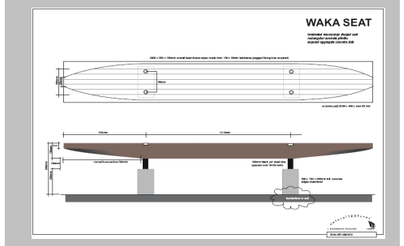
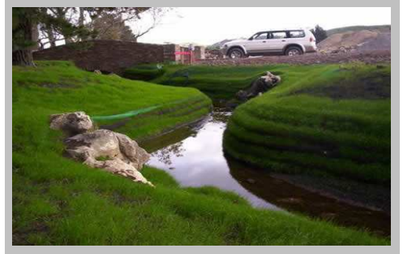
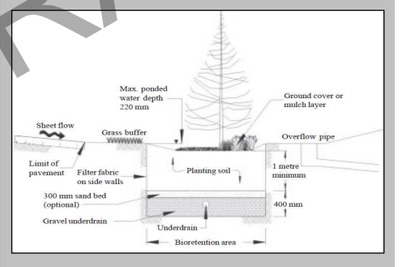
Waiwhetu Stream FMP Flood Management Options List *This Update - 18th April 2011*

Number	DM Ref	Description	Picture	Type	Cost Estimates	Flood Impact	Implemented?

Catchment Wide Options

Number	DM Ref	Description	Picture		Cost estimates	Flood impacts	Implemented?
N1	884533	**Source Control Toolbox** - Produce a Source Control Manual for New Development/Infill that provides guidance about source control solutions for property owners to consider. Contains advice on all other source control options Option 1 (1 page flyer) $2,000 Option 2 (6 page booklet) $5,000 - $10,000 Option 3 (12 page booklet) $10,000 - $20,000		Control	$2000 - $20,000	All source control combined estimated to save $1.5M AAD	
N2	884534	**Run-off Reduction** - Encourage landowners to reduce runoff from their land by education (advice) and financial incentives (e.g. grants): · Open spaces, council owned public land by 2015 · All private property by 2020 Run-off reduction can be achieved through; · Increasing permeable surfaces/reducing impermeable, (replace concrete with grass, gravel, bricks) · Adding rainwater detention areas or storage (rainwater storage tanks, ponds, swales, soakaways) · Upgrading storm-water devices Option 1 - TOTAL COSTS (Courses/Workshops) Option 1 - TOTAL COSTS (for storm-water devices)		Control	$10,000 per annum $500 per household	If applied to whole area upstream of Tilbury St to achieve a 50% reduction in runoff from this area, will reduce flood levels by up to; - 700mm near Waddington Dr - 500mm by St Ronans Ave - 400mm by Whites Line East - 150mm in Awamutu All source control combined estimated to save $1.5M AAD	Partly Implemented
N3	884538	**Prohibit Discharge of Stormwater** – prohibit direct discharge of storm-water to the street from all property in the Waiwhetu Catchment (would mean creating soakaway pits in gardens, easy to do)		Control	could be $50,000 to implement planning controls for this. Cost on owner / developer to implement	All source control combined estimated to save $1.5M AAD	
N7	884558	**Hazard Maps and LIM reports** - Ensure that development is compatible with flood risk by publishing a range of hazard maps. Make the information part of the PIMS and LIMS system. The hazard maps for the 1-in-100 year flood have been re-run to include effects of climate change, and the work completed in the channel between Bell Rd and Port Rd. These will be published later in 2011 The hazard maps only include details of flooding as a result of stream flow and do not include stormwater over land flows		Prevent	$3,000 *(does not include hydraulic model costs)*	No/controlled increase in damages	**Y**
N8	884563	**Minimum Floor Levels for new habitable buildings set to 1-in-100 year level –** To reduce future damages all new developments and additions to property should be built at a level above the 1-in-100 year flood level		Prevent	Estimation $50,000 - $100,000 to implement and consult on planning controls *(variable)*	No/controlled increase in damages	Advice is provided to this effect by GWRC, current building code stipulates 1-in-50 year level
N9	884565	**Property Purchase** – Purchase floodable private property when opportunity arises		Prevent	Market value at time of purchase, vaires dependant on areas	Directly removes damages	

