WHAKATANE DISTRICT COUNCIL

REVIEW OF AWATARARIKI CATCHMENT DEBRIS CONTROL PROJECT

JUNE 2012

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SYNOPSIS

S1 Following the 18th May 2005 intense storm event that caused considerable damage in the township of Matata, the Whakatane District Council (WDC) began working with the community on a recovery plan.

S2 This review is concerned with the works to control a possible future debris flow in the Awatarariki Stream Catchment of similar magnitude to the 2005 event.

S3 WDC received professional and legal advice on its responsibilities to mitigate the future potential risk and, having regard to the legal advice provided at the time, the Council resolved to proceed with works to control the effects of future debris flows from the Awatarariki Stream Catchment.

S4 WDC engaged Tonkin & Taylor Ltd (T & T) to consider options available. Some 11 options were identified in a preliminary options report (August 2005). One option identified was to "retreat" from the hazard and limit development on the debris fanhead of the Awatarariki Stream. The selected option (A2) was a debris dam in the catchment upstream of the escarpment and debris flood channel on the fanhead beside the existing Awatarariki Stream which was estimated to cost $3.7 million (M), including the replacement of the East Coast Main Trunk (ECMT) railway and repair of the State Highway 2 (SH2) bridges. The height of the debris dam proposed was 14 metres[1] (m) based on the estimated 100,000 cubic metres ($m^{3)}$ volume of debris to be contained.

S5 As the estimates of volume of debris deposited in the May 2005 event were refined, T & T concluded it was necessary to increase the dam size to contain the larger volume [250,000m^3] resulting in the dam

[1] Equivalent to a 4 storey building.

height increasing to 17 m[2]. This increased the estimated cost of the project to $5.262M excluding the bridge replacements.

S6 WDC made an application for Central Government for funding support, which was successful, and WDC approved a budget of $3.558 million for its share of the works. Together this provided sufficient funding to carry out the proposed mitigation works based on the costs estimated.

S7 Flood protection works downstream of the escarpment have been completed progressively since 2007 as well as preliminary design of the debris dam. Investigations and preliminary design have proceeded with upstream proposals, but no physical construction has commenced.

S8 In late 2007 T & T identified a range of possible debris detention structures (DDS) which were presented to the community for consultation. Early in the options assessment process it became clear that a barrier large enough to provide containment for 250,000m^3 (the design figure) was not practicable or affordable. The community and, in particular the tangata whenua, had concerns about the debris detention structures proposed, including the possible impact on culturally important sites. A partial containment option for 100,000m^3 was proposed with the balance of the design flow being directed over a spillway. An option using a flexible ring net was developed by T & T in conjunction with Geobrugg A G of Switzerland, estimated at $2.1 million (for the ring net) which would have a height of 10m and contain 95,000m^3.

S9 The Council approved the ring net option on 23 July 2008 and requested T & T to prepare a proposal detailing the scope and budget required for the ring net DDS and spillway.

S10 In June 2009, T & T presented its Preliminary Detailed Design Report to WDC. The height of the retained debris was proposed as 12m and the net would be 14m high. The project cost for the supply of the barrier and construction of the fanhead earthworks was revised to $2.789M.

S11 Detailed design was commenced by T & T in July 2010 and application was made by WDC for resource consents. The design was peer reviewed[3] and a number of concerns were raised regarding

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[2] Equivalent to a 5 storey building.
[3] The Peer Reviewers were Colin Newton of AECOM and Professor Tim Davies of Canterbury University.

the potential effectiveness of the spillway and increased complexity of the fanhead earthworks. In early 2011, T & T looked at deleting the spillway and provide greater containment with a retained debris height of 14m with a net height of 17m. This removed the requirement for both the spillway and fanhead earthworks, although it required a significant increase in the volume of debris to be retained. The estimated cost of the ring net and anchorages was re-estimated at $3.810M.

S12 In August 2011 Geobrugg provided WDC with an updated estimate of its 2008 estimate of the ring net costs. The WDC Project Manager expressed concern about the costs which were now in excess of the original budget. As at May 2012 expenditure on Awatarariki Catchment works were $4.814M[4] but the DDS had not been constructed.

S13 In January 2012 T & T expressed its concerns to WDC's Chief Executive about the ring net proposal which was estimated to have a maximum design life of 50 years and more expensive than originally envisaged. The poor ground conditions had resulted in a substantial increase in cost also affected by the high loads on the ring net to provide full containment. The estimated DDS costs were now estimated at $5M[5]. T & T recommended to WDC in March 2012 that the project be comprehensively reviewed.

S14 This Review was instituted by the Chief Executive in April 2012.

S15 The recommendation of this Review is that WDC take no further action to implement the ring net which is the current design solution for the DDS.

S16 Given the community objections and, particularly, those of the tangata whenua, which cannot be satisfactorily resolved, there is no reasonable possibility of constructing a DDS upstream of the escarpment. The recommendation of this review is that WDC does not pursue any further options upstream.

S17 If WDC adopts the recommendations to abandon the debris net proposal and not pursue any other DDS option upstream of the escarpment, it must, therefore, decide whether or not to take any further action to mitigate the risk of future debris flows in the Awatarariki Stream Catchment. If it decides to take no action, then it

[4] Compared with the approved budget of $5.262M in the 2006 business case for Government funding.
[5] Compared with $3.120 million in December 2008.

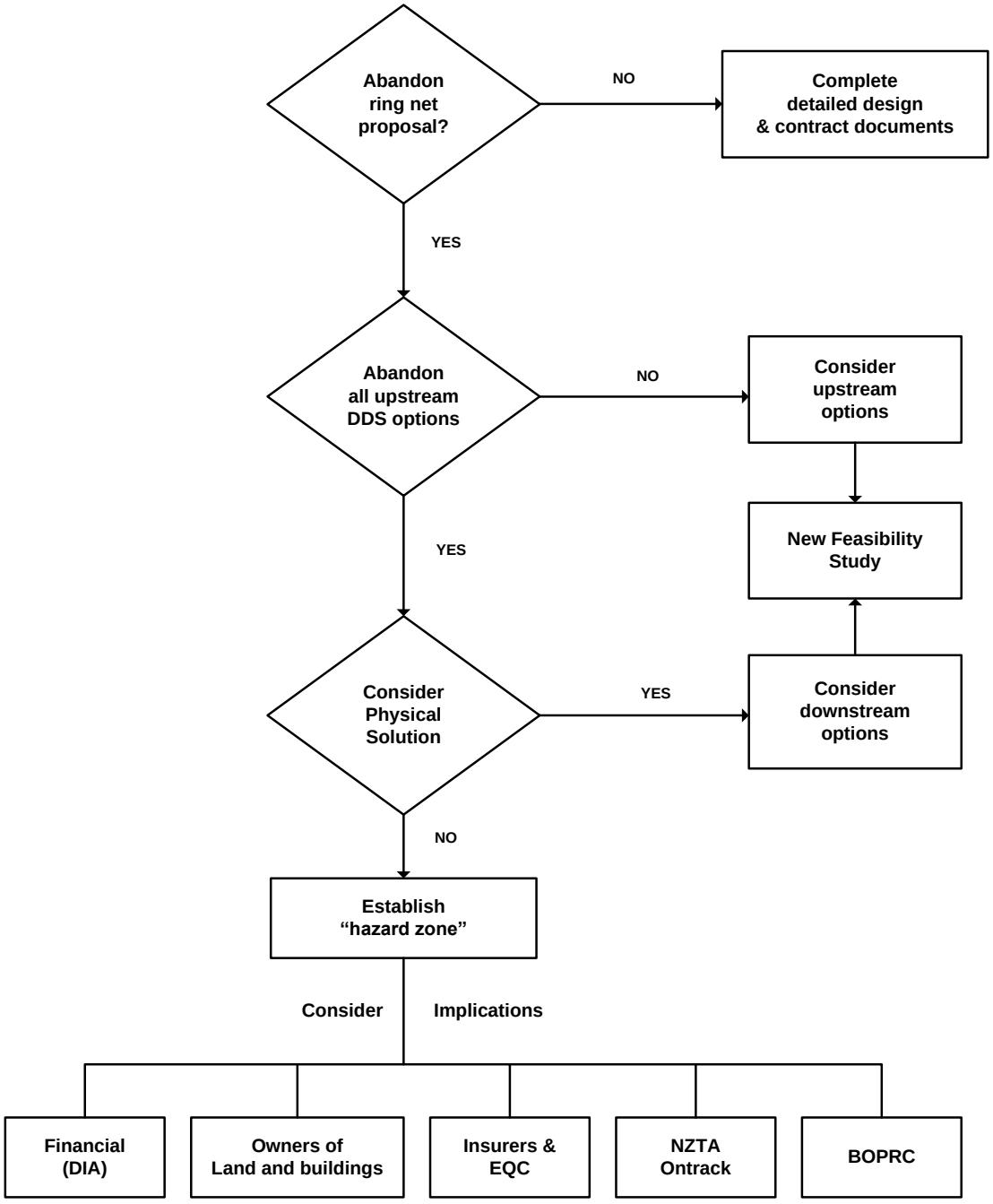
must have regard for the possible planning, legal and financial consequences that could follow.

S18 WDC could further consider the possible mitigation options downstream of the escarpment. The fundamental constraints with all of these are the restrictions presented by the ECMT railway bridge and SH2 (Moore's) bridge. Tranzrail and NZTA will need to be engaged in consideration of these options.

S19 Given the reinstatement of buildings on the fanhead since 2005 and the mitigation works that have been carried out (stream realignment, bank protection and lagoon construction), the situation that exists at this time is different from that when the options were proposed in August 2005.

S20 It is not possible within the scope of this review to identify any preferred option(s) which may include regulatory options. A detailed feasibility study of the 4 identified downstream options based on the current environment will be required. This is the next logical step for WDC to take in the event that it decides that a "no action" strategy is not acceptable.

S21 A suggested decision pathway to assist WDC in its deliberations is shown below.



DECISION PATHWAY

WHAKATANE DISTRICT COUNCIL

REVIEW OF AWATARARIKI CATCHMENT DEBRIS CONTROL PROJECT

EXECUTIVE SUMMARY

ES1. Introduction

ES1.1 On 18 May 2005 an intense storm event occurred in the catchments above Matata township in Whakatane District, resulting in flooding and debris flows in Matata. This caused the destruction of 27 homes and damage to varying degrees to 30% of the properties in urban Matata.

Immediately following the event and the initial response period, the Whakatane District Council (WDC) began working with the community on a recovery plan.

In relation to mitigation works for the Awatarariki Stream catchment and the Te Awa o Te Atua Lagoon, the proposed works sought to protect the affected community from future floods and debris flows. Two separate projects were confirmed by WDC:

- Flood protection works; and
- Works to control a debris flow of similar magnitude to the 2005 events.

ES1.2 In response to the 2005 storm event, the Council agreed “in principal (sic)” on a range of structural mitigation measures for the Awatarariki Stream catchment the resolution was:

“Option A2 – debris dam in catchment and debris flood channel on fanhead beside existing Awatarariki Stream watercourse, double span railway bridge.”

ES1.3 Tonkin and Taylor Ltd (T & T) proceeded with the preliminary design of this structural option which was debris detention dam 17 metres (m) high.

During the process of consultation with the community and Iwi[6] it was discovered that there was strong opposition to the proposed debris dam because of its impact and the potential to destroy waahi tapu sites including burial caves in the side of the hill.[7]

As a result T & T investigated other options. The selected option in July 2008 was a flexible ring net 14 metres high erected across the stream valley to provide partial containment of approximately 100,000 cubic metres (m^3). A spillway would limit debris accumulation behind the DDS to approximately 12m height. The ring net and anchorages were estimated to cost $2.1 million (M) and $300,000 for the spillway and other works.

As a result of a peer review commissioned by WDC and their own reflections on the design, T & T revised the design to provide for full containment of a 250,000 m^3 debris flow. This required the full 14m height of the ring net to be utilised for debris retention (i.e. no freeboard) and would allow for the spillway to be removed from the design, together with the fanhead earthworks at an estimated saving of $1.5M.

ES1.4 In early 2012, T & T approached the Chief Executive of WDC with concerns about the latest Geobrugg estimates of cost and that technical issues had not been resolved. The Chief Executive was concerned with the increased costs of the works and commissioned CPG New Zealand Ltd to *"provide a review of the current status of the proposed Awatarariki Stream Debris Flow Mitigation Project"*.[8]

Following receipt of the CPG review, WDC's Acting General Manager – Infrastructure and Chief Executive reported to the Council on 7 March 2012 on the status of the project and recommended:

". . .

2. THAT the Council request that further information be provided on the implications of a change to the Awatarariki Stream Debris Flow Mitigation Works (Debris Detention Structure) including:

- *Legal advice*
- *Existing Funding Commitments*

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[6] Comprising mandated representatives of Ngati Awa, Tu Wharetoa BOP, Ngati Rangitihi and Te Tino Rangitiratanga o Ngati Rangitihi Incorporated.
[7] Source: Tangata Whenua of Te Awa-o-Te Atua (8 January 2007); *"Cultural Impact Assessment"*.
[8] CPG New Zealand Ltd, (1 March 2012); *"WDC Matata Debris Flow Mitigation Structure – Overview Review"*.

- *Financial Implications*
- *Communications Plan*
- *Implications for the LTP and District Plan*
- *Resourcing options*
- *Project Control Group*
- *Consent commitments*

ES1.5 In March 2012 the Chief Executive engaged Alan Bickers of Jayal Enterprises Ltd *"to lead a review and provide strategic advice . . . on the current programme of works designed to manage risk from debris flows in the Awatarariki Catchment in Matata, including all ongoing commitments associated with the project"*.

ES2. Awatarariki Catchment Debris Control Project

ES2.1 WDC did a commendable job in responding to the 18 May 2005 event by obtaining specialised technical and engineering advice on the options available to it.

The work of the Institute of Geological and Nuclear Sciences (GNS) provided the basis for WDC to understand the hazard of the debris flows in the future, nature, magnitude and frequency of possible future hazard events and their likely consequences.

T & T provided a wide range of options for WDC to consider. The limitations of the cost estimates and potential engineering risks were possibly not fully appreciated by WDC in its policy response.

ES2.2 The responsibility of WDC for mitigation work (as compared with BOPRC) should have been investigated further. Irrespective of which local authority accepted responsibility, the estimated costs of the various options were likely to be similar and funded from similar groups of ratepayers. WDC sought to provide certainty to property owners as soon as possible and, therefore, progressed to investigation rapidly.

It would seem that, notwithstanding legal advice of its lack of any clear obligation to do so, WDC assumed that under a "retreat" option that it would be required to purchase affected property. That was a significant assumption which had a material effect on which of the mitigation options was preferred.

ES2.3 The selected Option A2 (debris dam in stream catchment and debris flood channel on fanhead) was identified as having the lowest discounted cost and lowest disbenefits and the WDC's decision to proceed on this basis was justified.

Option A2 was estimated to cost $5.262M and WDC made provision in its 2006 LTCCP for $3.56 million as its share of the capital cost of the works, which included the debris dam estimated at $3.120M. Central Government had agreed to fund one third of the estimated capital costs of the works (excluding replacement of the SH2 and ECMT bridges to be funded separately by their Government entities).

ES3. Project Review

ES3.1 Management of the project was led by WDC's Recovery Manager (Diane Turner) that originally started as part of the recovery phase following the event in 2005. This became a permanent role in late 2005 with responsibility to manage the suite of projects proposed for Matata. The Recovery Manager (Haydn Read) then contracted services to receive advice on engineering solutions and other technical information. The role reported directly to the Chief Executive, with regular update reporting to the Council.

ES3.2 The establishment of a Council Projects Team occurred around 2007. This consisted of the Project Manager (Barbara Dempsey) and several staff who reported to the Director of Works and Services (Haydn Read). The Project Team was responsible for the leadership and project management of all major capital projects within Council. The project team would, in some cases, report to a steering group which would invariably be the Strategic Leadership Team, although this did not occur with the Matata suite of projects. It would also, as a matter of course, report progress to Council at approximately quarterly intervals.

ES3.3 The Project structure for design of the Awatarariki Stream DDS project was complex because of the number of parties involved:

- Tonkin & Taylor Ltd,
- Geobrugg AG (Switzerland),
- Free Fall Geotechnical Engineering,
- Swiss Federal Institute for Forest, Snow and Landscape Research,
- Tritthard and Richter (Germany),
- Geovert Ltd.

There was, however, only one formal contractual relationship which was between WDC and T & T. Nevertheless, WDC was to pay professional fees to T & T for work done by others, including Geobrugg. Geobrugg had responsibility for net design and T & T for the anchorages, based on information to be provided by Geobrugg and Tritthard and Richter. There was some discussion between WDC

and T & T about design accountability but this was not fully clarified. T & T was heavily reliant on Geobrugg's design input for the ring net and anchorage load assessment and for estimating the costs of the ring net proposal.

ES3.4 The staged approach of T & T towards the implementation of this Project conforms to standard practice used by the Engineering Profession. A project is developed through stages which become progressively focussed. At each major stage there is usually a review of the Project risks and refinement of the cost estimates.

As the design of the ring net progressed, the estimates of costs were refined. The size of the ring net was increased as anchorage loads were better defined and the foundation costs escalated partly as a result of poor ground conditions. The ring net and spillway was estimated to cost $2.400M in May 2008, but by December 2011 it has escalated to $5.800M as a result of the change of scope.

ES3.5 It is clear from this review that the financial management exercised by WDC's Project Team of the Awatarariki Stream projects has been less than satisfactory. Expenditure to date is $4.814M against a budget of $5.262M without the most significant element having been constructed (viz. the DDS estimated at $3.120M). There are, in addition, elements of total project cost which were not adequately provided for in the Business Case:

- Escalation (from 2006);
- Resource and building consents (a nominal allowance of $100,000 was included);
- Legal costs and expenses;
- Project management by WDC (some provision was made but appears to have been inadequate.

There is significant concern within the local community at the incurred costs, particularly as the DDS has not been constructed.

ES3.6 On the basis of this review, it is recommended that WDC take no further action to implement the current design solution for debris detention (full containment debris net).

ES4. Consequences of Abandonment

ES4.1 In the event that WDC now decides not to construct a DDS upstream of the escarpment, it is important to consider possible consequences if parties placed reliance on the future protection that a DDS might provide.

ES4.2 It would appear that on the basis of the Environment Court's decisions that there would be no consequential impact on resource consents already issued.

ES4.3 On the basis of its statutory obligations under the RMA and BA, WDC will need to consider carrying out a change to its Operative District Plan to create a hazard zone in which development is prohibited. WDC needs to have regard for the legal advice it has received.

ES4.4 The Government funding to WDC is subject to an Agreement between it and the Council. The terms of that Agreement require WDC to use the funds for the purpose sought and to refund any part of the grant plus interest if not used for the Awatarariki Stream mitigation work.

WDC does not appear to have breached the terms of the Agreement, albeit that various estimates for items of work have been exceeded. If, however, WDC abandons the upstream DDS, it is potentially liable to return the unexpended Government funded portion of the project cost estimated at $150,000 (plus interest and GST).

WDC should appraise Government of its decisions following consideration of this review and, if another option is selected, seek additional Government funding.

ES4.5 In relation to consequences for owners of land and buildings potentially affected by future debris flows, it is noted that certificates under S.73(1) of the BA have been registered against titles. While WDC has some immunity as a result of S.393 of the BA, it needs to have regard for the legal advice it has received. It seems highly likely that if the DDS is not constructed that insurance companies may decide not to provide cover unless they are satisfied at the level of mitigation provided by WDC.

ES4.6 In relation to SH2 (Moore's) bridge it is likely that this will form a restriction for future debris flow and will need to be replaced.

ES4.7 The ECMT railway bridge is a double span structure. As such, the presence of a central pier may create a risk to the bridge in the event of a significant debris flow. The bridge was, however, designed and built in 2006 and Ontrack sought WDC's input to the preferred structure in July 2005, but proceeded before WDC had made a final decision because of the economic impact of further delays on their commercial customers, especially at Kawerau.

ES4.8 BOPRC has identified potential implications of abandoning the DDS as including the need to review the consents for the ECMT railway

bridge, implications for the proposed Regional Policy Statement (RPS), responsibilities for streams in urban areas, upper catchment land management and early warning systems.

ES5. Possible Future Strategy

ES5.1 The recommendation of this Review is that WDC take no further action to implement the debris net which is the current design solution.

ES5.2 Given the community objections and, particularly those of the tangata whenua, which cannot be satisfactorily resolved, there is no reasonable possibility of constructing a DDS upstream of the escarpment. It is recommended that WDC does not pursue any further upstream options.

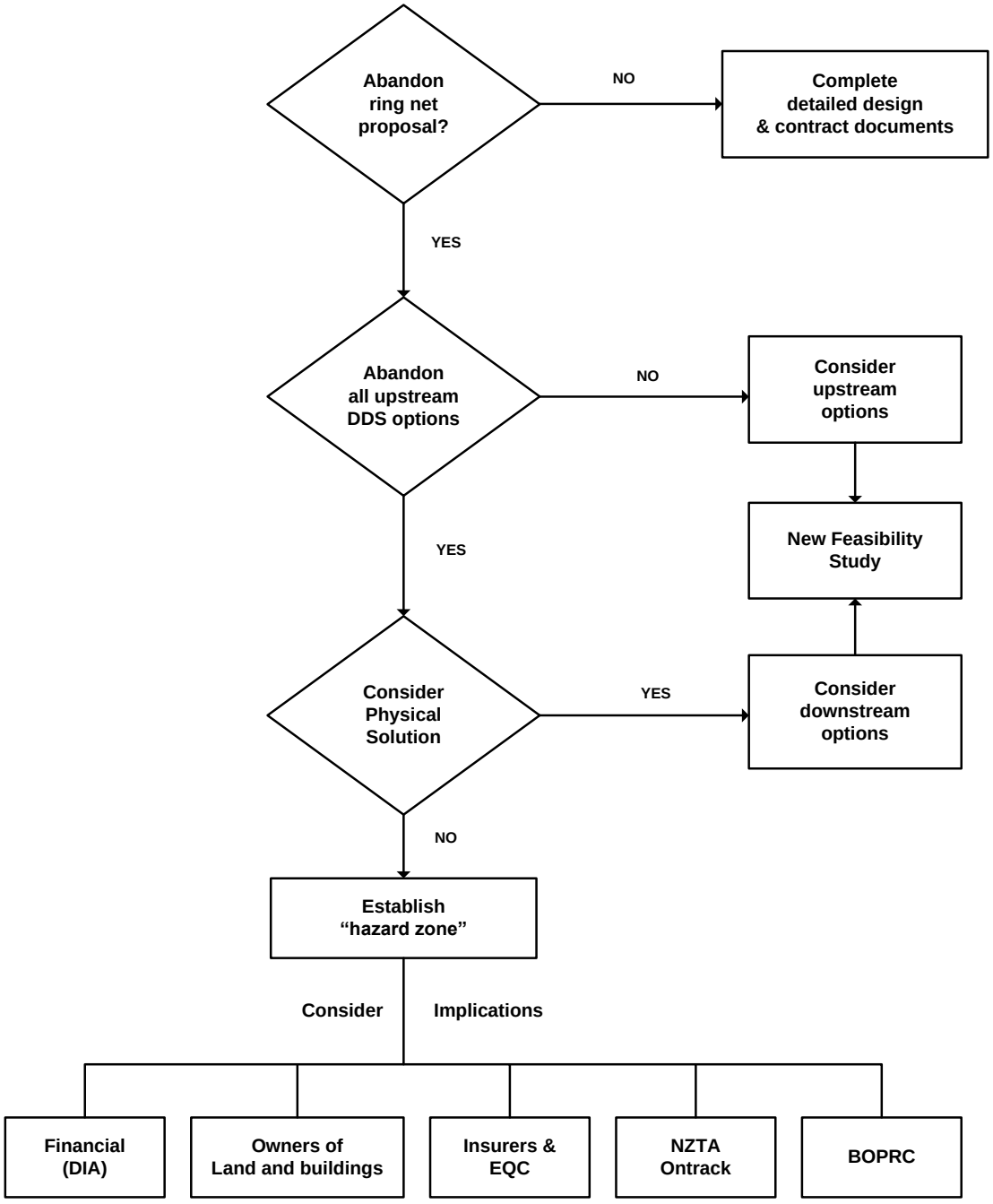
ES5.3 If WDC adopts the recommendation to abandon the debris net proposal and not pursue any other DDS options upstream of the escarpment, it must, therefore, decide whether or not to take any further action to mitigate the risk of future debris flows in the Awatarariki Stream Catchment. If it decides to take no action, then it must have regard for the possible planning, legal and financial consequences that could follow.

