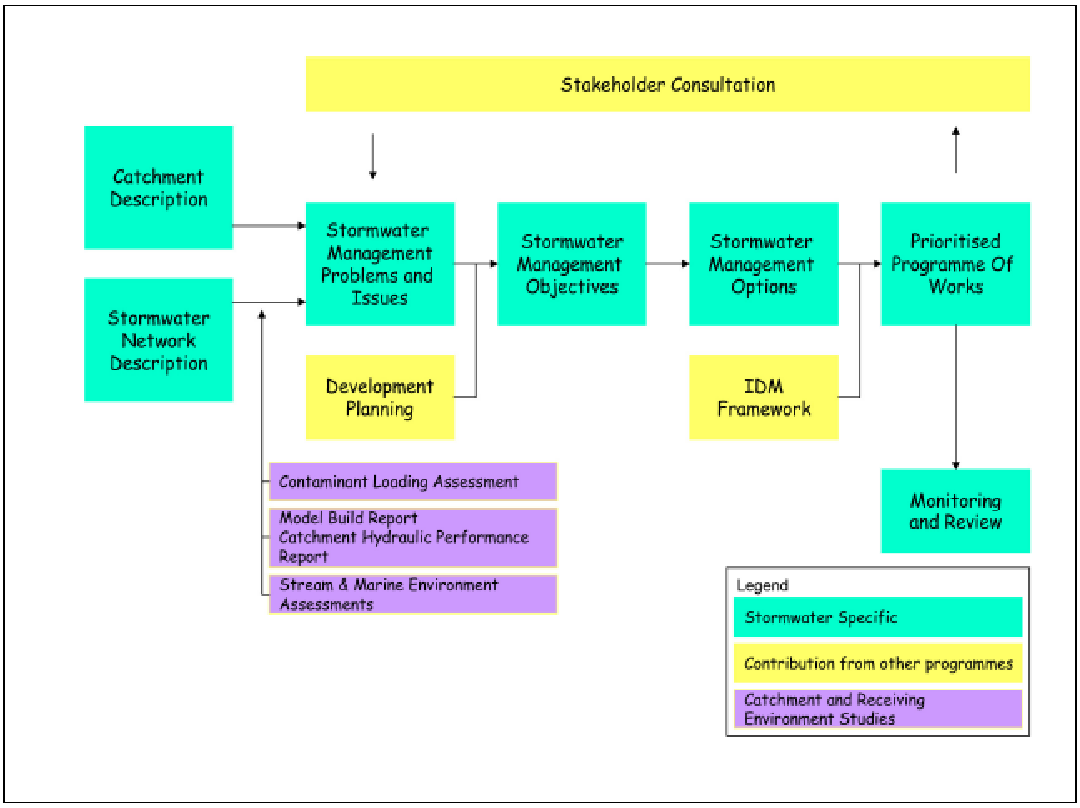
Table 1: Catchment Prioritisation

Quadruple Bottom Line Category	Label	Indicator	Main Weighting (%)	Sub Weighting (%)	Shore St	South Dunedin	Oral St	Kitchener St	Mason St	Halsey St	Halsey St	Wickliffe St	St Clair
Economic	1A	Annual OPEX	35	100	0	4	0	0	0	0	0	0	0
Social	2A	Community Pressures	-	-	-	-	-	-	-	-	-	-	-
Cultural	3A	Iwi (Kāi Tahu) considerations	20	100	4	4	4	4	4	4	4	4	3
Environmental	4A	Sensitivity of Receiving Environment	45	10	4	3	3	3	3	3	3	3	1
	4B	Asset condition/age/capacity restraints		30	2	4	3	2	3	2	3	2	2
	4C	Reported Flooding incidents		10	2	4	1	0	2	2	3	3	1
	4D	Reported Water Quality incidents		10	1	3	3	2	3	3	2	1	2
	4E	Presence of point source pollution sources		20	0	4	2	4	4	2	3	3	0
	4F	Presence of diffuse pollution sources		10	3	4	3	2	0	0	2	0	0
	4G	Development proposed within catchment		-	-	-	-	-	-	-	-	-	-
	4H	Sediment generating / erosion areas		10	2	0	2	0	2	3	2	0	2
	4I	Extent of waste / stormwater system interaction		-	-	-	-	-	-	-	-	-	-
					1.48	3.25	1.63	1.33	1.66	1.57	1.68	1.39	1.14

