HOW AUCKLAND COUNCIL ARE USING STORMWATER INTERVENTIONS TO MEET ENVIRONMENTAL REQUIREMENTS

Tom Porter (Auckland Council)

ABSTRACT

New Zealand needs to maintain and improve its water quality in a climate of increasing pressures from economic and population growth. While this puts pressure on the stormwater industry, it allows opportunities for innovation to help achieve environmental benefits and meet the requirements of the National Policy Statement for Freshwater Management (NPS-FM).

In line with the overarching theme of this conference *Wai Ora – Rising to the Challenge,* this report aims to demonstrate the significant role interventions can play in ensuring that water quality improves under the pressures of urban and agricultural growth.

Auckland Council is using a range of tools within stormwater management to maintain and improve water quality as required by the NPS-FM. This paper provides an overview of structural and non-structural interventions used in Auckland. By identifying and ultimately implementing the most appropriate and efficient intervention options we will be actively working towards improving water quality in the Auckland region, as required by the NPS-FM.

The paper also provides recommendations for how further work should be focused to help deliver the NPS-FM requirements. Different organisations are using interventions to target contaminants throughout New Zealand. The sharing of lessons learned from these interventions and data on how effective they are at contaminant removal should be a focus for all interested parties.

KEYWORDS

Interventions Water Quality NPS-FM Innovation

PRESENTER PROFILE

Tom is a water quality scientist in Auckland Council's Healthy Waters department. He has ten years' experience in water quality analysis and planning at a catchment and a strategic scale, including for several years for the Environment Agency in the UK. Tom looks to take an innovative and risk based approach to water quality planning and aims to consider the wider environmental and socio-economic benefits of healthy waters.

1 INTRODUCTION

Over recent years, public concern has grown regarding the quality of water in many of New Zealand's rivers and streams, lakes, wetlands, estuaries, and

aquifers (Parliamentary Commissioner for the Environment, 2015). The Ministry for the Environment states that New Zealand faces challenges in managing our fresh water to provide for all of the values that are important to New Zealanders (Ministry for the Environment, 2017a).

1.1 NATIONAL POLICY STATEMENT FOR FRESHWATER MANAGEMENT (NPS- FM)

The NPS-FM, first introduced in 2011, requires councils to set objectives and limits for freshwater quality and quantity, and to ensure that land use and water are managed in an integrated way. Water quality must be maintained or improved (MFE, 2017a). Regional authorities must implement the NPS-FM by 31st December 2025.

1.2 AUCKLAND'S KEY WATER QUALITY PRESSURES

Despite covering less than 2 per cent of New Zealand's total land area, the Auckland region contains over a third of the population and is growing at a very high rate. This places severe pressures on freshwater quality, particularly with regard to sediment, metals and other contaminants associated with urban areas (MFE, 2017b).

1.2.1 Urban growth

With Auckland's population forecasted to increase by over one million people (Cunningham et al., 2017). Lewis et al. (2015) states how in the period up to 2045 it is expected to see as many as 400,000 new homes built. The subsequent increase in vehicles on roads and associated increase in contaminants can also be expected.

1.2.2 Agricultural growth

New Zealand is experiencing a growth in the agriculture-based economy (MFE, 2017). This is putting pressure on receiving watercourses through increased nutrient concentrations (Parliamentary Commissioner for the Environment, 2015) and faecal contamination (Davies-Colley, 2013).

1.3 AUCKLAND COUNCIL'S ROLE AND RESPONSIBILITIES

'Water quality is a top priority' for Auckland's Mayor (Auckland Council, 2017).

Auckland Council as a unitary authority has the responsibility to ensure water is managed sustainably across Auckland and that it's fulfilling the requirements of the NPS-FM.

1.4 AIM OF THIS REPORT

To provide an overview of what Auckland Council is doing to improve water and deliver the NPS-FM. As part of the work being undertaken to implement the requirements of the Wai ora – Healthy Waterways Programme, Auckland Council is identifying the most appropriate intervention options, including regulatory and non-regulatory, to target the specific water quality concerns for the Auckland region.