ES5.4 WDC could further consider the possible mitigation options downstream of the escarpment. The fundamental constraints with all of these are the restrictions presented by the ECMT railway bridge and SH2 (Moore's) bridge. Tranzrail and NZTA will need to be engaged in consideration of these options.

ES5.5 Given the reinstatement of buildings on the fanhead since 2005 and the mitigation works that have been carried out (stream realignment, bank protection and lagoon construction), the situation that exists at this time is different from that when the options were proposed in August 2005.

ES5.6 It is not possible within the scope of this review to identify any preferred option(s). A detailed feasibility study of the 4 identified downstream options based on the current environment will be required. This is the next logical step for WDC to take in the event that it decides that a "no action" strategy is not acceptable.

ES5.7 A suggested decision pathway for WDC to consider is shown in the attached diagram:



DECISION PATHWAY

ES6 Other Recommendations

ES6.1 A number of other recommendations are made on how WDC can improve its project governance and management practices in the future, including:

- Project governance structures;
- Project implementation processes and practice;
- Business case requirements; and
- Project monitoring and reporting.

WHAKATANE DISTRICT COUNCIL

REVIEW OF AWATARARIKI CATCHMENT DEBRIS CONTROL PROJECT

1. INTRODUCTION

1.1 Background

1.1.1 On 18 May 2005 an intense storm event occurred in the catchments above Matata township in Whakatane District, resulting in flooding and debris flows[9] in Matata. This caused the destruction of 27 homes and damage to varying degrees to 30% of the properties in urban Matata. Major damage and disruption occurred to water and roading infrastructure, on-site wastewater systems and flooding of rural properties.

1.1.2 Evidence has shown that debris flows have occurred in Matata for thousands of years. The debris flow of 2005 was the largest of the three debris flow events believed to have affected the area since 1868, making the probability of a debris flow in Matata approximately once in 35 years. The probability of a rainfall event as large as the May 2005 event has, however, been estimated at once in 200 to 500 years.

1.1.3 Immediately following the event and the initial response period, the Whakatane District Council (WDC) began working with the community on the recovery plan. WDC sought advice from appropriate specialist agencies and engineering consultants on the options available to it for debris and flood mitigation works in 4 catchments:

- Waitepuru;
- Waimea;
- Awatarariki; and
- Ohinekoao.

WDC sought and obtained financial assistance from Central Government of $2.890 million (M) towards the programme of mitigation work in the Waitepuru and Awatarariki catchments.[10] Significant

[9] A description of the phenomena of “debris flows” is discussed later in this report.
[10] The grant towards Awatarariki Stream catchment was $ 1.756 M being one third of the estimated costs.

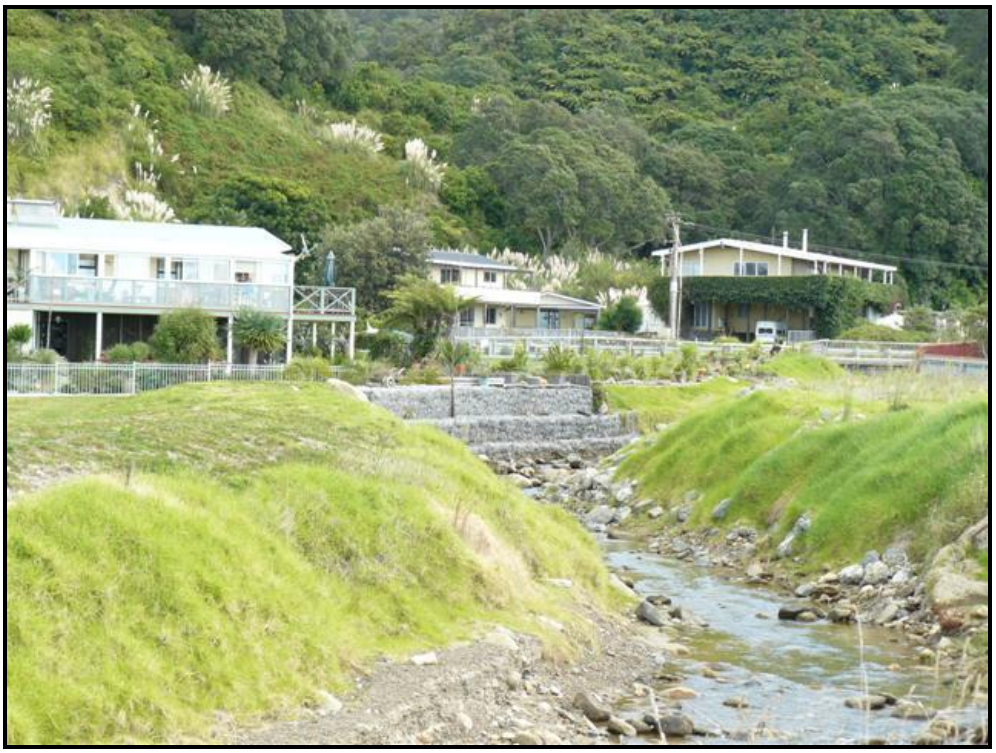
progress has been made with the implementation of the programme of flood mitigation works in these catchments.

1.1.4 In relation to mitigation works for the Awatarariki Stream catchment and the Te Awa o Te Atua Lagoon, the proposed works sought to protect the affected community from inundation from future floods and debris flows. Two separate projects were confirmed by WDC:

- Flood protection works; and
- Works to control a debris flow of similar magnitude to the 2005 events.

MATATA ENVIRONS – TOPOGRAPHY

1.1.5 The flood protection works in the lower reaches of the Awatarariki Stream includes reinforcing stream banks and the construction of 3 sediment deposition bays at the end of the stream at a point where it enters the Matata (Te Awa o te Atua) Lagoon.



BANK PROTECTION RIGHT BANK DOWN STREAM OF ECMT STATE HIGHWAY 2 (MOORE'S BRIDGE)

ENTRY OF AWATARARIKI STREAM TO LAGOON

1.1.6 WDC investigated a range of options to control debris flows in the Awatarariki Stream, specifically up to the magnitude experienced in 2005. It was decided to utilise a debris detention system (DDS) upstream of the escarpment to prevent large boulders and debris moving down the channel and damaging property and creating significant safety risk to those residing in the potential path of such debris flows (i.e. the debris fan area).[11] The selected option[12], for which the resource and building consents were sought was a flexible steel ring net designed to retain a large volume of debris with surplus being direct over a spillway and a controlled flow path.

1.1.7 WDC applied for resource consent for this option. The application was to be considered by an independent Commissioner[13], but was deferred pending the outcome of this review.

1.2 WDC's Response to 2005 Event

1.2.1 Following the event of 18 May 2005, it was agreed between WDC and the Government that there should be an integrated recovery plan for Matata involving all the relevant agencies. The recovery plan would include planning, land re-survey and possible land purchase, clean-up, stream diversion and community assistance.

1.2.2 A number of objectives were established:

> *" 1. To provide certainty to those property owners directly affected and the wider Matata community;*
>
> *2. To reduce risk to the community from debris flows to an acceptable level;*
>
> *3. To identify the options which will provide long-term solutions;*
>
> *4. To select solutions that are cost-effective, sustainable both now and into the future, and that are affordable for current and future ratepayers."*[14]

[11] Fortuitously, there was no loss of life or serious injury arising from the 2005 event.
[12] The original option was a debris detention dam.
[13] Alan Bickers was originally appointed by WDC as the Commissioner to hear and determine the application, but was relieved of that responsibility in order to lead this review.
[14] Diane Turner (Recovery Manager) and D R Christison (Chief Executive) WDC (10 August 2005); *"Management of Hazards and Risks – Matata and Environs"*.

1.2.3 WDC staff reported to the Council on the process of developing a rehabilitation plan for Matata and the non-structural options available to mitigate against future debris flow events[15], as well as preferred options for structural mitigation works[16] for:

- Ohinekoao,
- Awatarariki,
- Central (Matata) township,
- Waimea,
- Waimea Stream,
- Waitepuru,
- Awakaponga.

This report was supplemented by various detailed technical reports prepared by GNS Science[17] (GNS) and Tonkin and Taylor[18] Ltd (T & T).

1.2.4 As a result of its consideration of these and later reports, the Council agreed on 14 December 2005 on a range of structural mitigation measures for the various areas referred to (above). In respect of the Awatarariki Stream catchment the resolution was:

"That the Council confirms its earlier resolution (10 August 2005) to implement for Awatarariki Option A2 (debris dam in catchment and debris flood channel on fanhead beside existing Awatarariki Stream Watercourse) as outlined in the Tonkin & Taylor report titled 'Matata Debris Flows – Preliminary Infrastructure and Planning Options Final Report August 2005' ".

1.3 Implementation of Council Decision

1.3.1 T & T proceeded with the preliminary design of this structural option which was a debris detention dam (17m high) formed from local borrowed material and a spillway to divert excess flow to the left (north west).

1.3.2 During the process of consultation with the community and, in particular, with Iwi[19], it was discovered that there was strong opposition to the proposed debris dam because of the potential adverse effect,

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[15] Ibid.
[16] Diane Turner (Recovery Manager) and D R Christison (Chief Executive) WDC (10 August 2005); *"Management of Hazards and Risks – Matata and Environs – Structural Options"*.
[17] Formerly referred to as the NZ Institute of Geological and Nuclear Sciences Ltd.
[18] Environmental and Engineering Consultants.
[19] Comprising mandated representatives of Ngati Awa, Tu Wharetoa BOP, Ngati Rangitihi and Te Tino Rangitiratanga o Ngati Rangitihi Incorporated.

including the likelihood to destroy waahi tapu sites including burial caves in the side of the hill.[20]

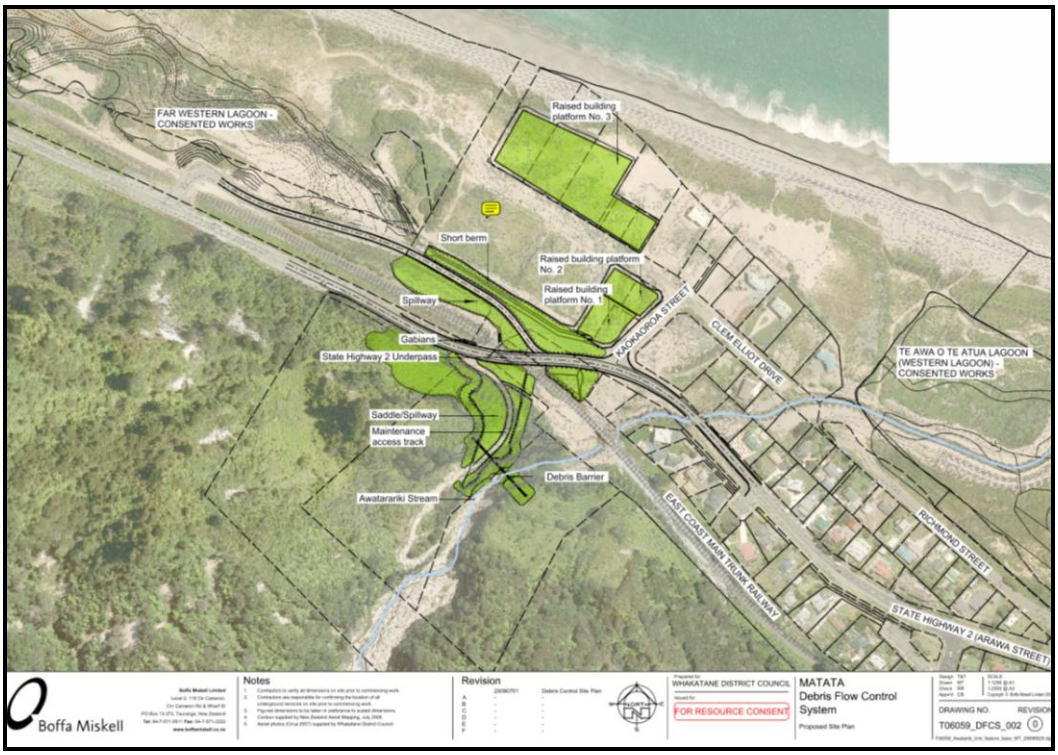
1.3.3 As a result T & T investigated other options to control debris flows in the Awatarariki Stream Catchment. The selected option was a flexible ring net 14m high erected across the stream valley to provide partial containment of approximately 100,000 cubic metres (m^3). This net would be supported by an overhead cable anchored into slopes on the sides of the stream.

Debris material exceeding the containment capacity of the ring net would be diverted via a spillway through the old quarry on the left bank terrace to open ground west of Matata through the SH2 underpass of the ECMT railway to open ground on the fanhead. The flow would be directed and controlled by an earth bund. It was likely that this bund could be overtopped in high flows and the risk to life and property would be managed by raising the building platforms in the area of Clem Elliot Drive and Kaokaoroa Street by approximately 2m. This "flexible net barrier" was approved by the Council on 23 July 2008.

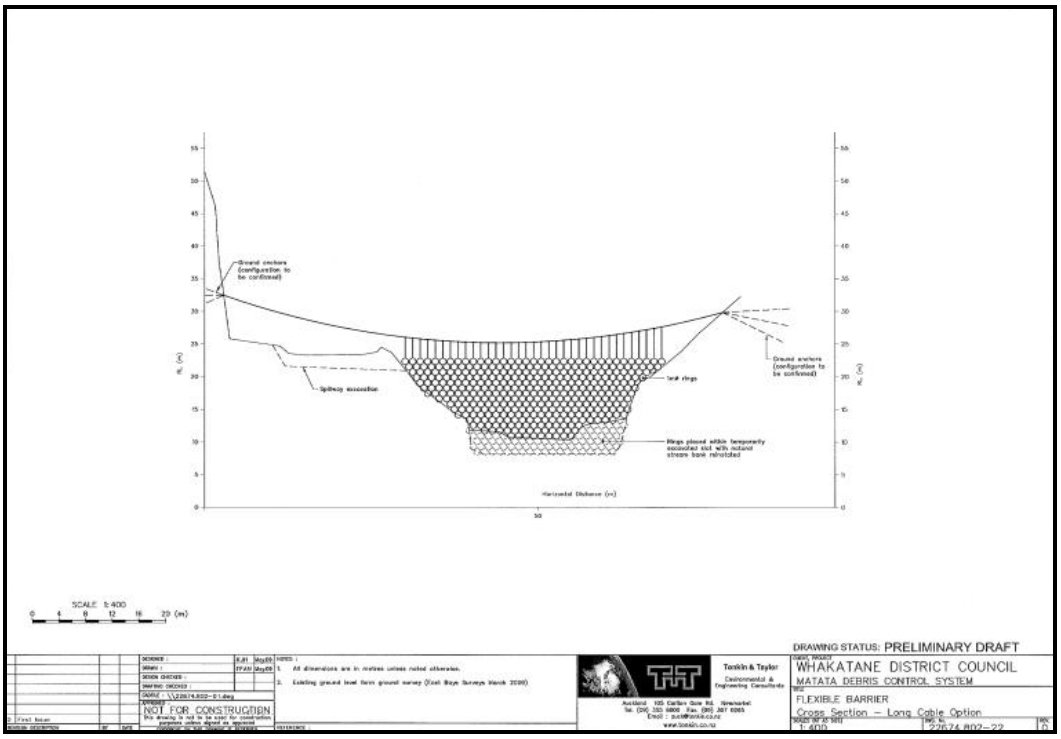
STATE HIGHWAY 2 UNDERPASS

In July 2009 WDC lodged applications for resource consents for this suite of works with Bay of Plenty Regional Council (BOPRC) and WDC's consent authority. The scope of works for which the consents were sought is shown on the plan which follows:

[20] Source: Tangata Whenua of Te Awa-o-Te Atua (8 January 2007); *"Cultural Impact Assessment"*.



SCOPE OF RESOURCE CONSENT APPLICATION USING RING NET DEBRIS BARRIER



PROPOSED RING NET DEBRIS BARRIER (RESOURCE CONSENT APPLICATION)

1.3.4 During the course of evaluating the applications WDC engaged AECOM (with support from University of Canterbury[21]) to conduct a technical review of the proposed suite of works[22]. The Reviewers raised concerns because the scale of the project was unprecedented in international experience and that the theoretical modelling was not based on a scenario comparable to that which might occur in the Awatarariki catchment. In particular, the Reviewers challenged T & T's scenarios for the operation of the proposed spillway, specifically whether it could become blocked during the later stages of a debris flow event.

1.3.5 As a result of the review and their own reflections on the design, T & T revised the design during 2011 to provide for full containment of a 250,000 m^3 debris flow which required the ring net to be 14m high. This, in their view would potentially obviate the need for the spillway and fanhead earthworks at a saving of $1.5M.

The freeboard originally proposed was to be utilised as part of the storage capacity rather than providing a margin of safety. An increase in the assumed angle of deposition from 0.4 degrees to 1.0 degrees, provided for a substantial increase in the estimated storage volume from 100,000 to 200,000m^3. There was, however, a need to increase the factor of safety which significantly increase the anchorage loads. This revised proposal would not be consistent with that forming the basis of the resource consent applications. T & T also advised WDC that as a result of the changes in design the cost of the DDS would increase.

The amended design providing for full debris containment in the ring net was different from the proposal for which resource consent had been sought. Whether or not this required a new application had not been addressed by the consent authority.

A second peer review[23] as carried out by AECOM which raised questions about (inter alia):

- Anchorage of the ring net;
- Height of the ring net;
- Corrosion protection in the coastal marine environment;

[21] Colin Newton (AECOM) and Professor Tim Davies (University of Canterbury).
[22] AECOM, (25 February 2011); *"Awatarariki Stream Debris Flow Control System – Peer Review of Resource Consent Application Technical Approval".*
[23] AECOM, (23 June 2010); *Awatarariki Stream Debris Flow Control System – Peer Review of Resource Consent Application Technical Approval".*

- Maintenance issues, including removal of debris;
- Public safety.

1.3.6 The WDC Project Manager expressed concern about the increased cost of the ring net barrier provided by Geobrugg in August 2011. T & T had identified the need for substantial increased anchorages because of poor ground condition and the additional factor of safety required to cope with larger storage volume and overtopping forces contributing an addition $2M (approximately) to the costs of the net.

1.3.7 T & T met with WDC's Chief Executive in January 2012 and expressed concern about the increased costs. T & T's concerns were recorded as follows:

" 1) The project, as it currently exists (Jan 2012), was very different to the one that had been envisaged at the commencement of the design and consenting process in 2009[24];

2) The cost of the barrier and its anchorages had increased significantly as a result of the requirement o increase the capacity of the barrier;

3) Estimated final project costs, were in our opinion, likely to be of a magnitude whereby the original decision to proceed with the project could be called into question;

4) Technical data provided by Geobrugg[25] in 2011 indicated a design life of possibly no more than 50 years for the flexible barrier. It is therefore very likely that the structure would need to be replaced well before it was subject to the design event debris flow (return period possibly in the order of 200 to 500 years). Other construction options (e.g. dams) provide near-permanent design life spans;

5) Given points 1 to 4 above, T & T are concerned that the project is now so different to that originally envisaged by WDC that the directive given by WDC in late 2011 to complete the detailed design phase and prepare a building consent application ASAP should be reviewed;

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[24] The most significant difference being the change in May 2011 from a partial containment system (100,000m^3) to a full containment system (250,000m^3) in order to satisfy peer reviewer concerns regarding spillway performance.

[25] Geobrugg A G, Switzerland are the designers and manufacturers of ROCCO ring net barriers for debris flows.

6) *T & T recommended a hold be put on our works until such time that a review was completed and that T & T would not proceed with the instruction to complete the detailed design phase and prepare a building consent application until a review of the project had been completed;*

7) *We took this position as the project parameters and financial estimates for the current proposal had changed so significantly when compared with those used when the flexible barrier (DDS)*[26] *was selected as a preferred option in 2008/2009;*

8) *As such, we consider it possible that use of the DDS to manage the hazard of debris flows on the Awatarariki Stream fanhead may no longer be more the most cost effective/feasible/preferred option; and*

9) *We also note that given the cost increase and given our understanding that other debris flow mitigation options were not acceptable to the community, it may be difficult to find a feasible solution which adequately mitigates risk to people and property."*

1.3.8 The Chief Executive of WDC was concerned with the increased costs of the works and commissioned CPG New Zealand Ltd to *"provide a review of the current status of the proposed Awatarariki Stream Debris Flow Mitigation Project"*.[27]

The conclusions of that work were (inter alia):

". . .

WDC has sought to mitigate the effects of an event similar to the 2005 event by means of constructing a debris detention structure. Debris flow events are poorly understood natural phenomena which include complex flow behaviour, and are substantially different from traditional fluid flows. Debris flow event of 250,000m^3 are not common, and the flow behaviour may not be as predicted by current modelling. The peer review process has determined that containment of some 250,000m^3 of debris is deemed necessary to satisfy the initial design aspirations.

The debris netting systems, similar to that as proposed by Geobrugg, have been successfully installed in a number of locations around the world, although it should be noted on a significantly smaller scale.

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[26] Debris detention structure.
[27] CPG New Zealand Ltd, (1 March 2012); *"WDC Matata Debris Flow Mitigation Structure – Overview Review"*.

(Retention volumes in the order of 1,000m^3 not 250,000m^3). As such, there are inherent risks incurred in adopting a design solution that has not been physically proven by field application with comparable loads and external conditions.

. . .

The current cost estimate of the proposed debris netting system is assessed at $5-$7m. The current cost estimate to remove debris, post construction from a further 2005 event, is assessed at $5m.

On the basis that a debris netting structure be constructed, it is presumed that greater property development could be anticipated of the fanhead area and its immediate surrounds. Should this be the case and an event larger than the 2005 event occur, or the structure fail-not perform as anticipated, then potentially the risk to human life would be greater with the construction of a debris structure as currently envisaged, than without.

As such, with a return period established in the order of 100's of years and a current building property asset value within the unsafe zone, being less than half the current projected build and debris removal costs ($2.6m vs $5-12M), the proposal to proceed with the scheme as detailed, does not indicate a cost benefit incentive to proceed. This assessment does not include a value against human life for cost benefit comparison purposes.

It is CPG's view that there is no current financially viable proposal which adequately mitigates risk to people and property and resolves the cultural environmental concerns over a 120 year design life."
CPG made the following recommendations to WDC:

" 1) Council be appraised of the current status of the Matata Debris Mitigation Scheme including rough order cost of the project as currently envisaged.

2) That Resource Consent, Building Consent and Design – construction drawings/specifications for the Debris Detention Structure remain on hold until such time as a clear directive from Council is determined.

3) Council seek further advice to understand the implications of placing the Debris Mitigation Scheme project on hold/or not proceeding with the project."

1.3.9 Following receipt of the CPG review, WDC's Acting General Manager – Infrastructure and Chief Executive reported to the Council on 7 March

2012 on the status of the project and in accordance with his recommendations:

*"*The Council at its meeting on 7 March 2012 resolved:

"1. That the debris detention structure planned for the Awatarariki Stream Catchment at Matata be placed on hold until the Council gains further detailed advice on the viability of the project and implications of any change". . . .

2. THAT the Council request that further information be provided on the implications of a change to the Awatarariki Stream Debris Flow Mitigation Works (Debris Detention Structure) including:

- *Legal advice*
- *Existing Funding Commitments*
- *Financial Implications*
- *Communications Plan*
- *Implications for the LTP and District Plan*
- *Resourcing options*
- *Project Control Group*
- *Consent commitments*

3. THAT the Council arrange a meeting of major stakeholders and directly impacted property owners to discuss a review of the Awatarariki Stream detention project.

4. THAT following the meeting of major stakeholders and directly impacted property owners the Council release these resolutions to the public."

1.3.10 On 16 March 2012, T & T wrote to WDC and made the following conclusions and recommendations:

"The Matata DDS design has developed considerably between 2008 and 2012. A number of changes to the project, brought about by a combination of land availability constraints and peer review opinion resulting in a more conservative design philosophy. This in turn resulted in an increased level of engineering cost to manage the increased levels of complexity and Factors of Safety. The changes have been such that the complete project construction cost is estimated now in the order of $6M. This is more than double the 2008 estimate.

