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Ko ngā wā kāinga hei whakamāhorahora

An investigation of alternative funding and incentive mechanisms to support implementation of WSUD in New Zealand

Activating WSUD for Healthy Resilient Communities

Contestable fund research: Activating water sensitive urban design for healthy resilient communities
April 2019
Sue Ira & Chris Batstone

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

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Cover: An alternative functioning piped system, Wanaka

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EXECUTIVE SUMMARY

It has long been acknowledged in New Zealand that there are significant challenges in securing funds for stormwater managers to address the costs of operating and maintaining desired levels of service, and for planning for future growth while meeting community aspirations to maintain or enhance the quality of the environment (Ira, 2012[1]; Landcare Research, 2005[2]). Despite this, the motivation for investigating alternative ways of securing stormwater funding has been low. However, the ratification of the National Policy Statement for Freshwater Management (NPS-FM) is likely to provide the impetus to effect the changes needed within governance and funding structures. The NPS-FM requires water quality targets to be set by regional and local councils to reduce contamination of New Zealand's freshwater, groundwater and marine receiving environments. The requirements of the NPS-FM means that a traditional piped "business as usual" (BAU) approach is no longer acceptable in New Zealand cities, and thus costs of infrastructure to avoid, remedy or mitigate the effect of urban contaminants on our receiving water bodies now need to be accounted for. Local Government New Zealand has identified that property rates (the primary funding mechanism for stormwater infrastructure across New Zealand) are not the best and only tool to address the funding challenges which are facing local authorities (National Council of Local Government NZ, 2015b[3]) and thus new, alternative means of funding for stormwater infrastructure must be sought.

Building on previous studies (Ira, 2012[1]; Landcare Research, 2005[2]) a literature review was undertaken to identify alternative funding options that are, or could, be used in New Zealand under the Local Government Act 2002 and Local Government Rating Act. The table below summarises some of the options discussed in the report and in Appendix A.

Summary of funding options (adapted from Landcare Research, 2005[2])

Funding of capital works only	Funding of capital or operational works	Other available funding mechanisms
Borrowing (loans or bonds)	Allocations and grants (e.g. from national roading charge revenues)	Voluntary offset credit and incentive schemes (e.g. reduction of fees to encourage behaviour change)
Vested asset or financial contributions	Regional sales tax	Negotiated agreements
Development contributions	General rate based on property value	Cap and Trade approach (i.e. creation of an economic market via water quality or quantity trading)
	Uniform annual general charge	Public private partnerships
	Targeted rates (these could be based on, for example, land area, impervious area or hydrological contribution)	
	Fees and charges	
	Penalties	

[1] Ira, S J T, 2012, A Review of Alternative Funding Solutions for Stormwater Management, Prepared by Koru Environmental Consultants Ltd. for Auckland Council. Auckland Council Technical Report 2014/008, January 2014

[2] Landcare Research. 2005. An Overview of Stormwater Funding Options for the Auckland Region. Prepared for the ARC. Report No: LC0506/012

[3] National Council of Local Government New Zealand. 2015b. Local Government Funding Review – A discussion Paper.

Additionally, the literature review also investigated where these mechanisms have been applied in cities around the world, what method of implementation was used and how successful they have been. The review (Table 2 in the main report) found that the application of a run-off based stormwater fee is a common means of funding stormwater services in the United States, Canada, United Kingdom and Europe. Additionally, many of the cities within these localities also include incentive-based fee credits/savings to promote behaviour change and incentivise the use of green infrastructure. The "Cap and Trade" approach (i.e. a quantity-based market instrument that restricts the total allowable level of emission, allocates this level among individuals as allowances, and permits the transfer of these allowances through free trade (Ira, 2012[1])) is also commonly used in the United States.

Internationally, the main objectives or focus of using an alternative means of funding stormwater were to:

- address under-capacity problems in aging infrastructure (Europe, the USA, Canada);
- provide an on-going and ring-fenced source of funding for maintenance of existing and future stormwater networks (Europe, the USA, Canada, Australia, New Zealand)
- meet regulatory requirements/ discharge limits (USA, New Zealand, Australia)
- promote green infrastructure (Europe, the USA, Canada, Australia)

In the majority of cases, the initial impetus for seeking new ways of funding stormwater service provision was in response to either a regulatory requirement for the reduction of pollutants (USA), dealing with escalating costs of aging under-capacity infrastructure (USA and Europe), or severe weather events (drought – Australia).

The report documents New Zealand and Australian case studies and also highlights commonalities and lessons learnt relating to implementation of the identified funding and incentive schemes internationally.

With respect to evaluating the right funding and incentive mechanisms for New Zealand, Landcare Research (2005 – p.6[2]) identified that any funding strategy should be based on five guiding principles:

1. **Sufficiency:** The need to secure adequate funds to renew existing infrastructure, improve service levels consistent with public priorities, and provide for growth.
2. **Certainty:** The need to ensure that sufficient funds will be available when required.
3. **Equity:** The principle of exacerbator (polluter) pays, i.e. those that generate additional demand for stormwater services should significantly contribute to its provision. This includes homeowners, commercial properties, road users and developers.
4. **Efficiency:** The principle that a funding mechanism should provide incentives for behaviour consistent with the goal of reducing stormwater volumes and contaminant to levels that achieve the desired environmental and social outcomes.
5. **Acceptability:** The likelihood that the recommended strategy would be politically acceptable.

Current funding models used within New Zealand (such as general rates) do not meet many of the guiding principles above, and we have not seen wide-spread use of the identified alternative funding mechanisms in New Zealand. Additionally, any funding strategy would need to take into account the public / private split of costs. Whilst it is imperative that an equitable funding strategy takes into account where these costs may lie, in reality all costs are borne in differing proportions by private individuals via "on-charging" from developers, network utility fees or rates (targeted and other wise), businesses increases the price of their goods or services, or everyday household costs (see Figure 1 in the main report).

Based on the abovementioned criteria, as well as the implementation of different alternative funding mechanisms across the world, it is clear that there is no silver bullet which can solve the funding gap facing councils and network operators in New Zealand. Rather, a toolbox approach to funding is needed. The exact make-up of this funding approach would need further investigation, but it could include the following elements:

- New development (greenfield and large scale brownfield) CAPEX costs to be funded through development and financial contributions and implemented in a way which provides greater flexibility for councils/ utilities to have more say in what types of assets are delivered;
- Targeted rates for stormwater OPEX funding of existing stormwater infrastructure and to cope with maintenance costs of new infrastructure;
- Incentives and reduced fees for properties incorporating green infrastructure;
- Road user charges to account for contamination from roads (up to 35% of impervious surfaces are located on non-rateable land, and 60% of expenditure associated with pollution control is required because of pollution caused by motor vehicles[12]);
- Cap and trade schemes for urban catchments which incorporate large rural areas;
- Third party operators and/or public private operators to deliver and manage standalone integrated water schemes.
- A national government incentives programme (similar to the Melbourne Water "Living Rivers" programme) which allows regions to sustainably implement the NPS-FM and provides support to WSUD projects in local councils, financing activities and employees to build capacity and facilitate projects which councils would not otherwise take on.

In conclusion, the main premise behind any funding strategy should be that of "polluter-pays". A key funding principle should be that whilst the whole community may benefit from stormwater infrastructure, the people who generate the effect should be required to pay to mitigate it. Linked to this, many of the public good outcomes and co-benefits that could be achieved from green infrastructure are generally wider than just stormwater management provision (e.g. health, safety and employment). As such, councils should look to leverage other government organisations to provide funds as a cost-share for the benefits that they receive from the green infrastructure. Finally, implementation internationally clearly demonstrates that effective implementation of WSUD requires that the funding strategy encompass fee credits and/ or programme incentives to assist in creating behavioural change within the community and increase awareness of stormwater effects.

It is recommended that this review form the building blocks to further investigate suitable funding systems and incentive mechanisms for New Zealand. Such an investigation should be initiated at the central government level, with sufficient focus being given to providing expertise, funding and increased capacity to councils across the regions of New Zealand to facilitate the sustainable implementation of the NPS-FM.

We recommend that future research be undertaken that identifies: the current state of three waters funding by local authorities; opportunities to identify and resource common toolbox mixes of solutions; opportunities for co-benefit based funding; and gaps in capacities to pursue the opportunities afforded by alternative potential funding regimes. These enquiries are motivated around the refinement and investigation of an appropriate incentives and funding policy to support WSUD implementation across regional areas of New Zealand.

1. Introduction

1.1 Background

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

WSUD is an alternative to conventional forms of urban development. It aims to integrate urban planning and water management in order to better manage, for example, water supply security, water quality in natural waterbodies, flood risk and amenity values of waterbodies[4,5]. While different jurisdictions place emphasis on different aspects of WSUD[6], the following concepts are particularly evident in a New Zealand 'understanding' of what WSUD comprises[7]:

- minimising impervious areas: WSUD aims to limit stormwater runoff and contaminant generation at source by minimising the construction of impervious surfaces, such as roads and roofs through urban design techniques such as clustering and innovative streetscapes.
- minimising site disturbances: WSUD aims to limit earthwork volumes and extent through careful urban design which complements the existing landscape.
- creating or enhancing natural areas: WSUD aims to protect and enhance/ restore natural areas as well maintaining the functioning of natural drainage systems, rather than replacing stream networks with piped systems.
- use of green infrastructure: WSUD uses green technologies (wetlands, swales, rain gardens, green roofs, infiltration) to better manage stormwater in a way that complements its approach to land use planning.

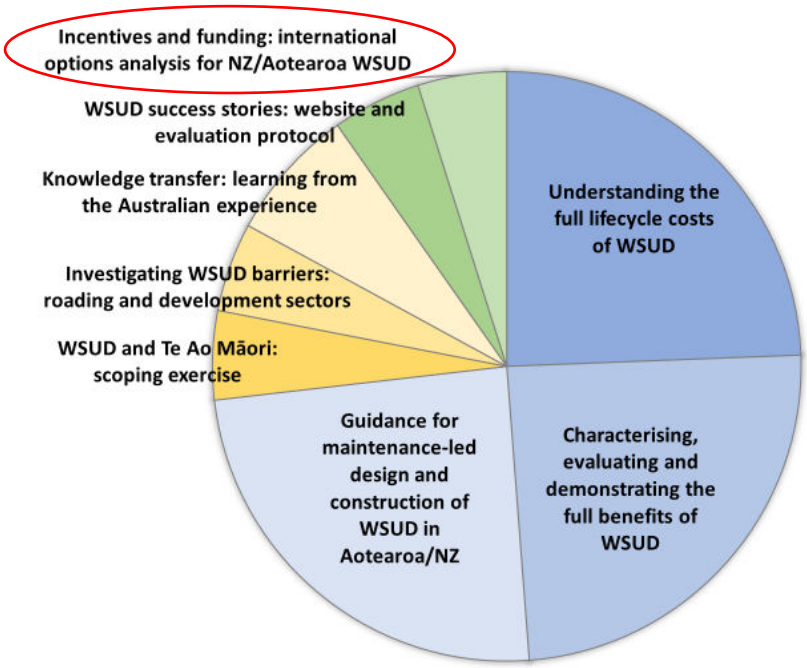
As discussed in the report on "*Understanding Costs and Maintenance of WSUD in New Zealand*" (Ira and Simcock, 2019[8]), WSUD has been offered up as a cost-effective solution which assists in addressing the effects of stormwater discharges. Whilst there are still gaps in our knowledge around the long term operating costs of green infrastructure practices, local and overseas research is starting to show that green infrastructure and WSUD can lead to costs savings as well as community benefits (Moores and Batstone, 2019[9]). In order for implementation of WSUD to be sustainable, and for benefits from the associated green infrastructure to endure, sufficient funding, over and above general rates, needs to be secured by network operators and councils to fund the on-going cost obligations associated with the construction, vesting, maintenance and renewal of stormwater infrastructure.

1.2 Project overview

There are three phases to the project. Phase 1 is now complete and was the discovery phase, involving engagement with WSUD's community of practice to determine the project's subsequent

[4] Mouritz, M., M. Evangelisti, and T. McAlister. 2006. Water sensitive urban design. In: T. Wong, ed., Australian Runoff Quality. Engineers Australia, Sydney, Australia, pp. 5-1–5-22.
[5] Hoyer, J., W. Dickhaut, L. Kronawitter, and B. Weber. 2011 Water Sensitive Urban Design: Principles and Inspiration for Sustainable Stormwater Management in the City of the Future. Jovis, Berlin, Germany, p. 144.
[6] Fletcher, T., W. Shuster, W. Hunt, R. Ashley, D. Butler, S. Arthur, S. Trowsdale, S. Barraud, A. Semadeni-Davies, J.-L. Bertrand-Krajewski, P. Mikkelsen, G. Rivard, M. Uhl, D. Dagenais, and V. Viklander. 2014. SUDS, LID, BMPs, WSUD and more – the evolution and application of terminology surrounding urban drainage. Urban Water Journal 12(7): 525-542.
[7] For instance, in Auckland – see Lewis, M., J. James, E. Shaver, S. Blackbourn, A. Leahy, R. Seyb, R. Simcock, P. Wihongi, E. Sides, and C. Coste. 2015. Water Sensitive Design for Stormwater, Auckland Council Guideline Document GD2015/004. Auckland Council, Auckland, New Zealand, p.193.
[8] Ira, S.J.T. and Simcock, R. 2019. Understanding costs and maintenance of WSUD in New Zealand. Research report to the Building Better Homes, Towns and Cities National Science Challenge.
[9] Moores, J. and Batstone, C. 2019. Assessing the Full Benefits of WSUD. Research report to the Building Better Homes, Towns and Cities National Science Challenge.

research priorities[10]. The pie chart below highlights key areas of research as determined in Phase 1.



