Planning Provisions for Debris Flow Risk Management on the Awatarariki Fanhead, Matatā

Section 32 Evaluation Report
Prepared for Whakatāne District Council

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Boffa Miskell

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Summary

In May 2005, heavy rainfall resulted in a debris flow in the Awatarariki stream in Matatā. It caused significant damage to land, buildings and road and rail infrastructure. While there were no deaths or injuries, the destructive force of this natural hazard was such that it could easily have been an outcome.

After the event, the causes of the debris flow were assessed and a range of options were identified for an appropriate way forward.

Initially, the Whakatāne District Council decided to establish an engineered Debris Flow Control System in the catchment to protect houses on the Fanhead. However, this system proved not to be viable and the Whakatāne District Council decided to pursue planning-based options.

In 2015, the Whakatāne District Council completed a hazard and risk assessment for debris flows on the Awatarariki Fanhead. The assessment identified the risks to life and property on parts of the Fanhead as being high. Risk is the combination of the likelihood of the event occurring and the consequence for life and property.

Under the Regional Policy Statement natural hazard policy, the Whakatāne District Council is required to take steps to reduce this high risk to a lower level (medium, or lower if practicable)

The Whakatāne District Council has developed the Awatarariki Debris Flow Risk Management Programme to manage risks from future debris flow. The most effective measure to reduce risk under this programme is a managed retreat which includes a proposal to enable relocation for owners of property in the high risk area. A detailed business case to support funding of this is being negotiated through District, Regional and Central Government.

Despite the managed retreat proposal, the resource management approach for managing debris flow risks on the Awatarariki Fanhead area needs to be changed to appropriately recognise and address the significant risk from debris flow hazards that has been identified.

Therefore, changes to the Operative Whakatāne District Plan are proposed, including:

- Identifying an Awatarariki Debris Flow Policy Area on the planning maps, including a “high risk”, “medium risk”, and “low risk” areas;
- Rezoning the high risk area from “Residential” to “Coastal Protection Zone”;
- Prohibiting all activities in the high risk area, other than those that relate to transitory recreational use of open space;
- Making any new activities and intensification of existing activities in the medium risk area subject to a resource consent application where natural hazard risk is assessed in deciding whether to grant or refuse resource consent, and what conditions might be imposed.

Because of existing use rights, changes to the District Plan are only effective in managing new development or redevelopment. However, a Regional Plan rule is not subject to existing use rights and can be used to remove existing residential activities that are subject to high risk. Therefore, changes to the Regional Natural Resources Plan are also proposed.

Changes to the Operative Regional Natural Resources Plan include:

- Adding new objectives and policies that set the intention to reduce the natural hazard risk on the Awatarariki Fanhead from high risk to at least a medium risk level;
- Prohibiting residential activities on identified residential sites within the high risk area with retrospective effect after a specified date (31 March 2021).

To initiate this process, the Whakatāne District Council requests, to Bay of Plenty Regional Council, a change to the Regional Natural Resources Plan.

1.0 Overview

1.1 Purpose

This report has been prepared to fulfil the obligations of the Whakatāne District Council (WDC) to prepare an evaluation report under section 32 of the Resource Management Act 1991 (RMA) for a Plan Change to the Operative Whakatāne District Plan (District Plan).

The report also fulfils the requirement to explain the purpose of, and reasons for, and to provide an evaluation report for a request to change the Bay of Plenty Regional Council's (BOPRC) Operative Regional Natural Resources Plan.

WDC is required to carry out an evaluation of whether any objective is the most appropriate means of achieving the purpose of the Resource Management Act 1991 (RMA) when preparing a Plan Change.

The evaluation must also have regard to the efficiency and effectiveness of policies, rules and other methods in considering whether they are the most appropriate means of achieving the objective.

The evaluation must consider the benefits and costs associated with each policy, rule or method and the risk of acting or not acting if there is uncertain or insufficient information on the subject matter of the provisions.

This report should be read together with the Whakatāne District Plan and Regional Natural Resources Plan, and the Proposed Plan Changes.

1.2 Background

The location and extent of the Awatarariki Fanhead is shown on the Map in Appendix 1.

A severe rainfall event on 18 May 2005 triggered several large debris flows in the Awatarariki, Waitepuru and Ohinekoao stream catchments at Matatā.

The debris flow in the Awatarariki Stream at Matatā caused significant damage to land, buildings, and road and rail infrastructure on the Awatarariki Fanhead. While no injuries or deaths occurred, it is evident that the destructive force of the debris flow was such that this could easily have been an outcome.

After the event, the causes of the debris flow were assessed and a range of options were identified for an appropriate way forward. Full details of this process are set out in Appendix 5, with the main elements summarised below.

The options identified were:

- "Retreat" – removal of existing dwellings that would be in the path of potential future events.
- "Dam Options" - debris detention in the stream catchment with a flood channel on the Fanhead;
- "Fanhead Options" - directing debris flows with a flood channel on the Fanhead.

In August 2005, WDC adopted a debris dam and debris flood channel option as the preferred mitigation measure for the Awatarariki catchment. In assessing the preferred mitigation measure, consideration was given to the protection of existing dwellings and the desire of residents to continue to live in the area. A cost benefit analysis was undertaken, which concluded that the debris dam and debris flood channel option offered the greatest net benefit to the community of Matatā and the protection of existing dwellings.

Following consultation with the community, the preferred option was confirmed by WDC in December 2005 and a process of design development followed. This included:

- Technical assessments and reports to develop and refine the preferred option (January 2005 – May 2009);
- Community consultation (May 2009);
- Recommendations on final concept (June 2009);
- Independent technical reviews (2009 – 2010).

During the design development, a range of debris detention structures in the upper catchment were presented to the Matatā community for consultation. The community expressed concerns about the structures proposed, including impact on the environment, cost and affordability. In addition, Iwi expressed concerns about potential flooding impact of a dam on culturally important sites in the upstream catchment.

The community feedback resulted in the preferred engineering design being a flexible ring net proposal in the upper catchment with deflection bunds and raised building platforms on the Fanhead. This proposal sought to minimise the environmental and cultural concerns raised by the community.

The proposal is described in a 2009 report by Tonkin and Taylor Ltd[1]. The proposed debris flow control system was to comprise:

- A flexible barrier net constructed within the catchment that would retain approximately half of the design debris flow event (100,000m³).
- A spillway to direct the remaining damaging debris flow material to the coastal strip and away from the town.
- The control of flows on the Fanhead using 1.5 m high berms and raised building platforms.

An overall plan of the proposed Debris Flow Control System is included in Appendix 2.

Independent technical reviews of the debris flow control system proposal during the detailed design phase raised concerns about the durability and stability of the ring net structure. Ultimately, these concerns could not be satisfactorily resolved through the final design.

An independent review of the project occurred in 2012[2]. The recommendation of the review was that WDC should take no further action to implement the debris flow control system proposal. Later in 2012, the WDC, following re-evaluation of lower catchment solutions, resolved there were no viable engineering solutions to manage the debris flow risk to people and properties on

[1] Report Whakatāne District Council Debris Flow Control System Awatarariki Stream, Matatā

[2] Review of Awatarariki Catchment Debris Control Project, Alan Bickers, June 2012

the Awatarariki Fanhead that met community engagement outcomes, engineering viability or feasibility, and to pursue non-structural planning-based options.

In 2013, WDC commissioned hazard and risk assessments for landslides and debris flows at Ōhope, Whakatāne and Matatā. This work identified the risk to life and property on the Awatarariki Fanhead as being high.

Work also commenced on investigating planning options to manage landslide and debris flow risks. This work was put on hold until new natural hazard policies under the Regional Policy Statement (RPS) became operative and provided guidance to territorial authorities on how they should manage natural hazard risk. The Natural Hazards provisions of the RPS became operative in 2016.

At the beginning of 2015, the WDC formed a Consensus Development Group, which included six landowners, to investigate all options. From this, WDC developed the Awatarariki Debris Flow Risk Management Programme.

The Awatarariki Debris Flow Risk Management Programme is a unified approach comprising ten work streams to manage the loss-of-life and property damage risks from future debris flows within the Awatarariki Stream catchment.

The ten work streams are:

1. Review hazard and risk modelling;
2. Property valuations;
3. Alternative escape routes;
4. Early warning systems;
5. Review rates and rates remissions;
6. Right turning hazard;
7. Managed voluntary retreat;
8. Building Act determination;
9. District Plan Change;
10. Legal quality assurance.

These work streams are now significantly advanced or completed. Of these, the most effective measure to reduce risk is managed voluntary retreat. A detailed business case to support funding of this is being negotiated through District, Regional and Central Government[3].

In accordance with the Regional Policy Statement, the resource management approach for managing debris flow risks on the Awatarariki Fanhead area needs to be changed to appropriately recognise and address the significant risk from debris flow hazards that has been identified to loss of life, and damage to buildings and structures. This is the purpose the proposed plan changes.

[3] Debris Flow Risk: A way forward for the Awatarariki Stream fanhead, Draft Indicative Business Case 16 August 2017

1.3 Scope of Plan Changes

The proposed Plan Changes are to both the Operative Whakatāne District Plan and the Operative Regional Natural Resources Plan.

1.3.1 Changes to the Operative Whakatāne District Plan

The proposed plan change will identify the risk areas on the planning maps, remove residential zoning from the high risk area and establish rules to appropriately manage activities in the risk areas.

The proposed plan change includes:

- Identification of the Awatarariki Debris Flow Policy Area on the planning maps, including a “high risk”, “medium risk” and a “low risk” area;
- Rezoning the high risk area from “Residential” to ““Coastal Protection Zone”;
- Recognition of debris flow hazards in the assessment criteria for natural hazards;
- A new policy that recognises the debris flow risk assessment methodology applied to the Awatarariki Fanhead;
- A new policy that sets the intention to reduce the overall natural hazard risk on the Awatarariki Fanhead from high risk to at least a medium risk level;
- A new rule that generally prohibits activities in the high risk area, other than those that relate to transitory recreational use of open space;
- A new rule that all activities in the medium risk area are subject to a resource consent process where natural hazard risk will be assessed as part of the determination of whether to grant or refuse resource consent, and what conditions might be imposed.

Changes to the Whakatāne District Plan are proposed under Part 1 of the First Schedule of the Resource Management Act (RMA): Preparation and change of policy statements and plans by local authorities.

1.3.2 Changes to the Operative Regional Natural Resources Plan

The proposed plan change will add a new issues-based section to the Regional Natural Resources Plan to specifically address Debris Flows on the Awatarariki Fanhead at Matatā. The scope of the proposed plan change is amended to include this issue.

The new section includes:

- Objectives and policies that recognises the debris flow risk assessment methodology applied to the Awatarariki Fanhead and sets the intention to reduce the natural hazard risk on the Awatarariki Fanhead from high to at least a tolerable (medium) risk level;
- A rule that prohibits residential activities on identified residential sites within the high risk area after 31 March 2021;
- Explanatory information.

Changes to the Regional Natural Resources Plan are proposed under Part 2 of the First Schedule of the Resource Management Act (RMA): Requests for changes to policy statements and plans of local authorities and requests to prepare regional plans. To initiate this process, WDC are requesting that BOPRC adopt these changes.

2.0 Resource Management Act Policy Direction

2.1 Purpose and Principles

In carrying out a s32 analysis, an evaluation is required of how the proposal achieves the purpose and principles contained in Part 2 of the RMA. Section 5 sets out the purpose of the RMA, which is to promote the sustainable management of natural and physical resources.

Sustainable management 'means managing the use, development, and protection of natural and physical resources to enable people and communities to provide for their social, economic and cultural wellbeing and for their health and safety, while -

- sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and
- safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and
- avoiding, remedying, or mitigating any adverse effects of activities on the environment'.

In achieving this purpose, councils also need to recognise and provide for the matters of national importance identified in s6, have particular regard to other matters referred to in s7 and take into account the principles of the Treaty of Waitangi referred to in s8.

2.2 Section 6 Matters of National Importance

Section 6(h) requires that persons exercising functions and powers under the RMA shall recognise and provide for the management of significant risks from natural hazards as a matter of national importance. This matter is directly relevant to the assessment of the plan change.

Section 6(h) was included as a matter of national importance under the Resource Legislation Amendment Act 2017. The amendment is aimed at providing greater national consistency and guidance to improve the way that natural hazards are planned for and managed[4]. Although, the catalyst for the amendment was the Canterbury earthquakes of 2010 and 2011, the scope relates to the management of all hazards.

The Awatarariki Fanhead has a significant risk from debris flow and Section 6(h) requires WDC to recognise and provide for the management of this risk.

Section 6(e) requires that persons exercising functions and powers under the RMA shall recognise and provide for the relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga.

[4] Improving Our Resource Management System – Discussion Document – February 2013

The pan-tribal cultural assessment undertaken in relation to the proposed debris dam originally proposed as a mitigation option and outlined in the Background section of this report, identified sites and areas with significant cultural values in this area[5]. The assessment found that structures built within the catchment to hold back debris had the potential to destroy burial caves in the sides of the stream valley. The overall preference, as an outcome of those pan-tribal cultural assessments, was for dwellings on the Fanhead to retreat from the flowpath of future debris and flood flows, thereby avoiding the need for any works in the stream catchment and risk to the burial caves in the sides of the stream valley.

2.3 Section 7 Other Matters

Section 7(b) of the RMA requires persons exercising functions and powers under the RMA to have particular regard to the efficient use and development of natural and physical resources. This matter is directly relevant to assessment of the plan change.

Investigation of options for management of debris flow risk on the Awatarariki Fanhead has identified that managed retreat is the most efficient long term outcome for the community. Structural or engineered options have been proven to place an unreasonable burden on the community due to the high capital and maintenance cost.

Section 7(i) the effects of climate change may also be relevant given that debris flow events are the result of extreme rainfall (RPS Policy NH 7A). High rainfall is a necessity for a debris flow to be generated[6]. Predicted climate changes resulting in a higher frequency and intensity of rainfall events increases the potential for debris flows in the future.

The hazard assessment identifies that several authors have assessed a link between rainfall intensity and debris flow initiation. However, given the recognised importance of local topographic, climatic and geological controls on debris flow initiation, such an approach has limited applicability to the derivation of a recurrence interval for debris flows.

2.4 Section 8 Treaty of Waitangi

All persons exercising functions and powers under the RMA must shall take into account the principles of the Treaty of Waitangi (Te Tiriti o Waitangi).

In this regard, consultation with Tangata Whenua has occurred at all critical stages of WDC's management response to the debris flow risk. Active steps have been taken to protect sites of significance identified through a pan-tribal cultural impact assessment. From this, it is understood that managed retreat of dwellings from the Fanhead is the preferred risk management strategy as it will mitigate adverse effects on those sites of significance.

2.5 Section 30 Functions of Regional Councils

The control of the use of land for the avoidance or mitigation of natural hazards is a function of regional councils under the RMA.

[5] Tangata Whenua of Te Awa-o-Te Atua Cultural Impacts Assessment Of Resource Consent Applications For Matatā Township Recovery Works by Whakatāne District Council & Others And Te Awa-o-te Atua (Matatā Lagoon) Rehabilitation Works by Department of Conservation 8 January 2007

[6] 7.2.1 Quantitative Hazard Assessment, Matatā Escarpment T&T Ref. 29115, Whakatane District Council, November 2013

2.6 Section 31 Functions of District Councils

The control of any actual or potential effects of the use, development, or protection of land, for the avoidance or mitigation of natural hazards is function of district councils under the RMA.

2.7 National Instruments

There are no National Policy Statement or Environmental Standards that are directly relevant to assessment of the proposed plan changes, other than the New Zealand Coastal Policy Statement.

The government has indicated that an NPS on managing risks from natural hazards is to be developed in 2018[7].

2.8 Section 85 - Environment Court Directions in Respect of Land Subject to Controls

Section 85(1) of the RMA deems that an interest in land shall not to be taken or injuriously affected because of any provision in a plan unless otherwise provided under the Act.

Despite this the RMA also provides under Section 85(2) that

> *"any person having an interest in land to which any provision or proposed provision of a plan or proposed plan applies, and who considers that the provision or proposed provision would render that interest in land incapable of reasonable use, may challenge that provision or proposed provision on those grounds—*
>
> *(a) in a submission made under Schedule 1 in respect of a proposed plan or change to a plan; or*
>
> *(b) in an application to change a plan made under clause 21 of Schedule 1."*

The Environment Court can, if it is satisfied that the provision makes any land incapable of reasonable use; and places an unfair and unreasonable burden on any person who has an interest in the land; may direct the local authority to do whichever of the following the local authority considers appropriate

> *"…*
>
> *(i) modify, delete, or replace the provision in the plan or proposed plan in the manner directed by the court:*
>
> *(ii) acquire all or part of the estate or interest in the land under the Public Works Act 1981, as long as—*
>
> *(a) the person with an estate or interest in the land or part of it agrees; and*
>
> *(b) the requirements of subsection (3D) are met; …*

Section 85 (3D) limits the direction to acquire land to situations where the land was acquired before the provision was publicly notified and the provision remained substantially the same.

[7] RLAB Departmental Report No. 1 Additional information for Select Committee (11 August)

Section 85 enables land owners at Matatā to seek directions from the Environment Court on the reasonableness of the provisions and their impact on their interests as land owners.

The proposed plan changes, as they are intended to apply in the high risk zone, will remove existing use rights for activities that would be significantly and adversely affected by a debris flow event. The risk assessment concludes that the high risk debris flow area should not be occupied due to the high risk should there be another debris flow event of similar scale to that in 2005.

In these specific circumstances the proposed controls on the land, whilst stringent, are not considered unreasonable.

2.9 New Zealand Coastal Policy Statement 2010 (NZCPS)

Section 75(3)(b) requires a District Plan or Regional Plan to give effect to the NZCPS.

The Awatarariki Fanhead is within the "Coastal Environment[8]" as defined by the NZCPS. The coastal environment extends inland to the crest of the escarpment at this location[9].

While the debris flow hazard is not a coastal hazard, the subject area is also susceptible to coastal hazards (coastal erosion, tsunami). In that regard, the plan changes are consistent with NZCPS policies that encourage change in land use where that would reduce the risk of adverse effects from coastal hazards[10].

Although not the reason for retreat from the affected area, retreat also has the potential to promote restoration of natural character[11], provide public open space[12], and to provide walking access to and along the coast[13].

The proposed plan changes therefore give effect to the NZCPS.

2.10 Regional Policy Statement

An analysis of the Regional Policy Statement on natural hazards as it applies to the Awatarariki Fanhead is included in Appendix 5.

The Regional Policy Statement includes a risk-based approach to natural hazard management[14].

The Regional Policy Statement imposes a duty on city and district councils within the region for land use planning, susceptibility mapping and detailed risk assessment for "extreme (prolonged or intense) rainfall hazard" that can result in landslides, debris flows/floods (flooding).