Given that the project is quite different to the one originally envisaged, T & T recommend the following:

- *No further effort be made in the pursuit of either a Resource Consent or a Building permit for the DDS subject to undertaking a review of the scheme and its design objectives;*
- *WDC should re-evaluate the level of debris flow risk mitigation desired on the Awatarariki Stream fanhead. If high levels of risk mitigation is still required then high cost solutions are still likely to be required. If however a reduced level of risk mitigation are considered appropriate for the level of debris flow risk mitigation sought for the Matata community then an alternative approach (including no mitigation) could be more appropriate;*
- *If high levels of risk mitigation are required then WDC should evaluate whether the DDS at $6M supply and construction is appropriate for a barrier of relatively limited design life or some alternative construction would be more suitable;*
- *If a lower level of risk mitigation is considered acceptable or more appropriate for the Awatarariki Stream and the Matata Community then options other than a full containment system or abandonment can be considered.*

It is our opinion that the levels of risk are such that mitigation works are required on the fanhead however we acknowledge that alternative options may be possible depending on the level of protection required by the council and the local community."

1.3.11 The implementation of the Project, including the resource consent application has been on hold since March 2012.

1.4 Project Review

1.4.1 In March 2012 the Chief Executive engaged Alan Bickers of Jayal Enterprises Ltd *"to lead a review and provide strategic advice . . . on the current programme of works designed to manage risk from debris flows in the Awatarariki Catchment in Matata, including all ongoing commitments associated with the project"*.

1.4.2 The terms of reference are set out in Appendix A to this report.

1.5 Project Methodology

1.5.1 WDC established a Project Team comprising the following persons to assist with the provision of background information for the review:

- Marty Grenfell – Chief Executive
- David Bewley – General Manager Strategy & Planning

- Paula Chapman – Acting General Manager Infrastructure
- Jeff Farrell – Manager Development and Compliance
- Julie Gardyne – Manager Policy
- Sandy Lawrie – Contractor (Financial advisor)
- Ross Boreham – Communications
- Bay of Plenty Regional Council representative – Dr Ken Tarborton/Roger Waugh

1.5.2 The review was conducted through a desktop study of a considerable volume of background documentation[28], in particular, the various reports prepared both for the DDS feasibility study, design and implementation, as well as the application for resource consents.

A site visit/community walkabout was conducted on 4 March 2012, attended by the Project Team, members of the local community, representatives of T & T and various other agencies and interested parties. This provided the opportunity for WDC to communicate the current status of the Project, the scope of the review and to hear the views of the residents.

Interviews were conducted with various persons involved with the Project (refer Appendix D):

An opportunity for members of the community to provide written input to the review was also provided. Those written submissions are summarised in Appendix F and cross referenced to the relevant sections of this report.

The Project Team met on 4 occasions.

A draft report was submitted to the Chief Executive for review by the Project Team to ensure that it met the requirements of the Project Brief and was clear and unambiguous. Following that review this final report has been produced.

1.6 Content of Report

1.6.1 This report comprises the following sections:

Section 2 - Awatarariki Catchment Debris Control Project. Discusses the 2005 Event, subsequent investigations, WDC's policy response, design of the

[28] The assistance and cooperation of Tonkin & Taylor is acknowledged.

mitigation works, significant events and estimated costs.

Section 3 - Project Review
Discusses project governance and management, development of the design solution, funding and financial management, contractual obligations and possible way forward.

Section 4 - Consequences of Abandonment
Implications for legal and insurance, resource consents, planning framework, consequences for other parties.

Section 5 - Possible Future Strategy

Section 6 - Recommendations

Appendix A - Project Brief

Appendix B - Glossary of Abbreviations

Appendix C - Bibliography

Appendix D - List of Persons Interviewed

Appendix E - Awatarariki Catchment Debris Control Options

Appendix F - Summary of Community Submissions

Appendix G - Suggested Template for Business Case for Capital Projects

2. AWATARARIKI CATCHMENT DEBRIS CONTROL PROJECT

2.1 18 May 2005

2.1.1 On 18 May 2005, a band of intense rain passed over the catchments behind Matata. It triggered many landslips, and several large debris flows which, with their associated flooding, destroyed 27 homes and damaged a further 87 properties in Matata. State Highway No 2 (SH2) and the East Coast Main Trunk railway (ECMT) were closed for many days. The rainfall intensity was considered to be not more than a 500-year recurrence event (about 10% probability in 50 years), and the associated debris flows were considered as having a similar recurrence interval. There is evidence that equally as large, and even larger debris flows have occurred many times since 7000 years ago. Historical records indicate that probably three smaller debris-flows have occurred since 1860.

AWATARARIKI STREAM FANHEAD
20 May 2005

2.1.2 Within days of the debris flow event WDC assembled a multi agency Hazards Team under the initial leadership of Tom Bassett of T & T. The original scope of work for the Hazards Team was prepared by

WDC and included (inter alia) the following:

"
- *To identify the cause of the disaster (landslip/flood or both)*
- *To identify the nature and extent of short and long term risks still facing Matata as a result of this event*
- *To identify what action plans and processes need to be put in place to address the short term and long-term risks still facing Matata as a result of the event*
- *To identify what future land use provisions need to be put in place."*

Technical investigations (referenced reports in this project) carried out as part of the hazard and risk management work scope included:

"
- *Stream reinstatement issues (T&T/WDC)*
- *Collation of topographical information (Environment Bay of Plenty)(EBOP)*29
- *Interviews for May 2005 flood experiences (Dr the Honourable Ian Shearer)*
- *Historical research into previous events (Dr the Honourable Ian Shearer)*
- *Hydrological analyses (EBOP)*
- *Computational hydraulic modelling of watercourses (T&T)*
- *Catchment processes (Institute of Geological and Nuclear Sciences) (GNS)*
- *Review of the regulatory and planning framework (T&T)*
- *Lagoon management plan (Department of Conservation)(DOC)"*

The objective for the investigation of infrastructure and planning options was to enable development of a detailed action plan of capital works and planning measures to address and mitigate future risk in events similar to that experienced on 18 May 2005.

The Scope of Services identified included:

"
- *Identification of at-risk properties*
- *Preliminary design of permanent stream courses, with low flow and flood flow channels as appropriate*
- *Preliminary design of debris control structures (embankments) to direct catchment outflows*
- *Cost estimates of works*

[29] Now referred to as Bay of Plenty Regional Council

- *Confirmation of land-use restrictions that may be appropriate given level of risk and suitability of engineered mitigation measures*
- *Planning process to initiate any changes to the District Plan."*

This preliminary report led to the first draft of T & T's report *"The Matata Debris Flows – Preliminary Infrastructure and Planning Options Report"* in July 2005.

2.2 Debris Flow Investigation

2.2.1 WDC engaged the Institute of Geological and Nuclear Sciences Ltd (GNS) *"to provide an analysis of the geological and runoff processes in the catchments under extreme rainfall conditions experienced during the 18 May 2005 storm event in the Matata catchments and assess likely future risk and consequences."*

The report[30] was prepared by Dr M J McSaveney, R D Beetham and Dr G S Leonard and defined the terminology uses as follows:

Debris Flow – a very rapid to extremely rapid (5-10 m/sec, 15-30 km/hour) flow of water-saturated, non-plastic (granular) debris in a steep channel.

Debris Flood – a very rapid (up to 5 m/sec) surging flow of water, heavily charged with debris, in a steep channel.

Debris Avalanche – a very rapid to extremely rapid (5-20 m/sec, 15-60 km/hour) shallow flow of partially or fully water-saturated debris on a steep slope without confinement in an established channel.

The following paragraphs are quoted or summarised from relevant portions of the GNS report.

2.2.2 The report noted that witness descriptions and physical evidence indicated that debris flows caused the damage to Matata in the vicinity of Awatarariki and Waitepuru Streams. Debris flows are classified by experts as a type of landslide. They are dense fluid mixtures of all manner of rock, soil, organic debris and water which move rapidly, and are capable of carrying immense boulders. Boulders up to 7 metres across were moved by Awatarariki Stream's debris flow. Evidence in

[30] Institute of Geological and Nuclear Sciences Ltd, (June 2005); *"The 18 May 2005 Debris Flow at Matata; Causes and Mitigation Suggestions"*.

the stream's headwaters indicates that the primary causative events that inevitably led to the debris-flow damage at Matata were landslips of the type termed debris avalanches, triggered by exceptionally heavy rain.

2.2.3 The landslips that initiated the debris flows were triggered by intense rain, probably in excess of 2 millimetres/minute which fell during a severe thunderstorm. This intense rainfall fell in a narrow band only a few kilometres wide that passed across the catchments to the south of Matata from near the mouth of Ohinekoao Stream to Awakaponga. Had this band of rain been some 500m closer to Matata, a different and much more devastating outcome might have occurred. The existing debris flows could have been larger, and other catchments also could have poured debris flows into Matata. In addition, there may have been more debris avalanches from the slopes immediately behind Matata. Such events have happened many times in the prehistoric past, creating the land on which Matata stands.

2.2.4 Debris flows are more dangerous than floods because they make the flooding associated with them exacerbate the effects of debris flow because:

(1) They travel faster than the flow of water in the same channel and pick up all of the floodwater in their path, thus delivering water to the catchment outlet faster than would be possible in a simple flood;

(2) Deposition of sediment from a debris flow can fill the normal stream channel and allow the draining water to flood into areas not normally accessible by floodwater.

2.2.5 Hyperconcentrated flows of sediment-laden water draining from the debris flows caused debris floods; water so highly charged with sand and silt that it no longer behaved like normal water. It flowed faster, was denser and capable of moving larger boulders than could be moved by a normal flood flow across the lowland fans at Matata.

2.2.6 The debris flows of 18 May 2005 directly damaged some homes and properties. Other homes and properties were damaged by debris floods that extended beyond the debris flows. A debris flow is usually accompanied by a debris flood, which is regarded by experts as an integral part of the total debris-flow event.

2.2.7 Parts of Matata are naturally protected from flooding and debris flows, because the ancient debris flows fans were trimmed by Tarawera River and the streams draining from the upper catchments now are cut deeply into the toes of the fans, leaving much of the land free from flood risk.

The low railway embankment gave some other parts of Matata varying degrees of protection from water and debris floods, by diverting shallow flows. The railway also increased the danger to some areas, because it diverted flows to areas not otherwise at risk.

2.2.8 GNS stated:

"There are areas around Matata that are unsafe for habitation. Significant areas of present-day Matata have always been at risk from debris flows, debris floods and debris avalanches. These are wider than the currently affected areas. With engineering works, it is possible to reduce the danger to some areas to commonly accepted levels, but there are other areas where such mitigation probably is not feasible. Here, it will be necessary either to accept the risk, or remove dwellings. Of course, areas designated as floodways or debris-flow routes will be uninhabitable, but could be used for recreation. Accepting the risk need not endanger lives".

2.2.9 GNS concluded that there is a probability of a debris flow of around once in 35 years, but that the probability of a debris flow as large or larger than the 2005 event may only be once in 500 years or so. Significantly, the GNS report stated:

"Once in 35 years is an unacceptably high probability, even for flood inundation, and when the added danger of debris, with greater damage to property and more danger to life is taken into account, the level of risk is very high, and at a level widely acknowledged to be unacceptable for dwellings".

2.2.10 GNS outlines 4 possible broad options to mitigate the risk of debris flows:

- Debris detention (somewhere in the catchment);
- Debris deflection (on the fanhead);
- Building regulation (prohibiting of buildings in the path of future debris flows); and
- Warning and evacuation through early detection of severe storms. (Able to mitigate the risk to life but not property).

GNS suggested that a combination of the above was needed.

2.2.11 The GNS report made a suite of recommendations:

"Effective engineering mitigation of the hazards to Matata requires integrating such protection with works associated with the railway and SH2. Of critical concern are bridges and culverts; where these are too

small or misaligned, they obstruct flow, causing deposition and a somewhat random choice of path for flows that follow. For effective works, the debris path must be predictable and controlled, otherwise, restricting building is the only safe option.

We recommend that:

- *Communities in the wider Bay of Plenty area explore the potential of having a locally based, weather-radar system for warning of severe storms.*
- *The Matata community pays attention to the danger of small steep streams, and allocates adequate space for them to pass safely through Matata.*
- *The community at Matata consider the feasibility of having debris-flow detention basins on Waitepuru and Awatarariki Streams.*
- *A bund be constructed on the Matata side of Awatarariki Stream to divert debris floods.*
- *Waitepuru Stream be diverted to a course that bypasses Matata – to reduce stream channel siltation and improve the safety from flooding.*
- *Residents adjacent to Waimea Stream be told that there is a danger from debris flows, but we do not know if debris-flow mitigation work is warranted.*
- *The hazard from inundation by hyperconcentrated flows from Waimea Stream be mitigated with an adequately designed railway culvert, and erosion-resistant channel downstream.*
- *Residents of properties landward of the railway between Simpson and Clarke Streets on Pakeha Road, be told of the risks of inundation and landslides at those sites. Consider possible mitigation options for these sites to reduce the risk.*
- *Realignment and redesign of the SH2 and railway bridges at Ohinekoao Stream if property on the seaward side of the railway is to be protected from debris flows and floods from the stream.*
- *A combined approach between the authorities controlling the railway, SH2 and the Matata community to provide overall effective flood and debris-flow mitigation works.*
- *The boulder bund at Awakaponga Stream be extended a little further, and covered with soil. We commend the initiative already taken there.*
- *Further, less robust bunds lower on the fan of Awakaponga Stream be considered to adequately protect property and dwellings there."*

2.2.12 So far as the Awatarariki stream catchment was concerned, the significant comments from the GNS report:

(a) Where bridges and culverts have the potential to obstruct flow, a predictable and controlled path for the debris flow must be provided or building in the path of the debris flow must be restricted;

(b) A debris detention basin should be considered for the Awatarariki Stream;

(c) A bund should be provided on the Matata side of the Awatarariki stream to divert debris floods;

(d) A combined approach should be taken by all the agencies involved (WDC, BOPRC, Transit NZ and Tranzrail) to provide overall flood protection and debris flow mitigation for Matata.

2.3 WDC's Policy Response

2.3.1 WDC needed to consider whether, beyond actions it was taking in relation to its civil defence and emergency management (CDEM) obligations, it had any responsibility to undertake mitigation work to protect life and property in the event of future debris flow events which, based on the GNS advice, were inevitable (although not necessarily of similar magnitude).

WDC needed to consider whether BOPRC had a responsibility to undertake mitigation.

Clearly, the possibility existed to abandon the area of risk ("retreat"), including development and buildings in the likely path of future debris flows leaving the Earthquake Commission (EQC) and private insurers to deal with compensation of owners of land and buildings within the scope of their insurance obligations. Issues of liability of WDC for permitting development on the fanhead had to be considered.

2.3.2 WDC engaged T & T[31] to undertake a review of its regulatory responsibilities in order to identify options for managing the risks of the natural hazards.

T & T's report[32] considered –

- Hazard identification;

[31] T & T were engaged in May 2005 in May 2005 under the emergency conditions that applied and not in accordance with normal procurement practice.
[32] Tonkin & Taylor Ltd, (August 2005); *"Matata Debris Flows, Hazard and Risk Investigations – Regulatory Review"*.

- Responsibilities for flood control works;
- Requirements under the Resource Management Act 1991 (RMA) and Building Act 2004 (BA);
- Planning instruments.

In relation to mitigating or avoiding damage to properties arising from future debris flows, T & T stated:

"In order for a territorial authority to meet its duties under both the RMA and the BA, hazards within the district must be identified.

To avoid future damage to property a focussed assessment of those potential hazards that can be reasonably expected to occur should be made. This will allow appropriate levels of risk to be determined, and mechanisms for avoiding any increase of risk to be developed.

Mechanisms for minimising risk where land has already been developed are limited. If properties are identified, through a plan change process, as being subject to natural hazards, future development could be limited by resource consent requirements. Likewise, future building consent applications could be issued subject to the natural hazard provisions of the Building Act. Future development of properties vulnerable to natural hazards is then controlled. In general, existing developments can only be protected.

While there does not appear to be liability to councils for failing to identify risks through the RMA process, there is the potential for liability if territorial authorities fail to control development where a natural hazard has caused property damage and there is a reasonable risk that damage could occur again in the future.

Additionally, there may be corresponding liability on a regional council if it failed to act in an existing development situation, notwithstanding any allocation of responsibility through the RPS, given that regional councils have the ability to impose controls in such circumstances."

In relation to the relative responsibilities of WDC and BOPRC concerning the carrying out of mitigation works, T & T concluded:

"A review of legislation relating to flood control works identified apparent conflicts in responsibilities for the construction, management and maintenance of flood control schemes. Due to the number of pieces of legislation relating to flood control, actual responsibilities have been difficult to identify.

Through its Regional Policy Statement the Bay of Plenty Regional Council appears to be limiting its responsibilities for flood control to existing flood control and drainage schemes. However, the provisions of the Soil Conservation and Rivers Control Act (1941) suggest that the Regional Council's responsibilities lie beyond already established schemes. If this is the case, then the ability of Regional Council to pass responsibilities for flood control works to territorial authorities would appear limited."

BOPRC's perspective was that flood protection of the urban area of Matata is WDC's responsibility, as this does not form part of the Rangitaiki Tarawera Rivers Scheme or the Rivers Asset Management Plan.

2.3.3 WDC sought legal advice from Brookfields (15 June 2005) which stated:

"• *The Council acknowledges the stream as part of the stormwater drainage system for Matata;*

• *The Council has a regular maintenance programme for streams; and*

• *The Council has in the past obtained resource consents and carried out work on the streams."*

The distribution of responsibility between WDC and BOPRC was unclear from this advice. It would seem logical that where a territorial authority uses a natural watercourse to dispose of stormwater (a very common occurrence) that it will incur a responsibility to mitigate or remedy the effects of its discharges, such as through maintenance which may be a condition of resource consent. It does not seem to follow that by using a watercourse to convey stormwater that it would incur responsibility for effects that are caused upstream of its point of discharge or flood protection.

The legal advice to WDC did conclude that if WDC had no duty to undertake work on streams but, nevertheless proposed to do so, then it could create for itself potential future legal issues of liability and raise the expectations of the community for WDC to carry out future mitigation works.

2.3.4 T & T also prepared a report[33] for WDC to identify preliminary infrastructure and planning options to manage the risks from potential future debris flows.

In relation to the Awatarariki catchment there were 11 options identified:

Option A1: Retreat from hazard, and limit development on fanhead ($1.5M)

Option A1a: As for A1 but including works to raise floors ($2.3M)

Option A2: Debris dam in catchment and debris flood channel on fanhead beside existing Awatarariki Stream watercourse ($3.7M)

Option A2a: As for Option A2, with flood channel for high flow diversion to far western lagoon ($4.7M)

Option A3: Debris dam in catchment and debris flood channel on fanhead beside realigned Awatarariki Stream watercourse ($3.6M)

Option A4: Debris flow bund and debris flood channel on fanhead beside existing Awatarariki Stream watercourse ($2.3M)

Option A5: Debris flow bund and debris flood channel on fanhead beside realigned Awatarariki Stream watercourse ($2.8M)

Option A6: Debris dam in catchment and debris flood channel on fanhead beside new western Awatarariki Stream watercourse ($3.7M)

Option A7: Debris flow bund and debris flood channel on fanhead beside new western Awatarariki Stream watercourse ($2.7M)

Option A7a: As for A7, with high flow floodway to far western lagoon ($2.7M)

Option A8: New Awatarariki stream path cut through ridge, and debris flow bund on fanhead with new debris flood channel ($3.1m to $7.6M)

Option A8a: Similar to A8, but aligned to cut through ridge behind quarry with debris flow channel towards far western lagoon under state highway and railway to west of present subway ($6.5m to $9M)

The extent of land considered to be affected by Option A1 (Retreat) is shown in the following plan.

[33] Tonkin & Taylor Ltd, (August 2005); *"The Matata Debris Flows – Preliminary Infrastructure and Planning Options Report"*.

OPTION A1 RETREAT

Refer to Appendix E for impact on properties i.e. protected and not protected. The options could be categorised as –

- Dam options (A2, A2a, A5 and A6); and
- Fanhead options (A4, A5, A7, A7a, A8 and A8a).

T & T commented on the varying benefits of the options in terms of private properties that would be protected/exposed in the event of future debris flow events. They also noted if structural works were not undertaken that many properties would be at risk from future debris flows and/or debris floods.

It would appear that in developing these options T & T had regard for the recommendations contained in the GNS report (refer 2.2.12) and conducted extensive research into methods of controlling debris flows used in Canada, Venezuela, China, Japan, USA and elsewhere in New Zealand (Thames and Aoraki Mt Cook).

T & T's recommendations were generally of a high level and related to:

- Development controls on affected properties;
- Debris control implementation;
- Hazard identification; and

- Risk management.

T & T did not recommend specific mitigation works for Awatarariki catchment but a process that should be followed to identify what needed to be done:

" • *Confirm the level of risk acceptable to the community, and the implications this has for planning,*

- *Determine sources of funding for capital works options and the process to confirm likelihood and extent of that funding,*

- *Identify and quantify as possible the benefits of each option in relation to affected properties,*
- *Consult with the community (residents, property owners, tangata whenua and other agencies) regarding selection and implementation of preferred options,*

- *Confirm likely resource consent and building consent implications of options,*

- *Maintain close communication and consultation with Ontrack and Transit NZ specifically to discuss capacity requirements for existing and replacement cross drainage structures on the land transport corridors and funding issues,*

- *Prepare a plan for detailed technical investigations to provide information for implementation of the preferred options. This information to include topographical data, geotechnical parameters for foundation design, assessment of seismic risk,*

- *Research further the scope for weather radar and rain gauge monitoring to identify and track storms and thus provide an effective early warning system.*

This represented a prudent and methodical approach to considering potential structural option to address the potential risks of future debris flows and selecting a preferred solution.

2.3.5 The Council's policy response was determined, in principle, at an extended meeting held on 10, 12 and 18 August 2005.

It is commendable that within 3 months of the debris flow event WDC's officers, with the support of T & T, were able to report to the Council on the options open to it and to recommend a recovery strategy.

The Council received the GNS report (refer 2.2) and the T & T report on *"Preliminary Infrastructure and Planning Options"* (refer 2.2.5). It did not appear to receive the T & T report *"Regulatory Review"* (refer 2.3.2) or Brookfields' legal advice (refer 2.3.3) at this meeting, but it was a document referred to at the Council meeting of 16 November 2005.

Over the 3 day Council meeting WDC's officers presented 3 important reports[34]:

1. *"Management of Hazards and Risks – Matata and Environs"*;

2. *"Management of Hazards and Risks – Matata and Environs – Mitigation Works"*; and

3. *"Management of Hazards and Risks – Matata and Environs – Additional Information"*.

The reports suggested objectives for the management of hazards as:

- Providing certainty for affected property owners;
- Reducing risk to the community from debris flows to an acceptable level;
- Providing long-term solutions; and
- Selecting cost-effective and sustainable solutions that were affordable.

It was significant that the reports noted that a full risk assessment had not been carried out, there was no benefit/cost analysis, the key agencies had not signed off and the community had not been presented with the full costing.

There were some critical aspects that needed to be considered for the Council to adopt a policy response:

- Whether WDC had a legal responsibility to undertake remediation;
- The extent to which BOPRC may have had some responsibility to undertake mitigation works;
- The appropriate level of risk that should be the basis of design, given that the level of service and cost needed to be balanced.

[34] These reports were presented over the names of Diane Turner, Recovery Manager and D R Christison, Chief Executive Officer.

Some of these matters had been considered by T & T and Brookfields so that the Council was sufficiently briefed to consider these fully and make an informed policy decision.

The reports referred to use of non-structural options, such as catchment management, early warning systems and regulatory controls.

Community input was reported:

- Little support for the concept of retrenchment;
- Desire to see little impact on property owners;
- Negative comments on dam options;
- Recognition that some properties would have to be sacrificed.

2.3.6 The Council resolution of August 2005 that initiated the policy response was:

"That the Council approves in principal (sic) the following structural mitigation work:

Awatarariki Stream – Option A2 – debris dam in catchment and debris flood channel on fanhead beside existing Awatarariki Stream watercourse, double span railway bridge."

