greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

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Committee	Environmental Wellbeing Committee
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Wellington Region – Flood Vulnerability and Climate Change Impacts Scoping Study

1. Purpose

- To inform the Environmental Wellbeing Committee of the findings of the Wellington Region – Climate Change Impacts on Floods and Erosion study.

- To recommend an interim amendment to the climate change values used for technical flood investigations.

- To recommend future use of the findings of this study.

2. The decision-making process and significance

Officers recognise that the matters referenced in this report may have a high degree of importance to affected or interested parties.

The matter requiring decision in this report has been considered by officers against the requirements of Part 6 of the Local Government Act 2002 (the Act). Part 6 sets out the obligations of local authorities in relation to the making of decisions.

2.1 Significance of the decision

Part 6 requires Greater Wellington Regional Council to consider the significance of the decision. The term 'significance' has a statutory definition set out in the Act.

Officers have considered the significance of the matter, taking the Council's significance policy and decision-making guidelines into account. Officers recommend that the matter be considered to have low significance.

Officers do not consider that a formal record outlining consideration of the decision-making process is required in this instance.

3. Introduction

One of the defining features of the Wellington Region is its floodplains. It features the floodplain of Te Awa Kairangi (Hutt River), one of New Zealand's most densely populated floodplains, the productive rural floodplains of the Wairarapa, and the developing floodplains of the Kapiti Coast and those surrounding Porirua harbour.

Flooding has the potential to cause major economic and social harm in these areas, and the impacts of these are expected to worsen with the effects of climate change.

This first stage study has been completed by Greater Wellington Regional Council (GWRC) to assess how well it is informed about flood risk, and to facilitate future long term planning. The study was completed through:

- Review of existing hydraulic models and scoping of update costs;
- Review of the numbers associated with climate change for use in technical investigations;
- Identification and assessment of floodplains at a regional scale;
- Prioritisation of at risk locations to assist with planning future investigations;

This work was reported in "Wellington Region – Climate Change Impacts on Floods and Erosion Study" by Opus International Consultants.

The outcomes of that report are now beginning to be used to assist with:

- programming hydraulic model updates;
- programming new flood plain management planning investigations;
- development of a flood hazard information database and public release strategy, and
- preparation for the impacts on flood risk of climate changes across the region.

4. Review of existing hydraulic models

The report reviewed hydraulic models held by GWRC. It assessed these to provide an overall quality score which assessed the models against a number of criteria, and highlighted issues in fairly broad terms. It did not include a detailed peer review of individual models. The output of this review is shown in **Attachment 1**.

The assessment was based on the model in the format it existed at the time of assessment. Two criteria highlighted as poor by the assessment across most models were Survey and Calibration.

The final stage of the review was a scoping of work requirements to update the existing hydraulic models. This cost- and time-estimating exercise was completed to assist with future planning of resource allocation through the Long Term Plan.

5. Review of climate change values

The report reviewed the current climate change guidance used by GWRC.

Current climate change effects being used for hydraulic modelling are:

- The increase in rainfall intensity to be used for calculation will be 16%.
- The Sea Level Rise to be used for calculation is 0.5m by 2100.

These values were recommended to and approved by GWRC's Catchment Management Committee on 22 February 2010. Details of this are contained in Report 10.82.

The Wellington Region – Climate Change Impacts on Floods and Erosion report reviewed these values against other scientific recommendations and proposed that GWRC amends these to:

- The increase in rainfall intensity to 20%, with a recommendation that an investigation into sub-regional values to supplement this is developed.
- An increase in the Sea Level Rise to be used to 0.8m by 2100.

These recommendations have been passed onto GWRC's Environmental Policy department for consideration in their development of an overall Council policy. GWRC Flood Protection believes that adoption of these amended values as an interim measure until that policy is endorsed will future proof its current and planned hydraulic modelling investigations as best as it can. These values are consistent with values used by Kapiti Coast District Council (KCDC) and recommended by a number of consultants we work with.

Note that these values to be used for climate change predictions are estimates only, and are likely to change over time as scientific knowledge and techniques develop.