Accordingly, the District Plan must give effect to the Regional Policy Statement through:

- Identifying areas susceptible to natural hazards;

[8] NZCPS Policy 1: Extent and characteristics of the coastal environment

[9] As delineated on Proposed Regional Coastal Environment Plan Planning Maps 19 a-c

[10] Ibid Policy 25: Subdivision, use, and development in areas of coastal hazard risk

[11] Ibid Policy 14: Restoration of natural character

[12] Ibid Policy 18: Public open space

[13] Ibid Policy 19: Walking access

[14] BOPRC RPS Policy NH 1B: Taking a risk management approach

- Assessing natural hazard risk;
- Managing natural hazard risk.

Risk is classified by a three-category risk management framework[15]:

- High natural hazard risk being a level of risk beyond what should be tolerated.
- Medium natural hazard risk being a level of risk that exceeds the Low level but does not meet the criteria for High risk.
- Low natural hazard risk being the level of risk generally acceptable.

Of relevance is the requirement in high risk natural hazard zones to reduce the level of risk to medium (and lower), if reasonably practicable[16].

Policy NH12A of the RPS requires risk assessments to be undertaken in the context of District or Regional Plan development, and specifically recognises the application of risk reduction measures to existing uses.

Policy NH 14C: Allocation of responsibility for land use control for natural hazards identifies that the Bay of Plenty Regional Council, city and district councils are responsible for specifying objectives, policies and methods, including any rules, for the purpose of the control of the use of land for the avoidance of risk from natural hazards. The policy identifies that city and district councils have the primary responsibility for developing any natural hazard rules. However, the policy has the following footnote which identifies circumstances where the Regional Council may intervene:

> "*Under section 30(1)(c)(iv) of the Act, the Regional Council has the function to control land use for the avoidance or mitigation of natural hazards. The Act allows the Regional Council to exercise that function in such a way as to override any existing use rights available under section 10(1) of the Act. The allocation of responsibilities under this policy does not remove the right of the Regional Council to exercise its functions and powers in that regard. Should it choose to do so, any such provisions will be subject to a plan or plan change process under Schedule 1 to the Act."*

The policy recognises that the Bay of Plenty Regional Council has the power to set land use rules, including conditions of resource consent, to address natural hazard risk to existing land uses and to address natural hazard risk on all land in the coastal marine area.

The proposed debris flow hazard management provisions for the Awatarariki Fanhead give full effect to the RPS natural hazard policies.

2.11 Regional Natural Resources Plan

The Regional Water and Land Plan has recently been compiled into a single volume "Regional Natural Resources Plan" (RNRP) along with all other operative regional plans.

The RNRP identifies the Regional Council functions under Section 30(1)(c)(iv) – Control of the use of land including objectives, policies, methods and rules in regional plans for the avoidance or mitigation of natural hazards.

[15] Ibid Policy NH 2B: Classifying risk

[16] Ibid Policy NH 3B: Natural hazard risk outcomes

A regional council can control the use of land for avoidance or mitigation of natural hazards under a regional plan rule. Existing use rights do not apply to land uses controlled by a regional plan and are therefore able to be extinguished through a specific regional rule[17].

2.12 Iwi Management Plans

The following Iwi Management Plans and associated provisions are considered relevant to this topic:

Iwi Management Plan	Relevant Provisions
Ngāti Rangitihi Iwi Environmental Management Plan	The mana of Ngāti Rangitihi is upheld, developed and recognised. Ngāti Rangitihi is an active participant in the decision-making processes of statutory bodies that affect the interests of Ngāti Rangitihi. Bay of Plenty Regional Council and Territorial Authorities will, in consultation with Ngāti Rangitihi, identify and provide opportunities for the practical experience of kiatiakitanga by iwi and hapū. Bay of Plenty Regional Council, Territorial Authorities and statutory bodies with responsibilities in the environment will ensure that matters of significance to Ngāti Rangitihi are identified during the preparation of plans, taken into account, and where appropriate, provided for. Bay of Plenty Regional Council will consult with Ngāti Rangitihi regarding reviews and changes to the Regional Policy Statement, regional plans and matters that are of importance to Ngāti Rangitihi. Ngāti Rangitihi shows leadership in protecting its relationship with the rohe including places of significance, customary resource areas and water bodies. Consultation be undertaken by applicants, statutory authorities and proposers with Ngāti Rangitihi. Natural hazard management is an important role of Councils, Civil defence and other agencies. Bay of Plenty Regional Council will co-ordinate the management of natural hazards throughout the Region by setting standards and ensuring consistently among Territorial Authorities. Place of Significance 148 – Kaokaoroa battle site and urupa.
Wahi Tapu Sites of Ngāti Awa	Site 299 Te Awatarariki – According to the ancestors of Ngāti Awa there are three taniwha of legend that live there. They are taniwha Kiore, Tuna and Tohora. Site 319 Te Kaokaoroa – This was the scene of a great battle between the Government forces and Tairawhiti reinforcements. The

[17] Section 10 (4)(a) RMA Certain existing uses in relation to land protected

Iwi Management Plan	Relevant Provisions
	battle raged for three days, and involved over 800 men, several of which were members of Te Tawera. Ngāti Hikakino and Ngāti Rangihouhiri lost many warriors in this historic battle.

In 2007, a Cultural Impact Assessment[18] was completed for the full suite of regeneration works for Matatā that followed the debris flow events. This was a joint assessment prepared by Ngāti Awa, Ngāti Rangitihi, and Ngāti Tūwharetoa.

At the time the CIA was prepared, a 17m high debris dam was proposed to mitigate debris flow effects from the Awatarariki Stream on the township. This proposal was not supported. Reasons for this included visual effects, the risk of inundation of burial caves, cost impact on the community, a request for other measures in the upper catchment to be explored further, and consideration to be given to an alternative which would require homes in the lower Awatarariki catchment to retreat from the Fanhead and the path of future debris and flood flows.

Following further investigation, conditional support was provided by the three Iwi to a lower level debris flow control system with a flexible barrier net, based on assurances that the risk to cultural sites and other effects from the works could be appropriately managed.

The proposed plan changes are generally consistent with the above matters.

3.0 Other Statutory Policy Direction

3.1 Local Government Act

Under the Local Government Act 2002, the avoidance or mitigation of natural hazards is one of the core services that councils must have "particular regard to".

3.2 Building Act

As a building consent authority under the Building Act, the WDC must refuse to grant building consents if land is subject to a natural hazard, or if the building will accelerate, worsen or result in a natural hazard on the land or on any other property.

Building consents may be issued on land subject to, or potentially subject to, a natural hazard where the above criteria are satisfied and it is reasonable for the Council to grant a waiver from one or more provisions of the New Zealand Building Code.

[18] Cultural Impacts Assessment of Resource Consent Applications for Matatā Township Recovery Works by Whakatāne District Council & Others; 8 January 2007

3.2.1 Dangerous Buildings

In 2006, the District Council applied to the Department of Building and Housing for a determination on the appropriateness of Dangerous Building notices it issued under the Building Act on eight houses affected by the 2005 debris flow on the Awatarariki Fanhead.

A “dangerous building” is one where in the ordinary course of events, the building is likely to cause injury or death to any persons in it or to persons on other property. Where a dangerous building notice has been issued, no person may use or occupy the building.

The Department of Building and Housing determination concluded that the eight houses were not dangerous because the storm event that would trigger another debris flow was less than a 200-year event and could not be said to occur “in the ordinary course of events”[19].

This determination has been superseded by the 2015 risk assessment and a further determination by the Ministry of Business, Innovation and Employment in 2016, as detailed below.

3.2.2 New Building Work

WDC has refused to grant waivers under the Building Act which would allow new building work on land on the Awatarariki Fanhead which is subject to high risks from future debris flow hazards.

WDC’s decisions were confirmed by the Ministry of Business, Innovation and Employment (MBIE) in 2016[20]. The MBIE determination accepts that the high-risk area of the Awatarariki Fanhead is subject to a natural hazard as defined under the Building Act and that building work has the potential to worsen the hazard through mobilisation of buildings during a debris flow. The granting of a waiver to allow new building work was not found to be reasonable because of the high life safety risk and the inability to mitigate that risk.

Based on this determination, WDC can reasonably expect to be supported by MBIE in refusing other similar waivers in the same circumstances that would allow new buildings or extensions of existing buildings within the Awatarariki Fanhead area that is subject to high debris flow risk. Based upon this determination (or the principles which underpin that determination) it is expected that no new building work will be able to be undertaken within the high risk area of the Awatarariki Fanhead.

3.3 Civil Defence Emergency Management Act 2006

One of the purposes of the Civil Defence Emergency Management Act 2002 (CDEMA) is to encourage and enable communities to achieve acceptable levels of risk by,

(i) identifying, assessing, and managing risks; and

(ii) consulting and communicating about risks; and

(iii) identifying and implementing cost-effective risk reduction; and

(iv) monitoring and reviewing the process;

[19] Determination 2006/119

[20] Determination 2016/034

All persons exercising functions in relation to the development and implementation of civil defence emergency management plans under this Act may be cautious in managing risks even if there is scientific and technical uncertainty about those risks.

Every regional council and every territorial authority within that region must unite to establish a Civil Defence Emergency Management Group and establish a Group Plan.

Land use risk reduction policies within a CDEM Group Plan should be linked to a Regional Policy Statement, then down to regional and district plans.

The CDEM Group Plan Goals include:

> "Goal 1: Reducing risk from hazards in the Bay of Plenty to acceptable levels
>
> Reducing the risk posed by hazards is a key element of CDEM. It is not possible to completely remove risk but the Bay of Plenty CDEM group will work with communities and key stakeholders to reduce risk to acceptable levels by:
>
> - Increasing our knowledge about the risks facing the Bay of Plenty.
> - Ensuring information about our hazards and risks is easily available and understandable.
> - Assisting in determining acceptable levels of risk and using this to influence policies such as long term plans, the regional policy statement, city, district and regional plans.
> - Ensuring that risks are proactively and responsibly managed.[21]"

The related "Reduction" objectives[22] are:

- Objective 1a - Improve the understanding of hazards within the Bay of Plenty, and their associated likelihood and consequences;
- Objective 1b - Undertake long term, strategic reduction of the risks from hazards through collaborative planning with CDEM stakeholders;
- Objective 1c - Continue to develop an understanding of the levels of risk acceptable to communities.

The plan changes are consistent with the CDEMA and the Bay of Plenty CDEM Group Plan.

3.4 Local Government and Official Information and Meetings Act (LGOIMA)

Under Section 44, a person may apply to a territorial authority for the issue of a Land Information Memorandum (LIM) in relation to matters affecting any land in the district.

The matters that must be in a LIM include:

> *"(a) information identifying each (if any) special feature or characteristic of the land concerned, including but not limited to potential erosion, avulsion, falling debris,*

[21] Bay of Plenty Civil Defence Emergency Management Group Plan, 2012-2017 Version 2 p3.

[22] Ibid p4

subsidence, slippage, alluvion, or inundation, or likely presence of hazardous contaminants, being a feature or characteristic that—

(i) is known to the territorial authority; but

(ii) is not apparent from the district scheme under the Town and Country Planning Act 1977 or a district plan under the Resource Management Act 1991"

This means that any person requesting a LIM for land within the hazard zones must be provided with information relating to debris hazards.

Hazard areas do not need to be included in the District Plan for the LGOIMA hazard provisions to apply.

3.5 Treaty of Waitangi Settlement Acts and Statutory Acknowledgement Areas

Three Settlement Acts relating to iwi within the Whakatāne District have been enacted, which include Matatā within the area of interest:

- Ngāti Awa Settlement Act (2005);
- Ngāti Tūwharetoa Settlement Act (2005);
- Ngāti Mākino Claims Settlement Act (2012);

Statutory acknowledgements are statements in Treaty of Waitangi settlements between the Crown and iwi partners that are intended to recognise the mana of iwi partners in relation to identified sites and areas. Statutory acknowledgements are an acknowledgement by the Crown of the cultural, spiritual, historic and traditional association of an iwi partner with each statutory site and area.

Consent authorities, the Environment Court and the Heritage New Zealand Pouhere Taonga are required to have regard to statutory acknowledgements when determining whether the relevant iwi may be adversely affected by the granting of a resource consent for activities within or adjacent to, or impacting directly on the statutory area.

The specific sites referred to in Statutory Acknowledgements are shown on the Planning Maps.

Te Kaokaoroa Historic Reserve, an urupa located on Kaokaoroa Street, is identified in the Ngāti Awa Settlement[23]:

"Te Kaokaoroa Reserve is sacred to several hapū of Ngāti Awa including Ngai Te Rangihouhiri II, Ngāti Hikakino, and Te Tāwera, because it commemorates a great battle between Government forces and the Tairawhiti force along Te Kaokaoroa o Toroa coastline in 1864.

…

Te Kaokaoroa Reserve is the resting place of Te Rangi-i-paea, a chief of Ngāti Hikakino, who was killed at the battle of Te Kaokaoroa. Many unnamed dead of Ngai Te Rangihouhiri II, Ngāti Hikakino, Te Tāwera, and other hapū of Ngāti Awa were buried at this site by Hori Kawakawa and other Ngāti Awa chiefs. Hoera-tama-titahi, chief of the

[23] Ngāti Awa Claims Settlement Act 2005Schedule 13 Statutory acknowledgement for Te Kaokaoroa Historic Reserve

Ngāti Porou contingent that was part of the Tairawhiti Force, also lies buried at Te Kaokaoroa.

Te Kaokaoroa is therefore the repository of many kōiwi tangata. Urupā are the resting places of Ngāti Awa tipuna and, as such, are the focus of whānau traditions. Urupā and wāhi tapu are places holding the memories, traditions, victories, and defeats of Ngāti Awa tipuna, and are frequently protected in secret locations.

The mauri of Te Kaokaoroa Reserve represents the essence that binds the physical and spiritual elements of all things together, generating and upholding life. All elements of the natural environment possess a life force and all forms of life are related. Mauri is a critical element of the spiritual relationship of Ngāti Awa whānui to Te Kaokaoroa."

The reserve is recognised for purposes relating to standing and notification under the Resource Management Act and the Historic Places Act including a requirement that relevant consent authorities forward summaries of resource consent applications to the Ngāti Awa governance entity.

Specific redress that indirectly relate to the Awatarariki Fanhead are identified as:

- **Ngāti Awa -** A Joint Advisory Committee is to be established over the Matatā Scenic Reserve and the Matatā Wildlife Refuge Reserve. This committee will be made up of equal numbers of members nominated by Ngāti Awa and the Department of Conservation.
- **Ngāti Tuwharetoa -** Joint Advisory Committee will be established over the Matatā Scenic Reserve and the Matatā Wildlife Refuge Reserve. This committee will be made up of equal numbers of members nominated by Ngāti Tuwharetoa (Bay of Plenty) and the Department of Conservation.

The proposed plan changes do not conflict with the identified outcomes in the Settlement Acts.

4.0 Resource Management Issues Analysis

4.1 Existing Environment

The Awatarariki Fanhead comprises an area of approximately 7 ha with access from Arawa and Richmond Streets to the local street network.

The Awatarariki Stream passes through the Fanhead, flowing through a sediment basin to Te Awa-o-Te Atua (Matatā Lagoon) which was restored following the debris flow event in 2005. Historically, the Rangitāiki and Tarawera Rivers flowed to the sea at this location. Immediately to the north is the Te-Awa-a-te-Atua Beach (Matatā Beach) and the coastal reserve.

Large boulders and other material from the debris flow in 2005 are clearly evident in the area. An initial clean-up of the area was proposed as part of a proposal for stream works and lagoon restoration in 2006. The Environment Court decision on the Awatarariki Stream and Lagoon restoration appeals specifically excluded the general clearance and removal of debris from the Clem Elliot Drive area on the basis that the works could have an adverse impact on Koiwi

(human remains). The Court also had concerns about the works having no clear hazard mitigation benefit and of enabling construction in an area at risk from future debris flows[24].

16 homes are located in the high risk area on the Fanhead. There are a further 18 vacant sections.

State Highway 2 and the East Coast Main Trunk Railway passes though the Fanhead adjacent to the stream exit point from the escarpment. The plan change proposals have no bearing on or implication for the East Coast Main Trunk Railway, nor its operation.

4.2 Susceptibility and Risk from Debris Flows on the Awatarariki Fanhead

4.2.1 Quantitative Risk Assessment

Susceptibility and risk from debris flows on the Awatarariki Fanhead have been carefully studied and assessed in a series of peer-reviewed reports undertaken since the May 2005 event.

The assessments that support the proposed plan changes are:

- Quantitative Landslide and Debris Flow Hazard Assessment Matatā Escarpment November 2013[25]
- Supplementary Risk Assessment Debris Flow Hazard Report, Matatā, Bay of Plenty, July 2015[26]
- Peer Review: Awatarariki debris-flow-fan risk to life and retreat-zone extent, November 2015[27]

The Supplementary Risk Assessment Debris Flow Hazard Report and Peer Review are included in Appendix 3.

There are uncertainties in the reporting caused by the limited records of past events and the consequent difficulty in assigning return periods to event magnitudes (i.e. how often debris flows are likely to occur and how big they are likely to be). Assessments have been based on a combination of computer modelling, aerial photography and geospatial plotting of individual boulders, as well as professional insights from recognised independent experts in the field of geological science on issues that are not readily quantified in modelling.

The assessments identify a debris flow is a significant threat to life and property due to the presence of large boulders and trees in the debris flow, combined with the volume, density, and velocity of the flow. The levels of uncertainty and threat risk mean that a precautionary approach has been adopted for the identification of a high risk area. A precautionary approach is appropriate in that it ensures the level of risk is not underestimated. The high risk area is the area where loss-of-life risk significantly exceeds levels that are generally acceptable, both internationally and nationally[28].

[24] Environment Court Decision 035/2009 Para 35, 61 and 67

[25] Tonkin & Taylor Ltd Ref: 29115 https://www.Whakatāne.govt.nz/about-the-council/council-projects/debris-flow-and-landslide-hazards

[26] Tonkin & Taylor Ltd Ref: 29115.2000

[27] M.J. McSaveney, T.R.H. Davies

[28] Annual loss of life risk modelled at greater than 10^{-5} but considered to be higher due to limitations of the model

The area susceptible to debris flows outside the high risk area is not free of risk from debris flows. Debris flow events could result in loss of life and damage to property outside of the high risk area. WDC also has a duty to control development in areas where the risk is assessed as being greater than low.

The extent of the area susceptible to damage from a debris flow (yellow area), the area subject to high risk (within the black dashed lines) and the area subject to medium risk (within the dashed red line) is shown on the plan provided by the Peer Review[29].

The high, medium and low risk areas are shown on the Map in Appendix 4.

