KĀPITI COAST : CHOOSING FUTURES

STORMWATER MANAGEMENT STRATEGY

Table of Contents

Kāpiti Coast District Council

in partnership with the community

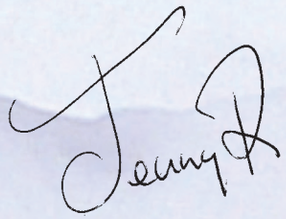
Introduction from Jenny Rowan, Mayor, Kāpiti Coast District

The majority of the 46,000 people who live in the Kāpiti Coast District live on a plain that extends along the western margin of the Tararua Range. Much of this coastal plain is only marginally above the existing sea level and is split at various points by a series of streams and rivers with steep catchments, all of which present varying levels of flood risk to the surrounding settlements which have grown up around them.

The District is vulnerable to the effects of climate change: rising sea levels; more frequent storm events; and heavier, more intense rainfall. The Stormwater Strategy provides a framework for the Kāpiti Coast District to respond to these threats over the next 30 years.

The Stormwater Management Strategy was developed through an extensive consultation process seeking community input into all aspects of the strategy, from levels of service, to acceptable risk and cost, to resilience and adaptation. Partnerships have been built between the Council, property owners, Iwi, communities and Greater Wellington Regional Council all of whom have a role to play in the effective management of stormwater and flood risk in the District. The Strategy is a guiding document that aims to ensure our community's vision to manage the District's stormwater and to adapt to the changing environment or provide appropriate protection from the potential destructive effects of flooding is achieved.

The aims of this Strategy cannot be achieved in isolation and it is closely linked to other Council strategies; the Development Management Strategy, the Coastal Strategy, the Sustainable Water Use Strategy and the Sustainable Transport Strategy.



May 2008

KĀPITI COAST DISTRICT COUNCIL
me huri whakamuri, ka titiro whakamua

What the Strategy Covers

This strategy is concerned with four broad matters[1]:

- identifying the acceptable levels of risk to people, property and environment from stormwater;
- managing the nature, location and scale of development in relation to stormwater risks and the effects of development on stormwater management;
- the nature, scale and timing of investment in stormwater infrastructure;
- long term community debate about adaptation to the uncertainties and changing stormwater risks arising from climate change.

The strategy discusses the main techniques for managing stormwater impacts. These are:

- information systems which enable people to make informed decisions;
- regulation of the location and design of settlement and structures;
- investment in on-site systems for managing stormwater run-off and re-use;
- investment in infrastructure for the transportation and treatment of stormwater.

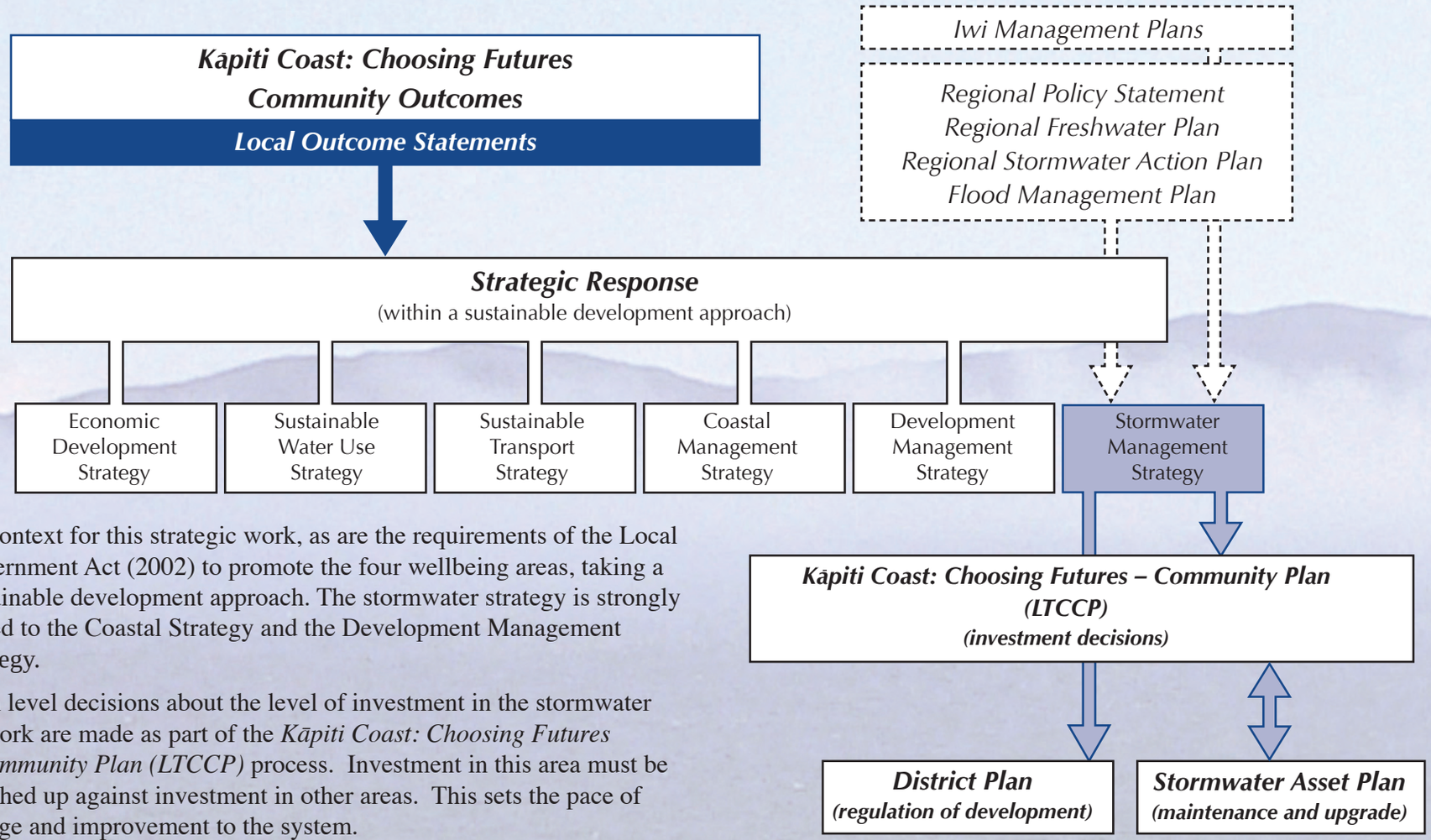
All of these areas are interdependent in some way. For example, design standards set to manage risk are the result of tradeoffs set in part by external statute but they are also shaped by the trade-offs between the nature and potential severity of a risk and the cost of protecting against it. This strategy summarises the main issues and describes the processes and priorities for addressing them.

[1] The strategy does not address any detailed issues on stormwater quality. Work on this component of the strategy will follow in a supplementary report in 2008.

Other Related Strategies

Iwi Management Plans

The Stormwater Management Strategy is part of a group of strategic documents that have been developed as a response to the community's vision for the future which has been developed since 2004. *Kāpiti Coast Choosing Futures – District Outcomes* and *Local Outcomes Statements* are the context for this strategic work, as are the requirements of the Local Government Act (2002) to promote the four wellbeing areas, taking a sustainable development approach. The stormwater strategy is strongly linked to the Coastal Strategy and the Development Management Strategy.



High level decisions about the level of investment in the stormwater network are made as part of the *Kāpiti Coast: Choosing Futures – Community Plan (LTCCP)* process. Investment in this area must be weighed up against investment in other areas. This sets the pace of change and improvement to the system.

What is Stormwater?

At a general level, there are two kinds of stormwater which is of concern in stormwater management:

- rainwater during and after periods of rainfall which is not absorbed into the soils and flows across the land. In a situation of unimpeded flow, this water finds a natural route across the land and into streams, rivers, lakes or the coast. The level of absorption is affected by the type of soil, the frequency of rainfall and the height of the water table;
- flood water from stream and river corridors that overtops river or stream banks and spreads out into surrounding areas. These natural stream and river flood ways are often areas where people have settled and have subsequently sought to confine the natural flow to avoid impacts on life and property.

Sometimes there are flat swampy areas with wetlands and lagoons that sit behind the main coastal dunes. In these areas, streams often merge and flow into each other, creating a series of wetlands. It can take very little water entering this area to have the streams 'flood' or merge, for example, the Waitohu, Mangapouri and Rangiuru Streams flow into an area behind the Ōtaki Beach settlement.

In some situations, stormwater may be trapped in low lying areas and sit as ponding for a period of time, depending on how high the water table is, how saturated the soils are and how quickly they can absorb the excess water.

The level of absorption is also affected by the amount of hard, impermeable surface in an area. In an urban area, the area of hard surfaces from roads, driveways and roofs of buildings will be large and will have a major impact on the nature and extent of stormwater run-off.

An Overview

The settled area of the Kāpiti Coast is on a low-lying coastal plain. Settlement has occurred close to rivers and in areas that will always be vulnerable to the effects of flooding and stormwater run-off. The area will be increasingly vulnerable to the effects of climate change over time.

For some time, the Kāpiti Coast District Council has taken a conservative or precautionary approach to managing development in relation to stormwater issues. The Kāpiti Coast recommended standards set for design and location of buildings are higher than those set nationally under the Building Act. New developments are required to provide significant on-site works to manage stormwater flows generated by the development under the Resource Management Act.

