1.1 Foreword

In February 2004, the floodplains of the Waiwhetu Stream and its major tributary the Awamutu Stream were subject to widespread flooding. This was the latest flood in a history of flooding and led to an agreement by Hutt City Council (HCC) and the Greater Wellington Regional Council (GWRC) to undertake a joint investigation to develop a floodplain management plan for the Waiwhetu Stream.

Work on the "Waiwhetu Project" (the Project) commenced in early 2005 through the formation of the Waiwhetu Stream Advisory Committee (WSAC), a Joint Committee formed under the provisions of the Local Government Act.

This report provides a summary of the investigations that have been completed under the direction of the Committee during Phase 1 of the Project, covering the period July 2005 to June 2006.

This report has been endorsed by the Waiwhetu Stream Steering Group. Refer to Section 10.3 for an outline of the consultative and decision making framework established for the Project.

In this report we have attempted to keep technical jargon to a minimum. Terms that may be new to you are marked with an end note number and are explained in the Glossary (Section 13).

1.2 Objectives of the Waiwhetu Project

The Advisory Committee is responsible for ensuring that the Waiwhetu Project achieves the following objectives:

- Flood risks are reduced to an acceptable level;
- Flood risk cannot be completely eliminated and that provisions must be implemented to handle residual risk;
- The methods chosen to reduce flood risk must be affordable;
- The priorities for funding flood mitigation must be considered within the context of the Councils' Long Term Community Consultation Plans;
- The aspirations and contributions of the local community to reduce flood risk are recognised; and
- The methods adopted to mitigate the effects of flooding must enhance the Waiwhetu Stream and its environment, its unique character, and the role that it plays in the life of the communities. Any new initiatives must be cognisant of the Waiwhetu Stream rehabilitation programme.

1.3 Investigations completed during Phase 1

The following investigations have been completed during Phase 1:

a) Identification of flooding and environmental issues concerning the catchments of the Waiwhetu and Awamutu Streams. Refer to the 'Issues Report' completed in November 2005, summarised in section 2;

b) Development of an evaluation framework to consider and compare the value of initiatives proposed to mitigate flooding and improve the floodplain environment. Refer to the 'Evaluation Framework Report' completed in January 2006, summarised in section 5.4;

c) Preparation of a flood damages assessment (FDA) model to predict the average annual flood damage (AAD) and to assess the benefits of proposed flood mitigation options. The FDA was completed in June 2006 and is reported in section 4;

d) The feasibility design of structural options for flood mitigation of the Awamutu Stream and the lower reaches of the Waiwhetu Stream. This work commenced in February 2006. A summary of the work completed to June 2006 is reported in sections 6 & 7;

e) Investigations into the remediation of the contaminated sediments within the lower reaches of the Waiwhetu Stream. This work has been advanced as part of the Lower Waiwhetu Feasibility Design. A summary of the work completed to June 2006 is reported in section 9;

f) The flood mitigation options to reduce flooding in the Waiwhetu Stream, upstream of Whites Line East, to be considered in Phase 2, have been identified. These are discussed in section 8; and

g) A programme of consultation to involve the community in the development of the Waiwhetu Stream floodplain management plan has been provided. The record of consultation is reported in section 10.

1.4 Progress with the Floodplain Management Plan

The preparation of the floodplain management plan is being staged over two phases. The plan addresses the issues which were identified in the Issues Report as critical for managing flood risk and enhancing the environment. Progress with addressing the critical issues is summarised below.

Critical issue 1) There is a finite upper limit to how much floodwater can be passed down the Waiwhetu and Awamutu Stream channels. Agreements on the upper limits are required to establish design standards for the streams.

a) The design standard[1] that has been adopted for the Awamutu Stream Feasibility Design (refer section 6) is the current 50 year ARI[2] storm. A 100 or 200 year ARI design storm will be targeted if equivalent design standards can be achieved in the Waiwhetu Stream;

b) The design standard that has been adopted for the Lower Waiwhetu Feasibility Design (refer section 7) is 50 cumec[3], the peak flood flow that is expected under current climatic conditions during a 50 year ARI storm. A 100 year or 200 year ARI design standard will be targeted but it may require community acceptance of high floodwalls along both banks of the stream. (Note: works designed for a 100 year ARI storm under current climate conditions will provide less than 100 year ARI flood protection if climate change occurs as is currently predicted); and

c) The design standards for the Waiwhetu Stream upstream of Whites Line East have not yet been determined. They will be the outcome of Phase 2 studies.

Critical Issue 2) ***Critical flooding of the lower reaches of the Waiwhetu Stream is most influenced by tidal conditions and may be mitigated by the construction of stopbanks and associated storm water improvements.***

d) The conclusion of the lower Waiwhetu Stream feasibility design is that, while tidal conditions are a factor, the critical factor is that the stream corridor is generally too small (width and depth) to pass the design standard flood flows;

e) Flood defences [4] in the order of 1.0m - 1.5m high will be required to contain the design standard flood. The rough order of cost (RoC[5]) for the construction of flood defences is $10 million;

f) A combination of flood defences and channel improvements will be required to pass larger floods, or to contain the design standard flood flow with lower flood defences. Refer to section 7 for a discussion of options. The rough order of cost for channel improvements and lower flood defences is $16-$19 million;

g) Construction of flood defences will mean that flood gates will need to be fitted to the storm water outlets flowing into the stream to prevent backflow into low lying areas. The cost of floodgates is not great and is included in the rough orders of costs detailed above; and

h) Stormwater improvements and pump stations may be required to control ponding on the floodplain due to local rainfall when the floodgates are closed. Improvements to stormwater systems may also be required during extreme events when the gates are open. Investigations into stormwater improvements will be undertaken during Phase 2. The rough order of costs to install pump stations on the major stormwater outlets to the Waiwhetu Stream is $4.7 million.