6. Identification and assessment of floodplains at a regional scale

Beyond the flood hazard risk known to GWRC through its current hydraulic models lie a number of floodplains which have lesser understood flood risk. These do not have publicly accessible, complete flood risk mapping, and are therefore potentially at risk through lack of information and understanding of flood risk.

In order to identify areas potentially at risk from flooding, the report completed a three tier floodplain mapping exercise. The three independent mapping exercises are:

- Floodplain soil mapping to identify areas of the region which have been or are currently comprised of alluvial deposits.

- Slope mapping to identify those areas of the region which have a shallow slope angle most commonly associated with floodplains.
- A regional scale flood model created through direct rainfall method to identify a first order flood map for the region. The modelling was completed for a simulated 1-in-100 year +30% rainfall event, and for a probable maximum precipitation (PMP) event.

7. Prioritisation of at risk locations to assist with planning future investigations

7.1 Identification of at risk locations

The outputs of the hydraulic model review and the regional floodplain mapping were then used to identify at risk locations. A map was produced through a process of considering risk factors, including floodplain extents and land use type, to visually highlight at risk locations. This map is shown in Figure 1.

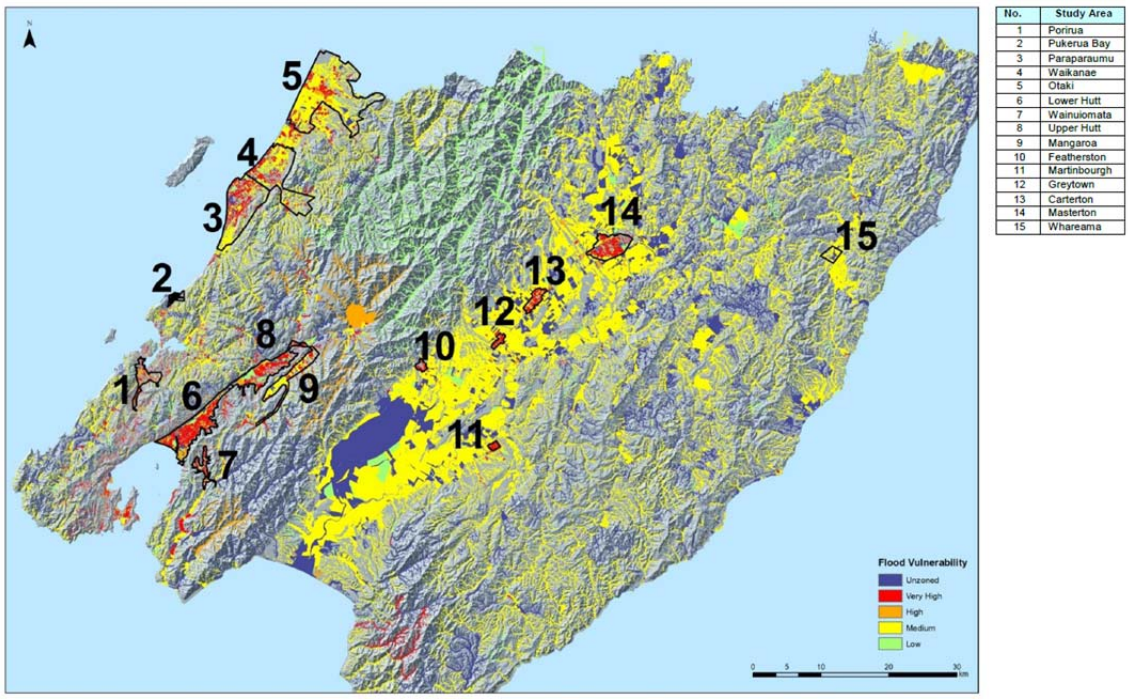


Figure 1. Broad-scale regional floodplain map

The following criteria were used to further assess the vulnerability of locations identified as being at risk:

- Hydraulic Model and LiDAR Coverage.
- Current flood risk management and quality.
- Potential for future development and intensification on the floodplain.