2.2 ICMP STRUCTURE AND DEVELOPMENT PROCESS

Following catchment prioritisation, the content and structure of the ICMPs had to be developed and agreed with a clear understanding of the inputs and stages required moving forward. Figure 2 depicts this development process, which necessitated effective co-ordination, communication and time-management. In practice this did not always go to plan and over time key delivery dates became tighter and more difficult to achieve (see Lessons Learned, section 2.1.3). In conjunction with this, it became clear that the interpretation of model results needed a pragmatic approach to ensure a balanced representation of actual problems and issues within each catchment. This is discussed further in the following section.

Figure 2: ICMP Development

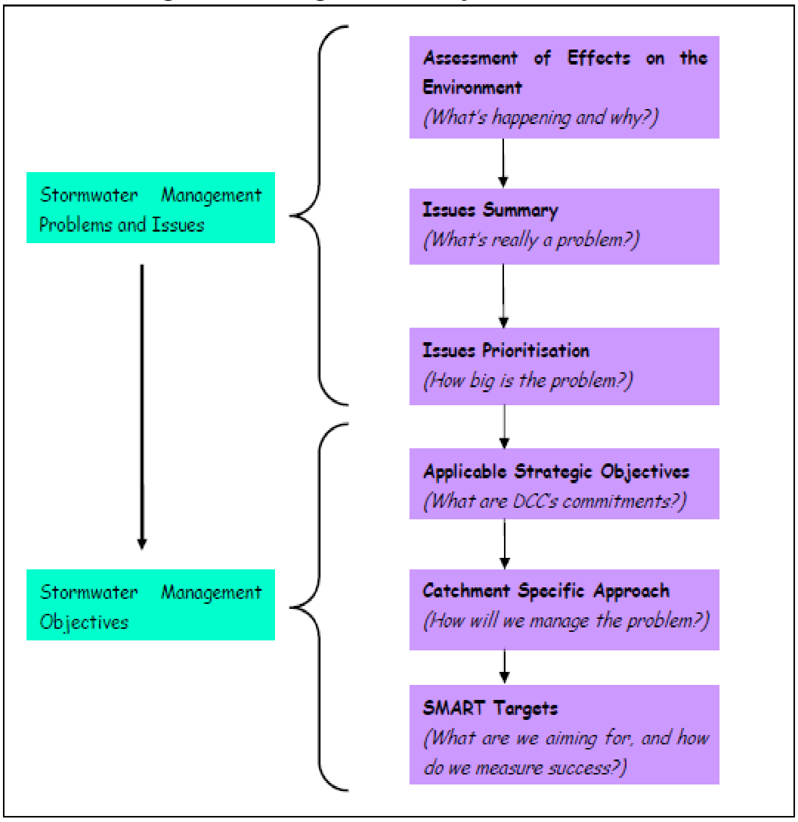


The content of each ICMP has five key sections: Baseline, Analysis, Targets, Solutions and Recommendations:

- The Baseline section presents the existing situation in each stormwater catchment.
- The Analysis section identifies and summarises the actual and potential environmental effects on the stormwater network and natural environment. The information presented in this section is used to identify the key stormwater management problems and issues for the catchment.
- Following this, the Targets section assigns a risk and consequence score to each issue, which are then prioritised and ranked. This information is used to determine a catchment specific approach for each issue. These approaches are categorised as either 'active' or 'passive' management depending on the prioritisation score ('active management' indicates that DCC will seek to implement changes to stormwater management in the catchment, whereas 'passive management' tends more towards monitoring and review of existing management practices to ensure that the targets set can be met). SMART targets are then set (refer to Figure 3), which provide the platform for development of catchment specific stormwater management options.
- The Solutions section contains all potential options and further evaluates a range of alternatives (where feasible) for those that are requiring 'active' management (see Section 2.3.1), allowing options to be compared across a consistent framework. Shortlisted options are then progressed through to the Recommendations section.
- The Recommendations section contains costed improvement actions that address the key issues identified within that catchment as well as indicative work periods and delivery dates. The recommendations suggest a prioritised programme of work for each catchment comprising of: capital work options, planning options, operation and maintenance tasks or further study.

