IMPROVED HAZARD MITIGATION
IN
WHAKATANE DISTRICT

Edgecumbe with Fonterra in foreground

The stopbank breach by Sullivan's farm

Flooding across Rangitaiki Plains

Flooding around Awatapu, Whakatane

To	The Minister for Civil Defence and Emergency Management
From	Bay of Plenty Regional Council (Environment Bay of Plenty) and Whakatane District Council
Date	October 2007
Subject	Business case, in response to the invitation to jointly present an integrated cross-council business case for solutions to reduce community risk from the Whakatane and Rangitaiki Rivers
Reference	CBC (Min (05) 7/20

Contents

Acknowledgements

Photographs included have been made available from the Bay of Plenty Times, the Whakatane Beacon and the Eastern Bay News.

Glossary

AEP	The annual exceedance probability (AEP) shows the likelihood of occurrence of a flood event of a particular size in any given year. For example, a 1 percent AEP used to be referred to as a one in 100 year event, and a .33 percent AEP used to be referred to as a one in 300 year event. AEP has been adopted to improve clarity that large events can occur more frequently than at 100 year intervals.
Differential freeboarding	designing one bank slightly higher than the other, so that in an overdesign event water is most likely to overflow in a known direction (selected to minimise the overall damage from an overdesign flood)
Freeboard	additional height allowance on a stopbank to provide an added safety margin, used to allow for wave effects and additional protection in more vulnerable areas
Toe loading	laying extra fill material adjacent to the 'toe' (bottom) of a stopbank structure. The extra fill material provides additional weight to resist upward seepage pressure.

Executive Summary

Environment Bay of Plenty and Whakatane District Council have developed this business case to seek Government financial assistance for solutions to reduce community risk from flooding of the Whakatane and Rangitaiki Rivers and from landslips along the Ohope escarpment.

Whakatane District communities have been severely impacted by a number of natural disasters over the last 20 years including the Edgecumbe earthquake in 1987, the floods of 1998 and 2004, and the Matata debris flow in 2005. The 1987 earthquake has a major impact on the town of Edgecumbe, dropping some parts of town and surrounding rural land by up to two metres. Areas that previously drained by gravity now have to be pumped. In flood conditions the Rangitaiki River, which flows through the town, runs higher than Edgecumbe's ground level. This situation makes it difficult to safely manage stormwater in heavy rains. Loans which the Council took out for the recovery works from earlier disasters are still being paid off. The recent floods have further added to the financial burden on Council and ratepayers.

It is extremely important to identify, fund and implement a long term solution that provides for and protects the wellbeing of people and property.

The extreme weather events in 2004 highlighted a need to develop a higher standard of flood and hazard mitigation in some areas. Environment Bay of Plenty and Whakatane District Council discussed this with Government, and in 2005 the Minister of Civil Defence invited the two Councils to jointly present a business case for solutions to reduce community risk from the Whakatane and Rangitaiki Rivers. This case also requests assistance with landslip prevention works along the Ohope escarpment.

The proposed works the Councils are seeking Government assistance with are:

- Edgecumbe/Rangitaiki $13,333,181
- Awatapu (Whakatane River) $1,926,297
- Ohope Escarpment/Otarawairere $3,341,994 (excluding $50,300 for full sewage scheme to be funded by residents).

The costs of the recommended works compare favourably with the $35 million estimated cost just to Edgecumbe/Rangitaiki of a single large flood event. Government contributed $29 million to recovery efforts in the Bay of Plenty after the July 2004 event.

Flood defence improvements would reduce costs in a similar future event, although the effect on ratepayers on top of recovery costs would be significant and exacerbate affordability issues.

Ideally, the Councils would appreciate a Government contribution of 70 percent to reduce the impact of these upgrade works on ratepayers. The Councils are happy to discuss any financial contribution that substantially lessens the cost to the community and improves the ability of the Councils to implement the suite of recommended works.

Initial repair and recovery works undertaken following the July 2004 flooding and earthquakes in the Eastern Bay of Plenty addressed priority repairs, and work is continuing to reinstate and strengthen flood and erosion protection. Government

assistance towards recovery works to date has been gratefully received. This business case discusses additional hazard mitigation to improve future protection levels for these communities.

The Councils commissioned engineering studies to identify recommended options to improve protection and reduce the impacts of future events on these communities. The recommended works are discussed in this document.

Implementing the recommended works will impose a significant cost on ratepayers in a district with high levels of deprivation. The more the Councils have to pay to implement these works the greater the rating impact will be on the residents, many of whom are on low fixed incomes. The Councils are seeking Government assistance to ensure that all of the recommended works are able to be instituted within a reasonable timeframe, and without imposing too great a financial burden on these communities.

Improving flood protection to these communities is consistent with national goals, supporting ‘Families - young and old’ and ‘Economic Transformation’. Additional protection should reduce future risks of flood, and consequent impacts such as interruptions to education, stressed families, economic disruption and communities’ ongoing ability to obtain insurance cover.

A joint central and local government investment in these communities would enable timely implementation of recommended works to reduce the impacts of future natural disasters, lessen future risks to life and improve community viability.

Section 1: Introduction and Background

1.1 Introduction

1.1.1 Purpose

This report presents Environment Bay of Plenty and the Whakatane District Council's request for financial assistance to execute additional hazard mitigation works to improve community safety in Edgecumbe/the Rangitaiki Plains, Whakatane's Awatapu suburb and along the escarpment in Ohope.

The report outlines the impact of a spate of natural disasters that has affected Whakatane District communities, including the July 2004 floods and landslips that underlie this business case. It discusses the current situation in each of the three areas, describing prior events, current hazard control systems and the works recommended and the outcomes the Councils hope to achieve by implementing these works.

The report also provides information on affordability issues for ratepayers in the Whakatane District, including the significant impact of responding to numerous serious natural disasters in recent years.

The Councils have considered and addressed the relevant factors identified in the Civil Defence and Emergency Management National Plan. This includes measures to address residual risk management and response, as regardless of the measures undertaken there is always the possibility of an event that exceeds the capabilities of even the full suite of physical flood protection works.

Environment Bay of Plenty and the Whakatane District Council would appreciate Government assistance towards the recommended works to reduce these community risks to an acceptable level. Appendix Three shows a number of rating impact scenarios to enable Government assessment of the rating burden faced and the difference assistance can make to ratepayers.

1.1.2 Problem definition

Areas in the Eastern Bay of Plenty have suffered from multiple natural disasters in recent years, which have highlighted the need to improve hazard mitigation for some communities.

The problem lies in affordability for district ratepayers to fund works recommended to protect communities and businesses from such events in the future. There is no question that severe weather events will occur again in the areas this business case discusses. The recommended works are designed to ensure the ongoing viability of these communities by managing and lessening the impact of weather-related risks.

After the July 2004 events Environment Bay of Plenty and Whakatane District Council recognised a need for assistance to implement additional works in the areas of Whakatane District that had been seriously affected. In 2005 the Minister of Civil Defence invited the two Councils to jointly present a business case for solutions to reduce community risk from the Whakatane and Rangitaiki Rivers. This case discusses solutions for the Awatapu suburb in Whakatane and for the Edgecumbe/Rangitaiki Plains and also requests assistance with hazard mitigation works along the Ohope escarpment.

Both local authorities have prioritised funding towards the recommended further works. Whakatane District Council's 2006 long-term council community plan provides for over $5 million,[1] and Environment Bay of Plenty has indicated it will make substantial contributions to the Rangitaiki whole-of-scheme works.[2] However the amount available will not cover all of the proposed works and assistance is sought from Government to enable all of the recommended works to be addressed, and to be completed in a timely manner without creating affordability issues for the community.

Without adequate work to mitigate the impact of future extreme weather events:

- Families and local communities will suffer from stress and uncertainty
- The ability to manage the risks of future severe weather may be reduced, disrupting lives and risking long-term health and educational consequences
- Eastern Bay of Plenty contributions to economic transformation are likely to be constrained.

Ideally the Councils would seek a Government contribution of 70 percent to reduce the impact of these upgrade works on ratepayers. However, the Councils are happy to discuss any financial contribution that substantially lessens the cost to the community and improves the ability of the Councils to implement the suite of recommended works.

The development of this case was delayed due to diversion of Council resources to address emergency work in Matata following the devastating 2005 debris flow, where remedial work and social rebuilding is also continuing with Government assistance (separate to this case). During this time engineering reports were commissioned to determine the best approach.

The Ministry of Civil Defence Emergency Management (MCDEM) has recognised the need to take a more holistic inter-agency response to civil defence emergencies. A 'whole of government - whole of community' approach to reducing future risks and vulnerabilities will help spread the economic costs of the work required, and the additional flood protection will contribute to the risk reduction goal of the National Civil Defence and Emergency Management Strategy.

1.1.3 Methodology, limitations and assumptions

Engineering reports were commissioned to identify the options, costs and benefits of various hazard mitigation works in each of these areas. The local communities have been consulted and there will be ongoing consultation as the works are implemented.

Due to the scale of the costs, a cost-benefit analysis was conducted on the works recommended in the Edgecumbe/Rangitaiki area, using estimates of the impact of a future 100 year, 20 year and 10 year flooding event in the Edgecumbe urban and rural surrounds. This assessment was based on the actual damage costs associated with the July 2004 event and potential additional costs identified by the project team.

Similar analysis has not been conducted for the Awatapu or Ohope/Otarawairere works because the scale of the works is lower and the Councils consider the risk to the community of not conducting the work to be untenable.

[1] In addition to over $5m for Matata works.
[2] Discussed as Edgecumbe/Rangitaiki scheme 5 later in this business case.

1.2 Background

New Zealand is vulnerable to severe weather events, and climate change estimates suggest that these are likely to become more common. The Interdecadal Pacific Oscillation (IPO) is a climate cycle strongly correlated to heavy rainfall and floods in the Bay of Plenty and it has shifted to an active phase around 1997-98, so a series of above average floods can be expected over the next 10 to 20 years.[3]

Relevant disasters of note in Whakatane District's recent history include:

- Debris Flow 2005: severe weather in the Bay of Plenty caused a devastating debris flow through Matata. Restoration works were prioritised due to high risk to life, and have been addressed in a previous business case. This event caused high additional rates/funding implications.
- Flooding and landslips July 2004: a band of severe weather stalled over the Eastern Bay of Plenty, and resulted in widespread flooding and landslips.
- Flooding 1998: Edgecumbe suffered flooding in a week-long low level flood.
- Edgecumbe Earthquake 1987: the earthquake caused massive damage, and a drop in land levels of more than two metres, greatly increasing flood risk.

In July 2004 severe weather accompanied by a swarm of earthquakes struck the Eastern Bay of Plenty. A civil defence emergency was declared at 10.00pm on Saturday the 17th of July, and remained in place until 4.30pm on 30 July, 2004. The heavy rain caused extensive flooding. Saturated hillsides gave way and a number of landslips occurred across the District including several along the escarpment at Ohope/Otarawairere.

Over 3,000 people were displaced from their homes during the floods and sheltered in evacuation centres and local marae.[4] All the roads to neighbouring Districts were cut off during and after the event by flooding or slips. The isolation added to the distress for residents, disrupted school bus services and restricted heavy vehicle access which in turn limited emergency response and recovery work.

This is an example of the type of significant event that the works in this case are designed to mitigate. There is no doubt that events of this magnitude will occur again in this area. The cumulative results of such events will be potentially devastating to the local communities and economies without works to reduce their impact to a manageable level.

Flooding in Awatapu, Whakatane

[3] McKerchar, A and Pearson C, Factors causing flooding to be New Zealand's Number One Hazard, in *Tephra*. February 1991. The IPO has an approximate 30 year cycle of 'benign' and 'active' phases.
[4] http://www.teara.govt.nz/EarthSeaAndSky/NaturalHazardsAndDisasters/Floods/5/en

Slips in the Whakatane District

Inundation of Edgecumbe and the Rangitaiki Plains

Slip on the Ohope escarpment

Section 2: Hazard Mitigation Locations

As noted above, the Councils have identified three specific locations for which they are seeking assistance with hazard mitigation:

1. Edgecumbe/Rangitaiki;
2. Awatapu (Whakatane River); and
3. Ohope escarpment/Otarawairere.

This section provides background on the existing problems in each of these three sites, outlines the current flood/hazard mitigation measures and sets out recommended works for each location.

2.1 Edgecumbe/Rangitaiki

This section looks at the direct impacts of flooding on Edgecumbe and the surrounding area and the flood protection that is sought and measures taken to date. It then discusses the options to address community risk from the Rangitaiki River and the cost-benefit analysis of the recommended works.

2.1.1 Background

The Rangitaiki floodplain has several settlements, and is a productive agricultural area. Edgecumbe is the main town within the plains, and is also the location of the Transpower substation that services the eastern Bay of Plenty.