The outputs from this process prioritised those locations through a scoring approach. These were subsequently reviewed against on the ground experience and observations. The output of this is the priority table shown in **Attachment 2** and the accompanying discussion text.

7.1.1 Discussion of Prioritisation results

When considering the Q100 +30% condition, **Paraparaumu** goes from sole highest priority to joint highest with **Masterton**. Both of these are the most urgent priorities; however, the benefit of the existing defences is less certain for Masterton and therefore, this has been set as the top priority for Stage 2. Furthermore, although the mapped location of Masterton is shown as having model coverage, it is in fact only to the SW where it comes within the Waingawa 2D model area, so in fact only a small proportion of the location is covered by modelling. This fact further justifies Masterton as having the highest priority.

The reason **Paraparaumu** comes out as such a high priority is the large flood extent under extreme conditions and the extent of high vulnerability land use (housing). The location boundary also takes in Raumati Beach and Raumati South which adds considerably to the vulnerability score. Another issue to note is that this area covers three separate watercourses: Tikotu Creek, Wharemauku Stream, and Whareroa Stream. Another factor to consider is that the priority score approach has little component of probability other than for extreme rainfall events. If it were the case that there is very little flooding under flow events of less than 100 year ARI, then the actual flood risk would be very low. The next stage of the study which incorporates the determination of actual flood risk (which will identify and account for flood probability), will quickly address these issues, and it is suggested that a more comprehensive risk-based priority listing be made at that time.

Carterton comes out as the third highest priority, largely as a result of not having any defences or having any coverage by existing flood models. Like Paraparaumu the absence of flood defences indicates that significant flooding has not historically occurred very frequently, and therefore it would be reasonable to assume that the actual flood risk from smaller events may not be as high as its current priority score suggests.

Greytown comes out as fourth priority as despite having a relatively small total vulnerability score, it scores lowly for flood defences, and is identified as an area for growth.

Otaki has been prioritised above Lower Hutt and Featherston due to its total flood vulnerability score, the presence of a vital stopbank with limited capacity at Chrystals Bend and its vulnerable location in the path of the Otaki River.

The Hutt Valley has been moved down the list, to reflect the high standard of protection (designed to protect against the 440 year ARI flood event) and good condition of the flood defences from the Hutt River. However, due entirely to the sheer size of the flood area under PMF conditions, it still requires a moderately high priority, reflecting the large residual risk.

7.2 Use of prioritisation outputs

The outputs of the prioritisation are currently being used to guide future planning of floodplain management investigations. The current investigations for the Upper Wairarapa Valley Floodplain Management Plans Project address the at risk location of Masterton and the Waiohine Floodplain Management

plan addresses the flood risk for Greytown and partly addresses the flood risk to Carterton.

The responsibility for the three streams in Paraparaumu is with KCDC through the Watercourses Agreement so we will work with KCDC officers to advise them of our work and assist if needed with the further investigation of the flood hazard.

8. Comparison with Queensland Reconstruction Floodcheck

8.1 Floodcheck Summary

The Queensland Reconstruction Authority completed investigation work which is part of a AUS$7.5 billion dollar project to fund reconstruction across the state of Queensland. The project was triggered by a series of significant flood events between November 2010 and April 2011.

The Queensland Floodcheck system went live in February 2011, and Queensland now prides itself on being the only state in Australia which has state wide floodplain mapping.

The system used in Floodcheck is a tiered representation of flood hazard information with the following levels of detail:

1. State wide flood mapping at a very coarse level which identifies generalised floodplain extents. This is titled Interim Floodplain Assessment.
2. Town level flood studies.
3. Historic flood event extents which have been photographed or mapped.
4. A catalogue of all known flood studies and who owns this information.
5. Information related to flooding which is held by local councils.

This is similar to the approach we have used for the Wellington Region, which compares well with the technical work carried out in Queensland.