4.2.2 Regional Policy Statement - Methodology for Risk Assessment

Change 2 (Natural Hazards) was incorporated into the Regional Policy Statement (RPS) and become operative on 5 July 2016. Change 2 inserted natural hazards provisions into the operative Bay of Plenty Regional Policy Statement. The change guides those preparing regional, city and district plans and considering resource consent applications in managing land use and associated activities according to their level of natural hazard risk. This includes the requirement to undertake risk assessment at the time of plan development, or where risk has been identified.

Policies NH 8A of the Regional Policy Statement requires that a risk assessment be undertaken. “Appendix L” sets out a “default methodology” to be used to assess risk.

Appendix L allows use of a default methodology in the RPS or use of a recognised risk assessment methodology included in a regional, city or district plan or recognised in the consideration of a resource consent application. This may include risk assessment methodologies incorporated in regulations or industry codes of practice. In this case, the assessment of risk has been undertaken using the Australian Geomechanics Society, 2007. Landslide Risk Management, Australian Geomechanics. This is a recognised risk assessment methodology (RRAM) in the RPS Natural Hazard Risk Assessment User Guide.

This methodology is proposed to become part of the regional and district plan policy framework through a Schedule 1 Plan Change process.

4.3 Relationship to other Areas Subject to Landslide and Debris Flow Risk

WDC has completed hazard and risk assessments for landslides and debris flows at Ōhope, Whakatāne and Matatā.

WDC has undertaken debris flow and debris flood hazard mitigation works on the Waitepuru Stream, the Waimea Stream, and the Ohinekoao Stream. Flood mitigation improvement works have also been undertaken on the Awatarariki Stream downstream of the State Highway 2 road bridge. These completed works have been considered in the landslide and debris flow risk assessments for Matatā.

Landslide risks at Ōhope, Whakatāne and Matatā will be the subject of future plan changes to include more appropriate objectives policies and rules to manage risk. In the meantime, the risk assessment findings are being applied to the control of development under the operative hazard

[29] Peer Review: Awatarariki debris-flow-fan risk to life and retreat-zone extent - M.J. McSaveney, T.R.H. Davies 17 November 2015

zone provisions for Ōhope and Whakatāne, and in other locations, through WDC's powers under the Building Act and Resource Management Act.

It is evident that for landslide risk, unlike the debris flow risk on the Awatarariki Fanhead, there are structural or engineering solutions that can be applied to reduce those risks to acceptable levels.

4.4 Effectiveness and Efficiency of Operative District Provisions

4.4.1 Objectives and Policies

The Operative District Plan contains objectives, policies and rules relating to the management of hazards, including "falling debris and debris flow" hazards.

The District Plan objective is to manage subdivision, use, development and protection of land to avoid or mitigate the adverse effects of natural hazards on the life and wellbeing of people, and significant environmental values[30].

Any development in an identified hazard area requires resource consent where the risk to life and property must be assessed in each case.

4.4.2 Planning Maps

The majority of the land on the Awatarariki Fanhead at Matatā is zoned "Residential".

Some natural hazard areas are identified on the Planning Maps including the "NHaz4" area for falling debris and debris flows. However, at present, this identification is limited to areas at Whakatāne and Ōhope and no such hazard areas are identified at Matatā.

At the time the District Plan was publicly notified, WDC had not completed the assessment of landslide and debris flow risks at Matatā. This is explained in an advice note in the District Plan document (including on the face of the planning maps)[31][32], which says that it is likely that the District Plan maps and rules that control land use and subdivision in areas affected by landslide and debris flow hazards will need to be changed once the landslide and debris flow risk assessment has been completed.

Further, the objective and policy framework within the District Plan was developed prior to-Change 2 (Natural Hazards) to the operative Regional Policy Statement. In time, WDC will update its other natural hazards provisions to give effect to the Regional Policy Statement.

4.4.3 Land Use Rules

Under the Operative District Plan rules for the Residential Zone on the Awatarariki Fanhead, residential use is a permitted activity.

[30] Objective Haz 1

[31] Planning Map 101B

[32] 18.2.6 Falling Debris and Debris Flows

There is no rule in the District Plan that restricts the use of land on the Awatarariki Fanhead to manage risk from debris flows.

Existing use rights apply to any activity that contravenes a rule in a District Plan if the use was lawfully established and the effects of the use are the same or similar in character, intensity, and scale to those existing before the rule came into effect.

This means that any new hazard controls in a District Plan cannot be applied retrospectively and the current residential activities and buildings can continue on the land even though they may be contrary to District Plan rules.

While this is the case, following the Ministry of Business, Innovation and Employment (MBIE) determination in 2016, it is unlikely a waiver would be given to allow a building consent to be issued for a new residential dwelling.

4.4.4 Subdivision Rules

There is a general subdivision standard in the District Plan[33] that requires each lot to contain a building platform that is located to *avoid* natural hazard events such as inundation, falling debris, and subsidence.

This criterion applies to an application for a "controlled activity" in the Residential Zone where no hazards are shown on the planning maps. Normally, such an application must be granted consent, but may be subject to conditions.

However, under Section 106 of the Resource Management Act[34] the WDC may refuse subdivision consent in circumstances where *there is a significant risk from natural hazards*.

This means that where a subdivision is unable to provide building platforms that avoid a natural hazard, WDC is within its powers to refuse to grant subdivision consent, including when it is a controlled activity under the District Plan.

Based on the information WDC has about the debris flow hazard risks affecting the Awatarariki Fanhead and the inability to adequately mitigate the hazard through physical measures, it is highly unlikely that WDC could grant consent to any subdivision on the Awatarariki Fanhead.

4.5 Managed Voluntary Retreat Strategy

WDC has no legislative powers to compulsorily acquire land to enable retreat from high risk hazard areas. Current legislative powers only enable compulsory acquisition of land for public works and for heritage sites.

Acquisition of hazard-prone land has been mandated by central government in the past. Examples include Little Waihī village at the southern end of Lake Taupō in 1846 and 1910; Franz Joseph in 1993; Aoraki Mount Cook village in 2004; and the Port Hills red zone in Christchurch where owners of properties exposed to a very high boulder roll risk were paid to retreat from the hazard following the Canterbury earthquakes.

While advocacy to change legislation to provide for such a power is possible, this is highly uncertain and unlikely to provide any timely resolution of issues at Matatā.

[33] Rule 12.3.1.1 d

[34] S106 Consent authority may refuse subdivision consent in certain circumstances

Given the functions and obligations it has to manage risk from natural hazards, and that District Plan rules cannot effectively reduce that risk on the Awatarariki Fanhead; and the stress and financial burden property owners and occupiers face, WDC has developed a managed voluntary retreat strategy. The retreat strategy involves the provision of financial assistance to affected property owners to leave the high risk area.

The financial assistance proposes purchase of affected property based on the current market value of properties, ignoring the debris flow risk. The financial assistance includes additional contributions towards legal expenses for the sale of each property and purchase of a new property, a contribution to relocation costs (where applicable), mortgage break fees (where applicable), updated valuations prior to any formal offer being made, optional valuations by a second independent party, and an appeal process.

WDC considers that this solution offers an effective way for property owners to relocate away from the high natural hazard risk and fairly recognises the private burden of cost that accrues.

The funding needed to support the voluntary retreat strategy is currently being negotiated between local, regional and central government supported by a comprehensive business case[35]. If funding is approved, formal offers will be made to affected land owners to realise the retreat in the shortest reasonable timeframe.

The land acquired under the managed retreat strategy is likely to be set aside for future public use. Future activities could include those associated with passive recreational use, including, access, walkways, fencing, and landscape development. It is also likely that some of the land not in WDC ownership would be used as a commemorative area for the battle of Kaokaoroa.

4.6 Issues Summary

WDC has a statutory responsibility to manage natural hazards in areas that are subject to significant risk.

The Awatarariki Fanhead area is known to be subject to high likelihood of a debris flow. Part of the area has an overall high risk classification under the RPS risk scale.

WDC has an obligation under the RPS to take steps to reduce high hazard risk at least to medium levels, and to reduce medium risk to be as low as reasonably practicable. Given the inadequacy of engineering solutions the only way to meet this obligation is to reduce the potential consequences of a debris flow event through land use planning mechanisms.

WDC proposes that current land uses on the Awatarariki Fanhead are subject to managed retreat, implemented through a package of district and regional planning provisions and a Council proposal for the purchase of affected properties at the current market value, ignoring debris flow risk.

The proposed managed retreat strategy provides a direct means of reducing risk. The outcome from this will remain uncertain while funding is secured and negotiations occur with land owners.

While the District Plan does not yet identify the debris flow risk on the Awatarariki Fanhead, the current situation is that it unlikely that any new subdivision or building could be allowed to occur on the land, as this would not comply with provisions of the Resource Management Act and

[35] Debris Flow Risk: A way forward for the Awatarariki Stream fanhead, Draft Indicative Business Case 16 August 2017

Building Act. Under these provisions, debris flow hazard risk can be managed so that it does not increase.

No District Plan provisions can ensure a reduction of risk because existing use rights continue to apply. Only a rule in the Regional Plan can remove existing use rights and reduce risk by terminating existing residential activities in the high-risk debris flow area.

Regardless of the managed retreat proposal, debris flow risk associated with existing and future development needs to be managed under the District and Regional Plans. This relates to:

- Managing the risk that could remain inside the high-risk area if there was incomplete take up of the managed retreat strategy, or failure of the managed retreat strategy;
- Managing the risk that remains in areas affected by debris flows in the medium risk area.

5.0 Consultation

Under Clause 3(1) of Schedule 1 of the RMA local authorities are required to consult the Minister for the Environment, local authorities who may be affected by the plan, the tangata whenua of the area who may be so affected, through iwi authorities.

5.1 Ministry for the Environment

Ministry for the Environment personnel have attended project team meetings by invitation and provided comments on draft assessments and plan change documentation.

5.2 Bay of Plenty Regional Council

Consultation has occurred with policy staff of BOPRC to discuss matters relating to Regional Policy Statement compliance and matters relating to the proposed plan change. BOPRC have provided comment on draft assessments and plan change documentation, including advice on aligning the plan change with the re-issued RNRP.

5.3 General Community Engagement on Debris Flow Hazard Management in Matatā

A summary of key decisions, actions and engagement since the 2005 debris flow event is included in Appendix 6.

5.4 Consultation on Proposed Plan Changes

In addition to the engagement that has occurred since the debris flow in 2005, consultation with the directly affected parties in the high and medium risk areas, the wider Matatā area, and Iwi, occurred during August, September and October 2017.

Drop in days for the property owners and occupiers in the high and medium risk areas were held at St Joseph's church hall on 15, 21, and 25 August 2017. These open days were well attended, with 28 people from the high and medium risk areas attending.

A drop in day was also held for the owners and occupiers of properties in Matatā was held on 13 September 2017. Eight people took the opportunity to attend this drop in day.

A review of the comments made during consultation meetings with the people with properties in the high risk area of the Awatarariki Fanhead falls into two groups of interests.

One group of interests generally accept that the risk to life and property is high, and that Council should advance the issue to let them move on with their lives. This group wants the Managed Retreat Package to be advanced as soon as possible. For some, the indicative offer needs further work to make it acceptable to them. This group had less interest in the details of the proposed Plan Changes because they saw the Managed Retreat Package as largely addressing the issue.

The other group, most of whom identify themselves as the "Matatā Action Group", do not support the Council and its approach to managing the debris flow hazard at Awatarariki. This primarily stems from 12 years of decisions and actions by WDC that they consider to be inappropriate. Most of this group do not believe that the risk assessments undertaken by Council and its consultants, including peer reviews, are credible. Some in this group indicated an acceptance of the risk, but expressed a wish to be able to be allowed to live with the risk.

For this latter group, the decision by WDC to request a change to the Regional Plan, when previously this was not proposed, has increased the displeasure with the process. Several of the Action Group members have expressed the view that initiating the Regional Plan Change was "closing the back door" before they had a chance to escape.

A view common to both groups is the focus on the Managed Retreat Package being concluded as expeditiously as possible, and an acceptable offer being made.

Consultation with Ngāti Awa, Ngāti Rangitihi, and Ngāti Rangitihi Raupatu Trust provided an initial indication support for retreat from the high risk area. Consultation with Ngāti Tūwharetoa ki Kawerau will continue to be initiated.

Ngāti Hinerangi Trust, representing the owners of 21,23,25,27 and 29 Clem Elliot Drive, 106, 108, and 110 Arawa Street, and 2 and 4 McPherson Street, were consulted separately. Given that Council have for some time worked with this group to enable their aspirations for that property, as a commemorative site for the battle of Kaokaoroa.

5.5 Advice from Iwi Authorities

Under Clause 4A of Schedule 1 of the RMA local authorities are required to:

- provide a copy of any draft policy statement or plan to any iwi authority previously consulted under clause 3 of Schedule 1 prior to notification;
- allow adequate time and opportunity for those iwi authorities to consider the draft and to supply advice; and
- have particular regard to any advice received before notifying the plan.

S32(4A) requires evaluation reports prepared in relation to proposed policy statements and / or plans to include summaries of:

- all advice received from iwi authorities concerning the proposal; and
- the response to that advice, including any proposed provisions intended to give effect to the advice.

The following is a summary of the advice received from iwi authorities specific to the draft / proposed provisions evaluated within this report:

5.5.1 Ngāti Awa

Ngāti Awa have repeated their preference for retreat from the lower Awatarariki catchment as stated in their 2009 addendum to a joint Cultural Impact Assessment undertaken alongside Ngāti Rangitihi and Ngāti Tūwharetoa ki Kawerau. It is acknowledged that the Whakatāne District Council endeavoured to find an engineering solution to manage the debris flow hazard. There was also concern expressed for the residents of the Awatarariki Fanhead, and Te Rūnanga o Ngāti Awa considers that the retreat option will bring certainty to the affected families and the wider community. Ngāti Awa have indicated they wish to submit on each of the plan changes once they are notified. These comments are consistent with the plan change, and it is considered that no further changes are required.

5.5.2 Ngāti Rangitihi

Te Mana o Ngāti Rangitihi Trust supports the comments made by Ngāti Awa relating to the Regional and District planning provisions proposed. They have also indicated that they wish to submit once the plan changes are notified. Following these comments, it is considered that no further changes are required.

5.5.3 Ngāti Tūwharetoa ki Kawerau

Comment from Ngāti Tūwharetoa ki Kawerau is expected to be received shortly.

Given that the 2009 addendum to the 2007 Cultural Impact Assessment from Ngāti Tūwharetoa ki Kawerau reached the same conclusion as that received from Ngāti Awa and Ngāti Rangitihi, it is anticipated that similar comment will be received.

5.5.4 Mataatua District Māori Council

A hui was held with Chairman Maanu Paul and Secretary David Potter at Whakatāne District Council on the 11th of September 2017. Also in attendance were Alice Kranenburg, Shane McGhie and Jeff Farrell from Whakatāne District Council and Martin Butler from Bay of Plenty Regional Council. Formal comments were received on the 4th of December 2017, and these align closely with the kōrero at the earlier hui.

Mr Paul and Mr Potter gave detail of historical murupara (debris flow) events, and said that they couldn't see any alternative but to retreat from the Awatarariki Fanhead. They cited climate change leading to more heavy rainfall events, which could increase the likelihood of more devastating murupara in the future. They have explicitly stated their support for the private plan change request to retreat from the Fanhead.

Mr Paul and Mr Potter commented that much of the Awatarariki catchment has been converted from bush to farmland. However, it is Whakatāne District Council's understanding the

Awatarariki catchment is small and steep, and predominantly in bush cover so is unsuitable for farming. The land use within the Awatarariki catchment has been fully considered in the risk assessment and does not change the need for, or form of the proposed plan changes.

Comments were also made about identifying the active Awatarariki, Waimea and Waitepuru geological faults dissecting Matatā, and including any homes within 20 metres of these faults in the retreat. Because of the discrete nature of the identified hazard, as well as the urgency relating to the high risk to life, plan change is limited to addressing debris flow hazard on the Awatarariki Fanhead. Other hazard issues affecting the District will be addressed in the future.

6.0 Evaluation of Objectives

Section 32(1)(a) requires that an evaluation report must examine the extent to which the objectives of the proposal being evaluated are the most appropriate way to achieve the purpose of this Act.

Objective 31 of the Operative RPS is:

> *"Avoidance or mitigation of natural hazards by managing risk for people's safety and the protection of property and lifeline utilities".*

Objective Haz 1 of the Operative District Plan is:

> *"Manage the subdivision, use, development and protection of land so as to avoid or mitigate the adverse effects of natural hazards on the life and wellbeing of people, and significant environmental values."*

No changes are proposed to the operative District Plan objective. The operative objective is consistent with, and assessed as the most appropriate way to achieve, the purpose of the Act which in this case is Section 6(h) the *management of significant risks from natural hazards*.

A proposed new objective for the Regional Natural Resources Plan is:

> *"Avoidance or mitigation of debris flow hazard by managing risk for people's safety on the Awatarariki Fanhead"*

This objective is appropriate having regard to:

Relevance

This objective is directed to addressing a resource management issue. It reflects the specific circumstances that apply on the Awatarariki Fanhead at Matatā and the focus on reducing risk to life. The proposed objective is consistent with, and assessed as the most appropriate way to achieve, the purpose of the Act which in this case is Section 6(h) the management of significant risks from natural hazards. The objective is within the scope of RPS Objective 31 which is *"Avoidance or mitigation of natural hazards by managing risk for people's safety and the protection of property and lifeline utilities".*

Feasibility

This outcome is realistically able to be achieved within council's powers, skills and resources.

Acceptability

The objective is consistent with, and gives effect to, the RPS provisions relating to natural hazard management. Therefore, the objective will not result in unjustifiably high costs on the community or parts of the community.

7.0 Evaluation of Provisions

7.1 Section 32 Requirements for preparing and publishing evaluation reports

Section 32(1)(b) requires that an evaluation report must

> *examine whether the provisions in the proposal are the most appropriate way to achieve the objectives by—*
>
> *i. identifying other reasonably practicable options for achieving the objectives; and*
>
> *ii. assessing the efficiency and effectiveness of the provisions in achieving the objectives; and*
>
> iii. *summarising the reasons for deciding on the provisions; and*

Section 32(1)(c) requires that an evaluation must contain a level of detail that corresponds to the scale and significance of the environmental, economic, social, and cultural effects that are anticipated from the implementation of the proposal.

An assessment under subsection (1)(b)(ii) must—

(a) identify and assess the benefits and costs of the environmental, economic, social, and cultural effects that are anticipated from the implementation of the provisions, including the opportunities for—
   i. economic growth that are anticipated to be provided or reduced; and
   ii. employment that are anticipated to be provided or reduced; and
(b) if practicable, quantify the benefits and costs referred to in paragraph (a); and
(c) assess the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the provisions.

7.2 Evaluation Method

7.2.1 Reasonably Practicable Options

The reasonably practicable options identified for evaluation are the outcome of a process of assessment and evaluation and engagement with the community and other stakeholders.