There is confidence in the management of the stormwater impacts created by development.

However, this development management framework is based on the premise that the stormwater network operates to the same specified standards. As with most communities in New Zealand, the current stormwater network does not deliver to the specified service standards across all parts of the District. The present community has inherited a system which in many cases is designed at lower standards. This may have been a deliberate trade-off between cost and risks but it may also have been because earlier communities did not expect such a high level of protection. In some places, stormwater pipe and culvert capacity is small and not capable of dealing with large storms.

There are now statutory standards that new developments must adhere to. There is also a growing expectation by people that they must have a much higher level of protection. This expectation may change over time as the cost of protection increases.

At the same time, there is increasing pressure on communities to manage the effects of stormwater on freshwater ecology and on coastal waters.

This has meant the application of new natural stormwater retention and treatment systems, such as artificial wetlands and detention ponds. This requires a catchment by catchment, site by site approach rather than simply applying standard solutions.

Communities across New Zealand are in a situation of catch-up, either in terms of system capacity or in terms of managing impacts on water quality. This catch-up programme must occur in a structured way that ensures that the main risks are documented, the right kind of solution is designed and the funds are allocated efficiently. This process has four aspects:

- identify the level of acceptable risk;
- understanding the kinds of works needed (and costs) to offset risks by catchment;
- assessing the environmental impacts/benefits;
- sourcing the best hydrological data and using sound modelling techniques;
- making decisions about what works have priority within the funding envelope available or expanding the amount of funding;
- construction.

Until recently, knowledge of stormwater network issues on the Kāpiti Coast was based on information from reactive studies carried out as issues have arisen in catchments. The Council

does have a good understanding of works needed to deal with specific local issues. It does not always have a catchment wide understanding, whereby works can be planned comprehensively for each catchment and dealt with as an integrated whole.

Work has been underway for four years on improving understanding of the level of risk based on more comprehensive studies and assessment against service standards.

Although, the Council has been at the forefront nationally of developing stormwater modelling using the new mapping technology, the comprehensive stormwater modelling of all catchments is not yet complete. It has proved difficult to advance this comprehensive analysis, given the pressure from individual property owners to deal with their specific issues and to respond to what they see as the priorities. This has delayed the shift from the traditional reactive approach to the more comprehensive approach. Since 2006, the Council has moved to separate out the strategic modelling and upgrade programme from the more reactive works.

The Council is funding a significant amount of catchment by catchment analysis over the next five years which will identify the total works needed and therefore the total cost. The impacts of climate change are also being factored into all modelling. At the time that this modelling work is completed, the community will understand the total cost of achieving the level of protection from risk that it has chosen. At that time it can debate the tradeoffs. This debate will happen catchment by catchment.

In the 2006/07 Long Term Council Community Plan, the Council committed to completing the then known needed works (as of 2005) within ten years. Similar levels of funding were provided for after that time, to cater for new projects as investigation and analysis of issues is carried out. At the same time the Council split the stormwater budget into two parts: one for work on catchments that have a districtwide strategic importance and a budget allocation that would deal with local issues based on localised risk.

Given the incomplete nature of the stormwater system, this strategy specifically addresses the two issues that arise as a result:

- are there some low-lying areas within the current urban areas where development of remaining sections should simply not happen?
- should development in some catchments be delayed until key infrastructure works to deal with existing risks are addressed?

1. Context

The interactions between land, water systems and climate define the nature and scale of stormwater risks for human settlement. Past interventions by communities in river and stream systems and past decisions about settlement will also have an impact on the level of risk.

Land and Soils

The Kāpiti Coast is a narrow coastal plain that extends along the western margin of the Tararua Range. The major landform on the plain are a series of fixed and mobile sand dunes which, under the influence of the prevailing westerly winds, have formed elongated dune ridges aligned northwest/ southeast roughly parallel to the present day coastline. Historically these dunes were interspersed with wetlands and the soil composition along the coastal plain is a mix of sand and peat, with varying degrees of drainage capacity. Clay soils are evident closer to the hills at the eastern edge of the coastal plain.

Inland from the coastal margin, rivers draining the Tararua Range have formed an alluvial plain that begins in Waikanae and widens to the north into the wider Ōtaki area.

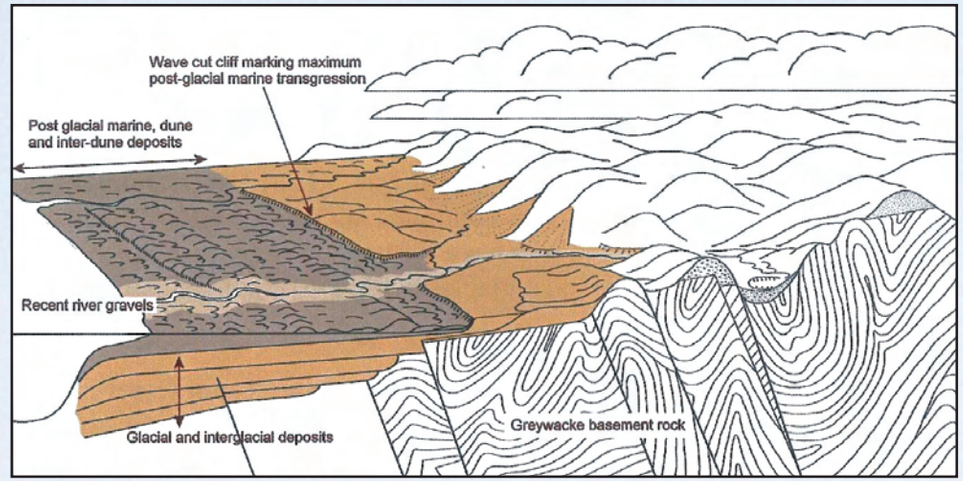


Figure 1: Kāpiti Coast Landforms

The most heavily populated areas of the Kāpiti Coast largely lie on this coastal plan, which in some places is only marginally above existing sea levels. The majority of Paraparaumu township for instance (the most heavily populated area in the region) lies on a series of low sand dunes and peat areas less than 7 metres above sea level.

Water

The coastal plain is split at various points by a series of relatively swift flowing streams and rivers with steep catchments, all of which present varying levels of flood risk to surrounding settlements. Many of them have been modified to some degree in order to protect the settlements which have grown up around them.

There is a cluster of small streams at Paekākāriki, with the Waikakariki into the town at Ames Street and small streams immediately to the north, with the northern Smith's Creek providing the water supply for the town.

There are no streams flowing through the coastal dune area of Raumati South but there are areas of natural ponding as surface run-off is trapped in low lying peat areas. Stormwater is pumped from some of these areas to the coast.

The Wharemauku and Tikotu Streams, and the Mazengarb Drain[2] flow through the extensive urban area of Paraparaumu and part of Raumati. Many of the streams have been heavily modified and although most are not piped along the main water course, the tributaries are piped. A number of streams have their origins to the east of the State Highway and railway, with the road and rail network acting as a barrier to flow in some corridors.

The back dune areas at Paraparaumu and Raumati were previously a mixture of dune and wetlands/ swamps. These areas are not served by a stream system for drainage. Stormwater is piped with a very gradual fall to the coast.

The Waikanae River is the main water supply source and the largest river in the southern part of the District. The river naturally floods across the lower reaches and has been modified at a number of points, as a consequence. It presents a flood risk to Otaihanga along the southern edge. Connected to the main river are a number of streams which flow through the Waikanae Beach area mainly to the north beach end.

Waikanae Beach also has a number of lagoons which are spring fed and are the highly modified remnants of the extensive lagoon and wetland system found behind the main dune system. There are localised flooding issues but improvements have made the area less prone to flooding.

The other main river system is the Ōtaki River which drains three major sub-catchments in the Tararua Range. The river has always presented a flood risk for the town which has been reduced over time by the building of stop banks. Work is planned at Crystalls Bend to complete protection along the northern edge. The area lying between the Ōtaki Beach settlement and the main town is vulnerable to flooding along across a 'delta' where the Mangapouri, the Rangiuru and the Waitohu Streams converge.

[2] The Mazengarb Drain is not a natural waterway but was created to drain a significant area of Paraparaumu at the time of development. At that time, some portions of the Tikotu Stream were redirected into the Mazengarb Drain.

Groundwater

A 2005 report[3] by Sinclair Knight Merz (SKM) for the Kāpiti Coast District Council defined three distinct hydro-geological settings across the Kāpiti Coast:

- shallow unconfined sand aquifers along the seaward margin of the coastal plain;
- shallow unconfined gravel aquifers adjacent to rivers and streams draining the Tararua Range;
- extensive semi-confined and confined aquifers hosted in glacial outwash gravel deposits underlying the majority of the coastal plain.

Of these hydro-geological settings, the unconfined sand aquifers along the seaward margin of the coastal plain are the main focus in terms of potential land development impacts. The Coastal sand aquifer is recharged by local rainfall, and discharges to numerous small streams that drain the coastal plain, as well as discharging directly to the sea. The discharge rate in the sand aquifer is low reflecting the limited gradient of the coastal plain.