8.2 Comparison of floodcheck with GWRC's current flood hazard information advisory service

The table in **Attachment 3** compares the current state of GWRC's floodplain modelling information against the Floodcheck system developed by the QLD reconstruction authority and identifies some examples of GWRC's equivalent work and how accessible this information is to the community.

The Floodcheck system now in place in Queensland is a single point at which an individual can identify all flood hazard information available for a property they are interested in. Unfortunately the level of information across much of the state is patchy and in many cases reliance on flood hazard defaults to the interim floodplain assessment. It is an easy to use tool with moderately intuitive controls.(http://qldreconstruction.org.au/interactive-map/)

The information held by GWRC generally has a higher level of detail across a greater percentage of the region when compared with Queensland; however, this information is much less accessible to the community than through the Floodcheck system. There is opportunity to incorporate this information within GWRC's Landinfo3 (http://mapping.gw.govt.nz/) website, however, due to the wealth of information contained it demands a steeper learning curve and has less intuitive controls than the single focus Floodcheck system.

A review of the current methods of flood hazard advice and information provided to the community may identify opportunities for increasing accessibility and improve community awareness, enabling more informed decision making and better region wide resilience.

9. Opportunities

9.1 Strategy for Flood Hazard Information

Flood Protection is aware that the information it holds on flood hazards is valuable and may help people make better decisions through being aware of risks. We are developing a strategy for making this information more available.

The Floodcheck system outlined in Section 8 provides a good example of accessible, easy to use flood hazard information for an affected community. It is a tool designed for an end user which has been appropriately marketed to its target audience. GWRC is well placed to implement a similar system; however, a thorough cataloguing and collation of flood hazard information followed by a scoping of requirements for an online accessible flood hazard information repository needs to be completed prior to implementation.

9.2 Update regional flood model, update flood models with LiDAR

The soon to be completed regional LiDAR collection provides an excellent opportunity to improve both local flood models and the regional level flood model completed as part of the Wellington Region: Impacts of Climate Change on Floods and Erosion Project. Further modelling based on the new LiDAR would improve the accuracy of modelled flood spreads in relation to ground contours. The new LiDAR information will be included in models as they are developed/updated, and will be a key factor in potentially bringing forward the update of high-priority models if necessary.

10. Recommendations

That the Committee:

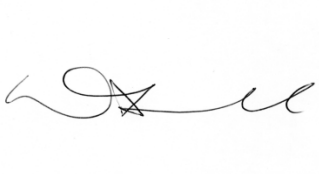
1. ***Receives*** *the report.*

2. ***Notes*** *the content of the report.*

3. ***Endorses*** *the use of interim Climate Change Design Criteria for flood hazard investigations/design, being:*
   - *the increase in rainfall intensity to be used for calculation will be 20% by 2100*
   - *the Sea Level Rise to be used for calculation is 0.8m by 2100.*

4. ***Endorses*** *the priority of at risk locations being used to guide long-term planning of FMP development and flood risk investigations.*

5. ***Endorses*** *the development of a strategy to improve accessibility to the flood hazard information and advisory service.*

Report prepared by:	Report approved by:	Report approved by:	Report approved by:
			
Alistair Allan Senior Projects Engineer Flood Protection	Mark Hooker Team Leader, Investigations Strategy & Planning	Graeme Campbell Manager Flood Protection	Wayne O'Donnell General Manager Catchment Management