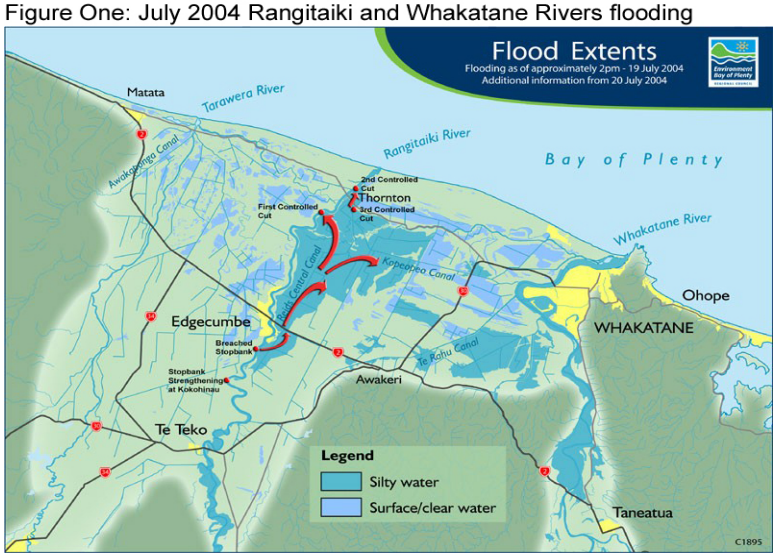
The 1987 Edgecumbe earthquake substantially increased flood risk, particularly in the southwest of the township, where the ground level dropped by over two metres. The ground has continued to consolidate since the earthquake. A survey carried out by Opus International Consultants Limited (Opus) in 2002 indicates that the southwest of Edgecumbe has subsided up to an additional half a metre. No further substantial subsidence is expected.

Areas that had previously been able to drain by gravity now have to be pumped. The west of the town is susceptible to regular flooding when the Omehau canal system in the surrounding rural area overflows. The areas of Totara and Kanuka Streets are particularly badly affected with streets flooding several times a year (although floodwater does not normally enter dwellings). The land was always flood prone even before the earthquake. At one stage it was reserved by the Department of Education for an intermediate school. Not needed for this purpose, it was then developed as a residential subdivision by Housing New Zealand. Local stormwater flooding in this area has been an ongoing problem ever since. A particular problem is the resulting inflow to the sewerage system when the streets pond with water. This increases the load on the sewer system by a factor of ten.

In the July 2004 heavy rain event the Rangitaiki River which runs through Edgecumbe quickly reached capacity and was close to overtopping the stopbanks in some places when a 100-metre-wide breach (Sullivan's breach) occurred in the stopbank above Edgecumbe. To compound matters the Matahina Dam exceeded its storage capacity and additional water had to be released into the River. This also identified weakness such as the State Highway 2 bridge at Edgecumbe, which acted as a dam and reduced flow along the floodway until the approaches washed out. Transit New Zealand has committed to lengthening and widening this bridge through its capital works programme, and that is essential for utilising the increased capacity of Reids Floodway.

Figure one shows the extent of the 2004 flooding in Edgecumbe and the Rangitaiki Plains. Flooding was worst on the east of the Rangitaiki River due to the stopbank breach, although a future overtopping or failure could occur on either side of the River.

Figure One: July 2004 Rangitaiki and Whakatane Rivers flooding



Flood waters entered Te Teko and Edgecumbe, and swamped some 17,000 hectares of farmland.[5] In Edgecumbe township 303 residents were evacuated from 129 homes damaged by floodwaters.

The Transpower Substation in Edgecumbe supplies the power from the main grid to the whole Eastern Bay of Plenty area. It was at high risk of inundation in the 2004 flood (and had also been at risk in the 1998 flood). Transpower evacuated its staff and emergency works continued for hours to reduce the level of inundation and protect the power supply. Council staff and contractors constructed and maintained emergency bunding around the substation. If water had disabled the power supply the lack of power for many of the region's flood and sewer pumps[6] would have greatly increased flood damage in Whakatane, Opotiki and other areas.

July 2004: Flooding around Edgecumbe substation

[5] Ibid

[6] The flood pumps in Whakatane are currently all powered by electricity. Four back up generators are available to borrow from Horizons Energy, the airport and the hire centre.

Damage was mitigated to an extent by the timing of the flood. A night-time breach could have delayed and restricted response measures, and if people were asleep when it occurred there would have a higher risk to life.

Fonterra's Edgecumbe factory was shut for off-season maintenance so did not suffer major production losses, although its reopening was delayed due to the clean-up required.

Inundation could have also seriously disrupted picking and processing of kiwifruit at Eastpack's kiwifruit packhouse in Edgecumbe if the flood has occurred in the main packing season (late March to mid-June), and at a different time of year some horticulturalists could have lost an entire growing season.

Fonterra and Eastpack are two of the significant employers and industries in the District. Any impact on their business continuity has flow-on effects throughout the region.

If the flooding had occurred in the peak milking season dairy farmers' seasonal production would have been seriously reduced.[7] In summer flooded pasture would have been dead after three to four days whereas in July pastures were able to survive inundation for longer periods. This would have increased resowing costs and the length of time cows needed to be grazed off farms.

2.1.2 Current Edgecumbe/Rangitaiki flood control systems

Environment Bay of Plenty targets a one percent AEP[8] flood control level along this scheme. Reids Floodway was designed so that where the main river channel reaches a level of 610 cubic metres per second (cumecs) some of the flow will divert down the floodway channel (south/upstream of Edgecumbe) and flow past on the eastern side, rejoining the River several kilometres later near the river mouth. Combined with the main channel the system should be able to convey up to 760

[7] As over 13,500 cows were sent out of the District during the flood this would have been a serious issue for some farmers if it had occurred in milking season.

[8] 1 percent AEP (annual exceedance probability) indicates the size of what has been assessed to be a 1 in 100 year flood event. It is intended to more clearly describe the average chance of a particular sized event happening in any year, as such events may happen more or less often than every 100 years.

cumecs. This gives a combined theoretical capability up to a 1 percent AEP level for the river.

In 1998 a flow of 464 cumecs (approximately 7 percent AEP) severely tested the scheme and revealed a number of stopbank weaknesses. These were addressed with:

- Toe loading and relief drainage at the Transpower site
- Relief drainage and cribwalling at the Fonterra site
- Improvements to stability and drainage of stopbanks and floodwall at College road in Edgecumbe.

Environment Bay of Plenty found dunes in the river bed were leading to the higher than expected water levels. It raised stopbanks at a number of vulnerable locations to restore them to a 50 year standard, which was accepted as a temporary solution for the reach from Edgecumbe to Thornton. The Asset Management Plan (AMP) documents this and notes that the channel capacity was to be reviewed after five years and if necessary the channel would be dredged to restore 1 percent AEP. Dredging was scheduled for 2008/09.

Following the stopbank breach in July 2004, a report[9] was commissioned to assess the cause. The report revealed a number of stopbank weaknesses that are currently being investigated and addressed and highlighted that had the Sullivan's breach not occurred there would almost certainly have been a breach or overtopping in another area of the scheme.

Environment Bay of Plenty then commissioned a report from OPUS to determine a suitable flood protection design for Edgecumbe and its environs. The report identified that:

(i) The hydraulic conveyance of the design flood event in the river and floodway below Edgecumbe is marginal

(ii) Reids canal is very narrow at some points, which greatly restricts its overall capacity, including constriction by the SH2 bridge (Transit has been planning to extend the bridge length to address this)

(iii) The foundation conditions make the stopbanks prone to piping failures under flood conditions

(iv) Dredging is unlikely to significantly increase long-term river conveyance capacity and is a high cost option

(v) Local stormwater is a problem in the west of Edgecumbe where low lying parts of the urban area are reliant upon a rural standard drainage scheme.

Environment Bay of Plenty has been conducting ongoing geotechnical investigations and repairs and upgrading of stopbanks along the Rangitaiki River.

A number of other recommendations have arisen from Opus's report into the mitigation measures for the Edgecumbe/Rangitaiki catchment works. The Councils have implemented or are exploring these:

- Maintain use of building controls such as minimum floor levels above modelled flood breach levels
- Assess/upgrade Edgecumbe stormwater system to ensure it can handle additional water flows from pressure relief trenches on main stopbanks
- Ongoing monitoring of the River mouth cross section to maintain flow capability

[9] Report by Ice Geo and Civil. Sullivan's Breach. 26 August 2004.

- Weather radar to improve the ability to predict the arrival of high risk weather systems
- Improved website information on flood risk levels and current water levels and rainfall
- Text-based warning systems
- Optimisation of Matahina and Aniwhenua hydro lakes for flood storage. Since 2004 Environment Bay of Plenty and Trust Power have worked closely to improve the flood forecasting model for the Rangitaiki River system to enable better use of this limited but useful additional storage capacity.

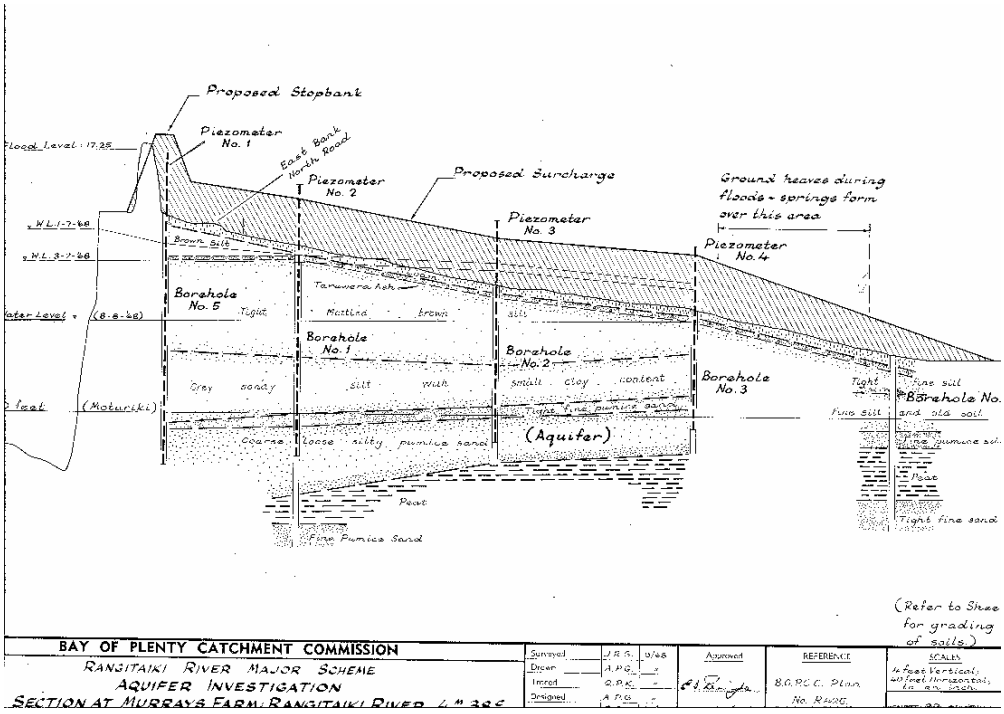
Whakatane District Council has previously considered addressing local stormwater flooding issues for the urban area in southwest Edgecumbe. Works were scheduled for 2007 but other funding priorities and recovery from the 2004 flood overtook the community. Council hopes Government assistance to increase affordability for the works recommended in this case will ensure that these works do not have to be further deferred.

2.1.3 Constraints on the Edgecumbe/Rangitaiki Scheme

Flood defenses can be used to manage and mitigate risk, but there will always be a possibility of the defenses failing or being overwhelmed. There are a number of issues that act as constraints on the type and extent of works that can be carried out as part of this scheme. Where solutions have been identified, they are specified.

Topography

The Rangitaiki Plains are low lying and along most of the lower reaches of the Rangitaiki River the river course is higher than the surrounding countryside. An example of this is depicted below. This gradient increases both the amount of land that would have to be designated as a floodplain and the height of stopbanks required to increase the flood protection level. The river's relative height compared to surrounding terrain also constrains the options for relocating the roads and buildings which closely follow the river course.



The local materials available for the stopbank defenses also impact on the risk in this area. The local soils are light, primarily pumiceous, sandy soils, which are prone to piping. This occurs where flowing water finds an outlet and washes away soil, creating a pipe or tomo. The costs of remedial work on the stopbanks have included additional drainage (particularly within the urban area). Imported fill and rock has been used to help reduce the weaknesses imposed by the surrounding soils and the use of local materials in stopbank construction.

Existing infrastructure
Existing stopbanks are often close or immediately adjacent to the river, constrained by roads, houses and other infrastructure. Dwellings, milking sheds and other infrastructure have typically been built on the small amount of higher land that is available, which tends to be alongside the river (where the level has built up over time from alluvial deposits). The works proposed in this report aim to protect to the current level of a 100 year flood event. The location of infrastructure and topography limits the practicability (in terms of costs and benefits) of any higher level of flood defenses in the Edgecumbe-Rangitaiki scheme at this point in time.