The **purpose of this report** is to provide a brief overview of the available alternative funding mechanisms for WSUD as well as potential incentives which can be used to activate implementation. An international literature review was undertaken and a summary of stormwater funding and incentive mechanisms which are currently in place around the world is provided. The report provides recommendations for future research and use of funding and incentive mechanisms within the New Zealand context.

In Phase 3 of the project, the research team will disseminate research findings from the 'quick win' activities as well as delivering a co-designed and prioritised longer-term plan for the continued delivery and implementation of WSUD research, beyond the life of this project.

1.3 Stormwater funding in New Zealand

In a recent review of three waters infrastructure provision and delivery (Minister of Local Government and Minister of Health, 2018[11]) the New Zealand Cabinet acknowledged that there are challenges facing council stormwater services, however that it is difficult to quantify these challenges due to a lack of good quality information about the condition of stormwater infrastructure, along with its susceptibility to climate change. In addition, it was acknowledged that along with the governance framework, funding and financing to upgrade infrastructure is one of the key problems facing three waters provision, with a resultant recommendation being that the NZ Government embark on a process of three waters reform over the next few years.

Despite this recent review, it has long since been acknowledged in New Zealand that there are significant challenges in securing funds for stormwater operators to address the cost of maintaining desired levels of service, and for planning for future growth with an aim to maintain or enhance the

[10] Moores, J., Batstone, C., Simcock, R. and Ira, S. 2018. Activating WSUD for Healthy Resilient Communities – Discovery Phase: Results and Recommendations – Final Report.
[11] Minister of Local Government and Minister of Health. 2018. Future state of the three waters system: regulation and service delivery. Paper prepared for the Cabinet Economic Development Committee of New Zealand.

quality of the receiving environment for the benefit of communities (Ira, 2014[12]; Landcare Research, 2005[13]). In 2004, PriceWaterhouseCoopers (PwC)[14] identified that to merely maintain the status quo of stormwater infrastructure in the Auckland region (i.e. focus management efforts primarily on flood mitigation) the cost to Council would be in the order of $1.9 billion over a 20 year planning horizon. Across New Zealand, the estimated cost of renewing the three waters network (wastewater, potable water and stormwater assets) is in the order of $30 billion to $50 billion over the next 15 years (National Infrastructure Unit, 2015[15]). Internationally many cities (see section 2.3) have needed to investigate alternative funding methods for stormwater infrastructure provision to secure funds for ongoing maintenance.

In Australia, historic severe droughts have led to a nationally funded "Water Sensitive Cities" Cooperative Research Centre to research and integrate management of the 3 waters and transition Australia's cities into water sensitive cities, and was the key driver behind the restructuring of governance and funding of stormwater infrastructure in Melbourne.

Despite the historic lack of funding for stormwater in New Zealand, the motivation for investigating alternative ways of securing stormwater funding has been low. However, the ratification of the National Policy Statement for Freshwater Management (NPS-FM) is likely to provide the impetus to effect the changes needed within governance and funding structures. The NPS-FM requires water quality targets to be set by regional and local councils to reduce contamination of New Zealand's freshwater, groundwater and marine receiving environments. The requirements of the NPS-FM means that a traditional piped "business as usual" (BAU) approach is no longer acceptable in New Zealand cities, and thus costs of infrastructure to avoid, remedy or mitigate the effect of urban contaminants on our receiving water bodies now needs to be accounted for.

PwC (2004[14]) determined that if water quality outcomes were identified to be important (as they have now through the NPS-FM), then expenditure could rise to as high as $11.2 billion over a 20 year planning horizon in Auckland. More recently, the Auckland Plan has identified a funding shortfall of between $10 - $15 billion to meet infrastructure costs. The Otago District Council envisages that meeting standards set through the NPS-FM will incur additional costs of around $10 million over 7 years, whilst Tasman District Council expects to spend an additional $2 million over the next 10 years (National Council of Local Government NZ, 2015b[17]).

In a local government review of funding, Local Government New Zealand (LGNZ) identified that property rates (the primary funding mechanism for stormwater infrastructure across New Zealand) are the cornerstone of funding for local government, however, they are not the best and only tool to address the funding challenges which are facing local authorities (National Council of Local Government NZ, 2015a[16]). Many local authority areas have very low rating bases, and some face either no growth or projected retrenchment (National Council of Local Government NZ, 2015b[17]), leading to a reduction in rates revenue.

The historic funding shortfall for the maintenance of existing stormwater infrastructure, low rating base within the New Zealand regions, and the water quality requirements set through the NPS-FM

[12] Ira, S J T, 2012, A Review of Alternative Funding Solutions for Stormwater Management, Prepared by Koru Environmental Consultants Ltd. for Auckland Council. Auckland Council Technical Report 2014/008, January 2014

[13] Landcare Research. 2005. An Overview of Stormwater Funding Options for the Auckland Region. Prepared for the ARC. Report No: LC0506/012

[14] PriceWaterhouseCoopers. 2004. Funding Auckland Regional Stormwater: An Options Analysis. Prepared for Infrastructure Auckland.

[15] National Infrastructure Unit. 2015. The Thirty Year New Zealand Infrastructure Plan 2015. The URL for this publication on the Infrastructure website at August 2015 is: http://www.infrastructure.govt.nz/plan/2015

[16] National Council of Local Government New Zealand. 2015a. Local Government Funding Review – 10 Point Plan: incentivising economic growth and strong local communities

[17] National Council of Local Government New Zealand. 2015b. Local Government Funding Review – A discussion Paper.

now provide New Zealand with the motivation and mandate needed to investigate alternative means of funding stormwater infrastructure provision to provide a stable, sustainable funding base.

1.4 Structure of this report

This report provides a summary of the various funding and incentive mechanisms available to councils to facilitate a sustainable platform for the implementation of WSUD.

- Section 2 provides a description of the various funding and incentive mechanisms, along with relevant case studies from New Zealand and Australia. It also summarises and tabulates the results of an international literature review on implementation of alternative funding mechanisms in the USA, Canada, Europe, Australia and New Zealand and provides key lessons learnt.
- Section 3 discusses key criteria which should be used when developing a funding strategy for New Zealand
- Section 4 concludes the report and provides recommendations for future work.

It is noted that in 2012 a comprehensive review of alternative funding mechanisms which could be used in the Auckland region was undertaken by Ira (2012[12]) and earlier by Landcare Research (2005[13]). The information provided in those reports relating to the different types of funding options and criteria for analysing funding options is still valid, and has been included in parts of Sections 2 and 3. Appendix A provides a summary of the different types of funding and incentive mechanisms.

2. Alternative funding and incentive mechanisms

2.1 Overview

Landcare Research (2005[13]) and NSCC (2005[18]) undertook a literature review to document funding mechanisms which are currently available for use in New Zealand and internationally. The list provided in Table 1 includes options that are, or could be, used in New Zealand under the Local Government Act 2002 and Local Government Rating Act (Landcare Research, 2005[13]).

Table 1 Summary of funding options (adapted from Landcare Research, 2005[13])

Funding of capital works only	Funding of capital or operational works	Other available funding mechanisms
Borrowing (loans or bonds)	Allocations and grants (e.g. from national roading charge revenues)	Voluntary offset credit and incentive schemes (e.g. reduction of fees to encourage behaviour change)
Vested asset or financial contributions	Regional sales tax	Negotiated agreements
Development contributions	General rate based on property value	Cap and Trade approach (i.e. creation of an economic market via water quality and quantity trading)
	Uniform annual general charge	Public private partnerships
	Targeted rates (these could be based on, for example, land area, impervious area or hydrological contribution)	
	Fees and charges	
	Penalties	

A general overview of these mechanisms, with a focus on the more innovative mechanisms, is given in Section 2.2. Appendix A also provides a summary of each the funding mechanisms shown in Table 1. It is noted that different financing options (such as sink funds, asset investments, etc.) are not covered in this report, however, they would form an important part of any funding strategy.

2.2 Funding options

2.2.1 General rates and uniform annual general charges

Revenue collection through general rates based on land or property value or Uniform Annual General Charges (UAGC) are intended to distribute the cost of service provision equitably among beneficiaries or users. It is predicated on the ability to pay principle[13]. As identified in Section 1.3, these types of revenue collection mechanisms are widely accepted for collecting revenue for a set of services (e.g. such as stormwater) delivered uniformly to each rating unit. Charging through general rates is the most common system used in New Zealand by regional and territorial local authorities. This is mainly because it is widely accepted, is easy to administer and allows for flexibility in that adjustments in expenditure can be made relatively simply in response to planning or political cycles[13].

However, general rates have a number of disadvantages[13], namely that:

[18] North Shore City Council. 2005. Stormwater Charging Study. Report prepared by Maunsell Ltd.

- increased charges (leading to a growth in revenue) is limited by public acceptability, which may not be closely related to factors influencing expenditure,
- its inherent flexibility can lead to manipulation of expenditure priorities that might be inefficient, and
- there is no incentive for individual ratepayers to change their behaviour in response to costs as there is no direct relationship between use and payment.

Because property size and type influences the generation of stormwater runoff, however, including payment for stormwater services as part of a UAGC is just as inefficient and inequitable as charging for stormwater services through a general rate. The reason for this is that neither mechanism bears any relation to the actual use of or contribution to the need for the service by the individual ratepayer. In general, charging for stormwater services through a UAGC disproportionately burdens small-footprint buildings. A further limitation is that the amount collected under a UAGC and uniformly charged targeted rates is constrained to a maximum of 30% of total rates revenue under s21 LGRA (2002)[13]. Appendix A contains further information about general rates and uniform annual charges.

2.2.2 Targeted rates

In general, "targeted rates" is a generic term that is used to target (Ira, 2012[12]):

- a specific activity or group of activities being funded, e.g., stormwater management
- a specific factor being used as the basis for charging, e.g., impervious surface area
- characteristics of the property being charged, e.g., properties within a specified zone.

Key advantages of using a targeted rate are that it:

- creates a dedicated revenue stream for a particular activity to meet the growing investment needs,
- provides for a transparent allocation of funds and information about the cost of the service, and
- it is consistent with the 'user-pays' principle.

Appendix A contains further information about targeted rates.

The "case study box" overleaf summarises the findings of a review process that the former Auckland City (ACC) and North Shore City (NSCC) councils undertook to investigate a targeted rating system. In 2004 the former NSCC prepared a new Stormwater Strategy 2004 to address two important issues across the City: firstly the achievement of sustainable goals for the environment via an ongoing reduction in stormwater quantity and improved stormwater quality; and secondly, that meeting these sustainable strategic goals will result in an increase in expenditure which would need to be funded. Resultantly, NSCC commissioned a scoping study to identify alternative funding options, including economic incentives to support implementation of the Stormwater Strategy 2004[18]. In 2004[19], ACC also undertook a scoping exercise to investigate two alternative funding methods for stormwater, namely a targeted rate and a development contributions policy.

[19] Temple, C. and Webb, G. 2004. Stormwater update, including the targeted rate. Auckland City council Report to the Annual Plan Direction Setting Meeting.

North Shore City Council (NSCC) and Auckland City Council (ACC) proposed impervious area charge (IAC): a case study

In 2004 the former ACC and NSCC investigated the implementation of a targeted rate. The main reasons for the targeted rate were to provide dedicated funding for higher environmental standards in the city, to provide a flexible and adaptable rating policy to fund road-related stormwater costs, and to base the targeted rate on impervious area to achieve greater equity in the allocation of costs.

NSCC (2005[18]) and ACC (2004[19]) recommended that new development should continue to be funded through development contributions, and that the targeted IAC would be used to fund improvements to the existing stormwater system and to ensure continued maintenance of the stormwater network. Given that a portion of the NSCC rates was already being allocated to stormwater network maintenance, the report recommended that, initially, the IAC should replace that portion of stormwater funding allowed for through the general rates in order to minimise any rate increases at the outset.

The following key issues for consideration with respect to implementation of the IAC were tabled:

1. **Determining what costs can be covered by an IAC:** the focus for both councils was to ensure the IAC covered the cost of improvements to and maintenance of the existing stormwater system. However, IACs cannot be applied to non-rateable land, such as roads. As a result, ACC (2004) stated that IACs could not be used as a stand-alone funding solution and that a uniform charge should be applied to cover 'public' areas.

2. **Taking account of the public/ private split:** The provision of stormwater networks is a public good from which all ratepayers (whether or not they are connected to the network) will benefit. As such, any equitable funding system needs to take account of the public and private split or distribution of benefits. NSCC (2005) proposed a 30% public: 70% private split, with "public" referring to public stormwater assets servicing public areas such as roads, opens spaces, non-rateable properties (such as schools and hospitals), etc. In reality, however, all costs are borne by the private individual (see Section 3). Given that 60% of expenditure on contaminants relates to motor vehicle use on roads[21], the proportion of public rating is considered relatively low.

3. **Allocation methodology:** ACC (2004) and NSCC (2005) state that several options for allocating a targeted rate should be investigated. One option tabled, which reduces the level of accuracy needed to determine the actual impervious area on a site, was the use of 'on-site impervious area bands'. Rather than using the actual impervious area, a series of impervious area bands (e.g. 0 – 99m^2, 100 – 199 m^2, 200 – 299m^2, etc.) could be used. ACC (2004) noted that within the Auckland Isthmus area, the majority of properties had <500m^2 impervious area, and that over the city as a whole, the most commonly impervious area ranged from 200m^2 to 350m^2. This approach is not dissimilar to that used by cities internationally (see Table 2).