2 HOW AUCKLAND COUNCIL IS MEETING THE NPS-FM

2.1 UNDERSTANDING THE ISSUES

In order to be able to maintain and improve Auckland's watercourses it's important to identify the priority issues and contaminants for catchments and accurately pinpoint the sources.

2.1.1 Mapping analysis of the whole region

Using LiDAR remote sensing mapping Auckland Council has mapped the land use and watercourses for the region. This has allowed current pressures on the environment and opportunities for improvements to be identified. Mapping projects can also identify the extent of features which help with water quality, for example in identifying the extent of wetlands (Lawrence et al., 2017).

2.1.2 Focused investigations

Auckland Council continues to undertake and publish research to quantify contaminant loads in catchments and identify their sources (Meijer, 2015; Shamseldin, 2011). This ensures that methods can be developed to best target these sources.

2.1.3. Freshwater Management Tool

A freshwater management tool being developed by Auckland Council will utilise the modelling packages Loading Simulation Program C+ (LSPC+) and System for Urban Stormwater Treatment and Analysis Integration (SUSTAIN). This will calculate contaminant loads for Auckland's catchments. It will allow Auckland Council to strategically plan the most cost effective methods to provide the necessary improvements across the catchments to achieve the requirements of NPS-FM and other relevant policies.

Being able to understand in-situ what an intervention will be able to achieve (with regards to contaminant reduction) will allow confidence in the data and assumptions being used in catchment models and decision support tools. It allows for more robust catchment planning and a stronger foundation for supporting business cases. The most effective approach to catchment planning takes into account the effectiveness of each stormwater practice, the costs of each practice, and resulting overall cost and effectiveness (EPA, 2018).

2.2 NON-STRUCTURAL INTERVENTIONS

Non-structural interventions are being used widely in Auckland, and across New Zealand, to deliver water quality improvements. They are pollution-prevention practices designed to prevent or minimize stormwater pollution (Taylor and Fletcher, 2007) and can be inexpensive, flexible and widely applicable (Boulet al, 2017).

Taylor and Fletcher (2007) identify five main non-structural Best Management Practice categories. These categories are all being utilised in some form in Auckland:

1. Town planning controls (e.g. requirements for low-impact development designs)

2. Strategic planning and institutional controls (e.g. city-wide stormwater quality management plans)
3. Pollution prevention practices (e.g. street sweeping)
4. Education and participation programs (e.g. awareness raising and behaviour change campaigns)
5. Regulatory controls (e.g. local laws that reduce erosion on building sites)

2.2.1 Auckland Unitary Plan requirements

The Auckland Unitary Plan describes how the people and communities of the Auckland Region will manage Auckland's natural and physical resources while enabling growth and development and protecting the things people and communities value (Auckland Council, 2018a). It provides the council with the rules and standards to manage the effects of activities, buildings and development on the environment.

2.2.2 Resource consents

With the high level of growth in Auckland it is vital that all developments are effectively managed pre and post construction to reduce the risk of environmental harm caused by stormwater runoff.

Ensuring that consent conditions are set and enforced for any projects that may have an impact on the health of Auckland's waters is a key way Auckland Council can prevent deterioration of water quality.

2.2.3 Auckland Council guidance documents

The following two key documents have been published to guide those involved in stormwater design to ensure good practice is included to deliver, amongst other functions, water quality benefits.

2.2.3.1 Stormwater Management Devices in the Auckland Region: Guideline Document 2017/001 (GD01)

The scope and objective of this guideline is to provide a user-friendly technical design guide to developers, designers and regulators which provides stormwater choice and design advice based on current good practice specific to the requirements of the Auckland Unitary Plan (Cunningham et al., 2017).

2.2.3.2 Water Sensitive Design for Stormwater : Guideline Document 2015/004 (GD04)

This document introduces the principles and objectives for Water Sensitive Design and guides the practitioner through a design programme for land development. (Lewis et al., 2015).