The above approach allowed for catchment-specific issues, options and performance targets to be appropriately defined for each of the ten catchments. As the ICMPs are considered to be 'live', the intention is that when each task is carried out, the influence on catchment management targets is assessed, and further tasks are undertaken as per plan or modified as necessary to achieve targets.

Figure 3: Target Development Process



2.3 LINKING STRATEGIC OBJECTIVES WITH TARGETS

Setting relevant and appropriate strategic objectives for stormwater management was crucial for the DCC. Significant time was spent ensuring that the objectives were pertinent across all the catchments so that appropriate management approaches and targets could be developed. It was decided that the strategic objectives of the ICMPs were to be based on both relevant statutory and non-statutory documents addressing stormwater management, as well as the direction given by the 3WSDS; with the aim of achieving benefits across the four 'wellbeings'. From this, six over-arching strategic objectives were established (Figure 4).

The cascade from strategic objectives to catchment specific approaches and subsequent targets went through multiple iterations due to differing perspectives on how approaches and targets should be set and expressed. The main 'grey area' was whether proposed strategic targets were actually approaches or vice versa. To address this issue, it was agreed that specific, measurable targets with timeframes were required in the form of SMART targets.

Ultimately, the DCC needed to ensure meaningful objectives and targets in the ICMPs that showed clear linkages to levels of service and other performance measures, so that any subsequent improvement programme would focus on relevant priority areas. For example, model results from a current 1 in 10 yr ARI rainfall event scenario predicted several areas of surcharge across a catchments' network - approximately 57 % of the network was predicted as having no spare capacity and approximately 16 % of the manholes in the catchment were predicted to overflow. However, as DCC are concerned with the potential flooding of habitable floor levels, the motto 'why do I care' was applied to these model predictions to ensure that they were reported within the context of strategic objectives and performance measures i.e. 'does (the issue) cause a problem that is related to one or more service level or performance targets?'. If no apparent problem was evident, the issue was recorded in the relevant report but no immediate action would be taken. Consequently, in the example above, the 'low level of service' issue was identified as requiring passive management rather than active management. SMART targets for this issue are aimed at progressively improving the level of service via the DCC's renewals planning process. Figure 5 illustrates this.

Figure 4: Strategic Objectives

Strategic Objectives
Development: Adapt to fluctuations in population while achieving key levels of service and improving the quality of stormwater discharges. Ensure new development provides a 1 in 10 year level of service, and avoids habitable floor flooding during a 1 in 50 year event.
Levels of service: Maintaining key levels of service of the stormwater network into the future by adapting to climate change and fluctuations in population, while meeting all other objectives.
Environmental outcomes: Improve the quality of stormwater discharges to minimise the impact on the environment and reduce reliance on non-renewable energy sources and oil based products.
Tangata whenua values: Adopt an integrated approach to water management which embraces the concept of kaitiakitaka and improves the quality of stormwater discharges.
Natural hazards: Ensure there will be no increase in the numbers of properties at risk of flooding from the stormwater network.
Affordability: To meet strategic objectives while limiting cost increases to current affordability levels where practical.