Other significant resolutions were:

"THAT the Council requests that the Government fund the appointment of a recovery Project Manager to oversee the rehabilitation projects and to coordinate the information and implementation processes required on any other Matata projects."

"THAT the Council supports the applications by other agencies (Department of Conservation, Transit New Zealand, Ontrack and Environment Bay of Plenty) to the Government as identified in the preferred options and that details of these be included in the rehabilitation plan."

"THAT the Council requests that Environment Bay of Plenty includes the Matata Stream catchments within their programme of annual inspections of catchments for the purpose of monitoring the condition of the catchment and initiating remedial measures as necessary to keep the catchment in good health and that an annual report be provided to the Whakatane District Council; and

THAT the Council requests that Environment Bay of Plenty undertakes a post storm reconnaissance of the Matata Stream Catchments for the purpose of monitoring the condition of the catchment and initiating remedial measures as necessary to keep the catchment in good health."

2.3.7 It is clear from the reasons for the decisions recorded in the Minutes that this was having regard for:

- Providing certainty to those property owners affected and the wider Matata community;
- Reducing the risk to the community from debris flows to an acceptable level;
- Seeking to provide long-term solutions;
- Seeking to ensure that cost effective solutions were sustainable in the future comprising preventative, regulatory and structural mitigation measures;
- Providing protection to existing dwellings; and
- Responding to input from the community and Iwi.

2.3.8 In November 2005 the Council received further reports based on the refinement of the various options under consideration. In particular a report from WDC's Recovery Manager[35] supported by further reports from T & T[36], Department of Conservation (DOC) and NZ Institute of Economic Research (NZIER)[37].

T & T reviewed 3 options for the Awatarariki Catchment:

- A1 Retreat from hazard;
- A2 Debris dam and debris flood channel on fanhead (as approved in principle);
- A5 Debris flow bund and debris flood channel on fanhead.

In respect of the Option A2, previously approved in principle by the Council (refer 2.3.6), T & T had revised the conceptual design because the volume of May 2005 debris flow had been re-estimated at

[35] WDC, Diane Turner Recovery Manager (November 2005); *"Management of Hazards and Risks – Matata and Environs"*.
[36] Tonkin & Taylor, (11 November 2005); *"The Matata Debris Flows – Awatarariki and Waitepuru Risk Management Options"*.
[37] NZ Institute of Economic Research, (November 2005); *"Matata Debris Flow Mitigation – Cost Benefit Analysis of Options"*.

330,000 m^3 for design purposes. Consequently, changes to the conceptual design were provided for this:

- The height of the debris dam had increased from 14m to 17m;
- A floodway across the lagoon (also applicable to A5);
- A deposition area for finer material at the head of the lagoon; and
- A drainage swale at Clem Elliot Drive to facilitate drainage from the rehabilitated subdivision.

These design changes had increased the capital costs of the 3 options (which included work on SH2 and ECMT bridges):

	November 2005 Estimate	**May 2005 Estimate**
A1 Retreat	$1.75M	$1.5M
A2 Debris dam, etc	$5.60M	$3.7M
A5 Bund	$3.45M	$2.8M

2.3.9 T & T's cost estimates provided for:

- Contingency and risk (25%);
- Professional fees (20%);
- Contractor's establishment and preliminary and general costs (P & G (10%).

The T & T cost estimates did not allow for:

- GST;
- Escalation;
- Land purchase;
- Resource and building consents[38];
- Legal costs and expenses;
- Operations and maintenance;
- Financing and depreciation;
- Project management by WDC, including community consultation.

The approach taken by T & T in identifying its assumptions and conclusions was in accordance with standard professional engineering practice. The nominal percentage allowances were also appropriate

[38] T & T included a nominal $100,000 for resource consents in its components of the capital cost estimates.

given the stage of project development. It was important, therefore, that in its reporting to Council that WDC staff should have made appropriate and adequate provision for the excluded cost elements identified by T & T.

2.3.10 WDC's Recovery Manager provided a summary of costs for the options as follows:

		Capital Cost[39]	Property Purchase[40]	Annual Costs[41]
A1	Retreat	Nil	$8.092M	$1.123M
A2	Debris dam, etc	$4.590M	$0.302M[42]	$0.845M
A5	Bund	$2.050M	$4.215M	$1.098M

While the Recovery Manager's estimates included some of the components excluded by T & T, they appear not to have included:

- Escalation;
- Resource and building consents in excess of T & T's provision;
- Legal costs and expenses;
- Financing;
- Project management by WDC;
- Plan change to support retreat option.

NZIER summarised the discounted costs and benefits at the nett present value (NPV) of the 3 options.

		Discounted Cost	Discounted Benefits	Nett Benefit
A1	Retreat	$13.86M	$2.28M	$-11.58M
A2	Debris dam, etc	$7.94M	$2.94M	$-5.00M
A5	Bund	$10.63M	$1.76M	$-8.87M

On the basis of this analysis Option A2 was the preferred option.

The Recovery Manager noted in her report that the costs of the project had risen significantly from the preliminary report in August 2005 because of the increase in design volume of debris. She recommended

[39] This excludes the work on the SH2, ECMT bridges and outstanding cleanup costs and hence differs from T & T's estimates.
[40] Based on 2004 valuation.
[41] Includes loan repayments, depreciation, maintenance, asset management, silt removal and annualised debris removal.
[42] Later increased to $0.672M bringing the estimated capital cost total to $5.262M.

that Option A2 be confirmed as the mitigation measure for the Awatarariki Catchment.

The Recovery Manager's report stated:

"Where a decision has been made to retreat from a hazard an assumption has been made that the Council will be proactive and purchase the property. This is an issue that the Council needs to carefully consider, as there is indeed no legal obligation to purchase".

This comment was based on legal advice received.

It is understood that the Council did carefully consider its legal obligations and notwithstanding that assumed that in the event of retreat from the hazard it was not obliged to purchase property. As a result of that assumption WDC included the full property purchase cost estimates costs in its economic analysis of options. If costs of property purchase ($8M) had been excluded from the economic analysis, it is clear that Option A1 would have been the preferred option on economic terms. Again, reasons for this policy decision were recorded.

2.3.11 The Recovery Manager's report referred to risks associated with the recommended plan which are summarised as follows:

- Failure to get agreement/commitment from key agencies;
- Community opposition to the preferred solutions;
- A change of Council policy as a result of new information;
- Lack of Central Government support;
- Inability to obtain resource consents;
- Lack of ongoing commitment to maintenance expenditure.

2.3.12 The potential engineering risks were not highlighted in the Recovery Manager's report.

The T & T report (11 November 2005) which was an important input to the Recovery Manager's report, did not include a risk analysis. Whether the inclusion of an engineering risk analysis would have influenced the Council in its decision over a choice of option is not known, but is probably unlikely.

SNZ HB 4360[43] outlined typical risks that may be applicable to significant engineering projects:

- Inaccurate estimating of the costs of a project (both capital expenditure and operating and maintenance costs);
- Inability to construct/operate the assets due to unforeseen conditions e.g. geotechnical matters;
- Inability to provide the intended level of service;
- Inadequacies of design or construction to achieve the desired outcomes;
- Failure to ensure that the assets are designed or constructed to avoid potential safety issues and environmental impacts;
- Failure to qualify for Government Assistance for recovery, where it is available;
- Delays in implementation of the project with consequential cost escalation and/or other adverse impacts;
- Failure to obtain the required consents with satisfactory conditions (identified by T & T).

2.3.13 The Council resolved to consult with the property owners in the catchment before a final decision because of the potential impact on rates. This occurred at a public meeting on 7 December 2005.

At its meeting on 14 December 2005 the Council resolved:

"That the Council confirms its earlier resolution (10 August 2005) to implement for Awatarariki Option A2 (debris dam in catchment and debris flood channel on fanhead beside existing Awatarariki Stream Watercourse) as outlined in the Tonkin & Taylor report titled 'Matata Debris Flows – Preliminary Infrastructure and Planning Options Final Report August 2005' ".

2.3.14 It would appear, nevertheless, that the Council had not completely excluded the possibility of "retreat" because on 21 December 2005 it resolved:

"That staff prepared report on the following:

1. Policy to aid Council decision making on choices between mitigating risk and/or retreating from natural hazards; and

[43] Standards New Zealand (2000); *"New Zealand Handbook – Risk Management for Local Government."*

2. Policy on Council's role, if any, in assisting in relocation of residents where retreat from natural hazards is the chosen option; and

. . ."

2.3.15 A "business case" for Government funding was apparently prepared in response to an invitation that WDC seek a contribution to the costs of mitigating the risk to Matata from similar events in the future.

The Business Case[44] was forwarded to Government on 13 December 2009 and stated:

"A total of $5,229,300 is proposed to be spent for the Matata regeneration package. Of this total, $1,333,100 is sought from Government through this Business Case and $2,746,300 will be met by Whakatane District Council."[45]

The amount sought from Government was initially only for the Waitepuru works and engagement of a Project Manager and did not include Awatarariki Stream mitigation work.

Following the Council meeting of 14 December 2005 a "Supplement" to the Business Case was submitted in relation to capital costs of Awatarariki Option A2 as follows:

Debris dam	$3,120,000	
Twin span railway bridge ECMT	1,000,000	*
SH2 (Moore's Bridge)	400,000	*
Upgrade Awatarariki Stream Channel	300,000	
Lagoon floodway	470,000	
Lagoon deposition area	550,000	
Clem Elliot Drive drainage swale	50,000	
Resource consents	100,000	
Property acquisition	672,000	
TOTAL	$6,662,000	

* Assumed to be fully funded by Ontrack and Transit NZ

The T & T estimates included 25% contingency and risk, 20% for professional fees and 10% for contractors' P & G and establishment.

Excluding the replacement of the ECMT and SH2 bridges, the net capital cost was estimated at $5,262,000.

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[44] WDC, (December 2005); *"Matata Business Case".*
[45] This excluded expenditure directly incurred by Government Agencies such as Transit NZ and Ontrack.

It was proposed in the Business Case supplement that the Awatarariki works be funded as follows:

Whakatane District Council	$3,508,000 (66.7%)
Central Government	$1,754,000 (33.3%)[46]

WDC also sought a Government contribution towards the cost of employing a Project Manager of $200,000.

The Government agreed to fund one third of the costs for Awatarariki Stream Catchment $1.756M[47], exclusive of the work to be carried out and funded by Transit and Outrack. It also agreed to fund $100,000 of the cost of employing a) Project Manager.[48] An Agreement for the terms and conditions of the Government funding was entered into by WDC (discussed later).

The approved WDC budget for its share of the capital costs of the Awatarariki works was $3.558M.[49] this was reflected in WDC's 2006 LTCCP.

Government also agreed that the Department of Conservation (DOC) could fund restoration works associated with the lagoon up to $225,000.[50]

2.3.16 In response to WDC's request of August 2005 (refer 2.3.6) BOPRC[51] indicated its willingness to include the Matata stream catchments in its annual programme of inspections and to assist WDC with post storm reconnaissance. BOPRC did, however, indicate that other than informal advice, its engineering staff had not been asked to provide technical input to the design options for any mitigation works for the Matata streams.

BOPRC gave a clear message that it was unsympathetic to suggestions that it should contribute towards the works proposed by WDC (other than those related to the Rangitikei-Tarawera River Scheme).

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[46] Letter from Colin Holmes, Mayor WDC (13 December 2005) to Hon Rick Barker, Minister of Civil Defence and Emergency Management.
[47] Government approved a package of $2.990M over 3 years for all the Matata projects.
[48] Letter: John Norton, Director of Civil Defence and Emergency Management (18 January 2006) to David Christison, Chief Executive, WDC.
[49] Council Budget 7 February 2006.
[50] Reference: Cabinet Minutes, CBC Min (06) 1/6 of 26 January 2006. Ultimately DOC funded $200,000.
[51] Letter: Jeff Jones, Chief Executive BOPRC (18 January 2006) to Diane Turner, Recovery Manager, WDC.

2.3.17 WDC did a commendable job in responding to the 18 May 2005 event by obtaining specialised technical and engineering advice on the options available to it.

The work of GNS provided the basis for WDC to understand the hazard of the debris flows in the future, nature, magnitude and frequency of possible future hazard events and their likely consequences.

T & T provided a wide range of options for WDC to consider. The limitations of the cost estimates and potential engineering risks were outlined by T & T, but possibly not fully appreciated by WDC in its policy response.

The responsibility of WDC for mitigation work (as compared with BOPRC) could have been investigated further. Irrespective of which local authority accepted responsibility, the estimated costs of the various options were likely to be similar and funded from similar groups of ratepayers. WDC sought to provide certainty to property owners and, therefore, progressed to investigation rapidly.

It would seem that, notwithstanding legal advice of its lack of any clear obligation to do so, WDC assumed that under a “retreat” option that it would purchase affected property. That assumption was significant as it had a material effect on which of the mitigation options (shown in 2.3. 10) was preferred.

The selected Option A2 (debris dam in stream catchment and debris flood channel on fanhead) was identified as having the lowest discounted cost and lowest disbenefits and the WDC’s decision to proceed on this basis was justified.

WDC made provision in its 2006 LTCCP for $3.56M as its share of the cost of the capital control works on the Awatarariki Stream catchment, which included the debris dam estimated at $3.12 million. Central Government had agreed to fund one third of the estimated capital costs of the works (excluding replacement of the SH2 and ECMT bridges to be funded separately by their Government entities). The estimated costs of works in the Awatarariki Stream catchment had, however, increased from $3.7M in August to $8.262M in December 2005, as a result of increasing the height of the debris dam.

2.4 Design of Awatarariki Catchment Mitigation Works

2.4.1 A critical element of the design of mitigation works was the level of service to be provided. In this case, the level of risk that is selected for mitigation is critical.

Risk is a measure of the probability and severity of an adverse effect (or consequence) arising from a risk event occurring.

Design standards (based on probability[52]) usually have regard for the potential consequences of events. Typical standards are:

- Local stormwater system – 5 to 10 years return period;
- Main stormwater systems – 10 to 50 years return period;
- Flood control – 100 years return period;
- Dams – 500 to 1000 years return period.

It was noted that the design standard adopted for the debris flow at Aoraki Mt Cook was 200 years return period.

2.4.2 BOPRC estimated the rainfall that fell on the catchments behind Matata to be not more than a 500-year recurrence event for the Bay of Plenty but, due to minimal data on such extreme events, the actual recurrence interval could be less than 500 years. The T & T *"Matata Debris Flow – Preliminary and Infrastructure Options Report* (August 2005) assumed the recurrence interval to be between 200 years and 500 years based on BOPRC's analysis and correlated this occurrence interval to the medium event probability that was adopted for debris flow protection to Aoraki Mount Cook Village. GNS estimated the 2005 debris flow volume at 200,000m^3.

GNS had concluded that the probability of a debris flow was once in 35 years, although a repeat of the magnitude of the 2005 event was once in 500 years. GNS stated in its report:

"Once in 35 years is an unacceptably high probability . . ." (Refer 2.2.9).

2.4.3 At its meeting on 10 August 2005 the Council established its policy for the design of the mitigation work by resolving:

"That Council adopts measures that provide a medium level of risk mitigation."

2.4.4 Based on this decision T & T adopted the following objective for the Awatarariki Catchment[53]. The basis of preliminary design parameters was, therefore, based on the May 2005 event:

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[52] Return period (years) or annual exceedance probability (AEP) (%).

[53] "*To protect the community from an event similar to May 2005 (200 to 500 year standard) and enable occupation of the debris fan area for development".*

- Debris volume 250,000m^3 of which 200,000m^3 was to be retained and 50,000m^3 carried to the lagoon[54];
- Approximately 50% of the fanhead available for debris deposition;
- 100 year flood design flow of 44 m^3/s;
- Debris flood design flow of 66 m^3/s.

A LIDAR[55] survey conducted after the May 2005 event[56] estimated the volume of debris and sediment at 350,000 ± 50,000m^3. This was based on the Masters degree thesis *"Slope failures and debris flow assessment at Matata, Bay of Plenty"* prepared by Daniel Costello. This was reviewed by GNS (Dr M McSaveney and Nick Perrin)[57] who considered it a creditable piece of work. Notwithstanding, they concluded:

"
- *The volume of debris from Awatarariki Stream presented in the thesis is inadequately supported by data to support revision of the currently accepted estimate by Tonkin & Taylor based on a comprehensive analysis of LIDAR data, verified by ground survey.*
- *The thesis contains no information requiring a re-evaluation of currently proposed options, and opens no new avenues to alternative options not already considered."*

2.4.5 T & T's engagement was authorised by resolution of the Council on 10 April 2006. This was for *"the provision of engineering consultancy services for the investigation, consenting and design process for projects in the Matata Regeneration Plan"*. (Refer to T & T's Terms of Engagement).

2.4.6 T & T proceed to design a solution in accordance with the Council's resolution (refer 2.3.13). Site investigations had been carried out by T & T in August-October 2006 and summarised in a Dam Concept report.[58] It was noted that there were a number of uncertainties, including permeability, particle size distribution and fault activity. Additional investigation work was recommended.

The basis of the proposed design solution included the following features:

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[54] The debris volume estimates were increased to 330,000m^3 in November 2005.
[55] Light detection and ranging technology.
[56] Bull J M, Miller H, Gravley D M, Costello D, Hikuora DCH and Dix J K (2010); *"Assessing debris flows using LIDAR differencing; 18 May 2005 Matata Event".* Geomorphology 124.
[57] Letter: Dr M McSaveney, GNS (1 August 2007) to Barbara Dempsey, WDC.
[58] Tonkin & Taylor Ltd, (October 2006); *"Proposed Matata Debris and Flood Mitigation Works – Geotechnical Investigation Report".*

- Retention structure to develop the necessary amount of debris storage[59];
- Hydraulic channel for discharge of "normal" stream flows without generation of a lake upstream;
- Provision for fish passage at normal stream flows;
- Spillway system for discharge of flood flows;
- Energy dissipation structure(s) to manage high energy flows from discharge channel and/or spillway;
- A screening system to retain debris while allowing water and smaller sediment to be discharged;
- Access for usual maintenance and for cleaning out debris flowing a "design" event;
- Resistance to static and hydraulic loadings;
- Stability under earthquake loading, including due allowance for potential fault movement;
- Resistance to internal erosion either through the embankment or the foundations and abutments.[60]

The Dam Concept Report identified further stages to be considered:

- Preliminary Design and Options Study,
- Consent Stage Design,
- Detailed Design, Building Consent and Construction.

The report also discussed the need for a risk assessment.

2.4.7 T & T then proceeded towards preliminary design which is the standard progression that occurs in the design development of any engineering project.

2.4.8 An alternative concept appears to have been proposed at a WDC Iwi Liaison Committee Meeting held at Ngati Rangitihi Marae on 28 September 2006. The WDC's then Director of Works & Services (Haydn Read) requested T & T evaluate this proposal.[61]

The proposal was shown in sketches prepared by R G Taylor and consisted of possibly five wire rope barricades strung across the

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[59] Debris storage of 330,000 m^3 was discussed.
[60] Tonkin & Taylor Ltd, (October 2006); *"Matata Regeneration Projects – Awatarariki Debris Dam – Definition of Dam Concept."*
[61] Email: Haydn Read, WDC to Tom Bassett T & T (29 September 2006).

Awatarariki Stream valley, up to 2m above the bed at approximately 30m separation. A buried concrete weir system was also proposed to stabilise the stream bed with an upgraded and reinforced channel downstream. T & T reviewed the suggested alternative and concluded as follows[62]:

"Although the proposed alternative debris control works for the Awatarariki catchment are valid in concept and would be practical for management of smaller events, from our analyses they are not extensive enough in height or in storage capacity to arrest, contain and manage effectively the volume of debris material associated with the design debris flow event.

Also aspects of access, and maintenance requiring replacement of structural elements, are likely to be significant issues requiring more detailed analysis. These aspects would also require ongoing management, with associated costs over the lifetime of the works.

However, given the physical inadequacies in terms of scale, it is recommended that this alternative option is not investigated further."

2.4.9 Since 2006, WDC had been working with a mandated group of representatives from Ngati Awa, Ngati Tuwharetoa (BOP) and Ngati Rangitihi who were preparing a Cultural Impact Assessment (CIA).

In 2006 and 2007 WDC identified its selected option to construct a 17m high debris dam. Iwi agreed that they would not include an assessment of a proposed debris dam structure at Te Awatarariki in the Cultural Impact Assessment[63] they prepared in 2007. Mandated representatives from Ngāti Awa, Tuwharetoa BOP, Ngāti Rangitihi and Te Tino Rangatiratanga o Ngāti Rangitihi Incorporated expressed strong opposition to the proposal to establish a fixed debris dam structure of that height in the location proposed. [64]

The reasons for opposition included:

" • *The potential for such a structure to destroy burial caves in the side of the hill at a height that would be inundated by stored water and flood and debris flows*

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[62] Letter: Tom Bassett, T & T to Haydn Read, WDC (20 October 2006).

[63] Tangata Whenua of Te Awa-o-Te Atua, Cultural Impacts Assessment Of Resource Consent Applications For Matata Township Recovery Works by Whakatane District Council & Others and Te Awa-o-te Atua (Matata Lagoon), Rehabilitation Works by Department of Conservation dated 8 January 2007.

[64] Letter: Beverley Hughes, Environment Ngati Awa, (8 October 2009) to Diane Turner, Chief Executive, WDC.

- *The prohibitive cost of such a structure on a community struck by a natural disaster*
- *The potential alternative solution to require homes in the lower Awatarariki catchment to retreat from the flow path of future debris and flood flows they are vulnerable to."*

Ngati Tuwharetoa (BOP) Settlement Trust expressed similar concern to the debris dam citing the following reasons:

"
- *The visual effect on the landscape of the dam structure;*
- *The potential for debris captured by the dam structure to be of such a height so as to inundate burial caves in the side of the hill;*
- *The effect on the community from a significant increase in rates arising from the cost of such a structure and ongoing costs of maintenance;*
- *An alternative solution to the imposition of a dam structure would be to require homes in the lower Awatarariki catchment to retreat from the fan head and flow path of future debris and flood flows."*[65]

WDC and T & T responded to this strong opposition and considered alternative options to its initial debris dam proposal.

2.4.10 T & T identified a range of potential debris detention structures[66] (DDS) for discussion with WDC and the community in October 2007.

These were:

- Embankment Dam,
- Open grid structure,
- Hybrid structure,
- File structure, and
- Flexible net barriers.

It was concluded by T & T that there were two potential alternative sites for the ring net:

(a) Upstream which would provide for 200,000m^3 (full containment) with 50,000m^3 conveyed to the lagoon, estimated at $3.0M.

(b) Downstream which would provide 90,000 – 130,000m^3 (partial containment) with 50,000 m^3 to the lagoon, estimated cost $3.0M.

[65] Letter: Anthony Olsen, Ngati Tuwharetoa (BOP) Settlement Trust (21 October 2009) to Diane Turner, Chief Executive, WDC.
[66] The Council's resolution referred a "debris dam" and this appears to have been widely interpreted.

Both options would require 13m high nets.

T & T considered that the downstream ring net was a preferred option because of its reduced environmental and archaeological impacts. It was considered to have "comparable" cost.

2.4.11 T & T continued to develop the ring net concept in conjunction with Geobrugg AG, the designers and suppliers of the net.

The proposal to change from a "debris dam" (as approved by Council in November 2005) was presented in a report[67] of 23 July 2008.
In its comparison of capital costs, the report stated:

	Comparative Option	Estimated Capital Cost
Upstream	Embankment Dam with slots	$3.300M
	Flexible net barrier	$3.000M
Downstream	Embankment Dam with slots	$2.650M
	Flexible net barrier	$2.400M

This compared with $3.120M for the debris dam that formed the basis of the Business Case (refer 2.3.15) and, hence it was an attractive option.

The Council received the report and resolved:

"That the Council approves the 'Flexible Net Barrier System as the Debris Detention Structure to be constructed at the downstream location, for the Awatarariki Catchment."

Significantly, this meeting again considered a "do nothing" option. The record of the meeting stated:

"The Director of Works and Services (Haydn Read) advised that . . . the Council had a duty of care under the Local Government Act 2002 to provide a safe place to live and could not abdicate its responsibility to individual home owners. The Director of Works and Services advised that the DBH had agreed that people could re-occupy their homes and rebuild in the Awatarariki Catchment on the understanding that the Council would be pursuing mitigation in the form of an engineering solution that took into account the low probability of risk . . .".