2.2.3 Pollution prevention practices

Throughout Auckland the removal of contaminants before it can enter a watercourse is a well-used and effective intervention. Auckland Transport removes over 6,400 tonnes of sediment from its roads per year (Auckland Transport unpublished briefing, 2018). As a high proportion of copper and zinc in road runoff can be in particulate form, removal of solids can reduce the loads of these metals discharged to receiving environments (Moores et al., 2012).

2.2.4 Informing and educating

2.2.4.1 Advocacy

Auckland Council promotes green infrastructure, sustainability and protecting the environment in various advocacy roles (Auckland Council, 2018c). Auckland Botanic Gardens has developed a sustainable water trail which provides the public with an interactive way to see sustainable stormwater practices in-situ (Auckland Botanic Gardens, 2018).

2.2.4.2 Campaigns

Specific campaigns are used to target identified issues. For example the Industrial Pollution Prevention Programme uses a proactive, non-regulatory, flexible approach to advise businesses on their current practices and ways to prevent contaminants entering waterways (Sustainable Business Directory, 2018). While the campaign has been effective in engaging with local businesses there is a need to undertake further monitoring to identify any changes in the contaminants entering the watercourses in these catchments.

2.2.4.3 Information providing – Safeswim

Safeswim is an Auckland Council operated website which provides the public with information on the health risks at 84 swimming sites. The models behind Safeswim produce a forecast for water quality at the swimming sites. This allows the public to make a real-time informed decision about any health risks of swimming and therefore avoid the risk from contaminated waters (Safeswim.org.nz, 2018). It also helps Auckland Council and Watercare identify problems and prioritise investment.

2.2.5 Potential further non-structural ways which could ensure water quality requirements met in Auckland

2.2.5.1 Reduction of contaminants

Reducing the concentration of copper allowed in brake discs in California led to an estimated 61% reduction in copper concentrations in urban run-off (EPA, 2018). While it may not be possible to change the composition of brake discs in New Zealand, if higher numbers of the population cycle or use public transport this will reduce the number of cars on the road and therefore the quantity of copper. There are opportunities to trial innovative non-structural methods such as adding mussel shells to reduce metal concentration (Craggs et al., 2010) and the use of dung beetles to reduce contaminants in run-off from fields (Northland Regional Council, 2018).

2.3 STORMWATER INFRASTRUCTURE ENHANCEMENT

Auckland Council carries out improvement work on the stormwater network and waterways to minimise flood risk while reducing pollution and improving water quality (Auckland Council, 2018a). The Healthy Waters Department of Auckland Council designs and delivers new stormwater infrastructure utilising a range of structural devices available such as swales and wetlands to provide contaminant removal while increasing stormwater attenuation and conveyance.

2.3.1 First flush

Auckland Council aims for its stormwater treatment devices, and those on private developments to manage the first flush. The first flush is generally characterised by a peak in some pollutant loads (such as sediments and metals) immediately prior to the peak in flow volumes (Shamseldin, 2011). It is thought that 40 – 50% of contaminants can be mobilized in the first 20% of the increased flow (Park et al. 2010). Best practice for water quality improvement therefore promotes the capture and treatment of the first flush, where practicable, as this is often more practical and cost effective than treating flow volumes from the entire storm event (Shamseldin, 2011). Further research into capturing the extent of the first flush is recommended.

2.3.2 Takanini Cascades

The Takanini Cascades is a good example of where Auckland Council is combining stormwater conveyance and ensuring healthy waters. Due for completion in 2020 it incorporates wetlands and natural stream features to increase floodwater storage while also providing a level of treatment (Auckland Council, 2018b). Vegetated wetlands are significantly more effective than ponds in reducing contaminants (Cunningham et al., 2017; Auckland Regional Council, 2003). Wetlands are also five times more efficient per unit area at reducing riverine nitrate concentration than the most effective land-based nitrogen mitigation strategies (Hansen et al. 2018). The wetland and stream will also provide a recreational amenity for the local community.

2.3.3 Major projects

Due to parts of Auckland being highly urbanized and with a mean annual rainfall of 1240mm, it's necessary to deliver large projects to safely convey wastewater and stormwater. These schemes also help Auckland work towards meeting the requirements of the NPS-FM by removing and treating contaminants.