Figure 5: Example of Issues, Approach and Targets

Issue (Problem Description)	Effects Summary	Strategic Objectives & Targets	Catchment Specific Approach	SMART Targets
Low Level of Service	16 % of stormwater network cannot accept rainfall from a 1 in 10 yr ARI, driven by both network capacity and tidal influence. Manholes predicted to overflow with pipes flowing full throughout approximately 57 % of system. This low level of service is currently occurring with no capacity for climate change effects. Flooding results in certain locations during a current 1 in 10 yr ARI rainfall event.	Maintain key levels of service of the stormwater network into the future by adapting to climate change and fluctuations in population, while meeting all other objectives. Ensure new development provides a 1 in 10 year level of service, and avoids habitable floor flooding during a 1 in 50 year rainfall event. 95% of customer emergency response times met. >60% resident's satisfaction with the stormwater collection service.	***Manage Passively*** Maintain or improve existing level of service in network – ensure no increase in the number of manholes predicted to overflow in a 1 in 10 yr ARI rainfall event. Design new pipes with capacity to convey a 1 in 10 year storm event. Undertake pipe renewals programme from 2012. Use Residents' Opinion Survey to gauge city wide satisfaction with the stormwater system performance	> 66 % of pipes to convey a 1 in 10 yr ARI rainfall event by 2060. < 16 % manholes predicted to overflow during a future 1 in 10 yr ARI rainfall event by 2060. < 0.8 % of catchment surface predicted to flood during a future 1 in 10 yr ARI rainfall event by 2060. > 60 % resident's satisfaction with the stormwater collection service (ongoing).
Low Confidence in the Knowledge of Effects on Harbour Environment Variability of Stormwater Quality Results	High variability of stormwater quality results, any trends in stormwater contaminant levels remain unclear. Poor information on actual effects of stormwater on harbour environment. Lack of data to assess linkages between pipe discharge and harbour environment quality.	Improve the quality of stormwater discharges to minimise the impact on the environment. Adopt an integrated approach to water management which embraces the concept of kaitiakitaka and improves the quality of stormwater discharges Nil recorded breaches of RMA. Ensure stormwater discharge quality does not deteriorate.	***Manage Actively*** Redesign monitoring programme to ensure stormwater quality data is collected within a robust monitoring framework. Include Halsey Street as a priority catchment in the monitoring programme. Develop method for determining linkages between stormwater quality and harbour environment. Consider the cost/benefit of stormwater quality treatment as part of flood mitigation works where practicable. Require source control of stormwater contaminants in new development of high-contaminant generating land uses. Enforce the Trade Waste Bylaw with respect to stormwater discharges.	Robust monitoring framework developed and implemented by 2012. Improve confidence in data supporting analysis of stormwater discharge quality and effects on harbour environment, with improved confidence in data by 2013. Review and prioritise catchments / discharges of concern and contaminant sources by 2013. Revise ICMPs to include new information, management approaches and ongoing monitoring protocols by 2014

Figure 5 also displays the approach and SMART targets developed for improving confidence in stormwater quality data. An issue was identified whereby the stormwater data collected over the past five years did not provide sufficient information to enable the assessment of effects on the environment to be sufficiently completed. This has prompted an approach that will ensure a robust monitoring framework is developed; linked back to DCC's strategic objectives relating to the improvement of stormwater discharge quality and avoiding adverse effects on the harbour environment. One benefit of undertaking the ICMPs in parallel is that this issue is city-wide, and the framework can be developed with all catchments in mind; each ICMP will have the same recommendation, which will then be incorporated into the overall 3 Waters Strategic Plan.

The development of meaningful targets involved several other aspects including: verification of model results; workshop discussions and flood complaint records helped to verify predicted flooding locations and extents. Where verification was not provided, modelled flooding was identified and flagged as requiring further verification, prior to progression of each issue. Providing context to the model outputs on network response and performance is essential to ensure recommendations are relevant.

2.3.1 OPTIONS DEVELOPMENT AND COMPARISON

The approaches and SMART targets provide guidance for development of catchment specific stormwater management options, with some catchments having several options ranging from capital works to planning/regulatory tools. Options deemed to be technically feasible and likely to meet the objectives and targets set for the catchments were evaluated and shortlisted using an optimised decision making (ODM) framework based on policy and procedures developed by WWS staff. This consisted of QBL analysis with stormwater specific criteria; and an additional two risk categories (Implementation Risk and Effectiveness (risk reduction)).