The costs of allowing for relocating stopbanks further out from the river, reduced availability of productive land and moving infrastructure would be prohibitive at present in terms of the scale of works and compensation. The councils recognise that a strategy to work towards providing for increased capacity in future would be useful to allow for climate change and are planning for current works and future needs accordingly.

Environment Bay of Plenty in association with Whakatane District Council is currently developing a Floodplain Management Strategy for this area (due to be completed in 2008/09) that will examine changes to land use in the future and other issues. This will include examining options such as:

- Strategic relocation of infrastructure over time (including roads and stopbanks) where practicable to enable future alterations to the scheme related to climate change and floodwater modelling.
- Additional solutions to minimise damage in an overdesign event, such as differential freeboarding in some areas of the stopbanks to manage the direction and extent of flooding in overdesign events.

The Floodplain Management Strategy will be developed in consultation with the community to explore future possibilities of this nature that may improve future risk management.

2.1.4 Recommended works for Edgecumbe/Rangitaiki

Opus assessed the impacts of each option for improving community protection both in an engineering sense to consider whether it was fit for purpose and in a sustainable development context looking at the effect on both current and future community wellbeing.

2.1.4.1 Recommended works

Opus identified that the highest priority for Edgecumbe/Rangitaiki is to implement the works to protect the integrity of the scheme. Strengthening the stopbanks and improving the capacity of the floodway system will reduce the risk of major flooding to other areas in events up to the level of the July 2004 flood (1 percent AEP). Generators for some pump stations to enable continued function in the event of a power outage are also recommended.

The scheme numbers used here refer to the engineering report and cost-benefit analysis scheme numbers, for cross-reference.

The wider scheme works reduce the risk to the urban area, and improve flood protection across the scheme area as a whole. The recommended works for the Rangitaiki plains and Edgecumbe area are, in priority order:

Wider Rangitaiki River Scheme Works (Scheme 5 – cost estimate $10.125 million[10])

- Improvements to Reids Floodway
  - Widening the narrow sections of the floodway to remove bottlenecks. Modelling shows that the most significant increases in flood water levels with predicted climate change will be in Reids Floodway, making improvements to this section of the defenses even more important. ($5.5m)
  - Changes to the bridge across the floodway to remove flow constrictions (Transit New Zealand - separate to this case).
  - Adding a control gate to Reids Floodway. A control gate could actively manage floodwater between the floodway and the main channel. This will enable the floodway to be used to protect areas of weakness identified in the main stopbanks in a severe or prolonged flood[11], to improve control of water flow during severe weather events and to divert flow down the floodway in a long-duration event to reduce pressure on stormwater drainage in the urban area. ($3.1m)
  - As part of the control gate project, there is no intention to increase the frequency of flow down the floodway. This has been a concern expressed by landowners downstream in the consultation to date. Flow would still commence in the 40 year flood as per the current overflow weir design. The only exception to this would be if there was distress in the main river stopbanks which required a reduction in the main river. A set of operating rules for the control gates would be devised to the satisfaction of all parties as part of the resource consent process.

- Stopbank investigations repair and remediation/strengthening
  - Remedial works for identified areas of weakness along the length of the protection works, including extensive relief drains and toe-loading in the stopbanks within the Edgecumbe urban area (in progress). ($1.5m)

Edgecumbe urban area works (total $3,208,181)

- Southeast (scheme 1 – estimated cost $690,000)
  The cost-benefit for this scheme is likely to be understated, given the wide dependency of many flood defenses in the wider Eastern Bay of Plenty region on the substation. Transpower recognise the benefits of this work and have indicated a willingness to contribute to providing a .33 percent AEP protection level to the substation, a total of $409,000. In light of this contribution, recommended works are:
  - raising stopbanks on the western Reids Floodway bank

[10] Stopbank investigations are still underway, so the final costs for some of these works are yet to be determined, but this is the best current estimate.
[11] The 1998 flood level lasted over seven days. The river level was not high enough for the spillway to be used to divert water down Reids floodway, but came within 0.5m of overtopping the stopbank downstream of Edgecumbe and caused damaging seepage. A control gate could have assisted with controlling the flow.

- o a new deflector bank by the Transpower substation; and
- o providing an emergency flood pumping location.

- Southwest (scheme 3 – protection - estimated cost $818,235)
  These works will protect residential properties against a range of minor flood events caused by land subsidence in the 1987 earthquake:
  - o construction of a low (0.8m approx) stopbank on the south and west of Edgecumbe (joining the main stopbank) to reduce flood run-off from rural areas into the low-lying south west of the town; and
  - o a flood pump station to control local stormwater flooding.

Northwest (estimated cost $891,000)

- Low stopbank works and ground contouring (scheme 4) are recommended for this area. This would primarily protect against inundation of streets and some houses from floods of ten year (10 percent AEP) size and greater. Land is less low-lying than in the southwest and it is closer to the Omeheu pump stations so rural runoff is able to drain faster.

Northeast (scheme 2, dependent on scheme 1 - estimated cost $808,946)

- Cost-benefit calculations show that given the lower risk levels if the whole-of-scheme works are completed this additional protection may require contributions from the direct beneficiaries, particularly Fonterra who are being consulted on their willingness to fund this work. Eastpack is on higher ground and would get limited additional benefit. Recommended works are:
  - o raising 700m of the existing Reids Floodway bank
  - o building 500m of new stopbank
  - o provide an emergency flood pumping location.

2.1.4.2 Other works considered for Edgecumbe/Rangitaiki

Several other mitigation works have also been considered for this area, but are considered less effective or otherwise impractical. Considerations included:

- Dredging. This was scheduled for 2008, but engineering analysis and modelling show this would be a high cost option with minimal and short-term benefit, so Environment Bay of Plenty has decided not to proceed.
- Relocation of infrastructure and engineering works to increase flood capacity by rebuilding stopbanks further out from the river. As discussed in the constraints, this would be impracticably costly.
- Relocation of Edgecumbe dwellings (estimated average cost $200,000 per dwelling. The 2001 census shows there are 591 occupied dwellings in Edgecumbe). The cost would be significant, and there are few suitable alternative locations in the area. The recommended works reduce risk sufficiently to make wholesale relocation unnecessary.
- High southwest stopbanks (estimated cost $1,270,000). This would create risks to life in the event of a breach inside the area, and the low ringbank recommended would provide positive benefits with less risk. High stopbanks are not supported by the community.
- High northwest stopbanks (high - estimated cost $1,050,125). These would have similar drawbacks to the high southwest stopbanks and similarly do not have the support of the community.
- Assistance to raise the few low-lying houses in the northwest. This would assist with smaller events, but events of 5 to 10 percent AEP or greater would still cause flooding. Raising houses does not address the street flooding and inflow to the sewerage system.
- River straightening. The engineering study considered options to straighten the river at Laws Bend, one of the more significant river meanders but this is not recommended because modelling shows that the gain would be minimal (100mm).

2.1.4.3 Cost-benefit analysis for Edgecumbe/ Rangitaiki Plains works

Due to the scale of the proposed works, Whakatane District Council and Environment Bay of Plenty requested a cost-benefit analysis of several flood mitigation scheme options for urban and rural Edgecumbe to assist in assessing and prioritising a preferred option or options.

This study presents flood mitigation options for two distinct areas:

1. Edgecumbe urban area
2. Wider Rangitaiki Plains (or “whole of scheme”)

The Edgecumbe urban area options provide local protection to defined sections of urban Edgecumbe. The wider Rangitaiki Plains options provide protection to the Edgecumbe urban area as well as the wider plains between lower Edgecumbe and Thornton.

The recommended works are assessed as separate schemes to allow a greater range of funding or financial contribution options to be considered. Some works protect primarily residential areas; others protect key infrastructure or large employers.

The costs of the 2004 civil defence emergency were used to develop base cost scenarios for the cost-benefit analysis. Other relevant factors have also been taken into account where practicable, or noted for consideration.

Considerations

Businesses on the Rangitaiki Plains face ongoing risk from weather-related flooding. This applies to both direct damage and the indirect results of reduced employment and discretionary spending, with multiplier effects throughout the community.

The cost-benefit analysis conducted for the Edgecumbe/Rangitaiki works estimated the damage costs from a single 100 year flood event as likely to be over $35 million.

Damage costs assessed as part of the analysis included:

- Damage to infrastructure, including Council assets, bridges, power lines, schools and potential damage to the Transpower substation
- Damage to residential and commercial property and contents
- Damage to other property
- Damage to agricultural land and related industries
- Emergency and assistance costs
- Potential risk to life.

There were a number of intangible costs identified by the project team that could not be readily quantified:

- Emotional stress and anxiety resulting from flooding
- Disruption to children's education[12]
- Financial loss owing to downturn in trade[13]
- Illness related to the event and displacement effects.

Accordingly the project team attributed an additional 50 percent to damage costs assessed to account for these intangible and largely immeasurable costs.

Other costs not quantified include the impacts on:

- contributions of voluntary time and other resources during the flooding and for clean up and recovery work;
- people who did not have insurance (111 of 141 homes assessed as uninhabitable until repaired had no contents insurance[14] and of the 1261 households across the Eastern Bay of Plenty that responded to a survey 429 had no contents insurance and 315 had no house insurance)[15]; and
- opportunity costs of work not done by local and central government agencies, non-government organisations, businesses and individuals because time and other resources were diverted to disaster responses and recovery.

Many people whose homes were damaged were unable to return for some time. Two homes were demolished or relocated. The drying time for inundated homes was up to six months. People were billeted in crowded situations, temporary relocations were often unavailable over the summer period, and many people stayed at the community hall and the marae for some time. Some families were relocated more than once, further exacerbating stress. The level of family violence reported doubled in the period following the flood.[16]

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[12] This could exacerbate low education levels in the District, which are noted in Appendix two.
[13] Forty-five businesses were surveyed in the Eastern Bay of Plenty after the 2004 event: 13 had direct damage; 33 estimated lost business; two staff were laid off; and 304 days of production or trade lost.
[14] *Whakatane state of emergency lifted,* NZ Herald 30.07.2004
[15] Eastern Bay of Plenty Floods-July '04: Recovery Report 11 to Director MCDEM, 3/9/2004.
[16] Recovery Report 12, October 2004

Central and local government, non-government organisations, marae, businesses and individuals also contributed considerable time, travel and other resources to the flood response and recovery work. The extent of these contributions has not been quantified.

Results

The cost benefit analysis determined that all the proposed flood mitigation schemes are economically beneficial. The table below shows the net present value (NPV) of the benefits of the scheme works and the total cost of construction. From this the project team derived the benefit-cost ratio figures detailed below.

Table One: Summary of cost benefit analysis

Category	Scheme	NPV benefit	Scheme cost	Benefit-cost ratio
Edgecumbe Urban area	Scheme 1*	$874,000	$381,419	2.3
	Scheme 2	$1,620,000	$808,946	2.0
	Scheme 3	$1,456,000	$818,235	1.8
	Scheme 4	$3,045,000	$891,000	3.4
Wider Rangitaiki Plains	Scheme 5	$16,154,000	$10,125,000	1.6
*This scheme will be upgraded to 300 year event protection and cost $690,000.				

A sensitivity analysis was conducted to assess the changes in the benefit-cost ratio if calculated benefits were reduced by 20 percent. The sensitivity analysis indicated that even if benefits were overestimated by 20 percent all of the recommended flood mitigation schemes remain economically viable.

The greater protection to the whole area provided by the whole-of-scheme works will decrease the likelihood that an event up to 1 percent AEP will affect the urban areas. This would reduce the nominal benefit-cost ratio for schemes 1 and 2. Scheme 1 remains viable in the different scenarios calculated.

The cost-benefit analysis does not reflect the potential damage to Transpower from an overdesign event (i.e., < 1 percent AEP). Damage in an overdesign event could be significant and consequently Transpower has discussed the prudence of providing an additional level of protection for this lifeline infrastructure. Construction costs for a .33 percent AEP protection level are estimated at $690,000.

Fonterra and to a lesser extent Eastpack may choose to contribute to the costs for scheme 2 to enable implementation and enhance their business security. The councils may require some contribution from these companies for these works.

The increased likelihood of flood events due to climate change is discussed briefly in Appendix E, but is not incorporated into the analysis as studies specific to the Eastern Bay of Plenty were not available. Based on information about impact on other areas, a reasonable assumption is that the results of climate change would increase the benefits of the recommended work further.

Due to a lack of reliable information this economic analysis, based primarily on the likelihood of an inundation in a 100 year event, does not reflect some of the wider social risks of power insecurity.

The ratings above and other factors identified in this analysis and business case were used in conjunction with the cost-benefit analysis to determine priorities.

2.2 Awatapu (Whakatane River)

2.2.1 Background

In the 1970s the Whakatane River was realigned to reduce flood risk to Whakatane town, following the large and damaging floods of 1964 and 1965. The river was shortened by cutting off a large meandering loop, leaving an area of low lying land between the oxbow lake left from the old river channel (now the Awatapu Lagoon) and the current Whakatane River channel. This low lying land was subsequently developed for the New Zealand government by Housing New Zealand to form the present day Awatapu subdivision.