2.3.3.1 Auckland's Central Interceptor

While the Central interceptor is a wastewater improvement project it will also convey stormwater during high rainfall events. Watercare is delivering this $1 billion project. The proposed 13 km long interceptor will reduce wastewater overflows by up to 80%, provide for population growth and mitigate the risk of pipe failures. The interceptor will be constructed between 2019 and 2025 to transport wastewater from Central and West Auckland to the Mangere Wastewater Treatment Plant (Watercare, 2018). Here it will receive treatment before being discharged to Manukau Harbour.

2.3.3.2 Western Isthmus Water Quality Improvement Project

The Western Isthmus Water Quality Improvement Project will consider a range of infrastructure solutions to address issues associated with the areas of combined stormwater and wastewater network within the isthmus area. Auckland Council and Watercare are working together to strategically use infrastructure to utilise the proposed Central Interceptor.

2.3.4 New developments

The high rate of housing growth in Auckland means it is important that robust plans are in place to ensure new developments do not lead to a deterioration in water quality. Auckland Council through the requirements of the Auckland Unitary Plan and guidance document GD01 require stormwater management plans for developments to be designed to mimic natural hydrology in the catchment (Cunningham et al., 2017). The application of water sensitive design is required in brownfield and greenfield developments under the Auckland Unitary Plan (Cunningham et al., 2017).

2.3.5 Understanding effectiveness of interventions

In order to learn lessons on which structural devices to use for water quality improvements, Auckland Council has undertaken research into the efficacy of structural interventions (Headley and Tanner, 2007; Fitzgerald and Bird, 2010). The effectiveness of structural interventions is of significant interest in the management of stormwater in New Zealand and can be very site specific due to hydrology and inflow contaminant concentrations (Barret, 2005).

The Freshwater Management Tool will provide Auckland Council opportunities to model how combinations of different interventions will reduce contaminant loads in catchments. This will allow for effective strategic planning across the region. It is therefore important that reliable data is available on the effectiveness of interventions to enable accuracy in the model predictions.

2.3.6 Driving innovation - Gross pollutant traps

Auckland Council has continued to ensure that innovation is used to ensure the best performance in its devices. Auckland Council clears over 118,000 catchpits (Auckland Transport unpublished report, 2018) which captures stormwater from roads and public land. Gross Pollutant Traps have had their performance improved through additional filters such as Tetra Traps. These have been shown to improve the quantity of contaminants trapped by the device (Fitzgerald, B. and Bird, W. 2010).

2.3.7 Increasing resilience

Stormwater interventions can help to ensure resilience, both with regards to protection from flooding and also from pressures on the environment. Making sure there is enough freshwater is a requirement of the NPS-FM. Water Sensitive Design can be used to direct stormwater to recharge the aquifer. (Cunningham et al., 2017; Lewis et al., 2015).

Restoring wetlands will provide environmental, ecological and amenity benefits. In 2008 there was 250,000 hectares of natural wetlands compared to approximately 2.5 million hectares pre human habitation (MFE, 2017). Wetlands also play a significant role in carbon storage. Storing 10 times more carbon than saltwater sites (Nahlik and Fennessy, 2016).

2.4 RURAL STORMWATER

Auckland Council is working with the rural community to ensure that the entire region meets the requirements of the NPS-FM. Although Auckland is most known for its urban centre, this only represents about 11 per cent of the region's land area (Ministry for Environment, 2017b). Rural areas have different sources of contaminants to urban areas, which need to be addressed. These are being address through the requirements of the Auckland Unitary Plan, advocacy and engagement and supporting local community projects. A significant range of interventions and good practice are being trialed and adopted in agriculture (MFE, 2017). Two of the main focuses of interest for rural Auckland are detailed below.

2.4.1 Riparian buffer

Riparian planting can perform several water quality improvements. It is widely being used throughout New Zealand as a measure to improve water quality. It is an effective way of excluding stock from watercourses (NIWA, 2016). Riparian buffers slows stormwater runoff and filters it, with direct uptake and transformation of contaminants by plants (Auckland Design Manual, 2018a). It has many other water quality benefits including bank strengthening, increased evapotranspiration and shading (Cunningham et al., 2017 ; Lewis et al., 2015).