4. **Cost and ease of implementation:** As part of their scoping studies, both NSCC (2005) and ACC (2004) estimated initial set-up and on-going operational costs of an IAC. High resolution aerial photography work was needed to check the accuracy of data and this then had to be cross-checked with the rates database. Legacy issues around allowing cross-lease in-fill development also needed to be resolved where these types of

developments led to shared impervious areas such as driveways. NSCC (2005) estimated $250,000 +/- 30% for the detailed business case and consultation phase, with an addition $420,000 +/- 30% for initial implementation (2005 NZ$ value). ACC estimated a figure of $85,000 (2004 NZ$ value) for initial data cleansing and $50,000 to resolve customer issues. The majority of these initial set-up costs related to data cleansing. In terms of on-going operational costs (related to monitoring and resolution of complaints), ACC estimated $50,000 per year (2004 NZ$ value) and NSCC estimated $140,000 per year (2005 NZ$ value).

5. **Impact on ratepayers:** Since residential landuse comprises the highest landuse proportion in both the former Auckland City and North Shore City districts, the implementation of an IAC would have a direct effect on the ratepayer. ACC (2004) found that property value and impervious area are not clearly related and that residential property owners, in relation to the amount paid within general rates, would most likely pay higher IACs than business properties. For example, a high value business property with the same impervious area as a low value residential property would pay the same IAC. This leads to a significant redistribution of the rates burden and potential lack of public acceptability. NSCC (2005) investigated applying a business differential to assist in reducing the IAC burden to low value residential properties, but did not recommend including it.

6. **Credits/ incentives:** NSCC (2005) strongly recommended that any targeted rating system should also include the flexibility to provide "credits" for mitigation measures in order to promote behavioural change around how stormwater is managed. No further information on how such a credit system could work was provided in the analysis, however, it was earmarked as an area for further investigation.

Despite these detailed analyses on implementing IACs in Auckland, neither council endorsed the proposed new IAC as a means of funding stormwater. Given that initial barriers around data cleansing and system set-up costs were identified and resolved, it is it is likely that political and community acceptability of the shift in rates burden from business to residential landowners may prove to be a barrier to implementation.

More recently Auckland Council has introduced a "Water Quality Targeted Rate" (2018-2019 tax year). The proposal allows for total investment of $856 million over ten years to deliver cleaner harbours, beaches and streams ($452 million collected via an additional council water quality targeted rate and $404 million funded via water charges from Watercare)[20]. The rate is based on property capital value, with 25.8% of the revenue requirement being raised from business. This equates to around $78 per property per annum. In general, the rate was reasonably well supported by the Auckland Community (60% of respondents supported the targeted rate and approximately 30% opposed it)[20]. Unfortunately the rate is not linked to the level of imperviousness on each property, nor the pollutant generation potential of different property types. This approach is contrary to key learnings (Section 2.3) from implementation of stormwater fees internationally and perpetuates the notion that non-polluters are subsidising the polluters, effectively giving them social license to continue polluting, and creating no incentives for on-going behavioural change.

[20] Auckland Council. Undated. AC WQ Targeted Rate: https://ourauckland.aucklandcouncil.govt.nz/media/19292/attachment-b-water-quality-targeted-rate.pdf . Accessed on 1 February 2019.

Key learnings from the ACC and NSCC case study, and the Auckland Council target rate include:

- Political will and community acceptability is key to the implementation of any targeted rating system.
- The public/ private split needs to be carefully considered and applied: up to 35% of impervious surfaces are located on non-rateable land (including roads), and as a result full recovery of stormwater costs by applying an IAC to private properties is inequitable (Landcare Research, 2005).
- The business/ residential shift in charging needs to be carefully considered – potentially the application of a business differential could be reconsidered.
- In order to abide by the "polluter-pays" principle, the rate needs to be linked to impervious area or landuse type - subsidising the polluters effectively gives them social license to continue polluting, and creates no incentives for on-going behavioural change. Reduced rates/ incentives could then be applied to areas which already incorporate stormwater management.
- IACs need to be used as part of a toolbox of funding methods (such as development contributions, credits, road user charges, etc.) which also incorporate incentives or credits to promote behavioural change.

2.2.3 Road user charges

Road user charges and taxes are already in place in New Zealand to deal with issues such as congestion. In 2004, WCC[21] undertook a study which determined that 60% of expenditure associated with pollution control is required because of pollution caused by motor vehicles. Additionally, as mentioned above, 35% of impervious surfaces are located on non-rateable land such as roads. These two points together suggest that a portion of the costs associated with mitigation of stormwater quality effects should be allocated to motor vehicle users. Councils agree, however, that local government would need to lobby central government to increase either the petrol tax or road user charges to assist with funding of stormwater effects from roads (Ira, 2012[12]). It is also important to consider other impacts from the roads themselves, such as thermal and hydrological impacts. Given that roads can be viewed partly as movement corridors (rather than just a conduit for motor vehicles), user chargers may need to extend beyond just motor vehicles or be combined with a secondary charging mechanism to capture the associated impact costs. Appendix A contains further information about road user charges.

2.2.4 Voluntary offset credit and incentive systems

Many stormwater utilities in the US and Germany offer credits or fee reductions for landowners who implement best management practices to reduce runoff. Credits range from 10% to 100% of the stormwater utility fee. One of the key purposes of credit and incentive schemes is to induce behaviour change and assist with voluntary implementation of green infrastructure. However, the fee reductions are often limited to non-residential properties, and the economic inducement of the credit is rarely sufficient to cause a property owner to retrofit controls or perform activities simply to obtain the reduced fee. In New Zealand the issue of subsidising or funding on-site stormwater management infrastructure of this type is the subject of some debate[13]. Subsidising the construction of on-site infrastructure is viewed as risky and expensive because subsidies would be financed as operating rather than capital expenditure and therefore need to be funded from the recurrent budget, i.e. rates. The issue of fee reduction or credit systems, incentive payments, and direct funding for on-site stormwater management systems in New Zealand needs further research[13].

[21] Waitakere City Council. 2004. Revenue and financing policy.

In Melbourne there are a number of offset credit and incentive programmes being applied by various levels of government and research institutions[22].

- The Little Stringybark Creek project is noteworthy for its local scale approach to price discovery in the form of a multi-stage auction process that sought co-funding from residents to locate WSUD devices on their properties. This project and relevant learnings for New Zealand are summarised in the case study box below.

- The Living Rivers incentives programme allows Melbourne Water to support WSUD projects in local councils, financing activities and employees that councils would otherwise not take on. By embedding WSUD practice (and champions) in councils the Living Rivers programme aims to motivate continuing WSUD implementation, not only by supporting progressive councils involved in the scheme but also via a snowball effect on other councils. The seed funding encourages partnerships between different levels of governance as well as a sense of willingness to invest in and implement on-the-ground WSUD projects due to a sense of "getting a good deal" through co-funding. As a result, the programme aims to deliver WSUD implementation across Melbourne at a scale that Melbourne Water are unable to achieve in isolation of local council buy-in. This type of approach could be considered by New Zealand central government departments to provide expertise, funding and increased capacity to councils across the regions of New Zealand to facilitate the sustainable implementation of the NPS-FM.

- The stormwater offset approach, whereby developers contribute to the construction of publicly-owned devices, has benefits for developers and local councils by avoiding issues associated with the construction and maintenance of WSUD devices on private land. However, it can be challenging to monitor how contributions are spent and ensure that effects generated by a given development are managed in the same catchment. The scope of the current review of stormwater management in Victoria includes recommendations to improve the offset system, as well as a range of other matters of relevance for stormwater management in New Zealand.

The Little Stringybark Creek Restoration Project[22]: a case study

The aim of the project was to restore the degraded Little Stringybark Creek by implementing alternative forms of stormwater management such as rain tanks, rain gardens and detention basins to reduce the volume of water and contaminants entering the creek. Along with a number of publicly funded works, the project relied on private residences retrofitting rain tanks to their houses for water re-use.

The project is noteworthy for its local scale approach to price discovery in the form of a multi-stage auction process that sought co-funding from residents to locate WSUD devices on their properties. This approach may be important for WSUD retrofit projects in NZ, with potential motivations for WSUD likely to vary between properties in relation to the distribution of private and public benefits and costs, and the capacity of individual properties to contribute to the quantum of environmental mitigation at the catchment scale. Melbourne University found that the adoption of WSUD (rain tanks at this private property scale) was most successful where it was enabled by simple administrative and funding processes. From the point of view of agencies

[22] Activating WSUD (2018). Activating WSUD for Healthy, Resilient Communities Study trip to Melbourne, November 2018 – Findings. Research report to the Building Better Homes, Towns and Cities National Science Challenge. https://www.landcareresearch.co.nz/__data/assets/pdf_file/0005/178682/Findings-of-Activating-WSUD-visit-to-Melbourne-Nov-2018.pdf

promoting uptake, a strategic approach to push uptake in priority areas was more effective for achieving objectives than a 'hands-off' approach. Rates of uptake were also assisted by taking proactive community engagement steps to normalize WSUD. A review[23] of the project implementation found that, given around to 50% of run-off from urban surfaces comes from private property, effective householder engagement, along with financial incentives and personal co-benefits, was crucial in ensuring uptake of the rain tanks.

2.2.5 Negotiated agreements

Recent research into mechanisms for encouraging reduction of non-point source water pollution has highlighted the potential of negotiated voluntary agreements. Negotiated agreements are contracts between regulatory authorities and regulated entities, most commonly between levels of government, and have been widely used in Western Europe[13] (see Section 2.3). Appendix A contains further information about negotiated agreements.

2.2.6 Cap and Trade schemes

A "cap and trade market" is a quantity-based instrument that restricts the total allowable level of an emission, allocates this level among individuals as allowances, and permits the transfer of these allowances through free trade. NIWA (2009)[24] and Washington State Department of Ecology (2018)[25] state that all cap and trade schemes follow the same basic steps:

1. Determine the "cap" or limit, i.e. the pollutant load (e.g. Total maximum daily load or similar) that is placed on the total amount of pollutant which can be discharged from all sources to maintain (or enhance) the current water quality state of a water body.
2. Define the "players" or stakeholders in the market (e.g. pollutant emitters, governing bodies, trading body, etc.).
3. Determine the initial allocation which establishes and allocates the "cap" amongst the identified players. This is known as the load allowance (and establishes the permitted baseline).
4. Determine the monitoring framework for the scheme (e.g. nutrient trading in the Lake Taupo catchment is modelled and monitored via the "Overseer" programme[24]).
5. Stakeholders can meet their allocation by meeting the set "cap" either by reducing pollution through their on-site actions or by "trading" credits from other sources who have reduced their pollutants to below their own allocation limit.

The USEPA provides further guidance around cap and trade schemes which includes information such as[25]:

- traders must be located within the same catchment area;
- trading may not negatively affect water quality intake for drinking water supply;
- trading may not result in an exceedance of the established cap/ water quality standard which has been set;
- the authority must define a common unit of credit (e.g. grams/phosphorus/day);
- the scheme must include a monitoring mechanism and processes to deal with uncertainty, compliance and enforcement;
- results should be regularly assessed to allow for continual improvement of the programme.

[23] Brown, H.L., Boss, D.G., Walsh, C.J., Fletcher, T.D. and RossRakesh, S. 2016. More than money: how multiple factors influence householder participation in at-source stormwater management. Journal of Environmental Planning and management. Volume 29 – Issue 1; pp. 79.97.

[24] NIWA. 2009. Nutrient trading to improve and preserve water quality. Water and Atmosphere 17(1)2009. Article written by Kit Rutherford and Tim Cox.

[25] Washington State Department of Ecology. 2018. Draft water quality trading/ offset framework: draft framework and response to comments. Originally printed in 2011 and revised in 2018. Publication no. 10-10-064

The particular advantages of cap and trade marketing are that it does not require the market regulator to have any prior knowledge of the efficient abatement cost, and that it sets an enforceable limit on total emissions irrespective of current land use or future development[13]. Its major weakness is that it requires accurate monitoring and enforcement of performance, which is difficult with diffuse source pollutants like stormwater. The application of the cap and trade approach to water pollution can also face legal and public acceptance obstacles around issues of property rights. The USEPA concluded that the legal issues associated with the implied property rights changes were a major constraint to its implementation[25]. The current nutrient cap and trade scheme for Lake Taupo has attempted to overcome this issue by using an existing use approach known as "grandparenting". This involves setting the allocation decision according to the best or most productive year for a farmer between 2001 and 2005. Many landowners had concerns about the inequity of this approach as it allowed high polluters to continue to discharge at high levels, whilst capping lower polluters at lower levels. However, the approach was eventually approved as it provided farmers with flexibility within their own farming operations[26].

2.3 Summary of funding mechanisms in use internationally

A comprehensive, systematic review of national and international literature was undertaken to investigate where these alternative funding and incentive mechanisms have been applied in cities around the world. The desktop review was undertaken based on a number of key "search terms" used in internet searches within the following scholarly databases: Google Scholar; EVRI; jstor.org; and Science Direct. Search terms included: water sensitive urban design, green infrastructure, low impact design, sustainable urban drainage systems, incentives, funding, targeted rates, cap and trade schemes, infrastructure funding, alternative funding of stormwater, stormwater rates. The search was undertaken over a period from January 2019 to March 2019.

With respect to the different types of funding mechanisms in use, the review found that the application of a runoff-based stormwater fee is a common means of funding stormwater services in the USA, Canada and Europe. Additionally, many of the cities within these localities also include incentive-based fee credits/ savings to promote behaviour change and incentivise the use of green infrastructure. The "cap and trade" approach (i.e. a quantity-based market instrument that restricts the total allowable level of emission, allocates this level among individuals as allowances, and permits the transfer of these allowances through free trade[12]) is also commonly used in the United States. Table 2 provides a summary of the cities reviewed along with the type of funding system.