Storm water from Awatapu is drained by a pump station in the centre of the residential area, with gravity drainage from the lagoon to the Whakatane River. The difficult drainage in the Awatapu area is compounded by the Wainui Te Whara Stream which rises in the steep hill country to the southeast of Whakatane, flows through town and discharges into the Awatapu lagoon. Flood waters from the stream pond in the lagoon during flood events, when the main river is high. This contributes to the already significant flood risk to the Awatapu residential area.

In July 2004 continuous heavy rainfall overwhelmed the flood defences in parts of Whakatane. The Whakatane River spilled into Whakatane's central business district and overflow from the Awatapu Lagoon caused serious flooding in the Awatapu suburb. Water and sewer pumps in Whakatane were flooded, and overflows occurred. Nearly 900 people were evacuated from 281 houses affected by the floodwaters in Awatapu. The remaining 178 houses in the suburb were isolated by water for three days, and the whole suburb was left strewn with debris and sewerage matter.[17] Sewerage spills and the stagnating floodwaters contributed to potential health risks and to the cost of clean-up, reducing the ability to salvage goods and personal possessions.

Many homes had no contents insurance,[18] and 315 of the 1261 households across the Eastern Bay of Plenty that responded to a survey did not have house insurance.[19] Assistance was provided through the goodwill and resources of charitable groups. People also used grants and advances from Work and Income, loans and hire purchase to replace whitewear, basic furniture, bedding and other items destroyed by the flooding or exposure to contaminated water.[20]

Because the river levels were higher than the water levels in the Lagoon the gravity drainage system through the floodgated culverts did not work[21]. This meant that over time the Lagoon filled up and then flowed over into the suburb and eventually inundated the Awatapu pump station. One of the pumps had already failed after ten hours continuous operation, and the flooding overwhelmed the remaining pump.

The river levels in the Whakatane River are estimated to have reached between a 125-year and a 150-year flow at Awatapu.

[17] Op cit. Report to Operations Committee August 2004.
[18] *Whakatane state of emergency lifted,* NZ Herald 30.07.2004
[19] Eastern Bay of Plenty Floods-July '04: Recovery Report 11 to Director MCDEM, 3/9/2004.
[20] *Home is where the stench is*, NZ Herald Friday July 30, 2004
[21] Op cit. Report to Operations Committee August 2004.

2.2.2 Current Awatapu (Whakatane River) flood control systems

Awatapu currently has stopbank protection along the river and the Lagoon, with gravity drainage from the Lagoon up to a 2 percent AEP level, and a pump station in the centre of the residential area to remove stormwater. The Awatapu pump station does not pump floodwater from the Lagoon. The Lagoon's gravity drainage is estimated to provide protection to around a 2 percent AEP event, with no allowance for climate change.

Works that were underway at the time of the 2004 flood to strengthen flood defenses within the Muriwai Drive area of Whakatane have since been completed and the 1 percent AEP flood design standard (including freeboard) now applies through the whole length of the Whakatane urban stopbanks. There is a higher freeboard (800mm) on the town side and a lower freeboard (500mm) on the rural side to direct overflow away from residences. Modelling shows that only minor overtopping is likely to occur in a 200 or 300 year flood event due to the width of the river.

The pump station in the centre of the Awatapu suburb has been repaired after it was inundated in 2004. This cost $88,984 and included raising and refurbishing the pumps ($69,154) and temporary pump hire ($19,830). The Government granted $23,000 in July 2005 towards these costs. This assisted in immediate restoration of existing flood protection measures at the main Awatapu pump station while investigation of further works was undertaken. Raising the pumping equipment should also provide additional security in future events.

Measures undertaken by the Councils to reduce the flood risk to Awatapu and Whakatane include:

- improved control of gravel build up to the west of the river mouth, to allow earlier river flow over the widened river mouth in a flood event
- Awatapu and Riverside Drive stopbank heights raised to 4.1m
- annual sediment removal from the Wainui Te Whara catchment
- installation of a level recorder in the Lagoon, monitored by the Whakatane District Council telemetry system
- a floodlight and monitored video camera adjacent to the pedestrian access way to allow visual monitoring of Lagoon levels (when there is power supply)
- regular inspections of the floodgates, including before and following heavy rain warnings
- an operations and maintenance plan that covers all of the Awatapu flood protection infrastructure.

Additional works the Councils will undertake include:

- a retention dam on Wainui Te Whara Stream
- a rain gauge in the Wainui Te Whara catchment following completion of the retention dam
- development of further Standard Operating Procedures to assist with planning and intelligence in natural disasters.

2.2.3 Recommended works for Awatapu (Whakatane River)

In light of the inability of the gravity drainage to control flood levels in the Awatapu Lagoon when the river levels were high an engineering report was commissioned to investigate the flood and report on a suitable flood protection design for Awatapu (*Report for Awatapu Flood Hazard: Mitigation Solution Study*: by GHD). The report determined that in current conditions protection should address a level between a 1

in 100-year event and a 1 in 300-year event. It examined a number of options, including:

- a low or high dam at Wainui Te Whara, which would cost $400,000 to 700,000 or $1.5m to $5m respectively plus associated land costs if the land owner was agreeable. A low dam would protect other Whakatane residents but would not effect the flooding at Awatapu. A high dam would be reliant on technical systems to be effective, and create additional risk to the whole Whakatane community.
- Raising the stopbanks around Awatapu at an estimated cost of over $2.5m. This would involve property purchase/options in over 100 properties, and be high-risk in the event of stopbank failure.
- Changing the stopbank height differential (currently lower on the Awatapu side). This would increase the risk to a larger number of houses, while not adding significant protection to Awatapu.
- Upgrading the existing Awatapu pump station. This was estimated to cost over $500,000 without generating capacity, be unlikely to cope with a 300-year storm event and would carry high residual risk.
- A new pump station at the Lagoon Outfall, estimated cost $750,000 plus generator capacity (total cost estimate $1.1m to $1.25m.)
- Additional pipes and flushing, estimated cost $210,000.

The report recommended repairs to the Awatapu pump station, and installation of a second pump station and associated infrastructure for Awatapu Lagoon. This would enable pumping from the lagoon directly to the river in severe floods, mitigating the effects of the inflowing floodwaters.

A subsequent more detailed GWD design report[22] investigated pump options for the proposed Awatapu Lagoon pump station and modelled those which met the criteria at a reasonable cost. The design brief was to provide protection to a 1 percent AEP 2080[23] flood design level[24] to allow for global warming.

The recommended new Awatapu Lagoon pump station will be located at the northeast end of the Lagoon and be served by two fixed pumps, and by two portable pumps which could be deployed elsewhere if required. A generator is also recommended to ensure the pumps are able to function if the power supply is interrupted. The recommended design is to install a generator set-up capable of providing some power to a number of adjacent pump stations as well.

The works identified and scheduled to install an Awatapu Lagoon pump station total $1,926,297.[25] These include:

- 2 Flygt pumps (submersible, $110,000)
- 2 portable Doda pumps ($80,000)
- Associated civil works ($829,632)
- Associated electrical works ($95,000 to $145,620)
- Electrical connection and 11kv work, switchgear, transformer ($70,000)
- Relocate water services ($30,000)
- Fees and contingency allowance ($298,545) [26]
- Generator ($350,000)[27]

[22] Awatapu Lagoon Disaster Mitigation Preliminary Design Report for Pump Selection Options
[23] It should be noted that this design standard does not infer that larger floods will not occur during a particular period, or even that only one such event will occur every 100 years.
[24] the predicted 1 percent AEP level in 2080, which is equivalent to current .33 percent AEP levels
[25] Costs exclude GST
[26] This estimate has an accuracy of between -15 percent to +20 percent.

- Consent fees ($12,500).

Additional measures that are being considered include:

- raising the level of the 11kv switching gear and transformers (Horizons)
- installation of stoplogs at floodgates.

These works are underway. Ratepayers in Whakatane will pay the majority of the cost for these works, and for additional operating costs identified. The Councils have taken significant steps to improve flood protection and response in addition to the recommended additional pump station and associated works. A Government contribution to these works will assist in achieving a significant reduction in risk to the community and reduce affordability issues in addressing the wide range of disaster response, recovery and risk reduction issues across the District.

[27] This cost has not been confirmed, and the purchase may be dependent on funding.

2.3 Ohope Escarpment/Otarawairere

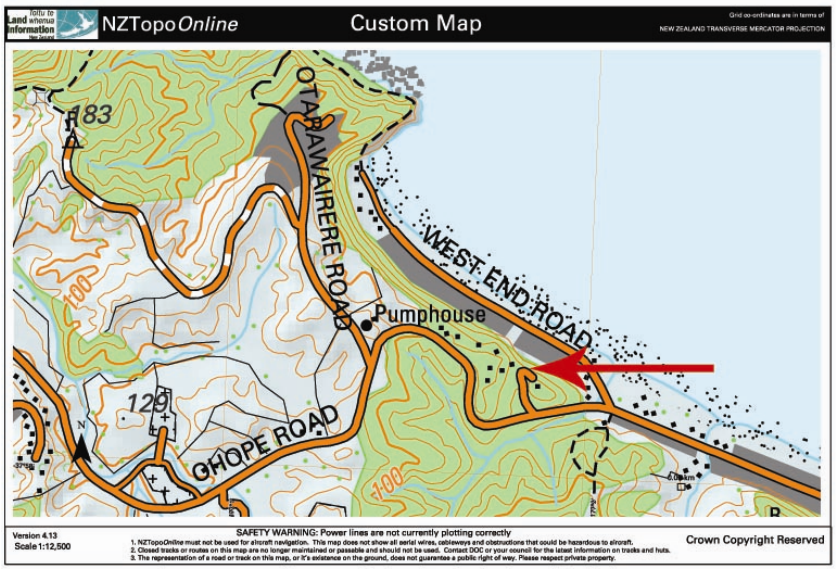
2.3.1 Background

Ohope is a predominantly coastal settlement located approximately six kilometres from Whakatane. At Ohope there is a steep escarpment which runs along above properties on West End Road. Houses atop this escarpment are located at the settlement of Otarawairere, and in Brown and Cliff Roads just off the main road into Ohope.

Otarawairere village was developed in the 1970s and is located above the northwest end of West End Road, Ohope. A steep escarpment separates the two settlements (access to Ohope is via Ohope road). There are 35 properties in the village, and wastewater is serviced by septic tanks.

A dozen properties are located in and off Brown and Cliff Roads at the other end of the escarpment. Brown Road is indicated on figure two by an arrow. Cliff Road is not shown, but is located off the main Ohope Road between Otarawairere and Brown Roads and runs approximately parallel to the escarpment. These properties are also serviced by septic tanks.

Figure two: escarpment at Ohope



The area has been subject to landslips in the past. A serious event occurred in 1946, with two landslips. Two more minor events in 1957-8 and around 1960 resulted in deaths. A boulder hit a child in a tent in the earlier event, and a man was killed outdoors in the second incident.

The 2004 extreme weather event resulted in approximately fifteen landslips, far more than in past events, and several of them were serious. The slips affected properties in the areas discussed, and in West End Road. One house was severely damaged and several suffered moderate damage, with many more suffering minor damage.[28]

[28] Tonkin & Taylor West End Escarpment Geotechnical Overview prepared for Whakatane District Council, Department of Conservation, Earthquake Commission.

Several of the affected houses were evacuated again for safety reasons when there was heavy rain in October 2004.

The majority of the slips including all of the major landslips occurred on the cliff below settlements or man made activity where the stormwater is not controlled.

Whakatane District Councils employed Tonkin & Taylor to undertake an assessment of the ongoing risks of landslips in this area, and what options were available to address those risks. The engineering assessment noted that the level of ground saturation was higher than expected.

Tonkin & Taylor investigations identified that stormwater runoff and wastewater seepage from the properties in the identified areas contributes significantly to the ground saturation levels and increased the extent and scale of the slips. High levels of moisture in the soil affect ground stability and increase the risk of slips.

Given increased urban development the investigation estimates that future landslip events are likely to cause similar or greater damage to the July 2004 event. Future landslips could damage or demolish houses, with a high risk of serious injury or death. Mitigation works would reduce this risk significantly, in conjunction with building controls.

2.3.2 Current hazard control for Ohope Escarpment/Otarawairere

Where practical to do so debris has been removed from the area. Some debris is suspended midway up steep slopes, and because of its inaccessible nature it is impractical to remove.

Small catch benches have been installed to collect future debris at a number of sites, and debris bunds have been built at other sites to protect against larger future debris slides.

Geological and vegetation monitoring has been undertaken, and the results will guide future work and development. Site-specific geotechnical investigation will be required prior to any further development of properties along the crest or below the escarpment.

Properties adjoining the escarpment have notices attached to their Land Information Memorandums to ensure future owners are aware of the risks and recommendations regarding planting and debris control.