Critical Issue 3) ***Critical flooding of the Awamutu Stream is determined by flood levels in the Waiwhetu Stream and may be mitigated by the construction of engineering works to prevent backflow into the Awamutu Stream from the Waiwhetu Stream.***

i) The Awamutu Stream Feasibility Design has investigated the effects of backflow from the Waiwhetu Stream, along with the effects of flooding from flood water originating within the Awamutu Stream Catchment (refer to section 6); and

j) The preferred flood mitigation options for the Awamutu Stream all require the construction of a flood defence on the north bank of the Waiwhetu Stream between the mouth and the railway embankment and a flood gate at the outlet of the Awamutu Stream. The preferred option will also require a pump station near the Seaview roundabout to reduce flood levels in Hutt Park and channel improvements on the Awamutu Stream: The RoC for the preferred flood mitigation option is $6.4million.

Critical Issue 4) ***Agreement is required on the preferred option for the remediation of contaminated sediments in the lower reaches of the Waiwhetu Stream before flood mitigation works can be finalised for the lower Waiwhetu Stream.***

k) The options to remediate the most contaminated reach of the Waiwhetu Stream have been evaluated;

l) The preferred option for remediation is to excavate the contaminated sediments from the stream bed for disposal at Silverstream Landfill, referred to as Option D In-stream Remediation (refer to section 9.); and

m) A review of international practice for in-stream remediation has identified precedents for in-stream remediation under similar conditions and jurisdictions (Environmental Protection Agency, USA). Consideration of options for in-stream remediation has been integrated with consideration of options for flood mitigation for the lower Waiwhetu Stream. Concept designs are discussed in section 9.4. The RoC for remediation of the contaminated sediment is $6 million.

Critical Issue 5) ***Planning controls will be required to control sediment, chemicals and hazardous waste entering the Waiwhetu and Awamutu Streams if the ecology is to be enhanced.***

n) Investigations into the sources of contaminants entering the lower reaches of the Waiwhetu Stream are being undertaken by GWRC and HCC (not as part of the Waiwhetu Project); and

o) Investigation of options for containing contaminants originating from roadways, site redevelopments, industrial sites and private property are to be undertaken in Phase 2.

Critical Issue 6) ***A sustainable management regime for the Waiwhetu Stream will need to be developed to enhance the stream environment.***

p) Investigations to propose sustainable management regimes for the Waiwhetu Stream are to be undertaken in Phase 2.

Critical Issue 7) ***Flood damages and environmental damages are expected to increase if measures are not taken to avoid or mitigate the risks.***

q) Flood hazards have been mapped for floods up to 1000 year ARI (refer to section 3.5);

r) Flood hazards have also been mapped for the Awamutu Stream assuming that the Awamutu Stream is separated from the Waiwhetu Stream by a flood defence and flood gate (reference 8);

s) A flood damages model has been developed to predict the flood damages that are likely to result from floods up to 1000 year ARI (refer to section 4);

t) Based on the current flood maps, the Average Annual Damage (AAD)[6] that can be attributed to flooding from the Awamutu and Waiwhetu Stream is $4.1 million per annum;

u) The reductions in Average Annual Damage (AAD)[7] that can be expected to follow construction of the flood mitigation options proposed by the Awamutu Stream Feasibility Design and the Lower

Waiwhetu Feasibility Design have been calculated and are reported in the Options Reports; references 10 and 11;

v) All options for flood mitigation that are currently proposed show positive benefit cost ratios (BCR)[8];

w) In preliminary design (to be completed in Phase 2), all options for flood mitigation will take account of climate change and the expected increases in the frequency of high intensity rainfalls and the frequency of tidal extremes; and

x) Phase 2 investigations will consider the effects of continuing development within the catchment and will propose physical works and planning measures to control, at source, increased run-off and contaminants.

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[1] **Design standard** - Design standards specify how a certain plant, piece of equipment, or pollution control mechanism should be designed. In the context of the Waiwhetu Project it refers to the largest flood that new and upgraded flood defences can safely contain.

[2] **ARI** refers to the Average Recurrence Interval. Over a very long time period we would expect a storm of this size to occur, on average, once every 50 years.

[3] **Cumec** – is the volumetric measure used for flood flows. Cumec is the abbreviation for "cubic metres per second". A cumec is equivalent to 1000 litres of water flowing past a point in the stream channel every second.

[4] **Flood defence** – is a continuous stopbank or floodwall built along the boundary of the stream corridor to contain flood waters within the stream corridor. Floodwalls perform identical functions to stopbanks and are used in places where there is not enough room to build stopbanks. A floodwall generally costs 5 to 10 times more than the equivalent stopbank.

[5] **RoC** – is the Rough order of Cost derived from first order costing of concept designs, $\pm$ 30%.

[6] **AAD** – the average annual damage is an assessment of the loss the community is incurring EACH YEAR as a result of flooding, with the streams in their current condition, under current climatic conditions. The AAD is calculated in a similar way to insurance premiums and is the sum that we would need to put aside each year to cover the total cost of flood damages that will be incurred in the years ahead. The AAD is calculated from tangible flood losses but includes a factor to account for intangible flood losses.

[7] **Reduction in AAD** is how we measure the benefit that results from the construction of flood mitigation works.

[8] **BCR** – a positive BCR indicates that the benefits of flood mitigation works (net present value of the reduction in AAD) is greater than the net present value of the cost of the works. In other words, it makes economic sense to build the works.