[67] WDC, Barbara Dempsey & Haydn Read, (July 2008); *"Matata Regeneration Project – Debris Detention Structure".*

The Director's statement, as recorded, concerning the Council's statutory obligations, is not an accurate representation of the legal advice WDC received from Brookfields in 2005 (which was necessarily inconclusive as to liability) (refer 2.3.3), and which suggested that action to carry out work in the watercourses was a matter of policy for the Council to decide and that WDC *"should maintain it has no responsibility to do so".*[68]

Similarly, the Statement, as recorded, about DBH's Determination[69] is not accurate because that determination makes no reference to the requirement for WDC to carry out mitigation.

The Director was also reported as saying that the "do nothing" was estimated to cost $14.21M to acquire 57 properties, but did note that WDC did have the option of not doing that.

The meeting received comments from Tom Bassett which were recorded as:

- Maintenance costs for the ring net were not available, but would be lower than "the higher engineered system";
- The steel rings could be easily replaced if needed;
- The manufacturer was confident the rings would have a 100 year life;
- The salt laden atmosphere of the location had been taken into account;
- The environmental impact was less than that of a debris dam;
- Cost would be within the budget approved in 2005.

The report from WDC officers did not contain an analysis of the potential engineering risks of the ring net alternative.

2.4.12 Consultation on the proposed ring net DDS commenced with Ngati Awa in late 2007 who acknowledged that the WDC's decision to change from the fixed debris dam to a proposed 11m ring net would contribute to some extent to the mitigation of issues identified by Ngāti Awa and other iwi.

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[68] Letter: M J Dickey, J M Sheppard & V T Bruton, Brookfields, (13 July 2005) to Diane Turner, Recovery Manager, WDC.
[69] Department of Building and Housing, Determination 2006/119 *"Dangerous Building Notices for Houses in Matata, Bay of Plenty"*.

Ngati Awa remained concerned with the potential effects of the ring net on historic pa sites on both banks likely to be affected by the anchorages, but were willing to explore this further. They were, however, concerned with the capacity of the ground to provide sufficient restraint.[70]

Ngati Rangitihi Raupatu Trust expressed concern about potential effect on sites of *"historical, spiritual and religious significance to Ngati Tionga"* noting that the proposed anchorage for the ring net would *"desecrate the first level of our historic Whakapaukorero Pa"* regarded as a waahi tapu.

Mere Butler referred to the waahi tapu site of the Battle of Te Kaokaoroa and the likelihood of an ancient burial ground containing koiwi.

It is clear that the construction of a DDS (whether a fixed debris dam or a flexible ring net structure) above the escarpment will be met with strong opposition from tangata whenua because of potential desecration of waahi tapu sites. While tangata whenua will be concerned, as members of the community, with the current uncertainty surrounding a firm course of action and the potential costs, the cultural objections are significant and appear to be well founded.

2.4.13 Detailed design was commenced by T & T in July 2010 and application made by WDC for resource consents. The design was peer reviewed and a number of concerns were raised regarding the potential effectiveness of the spillway and increased complexity of the fanhead earthworks. In early 2011, T & T looked at deleting the spillway and provide greater containment with a retained debris height of 14m with a net height of 17m. This removed the requirement for both the spillway and fanhead earthworks although it required a significant increase in the volume of debris to be retained. Under this proposal to factor of safety of freeboard was reduced. The estimated cost of the ring net and anchorages was revised to $3.810M.

2.4.14 In August 2011 Geobrugg provided WDC with an updated estimate of the ring net costs. The WDC Project Manager expressed concern about the costs which were now in excess of the original budget.

2.4.15 In January 2012 T & T expressed its concerns to WDC's Chief Executive about the ring net proposal which was estimated to have a maximum design life of 50 years and more expensive than originally

[70] Email: Beverly Hughes, Environment Ngati Awa, (22 May 2012) to Alan Bickers.

envisaged. The poor ground conditions and increase in the anchorage loads to provide full containment and a factor of safety (given there was to be no freeboard under the design load) had resulted in a substantial increase in costs. The estimated DDS costs were now estimated at $5 - 6 million.[71] T & T recommended to WDC in March 2012 that the project be comprehensively reviewed

2.5 Significant Events

2.5.1 The chronology of events and decisions which has been described so far, contains several significant events that have led WDC to the position in which it now finds itself.

(a) Decisions taken in late 2005 not to adopt the option of "retreating" from the hazard zone of the Awatarariki Stream fanhead was, in part, based on the assumption that WDC was obliged to compensate affected landowners at full value and led to the adoption of a policy of constructing debris flow control upstream of the catchment.

(b) The selection of a 17m high debris dam to contain 250,000 m^3 which was unacceptable to the community and, in particular the tangata whenua. This was identified in late 2007.

(c) The selection of a new option being a ring net in July 2008 to provide for partial containment of 100,000m^3 with the balance of the design flow being directed over a spillway and through the SH2 underpass onto the western portion of the fanhead.

As a result of the peer review process, this option was replaced by a full containment ring net (250,000m^3) in early 2011.

(d) T & T expressed concerns about the design life, cost and difficulty of providing anchorage of the ring net in early 2012 and the lack of resolution of some engineering design issues and recommended a complete review of the project.

2.6 Estimated Costs of the Project

2.6.1 The Project for remediation works in the Awatarariki Stream Catchment was defined by the Business Case submitted to Government for

[71] Compared with $3.120 million in December 2008.

financial assistance. This also led to WDC's budgetary provision in its long-term council community plan (LTCCP).

2.6.2 In relation to the proposed debris dam, the estimated cost provided in the Business Case was $3.120M (refer 2.3.15) which was inclusive of professional fees, contingency and risk allowance and contractor's P & G allowance.

2.6.3 With the progressive iterations of design, T & T updated the estimated cost of the DDS, particularly when changed to the ring net. These changes are summarised below:

(a)	May 2008 – Partial containment ring net (Includes Spillway costs)	$2.400M[72]
(b)	July 2009 – Partial containment ring net costs revised. (Includes spillway costs)	$2.789M
(c)	December 2011 – Partial containment ring net. (Includes spillway costs)	$3.800M
(d)	December 2011 – Full containment ring net	$5.800M

The above estimates cover the ring net and anchorages and, where shown, the spillway and fanhead earthworks, but exclude professional fees and other allowances, consequently it can be seen that from December 2005 until March 2012, the estimated cost associated with the DDS had doubled. This is referred to in T & T's letter to WDC of 16 March 2012.

T & T has been reliant on Geobrugg both for the design of the ring net, assessment of the anchorage loads to be resisted and the preparation of estimated costs of constructing the ring net. Geobrugg was accountable to T & T but the matter of Geobrugg's design accountability was not clarified by WDC. This is referred to later.

[72] The ring net and anchorages was estimated at $2.1M and the spillway works at $300,000.

3. PROJECT REVIEW

3.1 Project Governance & Management

3.1.1. Historically, significant Whakatane District Council projects, both capital and otherwise, have been managed through a project team structure and governed through either the Strategic Leadership Team (SLT) or through a standing committee of Council.

The project team prior to 2005 was managed either by the respective manager overseeing the area of business the project related to or another internal manager with the capability of doing so. In some instances, where deemed necessary, an external project manager would be contracted in for the role.

While attempts have been made to introduce business case templates and disciplines around project planning and reporting to assist decision making, standard practices do not exist uniformly across the Council today and formal templates are very limited. This was also the case at the time the decision was made to proceed with the Debris Detention Structure. Council's decision to proceed with the project was based on a series of internal and external reports.

Management of the project was led by Tom Bassett of T & T and later by the WDC's Recovery Manager that originally started as part of the recovery phase following the event in 2005. It became a permanent role appointed by the Council in late 2005 to manage the suite of projects proposed for Matata. The Manager then contracted services to receive advice on engineering solutions and other technical information. The role reported directly to the Chief Executive, with regular update reporting to the Council.

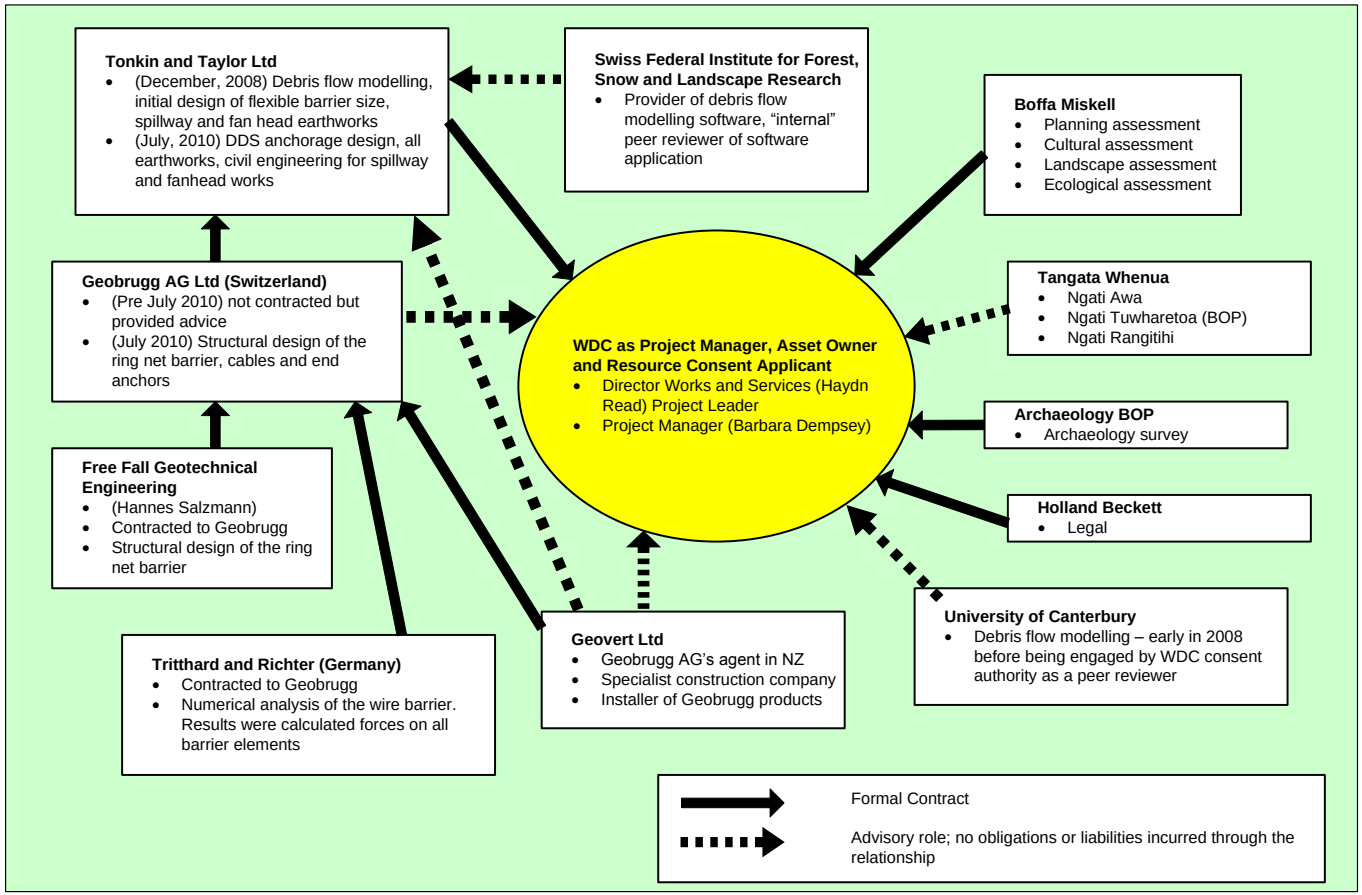
The establishment of a Council Projects Team occurred around 2007. This consisted of the Project Manager and several staff with an engineering background. The team reported to the Director of Works and Services. The Project Team was responsible for the leadership and project management of all major capital projects within Council. The project team would, in some cases, report to a steering group which would invariably be the Strategic Leadership Team, although this did not occur with the Matata suite of projects. It would also, as a matter of course, report progress to Council. Reporting to the Council however would not necessarily be against a set of strict criteria and would generally take the form of an update.

A policy in respect of project governance does not exist within Council and there does not appear to be any assessment criteria or financial

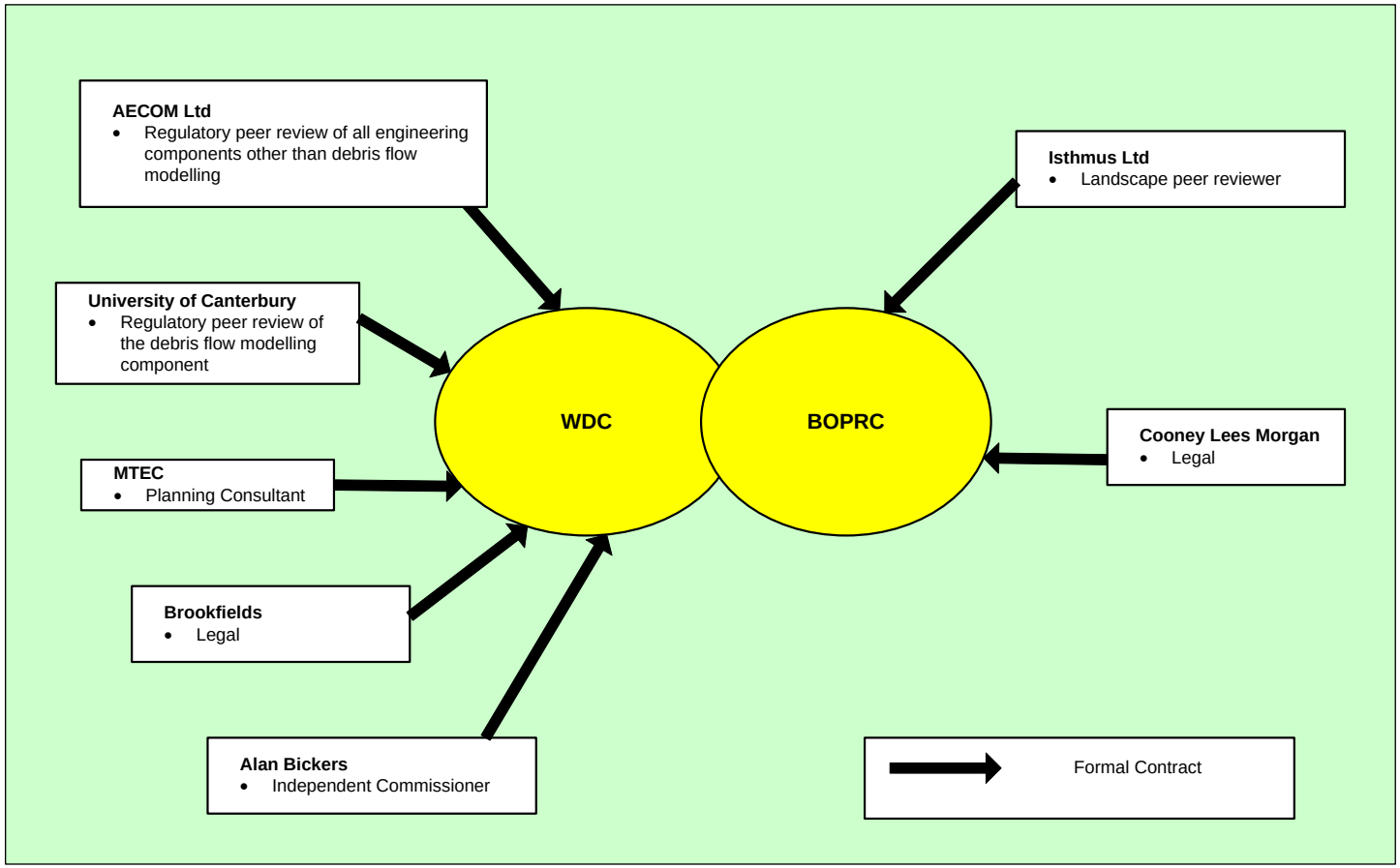
threshold to trigger the consideration of introducing a project governance layer. It is not uncommon for other local authorities to have such a threshold at which point Council will select and mandate a governance body made up of elected members and senior staff to provide a project governance role.[73]

[73] Source: Marty Grenfell, Chief Executive WDC.

3.1.2 The Project Management structure is shown in the following diagram:



AWATARARIKI DEBRIS DETENTION BARRIER PROJECT STRUCTURE



AWATARARIKI DEBRIS DETENTION BARRIER CONSENT AUTHORITY PROJECT STRUCTURE

For the project development, WDC had a contractual relationship with T & T.[74]

The various works undertaken by T&T on the Matata DDS has been covered by Letters of Engagement (LOE) prepared by T&T and signed by WDC:

- The design of the flexible barrier was initially undertaken in accordance with an LOE dated 18 December 2008. This covered the various design tasks required to determine the size of the barrier, configuration of the spillway/fan head earthworks and to supply design information required for the resource consent application.
- Detailed design of the fan head earthworks, barrier and anchors was covered by an LOE dated 1 July 2010 (signed by WDC on 1 October 2010). The scope also included the preparation of drawings and specifications. The design of the barrier structure was assigned to Geobrugg, whereas T&T was responsible for the DDS anchor design as well as all earthworks and civil engineering requirements for the spillway and fanhead works.
- Geobrugg (Geobrugg AG, Geobrugg NZ or Geovert) was not contracted to any party prior to late October 2010. Prior to this time, Geobrugg had provided a number of formal proposals and cost estimates directly to WDC, as well as participating in workshops and site visits at their expense. There was some debate as to whether Geobrugg would undertake detailed barrier design directly for WDC or through T&T. In the event, Geovert was contracted to provide the design services directly to T&T.
- Geobrugg AG of Switzerland has undertaken the structural design of the barrier. T&T provided the design flow velocity of the initial debris flow surge (based on discussions with Tim Davies), Geobrugg then developed the design loading sequence and calculated the impact and static barrier loads. The mathematics behind these calculations is based on research published by WSL in Switzerland (see below).
- Geobrugg gave the design loads they calculated to Tritthard and Richter of Radolfzell, Germany, who performed 3D numerical analysis of the wire barrier using the software EASY. The results were the calculation of forces on all structural elements of the barrier (rings, support cables etc).

[74] Letter: Kevin Hind, T & T (1 May 2012) to Jeff Farrell, WDC.

This analysis provided the magnitude and orientation of the loads at the ends of the support cables i.e. anchoring loads.

- Geobrugg NZ/Geovert has acted as Geobrugg AG's agent in New Zealand but have not fulfilled any technical role. All technical work (other than that completed by Tritthard + Richter) has been undertaken by Dr Hannes Salzmann who represents Geobrugg AG. Dr Salzmann has his own company (Free Fall Geotechnical Engineering). T&T is not familiar with the contractual arrangement that Dr Salzmann or Free Fall has with Geobrugg AG.

WSL is the Swiss Federal Institute for Snow and Avalanche Research (Wald, Schnee und Landschaft). WSL has a "Mass Movements" research unit headed by Dr Brian McArdell. They undertake research not only into the physical processes of debris flows but work closely with practitioners such as Geobrugg in the application of new technologies and guidelines regarding debris flow hazard analysis and defensive measures. WSL has developed a numerical model for debris flows called RAMMS[75].

WSL has not had a formal role in the Matata DDS project. WSL provided a copy of RAMMS software to T & T and provided free training in its use. Dr McArdell reviewed the RAMMS modelling undertaken by T&T and provided a letter stating that the modelling was undertaken in accordance with best practice. WSL had no obligations or liabilities with regards to the DDS project.

A meeting was held at T & T offices in Auckland involving personnel for T & T, WDC (Haydn Read and Jeff Farrell) and the peer reviewers on 9 August 2010, where it was clarified that Geobrugg had responsibility for net design and T & T for the anchorages, based on information to be provided by Geobrugg and Tritthard and Richter. There was discussion about who accountable for overall design of the project.

While the right question was asked, the separated responsibilities of T & T and Geobrugg was not sufficiently clarified. It is clear that WDC only had a contract with T & T. It has not contract with Geobrugg, Geovert, Tritthard and Richter. Hence, in the event of any claim in contract, WDC could only take action against T & T. It may have been possible for WDC to claim in tort against T & T's secondary consultants.

[75] Rapid Mass Movements – a modelling system for snow avalanches, debris flows and rock falls.

Geobrugg's input was a critical element of the Project because it was providing –

- Design of the ring net,
- Assessment of the anchorage loads required, and
- The estimated costs for constructing the ring net.

T & T and, in turn, were heavily reliant on Geobrugg's input and more emphasis should have been placed on defining their accountability.

3.1.3 WDC engaged T & T for various stages of this Project using letters of Engagement (LOEs):

(a) 8 June 2006 – Geotechnical investigation and engineering assessment covering Ohinekoao Stream, Waiorea Stream, Waitepuru Stream and Awatarariki Stream.

In relation to Awatarariki, T & T's proposal said that the *"information from the site investigations will enable us to evaluate foundation design parameters for proposed structure . . ."*. The LOE did refer to 3 stages of work for Awatarariki, including additional drilling for the preferred dam site.

The Council had authorised T & T's engagement by resolution on 10 April 2006. (Refer 2.4.5).

(b) 18 December 2008 – Detailed design and preparation of associated documentation (reports, drawings, specifications) for the Awatarariki DDS.

This proposal referred to the input of Geovert/Geobrugg and the Swiss Federal Institute for Snow and Avalanche Research. It stated that *"Geobrugg, the specialist flexible net supplier, will be involved in the design process so that key elements of the barrier design are considered and incorporated throughout the design, rather than only at the end".*

On 23 April 2009, T & T advised WDC that costs of this phase had increased by $17,410 as a result of additional work carried out.

(c) 1 July 2010 – Completion of detailed design and contract documentation. In relation to the DDS, it noted the allocation of the design responsibilities for the ring net structure:

- Assessment of loads and force vectors on the anchor blocks (Geobrugg),

- Detailed design of the anchors and anchor blocks, including global stability assessment (T & T),
- Detailed design of the main suspension cable, connections and net elements (Geobrugg),
- Production of construction drawings, specifications and quantities (as above).

The proposal noted that *"for the barrier design, the design of the anchor block forces will be a primary driver of the design programme"*.

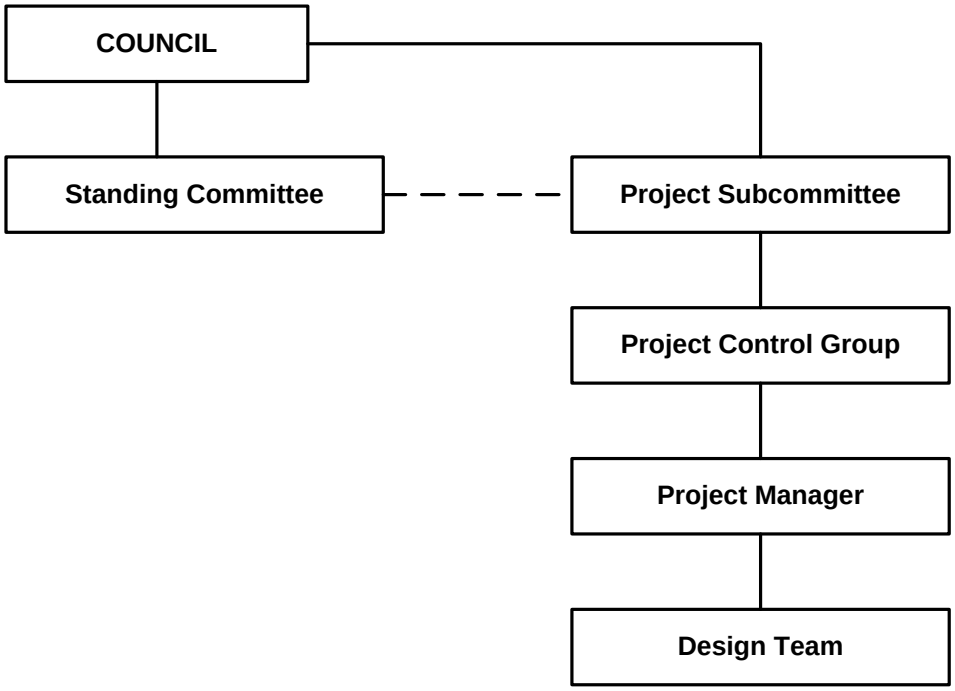
T & T's proposals referred to the IPENZ *"Short Form Model Conditions of Engagement (Commercial)"*. All work was proposed to be carried out on a time and expenses basis and T & T provided estimates of the cost. It would be usual for such arrangements that there also be a schedule of time-based rates for all the personnel who would be involved, but that was not included in any of the T & T's LOEs.