2.3.3 Recommended works for Ohope Escarpment/Otarawairere

The report by Tonkin & Taylor provided a number of engineering options for landowners to protect the stability of houses along the crest of the escarpment, and

those located at the base of the cliff. The report noted that the control of stormwater is the most essential method of stabilising existing areas and reducing the frequency of future landslips. It also noted that the septic soakage continually seeps into soils, so the ground is fully saturated by lower levels of rainfall, increasing instability and risk.

Tonkin & Taylor assessed a variety of possible options to address the stormwater and wastewater discharges. The assessment considered technical viability, sustainability and information gathered from community consultation.

The final report recommended replacing or modifying the current stormwater soakage system and septic tanks, piping stormwater away from the escarpment and piping wastewater to existing sanitary sewers below the escarpment. Stormwater from the roads in the affected areas will also be disposed of through the proposed works.

Tonkin & Taylor assessed the advantages, disadvantages and risks of different options, and consulted with the community. The following works were recommended as providing the best technical merit and cost benefit:

- Reticulate wastewater into existing sanitary sewers
- Reticulate stormwater from the west end of Cliff Road and pipe to an existing stormwater manhole near the Brown and Ohope Road intersection
- Reticulate stormwater from Brown Road and east end of Cliff Road and pipe to a soakage area on Council reserve on West End Road (with overflow to roadside). A Whakatane District Council property on West End Road has been assessed for drainage capability and set aside as a drainage reserve to facilitate these works.
- Reticulate stormwater runoff from Otarawairere and the roads and pipe to an outlet in Otarawairere Stream (excepting discharge to a smaller gully for properties at the north end of the village which are not suited to gravity lines).

The west end (Otarawairere) budget is $3,392,294, which includes $50,300 for installing a full rather than a partial sewerage scheme. It was identified that the partial scheme (deals with the liquid waste and leaves the solid) was sufficient to mitigate the risk. The $50,300 therefore represents an improved level of service, the cost of which should be met by the residents.

These measures should significantly reduce the future risk of landslips in this area, although there is always some residual risk from earthquakes, soil weathering and natural stormwater flow. Due to the high risk to life from landslips along this escarpment these works are underway. The community has been extensively consulted and a resource consent application has been lodged.

The costs for these works will be primarily borne by the ratepayers in Otarawairere, Cliff Road, and Brown Road and in West End below the escarpment, although the rest of the District would also contribute to costs over the identified rating threshold. This could have a significant effect on affordability for some ratepayers in this area, particularly those who are retired and have little or no supplementary income source, and some of the community have expressed serious concern about how they can meet the rates increases. [29]

[29] 2006 census figures show 318 (of 480) people aged 65+ in the Ohope census area unit (CAU) had incomes of $20,000 or less.

Section 3: Project Affordability

A number of circumstances in the Whakatane District combine to create affordability issues and reduce the District's capacity to respond to additional expenditure.

Human and financial resources in the District have been stretched by the frequency of natural disasters in recent years, personal losses, and the large scale of response required for basic emergency responses and recovery efforts.

The Whakatane District contains some of the most disadvantaged communities in New Zealand. In 2001 the majority of the District's census area units (13/19) including Edgecumbe and Awatapu had a deprivation index measure of either nine or ten.[30] The District has several of the funding pressures identified by the Local Government Funding Project, with large areas of Māori freehold land and parks that are non-rateable, and a dispersed population with low average incomes.[31] Appendix two addresses community demographic issues that contribute to affordability concerns in more detail.

Insurance cover and Government contributions helped ratepayers address the costs of immediate recovery and restoration work undertaken by the Councils. However, further works are needed to reduce future risks and costs. Current insurance cover held by the Councils will not contribute to the works identified in this business case. Whakatane District Council's primary income is rates, and it has budgeted over $5m to continue Matata restoration and protection works. The Councils' contributions to the works in this business case will add a further cost burden upon ratepayers.

The Councils will make provision for the ongoing additional insurance and operating costs (including staffing and increased maintenance, running costs and depreciation on assets such as control gates, generators and flood pumps) through rating adjustments.

The Councils have met with Transpower and Fonterra to discuss the proposed works on the eastern side of Edgecumbe. Both companies have expressed a willingness to support and contribute to the cost of further mitigation works that would increase the protection for their properties.

3.1 Impact on Ratepayers

District ratepayers face significant costs in addition to hazard mitigation works identified in this business case and flood recovery work underway in Matata. The Edgecumbe community is already facing considerable demands for infrastructure upgrades brought about by changing central and regional government requirements. Water supplied to the community has arsenic levels which now exceed the New Zealand Drinking Water Standards. Compliance with the standards may require commissioning a new water supply bore and extensive rerouting of the water mains. This work is predicted to increase the cost of water to the community by 65 percent.

The wastewater infrastructure is also under pressure. There is still a major inflow and infiltration problem contributing to excess water to the sewers as a legacy of the 1987 earthquake. This will be mitigated, but not completely solved, by the proposed stormwater works, and will require ongoing expenditure. The oxidation ponds which

[30] The deprivation index has a scale from 1 to 10 with ten percent of the country in each decile. A rating of ten indicates people are in the most disadvantaged ten percent of the country.
[31] Appendix Two provides more information on Whakatane District demographics.

treat Edgecumbe's sewage may also need tertiary treatment added to meet the requirements of the Environment Bay of Plenty Regional Plan for the Tarawera River. This plan sets standards for the discharge of treated wastewater that a conventional oxidation pond system cannot achieve. Potentially this could require capital expenditure of $1.5 million if disinfection, nitrogen and suspended solids removal has to be added to the wastewater treatment plant.

Other significant commitments include maintaining access routes and risk response planning.

Rates rises have been the subject of national controversy in recent years.[32] The costs of addressing recovery works and further hazard mitigation in addition to other Council responsibilities is expected to exacerbate rates rises in the Whakatane District. Tables in Appendix Three show the effect of the recommended disaster mitigation works on rates at different levels of Government contribution.

For residents in the directly affected area the combined rates impact would include:

- additional targeted district rates;
- additional targeted regional rates;
- a contribution to the portion of the works funded by general rates; and
- both Regional Council and District Council rates for other services.

The more the Councils have to pay to implement these works the greater the rating impact will be on the residents, many of whom are on low fixed incomes,[33] including New Zealand Superannuation[34] and the Domestic Purposes Benefit,[35] or low-paid unskilled and seasonal work. Many individuals and businesses within the areas where these preventative works are proposed have also faced significant private costs for flood recovery.

Whakatane District Council rates to meet the costs of hazard mitigation works are typically set at 50 percent for the directly affected area (with a $1,000 cap per property), 25 percent from the wider local community (with a $250 cap per property), and 25 percent from the District as a whole.

Under Environment Bay of Plenty rates policy, local landowners pay 80 percent of the scheme costs through targeted catchment management rates. The remaining 20 percent is paid through general rates to reflect the regional and national benefits accruing from the schemes. The proportion has recently been amended from 90/10 percent, but the rates impact on local farms is still significant.

The Regional Council rates alone for an average sized dairy farm (135ha) were $13,400 in 2004/05, and with additional costs for ratepayers these are estimated to increase to between $19,400 and $23,300 (an increase of 45 percent to 74 percent) by 2010/11 depending on the level of any Government contribution to these works.

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[32] A Government Inquiry into Local Government Rates is currently underway, as a consequence of public concern in light of financial and rates projections outlined in Long-term Council Community Plans and confirmed in local authority rating decisions during the June-August 2006 period.

[33] Refer Appendix Two: 58 percent of the District population aged 15 or over had an annual income of $20,000 or less, with even lower median incomes in Edgecumbe ($14,300) and Awatapu (Whakatane West - $15,158) than for the District as a whole.

[34] 2006 census figures show 318 (of 480) people aged 65+ in the Ohope census area unit (CAU) had incomes of $20,000 or less.

[35] For example, in 2001 29.4 percent of families in Edgecumbe were one-parent families with children.

For an average Edgecumbe urban ratepayer the Regional Council rate was $98 in 2004/05 and will increase by up to $177 by 2010/11 (180 percent). The effect on District Council rates for an average Edgecumbe residence in the ‘directly benefiting area’ could be a rates increase of over $500 per annum. Combined rates increases for disaster mitigation works could be an increase of around $700.00, excluding rates increases for other reasons.

For an average Otarawairere or Ohope ratepayer in the affected area the estimated rates impact of the works with no Government assistance is over $900 per annum in additional rates, an increase of approximately 48 percent. This is a significant extra cost to people on fixed incomes. The works will be paid off over 25 years, meaning a long-term increase in rates, without allowance for future rates-funded works.

Government assistance would help mitigate the extent of the impact on ratepayers, and improve the likelihood that all recommended works could proceed. Attending to recommended works now will also help to lessen the disaster recovery rates burdens from inevitable future events.

Section 4: Special Policy Considerations

Government recognises that disasters affect all of society, and in recognition of this it may provide support for new works that may improve mitigation/risk-reduction measures in addition to assisting with welfare and recovery.

The National Civil Defence Emergency Management Plan specifically allows for "Upgrading of facilities to a level greater than existed previously (to) be considered as special policy in cases where such upgrading would decrease the likelihood of a recurrence of the civil defence emergency."[36]

4.1 Decreased Likelihood of Recurrence

The 'whole-of-scheme' works proposed in the Edgecumbe/Rangitaiki scheme would bring systems up to a 1 percent AEP flood protection standard and enable better management of floodwaters between the main river and the floodway. These works should enable the scheme to protect the wider community from floods to the level of the July 2004 flood event. The other scheme works in this area would give additional protection to the Edgecumbe urban area, mitigating some of the flood risk induced by land subsidence from the 1987 earthquake, providing additional drainage to strengthen the stopbanks and adding a higher freeboard[37] to the main stopbanks through the town. A higher level of protection is also being discussed for the Transpower substation due to its critical role for the area.

The additional pump station in Awatapu will help prevent a recurrence of the flooding that occurred due to river levels being too high to allow gravity drainage from the Lagoon in July 2004. Without the additional pump capacity a similar event would be likely to overwhelm the current drainage system, and again risk inundation of the suburb. The extra pump station should provide protection to an even higher level (.33 percent AEP).

Hazard mitigation works in Ohope/Otarawairere are required to address identified landslip risks to homes in the area. Recent reports show that the extent of soil saturation caused by seepage from the septic tank systems and stormwater in Otarawairere and West End is far greater than expected. Until this is addressed, the additional water in the soil from a heavy rain is likely to create instability and landslips, with consequent risk to life and property.

4.2 Comprehensive Solution

Whakatane District Council and Environment Bay of Plenty have worked together to develop a holistic response to the community risks highlighted by the July 2004 event. An outline of the planned schedule of works, and funding allocation, is provided in Appendix One. This is subject to confirmation of Government assistance, as otherwise affordability issues may prevent the full schedule of works being undertaken. These works link with other projects that are already being implemented by the Councils.

MCDEM champions a comprehensive approach to hazard-risk management, considering risk reduction, readiness, response and recovery. The Councils support this approach.

[36] Extract from National Civil Defence Emergency Management Plan Order 2005, Clause 89 (3).
[37] Freeboard is the safety factor height above the adopted flood level, to allow for wave action, localised hydraulic effects and design uncertainties.

4.2.1 Risk reduction

Many risk reduction measures have already been detailed in this business case. The Floodplain Management Strategies being developed for each of the river schemes in the region will build on the work that has been outlined and link to existing work such as the Edgecumbe Urban and Rural Flood Hazard study.

The strategies will examine structural and non-structural options for sustainable management of flooding in the catchment areas. The strategy development will consider and consult on further measures to improve flood management over the next fifty years such as the use of differential freeboarding to manage flood overflow in over-design events, the potential to recreate wetland areas and possible relocation of stopbanks and infrastructure where appropriate. The strategies will address asset management, protection levels, funding sources, community input and work.

Environment Bay of Plenty has undertaken extensive modelling to assess the appropriate floor level building controls for future development taking into account flood defenses, possible flood, tide and breach scenarios and global warming (to 2055). Further information on the modelling is included as Appendix Four. Based on this information, both Environment Bay of Plenty and Whakatane District Council have implemented controls on future development to mitigate future flood risks, including floor level restrictions. Building is restricted in particularly low-lying areas of the floodplains, with no residential dwellings allowed in the floodway or low lying pumped basins. Existing buildings are not required to be raised, but major additions or new dwellings would have to meet higher floor level standards.

4.2.2 Readiness

The Bay of Plenty Civil Defence Emergency Management (CDEM) Group Plan sets out how the Bay of Plenty will ensure a state of readiness and lists specific steps to be taken by agencies and the community to be ready to respond to an emergency.

Both Councils have civil defence sections on their website, providing information on what people and businesses can do to be prepared for an emergency. Other measures are discussed in section 4.3.6, including community response plans and warning systems.