As a result of the low topographic gradient and undulating topography, the natural water table levels occur within 1 to 2 metres of the land surface across much of the coastal margin. Following periods of high rainfall the corresponding rise in the water table results in extensive ponding across many low-lying areas. Modelling of groundwater level variations indicates that significant areas of the coastal plain may potentially be affected by natural groundwater ponding following extreme rainfall events.

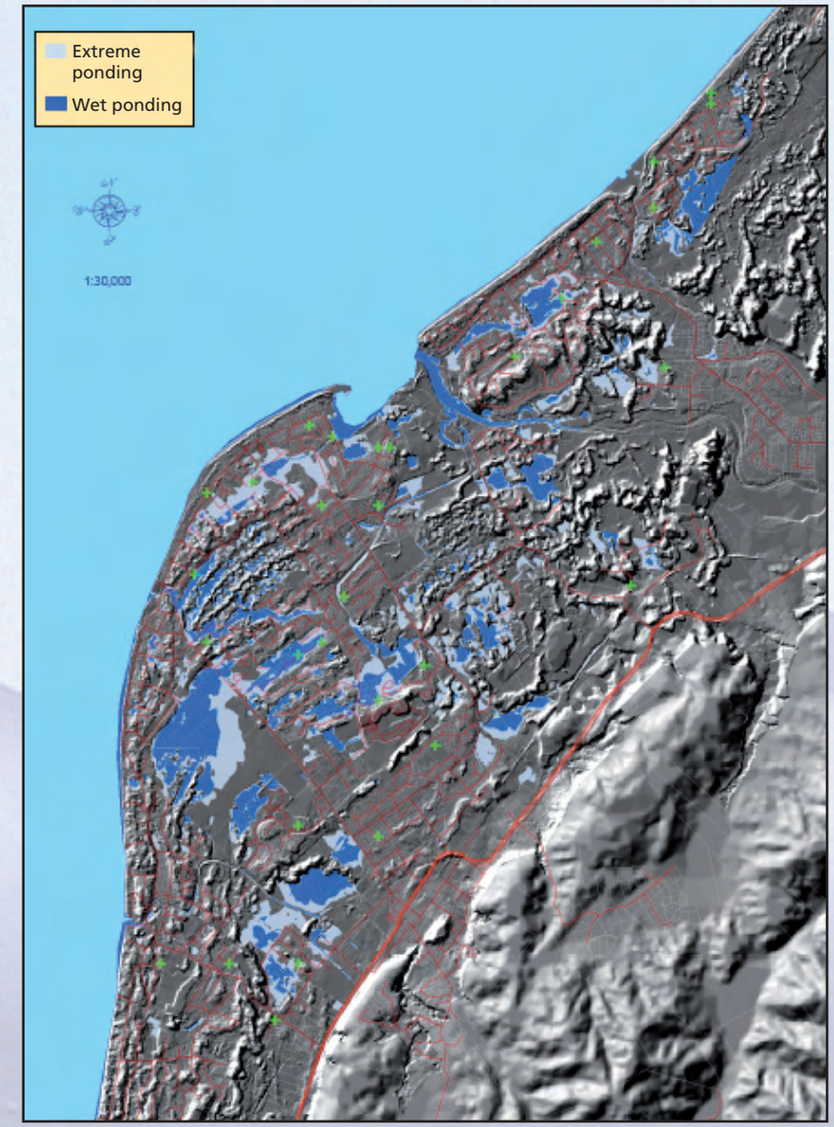


Figure 2: Example of areas vulnerable to groundwater ponding

[3] Michelle Malcolm 2005 *Review of Development Impacts on Stormwater Management;* Sinclair Knight Merz (SKM), Consultants, Wellington.

In many areas of the coastal plain natural groundwater ponding also occurs due to the low permeability of organic clay (peat) soils that accumulate in inter-dune areas. In these areas surface ponding occurs due to the accumulation of rainfall and runoff from surrounding dune areas which cannot infiltrate readily to the underlying water table. Figure 2 illustrates the areas where groundwater ponding could be expected after prolonged wet periods. While this figure illustrates extreme groundwater ponding conditions, it highlights the low lying nature of the district and the natural wetland and lagoon areas.

The analysis commissioned by Kāpiti Coast District Council in 2005 shows that the areas identified as vulnerable to ponding from elevated groundwater levels generally equate to those low lying areas prone to surface water ponding.

Climate

The Kāpiti region is subject to an average of 1000 mm of rainfall a year which produces a significant volume of stormwater runoff.

Over the last few years the Kāpiti Coast has experienced a number of extreme and quite localised storm events which have resulted in flooding at Paekākāriki, Otaihanga and on the State Highway. In the case of Paekākāriki, the weather caused the destabilisation of gravels in the steep valleys of the coastal escarpment and the blocking of culverts and stormwater systems closer to the coast.

There was also a major storm in 1998 that caused considerable damage, particularly in Otaihanga.

The local community expressed concern that the Kāpiti Coast was witnessing the initial affects of climate change. In 2005, the Kāpiti Coast District Council commissioned the National Institute of Water & Atmospheric Research Ltd (NIWA)[4] to provide the best available interpretation of the impacts of climate variability and change on the district's rainfall as it affects stormwater .

The report concluded that rainfall during 2004 was extreme, particularly during February. 2004 was the wettest year on record and the whole District recorded substantially more rainfall than the long term average. The analysis indicated no relationship could be discerned between the 2004 events and any recognised weather pattern that could indicate long term climate change. Without a significant pattern to correlate the data with, it was not possible to predict or implement strategies to manage a recurrence of those events.

[4] NIWA is a nationally recognized water and atmospheric research body that sources global climate modelling data from the IPCC Assessment Reports. These reports are internationally recognized and used worldwide. This work is then used for independent modelling of catchment flows at a district level.

Climate Change

The NIWA Report did note that there are indications that climate change over the next 30 – 80 years is likely to lead to more storm events similar to 2004. The key findings and implications for stormwater management are:

Table 1: Summary of 2005 NIWA Report Findings on Climate Change Impacts

	By 2030		By 2090	
	Mid estimate	**High estimate**	**Mid estimate**	**High estimate**
Temperature	+0.95°C	+1.70°C	+2.85°C	+5.10°C
Annual rainfall	+3.0%	+8.0%	+3.5%	+14%
Winter rainfall	+4.50%	+10%	+13%	+26%
Increase in intensity of extreme rainfall events	+5.9%	+13.6%	+22.8%	+40.8%
Sea level rise	+0.12m	+0.18m	+0.49m	+0.8m
High tides		37% of high tides exceed current high tide level (MHWPS)		90% to 100% of high tides exceed current high tide level (MHWPS)
High wind events	Incresed frequency of westerly winds		Incresed frequency of westerly winds	

These overall percentage increases overall do not necessarily translate to the same impacts in each catchment. For example, a recent study of the Wharemauku catchment shows that a 13% increase in rainfall would result in a 21% increase in water volume in the stream channel This makes the step of taking the climate change data and inserting it into the stormwater catchment modelling to identify final risks essential.

increased westerly winds and intensity of rainfall will increase rainfall in the ranges – increased likelihood of river flooding in flood plain areas

more frequent risk of larger flood event and coastal flooding from storm surges

reduced gradient for discharge of stormwater to the coast – possible increase in need for pumping and costs of pumping

need for:

- **greater peak load capacity for stormwater pipes;**
- **increased storage ponds capacity**

high water table and increased incidence of groundwater ponding

saltwater intrusion in some arts of the stormwater network

The 2007 NIWA Report is the second climate change update since the strategy was first developed. The implications from this second report indicate a greater chance of even more extreme weather events in a shorter time frame than previously predicted in their 2005 report.

Kāpiti Coast communities will have to face the possibility that what are currently 1:50 year stormwater events (in terms of intensity and potential damage) occurring with the frequency of a 1:20 year storm event. Given that the community plans and invests in stormwater management around an upper limit of 1: 50 and 1: 100 year stormwater events, this presents a major challenge and potentially significantly increased costs to maintain current service levels. This issue is covered in more detail in a later section.

Council will:

- ensure a review of base assumptions about climate change factors with the potential to affect stormwater management will be undertaken biannually;
- undertake a review of climate change factors following any major international/ national review or update of assumptions and rates of change, should this occur outside the two year review programme;
- advocate to the Greater Wellington Regional Council that it commissions regular updates of climate change assumptions and impacts, at a level capable of use at the local authority level for stormwater and flood management purposes.

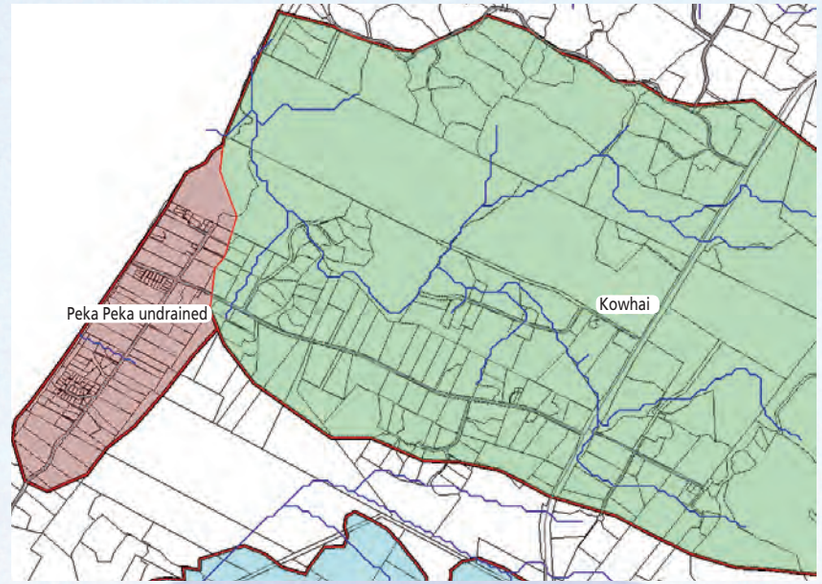
2. Management Areas

The District has been divided into a number of urban stormwater network management areas. The divisions are based in part on topography and stream catchments but also recognise local communities.