However further work needs to be undertaken to further quantify the effectiveness of riparian buffers. A Ministry of Primary Industries report for dairy and beef farms found a range of 0-96% effectiveness of reducing E.coli through riparian fencing. The most likely figure for effectiveness is 62% with highly effective planting at 86% (Muirhead, 2016).

Auckland Council is providing funding to rural land managers through a Waterway Protection Fund for fencing and planting to prevent livestock having free access to waterways. This funding matches up to 50 per cent of the project costs. Funding is given to projects with the greatest positive environmental impact. In early 2018 The Rodney Local Board awarded $230,000 to 30 applicants to fund 46,000 riparian plants and 322 km of new fences to keep stock out of waterways (Auckland Council, 2018d).

2.4.2 Onsite wastewater systems

In rural areas, including city fringes and satellite towns, onsite wastewater systems, such as septic tanks, are the main form of wastewater disposal. Old or improper maintenance/ design of these private devices are causing wastewater discharges, with recorded pollution instances identified across the region. This is an issue resulting largely from operation of private devices, therefore the Council is continuing to focus on effective education, engagement and enforcement.

3 RECOMMENDATIONS

My recommendations for Auckland Council and others involved in stormwater responsible for delivering the NPS-FM are:-

1) Increase the sharing of examples throughout the industry to build a bigger picture of what levels of effectiveness can be expected from interventions.

This will enable better decision making for where to use interventions and support business cases. It will allow higher confidence when including interventions within catchment models. It will also direct focus for where monitoring needs to take place

2) Identify how stormwater interventions can be used to deliver NPS-FM values and acknowledge these benefits when writing business cases for stormwater projects.
3) Include monitoring within the business cases for new stormwater schemes (before and after installation monitoring) to identify their effectiveness in contaminant reduction. A range of factors can influence the effectiveness of an intervention, therefore it is recommended to ensure continued monitoring of structural devices following installation for a significant period. This will allow for any performance deterioration over time to be recorded
4) Consider whole catchment approaches to water quality and identify where in the catchment NPS-FM requirements need to be met. This could include using models to strategically plan which types of intervention are utilized and where they are located to achieve the most cost effective result.
5) Ensure that stormwater schemes delivered in new developments meet their environmental requirements, and aim towards best practice. This should be ensured through education, facilitating their use and enforcement.
6) Ensure that the indirect benefits of stormwater schemes are acknowledged. For example the social, health and amenity benefits of green infrastructure.
7) Provide support for innovation within projects. And share the lessons learned from these projects.
8) Utilise the recent increase in public awareness and interest in water quality to help deliver behavioural change. For example by informing people about the good work being undertaken in the stormwater industry and educating the public on what role they can play.
9) Continue work to better understand the effect of rural and peri-urban pressures. For example the impact of onsite wastewater systems and contaminant run-off from lifestyle blocks.

4 CONCLUSIONS

Auckland Council is using the range of tools at its disposal to ensure that the region is on target to meet its requirements of the NPS-FM, under significant pressures from urban and agricultural growth.

It is too early at this stage of the NPS-FM process to assess how the region is progressing with achieving its environmental requirements. However Auckland Council has shown that both structural and non-structural interventions can be effective at reducing the level of contaminants in receiving waters.

Delivering the NPS-FM will require effective management of a number of contaminants. This will involve a range of intervention methods. More monitoring is needed to accurately assess the effect of both structural and non-structural interventions on the receiving watercourses. Continuing engagement and sharing of information between local authorities, government ministries and stormwater professionals should be encouraged to deliver the NPS-FM requirements.

There are opportunities through tools such as the Freshwater Modelling Tool to identify the most cost effective interventions to strategically achieve water quality improvements on a catchment and regional scale.

Recently there has been increased national and international scrutiny on the health of New Zealand's freshwaters. Although this places further pressure on the stormwater industry it provides opportunities for interventions to generate many environmental benefits.

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