This approach enabled issues to be ranked against a risk based framework and for associated solutions/options to be scored in terms of their effectiveness to solve the problem and on their benefit related to agreed outcomes and QBL objectives.

Overall, the ODM framework assists to demonstrate relative changes in risks when comparing options and the extent to which option 'trade-offs' can impact the ability to achieve key priority objectives (both within and across catchments). For example, choosing options to mitigate or reduce stormwater quality issues to achieve beneficial environmental outcomes at the risk of not achieving other objectives relating to flooding and development. Similarly, the potential impacts of any trade-offs can be demonstrated in terms of key performance measures, such as levels of service impacts. For example, when comparing modelled options for attenuation versus local upgrades - the former provided good protection in a 1 in 50 ARI rainfall event, but not during a 1 in 10 yr ARI. However the latter performed better in the 1 in 10 yr event, but did not provide protection during the 1 in 50 yr event. Subsequently, any decision needs to balance level of service commitments with value added in terms of risk mitigation per whole life cost and, of course, available budget.

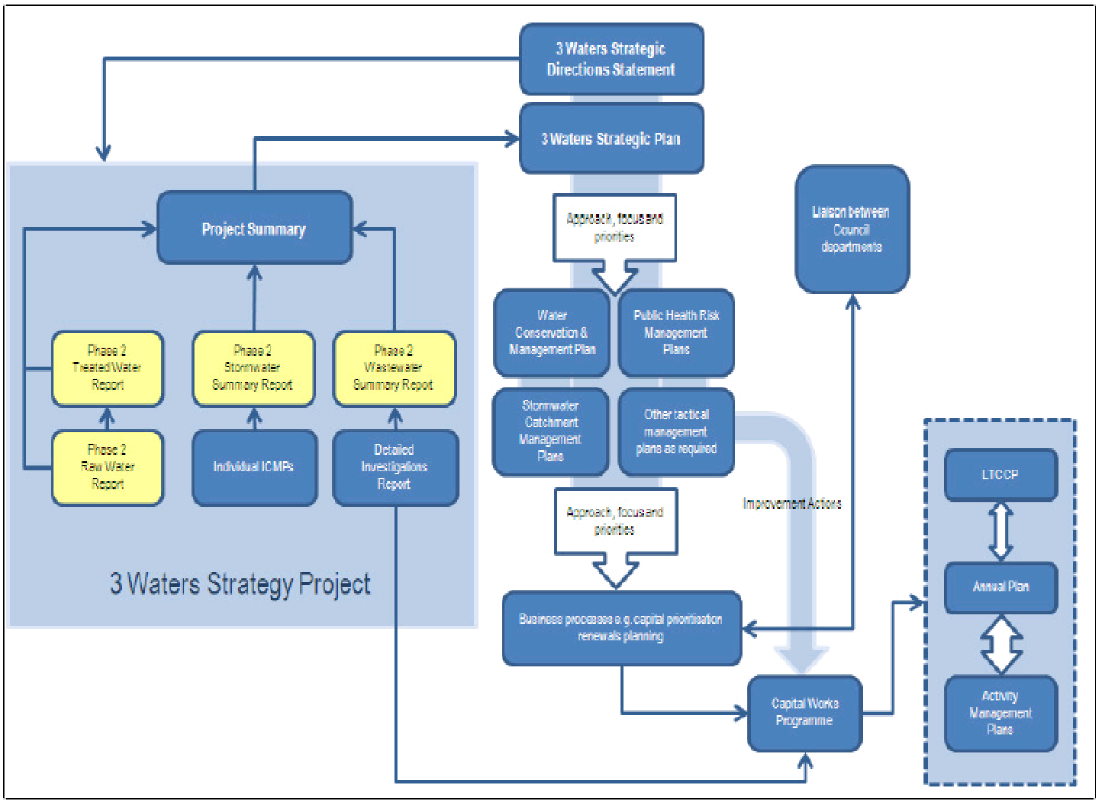
Seeking a better understanding of customers' willingness to pay is useful in this context. However, clarity on this can only be obtained once WWS fully understand and demonstrate the impacts of choosing different options on network performance and levels of service. This has the added dimension of dealing with issues across generations, particularly with respect to climate change and potential flood risk scenarios 50 years out, which poses questions of whether to invest in flood mitigation now to reduce effects in a particular area or invest in predicted flood areas for 'future-proofing'.