[26] OECD. 2015. The Lake Taupo nitrogen market in New Zealand: A review for policy makers. OECD Environment policy paper. ISSN 2309-7841

Table 2 Summary of funding and incentive mechanisms implemented in cities around the world

Location	Funding Mechanism(s)	Incentive Mechanism(s)	Description	Infrastructure Value & Funding Gap	Objectives/ Main Focus	Comments/ Features	Reference(s)
Mississauga, Ontario, Canada	Runoff-based fee	- grants and rebates; - stormwater fee credits	Financing study in 2012 (AECOM, 2013) highlighted that the stormwater programme was underfunded. New fee introduced in 2016 which is dedicated to maintaining the stormwater infrastructure and avoiding costily repairs. Various financing options were reviewed and it was decided that a stormwater charge would be the fairest and most equitable approach: based on the polluter-pays principle. Six-tier rating structure based on US$100 per billing unit. A billing unit equates to an average hard surface area on a single residential property of 151.1 - 194m2. The smaller the impervious area on a property, the lower the stormwater charge. In addition to this, properties can be given a rebate (reduce their charge) if they also implement best practice solutions which reduce peak flow reduction, provide water quality treatment , reduce the volume of run-off or prevent pollution. The rebates range from 5% - 40% and can be cumulatively applied to a maximum of 50%.	USD 1.7 billion in sw infrastructure assets with annual capital investment and maintenance payments of $14.6 million. Study identified that USD 35 million is needed annually for the stormwater programme to be sustainable.	- Close cost recovery gap for stormwater utility; - Gray infrastructure maintenance; - Integration with local and national programmes	The city has also developed an online tool which helps residents understand the stormwater fee and rebate scheme. They can enter their address and see a picture of their roof area and how the charge has been calculated.	Bassi, A., Cuellar, A., Pallaske, G. and Wuennenberg, L. 2017. *Stormwater Markets: Concepts and Applications.* Report prepared for the International Institute for Sustainable Development. AECOM, 2013; Sustainable Prosperity, 2016; CoM, 2016a and 2016b).
Halifax, Nova Scotia, Canada	Runoff-based fee	- grants and rebates; - stormwater fee credits; - debt strategy	Halifax Water (manages water, wastewater and stormwater infrastructure) initially included stormwater fees as part of the wastewater charge. Separate rates were established in 2013 to assist with meeting user demands, promote cost reductions and contribute to economic growth. In 2011 green infrastructure was made a top priority over gray infrastructure and the fee provided an alternative funding mechanism. Parcel-based system to calculate the fees, and charges based on precipitation and imperviousness. Stormwater charges for roads are billed to the Regional Water Commission. The system has 4 tiers ranging from no charge for impervious areas less than 50m2 to US$54 for areas greater than 400m2 (annually).	Not provided.	- Close cost recovery gap for stormwater utility; - Integrated asset management; - Integration with local and national programmes	The stormwater utility is integrated with water and wastewater infrastructure management and the utility is an independent unit which has the authority to implement policies and regulations applicable to both private and public sectors.	Bassi, A., Cuellar, A., Pallaske, G. and Wuennenberg, L. 2017. Stormwater Markets: Concepts and Applications. Report prepared for the International Institute for Sustainable Development. CWN, 2015; HRM, 2012
Philadelphia, USA	Runoff-based fee	- grants and rebates; - stormwater fee credits; - green infastructure incentive programs	Parcel based stormwater fee implemented in 2002 and 2010 for residential and non-residential properties respectively. PWD determined that green stormwter infrasructure investment would fulfill all project requirements and maximise social, economic and env benefits in an efficient timeframe (also allows for flexibility over the 25 year planning period). Includes a variety of tools to incentivise use of GI: - zoning incentives for green roofs; - green roof tax credits for businesses; - rain check rebate programme (support for home owners); - Green Acre Retrofit Programme (GARP - grants to contractors and project managers capable of conducting sw retrofits across multiple sites on a large scale).	Not provided.	- Green infrastructure; - Integration with local and national programmes	Sustainable Bus Network of Greater Phil. - the implementation of the GCCW created a Green Stormwater Infrastructure (GSI) industry with annual turnover of at least US$146.8 million and an economic impact of US$57 million.The industry supports more than 430 jobs and generates US$860,000 in tax revenues (Sustainable Prosperity, 2016). Substantial effort would be needed to replicate this approach to other areas (despite being based on impervious area charges) but it has led to the creation of a stormwater industry in Philly.	Bassi, A., Cuellar, A., Pallaske, G. and Wuennenberg, L. 2017. Stormwater Markets: Concepts and Applications. Report prepared for the International Institute for Sustainable Development. CoP, 2017; Sustainable Prosperity, 2016
Washington D.C., USA	Runoff-based fee	- grants and rebates; - stormwater fee credits; - green infastructure incentive programs; - environmental impact bonds	DC Water - Clean Rivers Project. Creation of a private market for trading stormwater retention credits (all new major projects >5,000 sq ft. If developers are unable ot meet regulatory requirements, they can buy stormwater retention credits by paying a fee to Dept of Energy & Env. Provides flexibility to project development and stimulates GI investment - money can be used to spread GI projects all over the DC area. SRC owners trade their credits in an open market to other parties that need them to fulfill regulatory requirements. Also the first city to issue an Environmental Impact Bond (EIB) to attract private funds for investments in GI. 30 year tax exempt municipal bond - EIB has 3 performance tiers (see table 4 attached). The performance-based nature of the EIB provides bene ts for DCWater and investors. Successful outcome is tier 2. The main benefit for DC Water is that the Risk Share Payment allows for recouping part of the investment and potentially using it to remediate the performance failure (EPA, 2017; Goldman Sachs, 2017). The key benefit for investors is that key risks such as financing risk, construction risk and regulatory risk are allocated to DC Water. Table 5 provides an overview of risk allocation between the water utility, DC Water, and the investors, Goldman Sachs and the Calvert Foundation.	Initially just to fund a US$3 million rain barrell retrofit project, but then expanded to include green roofs, rain gardens and permeable pavements.	- Green infrastructure development; - Compliance with national legislation; - SRC trading; - Decentralized amount of permeable surface throughout the city; - Integration with local and national programmes	DC's SRCT scheme is recognised by the C40 Cities Leadership Group as one of the world's most innovative progammes. EPA states that the FIG is a good financing tool for utilities facing sw funding challenges. It is replicable and scaleable. Could be a blueprint for other cities. expected 64,000 SRCs with an estimated worth of US$133,000. Average price in 2017 was expected to be US$2.10 per SRC.	Bassi, A., Cuellar, A., Pallaske, G. and Wuennenberg, L. 2017. Stormwater Markets: Concepts and Applications. Report prepared for the International Institute for Sustainable Development. CFN, 2016; DOEE, 2017 and 2017a; Goldman Sachs, 2017; Sustainable Prosperity, 2016.
Lancaster, Pennsylvania, USA	Runoff-based fee	- grants and rebates; - stormwater fee credits	Development of a 4-tier impervious area fee system based on the stormwater runoff from the property as related to precipitation and impervious area. <1,000 aq ft = US$15.48 and >3,000 sq ft = US$30.96/1000 sq ft area. A credit and rebate (grant) scheme is also proposed to be developed to reduce up front payments for GI, especially for private homeowners, also incentives around deductible sw fee credits.		- Close cost recovery gap for stormwater utility; - Green infrastructure development; - Grey infrastructure maintenance; - Integration with local and national programmes	Implementation uields more than US$120 million in avoided gray infrastructure investment capital cots and generates nearly US$5 million in annual benefits. Additional savings on gray infrastructure maintenance costs (US40.7 million), energy savings (US$2.4 million), improvements in air quality (US$1 million) and climate change benefits (0.8 million).	Bassi, A., Cuellar, A., Pallaske, G. and Wuennenberg, L. 2017. Stormwater Markets: Concepts and Applications. Report prepared for the International Institute for Sustainable Development. USEPA 2014a; CH2M HILL, 2014
Virginia	Trading and offset program	- offset credits which can be traded	Virginia's trading program was established in 2005 to ensure compliance with the Chesapeake Bay Tributary Strategies and allows for point source as well as certain non-point source to point source trade options. With respect to wastewater facilities discharging to the Bay watershed, these are authorised under a Virginia watershed general permit under which each is assigned a wasteload allocation (WLA). This allocation is based on Virginia's calculation of those sources' compliance with the Chesapeake Bay TMDL's loading levels. Wastewater facilities can either install nutrient removal technologies sufficient to comply with their WLA or they can purchase compliance credits from other facilities that have met their WLA. Offsets for stormwater is limited to new development. In 2012 the this process was reviewed.		- to reduce nutrient and sediment discharges into Chesapeake Bay - to meet the TDMLs set by the EPA for Chesapeake Bay	Focusses on point source to point source transactions and offsets, but non-point source to point source transactions are accounted for. Main focus also on wastewater, but was being reviewed.	USEPA. 2012. Virginia's Trading and Offset Programs Review Observations - Final Report. Accessed at https://www.epa.gov/sites/production/files/2015-07/documents/vafinalreport.pdf on 23 February 2019
Maryland	Non-point source cap management trading scheme		Maryland Department of Environment started a Phase 1 point source cap management policy (trading) for major WWTPs. This then was expanded to include agricultural land and non-point source credits. Relevant contaminants for trading include nitrogen, phosphorus and sediment.		- to reduce nutrient and sediment discharges into Chesapeake Bay.	Accounting guidance is provided which relates to reduction in pollutant loads to restoration of one impervious acre.	Teesley, M. 2017. MARYLAND TRADING and OFFSET POLICY and GUIDANCE MANUAL CHESAPEAKE BAY WATERSHED. Maryland Department of the Environment (presentation)
Newton, Massechusetts	Runoff-based fee		The fee was developed to manage and upgrade stormwater infrastructure, protect nearby natural waterbodies (e.g., Charles River and Crystal Lake), provide technical assistance with stormwater management issues, and provide educational programs for residents and schools. Fees based on a flat rate of US$6.50 per quarter, all other properties are US$37.50 per quarter.		- to manage/ upgrade stormwater infrastructure and fund educational programmes		USEPA. 2009. Funding Stormwater Programmes. EPA 90-1-F-09-004 (EAP Factsheet)
South Burlington, Vermont	Runoff-based fee		South Burlington Stormwater Utility created in 2006. The purpose of the fee is to help mitigate effects of stormwater and manage infrastrucuture (failing septic tanks and phosphorus runoff polluting Lake Champlain). User fees are based on the amount of impervious area on a property and set using the equivalent residential unit (ERU) method. Based on a single-family home in South Burlington of 2,700 sq ft of impervious surface, the assessed fee is US$4.50 per month> DDuplexes and triplexes are assessed fees of US$2.25 and US$1.50 per month, respectively. All other properties are assessed based on the amount of impervious surface. The utility funds a comprehensive program bringing in more than $1 million annually.		- to mitigate effects of aging infrastructure and reduce nutrient contamination		USEPA. 2009. Funding Stormwater Programmes. EPA 90-1-F-09-004 (EAP Factsheet)

Location	Funding Mechanism(s)	Incentive Mechanism(s)	Description	Infrastructure Value & Funding Gap	Objectives/ Main Focus	Comments/ Features	Reference(s)
Emscher Region (Rhine-Westphalia), Germany	State-based stormwater impervious area tax	- stormwater fee savings	Euro 0.80/m2 impervious area tax (higher than the average for US cities which varies bewteen Euro 0.04 - 0.16/m2). Tax was re-inforced by a disconnection convention/ policy agreed between the regional water authority, Federal State Ministry and 17 municipalities to implement a 15% disconnection rate over the next 15 years (2005), leading to about 26.4 billion m3/annum disconnected from thes surface water drainage system. Reduced taxes/ fees for retail and commercial premises which have large areas of imperviousness benefit greatly from disconnection savings. The savings for residential properties is relatively small. Well-focussed eduation and awareness campaigns assist with motivating residents and increase uptake.	Not provided.	- to promote green roofs and disconnect stormwater from surface water systems (reduce overflows, capacity issues, flooding and contamination).	Certificates of good practice are awarded to individuals and are intended to provide stimulus for further uptake. 60% of respondents supported the targeted rate and approximately 30% opposed it. The paper does not give the number of total respondents. *"It is the combination of credit incentives, community environmental values and the pivotal importance of the joint coordinated policies of the regulatory water authority and municipal landuse planning authorities, that are providing a collective drive to successful BMP implementation."*	Ellis, J.B., Green, C. and Revitt, D.M. 2010. Identifying success factors in urban surface water BMP implementation: Mission impossible? Novatech Chouli, E., Aftias, E. and Deutsch, J-C. 2007. Applying storm water management in Greek cities: learning from the European experience. Desalinisation. Volume 210, pp61-68
Brazil	Stormwater fee (proposed)		Estimated R$13 (in 2009) for a 160m2 residential unit.			- to reduce the funding gap and assist with funding existing and new stormwater systems	TUCCI C (2011) Urban Drainage Institutional Development in Brazil. Key note address. 12th International Conference on Urban Drainage, 11–16 September 2011, Porto Alegre, Brazil. Frisher-Jeffes, L and Armitage, N.P. 2013. Charging for Stormwater in South Africa. Water SA Vol. 39 No 3 WISA 2012 Special Edition 2013. ISSN 1816-7950 (On-line)
Sweden	Stormwater fees	- rebates	Cities have one public company that is responsible for energy, transport, water and sewage networks etc. If a property owner implements source control techniques he pays less. Untilities who are responsible for managing roads also pay fees.	Not provided.	- to promote green infrastructure (source control)		Chouli, E., Aftias, E. and Deutsch, J-C. 2007. Applying storm water management in Greek cities: learning from the European experience. Desalinisation. Volume 210, pp61-68
Denmark	Stormwater fees	- rebates; - stormwater fee credits	Very similar to the Swedish model above. Stormwater financed at a national level and drainage fees are split: 60% to wastewater and 40% to stormwater. Drainage departments offer incentives to property to: lower drainage fees, refund up to 40% of the connection fee) and to provide technical assistance.	Not provided.	- to promote green infrastructure (source control)		Chouli, E., Aftias, E. and Deutsch, J-C. 2007. Applying storm water management in Greek cities: learning from the European experience. Desalinisation. Volume 210, pp61-68
The Netherlands	Stormwater fees	- grants and rebates;	In accordance with national policy to reduce phosphorus and nitrate pollution, municipalities and industries pay fees to the Water Boards (river managers) according to emitted pollution. As part of this initiative, many municipalities also chose to promote disconnection of stormwater from the wastewater network (new national policy requires 20% of urban areas to be disconnected and use source control/ GI). Financial help is provided to home owners who want to disconnect (e.g. 5 €/m2 of disconnected surface for the municipality of Nÿmegen - 2007 value)	Not provided.	- to promote green infrastructure (source control) - disconnect existing impervious areas	Municipalities also focus on providing funding to build aesthetic source control (GI) projects, organise public interest campaigns, and offer technical guidance.	Chouli, E., Aftias, E. and Deutsch, J-C. 2007. Applying storm water management in Greek cities: learning from the European experience. Desalinisation. Volume 210, pp61-68
France	Stormwater fee (proposed)		A new water law introducing stormwater fees in order to provide funds for future stormwater management.	Not provided.	- to provide funds for stormwater management - to promote green infrastructure (source control)	The Seine St. Denis County has a preference for open air multi-functional installations (e.g. green spaces/ sport facilities that can be flooded in case of rain) because they are less expensive, make the best use of urban space and any malfunction is immediately visible.	Chouli, E., Aftias, E. and Deutsch, J-C. 2007. Applying storm water management in Greek cities: learning from the European experience. Desalinisation. Volume 210, pp61-68