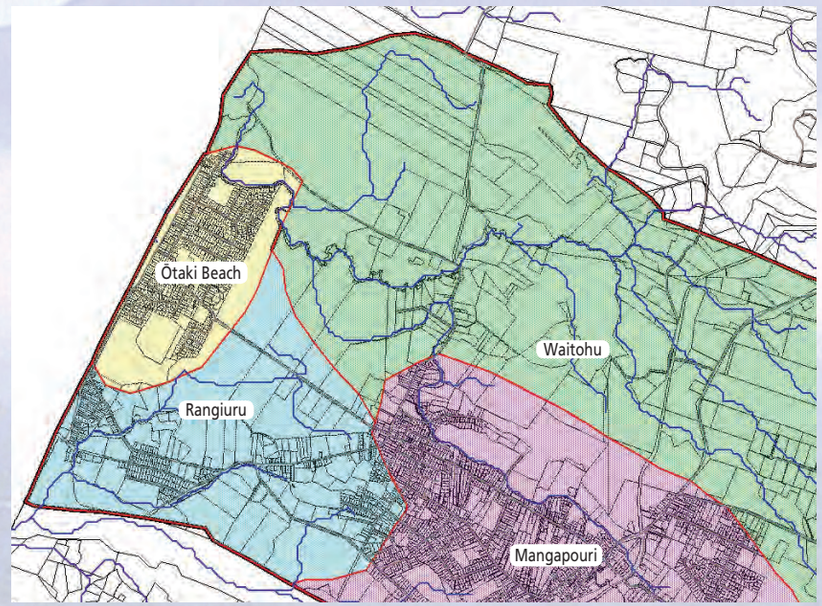
Stormwater Management Area	Area Description
Paekākāriki	Includes three streams affecting village
Raumati South	'unmodified' dune/peat area, no stream drainage – coastal influences
Wharemauku	major stream catchment with assets of Districtwide strategic importance
Paraparaumu Coastal	no stream drainage, network drains to sea
Tikotu	small stream, draining through town centre – coastal influences
Mazengarb	major catchment affecting Paraparaumu North
Paraparaumu North Beach	coastal dune area draining to beach – localised ponding and draining to estuary
Otaihanga	village area – susceptible to river flooding
Waikanae East	small stream draining south and west – SH1 and rail as barriers
Waikanae Central	river terrace – some headwaters to streams draining through Waikanae North
Waikanae North	future urban growth area – major wetlands, dune and peat area
Waikanae South	large urban area – influenced by river and complex stream system across 'delta'
Waikanae Old Beach	modified, spring fed tidal wetlands/ basin, major environmental issues
Waikanae North Beach	dune, peat area, Waimeha Stream and 'Black Drain' drain the area
Peka Peka Undrained	no stormwater network but requires stormwater management in relation to settled areas
Te Horo Beach	no stormwater network but requires stormwater management in relation to settled areas
Mangapouri	cover major part of Ōtaki town including Waitohu Plateau – older stormwater network
Rangiuru	cover local beach area near river, vulnerable to flooding from river and across 'delta'
Ōtaki Beach	main beach settlement – affected in north by Waitohu Stream mouth, mainly drains to coast

In addition, six associated catchment area have been identified. These areas have no stormwater network, are located outside the urban stormwater rating areas and there are no plans to provide a stormwater network service. However, they are relevant because works may be necessary in these areas from time to time, to relieve problems downstream in the urban stormwater management areas.

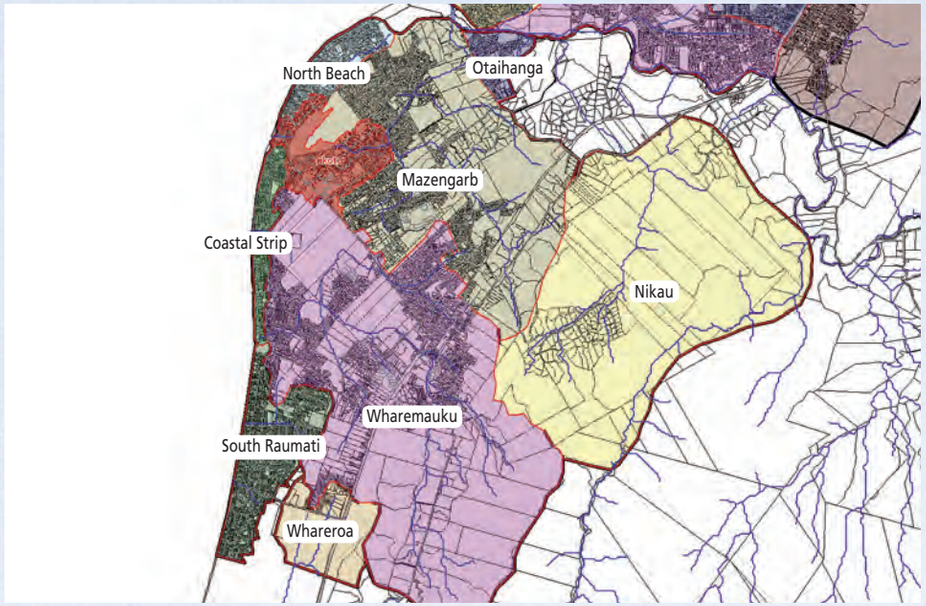
Associated Catchments	Description
Whareroa	dune and peat adjacent to Raumati South
Waikanae East	hill slopes north of the Waikanae East urban area drains into the Waikanae North area
Nikau (including Mauapoko Stream)	no stormwater network relevance is impact on lower Mazengarb area
Reikorangi	upper reaches of Waikanae River – requires management of erosion downstream effects
Kowhai	management of the Mangaone affects stormwater management of stream in north
Mangaone (west of SH1)	management of the Mangaone affects stormwater management at Te Horo Beach
Waitohu	flood management regime relevant to both Ōtaki town and Rangiuru Stream area