N10	884568	**Property Encroachments** – identify and remove all property encroachments into the Waiwhetu stream corridor		Control	?		
C2	884503	**Amenity Values –** Promote amenity enhancements for the stream (eg seating along banks, network of paths, riparian planting) to encourage recreational use and ownership by local community. · Establish pathway alongside stream, gravel path. 1.8m wide no edge. Clayton Fairbairn known cost for crusher dust path. · Provide seating areas with paving. 2seats and (50m2). 1 per 400m · Additional landscape planting. including riparian areas. $5m^2/m$ · Provide seating areas with paving. 2seats and (50m2). 1 per 400m		Amenity	$236/m ($354,000 total)		Work Carried out as part of Waiwhetu project
C9	884518	**Education – Good behaviour Residential** - Implement an education programme that promotes good behaviour by adjacent landowners to prevent illegal dumping, littering, grass clippings, using enforcement options if necessary.		Amenity	$49,000		
C9a	884519	**Education – Good behaviour Industrial** - GWRC runs a programme known as take charge, this has previously targeted Naenae industrial area, but has not yet worked on Seaview Gracefield. Promote and advance the Take Charge initiative. Raise awareness of pollution control hotline		Amenity	$49,000		
C9b	884522	**Education – Litter Control** - Reduce amount of wind blow, better bins, nets for recycling, wheelie bins instead of buckets?		Amenity			
C9c	884524	**Education – Care Group** - Implement a care group/series of care groups for the Waiwhetu stream areas to raise awareness of issues associated with the stream and create neighbourhood support.		Amenity	$49,000 p/a		
C10	884525	**Debris and Sediment Protection** - Construct, upgrade or replace debris control structures in eastern hill sub-catchments at stormwater inlets and stormwater drain outlets to intercept and filter out suspended sediments from stormwater in eastern hill sub-c		Control	$11,000 each *(est $4k - $11k depends on location)*		

C11	884527	**Bank Edge Repairs** - Remove existing failed bank edges, reduce slope angle and plant as required. Design stream channel alignment as per Gary William's recommendations. Maintain channel of the stream within the channel alignment.		Control			Some work ongoing as a result of current maintenance by both HCC and GWRC,
C11a	884529	**Bank Edge Reinforcements** - Remove existing failed bank edges and replace with more structural living walls or gabions. Primarily where bank edge and property boundaries create a vertical drop into stream. Living bank technology can be utilised Useful where no space available to widen out stream banks and increase flood capacity by creating an open environment.		Control			
C12	884531	**Ongoing or Improved Maintainance and Management budget** Can include; River Ranger, more frequent maintenance runs, additional planting, higher end solutions for stream management. Establishing design bed levels, and channel dimension standards · Option 1: Status Quo · Option 2a Enhancement – budget of $80,000 (e.g. employ river ranger to manage the stream) · Option 2b –Enhancement (budget of $150,000) · Option 2c Enhancement (Budget of $500,000)		Control	Between $80k pa and $500k pa *depending on level of service*		
S1	884603	**Source Control – Rain Gardens and Swales** Install rain gardens and swales along all public roads as a required part of all road maintenance, re-profiling and upgrading projects. Swales are vegetated areas used in place of curbs or paved gutters to transport stormwater runoff. They also can temporarily hold small quantities of runoff and allow it to infiltrate into the soil. A vegetated swale may also be known as a grassed channel Vegetated swales can serve as part of a stormwater drainage system and can replace kerbs, gutters and storm sewer systems. Swales are best suited for residential, industrial, and commercial areas with low flow and smaller populations. Swales can have significant environmental benefits but they do have limitations. Swales can reduce peak flows, remove pollutants, and promote runoff infiltration, and they tend to have lower capital costs. However, vegetated swales are typically ineffecti	 	Control	Basic cost of $194.00/m² *Additional costs may be incurred if disposal of excavated material required or special planting*	All source control combined estimated to save $1.5M AAD	