Several non-regulatory options (risk acceptance, engineering or structural, catchment management, warning and evacuation) are identified but excluded. The reasons for their exclusion are set out.

Managed voluntary retreat is identified as an option and whilst this offers a potentially effective option, it has not yet been proven as practicable as it remains subject to funding approval.

Regulatory options under the District Plan and Regional Natural Resources Plan are described in detail sufficient for evaluation.

7.2.2 Assessing Effectiveness

Effectiveness generally means consideration of the extent to which an intended outcome will be achieved by an option.

In this case, the relevant outcomes against which effectiveness of an option should be assessed are:

- Risk reduction in the High Risk Area to medium levels (and lower if reasonably practicable);
- Risk reduction in the Medium Risk Area to as low as reasonably practicable.

An option must be assessed as reasonably effective and not fatally-flawed before its efficiency is considered.

7.2.3 Assessing Efficiency

Efficiency is a measure of the cost per unit of benefit gained. The most efficient option will be the one that can achieve the outcome at least overall or net cost, taking into account all costs and benefits arising from the intervention.

This is confirmed and emphasised by the Environment Court in Royal Forest & Bird Protection Society Inc v Whakatāne District Council [2017] NZEnvC 051 (Royal Forest & Bird). In that decision, Judge Kirkpatrick confirmed at paragraph [59]:

> *"(59) In considering what rule may be the most appropriate in the context of the evaluation and the section 32 of the act, we consider that notwithstanding the amendments that have been made to that section in the meantime, the presumptively correct approach remains as expressed in Wakatipu Environmental Society Inc versus Queenstown Lakes District Council: where the purpose of the Act and the objectives of the plan can be met by less restrictive regime then that regime should be adopted. Such an approach reflects the requirement in section 30(1)(b)(ii) to examine the efficiency of the provision by identifying, assessing and, if practicable, quantifying all the benefits and costs from its implementation. It also promotes the purpose of the Act by enabling people to provide for their well-being while addressing the effects of their activities."*

The obligation under section 32(b)(ii) is to give effect to the objective in the least restrictive manner possible or, at the least cost possible.

Hence the efficiency of the options can be evaluated and compared by assessing the following:

- Costs and benefits of establishing the provisions;
- Costs and benefits of compliance with the provisions.

7.2.4 Economic Growth and Employment

Provision or reduction of economic growth and employment will not be significant issues for the proposed plan changes. The affected area does not contain any significant business or employment activities.

The removal of the ability to use parts of the Awatarariki Fanhead in the future in ways that create economic and employment opportunities will have minimal impact on community well-being in the long term. That is because of the relatively small area affected by the planning provisions and the high likelihood that other values and interests in the area would, in any event, have curtailed development beyond a small number of additional residential uses.

7.2.5 Risk of Acting or Not Acting

Risks of acting are:

- Future research on debris flows may identify new information that could reduce the assessed risk and may enable more existing development to remain on the Fanhead than provided for in the rules as proposed;
- Development of warning systems could improve reliability to the point that enables existing development to remain on the Fanhead.

In either case, unnecessary cost may have been imposed.

There is no indication that either of these outcomes are likely. The information on which the plan changes are based has been developed through a rigorous process and applies the best available information and methods. The efficacy of warning system, no matter how sophisticated, will rely on self-evacuation within a short timeframe that cannot be assured.

Risks of not acting are:

- Activities will remain susceptible to a debris flow event occurring that causes fatalities and damage to property as quantified in the risk assessment;
- The inability to obtain consents to enable development of land affected by the high hazard risks will not be reflected in the planning provisions that apply to the land in question;
- Potential for the District Plan to confuse and undermine public understanding of the nature of the risk;

The risks of not acting are considered to outweigh the risk of acting.

7.2.6 Scale and Significance

An evaluation must contain a level of detail that corresponds to the scale and significance of the environmental, economic, social, and cultural effects that are anticipated from the implementation of the proposal.

The proposed plan changes give effect to a higher-level RMA document, the RPS natural hazard policy. The RPS is directive, with the requirement to reduce risk from high to medium or as low as reasonably practicable being placed on the District Council. The appropriateness of this policy has been determined through the RPS plan preparation. The District Council is required to identify effective measures to reduce natural hazard risk and to assess efficiency.

While the degree of change is significant, this applies to a localised and limited number of properties and land owners and relates to a relatively unique set of circumstances.

The most significant effects of the change (removal of current land uses from high risk zone) will occur in the short to medium term. While the proposed changes are in part new and untested, there is a high degree of confidence in the assessment of natural hazard risk and the appropriateness and legal validity of the proposed plan provisions as a measure to minimise loss of life.

The evaluation and supporting documentation provide assessments of hazard risk to a level of detail and rigour using best practice methods that recognises the significant economic and social implications for identified individual property owners. Consultation with all directly affected land owners has occurred.

Non-regulatory options that might have avoided or lessened social and economic impacts on land owners have been evaluated by recognised experts using the best available data.

The other effects of the change (managing risk to land uses that remain in medium risk zone) are consistent with existing plan provisions and are of minor significance.

8.0 Non-Regulatory Options

8.1 Risk Acceptance

Although residents have indicated varying degrees of acceptance of natural hazard risk, WDC, BOPRC, and Central Government all have overarching legislative responsibilities to act on behalf of communities to reduce or mitigate risk to life safety from natural hazards.

There is a clear difference between individual acceptance of a risk and wider community acceptance, especially as risks relating to continued occupation of the high risk area are not confined to the current residents. Community risks remain for those engaged in any future response to a debris flow including the potential need to rescue affected homeowners, and supporting the recovery of the area for re-occupation

A financial costing of a repeat event (the same magnitude as 2005) can be found below. These costings were completed in 2016 as part of the Indicative Business Case development. The figures are reflective of a debris flow occurring in the year 2020. Inflation and discount value aren't included in these figures[36].

Loss of Life - $4,214,914 value of statistical life x 5 – based on magnitude 300,000m^3 with 200 return period	$21,074,570
Loss of 16 Dwellings as valued in 2016	$7,690,035

[36] Debris Flow Risk: A way forward for the Awatarariki Stream fanhead, Draft Indicative Business Case 16 August 2017 Page 67

Loss of 16 Household's contents - $76,000 each based on ANZ average house contents	$1,216,000
WDC and BOPRC Recovery Costs	$2,298,519
Welfare Response and Recovery Costs	$86,317
Total Costs of a repeat event in the year 2020	**$32,365,441**

8.2 Engineering or Structural

Engineering or structural options to reduce risk have been thoroughly investigated and proven not to be reasonably practicable.

This includes protection work undertaken on an area-wide basis such as debris dams, bunds and channels; and works to protect property in the high risk area such as raised building platforms and debris barriers.

8.3 Catchment Management

Catchment management options include measures such as tree planting to stabilise valley sides and active management of debris build up behind naturally occurring log-jam dams.

These options have been investigated and the conclusion is that effectiveness of measures of this type are uncertain and are likely to have only a minor influence on the size and impact of a debris flow event[37]. The intensity of rainfall that causes debris flow is such that it will overwhelm the catchment causing debris avalanches into the stream and bed scour that generate most of the destructive material in the flow.

It is estimated that a maximum of about 40,000 – 50,000 m^3 of debris may have been present in Awatarariki stream in storage behind log-jam dams prior to the 2005 debris flow. This is 8 – 14% of the estimated total volume of the event, and is less than the margin of error of the total volume estimate. Maintaining the catchment free of log-jams will not contribute to reducing debris-flow risk on the Awatarariki Fanhead.

These measures are also logistically difficult and require long term public resource commitments that cannot necessarily be assured.

On this basis, catchment management measures would not derogate from the precautionary approach recommended through the risk assessment process.

[37] The Significance of Sediment Stored Behind Log Dams to the 2005 Awatarariki Debris Flow; Implications for Risk Management; Tim Davies, Dept Of Geological Sciences, University Of Canterbury September 2017

8.4 Warning and Evacuation

Warning systems have the potential to reduce risk-to-life to an acceptable level by enabling residents to evacuate when it is known that a debris-flow is moving down the catchment, so that they are not in the flow-path when the debris-flow passes.

A further value of such a system would be to allow the road and rail corridors to be closed to traffic when a debris-flow impact is anticipated, again preventing possible deaths. In all these cases, the residual risk to life may be reduced substantially if an effective and reliable warning-evacuation system can be implemented.

Early warning systems and evacuation protocols have been investigated as a mechanism to protect life safety in case of an imminent debris flow in the catchment[38].

This investigation found that, while warning systems are feasible, due to the velocity of flow, proximity of dwellings, and the probable length of time it would take to evacuate, such systems cannot provide sufficient warning time, and that risk to life for residents on the Awatarariki Stream fanhead cannot be reduced by provision of a debris-flow warning system.

The investigation also found that a trip-wire debris-flow detection system at the lowest major confluence on Awatarariki Stream can trigger immediate deployments of lights and barriers on both road and rail corridors and prevent users from entering the high-risk area. Because road and rail users are present on the fan for different proportions of total time than residents, specific risk analyses would need to be undertaken to determine the acceptability or otherwise of their risk-to-life and hence the need or otherwise for a warning-closure system.

The behavioural impact of procedures for issuing warnings in hazard zones also require careful consideration. Indicators or thresholds for taking this course of action would need to be agreed ahead of time. Desensitisation by the “cry wolf” syndrome may arise if thresholds are set too low. Lives may be put at greater risk if thresholds are set too high.

Agreement would also be need reached on who would take the responsibility for the action and the continued operation of the monitoring equipment and warning systems.

On this basis, a warning system cannot be relied upon as a sound basis for allowing new development in areas of significant hazard or for existing development to remain where the risk is identified as being high.

8.5 Voluntary Managed Retreat

The option of managed voluntary retreat is discussed above in the context of background and described in the resource management issues analysis.

A detailed business case to support funding of this is being negotiated through District, Regional and Central Government[39].

Five Options are shortlisted for detailed consideration against strategic, economic, commercial, financial and management criteria.

The shortlisted options are:

[38] Awatarariki Fan, Matata: Debris-Flow Early Warning Systems Feasibility Study, T.R.H. Davies, Dept. Of Geological Sciences, University of Canterbury, December 2017

[39] Debris Flow Risk: A way forward for the Awatarariki Stream fanhead, Draft Indicative Business Case 16 August 2017

- Option 0: Status quo – to be used as baseline comparator.
- Option 1 (do minimum): Managed retreat of existing dwellings in high risk zone (300,000m^3 event), short timeframe (2020), and Plan Changes. Managed retreat for existing dwellings only (16 homes), based on magnitude event of 300,000m^3, delivered by WDC by 2020 and funded by central and local government through a retreat package.
- Option 2 (intermediate): Managed retreat of all properties in high risk zone (300,000m^3 event), short timeframe (2020), and Plan Changes. Managed retreat for all properties (16 homes and 18 vacant sections), based on a magnitude event of 300,000m^3, delivered by WDC by 2020 and funded by central and local government with a retreat package. The scale of event planned for is the same as Option 1. Option 2, however, also includes the 18 vacant privately owned sections as well as the 16 homes.
- Option 3 (less ambitious): Managed retreat of all properties in high risk zone (450,000m^3 event), long timeframe (2036), and Plan Changes. Managed retreat for all properties (18 homes and 18 vacant sections), based on magnitude event of 450,000m^3, delivered by WDC by 2036 and funded by central and local government through a retreat package.
- A magnitude 450,000m^3 event was also modelled by Tonkin and Taylor (2015) as a possibility and has been chosen to represent planning for a larger event compared with the 2005 debris flows. The risk to life safety of a repeat debris flow of this magnitude has been modelled as affecting an area containing 18 homes (2 additional properties to Options 1 and 2) and 18 privately owned sections.
- Option 4 (ambitious): Compulsory retreat of all properties in high risk zone (450,000m^3 event), short timeframe (2020). Compulsory retreat for all properties (18 homes and 18 vacant sections), based on a magnitude event of 450,000m^3, delivered by BOPRC or central government by 2020, and funded by homeowners and/or BOPRC and/or central government.

The preferred way forward is a managed retreat of 34 privately-owned properties on the Awatarariki Stream fanhead that have a high loss-of-life risk exposure to future debris flows. This option is represented by Option 2.

Of the 34 privately-owned properties within the area proposed for managed retreat, 16 are residential homes and 18 are vacant sites.

Managed voluntary retreat has not yet been proven as a practicable option as there are uncertainties about willingness to relocate, affordability and funding. This Business Case recognises that funding support from Government and the BOPRC will be necessary to commence the process of property acquisition, based on the preferred way forward and the short-listed options.

9.0 District Plan Options

Reasonably practicable options for achieving the objectives of the proposal through changes to the District Plan are described and evaluated below.

9.1 Option1 - Business as Usual

Retain the District Plan provisions as they are, as described above in the issues section.

9.2 Option 2 - Residential Zoning with "NHAZ4" Policy Overlay

Retain the Residential Zone and identify all the land susceptible to debris flow with an NHaZ4 (falling debris and debris flows) hazard notation on the District Planning Maps.

The effect of this would be to make any future development within the area susceptible to debris flow hazards a "discretionary activity" and subject to a hazard risk assessment.

This is primarily a change to the Planning Maps and would use existing District Plan methods for development control. No changes to objectives, policies and rules would be required.

9.3 Option 3 - Coastal Protection Zone with "NHAZ4" Policy Overlay

Rezone the area of existing residential land at high debris flow risk (retreat area) to Coastal Protection Zone and identify all land susceptible to debris flow hazard with an NHaZ4 (falling debris and debris flows) hazard notation**.**

Properties susceptible to debris flow outside the retreat area would retain a Residential Zone/NHaZ4 notation as for Option 2.

The effect of this would be to make any future development within the area susceptible to debris flow hazards a "discretionary activity" and subject to a hazard risk assessment.

This is primarily a change to the Planning Maps and would use existing District Plan methods for development control. No changes to objectives, policies and rules would be required.

9.4 Option 4 - Coastal Protection Zone with "Awatarariki Debris Flow Policy Area"

This option creates a new Awatarariki Debris Flow Policy Area with High Risk, Medium Risk and Low Risk Areas identified as hazard overlays on the Planning Maps.

In the High Risk Debris Flow Area, permanent occupation by susceptible activities would be a Prohibited Activity. The existing residentially zoned land would be zoned Coastal Protection

Zone reflective of its limited development potential, and future use and relationship to the coastal reserve.

In the Medium Risk Debris Flow Area, land would retain a Residential Zone and would be subject to controls through the Resource Consent process restricting future development unless a reduced level of risk can be proven.

In the Low Risk Debris Flow Area, land would retain a residential zoning. The level of risk would be identified in the District Plan and LIMs, and taken into account in any resource consent application proposing to intensify activities

Changes to Planning Maps, policies, and rules would be required.

9.5 Option 5 - "Awatarariki High Risk Debris Flow Zone" with "Awatarariki Medium Risk Debris Flow Policy Area"

This option would create a new Awatarariki High Risk Debris Flow Hazard Zone on the planning maps and make permanent occupation by susceptible activities a Prohibited Activity under the District Plan.

In the Medium Risk Debris Flow Area, land would retain a Residential Zone and would be subject to controls through the Resource Consent process restricting future development unless a reduced level of risk can be proven.

In the Low Risk Debris Flow Area, land would retain a residential zoning. The level of risk would be identified in the District Plan and LIMs, and taken into account in any resource consent application proposing to intensify activities.

Changes to Planning Maps and a new zone and overlay with related policy and rules would be required.

9.6 Excluded District Plan Options

Consideration has been given to other District Plan options including:

- Incorporating the changes for Awatarariki in a District-wide Plan Change to update Planning Maps, objectives and policies and rules relating to all areas that have been identified and assessed as having falling debris and debris flow hazards (i.e. at Ōhope, Whakatāne and Matatā);
- Incorporating the changes for Awatarariki in a District-wide Plan Change to the entire Hazards Chapter to give full effect to the RPS Hazards Policy.

These options have been excluded because of the discrete nature of the issues at Awatarariki and the desire to align the work streams within the Awatarariki Debris Flow Risk Management Programme. The programme for the plan change to give full effect to the RPS is likely to continue through to at least 2022, given the extent of investigation of multiple hazards and consultation that will be required.

9.7 Evaluation of District Plan Options

The following table evaluates the options in terms of their effectiveness and efficiency.

