INTEGRATED CATCHMENT MANAGEMENT WITHIN AN ADAPTIVE CONSENT FRAMEWORK

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ABSTRACT

A challenge that faces all stormwater network managers is finding the appropriate balance between good environmental outcomes and cost effective solutions. The resource consent process can lead to controls being placed on discharges through consent conditions that limit flexibility, does not provide for advancement in knowledge, or limits consent duration.

Faced with a short-term resource consent and the associated uncertainty, Dunedin City Council (DCC) were exploring a consent regime that provided a long term solution that is able to adapt to changes in knowledge, the environment and community priorities. Over the last five years DCC has developed an integrated catchment management program that includes stormwater network investigations, flow modelling and discharge monitoring. These studies informed 10 integrated catchment management plans (ICMP) for the city that prioritise all future stormwater management actions.

These ICMP, and the issue prioritisation process contained within, formed the basis for DCC's adaptive management consenting approach. While ICMP and adaptive management are not new concepts, combined they provide a consent framework that builds on water quality monitoring results and responds to environmental bottom lines while giving DCC the flexibility to adapt their stormwater management processes to be cost effective and meet stakeholder expectations.

KEYWORDS

Adaptive Management, Integrated Catchment Management Plan, Resource Consents, Stormwater Discharge.

PRESENTER PROFILE

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1 INTRODUCTION

A challenge that faces all stormwater network managers is finding the appropriate balance between good environmental outcomes and cost effective solutions. The process of obtaining resource consents for municipal stormwater discharges can lead to tight controls being placed on discharges through consent conditions. Strict conditions can reduce flexibility in the management options available and can limit the utilisation of advancements in knowledge. It can also lead to reduced consent durations.

Faced with a short duration resource consent and the associated uncertainty, Dunedin City Council (DCC) were exploring a consent regime that provided a long term solution that is able to adapt to changes in knowledge, the environment and community priorities.

Importantly, any regime for authorising stormwater discharges also needed to integrate with measures to manage all the "three waters" (stormwater, wastewater and potable water). This is to ensure that management measures are implemented that provide the best environmental, social and cultural outcomes whether they relate primarily to stormwater discharges, wastewater discharges or drinking water supply.

This paper describes the process DCC undertook to change the way they manage stormwater and ultimately the way they combined their new integrated catchment management regime with a resource consent regime that can adapt to environmental, stakeholder and financial changes.

2 BACKGROUND

2.1 DUNEDIN STORMWATER

Dunedin City covers a geographic area of 3,350km^2. The stormwater network comprises 363km of pipes and 11 pumping stations.

Discharges from ten stormwater catchments enter four distinct marine receiving environments – Andersons Bay (1 outfall) is at the head of the harbour and is partially enclosed by a causeway, the Upper Otago Harbour Basin (27 outfalls) which comprises the head of the harbour, Port Chalmers (3 outfalls) located halfway down the Otago Harbour, and St Clair (2 outfalls) which is open coastline.

While the water quality at St Clair is relatively high due to the high energy wave environment, the Port Chalmers, Upper Otago Basin and Andersons Bay environments are highly modified and therefore have degraded water quality and ecosystem values. This is likely due to a combination of historic harbour reclamation, historic land uses such as the gasworks in South Dunedin, historic and contemporary discharges and surface water inputs to the harbour.

The catchments contain a range of land uses as is shown in Table 1. The type of stormwater sampling undertaken after resource consents were granted in 2007 made it difficult to determine the relative concentrations of particular stormwater contaminants being discharged. However, these monitoring results did indicate that Dunedin's stormwater is typical of stormwater from urban areas elsewhere in New Zealand and provided valuable information as to potential contaminant sources.

Table 1: Catchment summary

Catchment	Catchment area	Discharge volume (m^3) 1 in 10 yr ARI, 60 minute duration	% commercial and industrial land use
Halsey Street	**334 ha**	**30,656**	**27 %[1]**
Kitchener Street	**137 ha**	**11,716**	**54 %[1]**
Mason Street	**209 ha**	**18,929**	**27 %[1]**
Orari Street	**341 ha**	**28,630**	**<1 %**
South Dunedin	**590 ha**	**38,492**	**20 %**
Portsmouth Drive	**39 ha**	**4,558**	**100 %**
Ravensbourne Road	**31 ha**	**832**	**48 %**
Shore Street	**101 ha**	**4,123**	**1 %**
Port Chalmers	**58 ha**	**3,569**	**9 %[1]**
St Clair	**164**	**7,274**	**0 %**

[1]Commercial, industrial and port land use

2.2 2007 RESOURCE CONSENTS

In 2007, DCC were granted 30 resource consents by the Otago Regional Council (ORC) to discharge stormwater to Otago Harbour and St Clair (the 2007 resource consents). Each consent related to a known stormwater outfall and there was no grouping of consents in relation to stormwater catchment or the receiving environment of the discharge.