Overall, the consistent approach, prioritisation framework and QBL assessment criteria for options analysis allows for meaningful debate when considering all of the ICMPs in parallel and attempting to prioritise issues and options across ten catchments.

2.4 ICMP IMPLEMENTATION

A common platform has been provided through the risk and decision-making frameworks to enable parallel consideration of all recommended management options across ten catchments. Recommendations within each ICMP provide indicative costs, work periods and delivery dates. Further coordination is required to bring this information together for a synchronised 3 waters approach for programming and implementation. In this case, a 3 Waters Strategic Plan will provide this 'coordination' by collating the recommendations from all ICMPs along with other 3 Waters work prepared by DCC. Figure 6 illustrates this process. It is intended that the detailed 3 Waters Strategic Plan will be completed by September 2011. The consistency in approach within all the ICMPs, as illustrated in the previous sections, is an essential component of this plans success.

Figure 6: Information Flow and Programme Coordination



The approach to capital programme prioritisation taken by WWS plays key role in the development of the 3 Waters Strategic Plan, as it considers all projects across all three waters. An integrated approach delivering benefits across catchments and waters is therefore preferable.

Integration of stormwater, wastewater and water supply management was undertaken at a macro level during Phase 1 of the 3 Waters Strategy Project; the opportunities for integration of the 3 waters continued during Phase 2. The notion of integration covers both business processes and network interaction.

From a network perspective, infiltration and inflow have been identified as problems in a number of wastewater catchments city-wide. Although a historic programme of sewer separation was thought to have enabled the stormwater system to operate totally independently from the wastewater sewerage system, the modelling results indicate that there are still issues with system interconnectivity. Hence, an integrated approach between stormwater and wastewater model outputs and recommended solutions is required. If there are multiple recommended solutions, it will be important to decide upon an optimal approach. This may involve works being carried out as packages as opposed to single discrete projects so that the interconnectivity issues do not get worse or cause problems elsewhere.

The ICMPs presented budget costs for favoured solutions, which are to be ranked across the three waters and a prioritised staged capital investment programme established. A key challenge for WWS staff will be configuring the programme of works with respect to operational and capital funds as well as staff resources. If there are significant capital works to be carried out, they will need to be planned within existing budgets and with appropriate delivery lead-in and construction timeframes. In some cases where budget constraints are an issue, a staged approach may be required or deferral of other projects considered to be a lower priority.

Because the ICMP documents are considered to be 'live', the intention is that when each task is carried out, the influence on catchment management targets is assessed, and further tasks are undertaken as per plan or modified as necessary to achieve targets.

2.4.1 LINKING ICMPS TO DISCHARGE CONSENTS

The ICMPs are not only being used to inform capital and operational investment decisions over the next 50 years, but also form the basis for DCC's application to renew its resource consents for stormwater discharge into the Otago Harbour. As such, there is the added challenge of translating this information into practical long-term consent conditions, whilst ensuring ongoing monitoring will provide meaningful results to gauge the success of ICMP implementation.

Stormwater quality is a key focus for the ORC in terms of its effect on the receiving environment. The development of the ICMPs was to include an assessment of stormwater quality contaminant loads, however the project team decided that contaminant loading assessments would not be undertaken as flow based monitoring showed a large variation of contaminant concentrations throughout an event. When coupled with fluctuations in existing monitoring data, the level of uncertainty was significant and any annual yield concentrations calculated using annual discharge volumes would be highly misleading. This is a problem associated with all of the stormwater catchments. To date, any trends in stormwater contaminant levels remain unclear and there is insufficient data to assess linkages between pipe discharge and harbour environment quality.