Criteria		**Option 1 - Business as usual**	**Option 2 - Residential Zoning with "NHaZ4" Policy Overlay**	**Option 3 - Coastal Protection Zone with "NHaZ4" Policy Overlay**	**Option 4 - Coastal Protection Zone with "Awatarariki Debris Flow Policy Areas"**	**Option 5 - Awatarariki High Risk Debris Flow" Zone with "Awatarariki Medium Risk Debris Flow" and "Awatarariki Low Risk Debris Flow" Policy Overlays.**
Effectiveness	Risk Reduction in High Risk Area	Low Zoning is ambiguous given very low likelihood of being able to develop. Reliant on general Building Act and RMA process to limit development. Inconsistent with other plan provisions. Doesn't achieve reduction of current high risk.	Low - Moderate Can prevent further development and subdivision. Discretionary activity consent for any new development or subdivision enables risk to be assessed as part of resource consent process. Likely perception of potential for residential use of the land while there is a very low actual likelihood of gaining consent for residential use. Existing use rights apply so existing residential activities can continue. Doesn't achieve reduction of current high risk.	Moderate Can prevent further development and subdivision. Discretionary activity consent for any new development or subdivision enables risk to be assessed as part of resource consent process. Possible perception of potential for residential use of the land while there is a very low actual likelihood of gaining consent for residential use. Existing use rights apply so residential activities can continue. Doesn't achieve reduction of current high risk.	Moderate Will prevent further development and subdivision. No ambiguity in plan provisions as rule reflects level of risk which is not capable of mitigation. Existing use rights apply so residential activities can continue. Doesn't achieve reduction of current high risk.	Moderate Will prevent further development and subdivision. No ambiguity in plan provisions as rule reflects level of risk which is not capable of mitigation. Existing use rights apply so residential activities can continue. Doesn't achieve reduction of current high risk.
	Risk Reduction in the Medium Risk Area	Low No reduction in risk – reliant on Building Act process. Inconsistent with other plan provisions.	Low/Moderate Can control further development and subdivision. Resource Consent process for any new development or subdivision enables risk to be assessed as part of resource consent process. Existing use rights apply so residential activities can continue. Can achieve reduction of current medium risk over time as redevelopment occurs.	Moderate Can control further development and subdivision. Resource Consent process for any new development or subdivision enables risk to be assessed as part of resource consent process. Existing use rights apply so residential activities can continue. Can achieve reduction of current medium risk over time as redevelopment occurs.	Moderate Can control further development and subdivision. Resource Consent process for any new development or subdivision enables risk to be assessed as part of resource consent process. Existing use rights apply so residential activities can continue. Can achieve reduction of current medium risk over time as redevelopment occurs.	Moderate Can control further development and subdivision. Resource Consent process for any new development or subdivision enables risk to be assessed as part of resource consent process. Existing use rights apply so residential activities can continue. Can achieve reduction of current medium risk over time as redevelopment occurs.
	Risk Management in the Low Risk Area	Low	Moderate	Moderate	Moderate	Moderate

Criteria		Option 1 - Business as usual	Option 2 - Residential Zoning with "NHaZ4" Policy Overlay	Option 3 - Coastal Protection Zone with "NHaZ4" Policy Overlay	Option 4 - Coastal Protection Zone with "Awatarariki Debris Flow Policy Areas"	Option 5 - Awatarariki High Risk Debris Flow" Zone with "Awatarariki Medium Risk Debris Flow" and "Awatarariki Low Risk Debris Flow" Policy Overlays.
		No management of risk – reliant on Building Act process. Inconsistent with other plan provisions. Fails to give effect to the RPS	The level, albeit low, is identified and persons considering purchase and/or development are made aware of the risk.	The level, albeit low, is identified and persons considering purchase and/or development are made aware of the risk.	The level, albeit low, is identified and persons considering purchase and/or development are made aware of the risk.	The level, albeit low, is identified and persons considering purchase and/or development are made aware of the risk.
Efficiency	Establishment process	Not assessed. An option must be assessed as reasonably effective and not fatally-flawed before its efficiency is considered.	Moderate Changes are over a discrete area with robust technical basis. Minimal changes to District Plan.	Moderate Changes are over a discrete area with robust technical basis. Minimal changes to District Plan.	Moderate Changes are over a discrete area with robust technical basis. Changes consistent with the Operative District Plan structure and potentially consistent with the format of pending national planning standards as indicated through Ministry for the Environment consultation.	–Low - Moderate Changes are over a discrete area with robust technical basis. Plan amendments to create new zoning and overlay are more extensive than for other options. Potentially inconsistent with the format of pending national planning standards as indicated through Ministry for the Environment consultation.
	Implementation process	Not assessed. An option must be assessed as reasonably effective and not fatally-flawed before its efficiency is considered.	Moderate Ambiguous approach in high risk area where there is no realistic prospect of resource consent being granted. Introduces appropriate consideration of risk for new development in Medium Risk Area.	Moderate - High Less ambiguous approach in high risk area where there is no realistic prospect of resource consent being granted. Introduces appropriate consideration of risk for new development in Medium Risk Area.	Moderate – High Provides unambiguous control in the High Risk Area. Introduces appropriate consideration of risk for new development in the Medium Risk and Low Risk Areas.	Moderate – High Provides unambiguous control in the High Risk Area. Introduces appropriate consideration of risk for new development in the Medium Risk and Low Risk Areas.

9.8 District Plan Option Evaluation Summary

Option 1

Option 1 (Business as Usual) does not reflect the actual natural hazard risk that is present and is inconsistent with the RPS and other District Plan provisions. Successful implementation of hazard risk management outcomes relies on the general requirements of the Building Act and RMA that apply to building and subdivision only, and does not deal with risk reduction.

Options 2 and 3

Options 2 and 3 (Residential or Coastal Protection Zone with NHaz4 hazard notations) are very similar in terms of activity status and assessment criteria for hazard management. A plan change for Option 2 or Option 3 would be limited to Planning Map amendments.

Retaining a Residential Zone in the high-risk hazard area is ambiguous in that it sets a planning direction that residential (i.e. new dwelling development) is enabled which is not the case given the very low likelihood of gaining consent for actual residential use through either a subdivision consent, or building consent process.

The Coastal Protection Zone is the zone that applies to other land in the coastal reserve, so this should promote a more consistent, long-term approach to land use decisions in the high risk area.

Options 2 and 3 are both ineffective in reducing high loss-of-life and property risk. Existing use rights would continue to apply, although would be effective in areas susceptible to debris flows that are outside the high-risk area.

Option 4

Option 4 provides a clear statement on the nature and implications of the debris flow natural hazard risk and differentiates between the two levels of risk.

This option sets a clear direction on land use management within the high risk area. Option 4 is consistent with the Operative District Plan structure and potentially consistent with the format of pending national planning standards as indicated through Ministry for the Environment consultation.

However, as existing use rights would continue to apply, this option is ineffective in achieving the objective of reducing high loss-of-life risk.

Option 5

Option 5 has the same effectiveness as Option 4.

As for Option 4, existing use rights would continue to apply, so this option is also ineffective in achieving the objective of reducing high loss-of-life risk. A specific zone may provide a clearer message to landowners and the wider community. However, the additional complexity of adding a new zone and overlay does not increase effectiveness and marginally reduces efficiency of the Plan Change process.

Outcome of Evaluation

Option 4 is assessed as the most appropriate option. However, any District Plan rules can only be effective in managing risk for redevelopment or for new development. The ability to reduce current risk is impeded by existing use rights.

To be effective in reducing risk in the high risk area, as required by the RPS, a change to the Regional Plan to prohibit residential activity in the high risk area is needed.

A proposed change to the District Plan that gives effect to Option 4 is included in Appendix 7.

10.0 Regional Natural Resources Plan Options

Reasonably practicable options for achieving the objectives of the proposal through changes to the RNRP are described and evaluated below.

As a change to a RNRP can only be made by Bay of Plenty Regional Council, WDC are requesting a Plan Change under Part 2 of the Schedule 1 to the Resource Management Act be undertaken by that Council, which has been prepared by WDC.

10.1 Option 1 – Business as Usual

Business as usual would continue with RNRP having no provisions related to the management of debris flow natural hazards. This method relies on District Plan provisions to manage natural hazards outside the Coastal Marine Area.

10.2 Option 2 - Residential Use of High Risk Sites on Awatarariki Fanhead a Prohibited Activity

A change to the RNRP would make all residential development on sites subject to high risk on the Awatarariki Fanhead a Prohibited Activity. Natural hazard provisions would be added to the Operative Regional Natural Resources Plan including an issues summary, and objectives, policies and rules.

Affected sites at Awatarariki subject to high risk would be specifically identified in a schedule. The prohibition would apply only to affected sites that are currently in residential use and/or have existing use rights under section 10 of the Act enabling a previous use to re-establish.

It is also reasonable to consider the anticipated completion of the managed retreat strategy property acquisition process (forecast as December 31, 2020) and to set an appropriate date shortly after this for the Prohibited Activity rule to apply. This will avoid creating conflict with the land purchase agreements. Three months after this date is proposed with a date of 31 March 2021 when the rule will apply.

A later date for the rule to apply could give more time for owners to address consequential impacts, but would also increase risk by prolonging their exposure to debris flow risks.

The prohibition would be enforceable under the provisions of the RMA through an abatement notice or enforcement order, both enforced by the Regional Council.

10.3 Option 3 - Residential Use of High Risk Sites on Awatarariki Fanhead Subject to Land Use Consent

Affected sites at Awatarariki subject to high risk would be specifically identified in a schedule as for Option 2. However, this option would make continued occupation of the high risk area subject to obtaining resource consent for a maximum fixed duration, with the actual occupation duration determined on a case by case basis through a resource consent application process.

Conditions could be imposed to limit residential use (including, for example, restricting the ability to let properties at short term holiday rentals).

10.4 Option 4 - Defer any Regional Plan Change until outcome of the offer to purchase is known, then Option 2 if required.

This option would defer action on a regional plan change until the outcome of the offer to purchase is known. The rationale for this is that if all owners were to reach an agreement on purchase, the need for a regional plan change would be avoided.

If a plan change were needed, this would follow Option 2.

10.5 Excluded Regional Plan Options

A regional plan change that addresses mitigation of high risk sites on a region-wide basis (i.e. at locations other than Awatarariki) has been excluded.

This option has been excluded because of the discrete nature of the issues at Awatarariki and the desire to align the work streams within the Awatarariki Debris Flow Risk Management Programme.

The programme for the plan change to give full effect to the RPS across the region is likely to continue over several years given the extent of investigation of multiple hazards and consultation that will be required.

10.6 Evaluation of Regional Plan Options

The table below evaluates the options in terms of their effectiveness and efficiency.

Criteria		**Option 1 - Business as usual**	**Option 2 - Residential Use of High Risk Sites on Awatarariki Fanhead a Prohibited Activity**	**Option 3 - Residential Use of High Risk Sites on Awatarariki Fanhead subject to Land Use Consent**	**Option 4 - Defer Regional Plan Change until outcome of the offer to purchase is known, then Option 2 if required.**
Effectiveness	Risk Reduction in High Risk Area	Low Relies on District Plan provisions to manage natural hazards which are ineffective at reducing risk. Doesn't achieve reduction of current high risk.	High Current residential activities in the high-risk area must cease, and property owners retreat from the area. No ambiguity in plan provisions as rule reflects level of risk which is not capable of mitigation.	Low - Moderate Current residential activities in the high-risk area must cease, and property owners retreat from the area at date to be specified in a resource consent. Has the benefit of allowing landowners to be involved in the decisions about the timing of retreat on an individual property scale. However, this would require landowners to apply for resource consent, and a decision made to allow some landowners to remain No ambiguity in plan provisions as rule reflects level of risk which is not capable of mitigation. Delayed retreat means high risk remains for a longer period. Effectiveness depends on how long the delay is for. Potential for inconsistent outcomes unless clear criteria are specified for establishing a date for the activity to cease.	Low - Moderate Effectiveness in risk reduction is dependent on success with negotiating managed retreat. Current residential activities in the high-risk area must cease, and property owners retreat from the area. No ambiguity in plan provisions as rule reflects level of risk which is not capable of mitigation. Delayed retreat means high risk may remain for a longer period. Effectiveness depends on how long the delay is for. Some landowners have indicated that they are not willing sellers.
Efficiency	Establishment process	Not assessed. An option must be assessed as reasonably effective and not fatally-flawed before its efficiency is considered.	Low - Moderate Likely to be highly contentious for those directly affected at Awatarariki. Prohibited activity status is likely to result in opposition from property owners. Even though locality specific, the change is likely to generate some region-wide interest given the perceived precedent that could be established. Some costs will be saved from two parallel plan changes. Costs will fall on either BOPRC or WDC depending on how the process is taken forward. (i.e. BOPRC adopting vs accepting the Private Plan change request).	Low - Moderate Likely to be highly contentious for those directly affected at Awatarariki and likely to generate region wide interest. Consent process is likely to result in opposition from property owners. Flexibility in how the consent would apply offers wider scope to address affected landowner circumstances. Some costs will be saved from two parallel plan changes. Costs will fall on either BOPRC or WDC depending on how the process that is taken forward. (i.e. BOPRC adopting vs accepting the Private Plan change). There are no known examples of a regional plan rule being used in this specific	Moderate - High This option could avoid the cost of a plan change. If a change were ultimately required, this may have a narrower scope with fewer parties affected.

Criteria		Option 1 - Business as usual	Option 2 - Residential Use of High Risk Sites on Awatarariki Fanhead a Prohibited Activity	Option 3 - Residential Use of High Risk Sites on Awatarariki Fanhead subject to Land Use Consent	Option 4 - Defer Regional Plan Change until outcome of the offer to purchase is known, then Option 2 if required.
			There are no known examples of a regional plan rule being used in this specific manner, however it is specifically provided for in the RMA.	manner, however it is specifically provided for in the RMA.	
	Implementation process	Not assessed. An option must be assessed as reasonably effective and not fatally-flawed before its efficiency is considered.	High Once in place, provides unambiguous control on development in High Risk Area. Retreat for some residents may come at an economic cost as well as a social cost.	Moderate This option would require owners to make an application for resource consent to remain by a specified date, beyond which the activity would have no use rights. Lack of agreement on consent outcomes may lead to appeals. Retreat for some residents may come at an economic cost as well as a social cost. Option may provide scope for these costs to be reduced.	High Once in place, provides unambiguous control on development in High Risk Area, as for Option 2.

10.7 Regional Plan Option Evaluation Summary

Option 1

Option 1 is ineffective as this relies on District Plan provisions to manage natural hazards, which are ineffective at reducing risk.

Option 2

Option 2 is the most effective option. It recognises the intolerable risk to life on parts of the Awatarariki Fanhead and, once is place, is the most efficient means of reducing this risk to medium or lower.

Options 3

Option 3 offers scope for tailoring the effective date of termination of residential use within the high risk area to an owner's individual circumstances, although any delay reduces effectiveness. Realising this benefit will depend on owners' willingness to cooperate in applying for resource consent to set an agreed termination date for residential activity either through a resource consent application.

Option 4

Option 4 of deferring a regional plan change until the outcome of the managed retreat strategy is efficient, but there is unknown potential for reduced effectiveness and greater risk to life from a debris flow event with delayed implementation. Delay could be minimised by linking a decision on whether to proceed with a change to key steps in the managed retreat policy process such as:

- Whether funding agreements have been reached with regional and central government;
- Whether there has been a positive response from landowners to settlement offers.

Outcome of Evaluation

Option 2 is assessed as the most appropriate option that will most effectively and efficiently reduce the risk to life in the identified high risk area.

A proposed change to the Regional Resource Plan that gives effect to Option 2 is included in Appendix 8.

10.8 Overall Evaluation

Option 4 is assessed as the most appropriate Option for the Proposed District Plan Change. Option 2 is assessed as the most appropriate Option for the Plan Change request to the Bay of Plenty Regional Council.

These two options, when combined, offer an integrated response within the current planning framework of both Councils and one able to reduce the risk that the landowners and other residents are currently exposed to in the High Risk area of the Awatarariki Fanhead.

Option 4 for the District Plan Change provides explicit identification of the level of risk on parts of the Awatarariki Fanhead. It provides a tiered approach to managing the risk on different parts of the Fanhead, with restrictive rules being imposed in the high risk area, and the medium and low risk areas being subject to appropriate management.

Option 2 for the Regional Plan Change is a necessary extension of this. It is the only statutory mechanism available to give full effect to the RPS, by reducing high risk, to a medium or lower level. Allowing people to extend the time they are able to live in the high risk area (Option 3), while may achieve the objective of reducing the risk over time, will continue to expose occupiers to a high loss of life risk.

11.0 Conclusion

The Whakatāne District Council has a responsibility to manage natural hazards in areas that are subject to significant risk.

The Awatarariki Fanhead is subject to high loss-of-life risk from a debris flow event. Whakatāne District Council has an obligation under the Regional Policy Statement to take steps to reduce this risk to a least a medium level, or lower if reasonably practicable. The high risk cannot be reduced by any practicable engineering or other solutions. Reducing the risk requires land use intensification and growth to be halted and existing uses to be moved out of harm's way in the high risk areas.

Whakatāne District Council's preferred method of reducing the high risk is managed retreat, including purchase of affected property.

Despite the proposed managed retreat strategy, any residual debris flow risk associated with future development and redevelopment will need to be managed under the District and Regional Plans. This relates to:

- Managing the risk that could remain inside the high-risk area if there were incomplete implementation, or failure, of the managed retreat package;
- Managing the risk that remains in areas affected by debris flows in the medium and low risk areas.

District Plan Option 4 is assessed as the most appropriate District Plan Change option. This option creates a new Awatarariki Debris Flow Policy Area with High Risk, Medium Risk, and Low Risk Areas identified as hazard overlays on the Planning Maps. In the High Risk Debris Flow area, any susceptible activities would be a Prohibited Activity. In the Medium Risk Debris Flow Area, further development and subdivision would be subject to a resource consent application where risk reduction is specifically assessed. The Low Risk Area is identified on the Planning Maps, with an associated description in the District Plan.

This option provides a clear statement on the nature and implications of the debris flow natural hazard risk and differentiates between the levels of risk. However, as existing use rights would continue to apply, this option is ineffective in achieving the objective of reducing high loss of life risk.

A proposed change to the District Plan that gives effect to Option 4 is included in Appendix 7.

Regional Plan Option 2 is assessed as the most appropriate regional plan change option. This option makes existing residential development on sites subject to high risk on the Awatarariki Fanhead a Prohibited Activity. Provisions would be added to the Operative Regional Natural Resources Plan including objectives, policies and rules.

Affected sites at Awatarariki subject to high risk would be specifically identified in a schedule. The prohibition would apply only to affected sites that are currently in residential use or that have existing use rights under section 10 of the Act enabling a previous use to re-establish. The rules would specify the date when the prohibition is to take effect. The prohibition would take effect following the anticipated completion of the managed retreat strategy property acquisition process (31 March 2021).

This option is effective at achieving the objective of reducing high risk hazards, and the timeframe is aligned with the implementation of the managed retreat strategy.

A proposed change to the Regional Resource Plan that gives effect to Option 2 is included in Appendix 8.

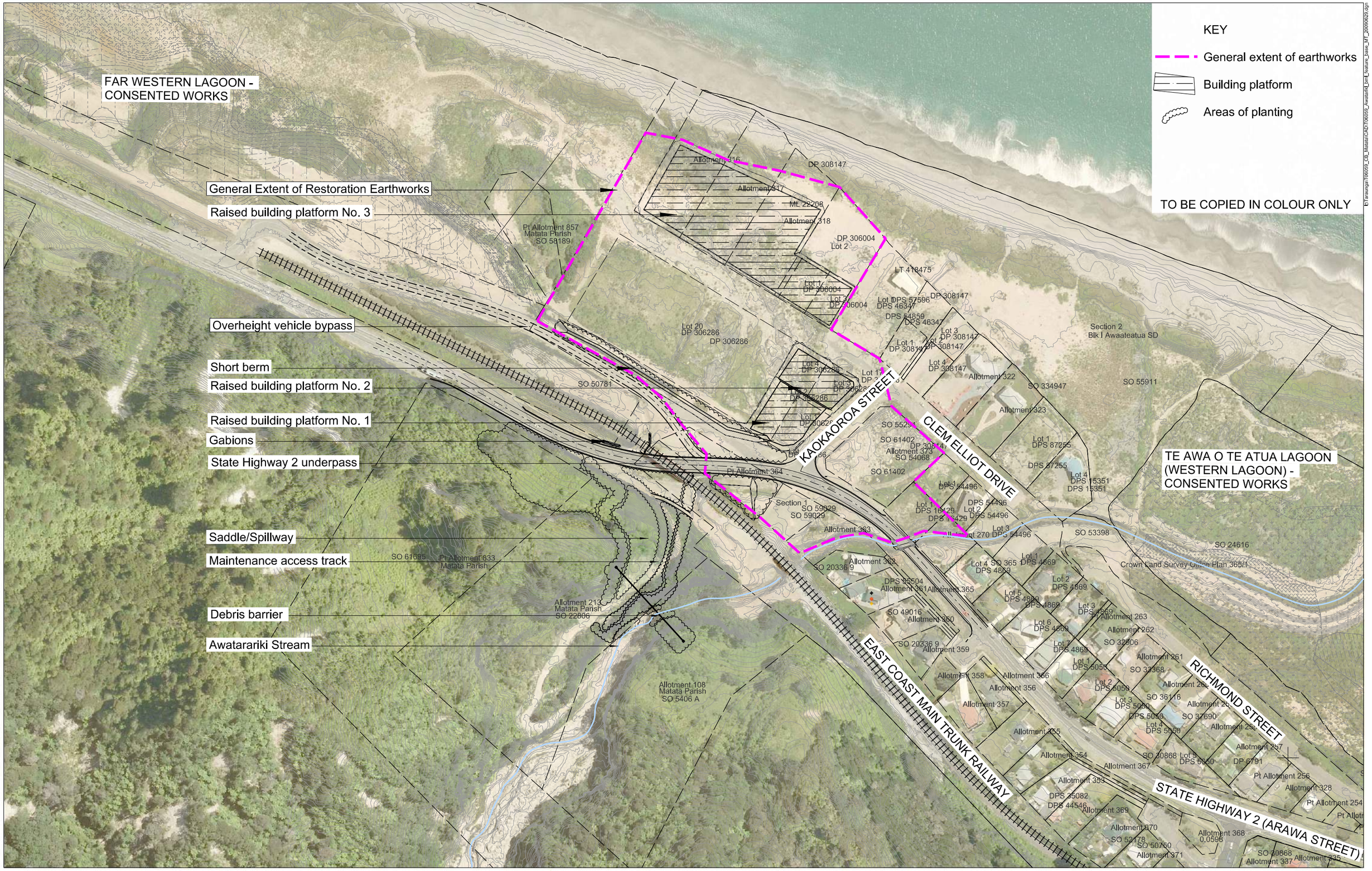
Appendix 1 – Location Plan

Appendix 1 – Location Plan

Matatā Locality

Awatarariki Stream and Fanhead Locality

Appendix 2 - Previously Proposed Debris Flow Control System



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Notes

1. Contractors to verify all dimensions on site prior to commencing work.
2. Contractors are responsible for confirming the location of all underground services on site prior to commencing work.
3. Figured dimensions to be taken in preference to scaled dimensions.
4. Contour supplied by New Zealand Aerial Mapping, July 2006.
5. Aerial photos (Circa 2007) supplied by Whakatane District Council.