These consents were granted for a five year term (November 2007 – November 2012) and included conditions requiring DCC:

- To complete ICMPs for stormwater catchments;
- To undertake monitoring (stormwater, sediments, ecology); and
- To consult with key stakeholders.

These resource consents did not contain any environmental triggers or bottom lines. The key focus was to generate a greater understanding of the stormwater catchments, discharges and the receiving environment.

These consents only relate to discharges of stormwater to the coastal marine area. Under the Regional Plan for Otago: Water, discharges of stormwater to surface water outside the coastal marine area is a permitted activity.

2.3 DCC 3 WATERS STRATEGY PROJECT

From 2008 DCC's Water and Waste Services Business Unit (WWSBU) made significant changes to its approach to the planning and delivery of water, wastewater and stormwater services, as well as the team and staffing structure required to enable such changes.

As part of these changes DCC developed the 3 Waters Strategic Direction Statement, which outlines a set of priorities and approaches for the management of the three waters.

The key strategic priorities relating to the discharge of stormwater are:

- '*We will improve the quality of our discharges to minimise the impact on the environment;*
- *We will limit cost increases to current affordability where practical; and*
- *We will adopt an integrated approach to the management of the three waters and embrace the concept of kaitiakitaka.*'

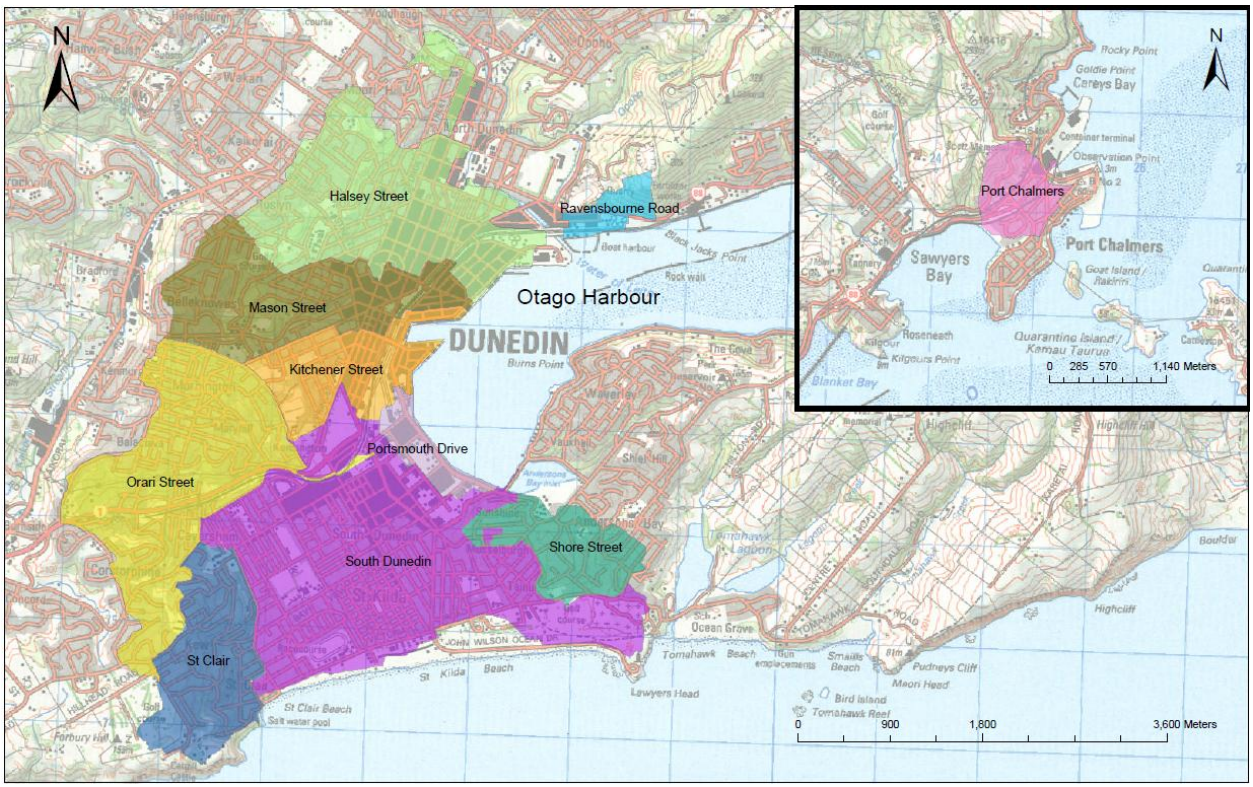
In 2008, DCC commenced the 3 Waters Strategy Project. The project undertook master level wastewater and water supply modelling and planning to investigate the performance of the three waters networks. In relation to stormwater, this included investigations into the quality and quantity of stormwater discharges and investigations into potential associated environmental effects.