Location	Funding Mechanism(s)	Incentive Mechanism(s)	Description	Infrastructure Value & Funding Gap	Objectives/ Main Focus	Comments/ Features	Reference(s)
Melbourne, Australia	Drainage charges/ levies	- grants - sw quality offsets (nitrogen)	Living Rivers programme has budget of approximately $3.2M that comes from the Waterways and Drainage Charge: paid as a portion of the water charge which is collected by the utilities but given to Melbourne Water to fund the living rivers programme. 38 Councils within MW operating area are eligible. It started in relation to wanting to clean up the Lower Yarra, before spreading to the rest of MW area. Purpose of the programme is to build local knowledge and capacity in stormwater management and streams. Funding of initiatives for councils and can help build capacity. As capacity gets built within te councils, bigger projects are funded and councils also begin to take the lead in investing in other projects. Developing strategies and plans (e.g. IWM) through to feasibility studies or designs, as well as construction of WSUD, also funded personnel to build up their capacity. E.g. have funded personnel with Yarra Ranges as they have a lot of sensitive areas and fringe growth – such as little Stringy Bark Creek. Melbourne Water also currently have a stormwater quality offsets programme which uses nitrogen as the trading metric. If a developer can't meet their obligations they can pay MW to offset their effect. City of Kingston have a developer contribution programme where they have identified treatment locations and developers who would have otherwise had private devices can contribute to the cost of building these devices. A proposed impervious area charge to be investigated (as recommended by the Greater Melbourne water Plan). The purpose of the charge is to reduce the volume of stormwater runoff, and would be used to disconnect impervious area around Melbourne.	The total value of stormwater infrastructure for the Greater Melbourne region ranged from AUD$20,600 million in 2010 to around AUD$40,050 million in 2050.	- reduce stormwater runoff volumes; - disconnect existing impervious areas; - promote implementation of WSUD	The magnitude of additional urban stormwater runoff volumes from Greater Melbourne ranged from 405 GL in 2010 to 700 GL in 2050. Total annual costs to manage stormwater runoff ranged from AUD$1020 million in 2010 to AUD$2003 million in 2050. The proposed impervious area tariff varied from $0.67/m2 to $1.36/m2 across Greater Melbourne (average value of $0.86/m2 and $583/property). This fee level would reduce sw volumes by 59 billion litres and costs by AUD$191 million by 2050 (effectively disconnecting 250km2 of impervious area by 2050). Stormwater levies and charges are also used in NSW.	Meeting with Melbourne Water on 21 November 2018. Coombes, P. 2018. Market Mechanisms for Better Stormwater Management. Prepared for the Stormwater Australia 2018 paper and retrieved from https://urbanwatercyclesolutions.com/betterstormwatermanagement/ on 22/1/2019 The Senate – Environment and Communications References Committee (Australia). 2015. Stormwater management in Australia: Chapter 4 – Management of stormwater by state governments, local governments and water utilities. Commonweath of Australia ISBN 978-1-76010-338-5 Accessed from: https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Environment_and_Communications/Stormwater/Report
Auckland, New Zealand	Capital Value fee; Wastewater charge	- targeted rate (no incentives)	In the 2018-2019 tax year Auckland Council introduced a "Water Quality Targeted Rate". The proposal would allow for total investment of $856 million over ten years to deliver cleaner harbours, beaches and streams ($452 million collected via an additional council water quality targeted rate and $404 million funded via water charges from Watercare). The rate is based on property capital value, with 25.8 per cent of the revenue requirement being raised from business. This equates to around $78 per property per annum.	Additional $856 million over 10 years.	- to address overflows of wastewater from the combined stormwater wastewater network in the Western Isthmus (86% of expenditure). - rehabilitation of rural streams, sediment contamination in the Southern Kaipara Harbour, fish passages, on-site septic tank compliance (10%). - remainder on contaminant containment and rehabilitation of streams in areas outside the Western Isthmus (4%).	60% of respondents supported the targeted rate and approximately 30% opposed it. The paper does not give the number of total respondents. It is noted that the rate is not linked to impervious area (i.e. "user-pays principle"), nor does it promote or incentivise green infrastructure or reducing/ disconnecting impervious areas within the greater city area.	AC WQ Targeted Rate Accessed on 1 February 2019 - https://ourauckland.aucklandcouncil.govt.nz/media/19292/attachment-b-water-quality-targeted-rate.pdf
Taupo, New Zealand	Cap and Trade scheme	- trading	In 2011 the Waikato Regional Council introduced a policy (Variation 5) to manage nutrient discharges into Lake Taupo. The water quality policy package had 3 main components: (1) a cap on nitrogen levels within the Lake Taupo catchment (2) establishment of a nitrogen market (3) formation of a body (Lake Taupo Protection Trust) to fund the initiative By 2015 nitrogen emissions had been reduced by close to 20% (the target set). The target was met through the buy-back of allocated nitrogen discharge allowances, which reduced the local economic and social impacts of the nitrogen cap.		- to reduce nitrogen discharges into Lake Taupo.	The trading price in 2012 was around NZ $300 per kg of nitrogen permanently removed from the crucial inflow. By mid-2015, the Trust had executed 23 trades in nitrogen discharge allowances equalling 151 066 kilos of nitrogen, and 17% of the cap had been traded. The policy allocated the allowances using an "existing use" approach, also known as "grandparenting". This involved awarding nitrogen discharge allowances to users based on historical use. In the case of the Lake Taupo catchment, this historical use was based on their highest productive year between 2001 and 2005. Whilst many were not supportive of this approach (as it 'rewarded' high nitrogen discharges'), it was felt that for farmers, the 'best year' allocation decision and the ability to trade allowed them some flexibility in their farming operations. Use of "OVERSEER" model to quantify nitrogen generation by farming activities.	OECD. 2015. The Lake Taupo nitrogen market in New Zealand – A review for policy makers. OECD Environment Policy Paper No. 04. ISSN 2309-7841 NIWA. 2009. Nutrient trading to improve and preserve water quality. Water & Atmosphere 17(1)2009 Duhon, M., McDonald, H. and Kerr, S. 2015. Nitrogen Trading in Lake Taupo - An analysis and evaluation of an innovative water management policy. Motu Working Paper 15-07 Motu Economic and Public Policy Research
Kapiti Coast	Fixed charge		Stormwater is currently funded via a fixed charge per property. Operating costs are funded through rates contributions and capital costs are funded from Development Contributions and loans. Depreciation is funded through activity fixed charges.			- to fund the operating and loan service costs of the stormwater network	Jeff Tate Consulting. 2013. Report: Options for funding stormwater management. Report prepared for Local Government Association of South Australia

Table 2 highlights that the main objectives or focus of using an alternative means of funding stormwater were to:

- address under-capacity problems in aging infrastructure (Europe, the USA, Canada);
- provide an on-going and ring-fenced source of funding for maintenance of existing and future stormwater networks (Europe, the USA, Canada, Australia, New Zealand);
- meet regulatory requirements/ discharge limits (USA, New Zealand, Australia); and
- promote green infrastructure (Europe, the USA, Canada, Australia).

In the majority of cases, the initial impetus for seeking new ways of funding stormwater service provision was in response to either a regulatory requirement for the reduction of pollutants (USA, Australia), dealing with escalating costs of aging under-capacity infrastructure (USA and Europe), or severe weather events (drought – Australia).

Literature on the performance of the different funding options is scant, however, the review did highlight commonalities and lessons learnt relating to implementation of funding and incentive schemes. These are summarised as follows:

- Offset schemes (such as those used in Melbourne) allow flexibility to developers to pay an offset charge where it is neither economically nor technically feasible to meet best practice standards on site[27]. This is often applied at a large sub-catchment scale where structure plans are developed for large greenfield development. As Melbourne Water manage stormwater catchments over a 40 ha threshold, they have made a conscious decision to support a smaller number of large assets (wetlands) that are best placed outside of individual property boundaries. Therefore whilst it may be economically feasible for the developers to simply locate something within their development, Melbourne Water deems it better to have more control through development contributions. This allows for projects to be delivered directly by Melbourne Water (pers comm. Stu Farrant, April 2019).

- Consultation on new funding mechanisms has demonstrated that the public are more accepting of those which support a "polluter-pays" principle and which include incentive-based mechanisms (such as offering subsidies, credits or reduced fees for people who implement on-site WSUD)[28].

- Incentives and rebate amounts must be high enough to promote WSUD implementation and behaviour change, and the fee therefore needs to be high enough to allow such a rebate[28], and the success factor of any incentive-based policy is generally determined by the buy-in of the local community[29].

- Getting the level of the targeted rate, IAC or fee is challenging and open to debate. The USEPA[30] recommend 3 different methods to calculate service fees. Impervious area is the single most important factor in each method (see Appendix B).

[27] The Senate – Environment and Communications References Committee (Australia). 2015. *Stormwater management in Australia: Chapter 4 – Management of stormwater by state governments, local governments and water utilities*. Commonweath of Australia ISBN 978-1-76010-338-5 Accessed from: https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Environment_and_Communications/Stormwater/Report

[28] Roy, A. H. Wenger, S.J., Fletcher, T.D., Walsh, C.J., Ladson, A.R., Shuster, W.D., Thurston, H.W and Brown, R.B. 2008. Impediments and Solutions to Sustainable, Watershed-scale Urban Stormwater Management: Lessons from Australia and the United States. *Environmental Management* 42:344-359

[29] Bassi, A., Cuellar, A., Pallaske, G. and Wuennenberg, L. 2017. *Stormwater Markets: Concepts and Applications.* Report prepared for the International Institute for Sustainable Development.

[30] USEPA. 2009. *Funding Stormwater Programmes*. EPA 90-1-F-09-004 (EAP Factsheet)

- Identifying the key physical indicators for policy evaluation is a key determinant for assessing (and designing) incentive programs[31]. Iftekhar *et al.* (2016[31]) employed agent-based modelling to study the effect of different incentive structures implemented in the "Dynamic Adaptation for enabling City Evolution for Water" (i.e. incentives for rain tank adoption in Australia). The study found that the cost-effectiveness of the incentive scheme varied depending on tank size: larger-sized tanks performed better for water savings and nitrogen removal whilst smaller tank sizes promoted quicker adoption but were less cost effective in terms of water savings and environmental services per dollar. Identifying and setting clear goals and assessment criteria for funding and incentive programmes is paramount to understanding the effectiveness of their performance in the market place[31].

- Linked to the point above, a clear linkage between the stormwater network/ programme costs, goals of the programme and structure of the funding is essential[18];

- Lessons learnt from implementation of impervious area taxes in Germany include[32]:
    - use pilot projects to trial policy-making and funding structures: start small and implement policies in stages;
    - political acceptability is paramount to successful implementation – ensure WSUD champions are in decision-making positions;
    - policies and funding structures have to be integrated across sectors and levels of government to achieve maximum effectiveness and success – harnessing and understanding the benefits of WSUD and green infrastructure to various government sectors allows for better integration and implementation of incentive programmes and funding policies;
    - work with communities to build participation, understanding and communication – this approach increases public acceptance and reduces legal challenges;
    - ensure transparency and equity in funding structures by estimating the stormwater burden generated from each property – individual parcel assessments (IPAs): determining each property's share of the stormwater burden helps to turn a non-point source or diffuse pollution problem into a point-source discharge which needs to be mitigated;
    - the low rate currently charged for stormwater removal in other countries (such as the United States) was identified as a key barrier for implementation of any new funding strategy (it is noted that this obstacle is likely to apply to the New Zealand context as well).