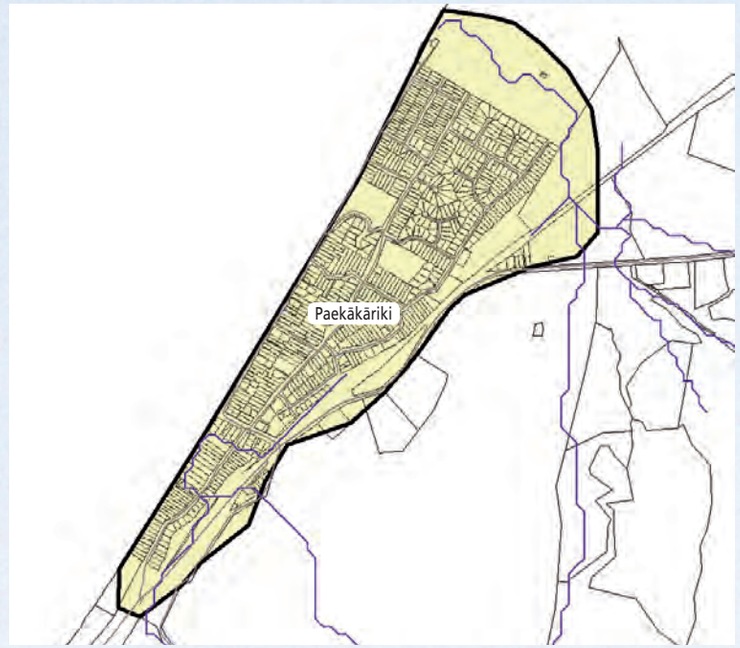
Peka Peka



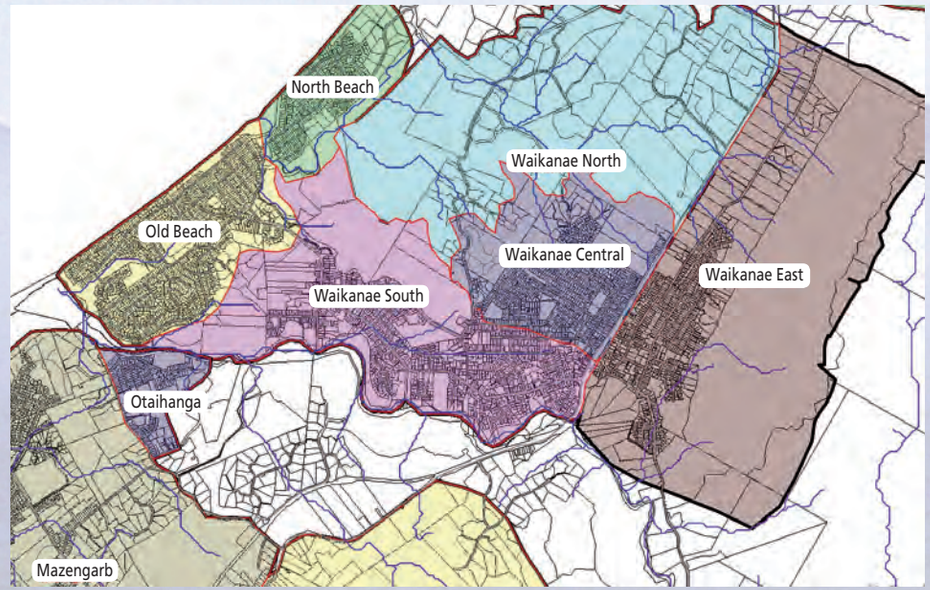
Ōtaki



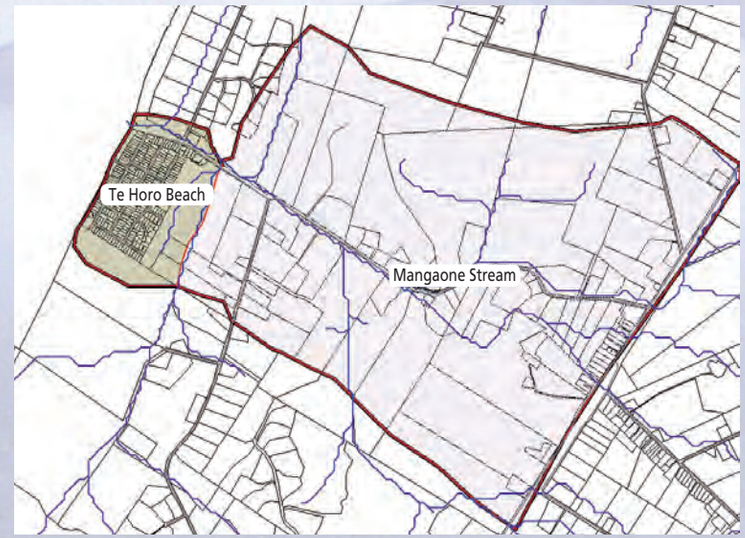
Paraparaumu



Paekākāriki



Waikanae



Te Horo

3. Partnerships and Processes

Property owners, local and regional government agencies all have a responsibility around stormwater. The agencies, groups and individuals involved in managing stormwater and flood risk in the District are shown in Table 2 below.

Table 2: Summary of Agency Responsibilities

Agency	Responsibility
Property owners	• maintenance of on-site drainage and stormwater systems • management of on-site systems to avoid external impacts
Communities	• active participation in discussions, debate and decision making about the preferred level of risk and expenditure around stormwater risks and water quality
Kāpiti Coast District Council	• maintenance of an urban stormwater network to agreed standards • management of development impacts on stormwater systems • regulation of location of development and design of structures in relation to specified stormwater risks
Greater Wellington Regional Council	• management of flood risks from main river flooding, rural and some identified urban stream catchments • management of specified stream corridors under the KCDC/GWRC agreement • administration of rural watercourses

Both Kāpiti Coast District Council and the Greater Wellington Regional Council have adopted an 'integrated catchment' concept for stormwater and water management. Kāpiti Coast District Council is working to integrate this work with wider decisions about urban growth management, transport and economic development. The Council is committed to a process whereby communities in each catchment are involved in debating the levels of acceptable risk, the potential solutions and impacts and costs. The first of these processes will be focused on Ōtaki and the need to ensure community involvement in stormwater management decisions ahead of major urban growth pressure.

In an environment where there are significant groundwater and stormwater management issues, it is important that property owners (and prospective property owners) take responsibility for managing their on-site systems and for being aware of and making clear decisions in relation to risk issues. Central to that will be improving general awareness that Kāpiti Coast is an area that is vulnerable to impacts of stormwater and to the impacts of climate change. A key role for Kāpiti Coast District Council will be to provide general information about the issues on a regular basis.

Council will work in partnership with communities of interest in relevant stormwater management areas, or combined areas, and with tāngata whenua to:

- maintain an overview of receiving water quality and impacts of stormwater on freshwater and coastal systems;
- ensure input into analysis of risks and potential programmes;
- provide a mechanism for discussion of options and issues;
- ensure consideration of values and the wider community and tāngata whenua vision for the future.

The focus will be on catchment wide stormwater management and solutions, rather than specific site by site concerns of individual landowners. Specific issues will be dealt with via the normal work programme.

4. Stormwater Risks

This strategy is focused around managing stormwater and managing development decisions in relation to the following broad risks areas:

- potential physical harm to people;
- potential to cause serious illness via contamination of stormwater;
- where people may be prevented from living in their home for short or long periods;
- where people are prevented from using or being assured of access to essential services;
- where the long-term ability to produce and transport food, goods and services essential to the maintenance of life and the economy is restricted.

Risk does not include the 'nuisance' created by disruption to people's lives from general impacts on travel time, or use of non-essential services, and short term nuisance associated with low level stormwater flow and ponding. It is important that risk is assessed clearly so that the community is not drawn into dealing with issues of nuisance to the detriment of dealing with matters of genuine risk.

The profile of risk varies across the District, shaped by topography and climate and also by the settlement characteristics and past stormwater management decisions. The assessment of risk also relates to whether there is an impact on people directly, on their property or on the environment.

[5] Water quality is to be addressed in the second stage of work on stormwater in late 2008.

Table 3: Summary of Risk Types

Risk area	Risk type	Affected by
Social	personal safety	scale/frequency of stream and river flooding
	personal health	duration of flooding
		cross-contamination from wastewater
	property loss/damage - individual property and community infrastructure	scale/frequency of stream/river flooding
		scale/frequency of flooding urban run-off
	access to essential services	scale/frequency of stream/river flooding
		duration of ponding
Economic	property loss/damage - individual property and community infrastructure	scale/frequency of stream/river flooding
		scale/frequency of flooding urban run-off
		duration of ponding
	movement of workforce	scale/frequency of stream/river flooding
	movement of goods	stormwater runoff – general
Environmental	ecosystem degradation	point of discarges
		general discarge (eg. road runoff)
Cultural	water quality to iwi[5]	capacity to filter stormwater runoff, or prevent cross-contamination from wastewater
	protection of historical sites	scale/frequency of stream/river flooding

In general, the Kāpiti Coast District's current urban stormwater regime is not exposed to catastrophic risk to life. However, there are some limited areas where there is risk to property to varying degrees and potentially, emerging risk to health around long-term ponding. The Ōtaki and Waikanae Rivers in major stormwater events do present significant risks to small parts of the community.

At a general level the usual approach to risk assessment is a three step process as follows:

- modelling the extent of primary and secondary stormwater flows and ponding under selected stormwater events;
- assessing how many people and properties are affected. For example, in one catchment while stormwater flows may be extensive, only a small number of properties many be affected, or only non-habitable buildings;
- then allocate investment across affected areas or catchments.

Considerable work has been undertaken to identify and model the extent of stormwater flows within the District. However, Kāpiti Coast District Council will not be undertaking such a detailed assessment across all catchments. Instead it has adopted the following process:

- identify key catchments which an initial scan suggests they have significant potential risk. This assessment is based on the number of people in the catchment, the nature and value of community assets, significance as places of employment and significance in terms of growth management;
- undertake a programme of stormwater modelling beginning with these strategic catchments but working through all catchments over time;
- undertake an assessment of numbers of properties affected and degree of impact within the selected catchments only;
- allocate stormwater funding into two areas:
  - a strategic investment upgrade budget to address identified risk issues in the selected strategic catchments;
  - a capital works budget for dealing with reactive local works for local issues in other catchments and in the strategic catchments where appropriate.

This approach recognises the significant costs of carrying out a detailed risk analysis in all catchments. Some catchments have very limited problems and the risk analysis is not needed at this stage. However, in the more complex catchments where an integrated catchment wide approach is needed the final step in the risk analysis is necessary. The split of funding for local and strategic works also means that a comprehensive and strategic approach to addressing risk is not overwhelmed by reactive local issues but the latter are still addressed over time.

In terms of the work completed the main points to note are:

- primary flow paths for the main rivers and urban streams have been mapped by Kāpiti Coast District Council and the Greater Wellington Regional Council. This information allows people to understand the river flood risks affecting their properties. The information has been included in the District Plan;
- modelling of urban stormwater run-off and impacts (over and above river/ stream flooding) has been undertaken in a number of urban catchments and sub-catchments. To some extent this work has been reactive, with modelling undertaken as problems and issues have arisen. Over the last two years, the Council has increased investment in modelling and review by catchments to move away from a simply reactive approach.
  - The areas reviewed to date are as follows:
  - Wharemauku Catchment;
  - Ōtaki urban areas;
  - Mazengarb Drain/Te Roto Drain catchments;
  - Tikotu;
  - Raumati North;
  - Paraparaumu North Beach;
  - Waikanae South.
- work has commenced on mapping areas vulnerable to long-term ponding when the water table is high;
- Kāpiti Coast District Council monitors stormwater discharges to stream receiving waters to identify any contaminated sources so that these can be investigated and mitigated;
- the Greater Wellington Regional Council monitors contamination risk for contact recreation (e.g. swimming)
- Ecosystem risk from stormwater has not yet been mapped and benchmark standards are being developed by the Greater Wellington Regional Council.