4.2.3 Response

The District acknowledges that physical flood protection measures are not failsafe, and response planning is continuously improving. The Bay of Plenty Civil Defence Emergency Management Group Plan outlines roles and responsibilities, and a number of Standard Operating Procedures (SOPs) detail how agencies will respond to emergency situations. A number of supplementary documents such as the Welfare Plan and Public Information Plan add further detailed planned responses.

The Councils have agreed Standard Operating Procedures (SOPs) and Contingency Plans that detail how the consequences of an emergency event will be managed at a local level and how response arrangements can be escalated. Training for staff who will work in emergency response has been programmed and undertaken.

4.2.4 Recovery

The Councils' long-term council community plans aim to rebuild the community and help strengthen economic growth, employment and social indicators. They are targeted at a community moving forward, supporting recovery efforts but also looking to encourage planning and community involvement in a productive future. The asset management plans, hazard mitigation works and civil defence plans provide a backdrop to support a community seeking strong families and economic transformation, and a sense of pride in the district and the nation.

4.3 Other Factors

The Ministry of Civil Defence and Emergency Management has identified a number of factors that can be used to assess the need for special policy measures. These include:

- An ongoing risk to life
- Ongoing community disruption
- Coordination, mediation and relationship building among involved parties
- Sound land-use management and application of building code measures
- Community understanding and acceptance of risks and ability to fund
- Best-practice asset management
- Suitable emergency management measures
- Sound financial risk management.

4.3.1 Risk to life and on-going community disruption

People in the areas affected by the July 2004 flooding and landslips suffered significant disruption. Over 200 homes damaged by the flooding and slips in the District were still unable to be reoccupied in September 2004.[38] Severe flooding and land instability cause risk to life, as shown in a number of incidents in New Zealand where people have been drowned or injured when swept away by floodwaters or killed by landslips.

Future severe weather events will offer ongoing risk to life until the works are completed. This particularly applies to the risk of landslips from the cliffs around the Otarawairere settlement onto properties below, which means these works are being given a high priority.

Work to install a pump station for the Awatapu Lagoon is also underway, due to the severe effects a further disaster would have on the community.

Fonterra and Eastpack are major direct and indirect employers for the wider Edgecumbe area, and the Edgecumbe substation is the major supplier of electricity to homes and industry within the wider Eastern Bay of Plenty. The ongoing effects on employment from a major flood which causes serious damage to one or more of these facilities could impact on the wider region, and potentially on national economic performance. Essential roading networks could also be inundated in the event of a major flood, cutting off evacuation routes and emergency assistance and response efforts.

The community suffered increased domestic violence after the July 2004 floods, schooling was disrupted for many children, and some people lost their jobs. The larger the impact of future flood events on peoples' lives within the District, the more disruption the community is likely to suffer.

[38] Eastern Bay of Plenty Floods-July '04: Recovery Report 11 to Director MCDEM, 3/9/2004.

4.3.2 Coordination, mediation and relationship-building

Whakatane District Council and Environment Bay of Plenty are committed to taking an integrated approach to civil defence emergencies and planning, and to other work.

Following the recent civil defence emergencies the Whakatane District Council and Environment Bay of Plenty in collaboration with government agencies, Māori and other contributors addressed the immediate requirements of recovery for the district. Government contributions to recovery efforts are also gratefully acknowledged.

Whakatane District Council and Environment Bay of Plenty have demonstrated their ability and commitment to coordination in addressing natural disaster mitigation works and future planning. They are both active in civil defence planning, and in other regional and sub-regional forums and collaborative work. The increasing commitment to working in a joined-up way enhances their ability to work together on hazard mitigation and other works.

After the flood event at Matata in May 2005, MCDEM and other stakeholders supported a new approach to the recovery process, working with Whakatane District Council on the regeneration plan for the community, and assisting with cost, risk, and payment contributions. A wide inter-agency approach has been taken to community recovery in Matata, and Government funding added appreciably to the ability of the community to begin repairing the damage and rebuilding their lives.

The Councils have been actively ensuring that the community are involved in identifying hazards and options to reduce risk. They are also strengthening relationships with major stakeholders through consulting on works that will provide mutual benefit and through forums such as the lifeline utilities group.

Regular progress reports are provided by newsletter to interested parties. A project office has been established in Matata and web pages[39] are maintained to keep communication clear and open. Whakatane District Council's project manager is also assisting with consultation and community updates on planned works for Awatapu, Edgecumbe and Otarawairere, and will continue to encourage the community to be well-informed and to contribute to discussions.

Staff from both Councils meet regularly to discuss the options available and what actions they can implement to provide a reasonable level of protection and manage residual risks.

4.3.3 Land use management and the building code

To reduce any additional hazard exposure the Councils have set minimum floor levels for future building development. Minimum floor levels are set from modelling of the stormwater and drainage systems. On the Rangitaiki Plains minimum floor levels are set on "flood breach" levels to provide a margin for worst case events.

Ongoing work is also examining the effects of predicted sea level rise on coastal hazards for the Whakatane District. Current predictions are that sea levels will rise by up to half a metre by 2100.[40] Whakatane District Council has budgeted for work to complete a Variation to the Proposed District Plan to enable better management of building and subdivision in areas predicted to be subject to coastal erosion and inundation over the next 100 years. As a preventative measure, some properties are

[39] www.easternboprecovery.org.nz
[40] http://www.mfe.govt.nz/publications/climate/preparing-for-adapting-climate-change-dec06/html/page3.html

likely to face restrictions in their ability to subdivide their land, construct new buildings or add to existing buildings.

Whakatane District Council has also set aside funding for a project to identify and research natural hazards that could affect the district.

4.3.4 Community understanding and acceptance of risks and ability to fund

Environment Bay of Plenty and Whakatane District Council have undertaken community awareness research and education around civil defence risks and preparedness measures under the Civil Defence Emergency Management Group Plan.

The ratepayers within the Rangitaiki Plains drainage and catchment management system have generally agreed to a service level which provides protection against a 100 year flood event. This level can be compromised in some events and its integrity would be enhanced by the proposed works.

The Councils have also consulted on the need to undertake works in Edgecumbe, the Rangitaiki Plains, Awatapu and Otarawairere through the long-term council community plan process and targeted news and meetings. This consultation has indicated that landowners generally support the proposed works, subject to the cost implications on the ratepayers being affordable.

Funding impacts have been discussed separately. There has been ratepayer feedback concerned about the impact on their rates, particularly from people on New Zealand Superannuation or other fixed or low income sources. Government assistance with funding would help to address those impacts.

4.3.5 Best practice asset management

The stopbanks and other flood defence works in both the Rangitaiki-Tarawera Rivers Scheme and the Whakatane-Waimana Rivers Scheme are managed under an Asset Management Plan (AMP). These plans address how to achieve and maintain agreed levels of service over a fifty year period and consider both financial and engineering issues. The river and drainage scheme AMPs are being reviewed from 2007/08 on a three-year rolling schedule.

Floodplain Management Strategies are also being developed in consultation with the community to improve management and appropriate land use in each of these schemes. Both Councils intend to jointly adopt the Strategy, which will also provide for future flood mitigation measures, planning controls, flood warning and flood hazard awareness and preparedness. Options for more gradual relocation of assets and other methods to increase the level of protection over time to account for climate change will be considered in the Floodplain Management Strategy.

4.3.6 Emergency management measures

The Councils have developed warning systems and evacuation plans, and are continuing to upgrade and improve those measures.

Environment Bay of Plenty monitors rivers, rainfall and meteorological sites throughout the Bay of Plenty. Thirty of these sites are telemetered, (the data they collect transmits back to base via a radio and phone network). Additional water level

measures have been installed in particular areas, such as the Awatapu Lagoon. Communication plans are in place, and are being updated.

At the request of Councils in the region and the Bay of Plenty Civil Defence and Emergency Management Group (with the general support of the Ministry of Civil Defence and Emergency Management), the MetService is exploring two sites for weather radar installations that should provide more accurate and timely advance weather warnings for the Bay of Plenty and adjacent regions. The MetService is working with the relevant landowners and other agencies to gain access agreements and resource consents for these, and this is expected to be operating within the next two years.

The Whakatane District Council has also been working with local communities to develop Community Response Plans (CRP's) for the communities that could be isolated by an event.

4.3.7 Sound financial risk management.

Environment Bay of Plenty and Whakatane District Council insure their flood protection assets through the Local Authority Protection Programme (LAPP) and private insurance, where that insurance cover is available. This cover will be extended to cover additional scheme assets against future risks. The river protection schemes were primarily self-insuring in the past, but following the frequent recent heavy rain events Environment Bay of Plenty has restructured its risk profile.

The insurance cover held by the Councils will not contribute to the mitigation works identified in this business case, but will be extended to cover additional scheme assets against future risks. In addition to the capital costs identified in this proposal, the Councils are also allowing for the fact that they will incur additional operating costs for the increased response capability (including staffing, insurance increases, control gates, added generators and flood pumps and increased maintenance, running costs and depreciation)

Section Five: Discussion

A number of areas within the Whakatane District suffered severe damage as a result of an extreme storm event in July 2004. The cumulative effects of the disasters have resulted in ongoing rates increases. The Whakatane District has low average incomes and some of the most deprived communities in New Zealand, which impacts on the sustainability of funding the works without Government assistance.

The scheme ratepayers, together with the Councils, are prepared to commit substantial funds to increasing the level of hazard mitigation, to ensure that the communities concerned can again enjoy an appropriate level of security and well being. However despite that high level of commitment, the recommended options to enable the schemes to provide the identified level of risk remediation may not be able to proceed as scheduled without substantial help from Government.

The works discussed in this business case are recommended to improve community safety. Funding these works will result in significant rates increases, and may result in delays to some of the recommended works in Edgecumbe/Rangitaiki or the purchase of some equipment to avoid creating affordability issues for ratepayers.

The works in Awatapu and the Ohope escarpment/Otarawairere are in progress, due to the risks posed to the community. Without Government financial assistance the cost impact of these works will pose significant hardship for some ratepayers in the area, particularly retired people.

Delays in also being able to implement Edgecumbe works due to the cumulative affordability effects of ongoing recovery works could increase the risks of a future event occurring before the recommended protective works are in place. If the urban works in the west of Edgecumbe do not proceed, the community will continue to suffer from frequent low level flooding in areas most affected by the subsidence caused by the 1987 earthquake. The control gates and floodway work will help to ensure that the scheme is able to manage a large event.

Environment Bay of Plenty and Whakatane District Council have taken a number of steps to reduce community risk in the event of a disaster, and have jointly identified the additional steps recommended to improve hazard mitigation. Environment Bay of Plenty and Whakatane District Council appreciate the Government support for communities in the District in recovery processes, and the invitation from Government to submit this joint business case.

A collaborative central and local government approach will assist with social cohesion and recovery, and reduce the need for future funding and other contributions to recovery assistance.

We therefore request that the Government gives favourable consideration to assisting with funding the recommended works.

Appendix One: Coordinated project schedules and funding

Flood Repairs and Mitigation: Summary of costs and work

Description of works	When done/ programmed	Reason for work	Cost (excl. GST)	Contributors (amount or percent)
Earlier related works where Government assistance is included				
Edgecumbe Township/ Rangitaiki River Scheme 2004 Flood Recovery Project (Environment Bay of Plenty)	Works 95 percent complete and will be completed by 30 June 2007	Recover from the devastating July 2004 flood event	$8.65m to completion (1)	Environment Bay of Plenty $3.9m Government $4.4m (2) Other: MAF $333,000
Awatapu pump station reinstatement	Work completed.	Repair and raise existing pumps in main Awatapu pump station	$88,984	Whakatane District Council $65,984 Government $23,000
Works included in this business case				
Edgecumbe & lower Rangitaiki River flood mitigation project	Initial investigation complete. Business Case claim to Government being progressed. No physical works commenced yet.	Enhance the integrity of flood protection to Edgecumbe and Rangitaiki Plains Reids Floodway widening and control gates	$8.6m (3)	***Contributions unknown at this stage. Included in this Business Case for consideration***
Stopbank Remediation – Lower Rangitaiki River Geotechnical Remedial works	Investigations are still progressing. Final scope of project unknown. Some physical works have commenced.	2004 flood event has highlighted areas of stopbank foundations that are susceptible to seepage induced failure.	Preliminary estimate $1.5m but investigations are still incomplete. Final scope/cost is unknown.	***Contributions unknown at this stage. Included in this Business Case for consideration***