- The implementation of cap and trade schemes can be technically challenging and the development of a trading framework requires specialised skills that many communities may not have access to. Additionally, there are difficulties around identifying clear units of trade (e.g. run-off volumes or kg of pollutant removed) as well as setting an appropriate cap limit[33]. It is also challenging to determine definitive contaminant loadings for different landuses, making the scheme vulnerable to challenges from developments and the public.

[31] Iftekhar, M.S., Urich, C., Schilizzi, S. and Deletic, A. 2016. Effectiveness of incentives to promote adoption of water sensitive urban design: A case study on rain water harvesting tanks. International Congress on Environmental Modelling and Software. Paper 64.
[32] Buehler, R., Jungjohann, A., Keeley, M and Mehling, M. 2011. How Germany became Europe's green leader: A look at four decades of sustainable policymaking. *The Solutions Journal*. Volume 2, Issue 5. Published on *Solutions* www.thesolutionsjournal.com
[33] Bassi, A., Cuellar, A., Pallaske, G. and Wuennenberg, L. 2017. *Stormwater Markets: Concepts and Applications.* Report prepared for the International Institute for Sustainable Development.

- Linked to the challenge identified above, credit-trading markets can be more costly than IACs for local governments to establish and administer – the credit-trading market design, administration and enforcement is often outsourced to external companies[34].

[34] Dougherty, S., Hammer, R. and Valderrama, A. 2016. *How to: Stormwater Credit trading programmes.* NRDC February 2016 Issue Brief

3. Evaluating the right funding mechanisms for NZ – criteria

Landcare Research (2005[13] – p.6) identified that any funding strategy should be based on five guiding principles:

1. **Sufficiency:** The need to secure adequate funds to renew existing infrastructure, improve service levels consistent with public priorities, and provide for growth.
2. **Certainty:** The need to ensure that sufficient funds will be available when required.
3. **Equity:** The principle of exacerbator (polluter) pays, i.e. those that generate additional demand for stormwater services should significantly contribute to its provision. This includes homeowners, commercial properties, road users and developers.
4. **Efficiency:** The principle that a funding mechanism should provide incentives for behaviour consistent with the goal of reducing stormwater volumes and contaminant to levels that achieve the desired environmental and social outcomes.
5. **Acceptability:** The likelihood that the recommended strategy would be politically acceptable.

The literature[12;35] suggests decision-makers should critically review a wide range of funding options in order to identify a toolbox of methods which meets the above five principles. The first stage of this critical review should be about establishing the goals of the desired funding approach, as the goals assist in refining relevant funding criteria[13]. Table 3 outlines key criteria which can be used for evaluating the funding options outlined above. When assessing funding options, it is important to firstly start with the requirements for an economically efficient pricing system, and then consider deviations from that system based on the strengths and weaknesses of the other criteria[13].

Table 3 Summary and explanation of relevant funding criteria (adapted from Ira, 2012[12])

Funding Criteria	Explanation
Appropriateness and Legislative Compliance	Consistency with institutional arrangements (e.g. legislation, plans, strategies, etc)
Effectiveness	Providing sufficient revenue to cater for growth and improve levels of service in acceptable timeframes Diversifying the rate burden Improving reliability and adequacy of the revenue stream Flexibility in use of funds (capital vs operation; public vs private uses)
Equity	Fairness – "the polluter-pays" principle – those who generate stormwater runoff and its contaminant load bear more of the costs associated with mitigation Recognising ability to pay
Acceptability	Easily understood - transparent and simple Consistent with public values and attitudes Perceived to be beneficial, equitable and fair
Economic Efficiency	Balancing costs and benefits, and includes an optimal mix of at source avoidance, treatment and mitigation of impacts: – Sets a fee where expenditure on effect reduction equals the community's benefit from that expenditure – Is flexible with respect to abatement, treatment and mitigation options – Considers scale of any proposed mitigaton to support long term management by councils/utilities

[35] Jeff Tate Consulting. 2013. Report: Options for funding stormwater management. Report prepared for Local Government Association of South Australia

Funding Criteria	Explanation
Incentives for Preferred Behaviour	Provides the right price signals for ratepayers (increasing stormwater charges with increasing contribution to flow or contamination) Provides opportunities for credits, reduced charges or subsidies
Ease/ Cost Effective	Able to be reviewed and adjusted to meet funding needs Relatively easy and inexpensive to implement, monitor and enforce
Sustainability	Provides for funding in the long term in a stable and predictable way

Landcare Research (2005[13]) undertook an assessment of a number of different funding options against these criteria (Table 4).

Table 4 Summary evaluation of financing and funding options (Landcare Research, 2005[13] - Table 4, page 28)

Criterion		Borrowing	Sinking funds	Vested assets	Development contributions	Grants	Road User Contributions	Regional sales tax
Appropriateness	Consistency with legislation	++	Uncertain	++	++	+	-	Uncertain
Effectiveness	Provides sufficient funding	–	-	-	–	-	-	-
	Taps sources of funds other than ratepayers	0	-	+	+	++	++	+
	Improves reliability of funding stream	0	+	+	+	0	+	–
	Flexible in expenditure	-	+	–	0	Uncertain	Uncertain	Uncertain
Fairness and equity	Beneficiary or exacerbator pays principle	0	0	++	++	-	+	-
	Ability to pay principle	0	0	0	0	0	0	0
Acceptability	Easily understood	+–	-	+	+	+	+	+
	Consistent with public values	+	-	+	+	0	+	0
	Perceived to be beneficial	+	-	++	+	+	+	-
	Perceived to be fair and equitable	+	-	+	+	0	+	Uncertain
Efficiency	Cost effective to implement and enforce	+–	0	-	+	0	0	Uncertain
	Motivates preferred behaviour	+	+	0	0	0	+	0
	Leads toward optimal mix of avoidance, treatment and mitigation.	++	-	-	-	-	++	-

-- / - / 0 / + / ++ strongly negative / negative / unaffected or mixed / positive / strongly positive

Based on the abovementioned criteria and assessment, as well as the implementation of different alternative funding mechanisms across the world, it is clear that there is no silver bullet which can solve the funding gap facing councils and network operators in New Zealand. Rather, a toolbox approach to funding is needed. The exact make-up of this funding approach needs to be further investigated, but it could include the following elements:

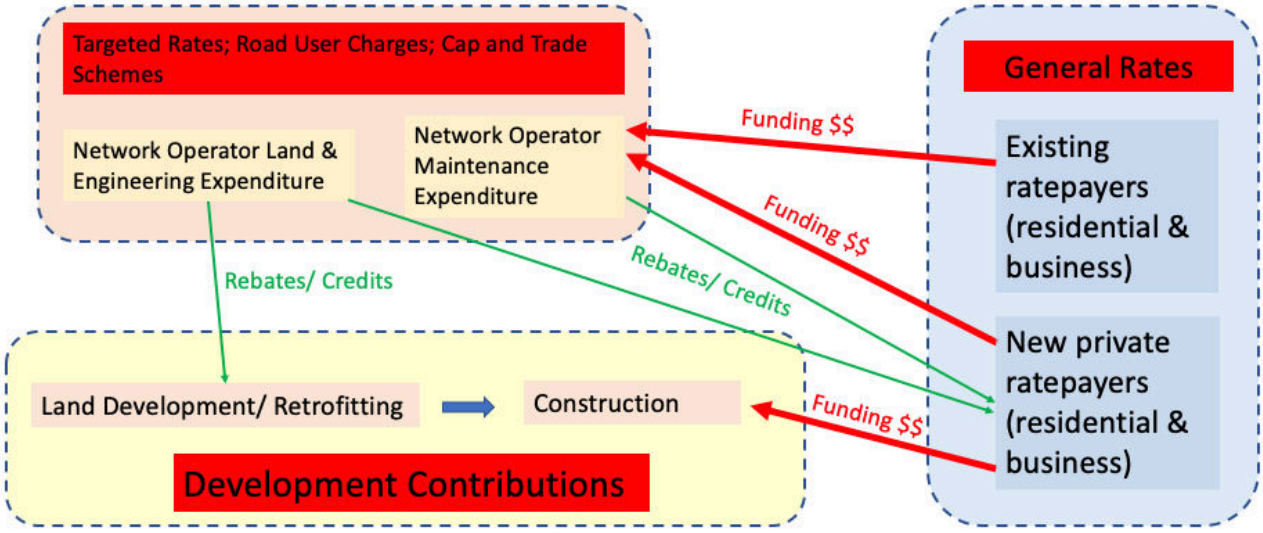
- New development (greenfield and large scale brownfield) CAPEX costs to be funded through development and financial contributions and implemented in a way which provides greater flexibility for councils/ utilities to have more say in what types of assets are delivered;
- Targeted rates for stormwater OPEX funding of existing stormwater infrastructure and to cope with maintenance costs of new infrastructure;
- Incentives and reduced fees for properties incorporating green infrastructure;
- Road user charges to account for contamination from roads (up to 35% of impervious surfaces are located on non-rateable land, and 60% of expenditure associated with pollution control is required because of pollution caused by motor vehicles[12]);
- Cap and trade schemes for urban catchments which incorporate large rural areas;
- Third party operators and/or public private operators to deliver and manage standalone integrated water schemes.
- A national government incentives programme (similar to the Melbourne Water "Living Rivers" programme) which allows regions to sustainably implement the NPS-FM and

provides support to WSUD projects in local councils, financing activities and employees to build capacity and facilitate projects which councils would not otherwise take on.

The key premise behind each of these funding solutions is that of "polluter-pays". The primary funding principle should be that, whilst the whole community may benefit from stormwater infrastructure, the people who generate the effect should be required to pay to mitigate it. Furthermore, any new targeted rate should assist in creating behavioural change within the community and increase awareness of stormwater effects. Current funding models used within New Zealand (such as general rates) do not meet either of these goals, and we have not seen wide-spread use of these alternative funding mechanisms in New Zealand. A uniform annual charge, although the simplest form of targeting (and most commonly used method), is not desirable given that it suffers from similar deficiencies to those associated with a general rate (see earlier discussion). Similarly, land area and land use rates are not desirable since they are both poor indicators of actual runoff or contaminant contribution. Targeted rates based on these factors are therefore just as inefficient and inequitable as value-based rating (as undertaken through general rates), and add a layer of complexity with little additional benefit (Landcare Research, 2005[13]). Whilst not directly discussed in this report, government could also consider the role of water metering as a tool to re-connect residents with their water usage, making it easier to promote and develop business cases for alternative water schemes such as rain water harvesting.

The funding toolbox identified above also assists with taking into account the public / private split of costs. As discussed in our research report on "Understanding Costs and Maintenance of WSUD in New Zealand", traditional financial models used to understand costs of stormwater infrastructure do not take into account or provide information around implications for where the cost will fall within the urban development value chain, i.e. whether they are developer-related, public utility, private business or house-hold costs. Whilst it is imperative that an equitable funding system take into account where these costs may lie, in reality all costs are borne in differing proportions by private individuals via "on-charging" from developers, network utility fees or rates (targeted and other wise), businesses increases the price of their goods or services, or everyday household costs. Figure 1 illustrates the value chain in respect of the toolbox of funding options.

Figure 1 The urban development value chain and relevant potential funding options



The USEPA (2009[30]) has identified key steps that stormwater utilities should follow when setting up an integrated funding programme. These include:

1. develop a feasibility or scoping study;
2. identify at least 1 political champion to assist overcoming political opposition (e.g. the mayor or a senior councillor);
3. roll out a public information programme;
4. adopt the relevant legal framework (e.g. a by-law or similar);
5. provide credits/ exemptions/ incentives as part of the funding strategy to assist in achieving stormwater programme goals and behaviour change); and
6. implement the funding regime.

As discussed in Section 2.2.2 (case study box) both the former Auckland City and North Shore City Councils considered the introduction of a targeted rate based on impervious area (NSCC, 2005[18]), however, neither was implemented due to the perceived 'low' political appetite for an additional rating mechanism (point 2 identified by the USEPA above), as well as the practical difficulties of implementing the preferred solution. Table 5 provides a qualitative assessment of the main targeted rates options as undertaken by NSCC (2005[18]). The assessment consisted of a simple "yes/ no" response as to whether or not the different types of potential funding mechanisms met each criterion. The different types of service fees considered included:

- an impervious area charge;
- a fee based on the hydrology of an individual parcel of land;
- a uniform service fee (i.e. a flat fee which would be over and above the general rates charge);
- a fee based on the total area of the property;
- a fee based on land-use zoning.

The status quo relates to stormwater being included within the general rates charges.

Table 5 Summary of Evaluation of Annual Stormwater Funding Options (from NSCC, 2005[18])

Criterion	Status Quo	Imperv. Area	Hydrology	Uniform Fee	Total Area	Land-use
Achieves strategic goals	No	Yes	Yes	No	No	No
Economically Efficient	No	Yes	Yes	No	No	No
Changes behaviour	No	Probably Yes	Yes	No	No	No
Ease of implementation	Yes	Yes	No	Yes	Yes	Yes
Fair and equitable	No	Yes	Yes	No	No	No
Acceptable to ratepayers	Yes	Probably Yes	Probably Yes	Probably Yes	Probably Yes	Yes
Price signal	No	Yes	Yes	No	No	No
Financially viable to NSCC	Yes	Yes	No	Yes	Yes	Yes
Permitted by legislation	Yes	Yes	No	Yes	Yes	Yes
Overall No. Yes's	**4**	**7-9**	**5-6**	**3-4**	**3-4**	**3-4**
Overall No. No's	**5**	**0**	**3**	**5**	**5**	**5**

Whilst a stormwater runoff charge was considered to be the most equitable approach to charging for stormwater services (Landcare Research, 2005[13]), the impervious area charge was preferred on that basis that:

- environmental and strategic benefits are likely to be very similar;
- impervious area charges will cost less to implement; and
- the LGRA permits paved, sealed or built-on areas to be used to assess liability for a targeted rate, but a runoff charge would require new legislation (NSCC, 2005[18]).