R1	884574	**CDEM – Warning Systems** · Provide earlier flood warnings to owners of properties in `high priority areas'. · Establish additional flow recorder and rain gauge for flood warning purposes. · Phone link to telemetry system for locals to check stream levels. · Install depth markers at bridges/other sensitive locations for community reference		Residual	CDEM		
R2	884576	**CDEM – Evacuation Plans** Evacuate high risk areas before inundation. Forecast triggers to be established for extreme events *High priority areas include the following: Hutt Park Road in the Lower Awamutu Sub-catchment; Riverside Drive South in the Bell Road Subcatchment; 8 properties on Elizabeth Street; a single property on Randwick Street; 7 Properties on Leighton Grove; a si* *A copy of the Flood Warning and Evacuation Report has been sent to HCC Emergency Management Office.*		Residual	CDEM		
R3	884577	**CDEM – Awareness** Raise awareness of the HCC Emergency Management Office Readynet system and encourage registration by local groups (in particular, residents in the `High Priority Areas'), to receive earlier warnings etc. Inform the local community of the Waiwhetu Catchment about the risks of flooding and what to do (e.g. local school programmes to reinforce preparedness in the home).		Residual	CDEM		
R4	884579	**Residual Protection – Insurance** Encourage owners of properties in flood prone areas within the Waiwhetu Catchment to insure their house and contents. May be of value to meet with NZ insurance council to discuss issue and look for a way forward. Impacts of 2010/2011 natural disasters in Australia and Worldwide likely to have an impact on insurers policies and guidelines.		Residual	FMP		

R5	884580	**Climate Change** · Raise awareness that this issue exists and where it is going to have the greatest impacts · Inform developers and property owners looking to redevelop/refurbish their land of current revised estimates for flood depths inclusive of CC and SL rise · Schedule regular review of models (5yr/10yr?)		Prevent	Within FMP budget for 1 model re-		
R6	884581	**CDEM – Education Residential** Inform the local community of the Waiwhetu Catchment about the risks of flooding and what to do (e.g. local school programmes to reinforce preparedness in the home).		Residual	$10,000		
R7	884583	**CDEM – Education Business** Disseminate information in the `Flood Warning and Evacuation Report' to named businesses in the report at risk from flooding, to allow a re-evaluation of their own emergency procedures.		Residual	$4,500		
R8	884584	**Flood Proofing** Raise awareness of flood proofing measures to target owners/occupiers of residential and commercial properties `high priority areas' and encourage implementation of these measures by a set date Create a guide of flood proofing solutions that can be distributed electronically and hardcopy to residents and business. See blue pages as published in UK for example of this in practise Encourage flood proofed repairs after flood damage occurs.		Prevent	$4,500 Excluding printing costs		
R9	884586	**Education – Raise Awareness in low risk areas** Target property owners/occupiers in `low priority' flood hazard areas to raise awareness of flooding issues and the importance of flood proofing measures		Prevent	possible to cover within FMP budget		
R10	884588	**Welfare and Recovery** · HCC and GWRC recovery co-ordinating team (e.g. photos, welfare, surveys to collect flood information) · HCC Emergency Management Office to confirm logistics and support required · Flood Protection to establish guidelines for flood pegging and train up staff on how to do it · Procedure regarding dealing with traumatised residents during collection of eye witness account information		Residual	FMP		

S1a	884604	**Source Control – Stormwater System** Address issues created by existing stormwater infrastructure. Investigate and improve problem areas with blocked drains, missing flap gates, and improve overland stormwater flow paths to reduce property inundation. Improve understanding of when stormwater is a nuisance as opposed to a hazard, encourage good stormwater management within private property		Control		*Capacity (HCC) working on stormwater strategy for Hutt Valley*

Upper Waiwhetu Options

Number	DM Ref	Description	Picture		Cost estimates	Flood impacts	Implemented?
N11	884572	**Vegetation Protection** Education programmes, new Bylaws or changes to Fire Management Plan to mitigate risk of fire and vegetation removal in the Upper Catchment		Control			Fire break work, planting work undertaken by HCC
C1	884502	**Naenae Concrete Channel** In the upper reaches, near Waddington Drive, remove concrete channel sections (approximately over 1.5km) and reintroduce more natural stream channel.		Control	$286 / m (estimated total cost $429,000)		
C3	884505	**Weir Removal** Remove weirs at Cleary St and upstream of Tilbury St to improve fish passage and restore natural sediment transport to the stream. Cleary St and upstream of Tilbury St (possible alternatives include V notching, or shallowing of weirs to balance impacts) Also possible to install rock ramp or vortex weir to encourage pool riffle effect in stream. Studies have been done by Landcare Research on the fish population in the Waiwhetu Stream and noted that Inanga were absent in upper regions of the Waiwhetu stream as may be expected due to the presence of the weir upstream of the park. Inanga have poor c		Control	$89,000 each ($178,000 total)		
C4	884507	**Weed Management – Glyphosate** Use Glyphosate (chemical) on managing cape Pond Weed. Upstream of White Line East (particularly stretch immediately upstream of White Line East to Cleary Street).		Control	$47,080 pa (contractors), $1,500 (Glyphosate)		Trial was proposed for end 2010, postponed until community consultation completed
C7	884514	**Weed Management – Status Quo** Continue use of existing methods (status quo) (i.e. manual and mechanical clearing, use of diquat).		Control	$1600/ha /pa Chemical and application costs are typically in the order of $1600/ha, including herbicide, spraying equipment and applicator.		Ongoing, by hand clearing, chemical not been used in recent years