A significant component of the 3 Waters Strategy Project was the development of 10 ICMPs, which was also a requirement of the 2007 resource consents.

3 INTEGRATED CATCHMENT MANAGEMENT PLANS

The 2007 resource consents required the implementation of a stormwater and environmental monitoring regime, and the preparation of an ICMP for each stormwater catchment. ICMPs were developed for the ten stormwater catchments in Dunedin. These ten catchments are shown in Figure 1.

Figure 1: ICMPs have been developed for these ten catchments



An ICMP for the South Dunedin catchment was completed as a pilot in 2010 and subsequently updated in 2012. The ICMPs for the remaining catchments were completed and submitted to the ORC in November 2011. While not statutory documents, the ICMPs influence operational plans such as activity management plans and annual plans. The Dunedin ICMPs provide:

- a description of each catchment;
- a description of the stormwater network;
- the stormwater management objectives for each catchment;
- the identification of stormwater management problems and issues for each catchment;
- a description of the long (35 years) and short term programme of works and priorities to implement each management plan;
- monitoring procedures to assess each plan's effectiveness; and
- procedures for revising each plan.

The ICMPs were developed utilising a range of technical information including:

- Details of the characteristics of each catchment, including topography and geology, pipe and channel networks (size, age, condition), groundwater, natural streams, land use, and historical complaints.

- Detailed hydraulic modelling (undertaken by an Opus International Consultants/URS New Zealand Ltd. project team) to assess the performance of the stormwater network under a variety of rainfall and sea level scenarios.

- An assessment of stormwater quality, based on the analysis of grab samples taken since 2005 by Ryder Consulting Ltd (Ryder Consulting), and three sets of detailed event - based quality samples taken from three different catchments. This information was used to provide an indication of the quality of stormwater discharging to the harbour and identify likely key contaminants.

- Receiving environment biological and sediment monitoring data. This data from between 2007 and 2010 was provided by Ryder Consulting. This data was used to assess the level of contamination in the receiving environment, and the ongoing effects of discharges.

A risk framework was developed for use across the 3 Waters Strategy Project. This is included in each ICMP and is used to assess and rank the issues in each catchment identified through the technical studies and monitoring by assigning a score based on risk and consequence. This information is then utilised to prioritise the recommendations for action and is a key feature of the adaptive consenting approach that will be discussed later. The risk framework is shown in Table 2.

Table 2: Risk framework

RISK / LIKELIHOOD	CONSEQUENCE				
	Negligible (1)	**Minor (10)**	**Moderate (40)**	**Major (70)**	**Catastrophic (100)**
Almost Certain (5)	**Low (5)** Manage Passively	**Moderate (50)** Manage Passively	**Very High (200)** Manage Actively	**Extreme (350)** Manage Actively	**Extreme (500)** Manage Actively
Likely (4)	**Low (4)** Manage Passively	**Moderate (40)** Manage Passively	**Very High (160)** Manage Actively	**Very High (280)** Manage Actively	**Extreme (400)** Manage Actively
Possible (3)	**Negligible (3)** Manage Passively	**Moderate (30)** Manage Passively	**High (120)** Manage Actively	**Very High (210)** Manage Actively	**Very High (300)** Manage Actively
Unlikely (2)	**Negligible (2)** Accept	**Low (20)** Manage Passively	**High (80)** Manage Actively	**High (140)** Manage Actively	**Very High (200)** Manage Actively
Rare (1)	**Negligible (1)** Accept	**Low (10)** Accept	**Moderate (40)** Manage Passively	**High (70)** Manage Actively	**High (100)** Manage Actively

Note
The Risk Matrix includes an indication of the minimum acceptable treatment strategy. In all cases the option of avoiding the risk should be considered first.