Fees and penalties are also used in New Zealand, however, they generally do not generate significant funds for development as the level of fines tend to be set by the Court and are rarely punitive.

With the ratification of the NPS-FM, the motivation and political appetite for environmental responsibility in New Zealand is changing. As mentioned previously, Auckland Council has recently introduced a targeted rate for the Auckland Region to upgrade infrastructure associated with water quality improvements. Whilst this is an encouraging first step in creating a transparent funding mechanism which is solely ring-fenced for water quality improvement works, the rate does not fully meet the equity and efficiency evaluation criteria as it does not adhere to the polluter-pays principle, nor does it provide incentives for behaviour change. Internationally, green infrastructure or WSUD projects are perceived to generate significant social and environmental co-benefits[9] and are viewed as attractive opportunities for subsidies, grants and investors[36]. Given that many of the public good outcomes and co-benefits that could be achieved from green infrastructure are generally wider than just stormwater management provision[27] (e.g. health, safety and employment), councils should look to leverage other government organisations to provide funds as a cost-share for the benefits that they receive from the green infrastructure. Pooling investments, green bonds and engaging insurance companies are all relevant approaches which overseas institutions are pursuing[36].

As highlighted in Table 2, the Taupo region is the first region of New Zealand to trial a cap and trade scheme to deal with nutrients discharged from farms to Lake Taupo. The planning of the scheme was extensive and followed basic steps outlined in Section 2.2.6[26]. Key lessons learnt from the programme include[26]:

- the trading and purchase of nitrogen discharge allowances is clearly linked to the resource consent process and is backed by a robust regulatory and monitoring system;
- the relevance of the lake for New Zealand and its economic importance for tourism were drivers for change – these clear drivers assisted with the lengthy journey to policy implementation and for obtaining support from politicians;
- compromises and effective communication and consultation were essential to successful implementation;
- the collaborative approach and commitment of various levels of government and iwi assisted in achieving the policy objectives for the cap and trade scheme, along with scientific knowledge and a set of innovative economic and regulatory actions designed to overcome negative economic outcomes;
- the Lake Taupo Protection Trust's independence from government, along with New Zealand's carbon trading market, helped to ensure the success of the buy-back of nitrogen discharge allowances – awareness of synergies that might be available in the wider environment is important.

[36] Browder, G., Ozment, S., Rehberger, B., Gartner, T., and Lange, G-M. 2019. *Integrating Green and Gray: Creating Next Generation Infrastructure.* World Bank Group and World Resources Institute Report. Accessed from www.worldbank.org

The above two New Zealand case studies, along with the international learnings cited in Section 2.3 provide a sound foundation for the development of an equitable and sustainable funding system for stormwater management in New Zealand. This review should form the building blocks to further investigate suitable funding systems and mechanisms through the three waters infrastructure delivery review (Minister of Local Government and Minister of Health, 2018[37]).

[37] Minister of Local Government and Minister of Health. 2018. Future state of the three waters system: regulation and service delivery. Paper prepared for the Cabinet Economic Development Committee of New Zealand.

4. Conclusions and recommendations

This research report has provided a summary of the funding shortfall that is facing New Zealand councils and network operators in relation to the provision of on-going, sustainable and green stormwater infrastructure. A literature review, based on a previous review undertaken by Ira (2012)[12] and Landcare Research (2005)[13], identified that there are a number of alternative funding and incentive options that are or could be used in New Zealand. The report has also documented where these mechanisms have been applied in cities around the world. The review found that application of a run-off based stormwater fee is a common means of funding stormwater services in the United States, Canada and Europe. Additionally, many of the cities within these localities also include incentive-based fee credits/ savings to promote behaviour change and incentivise the use of green infrastructure. The "cap and trade" approach described is commonly used in the United States.

What is clear from the research is that there is no silver bullet which can solve the funding gap facing councils and network operators in New Zealand. Rather, a toolbox approach to funding is needed which should be based on the 5 guiding principles:

1. sufficiency,
2. certainty,
3. equity,
4. efficiency, and
5. acceptability.

It is vital that the main premise behind any funding strategy is that of "polluter-pays". A key funding principle should be that whilst the whole community may benefit from stormwater infrastructure, the people who generate the effect should be required to pay to mitigate it. Furthermore, lessons learnt from international case studies clearly demonstrate that effective implementation of WSUD requires that the funding strategy encompass fee credits and/ or programme incentives to assist in creating behavioural change within the community and to increase awareness of stormwater effects.

It is recommended that this review form the building blocks to further investigate suitable funding systems and incentive mechanisms for New Zealand. Such an investigation should be initiated at the central government level, with sufficient focus being given to providing expertise, funding and increased capacity to councils across the regions of New Zealand to facilitate the sustainable implementation of the NPS-FM.

We recommend that future research be undertaken that identifies: the current state of three waters funding by local authorities; opportunities to identify and resource common toolbox mixes of solutions; opportunities for co-benefit based funding; and gaps in capacities to pursue the opportunities afforded by alternative potential funding regimes. These enquiries are motivated around the refinement and investigation of an appropriate incentives and funding policy to support WSUD implementation across regional areas of New Zealand.

Appendix A Funding and incentive options

Appendix A provides a description of the different types of funding options. Information has been taken directly from the Landcare Research (2005[13]) report. In some areas the text has been amended to reflect the current governance situation.

General Rate

Revenue collection through a general rate based on land or property value is predicated on the ability to pay principle. Charging for stormwater services through a general rate based on property or land value is the most common system used in New Zealand by both the regional and territorial local authorities. Its advantages are its widespread acceptance, administrative simplicity, and flexibility in that adjustments in expenditure can be made relatively simply in response to planning or political cycles. Its disadvantages, however, are that growth in revenue is limited by public acceptability, which may not be closely related to factors influencing expenditure, that its inherent flexibility can lead to manipulation of expenditure priorities that might be inefficient, and that there is no direct relationship between use and payment so there is no incentive for individual ratepayers to modify their behaviour in response to costs. Properties generating similar levels of runoff but of different value make quite different contributions toward stormwater management costs, i.e. there is vertical equity. On the other hand, low value commercial uses with high impervious surface area, e.g., car parks, contribute relatively little compared with high value commercial uses that may have lower impervious surface area, e.g., well-landscaped, multi-level apartment or office developments. Under a general rating system businesses, which generally have higher property values per unit area, contribute proportionately more to stormwater management costs than residential property owners.

Uniform Annual General Charge

In contrast to a property value-based rate, a Uniform Annual General Charge (UAGC, also known as a flat tax) is intended to distribute the cost of service provision equitably among beneficiaries or users. Such charges are a common feature of rating systems in North America and New Zealand and are widely accepted for collecting revenue for a set of services delivered uniformly to each rating unit. Because property size and type influences the generation of stormwater runoff, however, including payment for stormwater services as part of a UAGC is just as inefficient and inequitable as' charging for stormwater services through a general rate. It still bears no relation to the actual use of or contribution to the need for the service by the individual ratepayer. In general, charging for stormwater services through a UAGC disproportionately burdens small-footprint buildings, e.g., suburban residential properties, relative to large properties with high levels of impermeability.
A further limitation is that the amount collected under a UAGC and uniformly charged targeted rates is constrained to a maximum of 30% of total rates revenue under s21 LGRA (2002).

Targeted Rate

The generic term targeted rate applies to a range of charges that target:

- a specific activity or group of activities being funded, e.g., stormwater management
- a specific factor being used as the basis for charging, e.g., impervious surface area
- characteristics of the property being charged, e.g., properties within a specified zone.

The principle of separating a funding stream from the general rate and directing it to a specific purpose is consistent with the beneficiary and exacerbator pays principles.
A range of targeted rates reflecting use or contribution to demand for stormwater services are possible under the LGA (2002):

1 Targeted rate as a uniform annual charge
2 Targeted rate based on land area

3 Targeted rate based on land use
4 Targeted rate based on impermeable surface area
5 Targeted rate based on hydrological contribution (as a function of slope, soil type, land cover, land use, on-site storage, etc.).

Under sections 16-18 LGRA 2002, a local authority may set a targeted rate for one or more activities. A targeted rate can be set on a uniform basis for all rateable land (uniform annual charge), or differentially for different categories of rateable land. This provision is extremely flexible and can be used to set a separate stormwater rate on a range of factors including the area of land within the rating unit that is sealed, paved, or built on, or the extent of provision of any service to the rating unit by the local authority, e.g., volumetric charging for water services. The latter was being used by some Auckland councils for the supply of potable water and wastewater services.

The Act maintains the provision for the setting of differential rates based on category of land (use, size, location, value). This approach was to be used in Rodney District to differentially rate rural and urban property owners for stormwater services. The Act does provide some limitations that need to be taken into account by TAs considering a targeted rate:

- The sum of targeted rates set on a uniform basis (Uniform Annual Charge) and Uniform Annual General Charges cannot exceed 30% of total rates revenue [s21 LGRA (2002)]. However, targeted rates set for water supply or sewage disposal are excluded from this calculation.
- There is no provision for credits or discounts for mitigation to be implemented through a reduced charge under a targeted rate. These would therefore need to be reimbursed under the rates remission provisions of the Act.

Road User Charges

Vehicle use accounts for up to 60% of non-point stormwater contamination (Waitakere City Council 2004; Auckland City Council 2004). However, the only mechanism currently available for levying motor vehicle users would be through increasing the petrol tax or road user charges collected by central Government. Ongoing work on surface transport costs and charges following the passing of the Land Transport Management Act (2003) provides an avenue for continued lobbying for central funding of roading externalities.

Borrowing

Infrastructure assets have long life spans and require large amounts of capital investment, in particular amounts and time periods. They are therefore best financed through some form of debt programme with regular, sustainable funding mechanisms servicing the capital and debt repayment in addition to operating and maintenance costs. This also allows for equity between generations by spreading the costs of developing infrastructure over current and future users.

In New Zealand, financing is generally by NZ registered banks, although specialised lending services are provided by the Local Authority Bond Trust and Local Authority Finance Corporation. This is in contrast to North America, where financing through bond issues, i.e. capital raised from the public rather than financial institutions, is common. Bonds that are guaranteed by local government may require a lower interest rate than those issued by commercial organisations (IA 2004, p. 57). In Australia private sector funding is limited. A survey of local authorities and private sector investors identified two major constraints:

- Lack of critical mass in investment opportunities given the limited geographical boundaries of local authorities

- The difficulty in packaging infrastructure projects in such a way as to facilitate private sector engagement and form workable agreements and contracts. This was reported as primarily an issue of local government capacity.

Debt financing is still one of the most widely used and accepted mechanisms to fund replacement or upgrading of stormwater infrastructure in New Zealand. However, the Infrastructure Auckland report suggests there is increasing nervousness among TAs about further increasing gearing and having to increase rates to service increased borrowing. This is consistent with trends in Australia, where there is growing debt aversion among local authorities and State Governments. The combination of debt aversion and lack of dedicated recurrent charging mechanisms for stormwater system development is a major barrier.

Development Contributions

The use of development and financial contributions is common place in North America, Australia and New Zealand. It is based on charging a developer a contribution or 'impact fee' or to cover the cost of new infrastructure and services on the wider network. The approach is based on the assumption that current residents have already paid for the infrastructure that serves them (usually either through taxes or fees), and they should not need to pay for upgrading services to meet the demand of new developments (Landcare Research, 2005). Studies undertaken in the mid-2000s (PWC, 2004, BCG, 2004, Landcare Research, 2005, Hill Young Cooper *et al.*, 2007 and Auckland Council, 2011) all agree that stormwater CAPEX infrastructure requirements resulting from growth should be privately funded, in accordance with the "polluter-pays" principle. However, development contributions can only be used for capital expenditure on network infrastructure identified in a council LTCCP (LGA, 2002 – s204). The LGA (2002) (s102) requires councils to set development contributions policy, and use a transparent assessment methodology. A review into the development contributions process undertaken by the Department of Internal Affairs (DIA, 2013[38]) stated that approximately 2% of council revenue was generated via development contributions. Having said this, contributions to individual councils can be much higher and DIA, 2013[38] found that contributions comprised between 10% and 20% of 10 individual council's revenue in 2008. It is likely that the level of contributions is closely correlated with the level of growth within each council jurisdiction.

One of the main advantages of a development contribution is that the assessment method, rationale, activities and policy only need to be publicly debated and written once before becoming operational and applying to all developments. The key challenge is that the appropriate level of development contribution is difficult to set, especially where existing infrastructure does note adequately mitigate environmental effects and protect public health (Landcare Research 2005[13]). One of the main disadvantages of the contributions process is that it therefore leads to less efficient outcomes as it is focussed primarily on implementation. Development contributions provide little consideration of community choices between environmental quality and costs of stormwater treatment. Furthermore, development contributions cannot be used to fund maintenance, renewal or improvement works, they can only be used for capital expenditure (DLA Phillips Fox, 2008).

Financial Contributions

Financial contributions differ from development contributions in that they can only be imposed as a condition of consent granted under the Resource Management Act (2001). They can be used in tandem with development contributions, and can even apply to the same activity, so long as the purpose of the development contribution is different from that of the corresponding purpose of the financial contribution. As a result, many councils have retained financial contribution regimes under their district plans (DLA Philips Fox, 2008 p. 3 & 4).

[38] Department of Internal Affairs. 2013. *Development Contributions Review: Discussion Paper*.