It is considered that further monitoring is required to better understand the contaminant levels and establish any long term trends. In response to this, the ICMPs have recommended redesigning the city-wide framework for stormwater quality and harbour environment monitoring. A robust and meaningful monitoring regime is key to ensuring that discharges/catchments of concern are clearly identified so that the DCC selects the most appropriate stormwater quality management options.

In terms of likely discharge consent conditions - the current consents specifically outline which contaminants to monitor but do not stipulate levels/limits for discharges and the lack of data makes it difficult to clearly justify and set what these should be. The DCC would therefore prefer the consent conditions to require DCC to 'give effect to' the ICMPs as they contain the prioritised programme of works for each catchment covering both quality and quantity issues; and can be adjusted as more information is gathered over time. However, there are strong indications that the ORC is moving towards setting end of pipe contaminant limits for discharge consents in urban areas.

A key concern for DCC under this scenario is the ability to actually control inputs to the stormwater system. While some source control is possible, the likely sources of contaminants can be very diffuse and the majority of runoff is from areas that are already built, with little opportunity for retro-fitting. If quality discharge limits are imposed on the consent conditions, the DCC may potentially be held liable for issues (discharges) that it essentially has no effective control over. This is not considered a financially prudent approach and could have a significant impact on budgets (and hence rate-payers) in the future. Being able to 'give effect to' the ICMPs provides a level of flexibility required to ensure the implementation of management options have due regard to affordability and appropriately reflect the prioritisation of issues within and across catchments.

The DCC are considering a staged approach to stormwater quality monitoring, as follows:

- Redesign the monitoring programme to develop a robust framework that will yield good quality, useful data at appropriate sites to enable a sound understanding of both catchment stormwater quality and health of the harbour environment and allow any linkages between the two to be identified.

- Use the monitoring results to identify, with confidence, discharges/catchments of concern and potential sources of unacceptable contaminant levels.
- Following this, ICMP approaches will be reviewed and adjusted to reflect DCC's commitment to improve the quality of stormwater discharges to the harbour. The ICMPs will be updated to contribute to the stormwater management programme for Dunedin.

Ensuring the monitoring regime will provide meaningful results to gauge the success of ICMP implementation is key. Annual consent reporting can still contain an evaluation of results against relevant environmental guidelines, standards/benchmarks, other ICMP performance targets and any results/trends. Ultimately, ORC requirements are to be balanced with DCC commitment to environmental quality, service levels and affordability outlined in the 3WSDS.

The next decision to be made by the DCC is whether to apply for a 'global' consent or, alternatively, 10 separate consents reflecting the 10 different catchments and ICMPs. It is anticipated that the application for renewal will be lodged with the ORC in early December 2011.

2.5 BENEFITS & LESSONS LEARNED

One of the benefits of undertaking the ICMPs in parallel (or fast succession) is that while still in draft form, lessons learnt can be incorporated into all plans, improving both the consistency and the quality of the final reports. Several other benefits, as well as lessons learned, have emerged through the development of the ICMPs and some are outlined below:

- Have an over-arching long term strategic planning direction:
  (i) for the City (such as a Spatial Plan) – this was missing for Dunedin at the beginning of the project, which introduced uncertainty in terms of known or planned development areas in the future. WWS had to take the lead in reviewing and determining strategic influences such as population projections and potential imperviousness. While some if this time was unanticipated for the project programme, it did bring together key staff from various departments to develop a common data set to be used for future growth planning in Dunedin; and
  (ii) for water and waste services – (i.e. 3WSDS) highly important for guiding objectives, approaches and target setting; and clearly showing the cascade linking these with performance measures. A lack of 3 waters strategic direction at the beginning of the project lead to several time-consuming discussions on various issues before final agreement; and did affect analysis and recommendations.

- Keep asking questions - encourage all teams involved to always ask questions. In some cases assumptions were applied to models that, with a little further investigation, could have been clarified and corrected thus avoiding model re-runs and report modifications.