Recommendations for action contained in each ICMP are provided in four areas: further study, planning and education, operation and maintenance, and capital works. As ongoing monitoring provides further information, and technology advances, the iterative risk analysis and prioritisation process can be used to develop further recommendations for future work.

Through the development of these ICMPs, DCC have developed a greater understanding of the potential effects of Dunedin's stormwater discharge. This information has played a vital role in setting environmental triggers as part of the resource consent framework as will be discussed below.

4 ADAPTIVE MANAGEMENT

Adaptive management can be described as an iterative process for decision making when faced with uncertainty. Uncertainty is reduced over time as more information is gathered through, in this case, environmental monitoring. Information gathering and action occur in parallel (Allan and Stankey, 2009).

Adaptive management is not a new concept and has been applied to a number of aquaculture and infrastructure proposals in New Zealand. Through the process of obtaining authorisation for these proposals, a number of key requirements for adaptive management have been identified. In *Crest Energy Kaipara Ltd v Northland Regional Council A32/2009* the Environment Court set out requirements for adaptive management. These are summarised as:

i. Baseline knowledge – Collected so as to gain an understanding of the environmental bottom line;

ii. Triggers/objectives – Set so to ensure that the level of adverse effects remain appropriate. Used to determine when mitigation or management actions should be implemented. Must be certain and enforceable;

iii. Appropriate action – Implementation of management actions to ensure the resource is managed so as to achieve objectives or remain below set trigger values;

iv. Further monitoring – Adaptive management is an iterative process. On-going monitoring is required to increase baseline knowledge and to monitor the effectiveness of management actions undertaken.

Renewal of existing stormwater discharge consents differs to a new major infrastructure proposal such as Crest Energy's proposal in that information regarding the level of existing effects is potentially available. Also importantly, and especially in the case of Dunedin that has no real alternative discharge environment, the activity is essential. Further, as was confirmed through environmental monitoring undertaken as part of the 3 Waters Strategy Project, the adverse effects of the on-going stormwater discharge are not significant (Ryder Consulting, 2007 – 2010, Ryder Consulting, 2010b and Stewart, 2013).

Therefore, rather than adaptive management being applied to ensure DCC's stormwater discharges "get over the line", adaptive management in this context was investigated as a flexible management framework that builds on new information while ensuring environmental bottom lines are still met throughout the term of the consents.

In the case of stormwater discharges to the coast, the key drivers of this approach are to ensure that objectives outlined in the relevant statutory (New Zealand Coastal Policy Statement, Otago Regional Policy Statement and Regional Plan for Otago: Coast) and non-statutory documents (DCC's 3 Waters Strategic Direction Statement) are met so as to meet the community expectations in relation to stormwater, wastewater and drinking water related issues. An adaptive management approach also assists to direct funds toward real rather than perceived stormwater issues.

5 INTEGRATED CATCHMENT MANAGEMENT IN AN ADAPTIVE FRAMEWORK

Integrated catchment management and adaptive management are not new concepts. Managing environmental effects through setting environmental limits and applying a management plan to describe the methods that will be used to ensure compliance with these limits is common practice for large infrastructure projects. For these projects resource consents are often applied for without the benefit of a detailed construction methodology; this needs to be developed by the contractor once the construction contract is let or innovation and flexibility in construction methodology is stifled. Construction type management plans are generally only in place for a relatively short period.

However, similar issues exist with long term resource consents. Setting environmental limits and the methods to be employed to avoid, remedy or mitigate these effects in resource consent conditions can make it difficult to adapt to changes in the environment, changes in community priorities and changes to technology and knowledge.

Often the proposed solution is a reduced consent term. For infrastructure managers this creates its own issues. Securing funding for major infrastructure upgrades requires a level of certainty that may not exist in a short term resource consent. In addition the consent process can be extremely costly and distract staff from their day to day management roles for potentially significant periods of time.

DCC were investigating a solution that was long term; that provided flexibility as to the management methods that could be used; that enabled environmental limits to be adjusted as knowledge increased; and that focused action on issues that were of the greatest priority not just in relation to stormwater but across the three waters.

With an ICMP for each catchment under development, DCC developed an adaptive management consenting framework that centered on the risk analysis and issue prioritisation methods in these ICMPs.