Middle Waiwhetu Options

Number	DM Ref	Description	Picture		Cost estimates	Flood impacts	Implemented?
S7		**Modify Secondary Flowpaths** Modifications to topography of Mawson St to minimise flooding in Hayward Terrace		Control	$48,000	Reduced local storm-water flooding impacts	
S8		**House Raising** Raise houses where possible to above the 1-in-100 year flood level. (Limited by foundation and structure type)		Prevent	Rough order estimate of $70,000 per property	Would remove individual houses from floodway. Some houses are unable to be raised due to construction style.	
S10a		**Bridge Raising –** Whites Line East Option 1 – Increase X Section area from 20m² to 26m² Option 2 – Modifications to bridge structure Option 3 – New bridge with X Section of 36m² *(existing bridge has poor debris clearance character)*		Control	1 - $190,000 2 - $271,000 3 - $685,000	Debris is issue in flood event Reduction of flood levels upstream of this bridge, (refer to graph of flood waters down stream length)	
S10b		**Bridge Raising –** Te Aroha Pavilion Increase X Section, by lifting and re-piling, from 26m² to 41m² - *bridge capacity is major issue here*		Control	$32,000	Submerged during 100 year event Reduction of flood levels upstream of this bridge, (refer to graph of flood waters down stream length)	
S10c		**Bridge Raising –** Te Whiti Park Increase X Section from 28m² to 61m²		Control	$32,000	Does not cause property flooding at present, therefore not high priority Reduction of flood levels upstream of this bridge, (refer to graph of flood waters down stream length)	
S10d		**Bridge Raising –** Birdwood Road Increase X Section from 36m² to 59m² through excavation and bridge modifications		Control	$310,000	Does not cause property flooding at present, therefore not high priority Debris is issue in flood event Reduction of flood levels upstream of this bridge, (refer to graph of flood waters down stream length)	
S10e		**Bridge Raising –** St Ronans Ave (opposite) Option 1 - Increase X section 19m² to 22m² Option 2 – New Bridge with X Section 46m² *(Limited debris clearance concern at this bridge)*		Control	1 - $62,000 2 - $270,000	Debris is issue in flood event Reduction of flood levels upstream of this bridge, (refer to graph of flood waters down stream length)	
S10f		**Bridge Raising –** Rossiter Avenue Increase X Section from 18m² to 28m² Possible for greater X Section gains at increased cost, if required. Limited debris clearance is a concern at this bridge		Control	$310,000	Debris is issue in flood event Reduction of flood levels upstream of this bridge, (refer to graph of flood waters down stream length) Modelled	

S10g		**Bridge Raising –** Wyndrum Avenue Option 1 - Increase X Section from 21m² to 28m² Option 2 - Replace		Control	1 - ?? $32,000 ?? 2 - $120,000	Does not cause property flooding at present, therefore not high priority Reduction of flood levels upstream of this bridge, (refer to graph of flood waters down stream length)	
S10h		**Bridge Raising –** Norton Park Avenue Option 1 - Increase X Section 22m² to 35m² Option 2 – Replace Bridge		Control	1 - $165,000 2- $410,000	Submerged during 100 year event Raising by 500mm and clearing out channel reduces flooding upstream by up to 175mm *Refer Model Report page 57*	
S10i		**Bridge Raising –** Tilbury Street Increase X Section 19m² to 24m²		Control	$47,000	Does not cause property flooding at present, therefore not high priority Reduction of flood levels upstream of this bridge, (refer to graph of flood waters down stream length)	
S10j		**Bridge Raising –** off Hamerton St Increase X Section from 24m² to 34m²		Control	$75,000	Does not cause property flooding at present, therefore not high priority Reduction of flood levels upstream of this bridge, (refer to graph of flood waters down stream length)	