3.1.4 Major capital projects undertaken by a local authority are most effectively governed and managed by specific governance and management arrangements, so as to provide a greater level of oversight than is available for normal capital works. This is particularly important where the project development and implementation may extend over several years. It is also beneficial when specific project management arrangements have been necessary beyond those used for normal capital works. These specific arrangements are similarly beneficial for major projects utilising the input of external professional consultants.

Generally speaking, the Council should establish –

- A subcommittee of the Council as the primary body having governance oversight, and
- A Project Control Group (PCG) of senior counsel officers and consultants providing oversight of the Project Management.

Such an arrangement would be as follows:



TYPICAL GOVERNANCE/MANAGEMENT FOR SIGNIFICANT PROJECT

The resolution establishing the Project Subcommittee should set out its delegations and limitations, particularly where delegated authority is intended to exceed that of the Chief Executive. (Refer later).

3.1.5 WDC has utilised a standard template as the basis of reporting at a quarterly interval. That is an appropriate frequency whether or not there is a Project Subcommittee in place. The content of the template is quite useful.

It is important that these forms of project progress reports refer back to the parameters of the approved business case.

One area that could be improved is the risk management section which should again refer to the business case matters.

It is recommended that the template be reviewed and, in particular, the financial reporting.

The financial reporting must correspond to the line items set out in the approved business case which may require that the chart of accounts for expenditure allocation and accounting must be configured appropriately.

3.1.6 WDC does not have a standard template for a business case for major capital projects. The template used for the Matata Business Case was recommended by the Ministry of Civil Defence and Emergency Management. It was designed for applications for Government funding assistance toward disaster recovery and mitigation.

Such a business case template is not necessarily appropriate for routine use by local authorities, especially in relation to the range of their capital projects.

It is recommended that for future significant capital works a policy be developed requiring the approval of a business case and its content.

The scope of suggested content is included as Appendix G.

3.2 Development of Design Solution

3.2.1 The staged approach of T & T towards the implementation of this Project conforms to standard practice used by the Engineering Profession. A project is developed through stages which become progressively focussed. At each major stage there is usually a review of the Project risks and refinement of the cost estimates. It is usual to have a significant provision for contingency and risk in the early stages (25% as T & T allowed) and progressively reduce that to a minimum of 10% as the uncertainties are resolved and the risks eliminated.

3.2.2 The various stages, with their corresponding estimates, are as follows:

	Stage	Estimate Type
1.	Preliminary feasibility Study – identifying range of possible options	Preliminary assessment of possible cost – very broad brush
2.	Feasibility Study – reduced number of options	Assessment of possible cost – refined
3.	Preliminary design-selected option following site surveys and investigations used to develop business case	Preliminary estimate – using composite cost rates e.g. area
4.	Developed design – usually following full site investigation and used as the basis for any resource consent application	Revised preliminary estimate – may be based on estimated quantities
5.	Detailed design – used for preparation of contract documents and construction (including building consent)	Detailed estimate – based on schedule of quantities. (An estimate for comparison with tenders is a derivative of this).

It is important to ensure that at all stages of estimating, provision is made for "excluded items":

- Contingency and risk;
- Professional fees;
- Land purchase;
- Resource and building consents;
- Legal costs;
- Interest; and
- Escalation.

It is clear that T & T identified which of these items had been included or excluded from their project estimates. Some of the excluded items were included by WDC staff, but not all e.g. escalation. In some cases, the monetary allowance was insufficient.

3.2.3 In relation to the Awatarariki DDS, T & T adopted the standard approach to project development. The issues that have contributed to the current unsatisfactory situation can be identified as follows:

(a) Except for alpine areas, debris flows are not common in New Zealand and there is very little experience with designing and implementing solutions to mitigate these. T & T did considerable research and had regard for the recommendations of GNS.

(b) The selected design solution of a debris dam was unacceptable to tangata whenua and the wider community. It was unfortunate that tangata whenua input had not been obtained at an early stage which may have ruled out the debris dam option at the Feasibility Study stage.

(c) The ring net option was a technology that was new to New Zealand. Although widely used in Europe and Japan, the overall size of ring net was unprecedented. T & T was reliant on input from Geobrugg and others over many important aspects of the design. In particular, T & T had to accept Geobrugg's assessment of the anchorage loads to be restrained.

(d) The partial containment ring net was reliant on the operation of the spillway and there was considerable concern about that.

(e) The poor ground conditions were unable to provide the anchorage restraint required for the full containment ring net allowing for the removal of freeboard and consequent need to increase the anchorages' factor of safety in an acceptable manner. This in turn affect the overall project cost. Perhaps the issues with the anchorages could have been identified earlier but T & T were

reliant on others for the calculation of the net loads to be anchored and budgetary constraints on the scope of geotechnical investigations.

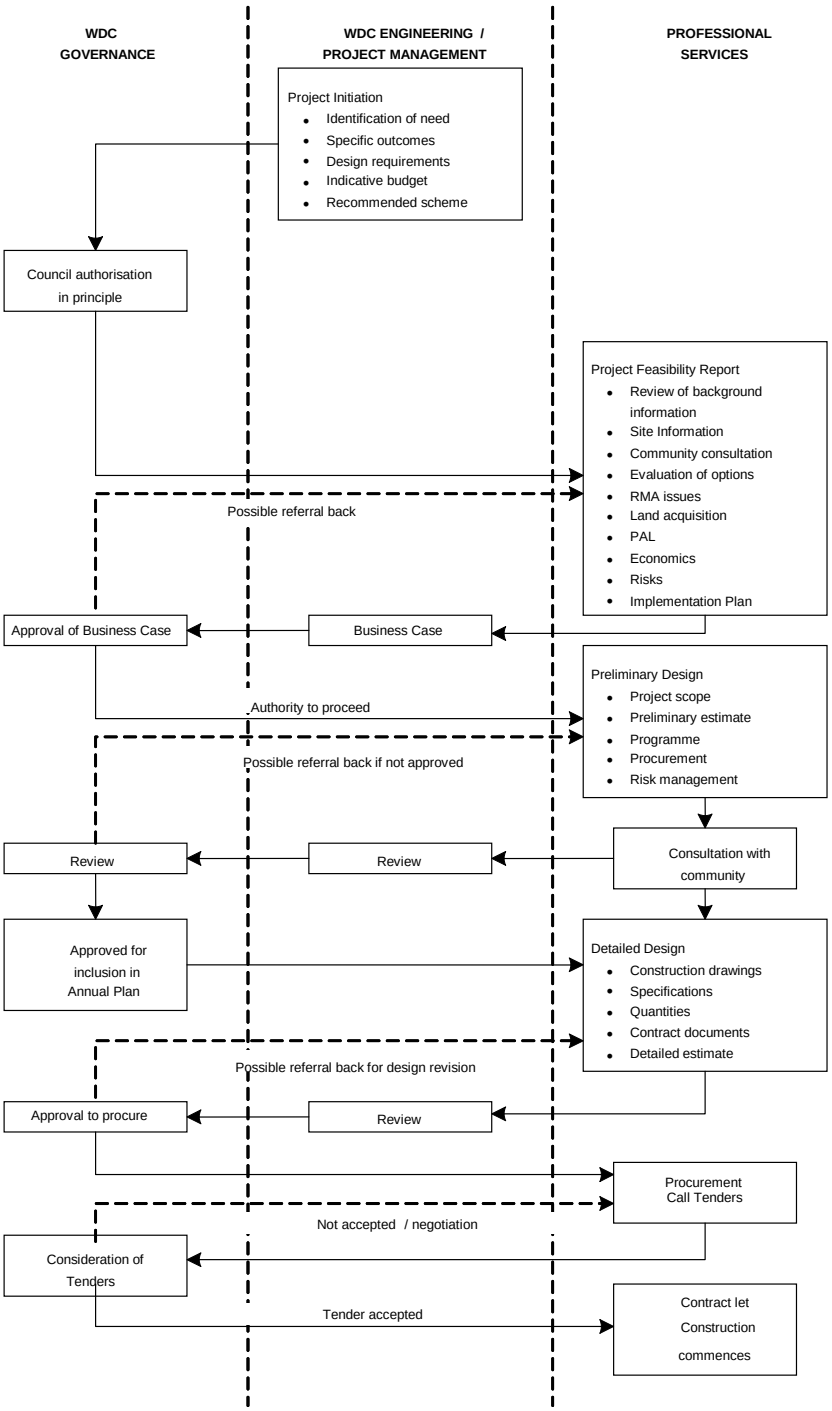
3.2.4 It has been noted that one element that has been missing from the project design and development has been an engineering risk management of the Project's implementation. T & T did provide a qualitative risk assessment in their 2008 report[76] which referred to potential risks including:

- Poor foundations;
- Abutments;
- Archaeological sites;
- Construction issues.

It is not clear the extent to which WDC and the designers sought to mange and/or mitigate these risks which, with the benefit of hindsight, were critical in the development of the design solution. Had there been effective risk management it may have resulted in the Project being reviewed at an earlier stage.

3.2.5 Based on this review it would seem that the adoption of a formalised standard approach to project development and implementation would be of benefit to WDC. It is recommended that WDC consider the following process:

[76] Tonkin & Taylor, (August 2008); *"Matata Regeneration Project – Awatarariki Stream Debris Detention"*.



RECOMMENDED PROCESS FOR PROJECT DEVELOPMENT

3.3 Funding and Financial Management

3.3.1 The Business Case to the Government for financial assistance was based on estimated capital expenditure of $5.262M for the Awatarariki catchment. Of this total Government was asked to fund one third viz $1.754M (refer 2.2.14)[77] plus $200,000 for project management.

Government grants via the Department of Internal Affairs (DIA) were for a total of $2.890M.[78]

3.3.2 As at 30 April 2012, expenditure[79] on the Awatarariki Catchment was:

Item	Business Case Estimate 2005	Actual Expenditure to 30 June 2011
Upgrade Awatarariki Stream channel	300,000	
Lagoon Floodway	470,000	
Lagoon Deposition Area	550,000	
Clem Elliot Drive drainage swale	50,000	
Subtotal for Stream works	$1,327,000	$2,773,682[80]
Debris detention structure	3,120,000	813,913
Resource consent stream works		477,260
Resource consent DDS	100,000[81]	88,782
Property acquisition	672,000	587,067
TOTALS	$5,262,000	$4,740,674

It is noted that in responding to a request for information under the Local Government Official Information & Meetings Act (LGOIMA) WDC's Chief Executive stated that expenditure on Awatarariki Catchment was $4,814,013.[82] Which included expenditure incurred during 2011/12 of $73,339 not shown in the table above.

3.3.3 These figures suggest that WDC has expended to date 91.5% of the Awatarariki catchment project budget. It has yet to construct one of the key elements of the project, viz. the DDS, which T & T has now

[77] An email from WDC, (14 December 2005), referred to an all up estimate of $6.662M of included works on the 2 bridges to be funded by Transit and Ontrack.
[78] Comprising $1.756M for Awatarariki and $1.134M for Waitepuru Catchments.
[79] The input of Sandy Lawrie in researching and preparing this analysis is acknowledged.
[80] Gross cost of stream works partly funded by granting $200,000 from DOC.
[81] Combined amount for both the stream works and the DDS.
[82] Letter: Marty Grenfell, Chief Executive, WDC, (8 May 2012) to Neville Harris, Sustainable Matata Inc.

indicated is estimated at $5 - 6M for the full containment ring net.[83] This would result in the final costs for the Awatarariki Catchment project likely to exceed $11M. This cost element will have a significant impact on the final costs of the Project if it proceeds.

3.3.4 The financial analysis suggests very significant over-expenditure on the stream works (162% compared with approved budget) and significant expenditure on the DDS (20%). This latter sum presumably comprises professional fees for the DDS which T & T estimated at 20% of the base capital cost, so expenditure of this item is currently at the budget estimate while the Project is still incomplete.

Budgetary provision for resource consent allocations was significantly underbudgeted being 560% of the nominal $100,000 allowed.

3.3.5 It is clear that the financial management exercised by WDC's Project Team has been less than satisfactory. The situation has been substantially contributed to by the lack of project risk management. There are, in addition, elements of total project cost which were not adequately provided for in the Business Case:

- Escalation (from 2006);
- Resource and building consents (a nominal allowance of $100,000 was included);
- Legal costs and expenses;
- Project management by WDC (some provision was made but appears to have been inadequate.

Submitters (refer Appendix F) have expressed concern at the poor financial management of the project, particularly because the DDS has not been constructed. This is a legitimate criticism.

3.3.6 For better financial management of projects, WDC should ensure that its chart of accounts correspond directly in the future to the major line items of the approved business case.

3.4 Contractual and Other Obligations

3.4.1 WDC has a contractual relationship with T & T for the provision of professional services. (Refer 3.1.3).

[83] Letter, K Hind, T & T (16 March 2012) to Paula Chapman WDC.

T & T contracted Geobrugg (and Geovert, their New Zealand agent) to provide design services to T & T.

The terms of T & T's engagement are based on a series of LOE (refer 18 December 2008) which incorporate the (IPENZ/ACENZ) *"Short Form Conditions of Engagement (Commercial)"* which provides:

"14. The Client may suspend all or part of the services by notice to the Consultant who shall immediately make arrangements to stop the services and minimise further expenditure. The Client and the Consultant may (in the event the other Party is in material default) terminate the Agreement by notice to the other Party. Suspension or termination shall not prejudice or affect the accrued rights or claims and liabilities of the Parties."

Consequently, WDC can suspend or terminate T & T's engagement by giving notice. It would appear that WDC does not have any contractual obligations to Geobrugg or any other party. T & T's engagement was on a "time and expense basis" and consequently outstanding professional fees payable to T & T would need to be calculated in accordance with that, even though the LOE's did not contain a schedule of time-based rates for the individual personnel which will by now be well established.

3.5 The Possible Way Forward

3.5.1 The original preferred solution to controlling future debris flows from the Awatarariki Catchment was to construct a debris dam above the escarpment. This concept was abandoned as a result of community concerns about such a structure, particularly from the Tangata Whenua because of potential adverse effects on cultural heritage sites.

The next iteration of the design concept was a debris control net. Two options were examined – upstream location and a downstream location. Again, there were design iterations from partial containment (100,000 m^3) to full containment (250,000m^3).

These debris detention proposals were to be complemented by works on the fanhead, some of which have been constructed and commissioned.

T & T has advised WDC that –

"It has become increasingly evident that the engineering and financial resources required to achieve a meaningful degree of risk reduction are well beyond those originally envisaged."[84]

Specifically, T & T has drawn attention to the anchorage requirements required for the debris nets, particularly the full containment option. Because of poor ground conditions and the loads on the ring net needing to be anchored, the size of anchorage required is much greater than originally envisaged with commensurate increased construction costs resulting in the costs of the DDS estimated at $5 - 6M compared with the original estimate of $2.1M of May 2008 for the ring net and anchorages.

The Chief Executive of WDC commissioned CPG to conduct a review of the Project. They noted in their report (inter alia):

" . . . there are inherent risks incurred in adopting a design solution that has not been physically proven by field application with comparable loads and external conditions.

. . . It is CPG's view that there is no currently financially viable proposal which adequately mitigates risk to people and property and resolves the cultural environmental concerns over a 120 year design life."

(Refer 1.3.7).

A peer review commissioned by WDC and carried out by AECOM[85], with input from Professor Tim Davies, raised concerns about the unprecedented scale of the debris net proposed, the useable life of the structure in the coastal marine environment, anchorage design issues and ongoing maintenance requirements.

Discussions with T & T during the course of this review have confirmed that they lack confidence that the debris net can be constructed because of the technical issues identified and, even if it can, the financial implications of constructing and maintaining such a structure are now much more significant than originally envisaged.

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[84] Letter: Kevin Hind and Doug Johnson, T & T to Paula Chapman, WDC (16 March 2012).
[85] AECOM, (25 February 2011); *"Awatarariki Stream Debris Flow Control System – Peer Review of Resource Consent Application Technical Approval"*.

On the basis of information considered in the course of this review, it is recommended that WDC take no further action to implement the current design solution for debris detention (full containment debris net).
The consequences of this recommendation are discussed in Section 4 of this Report.

4. CONSEQUENCES OF ABANDONMENT

4.1 Legal and Insurance Implications

4.1.1 WDC has sought specific legal advice which is private and confidential to it and cannot, therefore, be disclosed in this review.

WDC should give that advice careful consideration in conjunction with this review.

The following sections outline the issues that WDC must consider if it decides to abandon the current design proposal to construct a DDS upstream of the escarpment.

4.1.2 It is clear from the record that WDC was committed to construct a DDS upstream of the escarpment (refer 2.3.13). it is also clear from the record that it gave consideration to the possibility of "retreat" and the legal, financial and planning implications of that possibility had it decided to adopt such a policy.

Having made the decision to provide mitigation upstream of the escarpment, various other parties may have relied on that policy to make their decisions, specifically:

- Land owners;
- Insurers and the Earthquake Commission;
- Transit (now NZTA);
- Ontrack (now Tranzrail);
- BOPRC.

4.1.3 It is noted that WDC advised the Insurance Council of its intentions regarding the Awatarariki Stream mitigation works in 2007 which stated:

> **"*Awatarariki Debris Detention Structure***
>
> *Preliminary designs for the various configurations have been prepared...designs and technical information are currently being finalise and ot is anticipated that a public meeting will be held early to mid October 2007.*
>
> *Construction is not expected to commence before the 2008/2009 construction season".*[86]

[86] Letter: Diane Turner, Chief Executive, WDC (18 September 2007) to John Lucas, Insurance Manager, Insurance Council of NZ.

It is evident that the insurers had regard for this advice and queried the lack of progress in 2009:

> *"The insurance Council has concerns that the insurability of Matata could become a problem if planned protection works are not completed in the short term".*[87]

4.2 Implications for Resource Consents

4.2.1 The following resource consents were issued subject to decisions made by the Environment Court:

(a) **Consent No. 63741** for removal of temporary culverts and construction of a rail bridge over the bed of Awatarariki Stream (and associated works) built in 2006 under the emergency powers of S.330 of the RMA retrospective consent granted by BOPRC and confirmed by the Environment Court on 15 October 2008.

(b) **Consent No. 64474** for excavation and deposition earthworks within the Western Matata Lagoon (Awa-o-te-Atua Lagoon) involving reshaping of the lagoon to provide for sediment retention *inter alia*, excavation of Awatarariki Stream and associated earthworks to increase the channel capacity, armouring the banks of the Awatarariki Stream to prevent erosion, damming and diversion of water associated with the excavation and removal of sediment and debris from Clem Elliot Drive and construction of a drainage swale at Clem Elliot Drive to provide drainage from low lying areas into the western Matata Lagoon. This consent was confirmed by the Environment Court on 23 July 2009. This work has been completed.

(c) **Consent No. 64965** for ongoing use of in-stream structures and erosion protection works associated with the stabilisation of the Awatarariki Stream and restoration of the Awa-o-te-Atua Lagoon, authorise the damming and diversion of waterflow from the Awatarariki Stream through the Awa-o-te-Atua Lagoon, authorise and set conditions for ongoing maintenance including removal of sediment basins and wetland enhancement work. This consent was also confirmed by the Environment Court on 23 July 2009.

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[87] Letter: John Lucas, Insurance Manager, Insurance Council of NZ (24 April 2009) to Diane Turner, Chief Executive, WDC.

(d) **Consent No 64647** for the deposition of earth and debris material within the area of the Far Western Matata Lagoon (Railway Lagoon) and the stabilisation to prevent surface erosion problems, temporary discharge to treated sediment-contaminated stormwater from the proposed earthworks, and landscaping following completion. This consent was also confirmed by the Environment Court on 23 July 2009.

The relevant resource consents to be considered for the purposes of this review are those referred to as (b) and (c) above. Consent (b) refers to works on the Awatarariki Stream and lagoon which has been completed and (c) permits maintenance works.

4.2.2 The Environment Court concluded that the construction of a debris dam is not a relevant consideration in respect of these consents. The Court said:

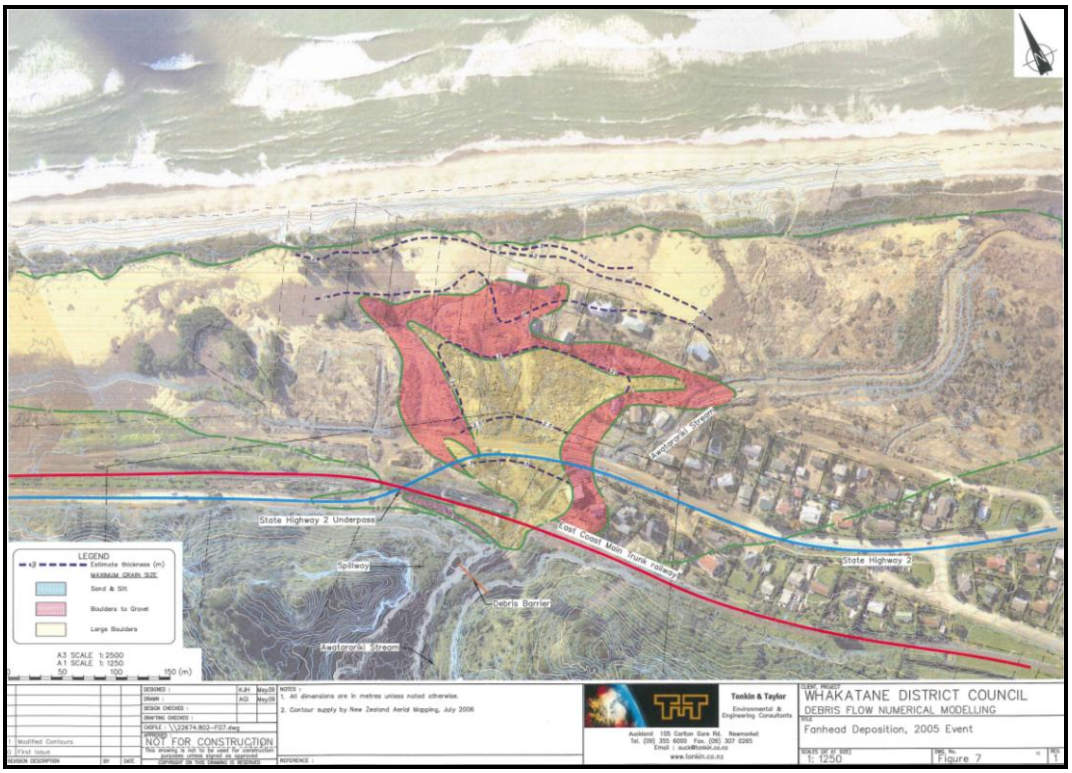
"We need to make it very clear however that the works the subject of these appeals do not seek to avoid or prevent a repetition of the 2005 debris flow events or their impact. Accordingly, as many witnesses pointed out, a repeat of the 2005 event would overwhelm and obviate any benefits from these works."

In the event that a DDS is not constructed upstream of the escarpment, it would appear on the basis of the Environment Court's decisions that there would be no consequential impact on the resource consents that have already been granted.

In relation to the resource consent for the replacement of the ECMT railway bridge, the question of whether the bridge was designed in the expectation of a DDS being built may not be relevant. It would appear that they were built, under the emergency provisions of the RMA, but Ontrack consulted with WDC on the preferred structural option.

4.3 Planning Framework Implications

4.3.1 If the DDS is not built upstream of the escarpment, then there is a significant area that may be subject to risk of inundation in the event of a major flood event and debris flow.