Table 4: Summary of Modelling Work and Priorities for Formal Risk Analysis

Stormwater Management Area	Current Extent of Modelling Analysis		Risk review priority
	Urban stormwater	Ground-water*	
Paekākāriki	30%		high
Raumati South	70%		medium
Wharemauku	70%		high
Paraparaumu Coastal	20%		medium
Tikotu	90%		medium-high
Mazengarb	90%		high
Paraparaumu North Beach	90%		medium-high
Otaihanga	10%		high
Waikanae East	40%		low
Waikanae Central	10%		low
Waikanae South	70%		medium-high
Waikanae Old Beach	70%		medium-high
Waikanae North Beach	0%		medium-high
Peka Peka Undrained	0%		medium
Te Horo Beach	0%		medium
Mangapouri	100%		high
Rangiuru	100%		high
Ōtaki Beach	100%		high

**all management areas to be modelled in conjunction with Greater Wellington regional Council groundwater model over next two years.*

Factoring climate change into risk assessment

Work is underway to model the extent of stormwater flows associated with climate change in association with the modelling programme. The 2005 NIWA Report has been used to re-model stormwater effects in the Wharemauku Stream catchment and the Ōtaki area. This has been done by applying a sensitivity test to identify how far the new sea level rise and rainfall figures will modify current estimates of flow paths, volumes, storage needs and groundwater ponding in particular areas.

This modelling is based on the estimates of changes of climate factors at 2080. Impacts will continue to increase as the information at 2080 shows.

Council will continue a stormwater modelling programme with the aim to have full modelling of all stormwater management areas by 2012 as set out in the Stormwater Asset Plans.

Council will include emerging climate change factors/ parameters in all future modelling of stormwater extent.

5. Levels of Service

The Council works to a specified level of service for the management of stormwater. Maintaining an agreed level of service costs the community money in that it has to invest in infrastructure and maintenance to provide the agreed level of protection.

The selected service level adopted by Council to guide its investment takes a middle ground on a continuum between low levels of temporary nuisance and inconvenience and the upper end of catastrophic events. Trying to deal with every single instance where a road or park, or even a backyard is temporarily flooded is extremely expensive. Equally, investing in infrastructure to the extent that a community is guaranteed to have no risk ever of flooding is impossible. The level of engineering that might be needed for this kind of guarantee can also impose unacceptable environmental costs.

A 'happy medium', where people are generally safe, residential property can be lived in, access to essential services is generally assured and the life supporting capacity and safe recreation use of water is maintained has been chosen.

Even this 'middle ground' is expensive with implications and costs having to be upgraded each time more information is gained from stormwater modelling. The community must constantly assess the level of risk it is prepared to live with, the service level it chooses and the amount of money it is prepared to spend.

Climate change will also bring greater uncertainty and higher risks. In this situation, the community will have to:

- regularly review whether it will maintain or reduce service levels over time, relative to the cost of achieving the agreed level;
- over time make decisions about the extent to which it is prepared to invest collectively to protect private property;
- identify whether there are any areas where it is not prepared to see development happen because of the long term risks.

The diagram on the next page outlines the service level standards used by Council.

more frequent but minor effect

no action taken to offset minor events

Service Level Standards

less frequent but major effect

no action taken to catastrophic events but limits set on where people can locate

Kāpiti Coast Service Level Standards

basis for subdivision and building controls
basis for investment in infrastructure

Statutory (Building)	**Council Policy**
design for 1: 50 year required for habitable buildings	design for 1:50 event required for habitable buildings
	design for 1:100 storm event recommended for habitable buildings
	all building sites must be designed at or above 1:100 storm event level
Statutory (Subdivision)	
non-residential buildings	1:50 storm event design required for all buildings
no requirement	except accessory buildings
no freeboard standard depending	minimum 30cm- 1 metre freeboard on circumstances
restriction on building in areas	no building within river and stream flood hazard areas corridors (primary and secondary flow paths), ponding areas and flood storage areas without a resource consent process. Very limited approval rates
option to place notices on title	mandatory notices on title for dwellings built in flood hazard and ponding areas
no requirement for action on ponding	duration of ponding where cause is off-site *no-build areas where ponding problematic (under investigation)*

Understanding the Service Level Standards

Stormwater Events

The frequency and severity of storms and flood events is expressed as a measure of the likelihood of their occurrence. For example, a 1: 50 year event means that there is a 2% chance that a storm event of that severity will occur in any one year. For a 1: 100 storm event, there is a 1% possibility that such an event will happen. It does not mean that such an event will only happen every 100 years.

The standard is used to:

- set rules for the location and design of buildings;
- identify the size of pipes etc needed for stormwater infrastructure.

Kāpiti Coast District Council uses a recommended design standard for habitable buildings that is higher than the statutory requirement (1: 100 storm event). It believes that the community should be taking a precautionary approach given the vulnerability of parts of the coastal plain. The Council requires a standard of 1:100 storm event for the design of all building platforms for new subdivisions.

It is assumed in the national standards that the risk of damage to non-habitable buildings is a matter for the building owners and insurers, given there is no risk to human life or health. Kāpiti Coast District Council recommends design for commercial buildings for a 1:100 storm event. The non-habitable part of any building should be designed utilising materials that will not be affected by floods occurring in a 1: 100 storm event.

Flow Paths

- a primary flow path is the initial area of stormwater flow in a storm. Generally works such as culverts and pipes are designed to take a certain amount of flow along these areas and then the water will disperse into secondary flow paths. For the Kāpiti Coast, the primary stormwater network is designed for a 1: 10 year storm event;
- a secondary flow path is expected to take the flow of water when the primary system is at capacity. Roads, parks and other open space will be used as secondary flow paths and therefore will be subject to some levels of flooding and flood storage. This is a normal part of stormwater management. Back yards may also be expected to take some water in a storm event as part of a secondary flow path. In these cases, there is a requirement not to build on these flow paths.

Ponding

- ponding is water which lies during and after an initial storm event. Kāpiti Coast District Council has set a standard for ponding which triggers works, provided that the ponding is a health problem and can be linked to something off-site caused by the external stormwater system. Development in ponding areas is closely managed;
- given the high water table and the propensity in some areas for ponding, the Council is investigating possible ‘no-build areas’ for some limited extreme circumstances.

Flood Storage

- these are areas (some naturally occurring) which have been included or designed into the stormwater network to store water in a storm and slow the release of water into the main flow paths. These flood storage areas are designed into new subdivisions and can also be provided in catchment headwaters. Development is not permitted in flood storage areas.

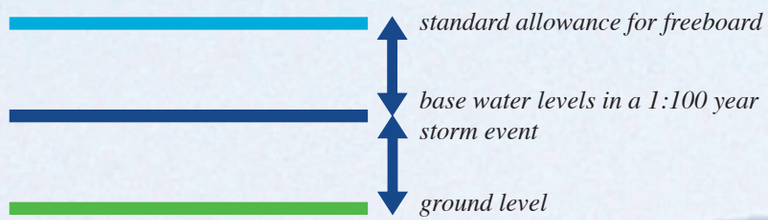
Freeboard

- freeboard is an extra allowance of height in the theoretical flood levels developed in stormwater modelling which requires the under floor joists to be above a specified height. This takes into account issues like waves generated in a storm, effects of wind and partial blockages. Again Kāpiti Coast District Council has set a higher standard.

Levels of Service – Allowing for Climate Change

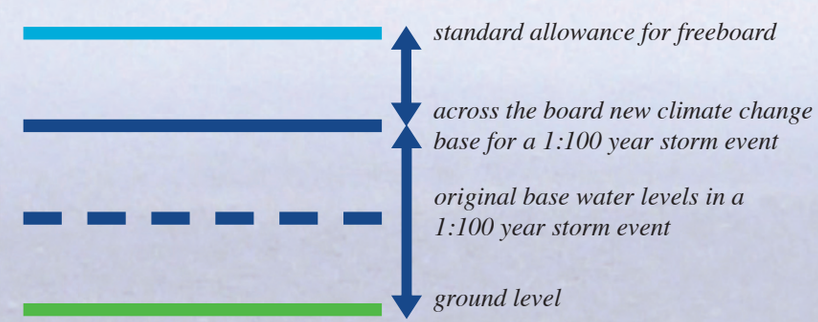
The use of freeboard builds in a level of precaution by allowing for modelling inaccuracies or wave action from wind on larger areas of flood water. It builds a margin above the base modelling level. A major strategic issue is whether levels of service standards should be further modified to bring in the new climate change levels as the new base, on top of which is built the freeboard allowance. The current is illustrated below.

Current Approach



One option is to include a standard provision for across the board and place freeboard on top of that again.