A key component of adaptive management is having a method for reducing uncertainty by improving the level of information for future decision making. Consequently, also at the center of DCC's adaptive management framework is a document outlining the environmental monitoring regime and environmental limits/triggers (the Monitoring Framework) and a three year action plan. The role these documents play in the adaptive management process is:

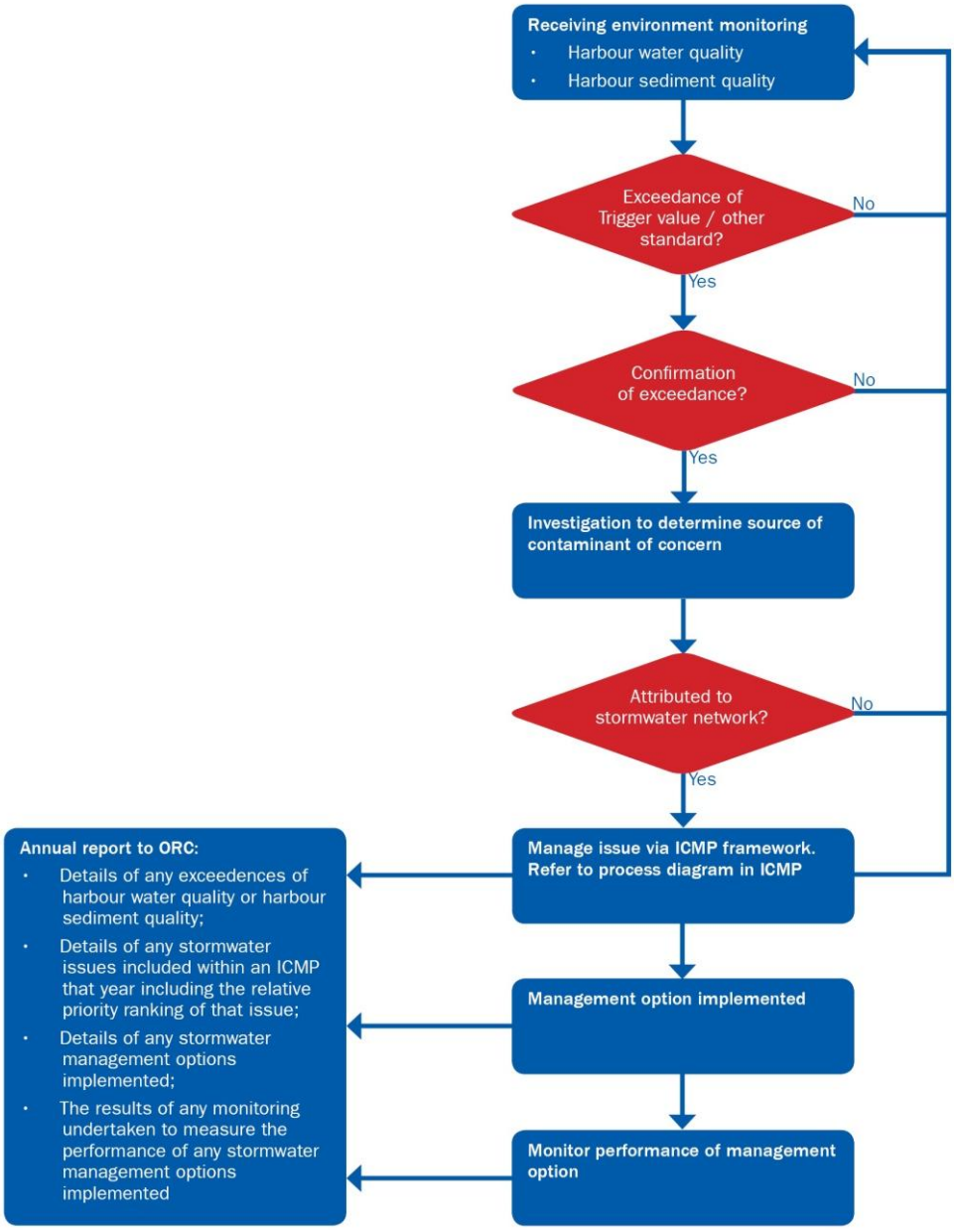
Monitoring Framework – This document contains details of monitoring to be undertaken to determine the effectiveness of stormwater management actions undertaken by DCC and to improve the overall knowledge of the discharge and receiving environment. It also contains trigger values for harbour water quality, sediment quality and ecology. These triggers have been set in the monitoring framework which is a requirement of the resource consent conditions. Importantly however, the Monitoring Framework sits outside the resource consent conditions so adjustments can be made efficiently by agreement between ORC and DCC as the level of information improves.