Description of works	When done/ programmed	Reason for work	Cost (excl. GST)	Contributors (amount or percent)
Edgecumbe urban scheme one[4] (southeast)	Consultation underway with Transpower about contribution. Business Case claim to Government being progressed. No physical works commenced yet.	Additional protection for the Transpower substation and residential property in Hydro Road and Konini Place.	$690,000	***Contributions unknown at this stage. Included in this Business Case for consideration***
Edgecumbe urban scheme two[4] (northeast)	Consultation underway with Fonterra about contribution. Business Case claim to Government being progressed. No physical works commenced yet.	Additional protection for Fonterra and Eastpack.	$808,946	***Contributions unknown at this stage. Included in this Business Case for consideration***
Edgecumbe urban scheme three[4] (southwest)	Business Case claim to Government being progressed. No physical works commenced yet.	Protection for property on Kanuka, Totara, Matai, Rimu and Kowhai Streets from low level flood events/impact of 1987 earthquake subsidence.	$818,235	***Contributions unknown at this stage. Included in this Business Case for consideration***
Edgecumbe urban scheme four[4] (northwest)	Business Case claim to Government being progressed. No physical works commenced yet.	Protection for property on Puriri, Matipo, Tawhara, Titoki, Rata, Hinau Streets, Riverslea Mall and Edgecumbe College from low level flood events/impact of 1987 earthquake subsidence.	$891,000	***Contributions unknown at this stage. Included in this Business Case for consideration***
Awatapu Lagoon pumpstation[5]	Costs finalised and work commenced.	The 2004 event revealed that a pump station was needed at the Lagoon.	$1,926,297	***Contributions unknown at this stage. Included in this Business Case for consideration***
Ohope Escarpment[6]	Consultation underway. Construction primarily in 2007/08	Investigations subsequent to 2004 show a need to reticulate both stormwater and wastewater to reduce soil saturation from runoff and seepage.	$3,392,294	***Private Drainage $50,300*** ***Other contributions unknown at this stage.*** ***Included in this Business Case for consideration***

Description of works	When done/ programmed	Reason for work	Cost (excl. GST)	Contributors (amount or percent)
Transit New Zealand bridge over Reids Floodway	Included in capital works programme Investigations are continuing	This bridge is narrow and has traffic safety issues, and constricts the flow through the floodway. A longer and wider structure is needed.		***Transit New Zealand***

Other works (considered under other business cases)

Matata Response and Recovery Works (Environment Bay of Plenty costs only)				
2005 'Matata' flood response costs to date	Response works already completed	To recover from disastrous flood and debris flow event	$550,000 to date. Expecting a further $400,000 (approx) of capital works.	***A claim for financial assistance of $243,000 is being considered by Cabinet soon***
Further Matata recovery works planned	Within next 12 months	For permanent remedial works on Waitepuru Stream diversion and Wilson's/ Awakaponga Canal	Preliminary estimate $400,000 (final design details still to be resolved)	***Contributions unknown at this stage. Subject to a claim to Government that will be submitted for consideration soon.***
Matata Response and Recovery Works (Whakatane District Council)				
Debris flow protection	Resource consent and other processes underway	Measures to protect the Matata community form future debris flow risks, including debris bunds and a dam	Estimated cost $9.28m	***Whakatane District Council $5.206m Government agencies $4.074m***

Notes:

1. *This is just the Rangitaiki River Scheme's share of the overall restoration project (i.e., excludes Whakatane River Scheme costs and other schemes' costs).*
2. *The Government provided $6.166 million to contribute to initially identified Environment Bay of Plenty costs across the Eastern Bay of Plenty following the July 2004 events. The Rangitaiki River Scheme proportion of that funding was $3,317,000. A further claim that is still being considered by Cabinet includes a further $1,145,229 towards Rangitaiki works.*
3. *Includes the Floodway widening project ($5.5m) plus the Spillway control structure ($3.1m). Excludes the Edgecumbe urban perimeter works that will be carried out by Whakatane District Council.*
4. *Whakatane District Council have allocated $1.97m by 2009 in their long-term council community plan towards works in Edgecumbe. Without other funding, it is likely that some of these works will not proceed. (see also notes 5 and 6)*

5. *Whakatane District Council have allocated $925,000 in their long-term council community plan towards works in Awatapu. The full cost of these works has since been quantified as $1.8m. Funding may need to be reallocated from elsewhere, and the generator may be deferred.*
6. *Whakatane District Council have allocated $1.33m in their long-term council community plan towards works in Otarawairere and Ohope to reticulate stormwater and wastewater and reduce landslip risks along the escarpment at Ohope. The full cost of these works is estimated at approximately $3m.*

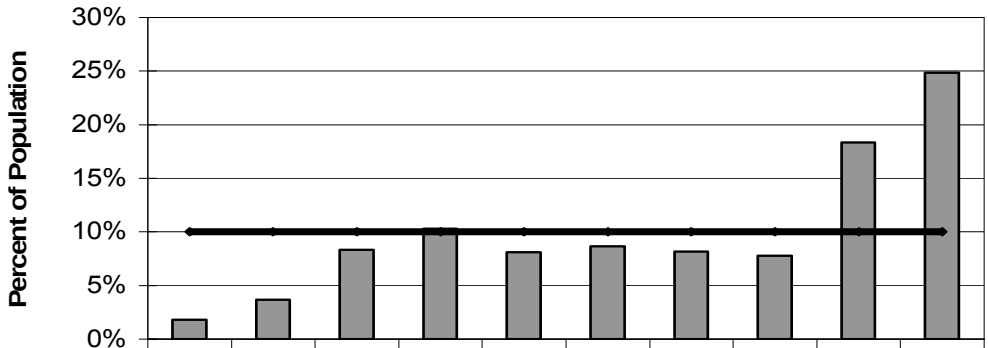
Appendix Two: Whakatane District Demographics

The demographic profile of the Whakatane District creates affordability challenges for many ratepayers. The District has had a largely static population over recent years, with some population increases within Whakatane and beachfront locations offset by depopulation in more rural areas. In line with national trends unemployment has reduced in recent years and house prices have escalated, particularly in beachfront locations. The Councils and the Eastern Bay of Plenty Regional Economic Development Agency are working to promote business development, job creation and Whakatane as a destination.

The July 2005 report on *Local Authority Funding Issues* identified Whakatane as one of the local authorities that has constraints on its ability to collect adequate rates to fulfil its functions, including large amounts of Māori freehold land which are difficult to rate. The report also identifies a number of other factors linked to affordability issues, several of which apply to Whakatane District, including high levels of non-participation in the labour force, unemployment, unskilled and semi-skilled workers with consequent low incomes, and lower population densities (which makes the cost of infrastructure and services higher per person).[41]

The Whakatane District has a relatively low ratepayer base and covers large areas. It includes some of the poorest areas in the country such as Murupara, the Urewera, Te Teko and Taneatua, and has an average deprivation index[42] rating of eight, which creates pressures on the ratepayer base. In 2001 thirteen of Whakatane District's nineteen census area units, including Edgecumbe and Whakatane West (Awatapu), had a deprivation index measure of either nine or ten, meaning the District contains some of the most disadvantaged communities in New Zealand.

Chart 6 - Whakatane District



	1	2	3	4	5	6	7	8	9	10
Whakatane	2%	4%	8%	10%	8%	9%	8%	8%	18%	25%
New Zealand	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%

Index of Deprivation

Source: Safer Communities, September 2003: Whakatane District Council

[41] *Report of the Joint Central Government/Local Authority Funding Project Team, 8 July 2005.*

[42] The deprivation index has a scale from 1 to 10. A higher rating indicates more deprivation. Ten percent of the country is in each decile. Factors that will increase the score include low income, high unemployment, no academic qualifications, overcrowding, no car, no phone, living in rental accommodation and single parent families.

The deprivation index comparative table above shows the high concentration of Whakatane District's population in the most deprived sectors of the community, relative to the rest of New Zealand.

Poverty is an indicator that people are less likely to be adequately insured to meet the personal costs of flood damage, repair to their homes, and replacing goods and personal possessions.[43] These factors contribute to a high risk of ongoing and increased deprivation after emergencies, in addition to disruptions to education and family life.

Employment rates are an important measure of well-being. The national rate of working age beneficiaries in December 2006 was 12.14 percent, which compared to 14.58 percent for Whakatane.[44] Only 40 percent of Edgecumbe's population aged 15 years or over in 2001 was employed fulltime. There are also high rates of single parent families in both Edgecumbe and Awatapu. In 2001 one-parent families with child(ren) were 29.4 percent of families in Edgecumbe, and 27.5 percent of families in Whakatane West, compared to a Whakatane District rate of 24.2 percent and a New Zealand rate of 18.9 percent.

The District also has relatively low incomes, with 58percent of people aged 15 years and over in the Whakatane District reporting an annual income of $20,000 or less, compared with 52.8percent for New Zealand as a whole. The District's median income is $15,900 (Edgecumbe's median is $14,300 and Whakatane West's $15,158), compared with $18,500 for all of New Zealand[45]. Increases in annual rates can be significant (even with a $500 rebate through the improved rates rebate scheme) to someone with a total pre-tax income of less than $16,000.

Education levels are also low in the District –the level of school leavers with higher than NCEA level 1 was 56.5 percent in Whakatane District in 2004. This compares to a New Zealand regional range of 57.7 to 77.6 percent. Similarly, the proportion of people aged 25-64 with higher qualifications in Whakatane District was 66.8 percent, and regions throughout New Zealand ranged from 69 to 84 percent.[46] These communities are likely to be particularly vulnerable if there is ongoing and repeated disruption of their schooling.

The decline in home ownership rates in Edgecumbe and Whakatane West between 1991 and 2001 were nine percent and twelve percent respectively, compared to an eight percent decline nationally. Home ownership rates in Edgecumbe dropped again from 72 percent in 2001 to 64 percent in 2006 (69 percent including those whose home is held in a trust by the usual resident).

In 2006, 28 percent of people in Edgecumbe who owned their own home had a household income under $30,000. (Ohope 20 percent, Whakatane West 23 percent)

[43] For example, of 141 homes in the Whakatane District identified at the end of July that were assessed as uninhabitable until repaired, 111 did not have contents insurance.
[44] This estimate is based upon population figures from the 2006 census regional summary tables (Statistics New Zealand) and the Ministry of Social Development's national and Bay of Plenty region benefit factsheets. A limitation is that current census figures only allow consideration of ages 20 to 64, whereas working age beneficiaries are aged between 18 and 64. The actual figure is likely to be greater, proportionately more so for Whakatane which has a high youth population.
[45] Census 2001. Statistics New Zealand.
[46] Social Report, Ministry of Social Development, 2006

Appendix Three: Rating Impacts

Environment Bay of Plenty Rates

Rate Examples	Rural – average (135ha Dairy unit)	Edgecumbe Urban – average	Edgecumbe Urban – upper impact
2004/05 rates	$13,400	$98	$488
2006/07 rates	$15,800	$141	$714
Impact of further Edgecumbe/Rangitaiki works (5)			
No Government contribution (1)	$23,300	$275	$1,382
33 percent contribution (2)	$21,400	$235	$1,180
50 percent contribution (3)	$20,500	$215	$1,079
70 percent contribution (4)	$19,400	$191	$955

Notes:

1. *The combined affect of carrying out all of the proposed capital works with no further Government contribution adds 194 percent to the 2004/2005 River Scheme rates (see note 5 below).*
2. *The combined affect of carrying out all of the proposed capital works with 33percent further Government contribution adds 150 percent to the 2004/2005 River Scheme rates (see note 5 below).*
3. *The combined affect of carrying out all of the proposed capital works with 50percent further Government contribution adds 128 percent to the 2004/2005 River Scheme rates (see note 5 below).*
4. *The combined affect of carrying out all of the proposed capital works with 70percent further Government contribution adds 101 percent to the 2004/2005 River Scheme rates (see note 5 below).*
5. *Properties located in the affected area pay various layers of flood protection and drainage rates. The percentage rate increases applying to the river scheme rates will not apply to the other rates, hence the overall rate increase when combined will be lower (refer to the examples in the table above).*

Environment Bay of Plenty rates have risen from $4.7m in 1990/91 to $14.8m (excluding targeted river scheme rates) in 2007/08 to meet resource management and other responsibilities. The total rate take for 2007/08 is budgeted at $19,360,100, but this will increase further to address the costs of mitigation works.

Half of the Regional Council's general rates expenditure is on natural resource management, with six percent on flood control and drainage and a further four percent on hazards and safety (in addition to the $4.5m of targeted rates for river and drainage works).

Rating Affect on Average Properties of Disaster Mitigation Works
Whakatane District Council Rates

	Edgecumbe		**Awatapu**	**Otarawairere**	
	Impact on property identified as directly benefiting		Whakatane-wide rate impact	Impact on property identified as directly benefiting	
2006/07 Rates	1,733.00		1,458.00	2,028.00	
Additional rates for disaster mitigation works*					
	Direct benefit catchment rate	Community rate	Additional rate for every Whakatane residence	Direct benefit catchment rate	Community rate (rest of Ohope)
0 percent Subsidy	517.90	130.99	25.85	895.60	15.59
33 percent Subsidy	345.27	87.33	17.24	600.05	10.44
50 percent Subsidy	258.95	65.50	12.93	447.80	7.79
70 percent Subsidy	155.37	39.30	7.76	268.68	4.68

1. *2006/07 Rates do not include any Disaster Mitigation Rates charged as part of the progressive timetable*
2. **There is also a District-wide rate for disaster mitigation works which applies to all properties at a rate of up to $11.17/$100,000 capital value*
3. *There will be a cumulative effect of adding the District-wide rate for disaster mitigation works – in addition to Regional Council rates*
4. *The impact on the Awatapu community has been dispersed by the decision to target the rate for these works to the whole Whakatane township*
5. *Projected rates increases due to other factors, such as other planned infrastructure works, are not shown here*
6. *Calculations are based on a 25 year loan at 8.1 percent interest. This may need to be adjusted for rising interest rates*

The Whakatane District Council rates take has increased to $28.5m for 2007/08 from $25.5m in 2006/07. $5.2m is allocated to be spent on hazard-related works at Matata, and a further $4.225m was allocated in the long-term council community plan (LTCCP) to address works identified in this business case.