- Consistency in approach - both in terms of team members involved as well as ICMP format and content. While unavoidable during a long-term project such as this, changing team members (in both the client and consultant organisations) over the course of ICMP development introduced different approaches to model development, interpretation of results and expectations of ICMP content. This resulted in a number of model re-runs and report iterations which delayed key deliverables, increased project costs and compromised quality. While this is not necessarily unexpected for a project of this size, it is important for the project team to enable the consideration of new concepts and accept some project 'fluidity' within the agreed programme. Similarly, it is equally important to ensure that the project programme is realistic and reflects these aspects while meeting client expectations.

- Provide a balanced view - initially, the model results report was titled a 'deficiencies report' and most of the analysis on infrastructure capacity discussed the results in a negative context, for example that 16% of the network failed during a 1 in 10 yr ARI rainfall event. Simply turning comments like this into an optimistic expression (that 84 % of the network was able to cope with a 1 in 10 yr ARI rainfall event) helped to provide this balance, as did naming the report a 'hydraulic performance report' (see Figure 2). It was important to demonstrate that although network deficiencies exist the stormwater network provides a number of benefits to the community by collecting the flows within the system and directing it to the receiving environment. It was also beneficial to reinforce the serviceability, availability and quality standards of the stormwater activity.

- Put model results in context – Interpretation of all available information (not just model results) was key to providing an accurate reflection of the current and future catchment issues. While confidence in the model outputs range from 'low' to 'good' across all of the catchments, ICMPs need to be clear that the outputs are 'predictive'. The model output is not absolute, yet it is considered an adequate tool for the purposes of indicating areas with a potential to flood, and allowing the comparative effects of the different rainstorms and climate change scenarios to be assessed. Moving forward, confidence in the model will be increased (via detailed survey data and flow calibration) in locations where capital works are progressed.

- The importance of effective project management and quality control cannot be understated. With a variety of teams involved across all three water networks, the establishment of a Project Control Group was necessary.

- Recognising a long-term, integrated and inter-generational approach is required when planning for future needs and resources across the three waters.

- Integration – a collaborative and integrated approach to modelling was key, both in terms of modelling software and cross-team communication. Great care was taken to design the database architecture within the models (InfoWorks WS and CS) to ensure a coordinated approach was taken from the start. The modelling teams met on a regular basis to discuss progress and ensure continued integration across the models. Furthermore, having all models and information prepared within the same time frame will allow for any necessary model merging to be less complicated to undertake.

- Communication & taking a pro-active approach - decisions made across a variety of Council departments influence the management of three waters. DCC WWS recognise the importance of taking a more pro-active approach to ensure that ongoing liaison across Council departments is maintained to enable informed and integrated decisions to be made. Staff within DCC WWS are now mapping the next steps for ICMP implementation and further communication with other staff and stakeholders. The importance of continuous interaction and ongoing liaison across Council departments should not be understated - the collaborative approach required to give effect to the stormwater management principles and priorities is essential.

3 CONCLUSIONS

The DCC is nearing the completion of ten stormwater ICMPs. The ICMPs were identified as a key deliverable from a comprehensive 3 Waters Strategy Project. This project led the development of hydraulic network models for water, wastewater and stormwater and is enabling DCC to determine levels of service across all three waters, as well as determine capital and operational requirements and costs associated with network improvements. The ICMPs provide for this through setting targets and priorities for phased investment. The ICMPs also form the basis of DCC's pending application to renew the city's stormwater discharge consents. During 2011, WWS staff will be considering all the ICMP priorities and developing a strategic programme across ten stormwater catchments and numerous wastewater and water systems simultaneously, as well as working with specialists to determine the most appropriate approach to the use of ICMPs in setting meaningful long-term discharge consent conditions. Overall, ICMP development has provided momentum to improved asset management processes and business practices within the DCC and will provide greater confidence in the investment decisions that would deliver best value to customers and ratepayers over the long term.

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