ICMPs – These have been discussed above. However, the important component of these documents in relation to the resource consent framework is the risk analysis and issue prioritisation process contained within. If trigger values are exceeded, the risk analysis and issue prioritisation process determines the type of management action that will occur.

Three Year Action Plan – The action plan captures the priority management issues and sets a timeframe around these for action. The three year timeframe of the plan coincides with the annual planning process. An associated resource consent condition requiring that the plan is implemented within specified timeframes ensures that when priority issues arise, the consent holder is bound to action.

A summary of how the monitoring framework and ICMPs interact is shown in Figure 2.

Figure 2: Issue identification process



A narrative of how the adaptive management consent framework operates is:

Environment and stormwater quality monitoring is undertaken in accordance with the Monitoring Framework. The results of this monitoring are compared to trigger levels also set in this Monitoring Framework. If the triggers are exceeded and this exceedence is attributable to the stormwater discharge, then the issue is placed into the risk matrix within the ICMP for the catchment. Based on the risk score, the issue is prioritised

alongside issues across the three waters. Priority management actions are then placed into the Three Year Action Plan and implemented. Monitoring continues to gain further knowledge of the discharge, the receiving environment and the effectiveness of the management actions taken to address the issue identified.

The outcome of applying this adaptive management approach is that a vital activity can continue to occur under a long term consent with minimal risk to values associated with the Otago coastal environment. Through ongoing monitoring and discussion, further information will be gathered regarding the environment, community values and expectations, and technological solutions. Armed with this information triggers will be tightened or relaxed and monitoring frequency, type and location will adjust.

However, adaptive management may not be appropriate in all situations. When deciding whether an adaptive management approach is appropriate, it is important to consider the key requirements outlined in *Crest Energy Kaipara Ltd v Northland Regional Council A32/2009*. This was done in relation to utilising such an approach for DCC stormwater discharges.

i. **Baseline knowledge** - The DCC propose to utilise the environment and stormwater characterisation data obtained to meet the 2007 consent compliance requirements and as part of the 3 Waters Project. It is acknowledged that this data is incomplete and as a consequence it will be bolstered by future environmental and stormwater characterisation monitoring proposed in conditions of consent. This will ensure a fuller picture of the state of the stormwater receiving environments is obtained over the life of the consent.

ii. **Triggers / Objectives** - The DCC set a number of triggers based on relevant environmental standards and the objectives outlined in the ICMP for each stormwater catchment. This will ensure that adverse effects are identified and addressed through relevant actions and that strategic stormwater objectives will be met. As the triggers adopted are well documented either through the relevant standard or within the monitoring framework, they provide an appropriate level of certainty. As actions are required to be implemented if these triggers are exceeded, and there are consequences if these actions are not undertaken, they provide a level of enforceability.

iii. **Appropriate actions** – The ICMPs for Dunedin contain a method for prioritising stormwater issues and inserting them within an action plan for a three year period. Where monitoring undertaken as part of consent compliance indicates an actual or potential significant adverse environmental effect is occurring as a result of a stormwater discharge, this matter will receive appropriate high prioritisation for action and can therefore be addressed in a timely manner. The prioritisation process ensures that actions taken are appropriate given the monitoring being undertaken.

iv. **Further monitoring** – The DCC propose on-going monitoring throughout the term of consent. This will increase the level of baseline knowledge and monitor the effectiveness of any actions taken to better meet stormwater objectives or remedy any breach of an environmental trigger.

6 CONCLUSIONS

DCC's stormwater consents were granted in 2013. Therefore it is too early to evaluate the effectiveness of the approach discussed in this paper within the Dunedin context.

However, some comfort can be taken from the fact that monitoring undertaken to date has not identified significant adverse environmental effects and the regime now in place sets more stringent environmental triggers than have previously existed. To account for change, both the monitoring regime and environmental trigger values can adapt throughout the life of the consent to ensure the consents are effective.

In addition, specific management actions will only be required when issues are identified through a robust monitoring process. This will ensure environmental effects are avoided, remedied or mitigated through a process that focusses management actions and therefore spending on issues that are significant.

In summary the key points of the resource consent framework are:

- Monitoring of the Receiving Environment
    - Harbour Water Quality
    - Harbour Sediment Quality
    - Ecology;
- 'Feedback loop' to respond to triggers for receiving environment quality;
- ICMPs are a tool for assessing the risk and therefore priority of issue if triggers exceeded; and
- An agreed timeframe within which to implement mitigation measures if issues identified.

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