As an indication of other expenditure, over $5.1m in rates was budgeted for transport and $6.3m for water-related services in 2007/08 in the LTCCP.

Appendix Four: Flood Modelling

Hydraulic modelling of the Rangitaiki Plains has been undertaken by Phil Wallace, consultant to Environment Bay of Plenty and reported in Operations Publication 2006/06 titled “Hydraulic Modelling of the Rangitaiki Plains Tarawera River to Rangitaiki River”.

The modelling has been used to produce flood maps that are used to assist in the process of determining 50 year flood levels on the Rangitaiki plains. The flood maps are currently being used by Environment Bay of Plenty, Whakatane District Council and consultants to set appropriate levels for building and subdivision consent applications. Two sets of maps have been produced;

1. 50 year flood maps of Rangitaiki Plains between the Rangitaiki and Tarawera rivers, referred to as G127, sheets 1 and 2.

2. 50 year flood map of the Kope – Orini basin, referred to as Figure R745

Computer software packages called MIKE11 and MIKEFLOOD were used to model the flood areas on the Rangitaiki Plains. Five flood scenarios were modelled to produce these maps namely:

- a breach at Laws Bend, Rangitaiki River (left bank), with 100 year tide level and 20 year flow in the Rangitaiki River
- a breach at Laws Bend, Rangitaiki River (left bank), with 20 year tide level and 100 year flow in the Rangitaiki River
- a breach downstream of Thornton Road, Rangitaiki River (left bank), with 100 year tide level and 20 year flow in the Rangitaiki River
- a breach downstream of Thornton Road, Rangitaiki River (left bank), with 100 year tide level and 20 year flow in the Tarawera River
- 100 year rainfall on the Rangitaiki Plains and 20 year tide level

The breaches modelled do not necessarily represent the most likely positions but are sites that have recently been subject of geotechnical investigations to determine their stability. The modelling took into account:

- global warming effects expected in the year 2055 namely sea level rise and increased rainfall intensity and frequency
- topographical contour data obtained since the 1987 Edgecumbe earthquake including heights of flood protection stopbanks
- type of land use that effects the amount of flooding for example rural and urban areas
- pumps, floodgates, drains and canals available in the area that can remove floodwaters

The two sets of maps represent the maximum flood levels from each of the five scenarios and include a 500 mm freeboard allowance. Freeboard compensates for

factors such as wave action, localised hydraulic effects and uncertainties in modelled design flood levels.

The maps provide a very good tool for estimating flood levels, however users of the maps are cautioned to undertake site specific surveys and make comparisons against actual water levels occurring during major events such as July 2004 and May 2005 floods.

Limitations of the maps and the modelling used to produce them are that they are dependant on the accuracy of the floodplain topography used in the model inputs Accuracy of the flood maps will improve when new LIDAR topography becomes available in 2007 and a finer model resolution is used with the new topography.

Appendix Five: Extracts Related to Flood Risk

http://www.envbop.govt.nz/media/pdf/CDEMG_Plan_2005.pdf

Bay of Plenty Civil Defence and Emergency Management Plan, Appendix 1

1.1.2 Probability of Hazard Occurrence

Climate change indications are that by the year 2080 that the temperature will increase by two degrees. Rainfall intensity will be up between 11 and 14 percent. Flood magnitudes across the region will go up from 10 to 22 percent. The rainfall frequencies will double and the Whakatane flood frequency will treble.

Current studies by Environment Bay of Plenty and allied experts suggest that the maximum likely event (described above) is a probability.

Global climate change will increase the frequency and/or intensity of heavy rain events in the region. Any increase in frequency or intensity will increase the amount of water to be held by a river channel and increase the amount of run off from developed areas. Many of the flood defenses in the region have been designed to handle larger flows, but it is still likely that with increased frequency or intensity of rainfall there will be more floods. Most floodplains are already developed, or restrictions have been put on future development to militate against the flood hazard. An increase in population and investment in these areas will increase the values at risk in flood events.

1.1.4 **Scenario Commentary**

Flooding, whether small or large, has the potential to cause damage, loss of life and significant economic and community disruption. Flood hazard has been managed in the region for many years and many rivers have specific management plans in place. These activities need to continue and be built upon.

The July 2004 floods in Eastern Bay of Plenty highlighted the need to have good systems in place concerning welfare, rural response, evacuation, difficulties in access for essential services, increased dangers to road users and the threat to the Edgecumbe power sub station.

There is a high level of manageability for flood events. In this region there are various levels of structural protection on the rivers capable of the highest consequences. Effective management of flooding hazards requires a whole catchment approach to be adopted.

Sullivan's Breach, Rangitaiki River Stopbank - A review of the causes of the breach. (Ice and Geo report prepared for Environment Bay of Plenty)

A breach occurred in the Rangitiaki River stopbank adjacent to Hydro Road, just upstream of Edgecumbe, at approximately 10am on Sunday 18th July 2004. The river was flowing very high at the time and water poured through the breach causing serious flooding of farmland, the railway, roads, and buildings downstream. The breach in the stopbank widened to about 100m and water flowed through for several days.

Heavy rain began falling in the Bay of Plenty on Thursday 15 July 2004 and continued for the next three days. The rainfall recorded by NIWA at station B76972 in Edgecumbe was as follows (Reference 1):
14 July 5.2mm
15 July 66.1mm

16 July 100.0mm
17 July 91.0mm
18 July 21.8mm
Total 284.1mm

Some parts of the Bay of Plenty experienced over 300mm of rain. Surface flooding occurred in many areas as drainage systems and pumps could not cope with the volume of water. The surface flooding in some areas made it difficult to detect leakage from stopbanks.

Fortunately the upper catchment of the Rangitaiki River received only about 120mm of rain and not nearer the 300mm experienced in the rest of the catchment.

The stopbanks at the breach site are designed to contain a flow of 780 cumecs (780 cubic metres of water per second) which is the estimated flow resulting from a storm with a 100 year return period. In July 2004 the peak flow estimated from dam spillage and downstream records is approximately 771 cumecs. The stopbank breached at about 650 cumecs, before the peak flow was reached. Fortunately the river peaked only 10 hours after the breach and dropped steadily over the next five days. This reduced the flow through the breach before it was closed.

The flood flow in the river was the greatest recorded since 1944. In contrast the flood which occurred in July 1998 and caused stopbank problems at the Edgecumbe substation and elsewhere was only 464 cumecs.

Piping occurs when there is an outlet for flowing water and there is enough hydraulic gradient to remove soil particles. Continuous soil particle removal can result in the formation of a “pipe” or “tomo” under a stopbank. The light, predominantly pumiceous, sandy soils of the Rangitaiki Plains are susceptible to piping.

A surface layer of cohesive soil can prevent piping developing if it remains intact and the water pressures below it do not exceed the weight of the soil layer.

At the breach site it is possible that the fence posts (which had only been driven a week earlier than the breach) penetrated the upper slightly cohesive soils to a higher permeability layer below, effectively creating a short circuit.

A good root structure and the build up in humus under pasture helps bind soil aggregates and some tensile strength can result in the upper soils (Reference 3). At this site there was no mature mat of pasture roots due to the use of the paddock for growing watermelons and subsequent ploughing and sowing of pasture in February. Vegetable crops and the associated rotary hoeing result in rapid breakdown in soil organic matter and a sparse root system.

One witness observed the final stopbank failure originating in the paddock some distance inland from the stopbank. This failure is considered to be due to heave of the upper soil layer and the rapid escape of water from layers of high permeability below.

Once the upper soil layer is lost the non cohesive layers of light soil below could rapidly erode back to the stopbank. This would cause the stopbank, made of more competent soil, to drop down into the hole formed below and be overtopped.

The plains are… geologically very young and unconsolidated which means they are highly susceptible to liquefaction and settlement following significant earthquakes.

The plains have been built up by over-bank alluvial deposits from meandering rivers in flood, wind blown sand, airfall ash deposits and peat formation in depressions. The active volcanism of the upper Rangitaiki River catchment and the high erodibility of the volcanic tephra result in a large source of sediment which can be deposited on the plains. The outcome of the plain formation processes is a wide and unpredictable variety of soil types and grain sizes within small horizontal and vertical distances.

The Rangitaiki Plains have been formed by several processes and in particular by flooding. The earliest flood recorded following European settlement was in 1904. Other significant events occurred in 1924 and 1944. Fifteen floods occurred between 1944 and 1964, causing extensive inundation and river bank erosion.

The stopbank appears to have functioned satisfactorily until the 1987 Edgecumbe Earthquake. During this period the largest flood in the river was 372 cumecs.

The highly permeable foundations of the stopbanks within the Rangitaiki Plains have been well recognised and efforts have been made through regulation to reduce the risk of stopbank failure. Clause 9.1 of the Bay of Plenty Regional Council Floodway and Drainage Bylaw 2002 states:

> *No person shall, without the prior written authority of the Council undertake any of the following activities-*
> *(a) The digging or maintenance of any drain, or any excavation within 150 metres from the landward toes of the Rangitaiki River Stopbanks:*

The clause goes on to give the following explanation:

> *The lower reaches of the Rangitaiki and Tarawera Rivers have layers of soils that are susceptible to piping failures beneath the stopbanks during flood events. The purpose of this rule is to minimise the risk of such failures occurring.*

Clause 4.1.5.2 of the Whakatane District Plan Rural contains more detailed requirements. Normal farming activities such as ploughing and fencing are allowed.

On 2 March 1987 the Rangitaiki plains experienced a Richter magnitude 6.2 earthquake. This was preceded by a series of foreshocks as big as Magnitude 5.2 starting on 23 February and was followed by several significant aftershocks. It was estimated that the main earthquake was centred within the 10km of the earth's surface.

The earthquake caused reactivation of the Edgecumbe, Onepu and Rotoitipakau Faults and several new surface ruptures ranging in length from 0.5 to 7.0km. Typically the north-western side of the rupture dropped relative to the south-eastern. The largest displacement was near the centre of the Edgecumbe Fault rupture which is as close as 700m to the Sullivan's Breach site. This displacement was up to 2.5m vertically and 1.8m horizontally

Following the Edgecumbe Earthquake 1 to 2m of ground settlement was recorded extending from where the fault crossed the river to downstream of Edgecumbe. Near McCrackens Road this settlement was measured at up to 7mm a day. Local farmers are still experiencing ground movement, 17 years after the major event and regularly have to re-hang some gates.

Indirectly the earthquake may have influenced the outcome on 18 July 2004 as the stopbank was 1.2m higher relative to the natural ground surface than the pre-1987 stopbank. Therefore the head difference across the stopbank from the river to the ground on the landward side was higher than it would have been pre-1987. Allowing

for the approximately 0.7m of freeboard when the breach occurred, the water level was 0.5m above the top of the pre-1987 stopbank. The increase in head differential may have been enough to cause the breach.

At about 4pm on 18 July 2004 a small but significant earthquake rocked the Bay of Plenty. This coincided with the arrival of the flood peak at Sullivan's Breach. The breach had occurred six hours earlier. The Institute of Geological and Nuclear Sciences has confirmed that there were three small foreshocks between magnitude 2.0 and 3.1 from 12.38am to 3.37am. These appear to have been centred at between 7 and 8km depth and were not felt (Reference 10). It is considered that these foreshocks did not contribute to the breach.

There was local knowledge that the paddock well out from the toe of the breached section of stopbank became spongy in even small floods and this had also been noticed within the section of McCrackens Bend between the two surcharges. It is unlikely that this knowledge was ever passed on to any Regional Council staff.

It is difficult to imagine more unfavourable conditions at the time of the stopbank breach than actually occurred. These conditions include the following:

1. The thin layer of low permeability soils above high permeability soils in some areas (less than 1m).
2. The magnitude of the flood in the river.
3. The saturation of the ground by the high rainfall.
4. The fall of the ground away from the landward toe of the stopbank.
5. The use of the river berm as a borrow area.
6. The lack of a good root structure in the surface soils which may have added some minor amount of tensile strength and reduced piping potential.
7. The row of fence posts along the stopbank toe possibly penetrating to the high permeability soils.

It is considered that given the magnitude of the flood the first condition would have been sufficient to cause stopbank failure. The remaining conditions may have just made the failure occur earlier than would have happened otherwise.