POSSIBLE AREA OF FUTURE DEBRIS UNMITIGATED FLOWS (Based on observation of 2005)

4.3.2 If this situation remains WDC must consider the implications of the RMA and BA.

S.106 of the RMA provides:

> ***"106 Consent authority may refuse subdivision consent in certain circumstances***
> *(1) A consent authority may refuse to grant a subdivision consent, or may grant a subdivision consent subject to conditions, if it considers that–*
> *(a) the land in respect of which a consent is sought, or any structure on the land, is or is likely to be subject to material damage by erosion, falling debris, subsidence, slippage, or inundation from any source; or*
> *(b) any subsequent use that is likely to be made of the land is likely to accelerate, worsen, or result in material damage to the land, other land, or structure by erosion, falling debris, subsidence, slippage, or inundation from any source; or*
> *(c) sufficient provision has not been made for legal and physical access to each allotment to be created by the subdivision.*
> *(2) Conditions under subsection (1) must be–*
> *(a) for the purposes of avoiding, remedying, or mitigating the effects referred to in subsection (1); and*
> *(b) of a type that could be imposed under section 108."*

S.71 of the BA provides:

*"**71 Building on land subject to natural hazards***

(1) A building consent authority must refuse to grant a building consent for construction of a building, or major alterations to a building, if–

(a) the land on which the building work is to be carried out is subject or is likely to be subject to 1 or more natural hazards; or

(b) the building work is likely to accelerate, worsen, or result in a natural hazard on that land or any other property.

(2) Subsection (1) does not apply if the building consent authority is satisfied that adequate provision has been or will be made to–

(a) protect the land, building work, or other property referred to in that subsection from the natural hazard or hazards; or

(b) restore any damage to that land or other property as a result of the building work.

*(3) In this section and sections 72 to 74, **natural hazard** means any of the following:*

(a) erosion (including coastal erosion, bank erosion, and sheet erosion):

(b) falling debris (including soil, rock, snow, and ice):

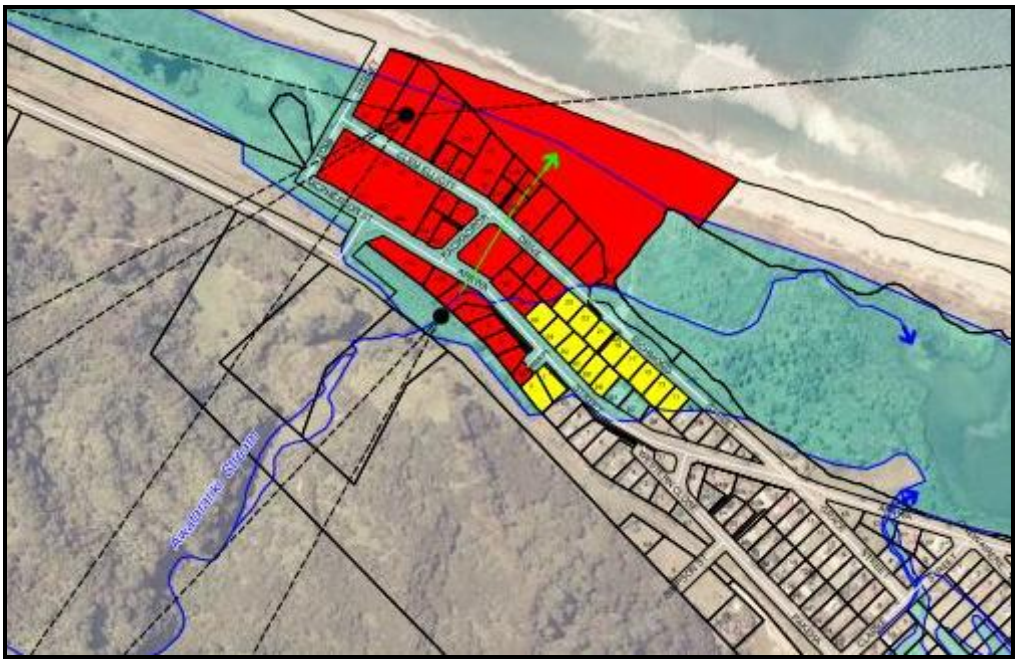
(c) subsidence:

(d) inundation (including flooding, overland flow, storm surge, tidal effects, and ponding):

(e) slippage."

These statutory provisions were drawn to the attention of WDC, and it was advised that future development of land likely to be affected by debris flows would be subject to consideration of these provisions, and may not be permitted.

4.3.3 The Operative Whakatane District Plan contains various controls in relation to development of land, likely to be subject to inundation. If a DDS is not built it would be appropriate and probably essential for WDC having regard to the statutory provisions to implement a Plan Change to create a form of "hazard zone" to the west of Matata of land at risk of inundation. The possible extent of this area is shown on the following plan.



POTENTIAL AREA OF HAZARD ZONE

The purpose of this zone would be to prohibit development, including the building of houses. There would also be some potential changes to the Regional Policy Statement to reflect this also.

4.3.4 There will be a number of potential consequential implications for land owners arising from such a rezoning. The matter of potential liability that could follow is not addressed in this review.

4.3.5 It would seem, however, that if the DDS is not constructed and no other steps are implemented to mitigate the risk of future debris flows, that WDC may find itself responsible for future damage unless it takes steps to rezone land which is potentially at risk.

4.4 Financial and Funding Implications

4.4.1 The Government agreed to fund a maximum $3,251,250 (GST inclusive) of WDC's capital expenditure for mitigation works ($2.890M exclusive of GST). This was allocated as:

- Awatarariki Catchment $1.756M
- Waitepuru Catchment $1.134M

WDC entered into a funding agreement with the Government on 16 May 2006.

4.4.2 Some relevant provisions of this Agreement are:

- Clause 4 – The grant and any interest earned may be used *"solely for the purpose of risk mitigation measures for the Waitepuru and Awatarariki Streams as specified . . ."* in the Business Case and supplement of December 2006. (Refer 2.3.15).
- Clause 9 – The agreement may be reviewed on the initiative of either the Government or WDC in the event of significant variation of the scope of the project and/or the estimated costs.
- Clause 10 – If the project was not completed by 30 June 2008 the agreement would be reviewed with a view to extending its term or returning unused funds and interest.
- Clause 11 – Council will refund any part of the grant plus interest not used for the project (when reviewed on 30 June 2008).
- Clause 13 – Council will produce evidence of costs incurred.

4.4.3 A variation to the Agreement in 2009 extended the project completion date until 30 June 2013.

4.4.4 Provided that the cost allocation to the Project and financial records are correct, WDC does not appear to have breached the terms of the Agreement to date, albeit that various estimates have been exeeded.

If, however, WDC abandons the upstream DDS, it is potentially liable to return the current unexpended Government funded portion of project cost being approximately $150,000 (plus interest and GST) at the present time. WDC should appraise Government of its decision and, if an another option is selected, seek additional Government Funding.

4.5 Consequences for Other Parties

4.5.1 Some of the consequences for land owners affected by potential rezoning and the inability to build have been alluded to in 4.3.4 and are more specifically addressed in the legal advice received.

4.5.2 In 2006 WDC sought a determination[88] from the Department of Building and Housing (DBH) about whether it should continue to prevent the

[88] Refer to Part 3 Subpart 1 of the BA.

occupation of 3 houses[89] affected by Awatarariki Stream. WDC provided DBH with full information on the investigations it had undertaken and the Council's policy decisions in terms of the proposed Awatarariki Stream debris mitigation works.

WDC has the statutory power to prohibit the occupation of building (under S.125 of the BA) until mitigation works have been undertaken to reduce the danger.

DBH held the view[90] that restricting the occupation of houses was only justifiable if the risk of injury or death for people living in the houses was so high as to be likely in the ordinary course of events.

DBH noted T & T's report that a future debris flow was likely to occur in a storm of similar magnitude to the 2005 event (200-500 years probability). DBH also noted the provisions of the GNS report and reached the conclusion"

". . . that the houses are not likely to cause injury or death in a 10 year event but are likely to cause injury or death in an event of the order of 500 years." Consequently, DBH determined that the houses are not "dangerous" in terms of S.121 of the BA and that WDC should not require the houses to remain unoccupied.

DBH has had regard for the frequency of the storm events but appears not to have addressed the absence of a direct correlation between the storm frequency and the triggering of a debris flow.

4.5.3 A number of houses[91] within the affected zone have been reinstated since the 2005 event.

Where these have been on the basis of a "like for like" repair, there have been no building consents issued. There have, however, been building consents issued for buildings on 10 properties on the fanhead since May 2005. All but one[92] of the consents issued are subject to a notice under S.73(1) of the BA which recorded on the title of the land. WDC needs to consider the legal advice provided to it in relation to potential liability and note that S.393 of the BA provides some immunity to WDC.

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[89] 7 Pioneer Road, 7 & 16 Clem Elliott Drive.
[90] DBH, (7 December 2006); *"Determination 2006/119 – Dangerous building notices for houses in Matata, Bay of Plenty."*
[91] Building consents were issued in relation to 10 properties covering dwellings and accessory building.
[92] The exception was for a garage on 21 Richmond Street.

4.5.4 In relation to the interests of insurers of buildings potentially affected the certificate under S.73 registered against the title represents clear notice and they are able to make an informed decision on whether or not to provide insurance on buildings and if so, any special provisions that may apply.

The terms of insurance cover are not known, but it has been suggested that some insurance has been provided for existing building owners on the understanding the WDC would construct a DDS in the Awatarariki Stream Catchment. The Insurance Council has indicated to WDC that if the DDS does not proceed that it was highly likely that insurance companies would withdraw from providing cover.

WDC should have regard for the legal advice it has received on this matter.

4.5.5 WDC communicated with the Earthquake Commission (EQC) shortly after the event and received the following response:

> *"It is not clear to me what the connection is between the actions of EQC and the hazard management options and solutions being explored by your council...EQC's responsibilities are to individual property owners and cannot be delayed for external reasons...Each claim is determines and settled in its own time..."*[93]

In terms of the possible implications at this time, where a notice has been registered on a title under S.73(1) of the BA the EQC is able to decline a claim made under any insurance of any property.

The DBH Determination (refer 4.5.2) noted as follows:

"The Earthquake Commission did not wish to make formal submissions, but observed that:

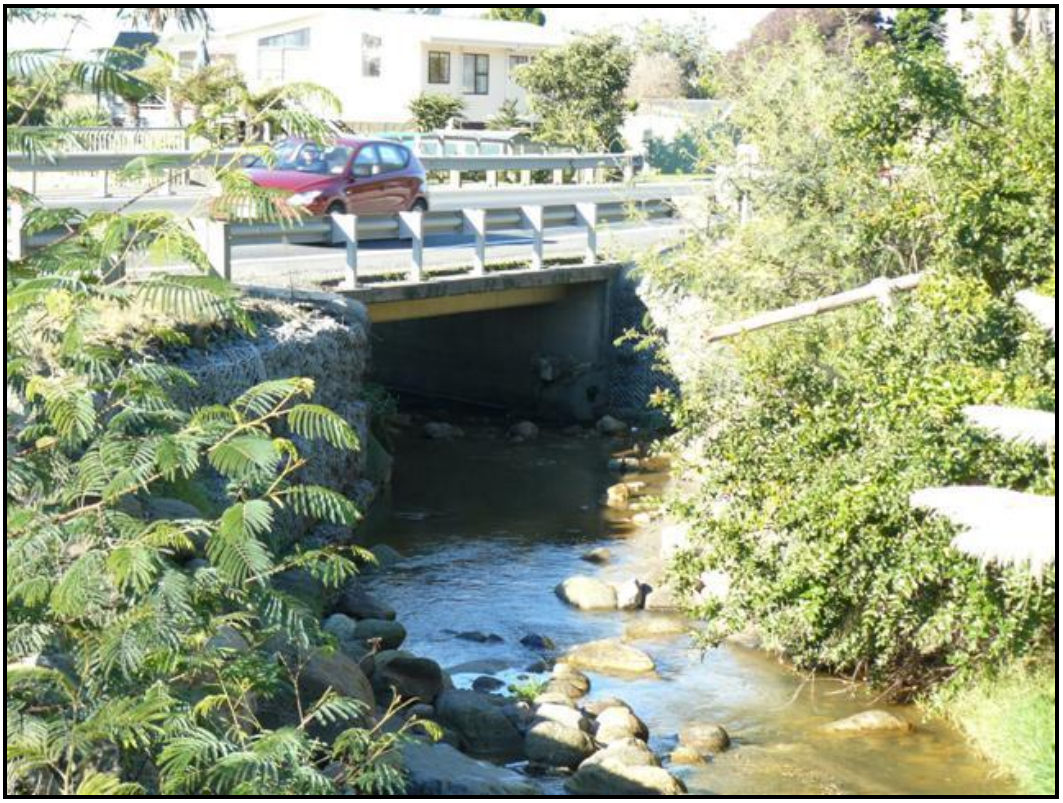
(a) Section 121 referred to a building, not the location of a building. A building should not be declared dangerous simply because it was at risk of damage from natural disaster as distinct from being likely to cause injury or death. If only location were to be considered, a great many existing buildings throughout New Zealand could be declared to be dangerous. Sections 71 to 73 provided a regime for considering such issues in relation to applications for any building consents necessary for the repair of damaged buildings.

[93] Letter: David Middleton, General Manager, EQC (10 August 2005) to Diane Turner, Recovery Manager, WDC.

(b) The 2005 event was reported as a 1 in 500 year event and could not properly be considered to have occurred in 'the ordinary course of events'."

Again, WDC should have regard for the legal advice it has received.

4.5.6 It is understood that SH2 (Moore's) bridge did not require significant repair after the 2005 event, but blockage had to be cleared. T & T have carried out an assessment of the flow capacity of the existing SH2 (Moore's) bridge.[94] This noted that in the 2005 event the waterway was almost completely blocked. The bridge is currently the most constricted cross channel section between the escarpment and the lagoon. It is a single span structure with a span of approximately 8m with limited vertical clearance. The bridge is not well aligned to the general alignment of the Awatarariki Stream and this is likely to reduce capacity in significant flow events, resulting in localised secondary flow paths.



SH2 (MOORE'S) BRIDGE
Note misalignment between bridge and stream

[94] Letter: Tom Bassett, T & T, (29 April 2009) to Barbara Dempsey, WDC.

T & T's review of the capacity led them to the following conclusions:

- The bridge waterway has a theoretical capacity to cope with the 100 year flow event;
- The maximum freeboard available at the upstream side of the bridge would be approximately 250mm;
- The design flow of 66m^3/s would significantly overwhelm the bridge.

4.5.7 If a DDS is not constructed there may be implications for the ECMT railway bridge. The original options for mitigation downstream of the escarpment referred to the need for "a single span railway bridge". Option A2 referred to a "double span railway bridge". That is what has been constructed.

TWIN SPAN ECMT RAILWAY BRIDGE
(Note central pier)

The capacity of the waterway under the railway bridge is not known precisely but T & T have indicated that the central pier would likely constrain the flow. The absence of the upstream DDS could, therefore, increase the risk to the bridge in the event of a significant debris flow if

the design of the bridge is insufficient to resist such a loading. It should be noted, however, that the bridge was apparently rebuilt (or at least designed) before WDC had decided on a DDS. Ontrack did consult with WDC on its plans but was under pressure to restore the rail service as a matter of priority given the economic impact of further delays on its commercial customers, especially at Kawerau.

There may, however be issues if WDC selected a new mitigation option that is reliant on the bridge being able to pass the full magnitude design debris flow.

4.5.8 BOPRC has identified the possible implications of WDC abandoning the construction of the DDS[95] as follows:

(1) A technical review of the assumptions made for the resource consent for the ECMT bridge will be required;

(2) The RPS review will need to consider the risk management of natural hazards and allocation of roles for WDC and BOPRC;

(3) There will be a need to clarify responsibility for stream flow through urban areas;

(4) Land management in the upper catchment will need to be considered, including the ongoing responsibility for periodic inspections.

(5) A flood/debris flow and high intensity warning system may need to be considered.

4.6 Summary

4.6.1 In the event that WDC now decides not to construct a DDS upstream of the escarpment, it is important to consider possible consequences if parties placed reliance on the future protection that a DDS might provide.

4.6.2 It would appear that on the basis of the Environment Court's decisions that there would be no consequential impact on resource consents already issued.

[95] Email: Roger Waugh, BOPRC (15 June 2012) to Alan Bickers.

4.6.3 On the basis of its statutory obligations under the RMA and BA, WDC will need to consider carrying out a change to its Operative District Plan to create a hazard zone in which development is prohibited. WDC needs to have regard for the legal advice it has received.

4.6.4 The Government funding to WDC is subject to an Agreement between it and the Council. The terms of that Agreement require WDC to use the funds for the purpose sought and to refund any part of the grant plus interest if not used for the Awatarariki Stream mitigation work.

WDC does not appear to have breached the terms of the Agreement, albeit that various estimates for items of work have been exceeded. If, however, WDC abandons the upstream DDS, it is potentially liable to return the unexpended Government funded portion of the project cost currently estimated at $150,000 (plus interest and GST).

WDC should appraise Government of its decisions and, if another option is selected seek additional Government funding.

4.6.5 In relation to consequences for owners of land and building potentially affected by future debris flows, it is noted that certificates under S.73(1) of the BA have been registered against titles. While WDC has some immunity as a result of s.393 of the BA, it needs to have regard for the legal advice it has received. It seems highly likely that if the DDS is not constructed that insurance companies may decide not to provide cover unless they were satisfied at the level of mitigation provided by WDC.

4.6.6 In relation to SH2 (Moore's) bridge it is likely that this will form a restriction for future debris flow and will need to be replaced if WDC wishes to pursue any of the downstream options. Consultation with NZTA will, therefore, be essential.

4.6.7 The ECMT railway bridge is a double span structure. As such, the presence of a central pier may create a risk to the bridge in the event of a significant debris flow. The bridge was, however, designed and built in 2006 and Ontrack sought WDC's input to the preferred structure in July 2005, but proceeded before WDC had made a final decision because of the economic impact of further delays on commercial customers, especially at Kawerau. Consultation with Tranzrail is necessary if any of the downstream options is to be considered.

4.6.8 BOPRC has identified potential implications of abandoning the DDS as including the need to review the consents for the ECMT railway bridge, proposed RPS implications, responsibilities for streams in urban areas, upper catchment land management and early warning systems.

5. POSSIBLE FUTURE STRATEGY

5.1 Existing Design Solution

5.1.1 This Review has recommended that WDC takes no further action to implement the current design solution for mitigating the risk of future debris flows in the Awatarariki Stream Catchment. (Refer 3.5.1).

5.2 Possible Options Available to WDC

5.2.1 Ontrack engaged with WDC in July 2005 in order to "*seek (its) ideas, views, comments and concerns on possible future works (permanent works) and how Ontrack's structures could be reinstated in a manner consistent with the town's (Matata's) objectives".*[96]

Ontrack indicated that it was considering two permanent replacement options:

- A bridge structure with a central pier, and
- A single span bridge structure.

Ontrack referred to the potential problems of the central pier to increase debris detention. It would appear that Outrack proceeded to design and construct the replacement bridge before WDC had finalised a mitigation option, because of the adverse economic impact caused by the loss of the ECMT.

It is, therefore, appropriate that WDC consider what other options are available to it.

The GNS report (June 2005) stated that there were 4 broad types of options to mitigate the risks from debris flows:

- Debris detention in the catchment;
- Debris deflection on the fan;
- Building regulation prohibiting of building on areas or risk; and
- Warning and evacuation.

In relation to the Awatarariki Stream Catchment, GNS noted that if there was not an upstream DDS that the ECMT railway bridge would become

[96] Ontrack (NZ Railways Corporation), (8 July 2005); *"Emergency Works: East Coast Main Trunk Line (Matata) – Information Pack"*.

the default structure and there would likely be an unconstrained flow path for the debris, similar to the 2005 event. The report stated:

"If the channel under the railway is not designed to pass future debris flows, then the railway becomes a significant contributor to the future inundation hazard on land below it, because it prevents any possibility of control of flow in future events."

GNS also noted that if the debris flow was able to pass under the railway bridge that the gradient on the fanhead was such that the debris flow will slow and stop on the fanhead. Hence, mitigation on the fanhead must be able to cope with the volume of the debris flow to be deposited.

GNS said *"a strong, erosion-resisting bund several metres high, and passing between the rail bridge and the foot of the fan could be constructed to keep a hyperconcentrated flow from spilling into existing (surviving) areas of Matata that are in the Awatarariki Stream fan."*

If the option of upstream DDS was not adopted, GNS noted that the bund would need to be much more substantial and robust to avoid damage from the debris flow or over-topping. The bund would need to be constructed on the Matata side (east) of the Awatarariki Stream and the portion of the fanhead to the west of the stream would remain at risk from future debris flow.

5.2.2 The T & T report (August 2005) identified 11 options for managing debris flows in the Awatarariki Stream Catchment (refer Appendix E). T & T had regard for GNS recommendations in developing these options. Option A1 was *"retreat from the hazard and limit development on the fanhead"*. This option is still able to be considered, notwithstanding that repairs and reinstatement of buildings on the fanhead has been carried out since 2005.[97] The legal and liability implications of this need to be considered by WDC.

5.2.3 The original upstream options (A2, A2a, A3 and A6) have now been abandoned and, if WDC agrees with the recommendation, the debris ring net variant.

From a purely technical perspective it may, however, be possible to consider a possible upstream option of constructing a DDS, such as a barrier. Such a structure would consist of an open steel grillage or

[97] This work (with the exception of a garage) has been granted building consent subject to S.72 and 73 of the Building Act 2004.

concrete slot structure[98] that is anchored to the bedrock in a confined section of the stream. Its function would be to "filter" large boulders, trees, etc and allow smaller debris to pass through.

Given the poor ground conditions, there will be potential engineering difficulties in constructing such a structure. It is likely to give rise to the same community and tangata whenua objections that were raised with the debris dam given the scale of the structure.

In order to further pursue such an option, it would be necessary to find a site which would raise no opposition from tangata whenua and not create significant other adverse environmental effects, while still being and effective DDS. This would appear to be impracticable.

Consequently, it would appear that the likelihood of constructing any form of DDS upstream of the escarpment is now impracticable given the objections of the community and tangata whenua and the potential engineering issues to be addressed.

It is recommended that WDC does not pursue any further upstream options.

[98] Sometimes called a Sabo Dam.

5.2.4 The possible options downstream of the escarpment that could be considered are:

A4 - Debris flow bund and debris flood channel on the fanhead beside the existing Awatarariki Stream with single span railway bridge.

OPTION A4

A5 - Debris flow bund and debris flood channel on the fanhead beside the realigned Awatarariki Stream with single span railway bridge, new SH2 (Moore's) bridge.

OPTION A5

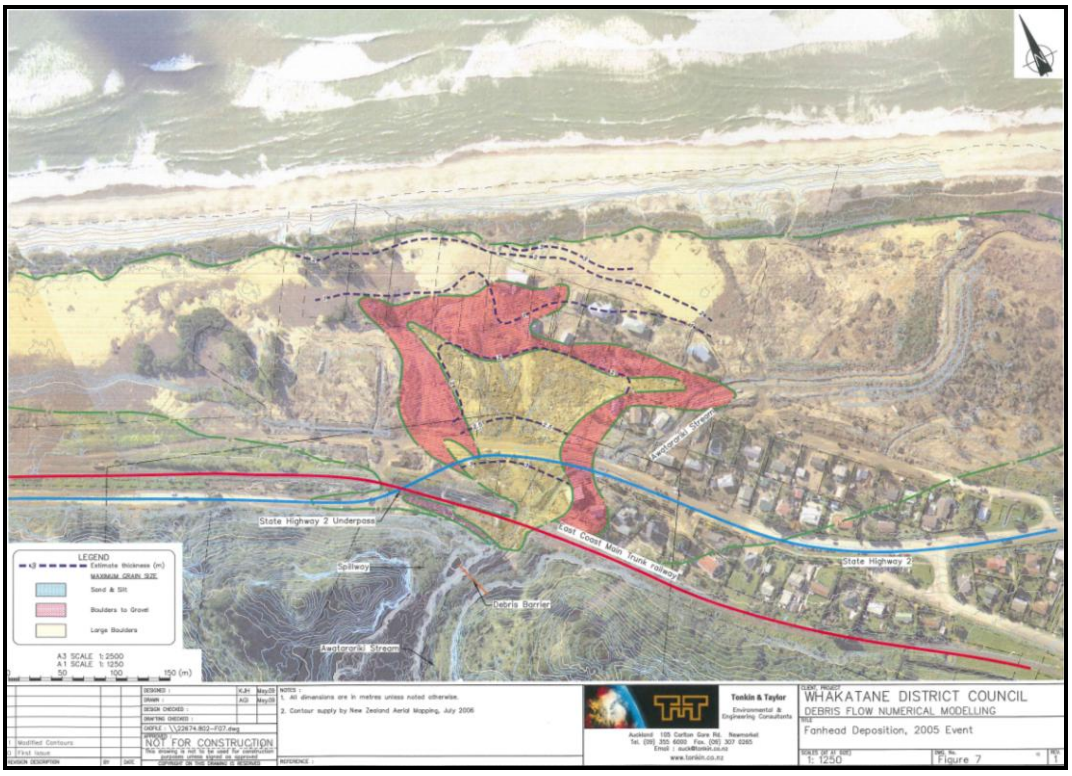
A7 - Debris flow bund and debris flood channel on fanhead beside new western Awatarariki Stream watercourse, single span railway bridge and new SH2 (Moore's) bridge.