Allocations or Grants
Allocations from a grant issued through a national or Government agency or a dedicated infrastructure improvement fund set aside from general tax revenue are significant contributors to specific infrastructure projects in some jurisdictions. In New Zealand this mechanism has traditionally been used to provide support for development and maintenance of the local roading infrastructure and has been funded from roading charges. As discussed in section 2.2.3 above, there is a reasonable case for national road users to contribute to the costs of local stormwater management. The appropriate size of any payment should be related to the contribution of road usage to stormwater and contaminant runoff. However, any payment would not be fully economically efficient unless it was also related to the most cost efficient form of abatement which may involve mitigation elsewhere in the catchment.

Alternative sources of revenue from national sources such as sales taxes on "polluting" products such as vehicle technology, roofing products and/or materials have also been raised as possibilities.

Regional Sales and Petrol Tax
In a similar manner to allocations and grants from national revenue collection mechanisms, there is a potential to set regional sales taxes to contribute to major local infrastructure investment needs. While these have been used in North America, e.g., Las Vegas funds much of its public services from local sales tax revenue, there is little support for this approach in New Zealand, e.g., Kerr (2005). In New Zealand, increases in petrol sales tax in 2002 and 2004 were both justified by the need to invest additional funds in roading projects in specific regions, but the tax has been applied uniformly across the country. In principle, regional sales taxes suffer the same inherent strength - levying contributors to the problem, and weakness - being difficult to assess, as allocations and grants from nationally collected charges.

Fees and Penalties
In New Zealand, these generally cover the cost of providing the service being charged for, i.e. reviewing the plan, conducting the inspection, measuring the indicator, enforcing the condition, etc. In other jurisdictions, hook-up or installation fees can be charged as recoupment payments for buying into surplus capacity in existing infrastructure. In New Zealand the developer contribution performs this function. Similarly, penalties generally do not generate significant funds for development; levels of fines are generally set by the Courts and are rarely punitive. Effectively, maximum penalties tend to be set at a level consistent with the recovery of costs involved in dealing with the effects of the breach.

Voluntary offset credit and incentive systems
Many US stormwater utilities offer credits or fee reductions for landowners who implement best management practices to reduce runoff. Credits range from 10% to 100% of the stormwater utility fee (Doll & Lindsey 1999). Factors for which credits are generated include:

- Detention volume
- Peak discharge detention
- Retention volume
- Total runoff abatement
- Water quality controls
- Reduction in pollutant loading
- Maintenance of onsite devices
- Development intensity

Fee reductions through credit provisions are usually, however, limited to non-residential properties, and the economic inducement of the credit is rarely sufficient to cause a property owner to retrofit

controls or perform activities simply to obtain the reduced fee (Cyre 2005a; Parikh et al. 2005). North American cities have had far greater success with public education and regulatory requirements than with pricing incentives attained through the user fee rate design (Parikh et al. 2005). Despite this, more than half the stormwater utilities in the United States adopt rate methodologies that incorporate user fee "credits" or positive behaviours and practices. One reason is that the general public and, especially, the business community have been more accepting of user fee structures that include such credits than of those that do not (Parikh et al. 2005). An additional incentive for local governments to provide credits is that the courts in the United States recognize a credit mechanism as a characteristic of a user fee and not of a tax. Since laws in many states limit the types of "taxes" that cities, counties, and special-purpose districts may adopt, but are more lenient in the local adoption of user fees, the adoption of user fee credits is more widespread than pure economics might justify (Parikh et al. 2005).

In contrast, credit systems in Germany appear to have been very successful. By 1996, 29 cities provided capped subsidies for reducing impervious area that range from NZ$900 to NZ$19,000 (NZ$9-NZ$110 per square metre) (Maunsell 2005). The two most commonly subsidised activities were construction of green roofs and rainwater tanks.
In New Zealand the issue of subsidising or funding on-site stormwater management infrastructure of this type is the subject of some debate. Subsidising the construction of on-site infrastructure is viewed as:

- risky because it becomes a private asset and the TA has limited control over its use and maintenance;
- expensive because subsidies would be financed as operating rather than capital expenditure and therefore need to be funded from the recurrent budget, i.e. rates.

Direct funding of on-site infrastructure would mean costs could be considered as capital investment, but ownership of assets on private land would potentially generate additional liability for maintenance, access, and consideration for the use of land. The issue of fee reduction or credit systems, incentive payments, and direct funding for on-site stormwater management systems in New Zealand needs further research.

Negotiated agreement programmes
Recent research into mechanisms for encouraging reduction of non-point source water pollution has highlighted the potential of negotiated voluntary agreements (Parikh et al. 2005; Randall 2003). Negotiated agreements are contracts between regulatory authorities and regulated entities, most commonly between levels of government, and have been widely used in Western Europe since the early 1980s (Bruyninckx 2001 in Randall 2003). In 1997, the European Environmental Agency reported 312 active agreements in 15 countries, covering climate change, water pollution, air pollution, waste management, soil quality, and ozone depletion. Recent research at Ohio State University (Randall 2003) explores the effectiveness of performance contracts between regulators and groups of individual landowners in reducing non-point source nitrogen and phosphorous emissions.

Historically, the potential to use negotiated agreements with TAs to target outcomes in specific catchments or receiving environments beyond those directed in the Air Land and Water Plan or determined as the Best Practicable Option in Integrated Catchment Management Plans deserved further consideration by the ARC. It is unclear, however, how this could be implemented now that all councils have been amalgamated into one organisation.

Market-based quantity instruments
A "cap and trade market" is a quantity-based instrument that restricts total allowable level of emission, allocates this level among individuals as allowances, and permits the transfer of these

allowances through free trade. Emitters that keep their emissions below their allotted level may sell their surplus allowances to others. The subsequent reallocation of allowances results in the equalizing of marginal abatement costs and the lowest cost allocation of the abatement burden. The approach has been very successful in air pollution abatement, e.g., $S0_2$, and is actively being explored for water quality trading and carbon trading.

The particular advantages of cap-and-trade marketing are that it does not require the market regulator to have any prior knowledge of the efficient abatement cost, and that it sets an enforceable limit on total emissions irrespective of current land use or future development.
Its major weakness is that it requires accurate monitoring and enforcement of performance, which is difficult with diffuse source pollutants like stormwater. The most common approach in the US is to establish a monitoring exchange that calculates tradable allowances from the successful adoption and implementation of individual best management practices. Trading ratios are used in the calculations to allow for uncertainty in the relationship between the estimated and actual reductions from individual BMPs, and for location effects caused by the spatial impacts of emissions.
The application of the cap-and-trade approach to water pollution problems can also face legal and public acceptance obstacles around issues of property rights. In the urban environment where there have historically been few controls on stormwater delivery from existing properties, it is likely that the right to deliver an unlimited amount of stormwater to a publicly managed stormwater system, constrained only by site coverage limits, is considered an existing property right. Constraining a perceived right will generate opposition unless there is a very clear and accepted reason for the constraint. The potential for the use of the cap-and-trade approach to limit emissions by individual land owners has been considered by a research team within the USEPA. They concluded that the legal issues associated with the implied property rights changes were a major constraint to its implementation (Parikh 2005). This may also be the case in New Zealand. However, an alternative application of the approach could be considered by the ARC, i.e. the development of a cap-and-trade system between catchments for the delivery of TSS and other contaminants of concern to major receiving environments (Tamaki estuary, Manukau Harbour, Upper Waitemata harbour, etc.). This could be implemented through the catchment management plan or network discharge consent process at the consolidated catchment environment level.

For major receiving environments these requirements provide only limited control over the total delivery of contaminants. The situation is complicated by multiple catchments, variable landforms and soil characteristics, and the spatial distribution of major contaminant sources. The use of proportional reduction limits and methods-based controls is likely to lead to inefficient abatement effort. For example, it may be possible to reduce TSS delivery at no additional cost by reducing emissions by 90% from a catchment contributing a high proportion of the total sediment load and achieving only 50% reduction in a neighbouring catchment with a lower sediment delivery ratio. The adoption of a cap on total delivery of contaminants and allocation of tradable allowances by catchment has the potential to promote the most efficient investment in abatement effort across catchments.

Appendix B Methods for Calculating Stormwater Service Fees

The USEPA provides information on three basic methods for calculating stormwater service fees[39]:

Types of Stormwater Utilities

There are three basic methods that stormwater utilities use to calculate service fees. These are sometimes modified slightly to meet unique billing requirements. Impervious area is the most important factor influencing stormwater runoff and is therefore a major element in each method.

Equivalent Residential Unit (ERU)

The ERU method (also known as the Equivalent Service Unit (ESU) method) is used by more than 80 percent of all stormwater utilities. It bills an amount proportional to the impervious area on a parcel, regardless of the parcel's total area. It is therefore based on the effect of a typical single-family residential (SFR) home's impervious area footprint. A representative sample of SFR parcels is reviewed to determine the impervious area of a typical SFR parcel. This amount is called one *ERU*. In most cases, all SFRs up to a defined maximum total area are billed a flat rate for one ERU. In some cases, several *tiers* of SFR flat rates are established on the basis of an analysis of SFR parcels within defined total area groups. A tiered SFR flat rate approach improves the equitability of the bills sent to homeowners. The impervious areas of non-SFR parcels are usually individually measured. Each non-SFR impervious area is divided by the impervious area of a typical SFR parcel to determine the number of ERUs to be billed to the parcel.

Advantages

The relationship (or nexus) between impervious area and stormwater impact is relatively easy to explain to the public—you pave, you pay. The number of billable ERUs can be determined by limiting the parcel area review to impervious area only. Because pervious area analysis is not required, this approach requires the least amount of time to determine the total number of billing units.

Disadvantages

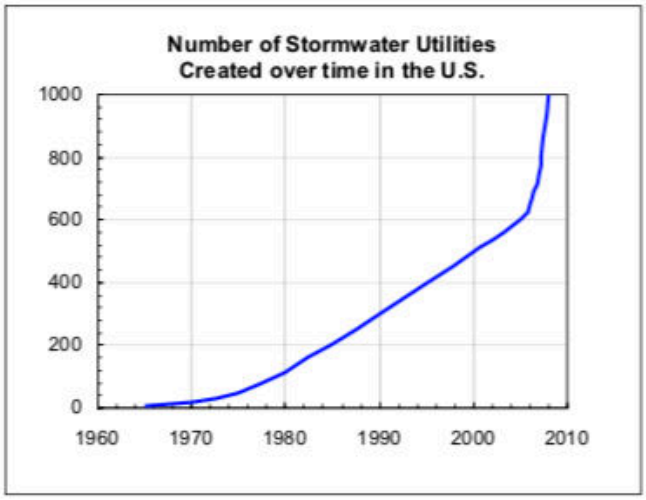
Because the potential effect of stormwater runoff from the pervious area of a parcel is not reviewed, this method is sometimes considered to be less equitable than the Intensity of Development (ID) or Equivalent Hydraulic Area (EHA) methods (discussed below) because runoff-related expenses are recovered from a

[39] **USEPA. 2009.** ***Funding Stormwater Programmes*****. EPA 90-1-F-09-004 (EAP Factsheet)**

smaller area base. This method could still be used to charge a fee to all parcels - pervious as well as impervious - to cover expenses, such as administration and regulatory compliance unrelated to impervious area.

What is a stormwater utility?

A stormwater utility, operating much like an electric or water utility, may collect fees related to the control and treatment of stormwater that can be used to fund a municipal stormwater management program.



Intensity of Development (ID)

This stormwater cost allocation system is based on the percentage of impervious area relative to an entire parcel's size. All parcels, including vacant/undeveloped parcels, are charged a fee. For developed parcels, fees are based on their *intensity of development*, which is defined as the percentage of impervious area of the parcel. Vacant or undeveloped parcels contribute to runoff and are assigned a lower fee. Rates are calculated for several ID categories and are billed at a sliding scale, as shown in the table below. For example, an SFR parcel, which is categorized as *moderate development*, would pay \$0.16/month/1,000 square foot (ft^2) (or \$1.60 for a 10,000 ft^2 lot).

Category (impervious percentage range)	Rate per month per 1,000 square feet of total served area (impervious plus pervious)
Vacant/Undeveloped (0%)	\$0.08
Light development (1% to 20%)	\$0.12
Moderate development (21% to 40%)	\$0.16
Heavy development (41% to 70%)	\$0.24
Very heavy development (71% to 100%)	\$0.32

Advantages

The ID method accounts for stormwater from the pervious portion of parcels. Therefore, it can be more equitable than the ERU method. If a parcel's impervious area is increased slightly because of minor construction modification, it probably would not be bounced up into the next higher ID category. This reduces the time required for staff to maintain the billable unit master file.

Disadvantages

The ID categories are broad, and parcels are not billed in direct proportion to their relative stormwater discharges. This method can be more difficult to implement than the ERU method because parcel pervious and impervious areas need to be reviewed. It is also more complicated to explain to customers than the ERU method. This method might also discourage urban infill and inadvertently encourage sprawl.

Equivalent Hydraulic Area (EHA)

Parcels are billed on the basis of the stormwater runoff generated by their impervious and pervious areas, charging impervious area a much higher rate than the pervious area.

Advantages

The EHA method accounts for flow from the pervious portion of parcels. Therefore, it might be more equitable than the ERU method. Like the ID method, it accounts for undeveloped/vacant parcels and allows them to be billed, but it is fairer than the ID method because parcels are billed on the basis of individual measurements of pervious and impervious areas.

Disadvantages

Because pervious area analysis is required in addition to impervious area, this approach requires more time to determine the total number of billing units. It is also more complicated to explain to customers than the ERU method.

These are three basic methods that utilities can use to calculate fees, but it is becoming clear that municipalities will need to be creative to find what will work for their community. In San Mateo County in California vehicle registration fees were increased to address stormwater pollution issues associated with vehicles and transportation infrastructure.