Revision

Rev	Date	Comment
A	25.11.09	Issued For Consent

Prepared for:
WHAKATANE DISTRICT COUNCIL

Issued for:
FOR RESOURCE CONSENT

MATATA
Debris Flow Control System

Overall Plan

Design	T&T	SCALE	
Drawn	MT	1:1250 @ A1	
Check	RR	1:2500 @ A3	
Appv'd	CB		

DRAWING NO. REVISION

T06059_DFCS_000 (0)

T06059_AwatarikI_bml_feature_base_MT_20090629.dgn

Appendix 3 – Supplementary Risk Assessment Debris Flow Hazard Report and Peer Review

REPORT

Whakatane District Council

Supplementary Risk Assessment
Debris Flow Hazard
Matata, Bay of Plenty

Report prepared for:

Whakatane District Council

Report prepared by:

Tonkin & Taylor Ltd

Distribution:

Whakatane District Council	**pdf copy**
Tonkin & Taylor Ltd (FILE)	**1 copy**

July 2015

T&T Ref: 29115.2000

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Executive summary

On 18 May 2005, the township of Matatā was impacted by large debris flows generated by intense rainfall within adjacent hill country. The largest and most destructive of these debris flows originated within the catchment of the Awatarariki Stream. In July 2013, Whakatane District Council (WDC) commissioned Tonkin & Taylor (T&T) to undertake a detailed risk assessment capable of identifying the magnitude of risk for individual properties, as well as the overall societal risk from debris flows originating within the Awatarariki Stream.

The assessment has been made primarily on the basis of detailed numerical modelling calibrated to the 2005 event. The results of the modelling has been used to prepare a series of maps that estimate the distribution of the debris flow intensity zones within the vicinity of the Awatarariki Stream for a range of events of different magnitude. The debris flow intensity estimates have in turn been used to estimate individual loss of life, societal loss of life and property loss risk values, both for the current property density and a possible future higher density scenario.

The results of the analyses are as follows:

- The area affected by the 18 May 2005 event is considered to be a high hazard zone;
- The individual loss of life risk for the Awatarariki fanhead west of the stream is typically 10^{-4} or greater except, for the few most distant properties;
- The individual loss of life risk east of the stream is significantly lower than the west, although some properties have risks of 10^{-4} or greater;
- Societal risks for much of the fanhead are significant, with cumulate risk being in excess of 10^{-3}.
- The risk estimates exceed those values commonly adopted as defining what an acceptable risk is. However, that being said, New Zealand currently does not have any established criteria for determining whether a particular risk is acceptable, tolerable or unacceptable.

This report supplements the broader scale risk assessment presented in T&T (2013b). This earlier report should be referred to for additional background information. A draft of this report was issued in November 2013 for public comment. Responses to the issues raised in the public consultation process are noted where relevant.

Definitions

Alluvium
A general name given to materials transported and deposited by streams and rivers.

Alluvial Fan
A fan or cone-shaped deposit of sediment built up by streams. Typically located at the point where a stream changes from a confined to unconfined condition.

Acceptable risk
A risk which society is prepared to accept without the need for management or further expenditure to reduce the level of risk.

Annual exceedance probability
The probability that an event will occur or a certain value will be met or exceeded. Also known as the probability of occurrence.

Castlecliffian
New Zealand Stage from 1.1 million years to 11,000 years before present. Terminates near the end of the Younger Dryas cold spell.

Colluvium
A general term applied to any loose and heterogeneous mass of soil and rock fragments deposited by downslope creep and periodic movement by sheetwash etc. May occur as a layer parallel to the slope surface or a fan or cone at the base of slopes.

Consequence analysis
The assessment of those elements at risk (people, property etc), the temporal probability of people or vehicles to be present and the vulnerability of the element with respect to loss of life or physical damage. One of the elements of Risk Estimation.

Debris
Loose unconsolidated mixture of silt, sand, gravel, cobbles and boulders with some clay.

Debris Avalanche
A very rapid shallow flow of partially or fully saturated debris on a steep slope independent of established channels.

Debris Flood
A very rapid surging flow of water heavily charged with debris.

Debris flow
A very rapid flow of water saturated, non-plastic debris that passes along established channels. Often deposits onto an open or unconfined fan.

Debris Fan
A fan or cone-shaped deposit of sediment built up by debris flows.

Digital Elevation Model (DEM)
Digital height data usually developed from LiDAR data

Earthquake Magnitude
A measure of the energy released by the rupture of a fault line. Measured in terms of Moment Magnitude. Formerly measured in the Richter or Local Magnitude.

Elements at risk
Population, structures and infrastructure potentially affected by landslides.

Fanhead
The upslope higher-energy portion of an alluvial or debris fan where the coarsest material is deposited.

Frequency
The number of events during a particular time period. In the case of landslides frequency is normally defined as number per annum.

Hazard
A condition with the potential to cause an undesirable consequence. In landslide studies, hazard represents the frequency and/or intensity of landslide occurrence and is therefore closely associated with probability of occurrence.

Holocene
A geological epoch which began at the end of the Pleistocene (around 12,000 to 11,500 years ago) and continues to the present. Meaning "entirely recent", it has been identified with the current warm period.

Ignimbrite
The deposit of a pyroclastic density current, or pyroclastic flow which is a hot suspension of generally rhyolitic particles and gases.

Individual risk
The risk to a single person, usually the person considered most at risk. Differs to societal risk which considers the risk to a number of people.

Intolerable risk
Risk which cannot be justified except in extraordinary circumstances.

Jurassic
The Jurassic is a geologic period that extends from 201 million to 145 million years ago. The Jurassic is also known as the Age of Reptiles.

Landslide
The down slope mass movement of soil and/or rock.

Landslide inventory
Database recording the location, classification, area/volume and spatial distribution of landslides that exist within an area. Can be in the form of tables and/or maps.

Landslide hazard
The potential for a landslide to cause and undesirable consequence.

Landslide susceptibility
The qualitative or quantitative assessment of an areas potential to generate and/or be inundated by landslides.

LiDAR
Light Detection and Ranging is a remote sensing technology that measures distance by illuminating a target with a laser and analysing the reflected light.

Likelihood
Same as probability.

Loss of Life Risk
The annual probability that a person (usually the person most at risk) will be killed by the hazard being considered.

Person most at risk
The theoretical person who has the largest occupancy of a site

Pleistocene
The geological epoch which lasted from about 2.6 million to 11,700 years ago, spanning the world's recent period of repeated glaciations.

Probability
The likelihood of a specific outcome, expressed as a number between 0 and 1.

Property Loss Risk
The annual probability that a structure such as a building will be damaged by a landslide.

Qualitative
Descriptions or distinctions based on some quality or characteristic rather than on some quantity or measured value

Quantitative
A type of information based in quantities.

Quaternary
The most recent of the three periods of the Cenozoic Era, it spans from 2.6 million years ago to the present. It is characterized by a series of glaciations and by the appearance and expansion of modern humans.

Return Period
An estimate of the average time between occurrences of an event. It the inverse of the expected number of occurrences in a year.

Recurrence Interval
The recurrence interval is the same as the return period.

Risk
A measure of the probability and the severity of an adverse outcome. Risk = Hazard x Consequence, or the expected loss.

Risk analysis
The use of available information to estimate the risk to individuals, populations or structures.

Risk assessment
The process of risk analysis and risk evaluation.

Risk estimation
The process used to produce a measure of the level of risk being analysed. Involves frequency analysis and consequence analysis.

Risk management
The complete process of risk analysis and evaluation.

Risk mitigation
The process by which risk is reduced or eliminated through the undertaking of treatment options or risk transfer. Part of the risk management process.

Runout
The furthest distance that landslide debris travels down-slope beyond its source. Particularly refers to the lateral distance that debris travels beyond the base of the slope on which the landslide occurred.

Societal risk
The risk to society as a whole. Where the results of an event goes beyond that of an individual.

Temporal-spatial probability
The probability that the element at risk is in the affected area at the time of the landslide.

Tephra
The fragmental material produced by a volcanic eruption regardless of composition, fragment size or emplacement mechanism.

Tolerable risk
A risk that society is willing to live with so as to secure certain benefits. Kept under review and further reduced as and when possible.

Unacceptable risk
Risk which cannot be justified except in extraordinary circumstances. Same as intolerable risk.

Vulnerability
The degree of loss for a given element affected by landslides. Expressed on a scale of 0 to 1. For a person, vulnerability is the probability that a particular life will be lost. For a property, vulnerability is expressed as a loss in value.

Zoning
The division of land into homogeneous areas or domains with a uniform assigned property such as hazard or risk rating.

1 Introduction

On 18 May 2005, the township of Matatā was impacted by large debris flows generated by intense rainfall within adjacent hill country. The largest and most destructive of these debris flows originated within the catchment of the Awatarariki Stream. Following an extended period of options assessment, Whakatane District Council (WDC) decided in late 2012 not to proceed with an engineered solution to reduce the risk posed to occupants of the Awatarariki Stream fanhead from future debris flows. Other planning-based approaches are now being investigated.

In March 2013, WDC commissioned Tonkin & Taylor Ltd (T&T) to undertake a Quantitative Landslide Risk Assessment (QLRA) of the Matatā Escarpment. The purpose of the assessment, which was undertaken along the general lines of the QLRA previously undertaken for the Whakatāne and Ōhope Escarpments, was primarily to map the intensity and extent of the landslide and debris flow hazard within the vicinity of Matatā.

The study provided a broad assessment of the individual loss of life risks for potentially affected areas based primarily on observations made of the 2005 debris flow event, supported by the modelling principles and methodologies used for the Whakatāne and Ōhope escarpment project. The available information was not adequate to assess the risk to individual properties.

Following a review of the outcomes of the event-based assessment, and as a consequence of recognising that debris flow hazards have features distinct from those associated with more typical landslides, WDC determined that a supplementary assessment of the debris flow risk to property owners on the fanhead was merited. WDC subsequently commissioned T&T to undertake a detailed risk assessment capable of identifying the magnitude of risk for individual properties, as well as presenting for the first time, an assessment of overall societal risk. The supplementary risk assessment was prepared because of the complex nature and widespread impact of the debris flow hazard, and because individual owners were unlikely to have the capacity or capability to prepare such an assessment.

This report presents the results of the detailed risk-based assessment. It has been based largely on a series of detailed computer models developed through correlations with the 2005 debris flow event. This supplementary report presents only that information directly relevant to the completion of the detailed risk assessments. It is intended that the results presented here will be read in conjunction with T&T (2013b), which presents extensive background information which are not repeated here.

A draft of this report was issued in November 2013 for public comment. Responses to the issues raised in the public consultation process are noted where relevant.

2 Purpose and Scope of work

The purpose of the detailed quantitative debris flow risk assessment is to characterise the magnitude of loss of life risk across that area of Matatā that could potentially be affected by future debris flows emerging onto the fanhead of the Awatarariki Stream. The study does not consider debris flows originating in other streams exiting the Matatā Escarpment.

The scope of work defined by WDC in their briefing document to T&T was to provide a detailed and site-specific quantitative landslide (debris Flow) risk assessment report of the Awatarariki Stream fanhead at Matatā. The report reflects the variable levels of loss of life risk for individual properties on the Awatarariki fanhead as well as a brief commentary on the scale of property loss risk.

This study covers all areas of Matatā potentially affected by future debris flows generated within the catchment of the Awatarariki Stream (Figure 1, Appendix A) as determined by the modelling. As such, the entire township was included in the study, although the analyses identified those areas effectively outside of the Awatarariki debris flow hazard area.

A post 2005 debris flow event aerial photograph showing the property boundaries and major features of the fanhead as referred to in this report is presented as Figure 2.

3 Methodology

3.1 General

The broad-scale debris flow hazard and risk assessment presented in T&T (2013b) was based primarily on the observed and inferred effects of the 18 May 2005 debris flow event. Judgements were made as to what effects both larger and smaller future debris flows would have on the Awatarariki fanhead.

In order to develop a detailed understanding of potential impacts of future debris flows, it is necessary to assess in detail, a number of separate and interrelated factors, such as debris flow travel paths, flow thickness, flow velocity, boulder travel distance, impact forces etc. for a range of potential event magnitudes and recurrence intervals.

In order to do this, detailed numerical modelling of the fanhead was undertaken using the debris flow module of the software program RAMMS. This software was previously used by T&T to undertake analysis of the formerly proposed Awatarariki debris detention barrier (T&T, 2009b).

3.2 Debris Flow Modelling

3.2.1 Software

RAMMS (Rapid Mass Movement) is a "2D" numerical debris flow simulation program developed by the Swiss Federal institute for Forest, Snow and Landscape Research (WSL) and the Institute for Snow and Avalanche Research (SLF). RAMMS models the movement of debris flows over a 3D digital terrain, yielding runout distance, flow heights, flow velocities and impact pressure.

Information about RAMMS can be obtained from http://ramms.slf.ch/ramms/

The modelling is able to reflect the post-2005 changes in terrain on the fanhead as well as the effects of embankments etc.

3.2.2 Event initiation

Previous modelling undertaken by T&T (2009a) for the Awatarariki debris detention structure was used a beta version of RAMMS provided by WSL. One of the limitations of RAMMS at that time was that one or more landslides defined by GIS shape files needed to be initiated within the hills of the stream catchment in order to generate a debris flow of a particular volume. It was not possible to model a single debris flow event with multiple surges, nor to define specific flow characteristics (such as velocity or height) at any particular observation point.

The debris flow module used in the RAMMS modelling reported here allows the use of a hydrograph which defines the discharge (m^3/s) and duration (s) of the flow at a point along the flow path. Because of the significant influence that the former rail bridge appears to have had on the outcomes of the 18 May 2005 debris flow event, the back analysis was undertaken with the hydrograph position set immediately upstream of the bridge. All subsequent forward (i.e. predictive) analyses retained this same hydrograph position for the purpose of consistency.

The back analysis of the 18 May 2005 event and the forward analysis of a 300,000m^3 event were both undertaken using a 2 surge hydrograph based on the flow characteristics described in Section 4. This hydrograph is reproduced in Figure 3. This hydrograph was scaled to provide both smaller and larger volume events with broadly similar characteristics.

3.2.3 Event magnitude

Four debris flow events have been modelled: 50,000m^3, 150,000m^3, 300,000m^3 and 450,000m^3. The 300,000m^3 model is considered to be approximately the same magnitude as the 18 May 2005 event. These values represent the volume of the flows active within the Awatarariki Stream channel rather than the post-event deposits which tend to be somewhat smaller in volume.

3.2.4 Return period

The return period (or recurrence interval) of large debris flows of the type that impacted Matatā in 2005 are difficult to estimate. Based on previous assessments presented in T&T (2009a) and T&T (2009b), it is assumed that the 2005 event (i.e. also the 300,000m^3 forward analysis) had a return period of several hundred years. Given the range of possible return periods for the 2005 event, two values have been adopted as a means of assessing the sensitivity of the results to this parameter. These values are 200 years and 500 years respectively. Proportional ranges are also provided for smaller and larger magnitude design events. These values are presented in Table 3.1.

3.2.5 Flow parameters

Flow parameters were selected on the basis of the 2009 debris detention structure modelling (T&T, 2009a) as well as extensive additional back analyses undertaken for this study. The flow RAMMS flow parameters adopted for the Awatarariki Stream fanhead are as follows:

Flow density (ρ):	1700 kg/m3
Coulomb-type friction (μ):	0.02
Viscous-turbulent friction (Xi):	1500 m/s^2
Earth pressure coefficient (λ):	1.75

3.2.6 Modelling outputs

RAMMS models debris flows in a step-wise manner equivalent to the passage of time. Outputs include flow depth and flow velocity, either instantaneously or as maximum values. An example of the output is presented as Figure 4.

Because RAMMS models debris flows a single phase fluid, there is no distinction between the boulders which rapidly drop out of the thinning flow and the finer-grained component that is capable of travelling a considerably greater distance. It is critical however to be able to estimate those areas of the fanhead that may be impacted by the large boulders carried by the debris flow, as these are most likely to be associated with property damage and the potential for fatalities.

The potential for a debris flow to carry (or deposit) its boulder component is a function of both flow depth, flow velocity and density. The deeper and faster a debris flow travels, the greater is its capacity to carry large boulders. One means of representing the ability to transport boulders is the Debris Flow Intensity Index (I_{DF}) or Momentum Flux, which is defined as:

$$(I_{DF}) = dv^2$$

Where: d is flow depth and v is flow velocity. It can be seen from the form of the equation that the Intensity Index is related to kinetic energy and momentum.

It was possible by extracting depth and velocity data from RAMMS into a spreadsheet, to calculate I_{DF}. Importing the results into mapping software allowed the distribution of I_{DF} across the

fanhead area. The mapping of I_{DF} across the fanhead for debris flows of different magnitudes provided a means of defining debris flow hazard zones. This is discussed further in Section 5.