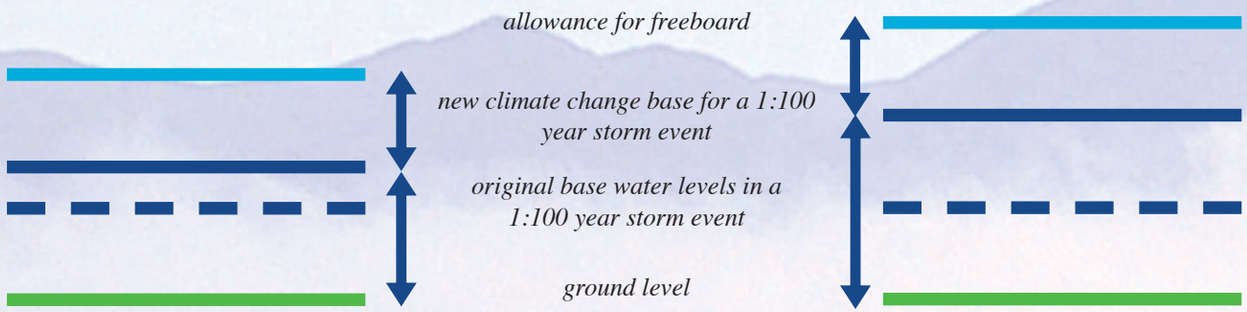
A Standardised Option



In reality the impacts of climate change will vary across catchments and sub-catchments. In one catchment, there may only be a 70mm increase over the old base line, in another catchment it may 400mm. There could be as much as 1 metre variance in heights.

It is proposed that the new climate change information be used to test the impacts on base levels on a case by case basis and that freeboard be adjusted to take account of climate change impacts in that specific site or stormwater management area. For example, if climate change shifts the base for a 1:100 year event by 70mm then an adjustment is made to the freeboard by 70 mm.

The Preferred Approach



Example A **Example B**

Council will apply a climate change test to flood hazard levels and adjust freeboard service level requirements on a case by case basis, ensuring that a minimum best practice standard for freeboard is maintained in all situations, after provision for climate change impacts. This will be required for all new infrastructure, subdivision and building.

Current Service Levels

The various Kāpiti Coast communities have inherited stormwater networks which have differing levels of capability. This variance is the result of past knowledge about stormwater flows, different views on risk and changing views about what was an acceptable level of investment to solve the problems. The focus on 1: 100 storm events as a standard is only relatively recent and reflects growing community expectation about acceptable levels of risk. Given the cost of designing, building and maintaining a system to these standards, the community will have to continually debate the trade-off between risk and cost.

Table 5 sets out the current situation in terms of levels of service offered by the current stormwater system in each stormwater management area.

In making choices about service levels, each community will need to make trade-offs between risk, cost and environmental impacts. For example, it may be appropriate for a stream corridor to be developed as a floodway able accommodate up to a 1:100 year storm event rather than 1: 50 years but will lead to a highly modified environment. Another community may be prepared to accept a higher risk level and flooding of secondary flow paths (including across private land) in order to maintain natural systems. These decisions will be addressed for each stormwater management area.

Table 5: Summary of Current Service Levels

Stormwater Management Area	Current Service Levels	
	Urban stormwater	Groundwater
Paekākāriki	Q5 no secondary overflow	low
Raumati South	Q1-10 no secondary overflow	high
Wharemauku	Q10-100	medium-high
Paraparaumu Coastal	Q2-20	medium
Tikotu	Q2-100	medium
Mazengarb	Q2-100	medium
Paraparaumu North Beach	Q2-100	medium
Otaihanga	Q5 no secondary overflow	medium-high
Waikanae East	Q5-Q10 hill overflows	medium
Waikanae Central	Q2-Q10 road overflows	low-medium
Waikanae South	Q2-100	
Waikanae Old Beach	Q2-Q100 no secondary overflow	medium-high
Waikanae North Beach	Q2-Q100 no secondary overflow	low
Peka Peka Undrained	Q1 soakpits	medium-high
Te Horo Beach	Q1 soakpits	medium
Mangapouri	Q2	low
Rangiuru	modelling underway	low
Ōtaki Beach	modelling underway	low

6. Development

Three aspects of development need to be managed in relation to stormwater. These are:

- **where can development occur?**

  This is an issue of the risk to the people who will occupy the new development Are there any areas where no development should happen? Are there areas where extra precaution should be taken?
- **what is the effect of hard surfaces that will be created by a development?**

  What should be required of any new development to reduce the effects? What contribution should new development make to community investment in infrastructure and any actions to manage stormwater?
- **when should development occur?**

  In a situation where the stormwater management system is not fully completed, should any development wait until that work has been completed?

This section sets out Council's strategy for dealing with these issues.

Managing the Location of Development

Council will continue to manage the location and density of development based (amongst other factors) on the level of risk identified via flood hazard maps and rules set out in the District Plan.

This will include areas where development may not occur at all, or where particular conditions will be placed on development to reduce risks. Flood hazard maps will be regularly updated as new material becomes available, including impacts of climate change on stormwater and the effects of completion of new infrastructure projects on risk levels.

Council will work with the Greater Wellington Regional Council to develop and maintain a groundwater ponding hazard database for those existing urban areas which are known to be potentially vulnerable to fluctuating groundwater levels. This information will be used to:

- identify areas where no further infill development may occur because of effects on surrounding properties and/or implications for the land proposed for development and there is uncertainty about the effectiveness of any mitigation measures;
- identify areas where particular conditions on development and/or notification of risk levels on the title may be necessary before development may occur.

The use of flood hazard maps to manage the location and design of buildings is a long standing method used under the District Plan and will continue to be used by the Council.

There has been interest from individuals and community groups in knowing whether the cumulative effects of development, removal of peat and development on compacted sand increased hazards, particularly hazards from long term ponding. The review of these issues has shown no causal relationship but the review process does show that there are naturally low lying areas where settlement may be problematic and stormwater management solutions increasingly complex and difficult. The new policies propose the introduction of a new groundwater ponding database is an new initiative. It will take 2-3 years to complete and in the interim a precautionary approach will be taken in low lying areas in zoned residential areas.

Managing the Effects of Development

Kāpiti Coast District Council will continue to require all developments to:

- provide on-site retention works capable of providing for a 1:100 storm event;
- contribute to investment in relevant off-site stormwater infrastructure at a level set out in Council's Development Contributions policy.

On-site disposal and retention/off-site infrastructure contribution

For some time, new developments have been required to achieve what has been termed hydraulic neutrality. This is where the water that was no longer able to be absorbed on site because of new hard surfaces must be able to be disposed on-site or stored on site and released at a rate that does not exceed the peak storm water of the pre-development situation. The retention system must be able to cope with a 1: 100 year storm event.

With a new development the introduction of hard surfaces such as a building or a driveway reduces the absorption of the water on-site. Traditionally this water would run off-site and would be transported by the stormwater system for disposal elsewhere. With each new development, higher water flows are generated which must be catered for.

On-site disposal systems can and do achieve hydraulic neutrality, that is the extra flows are dealt with on site and no extra volume of stormwater leaves the site. These types of systems are most effective in sites located over sands or gravels, but are not likely to be suitable in silts and clays.

In the retention situation the concept of hydraulic neutrality does not mean that this additional run-off would never leave the site but rather it requires the construction of on-site solutions, such as storage ponds, to slow the release of this water. The total volume of water released is the same but the peak is lowered and spread over a longer period. There is generally a front-peak of stormwater run-off, for which the primary stormwater infrastructure system must be designed. If the additional run-off can be slowed and prolonged then the risks and impacts on the system can be flattened.

This is where the notion of neutrality arises, in that the development should have a neutral impact on peak flows. The current design standard is that a new development must be able to cope with a 1: 100 storm event.

On review, it has been concluded that the use of the term neutrality in the retention situation is misleading because irrespective of whether water can be stored on-site and released slowly, the new development has an effect on the wider system because the development does prevent some level of water being absorbed on site.

The amount that passes off-site, combined with the requirement to flatten peaks, means that the downstream effect is relatively small. Although the effects of the peak may be considerably lessened and therefore the need for peak capacity lessened, the infrastructure system must still be capable of handling an increase in volume. This is especially important in terms of cumulative impact.

In 2006/07 Kāpiti Coast District Council moved to require some contribution to off-site stormwater infrastructure based on new development impacts management, in addition to the requirements for on-site management. That level of contribution is calculated at the low end of impacts and is set out under the Development Contributions Policy and is subject to regular formal review and consultation under the Local Government Act (2002).

Design requirements and recommendations for on-site retention works are included in the Subdivision and Development Principles and Requirements. These are regularly updated. The key focus of the next year will be review of design requirements for on site disposal and on-site retention works around 1: 2 and 1: 5 year events to ensure consistency with the approach required for a 1: 100 year event.

Other Issues:

As noted earlier a community concern has been the perception that the removal of peat and sand, and replacement with compacted sand exacerbate stormwater effects because it reduces infiltration of stormwater. Work on this issue was undertaken during 2005/06 and showed clearly that this development process did not reduce the permeability. Where sand replaces peat permeability is increased but where compacted sand replaces un-compacted sand, permeability is reduced and the stormwater implications of this need to be dealt with through the on-site disposal/retention systems.