Model	Year	Adequacy (good, poor, uncertain)							Overall Quality
		Hydrology[IV]	Survey[I]	Schematisation	Loss coefficients[II]	Roughness	Floodplain levels	Calibration[III]	
Hutt River	2006	Average	Poor	Good	Good	Good	1D	Good	OK
Kopuaranga	2006	Poor	Poor	Poor	Good	Good	1D	Poor	Poor
Mangaone	2004	Poor	Poor	Poor	Good	Good	1D	Poor	Poor
Mangaroa	2005	Average	Poor	Good	Good	Good	2D	Uncertain	OK
Otaki River	2007	Good	Poor	Good	Good	Good	Mixed	Uncertain	OK
Otaki Stormwater	2007	Good	Poor	Good	Uncertain	Good	2D	Poor	OK
Pinehaven	2010	Good	Good	Good	Good	Good	2D	Poor	Good
Porirua	2011	Excellent	Good	Good	Good	Good	2D	Poor	Good
Ruamahanga	2003	Good	Poor	Good	Good	Good	1D	Poor	OK
Waikanae River	2010	Good	Good	Good	Good	Good	2D	Poor	Good
Waikanae Stormwater (Waimeha-Ngarara)	2010	Good	Poor	Good	Uncertain	Good	2D	Poor	OK
Waingawa	2008	Good	Good	Good	None	Good	2D	Poor	OK
Wainuiomata	2011	Average	Poor	Good	None	Good	2D	Poor	OK
Waiohine	2010	Excellent	Good	Good	Good	Good	2D	Uncertain	Good
Waitohu	2010	Average	Good	Good	Good	Good	2D	Poor	Good
Waiwhetu-Awamutu	2011	Good	Poor	Good	Good	Good	2D	Poor	OK
Wharemauku (Paraparaumu SW)	2009	Poor	Uncertain	Good	Good	Good	2D	Good	OK

(I) All survey and LiDAR data has to be at most 5 years old for the survey data to be considered "Good"
(II) "None" in this column denotes that the model has no structures requiring loss coefficients
(III) At least 3 relevant measured events are required for a calibration to be considered as being "Good"
(IV) Taken from hydrology assessment in Table 2.2

Attachment 1

Attachment 2

Priority Table

Location	PMP Priority Score	Q100+30% Priority Score	Overall Priority
Masterton	5	5	1
Paraparaumu	6	5	2
Carterton	4	4	3
Greytown	3	3	4
Otaki	3	2	5
Lower Hutt	4	4	6
Featherston	3	2	7
Martinborough	2	2	8
Upper Hutt	2	2	9
Mangaroa	2	2	10
Waikanae	2	1	11
Pukerua Bay	2	2	12
Porirua	2	1	13
Wainuiomata	1	1	14
Whareama	1	1	15

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Attachment 3 – Comparison of Floodcheck system with GWRC's current service

QLD	GWRC	Description	Notes	GWRC Example	Availability to public
Interim Floodplain Assessment	Regional Floodplain Mapping	Identifies at a region wide/state wide level which areas are floodplains.	The GWRC and Queensland approach are very similar, and at a scale appropriate for the areas of the study	Floodplain mapping carried out under the Climate Change Effects assessment	GWRC have not publicised this information and do not provide it to the community or District Councils through the flood hazard advisory service
Town level flood studies	River Specific Hydraulic Models	A more detailed identification of flood spread for specific areas	The GWRC approach is on a catchment or sub catchment basis, this is facilitated by the topography of the Wellington region which contains smaller catchment sizes. The QLD studies focus at a town level and do not in many cases extend upstream or downstream from urban boundaries. Ie the full flood system is not mapped through this method.	Waiwhetu, Wainuiomata, Mangaroa flood hazard information sheets	GWRC publicise the 1-in-100 year flood hazard information to the community, and make other modelled events available on request. Some of this is available through GWRC's online resources
Historic Flood extents	Historic Flood Extents	Photographic, eyewitness, surveyed information		Hutt River: A Modern History	GWRC make use of this information to calibrate flood models. It is occasionally provided through advisory responses when identified by GWRC officers responding to an enquiry or where specific historic information is sought by a member of the community. It is generally not easily accessible by the community and is not stored in a database form for easy access by GWRC officers
Catalogue of all known flood studies	Not held by GWRC	Contains a list of all flood hazard investigations which have been completed by corporate entities generally related to site specific developments			GWRC has some awareness of these studies through its advisory service. This information is not easily accessible to the community. GWRC may not be aware of all flood studies done by others.
Information relating to flooding held by	LIM reports	Contains known flooding event information at a	In New Zealand this information is held by TA's and supplied to the community through LIM reporting	LIM report	This is accessible to the public but usually at a cost. The quality of information depends on the local authority which holds it.

local councils		property level			