3.3 The assessment of risk

3.3.1 Definition of risk

Risk is the product of hazard and consequence. It can be defined in terms of either risk to people or risk to property. When considering risk to people, there is often a distinction drawn between the risk to an individual (i.e. loss of life risk) and the risk to groups of people (i.e. societal risk). Definitions of these types of risk to people are as follows:

> *Loss of life risk is the frequency at which an individual may be expected to sustain a given level of harm from the occurrence of a specified hazard. It is usually reported as an annual probability for the "person most at risk" e.g. the person most at risk has a 1 in 10,000 chance (10^{-4}) per annum of being killed by the hazard;*
>
> *Societal risk expresses the relationship between the frequency of an event and the number of people suffering from a specific level of harm in a given population. It is usually reported as a set of related probabilities e.g. the annual probability that the hazard will result in 1 or more fatalities is 1 in 10,000 (10^{-4}), 10 or more fatalities is 1 in 100,000 (10^{-5}) and 100 or more fatalities is 1 in a million (10^{-6}).*

The risk to property (property loss risk) is also considered in some cases. This is usually reported either as a proportion of the structure (damage ratio e.g. 60%), relative level of damage or as a dollar value.

3.3.2 Individual Loss of Life Risk

Loss of life risk for a residential community from a debris flow hazard can be represented in the following form:

$$R_{(LOL)} = P_{(H)} \times P_{(S:H)} \times P_{(T:S)} \times V_{(D:T)}$$

Where:

- $R_{(LOL)}$ annual loss of life risk
- $P_{(H)}$ annual probability of a debris flow occurring
- $P_{(S:H)}$ probability of the debris flow impacting a particular location (i.e. spatial probability)
- $P_{(T:S)}$ probability that someone is present at the impacted property (temporal spatial probability)
- $V_{(D:T)}$ vulnerability of the individual to impact i.e. the probability of a fatality occurring given that an impact has occurred and a person is present

3.3.3 Societal risk

As described above, societal risk is a means of relating the likelihood of an event with the expected number of fatalities resulting from it. Societal risk is most commonly used where a large number of casualties could result from a single event e.g. dam burst.

The simplest method of estimating societal risk is to multiply the annual loss of life risk for an individual by the number of people expected to be present. This is commonly referred to as the Expected Value.

A more common way of representing societal risk is to calculate the number of deaths that can be expected for a range of events with different return periods or recurrence intervals. By cumulatively adding these risks from the largest to the smallest event, a Frequency – Number (F-N) relationship can be developed. By plotting the results of the calculations on established F-N charts, an assessment can be made as to whether the societal risk is acceptable, tolerable or unacceptable.

3.3.4 Property Loss Risk

Property loss can be expressed in a number of different ways. For the purpose of this report, it is expressed in a qualitative way as defined in Table 3.2.

Table 3.1: Assumed event magnitudes and return periods

Event No.	Magnitude	Return Period (years)
1	50,000m^3	50 - 100
2	150,000m^3	100 - 250
3	300,000m^3	200 - 500
4	450,000m^3	500 - 1000

Table 3.2: Property Loss Risk Matrix (AGS, 2007)

Likelihood		Consequences to Property (with indicative approximate value of damage)				
(over lifetime of the building)	Indicative Value of Approximate Annual Probability	Catastrophic (200%)	Major (60%)	Medium (20%)	Minor (5%)	Insignificant (0.5%)
Almost Certain	10^{-1}	VH	VH	VH	H	M or L
Likely	10^{-2}	VH	VH	H	M	L
Possible	10^{-3}	VH	H	M	M	VL
Unlikely	10^{-4}	H	M	L	L	VL
Rare	10^{-5}	M	L	L	VL	VL
Barely Credible	10^{-6}	L	VL	VL	VL	VL

4 A Review of Previous Debris Flow Events at Matatā

4.1 18 May 2005 Event

The 18 May 2005 event is moderately well documented, having being witnessed by a number of residents as well as being inspected by geologists and engineers from T&T and GNS Science[1] in the immediate aftermath of the disaster. A valuable record of observations was compiled by Dr the Hon Ian Shearer via a series of interviews conducted with residents who witnessed the event as it unfolded. Relevant extracts from Shearer (2005a) are presented in Appendix B.

Photographs of the aftermath of the 18 May 2005 event are presented in Appendix C to support the descriptions of the effects of the debris flows described within this report.

Based on aerial photograph interpretation, a debris distribution map has been prepared (Figure 5). From a consideration of the available information (provided in detail in previous T&T and GNS reports), we have assumed the following with respect to the 18 May 2005 event:

- The debris flow occurred in two main surges;
- The nature of the flow surges and the direction of travel of the debris was significantly affected by the blocking of the rail bridge by timber debris and by the presence of obstacles in the stream;
- The debris flows deposited some 250,000m^3 of debris on the fanhead with additional material lost to both the lagoon and ocean. A flow volume of 300,000m^3 has been assumed for the purposes of back analysis of the fanhead area;
- The rainfall that initiated the debris flows had a return period of between 200 to 500 years; and
- Flows across the upper fanhead reached depths in excess of 3m. Flows thinned rapidly as the debris moved away from the rail bridge.

A number of submissions from residents were received as a result of the draft version of this report being issued in November 2013. These reflected personal opinions on the extent of debris flow impact on a particular property during the 2005 event. These tended to be contradictory and of a small-enough scale that modifications the assessment were not justified.

4.2 Pre-2005 Events

Geomorphological evidence points to alluvial flood and debris flow events having formed the Awatarariki fanhead over the past several thousand years. Details supporting this, such as the presence of large boulders within the township as well as out at sea, have been presented in earlier T&T and GNS reports.

Shearer (2005b) undertook a review of historic flood events in and around Matatā. He lists 28 floods that have occurred in the eastern Bay of Plenty in the last 137 years, some of which are known to have affected Matatā. One event in 1869 destroyed a flour mill on what is presumed to be on the fan of Awatarariki Stream. It is thought that floods in 1906, 1939 and possibly 1950, may also have been associated with debris flows.

Mapping undertaken by both GNS and T&T indicates that low-angle alluvial/debris fans extend well out from the base of the Matatā Escarpment and beyond the area affected by the 18 May

[1] Then the Institute of Geological and Nuclear Sciences Limited

2005 event. The evidence for the presence of this material is subtle and may be related to lower-hazard alluvial processes rather than major debris flow events. Nevertheless, the presence of these deposits, together with other evidence, may suggest that debris flows larger than the 2005 event may have occurred in the distant past.

Based on the information available we conclude that:

- Large potentially destructive debris flows have previously occurred on the fanhead of the Awatarariki Stream, as well as other locations around Matatā;
- The 2005 debris flow event is expected to be classed as rare, with a return period of several hundred to a few thousand years rather than decades or many thousands of years;
- There is geomorphologic evidence of debris flows potentially much larger than the 18 May 2005 event having occurred previously; and
- There is some evidence for smaller debris flows and/or floods having affected the fanhead in approximately 50 year intervals.

5 Hazard Assessment

A necessary first step in the calculation of risk is the establishment of the underlying hazard. With respect to Matatā, this involves characterising the frequency, physical extent and intensity of past and future debris flows. This section presents the basis on which debris flow hazard zones were defined for the Awatarariki Stream fanhead.

5.1 General

The hazard associated with debris flows emerging from the catchment of the Awatarariki Stream is ultimately a function of distance from the point where debris flows emerge onto the fanhead from the narrow escarpment gulch located immediately upstream from the East Coast Main Trunk Railway bridge. There are two main reasons for this:

- The velocity and thickness of the debris reduces with distance as the flows spread out across the unconfined fanhead. This also directly reduces the ability of the debris flows to transport larger boulders and trees;
- The greater the distance a location is from the source of a debris flow, the larger and therefore less frequent any impacting event will be.

Modelling using RAMMS has shown that as debris flow volume increases, both the distance and area covered by the debris increases, but at an ever decreasing rate. An increase in event volume appears to result in a somewhat larger spatial extent accompanied by an increase in flow and deposit thickness.

5.2 Definition of hazard zones

In reviewing the effects of the 2005 event, it has been possible to identify a number of areas where the debris flows had relatively distinct impacts (Figure 5):

- Essentially complete destruction of property occurred within the inner zone of significant boulder and timber accumulation;
- Significant property damage occurred in the intermediate zone of abundant boulders and trees within a sand, silt and gravel matrix. Depending upon individual circumstances, some of the dwellings located within this area were able to be repaired whereas others required demolition and replacement;
- Repairable damage occurred within the outer zone dominated by the deposition of sand, silt and gravel.

As described in Section 3.2.6, a Debris Flow Intensity parameter (I_{DF}) has been adopted as an appropriate metric to map the reduction in the debris flow hazard across the fanhead as the flows thinned, slowed and deposited their coarser and most destructive components (Figure 6).

By comparing the I_{DF} contours from the RAMMS back analysis (Figure 7) with the depositional patterns observed from the 18 May 2005 event (Figure 5) it has been possible to match I_{DF} to the depositional patterns observed. Four intensity zones have been defined. These are described in Table 5.1 together with photographs of examples from 2005.

The results of the RAMMS modelling and back analysis has been used to prepare a series of maps that estimate the distribution of the debris flow intensity zones within the vicinity of the Awatarariki Stream. These modelling scenarios cover 50,000m^3 (Figure 8), 150,000m^3 (Figure 9), 300,000m^3 (Figure 10) and 450,000m^3 (Figure 11).

Table 5.1: Definition of Intensity Index (I_{DF}) zones

Intensity Zone	Intensity Index (I_{DF})	Debris Description	Description of Effects
1 Red	>15	Mass boulder passage and deposition. Abundant boulders of several metres in diameter with large trees. Deposits several metres thick, boulders commonly being clast supported (boulder to boulder contact)	Complete destruction of surface infrastructure and dwellings. Total loss of dwellings can be expected Impact force from 1m diameter boulder: 15 – 60 kN Impact pressure from flow: 20 – 200 kPa
2 Orange	15 - 5	Abundant boulders and trees within a matrix of sand silt and gravel. Boulders to several metres in diameter but typically less than 1m. Boulders are matrix supported	Severe to moderate effects depending on nature of structure and individual circumstances with respect to boulder impact. Total loss of some dwellings, significant to damage to others Impact force from 1m diameter boulder: 10 – 15 kN Impact pressure from flow: 5 – 20 kPa
3 Yellow	5 – 0.5	Predominantly sand, silt and gravel with occasional boulder, typically less than 0.5m in diameter, although occasional boulders up to 2m in diameter may enter this zone	Generally minor structural damage to dwellings but significant damage to furnishings etc from water and sediment inundation of lower storey. Some significant localised damage may result from isolated boulder impact Impact force from 1m diameter boulder: <10 kN Impact pressure from flow: <5 kPa
4 Blue	<0.5	Predominantly silt and sand-laden water (debris flood) with minor coarse material. No or rare boulders present	Generally insignificant structural damage but flood damage to lower storey Impact force from 1m diameter boulder: Not applicable Impact pressure from flow: <5 kPa

Examples of qualitative risk zone debris type and structural damage

			
Intensity Index Zone: 1 (Red) I_{DF} : > 15	Intensity Index Zone: 2 (Orange) I_{DF} : 5 - 15	Intensity Index Zone: 3 (Yellow) I_{DF} : 0.5 – 5.0	Intensity Index Zone: 4 (Blue) I_{DF} : 0.0 – 0.5

Each of the debris flow intensity zones can be used as a metric for the debris flow hazard, although the hazard effectively changes depending upon the magnitude of the event being considered. For the purposes of representing the overall debris flow hazard within the vicinity of the Awatarariki Stream fanhead, a single debris flow hazard map (Figure 12) has been developed based on the distribution of debris from the following events;

- High Hazard Zone: area impacted by a debris flow with half the volume of the 2005 event (i.e. 150,000m^3) or larger;
- Medium Hazard Zone: area impacted by a debris flow with the same volume as the 2005 event (i.e. 300,000m^3) or larger;
- Low Hazard Zone: area impacted by a very large (i.e. 450,000m^3)[2] but rare debris flow event.

This confirms the more general distribution of hazard zones presented in T&T (2013b).

[2] T&T (2013b) based the low hazard zone on an area affected by a debris flow twice the size of the 2005 event i.e. 600,000m^3. In this report the over-size event has been assumed to be 450,000m^3 as currently it is speculative to assume that the Awatarariki Stream catchment has the capability to generate a debris flow that is twice the volume of that seen in 2005.

6 Risk assessment

The concept of risk was introduced in Section 3.3. This section presents qualitative assessments of loss of life and property loss risk for those properties potentially at risk of being impacted by debris flows originating within the Awatarariki Stream.

6.1 Quantitative Loss of Life Risk

The quantitative loss of life risk i.e. the annual probability of the person most at risk being killed by a debris flow has been calculated for all areas across the Awatarariki Stream fanhead and beyond using the equation presented in Section 3.32. The calculations are presented in Table 6.1.

The process of the risk calculation is as follows:

- The same four debris flow event magnitudes used in the RAMMS modelling have been adopted for the loss of life risk calculations: 50,000m^3, 150,000m^3, 300,000m^3 and 450,000m^3;
- A shorter and longer return period was adopted for each event magnitude. This allowed the sensitivity of the results to the uncertainty around the return period of the debris flows to be assessed. The risk calculations have been undertaken for Case 1 where shorter return periods are assumed for the suite of design magnitude events and Case 2 where longer return periods are assumed for each debris flow magnitude;
- The fanhead is divided into six risk zones based upon the potential physical effects of debris flow impact. These risk zones are the same as the Intensity Index zones shown on Figures 8 to 11, although Zones 3 and 4 are both divided into sub-zones which represent areas inside and outside the main boulder field respectively. Each zone and subzone are identified on Table 6.1 with a unique cell colour;
- The probability of boulder impact ($P_{(S:H)}$) and the vulnerability of occupants of dwellings to such an impact ($V_{(D:T)}$) have been estimated based on observations made in 2005 as well as a consideration of the velocity and thickness of flows predicted by RAMMS. The values assigned to each risk zone are defined in Table 6.1 and their distribution across the fanhead are shown on Figure 13;

A common factor associated with each risk zone is an occupancy rate of 75% for the “person most at risk”. This is consistent with the other risk assessments undertaken for the Whakatāne and Ōhope (T&T, 2013a) and Matatā escarpments (T&T, 2009b). An assumed occupancy greater than 75% would result in a corresponding increase in the calculated loss of life risk.

The loss of life risk at any particular location depends upon whether it can be impacted significantly by one or more of the events of different magnitude. The risks for each are cumulative. This is illustrated on Figure 14 where three hypothetical dwellings are shown at increasing distances from the apex of the fanhead. A dwelling located a significant distance from the apex will only be impacted significantly from larger volume – longer return period (low frequency) events, whereas a dwelling located near the apex of the fanhead can be affected not only by the large events but also from intermediate and low volume - short return period (higher frequency) events. The risk at any particular location is therefore a product of the complex interrelationship between location, event return period and debris travel distance.

Table 6.1: Design Loss of Life Risk Factors

Flow Intensity Zone	Boulder Impact Zone	Probability of structural impact $P_{(S:H)}$	Vulnerability ($V_{(D:T)}$)	Comments
1	Inside main boulder field	1.00 (100%)	0.75 (75%)	Certain to be impacted by mass boulders
2	Inside main boulder field	1.00 (100%)	0.20 (20%)	Certain to be impacted by mass boulders
3	Inside main boulder field	0.20 (20%)	0.05 (5%)	Risks associated with single boulders
3	Outside main boulder field	0.05 (5%)	0.05 (5%)	Risks associated with rare boulders
4	Inside main boulder field	0.10 (10%)	0.05 (5%)	Risks associated with rare single boulders
4	Outside main boulder field	0.01 (1%)	0.01 (1%)	Risks associated with very rare boulders

The loss of life risk calculated for each risk zone in Table 6.2 correspond to the equivalent spatial areas shown on Figures 8 to 11. The cumulative effect of having overlapping risks was assessed by overlapping each of the risk zones graphically to identify 22 zones with a unique combination of risk. These areas, together with the individual risk components that contribute to them, are presented in Table 6.1 as zone combinations A to J.

By summing the risk contributed by each magnitude event, contours of loss of life risk were able to be developed for both the shorter return period and longer return period event scenarios. The resulting loss of life risk contours for shorter and longer return periods are presented in Figures 15 and 16 respectively. As would be expected, the annual loss of life risk is somewhat higher for the shorter return period (i.e. more frequent) events than the longer return period (i.e. less frequent) events. The similarity in the two sets of results indicate however that the cumulative loss of life risk is not sensitive to the range of return periods assumed.

It is important to note that although the potential impacts of future debris flows can readily be estimated for the upper and central parts of the fanhead, such estimates become increasingly less reliable towards the boundaries of the potentially impacted areas.

Caution must be used when interpreting the level of risk for those properties located east of the Awatarariki Stream.

6.2 Quantitative Societal Risk

The level of societal risk depends upon the assumed population of the impacted area. For the case of Matatā, two scenarios have been modelled:

- A low density model in which the number of dwellings in the vicinity of the Awatarariki Stream does not increase above its current status;
- A higher density model in which dwellings are assumed to be present on those properties in the Clem Elliot Drive area that are currently undeveloped. The distribution of dwellings assumed in the calculations is shown on Figure 17. Based on discussions held at the time of the debris detention structure project it has been assumed that the majority of properties south of Clem Elliot Drive will not be developed.
- An occupancy of between 2 and 3 people per dwelling has been assumed (i.e. average of 2.5 persons per dwelling)

6.2.1 Expected Value

By overlying the individual loss of life risk contours shown on Figures 15 and 16 with the current and assumed residential density shown on Figure 17 and assuming an average dwelling occupancy of 2.5, the number of people potentially exposed to a certain level of individual loss of life risk can be estimated. The results for time periods of 50 and 100 years are presented in Table 6.3.