Lower Waiwhetu Options

Number	DM Ref	Description	Picture		Cost estimates	Flood impacts	Implemented?
S4c		**Lower Waiwhetu Structural Option 3** 50 year maximum in stream work (widening and deepening existing channel), 50 year level flood defences		Control	Estimated at $27M prior to Waiwhetu Project for complete works package	Protect up to 50 year level of flooding	In stream work completed bell Road to Port Road
S4d		**Lower Waiwhetu Structural Option 4** 50 year maximum in stream work (widening and deepening existing channel), 100 year level flood defences		Control	Estimated at $29M prior to Waiwhetu Project for complete works package	Protect up to 100 year level of flooding	In stream work completed Bell Rd to Port Rd
S9a	884626	**Bridge Raising -** On Track Railway Bridge Increase area for water beneath bridges that block flood flows. This can be achieved by raising the bridge spans and also widening and excavating the stream bed. Different methods are appropriate for different bridges.		Control	$899,000 Removal and bury services $100,000 excavation only	Reduction of flood levels upstream of this bridge, (refer to graph of flood waters down stream length)	
S9b	884626	**Bridge Raising -** Wainui Road Bridge Increase area for water beneath bridges that block flood flows. This can be achieved by raising the bridge spans and also widening and excavating the stream bed. Different methods are appropriate for different bridges		Control	$908,000 Bridge raising $100,000 excavation only	Reduction of flood levels upstream of this bridge, (refer to graph of flood waters down stream length)	
S9c	884626	**Bridge Raising -** Seaview Road Bridge Increase area for water beneath bridges that block flood flows. This can be achieved by raising the bridge spans and also widening and excavating the stream bed. Different methods are appropriate for different bridges		Control	$134,000 Bridge modifications, can't raise, no need to raise? $100,000 excavation only	Reduction of flood levels upstream of this bridge, (refer to graph of flood waters down stream length)	Bridge capacity incresed during Waiwhetu works to 50m²
S9d	884626	**Bridge Raising –** Whites Line East Option 1 – Increase X Section area from 20m² to 26m² Option 2 – Modifications to bridge structure Option 2 – New bridge with X Section of 36m² *(existing bridge has poor debris clearance character)*		Control	1 - $190,000 2 - $271,000 3 - $685,000	Reduction of flood levels upstream of this bridge, (refer to graph of flood waters down stream length)	

S9e	884626	**Bridge Raising -** Hutt Park Bridge Increase area for water beneath bridges that block flood flows. This can be achieved by raising the bridge spans and also widening and excavating the stream bed. Different methods are appropriate for different bridges			Control	$908,000 Raising $100,000 excavation only	Reduction of flood levels upstream of this bridge, (refer to graph of flood waters down stream length)	Bridge capacity incresed during Waiwhetu works to 38m²
S9f	884626	**Bridge Raising -** Port Road Bridge Increase area for water beneath bridges that block flood flows. This can be achieved by raising the bridge spans and also widening and excavating the stream bed. Different methods are appropriate for different bridges			Control	$908,000 Will require annual dredging to remove sediment build up at mouth. $100,000 excavation only	Reduction of flood levels upstream of this bridge, (refer to graph of flood waters down stream length)	Capacity of bridge modified during Waiwhetu Works to greater than 40m²
S9f	884626	**Bridge Raising -** Bell Road Bridge Increase area for water beneath bridges that block flood flows. This can be achieved by raising the bridge spans and also widening and excavating the stream bed. Different methods are appropriate for different bridges			Control	$908,000 $100,000 excavation only	Reduction of flood levels upstream of this bridge, (refer to graph of flood waters down stream length)	Capacity of bridge modified
LA1		**Waiwhetu Mouth Floodgates** Add floodgates and pump station to mouth of Waiwhetu stream at confluence with Hutt River.			Control		Would remove all flooding issues in stream unless failure of pumps occurs, in which case would revert to current situation, or worse due to physical blockage of flow. Only resolve up to design event level.	
LA2		**House Raising** Raise houses where possible to above the 1-in-100 year flood level. (Limited by foundation and structure type)			Control	Rough order estimate of $70,000 per property	Would remove individual houses from floodway. Some houses are unable to be raised due to construction style.	