OPTION A7

All of these options assumed a single span railway bridge and a new SH2 (Moore's) bridge. The ECMT railway bridge is not single span and has a central pier.

5.2.5 There is a possible additional downstream option that could be considered. This option would be the construction of a debris detention basin in the area north of the existing SH2 alignment as suggested by GNS (refer 2.2.12).. The debris detention basin would be a constructed storage area in which the large boulders, trees and sediment would be contained. It could have a concrete/steel outlet structure designed to allow passage of debris of a specified size.

T & T has carried out numerical modelling of the design debris flow and potential deposition area which is shown in the following figure. This would equate approximately to the required area of the debris basin if it was constructed.



GENERAL EXTENT OF POSSIBLE DEBRIS BASIN (Orange)

This option is likely to require realignment of the ECMT railway as well as SH2, replacement of the two bridges, as well as significant property purchase, loss of road access, etc as identified by GNS.

5.3 Conclusions

5.3.1 It is clear that all of the possible options downstream of the escarpment are contingent on future debris flows being able to pass under the existing ECMT railway bridge and SH2 (Moore's) bridge.

GNS had noted the potential issues, particularly with the ECMT bridge (refer 5.2.1) and all the downstream options required a single span bridge. The reconstructed bridge has a central pier which is likely to be an impediment to the debris flow. Hence, consultation with Tranzrail will be required at an early stage.

5.3.2 It is clear from T & T's analysis of the flow capacity of SH2 (Moore's) Bridge that it is unlikely that any of the options downstream of the escarpment could be successful without its replacement (Refer 4.5.6). Given the vertical and horizontal alignment of SH2 in the vicinity following the construction of the underpass, this may present some technical issues. Hence, WDC will need to engage with NZTA if it wishes to pursue the downstream options.

5.3.3 Some members of the local community and Ngati Rangitihi Raupatu Trust Inc have suggested that a preferred solution is to direct the debris flow to the ocean. The potential problem with this suggestion noted by GNS (agreed by T & T) is that the stream gradient flattens downstream of the escarpment from approximately 2.1 degrees to 1.5 degrees, resulting in reduced flow velocity and deposition of debris which will ultimately result in overtopping of the stream and inundation of the fanhead and adjacent land. This is, in fact, the geomorphic process by which the fanhead was formed in the first place. The suggestion of a steel-lined channel[99] formed with sheet piling may reduce the coefficient of friction but is unlikely to result in a satisfactory outcome in terms of the level of protection sought.

T & T have modelled the potential area of debris deposition (refer 5.2.5) which demonstrates that the debris flow would be deposited in a manner to extend the existing fanhead.

Although this option may seem to some members of the community to offer a potential alternative the expert advice of GNS and T & T is that it is unlikely to be satisfactory. There is considerable community support for an option of the direct cut to the ocean and there may be some scepticism about the GNS and T & T conclusions. WDC may wish to

[99] Email: David Potter, Ngati Rangitihi Raupatu Trust Inc, (25 April 2012) to Alan Bickers. Also acknowledgement to Neville Harris, Sustainable Matata Inc for graphical presentation prepared by Joos Potter, Tangihia Consultants and Associates Ltd.

consider how to assuage this and could seek a further independent peer review.

5.3.4 The recommendation of this Review is that WDC take no further action to implement the debris net which is the current design solution. Given the community objections and, particularly those of the tangata whenua, which cannot be satisfactorily resolved, there is no reasonable possibility of constructing a debris detention structure upstream of the escarpment.

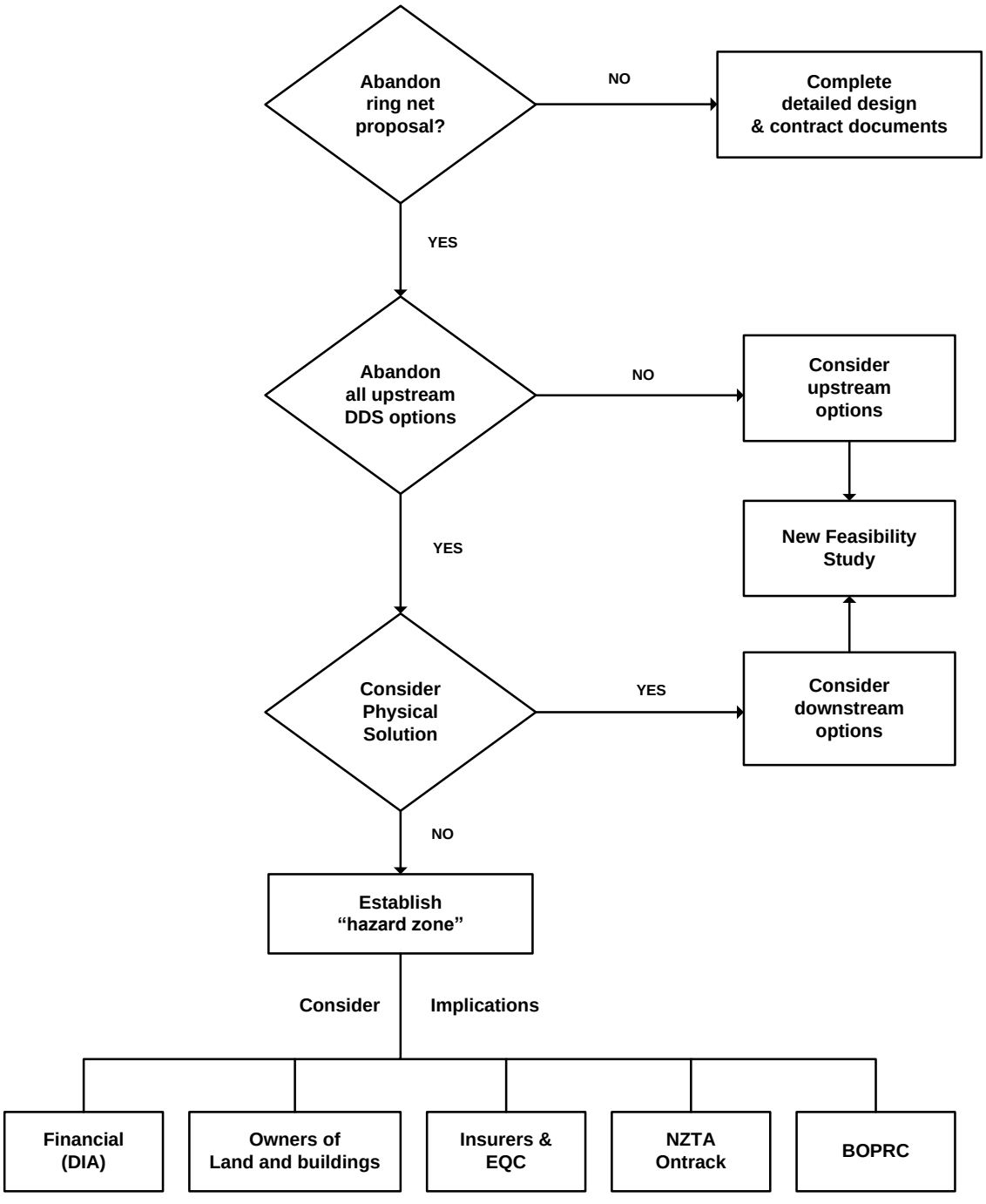
It is, therefore recommended that WDC take no further action to develop solutions for debris detention upstream of the escarpment.

5.3.5 If WDC agrees not to pursue any upstream options, it must, therefore, decide whether or not to take any further action to mitigate the risk of future debris flows in the Awatarariki Stream Catchment. If it decides to take no action, then it must have regard for the possible planning, legal and financial consequences that could follow.

5.3.6 WDC could further consider the possible mitigation options downstream of the escarpment. The fundamental constraints with all of these are the restrictions presented by the ECMT railway bridge and SH2 (Moore's) bridge. Tranzrail and NZTA will need to be engaged in consideration of these options.

5.3.7 Given the reinstatement of buildings on the fanhead since 2005 and the mitigation works that have been carried out (stream realignment, bank protection and lagoon construction), the situation that exists at this time is different from that when the options were proposed in August 2005. It is not possible within the scope of this review to identify any preferred option(s). A detailed feasibility study of the 4 identified downstream options based on the current environment will be required. This is the next logical step for WDC to take in the event that it decides that a "no action" strategy is not acceptable.

5.3.8 A suggested decision pathway is shown below to assist WDC in deciding the way forward.



DECISION PATHWAY

6. RECOMMENDATIONS

6.1 Current Design Solution

6.1.1 That WDC take no further action to implement the current design solution for debris detention (full containment debris net) or any option based on debris detention upstream of the escarpment.

6.2 Future Design Options

6.2.1 Assuming that WDC remains committed to a policy of debris detention within the Awatarariki Stream, that it conducted a new feasibility study of at least the following existing Option A4, A5 and A7, as well as an additional new option of debris basin.

6.2.2 That discussions be held with NZTA on the capacity of SH2 (Moore's) bridge and Tranzrail regarding the ECMT railway bridge to accommodate the design debris flows if upstream debris detention options are abandoned.

6.3 Governance of Major Projects

6.3.1 That for future major projects that WDC establish by resolution an ad hoc Project Subcommittee to provide governance oversight of the project. The terms of reference should include at least the following:

- Scope of the project;
- Membership of the Subcommittee and its Chair;
- Frequency of meeting to receive progress reports from management;
- Frequency of reporting to Council;
- Delegated authorities and, in particular approval or recommendations for:
  - Project scope and desired outcomes and variations thereof;
  - Business case;
  - Approval of contracts exceeding the Chief Executive's delegated authority;
  - Methods of procurement.

6.3.2 That the content of the standard project reporting template be reviewed so that it better conforms to the business case in relation to –

- Scope of project and achievement of the desired outcomes;
- Reporting of project costs in a form that corresponds to the line items of the approved budget;
- Project programme;
- Management of risk.

6.3.3 That WDC establish a policy covering the preparation of a business case for major capital works (including the applicable threshold and content) and its approval by Council or Chief Executive. Accountability for the development and implementation of capital projects, including financial management, should be on the basis of the approved business case.

6.3.4 That WDC establish a generic process for project development (including the applicable threshold).

APPENDIX A

PROJECT BRIEF

Objective: To lead a review and provide strategic advice to the Council on the current programme of works designed to manage risk from debris flows in the Awatarariki catchment, including all ongoing commitments associated with the project.

It is considered that the project will consider, amongst other matters, the following:

1. The process that was followed to identify options and the assessment used to choose the ring net debris detention structure (DDS) as the preferred solution.

2. The likely effectiveness of the proposed DDS to protect human life, property and infrastructure downstream of the proposed location of the structure. Any design limitations and assumptions should be identified and the appropriateness of those assessed, relative to risk and consequence.

3. The financial implications (capital) for the community and the District of constructing the proposed DDS based on the Council's proposed funding philosophy for Disaster Mitigation Projects (68% District wide/ 32% Matata community).

4. The financial implications (operational) for the community and the District of the ongoing maintenance and life cycle costs of the debris detention structure, the Awatarariki stream and the Matata Lagoon, as part of the design solution.

5. Any contractual obligations that the Council has or that are implied through its actions in relation to its current decision to build a DDS.

6. Any legal and insurance implications for the Council and homeowners from the issuing of building consents and the reconstruction of houses since the 2005 event. These building consents have been issued under s72 of the Building Act 2004 and some houses have been insured on the basis that a DDS would be built.

7. The implications on any resource consents and/or conditions of resource consent already issued for associated disaster mitigation projects at Matata if the DDS does not proceed.
8. The planning framework, including the District Plan zoning of land downstream and the implications for landowners to make "reasonable

use" of their land (s.85 RMA), and the Proposed Regional Policy Statement in regard to tolerable and intolerable risk from natural hazards events.

9. The implications of the Councils draft LTP 2012 to 2022, including its policy on determining significance.

10. The consequences of previous agreements with the community, particularly with affected landowners, the Regional Council, consent authorities and Central Government agencies such as NZTA, Ontrack and Government funding agencies.

If through this process, issues are identified with other disaster mitigation projects undertaken at Matata (Ohinekoao, Waimea and Waitepuru Streams), then these should be included in the report.

APPENDIX B

GLOSSARY OF ABBREVIATIONS

ACENZ	Association of Consulting Engineers New Zealand
BA	Building Act 2004
BOP	Bay of Plenty
BOPRC	Bay of Plenty Regional Council (formerly “Environment BOP”)
CDEM	Civil Defence and Emergency Management
CIA	Cultural Impact Assessment
DBH	Department of Building and Housing
DDS	Debris detention structure
DIA	Department of Internal Affairs
DOC	Department of Conservation
EBOP	Environment Bay of Plenty (now BOPRC)
ECMT	East Coast Main Trunk railway
EQC	Earthquake Commission
GNS	Institute of Geological and Nuclear Sciences Ltd (also referred to as GNS Science)
GST	Goods and Services tax
IPENZ	Institution of Professional Engineers New Zealand
LGOIMA	Local Government Official Information and Meetings Act
LIDAR	Light detection and ranging technology
LTCCP	Long-term council community plan
m	Metres
M	Million
m^3	Cubic metres
m^3/s	Cubic metres per second or cumecs (flow measure)
mm	Millimetres
NPV	Nett present value
NZIER	NZ Institute of Economic Research
NZTA	New Zealand Transport Agency
P & G	Preliminary and General costs, including profit margin

PCG	Project Control Group
RAMM	Raid Mass Movements (a software package for modelling debris flows, avalanches and rock falls) produced by the Swiss Federal Institute for Snow and Avalanche Research
RMA	Resource Management Act 1991
RPS	Bay of Plenty Regional Policy Statement
SH2	State Highway No 2
SLT	Strategic Leadership Team
T & T	Tonkin & Taylor Ltd
WDC	Whakatane District Council
WSL	Wald, Schnee und Landschaft (Swiss Federal Institute for Snow and Avalanche Research)

APPENDIX C

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WDC, Diane Turner Recovery Manager (November 2005); *"Management of Hazards and Risks – Matata and Environs"*.

Whakatane District Council, (December 2005); *"Matata Business Case".*

APPENDIX D

LIST OF PERSONS INTERVIEWED

- Kevin Hind, Principal, Engineering Geologist, T & T;
- Tom Bassett, Principal, Senior Water Resources Engineer, T & T;
- Colin Newton, Industry Director-Energy, AECOM;
- Andrew Green & Linda O'Reilly, Brookfields.

APPENDIX E

AWATARARIKI CATCHMENT DEBRIS CONTROL OPTIONS

Option		Capital Cost Estimate	Impact for Properties	
			Not protected	Protected
A1	Retreat from hazard, clean up remaining debris, single span railway bridge	$1.5 M	• 60 properties in area exposed to future debris flows and floods	Nil
A1a	As for A1, but including specific property works to raise floors above likely debris flood levels	$2.3 M	• 60 properties in area exposed to debris flows and floods	Approximately 20 houses raised
A2	Debris dam in catchment and debris flood channel on fanhead beside existing Awatarariki Stream watercourse, double span railway bridge	$3.7 M	• 3 properties required for works	57 properties
A2a	As for Option A2, with flood channel for high flow diversion to far western lagoon	$4.7 M	• Up to 11 properties required for works	49 properties
A3	Debris dam in catchment and debris flood channel on fanhead beside realigned Awatarariki Stream watercourse, double span railway bridge	$3.6 M	• 4 properties required for works	56 properties
A4	Debris flow bund and debris flood channel on fanhead beside existing Awatarariki Stream watercourse, single span railway bridge	$2.3 M	• 4 properties required for works • 36 properties in area exposed to debris flows	20 properties
A5	Debris flow bund and debris flood channel on fanhead beside realigned Awatarariki Stream watercourse, single span railway bridge, new State Highway bridge	$2.8 M	• 5 properties required for works • 27 properties in area exposed to debris flows	28 properties

Option		Capital Cost Estimate	Impact for Properties	
			Not protected	Protected
A6	Debris dam in catchment and debris flood channel on fanhead beside new western Awatarariki Stream watercourse, double span railway bridge	$3.7 M	• 6 properties required for works	54 properties
A7	Debris flow bund and debris flood channel on fanhead beside new western Awatarariki Stream watercourse, single span railway bridge, new State Highway bridge	$2.7 M	• 10 properties required for works • 12 properties in area exposed to debris flows	38 properties
A7a	As for A7, with high flow floodway to far western lagoon	$2.7 M	• 13 properties required for works • 9 properties in area exposed to debris flows	38 properties
A8	New Awatarariki stream path cut through ridge, and debris flow bund on fanhead with new debris flood channel, single span railway bridge, new State Highway bridge and overpass	$3.1 M to $7.6 M	• 11 properties required for works • 14 properties in area exposed to debris flows	35 properties
A8a	Similar to A8, but aligned to cut through ridge behind quarry with debris flow channel towards far western lagoon under state highway and railway to west of present subway	$6.5 M to $9 M	• No private properties required for works • No properties in area exposed to debris flows	60 properties
Notes	• Capital cost estimates include railway and State Highway drainage structures • Estimated annual costs (refer Section 7.5) ➢ For all options, siltation management: $45,000 pa ➢ For all asset management and maintenance: $12,500 pa			

Source: Tonkin & Taylor Ltd, (August 2005); *"The Matata Debris Flows – Preliminary Infrastructure and Planning Options Report"*.

APPENDIX F

SUMMARY OF COMMUNITY SUBMISSIONS

Submitter's Name	Submission	Comment in Report
Michelle Beach	Expresses concern about building in path of debris flows.	Sections 4.5.1 to 4.5.5
	Favours a direct channel to sea with bunds to protect property.	Section 5.3.3
	Concerned with length of time to resolve Awatarariki mitigation works.	Not specifically addressed.
Mere Butler	Concerns with effect of proposals on waahi tapu sites.	Section 2.4.12
Ed Campion	Favours a direct channel to the sea.	Section 5.3.3
Rob Dawson	Concerned with costs incurred to date on project and effect on ratepayers.	Sections 3.3.4 and 3.3.5 and 4.4.1 etc
	Opposes debris dam.	Sections 5.2.3 and 6.1.1
	Favours retreat with buy out of properties	Sections 4.3.2 to 4.3.4
Neville Harris	Opposed to ring net proposal.	Sections 1.3.5 to 1.3.10, 3.5.1
	Concerned with under-estimate of debris volume.	Sections 2.2.2, 2.3.8, 2.4.4
	Favours a direct channel to the sea.	Section 5.3.3
Bill Hutchinson	Frustrated with WDC's handling of project.	Not specifically addressed.
	Opposed to any form of debris detention structure.	Sections 5.2.3, 5.3.3 and 6.1.1
	Favours a direct channel to the sea.	Section 5.3.3
	Buildings should not have been permitted on debris fanhead.	Sections 4.5.1 to 4.5.5

Submitter's Name	Submission	Comment in Report
Paul and Angela Knight	Buildings should not have been built on debris fanhead west of Awatarariki Stream. Opposed to ring net and any form of debris detention. Concerned with costs and funding. Concerned with effect of ECMT bridge.	Sections 4.5.1 to 4.5.5 Sections 1.3.5 to 1.3.10, 3.5.1, 5.2.3, 5.5.3 and 6.1.1 Sections 3.3.4 and 3.3.5 Section 4.5.7 and 4.6.7.
Brian Lonsdale	Concerned with WDC's governance and management of project. Concerned with costs, funding and impact on the community.	Section 3.1.1, 3.1.3, etc Sections 3.3.4 and 3.3.5
Judith Mills	Concerns with Waitepuru Stream and WDC's non-compliance with terms of resource consents.	Review does not address Waitepuru (outside scope). WDC is currently undertaking a resource consent compliance audit of Waitepuru Works.
Environment Ngati Awa Te Renunga o Ngati Awa (Beverley Hughes)	Summary of tangata whenua concerns about upstream debris detention structures and effects on waahi tapu sites.	Sections 2.4.10, 2.4.12 and 5.3.4
Ngati Rangitihi Raupatu Trust (Manu Paul)	Favours a direct channel to the sea.	Section 5.3.3
Greta Nicholson	Options other than ring net proposal should be considered. Area west of Awatarariki Stream on fanhead is an historical hazard zone.	Sections 5.2.3 to 5.2.5 Sections 4.5.1 to 4.5.5
NZ Transport Agency (Dilip Datta)	Seeking information on alternatives if upstream debris detention not proceeding.	Sections 4.5.6 and 4.6.6
Robyn & Marilyn Pearce Laurie and Lesley Hema Lyall Magee	Supports building debris dam as originally proposed. Concern at costs to date.	Sections 2.4.6 to 2.4.10 Sections 3.3.4 and 3.3.5

Submitter's Name	Submission	Comment in Report
David Potter for Ngati Rangitihi Raupatu Trust	Submitting conceptual outline of direct channel to sea prepared by Joos Potter, Tangihia Consultants and Associates for Neville Harris and others.	Section 5.3.3
Lee & Earl Schlichting	Opposed to ring net and debris dam. Proposed upstream catchment work. Concern with restrictions on property.	Sections 1.3.5 to 1.3.10, 3.5.1, 5.2.3, 5.3.3 and 6.1.1 Section 2.3.16 Sections 4.5.1 to 4.5.5
Keith Sutton	Concerned with impact of remediation costs on ratepayers and delays. Concerned with breaches of resource consent conditions by WDC. Concern with restrictions on property.	Section 3.3.4 and 3.3.5 Not part of scope of review, WDC conducting audit of consent compliance. Section 4.5.1 to 4.5.5
Pam and Bill Whalley	Not in favour of debris dam. Concerns about risk from direct channel to sea. Frustrated with indecision and additional costs of rates and insurance.	Sections 1.3.5 to 1.3.10 Section 5.3.3 Section 3.3.4 and elsewhere.

APPENDIX G

SUGGESTED TEMPLATE FOR BUSINESS CASE FOR CAPITAL PROJECTS

BUSINESS CASE
SUGGESTED TEMPLATE

1. Description of the asset(s) to be acquired/created through the capital expenditure and the service or benefits which will result from it.

2. The justification for the capital expenditure (with reference to the LTCCP, Activity Strategy, Activity Management Plan and/or Asset Management Plan).

3. The options considered and the basis of selecting a preferred option. (Reference the Project Feasibility Report)

4. The Preliminary Assessment of the estimated aggregated cost of the asset(s) to achieve full operational capacity, including assumptions on which the estimate has been prepared. (This should make provision for all cost elements including contingencies and risk allowances, professional fees, resource and building consents, land purchase, cost escalation until completion).

5. The proposed source of capital funding (e.g. rates, loans, reserves, financial contributions) with reference to LTCCP.

6. The estimated additional/reduced annual operating expenditure resulting from procurement/creation of the asset(s), including depreciation and interest (outline of assumptions and their basis to be included) and the proposed source of funding of these.

7. The estimated additional annual revenue resulting from the asset(s) to be acquired (if any), including an outline of assumptions made and the basis for these.

8. The economic justification for acquiring the asset(s) (i.e. benefit/cost ratio return on capital employed).

9. The proposed method of procuring the asset(s), including identification of project elements and “bundling” of elements with an explanation of reasons.

10. The proposed programme for purchase/creation of the asset(s) with main activities identified and key milestone events and projected annual cash flows required. (Include a critical Path Network diagram [with constraints and float] and a Gantt chart).

11. Any approvals/consents required from regulatory authorities.

12. An analysis of risks associated with the economic analysis, project development and design, procurement and construction and commissioning and proposed measures to minimise/manage these.

13. Other relevant information.