Managing the Timing of Development

Where Council has made a decision in its Long Term Council Community Plan in relation to the timing of infrastructure upgrade works and public or private developments may be proposed that require earlier community investment if they were to proceed, Council will either:

- require a staging of any proposal to fit with existing capacity via any consent application process under the Resource Management Act;

or,

- provide the opportunity for the 'forward purchasing of infrastructure upgrade works' by a developer, provided that this does not trigger additional community investment demands, is not inconsistent with the Kāpiti Coast District Council Stormwater Asset Plan and all other issues, requirements and conditions set under the Resource Management Act are fully satisfied.

In this situation, the developer would fund all costs associated with the needed upgrade, irrespective of whether the effects of the development contributed to only a portion of the needed upgrade in capacity or performance. The developer would recoup that portion not attributed to the development impacts at the time scheduled in the Long Term Council Community Plan for rates funded investment.

Development decisions within the urban area sit on a substructure of the existing stormwater management network.

Although the on-site retention policy slows release of water from a site, water will still be released into the system after that time. In addition, as a catchment is built up, the total volumes of water that must be managed will increase.

The ideal for the network on the Kāpiti Coast is that it is capable of handling a 1:100 year flood in those areas where habitable buildings will be affected. This service standard has not yet been achieved in all catchments. In some places, the system may only be capable of handling a 1:50 year or a 1:2 year storm event.

Where a catchment may not yet have 1:100 year event protection, it may not be appropriate for more water to be released into the catchment until the necessary work has been built. However, under the Resource Management Act , if a development is approved, the requisite works to which the new development has contributed must be constructed within a certain time period. This begins to dictate the timeframe for community investment.

A community may not have identified the upgrade of stormwater infrastructure in the relevant catchment as a priority. This may be because of greater risks and priorities in another catchment, or because of the overall affordability of total Council expenditure for the community.

It is not always acceptable to the community to have individual development proposals dictate the speed at which the community may invest in particular kinds of infrastructure. The community may have other investment priorities in the shorter term.

The policy of potentially requiring staged development currently applies in the consideration of private plan change proposals. The policy makes it clear that if the only final constraint on a proposed development is provision of particular infrastructure, and the developer wishes to speed up a project in order to allow earlier development, then they must fund those costs in the short term and not look to the community to do so.

This policy does not currently apply so clearly for resource consent applications. A review of District Plan provisions in relation to land-use consents will be carried out during 2008.

The Council will continue to upgrade the stormwater network to meet service levels using the following framework:

- design of primary flow path systems to accommodate 1:10 year storm event and secondary flow path systems to accommodate a 1:100 storm event at the rate dictated in the investment programme in the Long Term Council Community Plan;
- ensuring sufficient flexibility to accommodate community decisions to adjust these service levels downwards in some limited situations;
- setting strategic catchment priorities on a three yearly basis, funded in parallel to local works;
- local site by site upgrades where works have been identified as a priority under the prioritisation methodology.

7. Stormwater Network

The Kāpiti Coast District Council manages a network of natural streams, open drains, pipes, retention ponds bridges and culverts in the main urban areas of the District. The piped network is relatively new, with age and condition generally not presenting a problem. The main characteristics of the system are:

- coastal areas where stormwater is generally discharged to the sea;
- southern peat and dune areas which do not drain to any water course and are served by pump stations;
- Paraparaumu and Waikanae open water courses with smaller branches that are piped;
- varying design levels across the District depending on when the stormwater infrastructure was installed;
- significant north/ south barriers to flow in the form of the Railway and State Highway 1;
- vulnerability to key climate change factors – e.g. sea level rise and storm surges.

Over the last five years, the Council has used a prioritisation system which allows for objective ranking of identified stormwater works to establish which works will be done first. Until 2005, the ranking was concerned with extent and severity of flooding; since then the issue of groundwater ponding has been given more emphasis. Groundwater ponding under a house and prolonged groundwater ponding around a house are now used as factors in assessing priority. (Note: this does not mean that works will be undertaken to prevent all ponding on properties).

In the last two years, there have been concerns that the focus on localised projects has meant that there has been limited time and resources to undertake works that will deal with problems in a catchment as a whole. In some cases, this has meant that some local works have been advanced when it would have been more effective to wait a little longer and address the wider issues.

For that reason, the Council introduced a new layer to the stormwater forward programme which separates out major catchment works from local works and advances them in parallel. Catchments are selected on the basis of their strategic significance to the District, the complexity of the issues and/ or severity of problems across the whole catchment.

The stormwater forward programme of works is set out in the stormwater asset plan with the capital expenditure programme also set out Part 2 of *Kāpiti Coast: Choosing Futures – Community Plan* (Kāpiti Coast District Council's Long Term Council Community Plan under the Local Government Act 2002). The strategic priorities are published every three years in Part 1 of the Community Plan. The current strategic priorities are set out below:

The Council will continue to:

- manage the effect of point discharges of stormwater on water quality according to the standards set out in resource consents approved by Greater Wellington Regional Council;
- encourage on-site management and pre-discharge treatment of stormwater where appropriate;
- participate in Greater Wellington Regional Council processes to develop further receiving water standards and requirements for stormwater system upgrades;
- where possible, undertake planting and restoration of stream and drain edge vegetation cover, in a way that does not impede water flow in storm events;
- undertake stream maintenance in a way that minimizes adverse impacts on stream ecosystems.

Table 6: Stormwater Work programme Priorities as set out in the 2007/08 Annual Plan

investigation work to be undertaken

physical works to be undertaken

design work to be undertaken

Strategic Investigations	**2007/08**	**2008/09**	**2009/10**	**2010/11**	**2011/12**
Mangapouri, Rangiuru, Ōtaki Beach					
Wharemauku					
Waikanae Old Beach/North Beach					
Mazengarb					
Strategic Investigations					
Wharemauku – twin and triple cell					
Wharemauku – Epiha Street					
Ōtaki					
Mazengarb					
Waikanae Old Beach/North Beach					

8. Acceptable Risk, Acceptable Cost, Resilience and Adaptation

Investment Decisions

Kāpiti Coast communities have established a standard for protecting themselves from effects of stormwater and significant investment has been identified to bring networks and systems up to that standard. Until recently that planned investment has been based on assumption of climate system stability although with clear weather cycles. Overall it has been possible to plan for and achieve certain standards over time.

Climate change has introduced a level of uncertainty. As the science of climate change has developed it is possible to assess impacts on service standards. As noted earlier, it is now possible to identify that more extreme stormwater events will become more frequent on the Kāpiti Coast and the level of rainfall will rise. This has implications for groundwater levels and for the size and capacity of the network. Whereas it was possible to see an end in sight for upgrading the system to the set standard level, this is now a continually moving situation.

As the impacts and costs become clearer, the Kāpiti Coast communities will need to make the following choices:

- is the community prepared to pay the increased money cost of protection or is it prepared to accept more risks;
- what can people do to make themselves and their homes more resilient to changing stormwater effects? Can and should they always expect the community to intervene?
- is the community prepared to accept increasing modification to natural systems (non-financial costs) in order to maintain service levels? For example, natural streams may have to be turned into floodways to cater for increased stormwater volumes.

Council will prepare a ***'Climate Change and Stormwater'*** discussion paper (as part of a wider regular update on climate change issues affecting the coast) at each three year Long Term Council Community Plan review cycle. It will set out any new projected stormwater network upgrade and maintenance costs relative to service standard levels. Climate change impacts will be included.

It will encourage community debate on what are acceptable trade-offs between financial and non-financial costs, and acceptable levels of stormwater and flood risk. These debates and decisions will shape the level of investment in the forward programme for stormwater management.

It is important that these trade-offs are continually reviewed and debated as every new piece of stormwater pipe built or replaced is expected to last 80-100 years. Over that time climate change effects are expected to increase significantly.[6]

[6] The Long Term Council Community Plan already seeks community input into service standards. It is always difficult for people to understand and have input into these debates. Given the importance of stormwater and climate change, a more structured and targeted debate is needed.

Adaptation and Resilience

In a situation of increased rainfall and likely groundwater levels and ponding, the community not only needs to think about acceptable levels of risk but must also think about whether there are different forms of building and urban development over time. For example, the current trend for houses to be built on concrete slabs rather than on piles may be reducing the long term resilience of the building stock.

This review of methods could range from looking at models for building design that are being used in countries that have high rainfall and either permanent or prolonged ponding through to a continued assessment of the need (if at all) for managed retreat in some areas. To some extent the concept of managed retreat will be linked to decisions by the private insurance sector about insurance costs but it may also include decisions by the community that it is not prepared to invest in stormwater works in some areas.

Council will continue to regularly review, in discussion with the community ways to increase community, business and household resilience and adaptation in relation to the anticipated changes in stormwater risks.

Future Challenges

The combination of sea level rise and increased storm frequency and severity may require the idea of managed retreat to be carefully considered over time. At this stage, this is a possibility and not a certainty and will also depend on people's view of risks and trade-offs. Some things may be permissible in 'at risk' areas provided this is clearly shown on property titles, for example. These issues will be considered at regular intervals over future years.

Art by Bodhi Vincent

“Kapiti in the mist” image by Jonothan Parker

The Stormwater Management Strategy is one of a number of Kāpiti Coast District strategies which set out the long term strategic response to the District's Community Outcomes.

Like the other strategies it is produced in response to the Community Outcomes and links directly to the Long Term Council Community Plan.

KĀPITI COAST
DISTRICT COUNCIL
me huri whakamuri, ka titiro whakamua

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