Table 6.2: Loss of Life Risk Calculation Matrix

Loss of Life Risk Calculations for Awatarariki Stream Fanhead

Definitions

$P_{(H)}$	Annual probability of debris flow event
$P_{(S:H)}$	Probability that the debris flow will impact the house
$P_{(T:S)}$	Probability that someone will be home
$V_{(D:T)}$	Probability that a fatality will result from a direct impact of the house or property

Legend

- Risk Zone 1 (Debris Flow Intensity Index >15)
- Risk Zone 2 (Debris Flow Intensity Index 5 -15)
- Risk Zone 3 (Debris Flow Intensity Index 0.5 -5) within boulder field
- Risk Zone 3 (Debris Flow Intensity Index 0.5 -5) beyond boulder field
- Risk Zone 4 (Debris Flow Intensity Index <0.5) within boulder field
- Risk Zone 4 (Debris Flow Intensity Index <0.5) beyond boulder field

Case 1: Shorter return period events assumed

		Common Risk Factors		Risk Zone 1			Risk Zone 2			Risk Zone 3			Risk Zone 3			Risk Zone 4			Risk Zone 4		
Event Volume	Return Period (yrs)	$P_{(H)}$	$P_{(T:S)}$	Variable Risk Factors		$R_{(LOL)}$	Variable Risk Factors		$R_{(LOL)}$	Variable Risk Factors		$R_{(LOL)}$	Variable Risk Factors		$R_{(LOL)}$	Variable Risk Factors		$R_{(LOL)}$	Variable Risk Factors		$R_{(LOL)}$
				$P_{(S:H)}$	$V_{(D:T)}$		$P_{(S:H)}$	$V_{(D:T)}$		$P_{(S:H)}$	$V_{(D:T)}$		$P_{(S:H)}$	$V_{(D:T)}$		$P_{(S:H)}$	$V_{(D:T)}$		$P_{(S:H)}$	$V_{(D:T)}$	
50,000m3	50	2.00E-02	7.50E-01	1.00E+00	7.50E-01	1.13E-02	1.00E+00	2.00E-01	3.00E-03	2.00E-01	5.00E-02	1.50E-04	5.00E-02	5.00E-02	2.11E-05	1.00E-01	5.00E-02	3.00E-06	1.00E-02	5.00E-02	3.75E-09
150,000m3	100	1.00E-02	7.50E-01	1.00E+00	7.50E-01	5.63E-03	1.00E+00	2.00E-01	1.50E-03	2.00E-01	5.00E-02	7.50E-05	5.00E-02	5.00E-02	1.05E-05	1.00E-01	5.00E-02	1.50E-06	1.00E-02	5.00E-02	1.88E-09
300,000m3	200	5.00E-03	7.50E-01	1.00E+00	7.50E-01	2.81E-03	1.00E+00	2.00E-01	7.50E-04	2.00E-01	5.00E-02	3.75E-05	5.00E-02	5.00E-02	9.38E-06	1.00E-01	5.00E-02	1.88E-05	1.00E-02	5.00E-02	1.25E-08
450,000m3	500	2.00E-03	7.50E-01	1.00E+00	7.50E-01	1.13E-03	1.00E+00	2.00E-01	3.00E-04	2.00E-01	5.00E-02	1.50E-05	5.00E-02	5.00E-02	2.11E-06	1.00E-01	5.00E-02	3.00E-07	1.00E-02	5.00E-02	3.75E-10

Case 2: Longer return period events assummed

		Common Risk Factors		Risk Zone 1			Risk Zone 2			Risk Zone 3			Risk Zone 3			Risk Zone 4			Risk Zone 4		
Location	Return Period (yrs)	$P_{(H)}$	$P_{(T:S)}$	Variable Risk Factors		$R_{(LOL)}$	Variable Risk Factors		$R_{(LOL)}$	Variable Risk Factors		$R_{(LOL)}$	Variable Risk Factors		$R_{(LOL)}$	Variable Risk Factors		$R_{(LOL)}$	Variable Risk Factors		$R_{(LOL)}$
				$P_{(S:H)}$	$V_{(D:T)}$		$P_{(S:H)}$	$V_{(D:T)}$		$P_{(S:H)}$	$V_{(D:T)}$		$P_{(S:H)}$	$V_{(D:T)}$		$P_{(S:H)}$	$V_{(D:T)}$		$P_{(S:H)}$	$V_{(D:T)}$	
50,000m3	100	1.00E-02	7.50E-01	1.00E+00	7.50E-01	5.63E-03	1.00E+00	2.00E-01	1.50E-03	2.00E-01	5.00E-02	7.50E-05	5.00E-02	5.00E-02	1.05E-05	1.00E-01	5.00E-02	1.50E-06	1.00E-02	5.00E-02	1.88E-09
150,000m3	250	4.00E-03	7.50E-01	1.00E+00	7.50E-01	2.25E-03	1.00E+00	2.00E-01	6.00E-04	2.00E-01	5.00E-02	3.00E-05	5.00E-02	5.00E-02	4.22E-06	1.00E-01	5.00E-02	6.00E-07	1.00E-02	5.00E-02	7.50E-10
300,000m3	500	2.00E-03	7.50E-01	1.00E+00	7.50E-01	1.13E-03	1.00E+00	2.00E-01	3.00E-04	2.00E-01	5.00E-02	1.50E-05	5.00E-02	5.00E-02	2.11E-06	1.00E-01	5.00E-02	7.50E-06	1.00E-02	5.00E-02	2.00E-09
450,000m3	1000	1.00E-03	7.50E-01	1.00E+00	7.50E-01	5.63E-04	1.00E+00	2.00E-01	1.50E-04	2.00E-01	5.00E-02	7.50E-06	5.00E-02	5.00E-02	1.05E-06	1.00E-01	5.00E-02	1.50E-07	1.00E-02	5.00E-02	1.88E-10

Distribution of Loss of Life Risk for shorter return period events

Zone Combination	450,000	300,000	150,000	50,000	Sum
A1	3.75E-10	1.25E-08	1.88E-09	3.75E-09	1.85E-08
A2	3.00E-07	1.88E-05	1.88E-09	3.75E-09	1.91E-05
B1	2.11E-06	9.38E-06	1.05E-05	3.75E-09	2.20E-05
B2	2.11E-06	9.38E-06	1.05E-05	2.11E-05	4.31E-05
C1	1.50E-05	9.38E-06	1.05E-05	3.75E-09	3.49E-05
C2	1.50E-05	9.38E-06	1.05E-05	2.11E-05	5.60E-05
D1	1.50E-05	3.75E-05	1.05E-05	3.75E-09	6.31E-05
D2	1.50E-05	3.75E-05	1.05E-05	2.11E-05	8.41E-05
D3	1.50E-05	3.75E-05	1.88E-09	3.75E-09	5.25E-05
D4	1.50E-05	3.75E-05	7.50E-05	2.11E-05	1.49E-04
D5	1.50E-05	3.75E-05	7.50E-05	1.50E-04	2.78E-04
E1	3.00E-04	3.75E-05	1.05E-05	3.75E-09	3.48E-04
E2	3.00E-04	3.75E-05	1.05E-05	2.11E-05	3.69E-04
F1	3.00E-04	7.50E-04	1.05E-05	2.11E-05	1.08E-03
F2	3.00E-04	7.50E-04	1.05E-05	2.11E-05	1.08E-03
F3	3.00E-04	7.50E-04	7.50E-05	2.11E-05	1.15E-03
G1	3.00E-04	7.50E-04	7.50E-05	3.75E-09	1.13E-03
G2	3.00E-04	7.50E-04	7.50E-05	1.50E-04	1.28E-03
H1	1.13E-03	1.13E-03	1.50E-03	1.50E-04	3.90E-03
H2	1.13E-03	7.50E-04	1.50E-03	1.50E-04	3.53E-03
I1	1.13E-03	1.13E-03	5.63E-03	3.00E-03	1.09E-02
J	1.13E-03	1.13E-03	5.63E-03	1.13E-02	1.91E-02

Distribution of Loss of Life Risk for longer return period events

Zone Combination	450,000	300,000	150,000	50,000	Sum
A1	1.88E-10	2.00E-09	7.50E-10	1.88E-09	4.81E-09
A2	1.50E-07	7.50E-06	7.50E-10	1.88E-09	7.65E-06
B1	1.05E-06	2.11E-06	4.22E-06	1.88E-09	7.38E-06
B2	1.05E-06	2.11E-06	4.22E-06	1.05E-05	1.79E-05
C1	7.50E-06	2.11E-06	4.22E-06	1.88E-09	1.38E-05
C2	7.50E-06	2.11E-06	4.22E-06	1.05E-05	2.44E-05
D1	7.50E-06	1.50E-05	4.22E-06	1.88E-09	2.67E-05
D2	7.50E-06	1.50E-05	4.22E-06	1.05E-05	3.73E-05
D3	7.50E-06	1.50E-05	7.50E-10	1.88E-09	2.25E-05
D4	7.50E-06	1.50E-05	3.00E-05	1.05E-05	6.30E-05
D5	7.50E-06	1.50E-05	3.00E-05	7.50E-05	1.28E-04
E1	1.50E-04	1.50E-05	4.22E-06	1.88E-09	1.69E-04
E2	1.50E-04	1.50E-05	4.22E-06	1.05E-05	1.80E-04
F1	1.50E-04	3.00E-04	4.22E-06	1.05E-05	4.65E-04
F2	1.50E-04	3.00E-04	4.22E-06	1.05E-05	4.65E-04
F3	1.50E-04	3.00E-04	3.00E-05	1.05E-05	4.91E-04
G1	1.50E-04	3.00E-04	3.00E-05	1.88E-09	4.80E-04
G2	1.50E-04	3.00E-04	3.00E-05	7.50E-05	5.55E-04
H1	5.63E-04	1.13E-03	6.00E-04	7.50E-05	2.36E-03
H2	5.63E-04	3.00E-04	6.00E-04	7.50E-05	1.54E-03
I1	5.63E-04	1.13E-03	2.25E-03	1.50E-03	5.44E-03
J	5.63E-04	1.13E-03	2.25E-03	5.63E-03	9.56E-03

Table 6.3: Societal Risk – Expected Value Analysis

Time Period (years)	Expected No. of Fatalities/Time Period	
	Current Population Density	Fully Developed Density
50	1	4
100	2	8

6.2.2 F-N Curve

The usual means of representing societal risk is through the development of a Frequency – Number (F-N) curve, which relates the number of expected fatalities with the return period of the relevant hazard. Societal risk calculations for the current and assumed increased residential density are presented in Tables 6.4 and 6.5 respectively.

The analyses were restricted to I_{DF} Zones 1 and 2 only as the potential for fatalities to occur are realistically restricted to these areas. An average 24 hour occupancy of 75% has been adopted. By calculating the fatalities per annum expected from each magnitude event in each zone, it is possible to develop a cumulative frequency of risk that is the basis of the F-N Curve presented as Figure 18.

6.3 Property Loss Risk

The distribution of the various debris types based on I_{DF} have been developed from modelling for the 50,000m^3, 150,000m^3, 300,000m^3 and 450,000m^3 design events. These are shown on Figures 8, 9, 10 and 11 respectively. Although similar to the hazard map, these assessments include an element of consequence in their evaluation, hence they represent a qualitative or semi-quantitative measure of risk.

The meaning of the I_{DF} zones in terms of their debris type and potential damage is defined in Table 5.1, together with photographs of equivalent effects from 18 May 2005.

In summary, the effects of future debris flows on standard dwellings are expected to be as follows:

- Zone 1: Complete destruction of property from passage of the main boulder front;
- Zone 2: Severe to moderate structural damage depending upon the number of strikes from individual boulders that extend beyond the main boulder front;
- Zone 3: Generally minor structural damage, with impacts from individual boulders possible. Most property damage is from silt and sand-laden water;
- Zone 4: Generally insignificant damage unless one of the relatively few boulders than makes it this far happens to impact the dwelling. The probability of such an impact is much greater inside the main boulder field. Most property damage is from silt and sand-laden water.

Note that these expected effects do not apply to any dwelling (or other structure) constructed specifically to resist the effects of debris flow impact.

An estimate of property loss risk has been made based on the debris flow intensity I_{DF} and the terminology used in Table 5.1. The property loss risk is presented in Figure 19.

Table 6.4: Societal risk calculations – current residential density

Event Magnitude	No. of Houses			Occupants			Vulnerability		No. Fatalities		Assumed average occupancy	Total No. Fatalities
	Risk Zone 1	Risk Zone 2	Total	Risk Zone 1	Risk Zone 2	Total	Risk Zone 1	Risk Zone 2	Risk Zone 1	Risk Zone 2		
50,000m^3	0	0	0	0	0	0	0.75	0.2	0.0	0	0.75	0.0
150,000m^3	0	4	4	0	10	10	0.75	0.2	0.0	0.8	0.75	0.6
300,000m^3	3	5	8	7.5	12.5	20	0.75	0.2	5.6	1	0.75	5.0
450,000m^3	3	8	11	7.5	20	27.5	0.75	0.2	5.6	1.6	0.75	5.4

Event Magnitude	Return Period (yrs)	$P_{(H)}$	No. of houses in Risk Zones 1 and 2	No. of people present	Estimated fatalities (N)	% of total residents killed	Fatalities per year
50,000m^3	100	1.00E-02	0	0.0	0.0	0.0	0.00E+00
150,000m^3	250	4.00E-03	4	10.0	0.6	2.2	2.40E-03
300,000m^3	500	2.00E-03	8	20.0	5.0	18.1	9.94E-03
450,000m^3	1000	1.00E-03	11	27.5	5.4	19.7	5.42E-03
		Total of suburb	11	27.5			

F-N Curve

Event Magnitude	Return Period (yrs)	$P_{(H)}$	Estimated fatalities (N)	Cumulative Frequency
450,000m^3	1000	1.00E-03	5.4	1.00E-03
300,000m^3	500	2.00E-03	5.0	3.00E-03
150,000m^3	250	4.00E-03	0.6	7.00E-03
50,000m^3	100	1.00E-02	0.0	1.70E-02

Note: Societal Risk Zones 1 and 2 are equivalent to the Debris Flow Intensity Zones 1 and 2 defined in Table 5.1. Zones 1 and 2 are represented by the pink and orange areas on Figure 17 respectively. It is assumed that fatalities do not occur within the lower I_{DF} zones 3 and 4.

Table 6.5: Societal risk calculations – increased residential density

Event Magnitude	No. of Houses			Occupants			Vulnerability		No. Fatalities		Assumed average occupancy	Total No. Fatalities
	Risk Zone 1	Risk Zone 2	Total	Risk Zone 1	Risk Zone 2	Total	Risk Zone 1	Risk Zone 2	Risk Zone 1	Risk Zone 2		
50,000m^3	1	2	3	2.5	5	7.5	0.75	0.2	1.9	0.4	0.75	1.7
150,000m^3	2	6	8	5	15	20	0.75	0.2	3.8	1.2	0.75	3.7
300,000m^3	4	15	19	10	37.5	47.5	0.75	0.2	7.5	3	0.75	7.9
450,000m^3	5	19	24	12.5	47.5	60	0.75	0.2	9.4	3.8	0.75	9.9

Event Magnitude	Return Period (yrs)	$P_{(H)}$	No. of houses in Risk Zones 1 and 2	No. of people present	Estimated fatalities (N)	% of total residents killed	Fatalities per year
50,000m^3	100	1.00E-02	3	7.5	1.7	2.5	1.71E-02
150,000m^3	250	4.00E-03	8	20.0	3.7	5.5	1.49E-02
300,000m^3	500	2.00E-03	19	47.5	7.9	11.7	1.58E-02
450,000m^3	1000	1.00E-03	24	60.0	9.9	14.6	9.88E-03
		Total of suburb	27	67.5			

F-N Curve

Event Magnitude	Return Period (yrs)	$P_{(H)}$	Estimated fatalities (N)	Cumulative Frequency
450,000m^3	1000	1.00E-03	9.9	1.00E-03
300,000m^3	500	2.00E-03	7.9	3.00E-03
150,000m^3	250	4.00E-03	3.7	7.00E-03
50,000m^3	100	1.00E-02	1.7	1.70E-02

Note: Societal Risk Zones 1 and 2 are equivalent to the Debris Flow Intensity Zones 1 and 2 defined in Table 5.1. Zones 1 and 2 are represented by the pink and orange areas on Figure 17 respectively. It is assumed that fatalities do not occur within the lower I_{DF} zones 3 and 4.

7 Discussion and Conclusions

A quantitative risk assessment of the debris flow hazard in the vicinity of the Awatarariki Stream has been undertaken, based mainly on detailed numerical modelling, calibrated to observations made of the 2005 debris flow event. The results of the analysis are:

- The area affected by the 18 May 2005 event is considered to be a high hazard zone;
- The individual loss of life risk for the Awatarariki fanhead west of the stream is typically 10^{-4} or greater except, for the few most distant properties;
- The individual loss of life risk east of the stream is significantly lower than the west, which is consistent with the distribution of damage observed in 2005. Nevertheless some properties have risks of 10^{-4} or greater, with a larger number being 10^{-5} or 10^{-6}. The steep gradient of these eastern risk contours requires extreme caution to be used when interpreting the risk of individual properties in this area;
- Societal risks are significant with cumulate risk being in excess of 10^{-3}.

Whether these levels of individual or societal risk are acceptable or not is a vexed question, as different individuals, groups, communities and societies view these issues differently. The discussion below provides some background on the assessment of risk levels, however it is not the intent nor purpose of this study to determine what is, or is not, an acceptable risk. This is for others to decide.

7.1 Individual Loss of Life Risk

New Zealand does not have established criteria for determining whether a particular annual loss of life risk is acceptable, tolerable or unacceptable. Some movement to defining or adopting such terminology has recently been made in Christchurch with respect to the boulder roll and cliff collapse risk associated with the recent earthquake events. Nevertheless, these are still not adopted as criteria elsewhere.

A number of overseas government and non-government organisations have published what they consider to be reasonable interpretations of these limits with 10^{-4} to 10^{-5}/annum typically be adopted as the limit for acceptable risk for the person most at risk.

If such commonly adopted criteria were also to be adopted at Matata, significant parts of the fanhead would be considered to have an unacceptable level of risk, especially the part west of the stream (Clem Elliot Drive area)

How this compares to other hazards in New Zealand can be gauged from Figure 20.

7.2 Societal Risk

Similarly with societal risk, a number of different agencies have defined acceptable, tolerable (if reduced as low as reasonably practicable) and unacceptable based on Frequency-Number charts. This report does not consider one to be better than the other. If however we plot our results on the F-N chart presented in the AGS (2007) we find that the societal risk for Debris Flow Intensity Zones 1 and 2 (which cover much of the fanhead – see Figure 17) lie in the unacceptable risk category for both the lower and higher residential density cases (Figure 18).

7.3 Property Loss Risk

The potential for future damage to property has been assessed based on calculated debris flow intensities. It is clear from both the numerical modelling and the observations made of the effects

of the 2005 event, that significant property damage can be expected to occur for a range of debris flow event magnitudes. The most significant damage can be expected to occur west of the Awatarariki Stream, although, as was experience in 2005, some property loss can be expected to the east. The level of property loss can be expected to be very significant should the Clem Elliot Drive area be more developed than it currently is.

7.4 Further Assessments of Individual Properties

It is believed that RAMMS has provided a realistic means of evaluating the likely spatial extent of impact from future debris flows of varying magnitudes. Debris flows are however very complex in terms of their flow mechanisms and composition. Without some additional knowledge with respect to the volume and frequency of future debris flow events, we do not believe that additional numerical modelling would provide any additional information that could assist in the assessment of loss of life or property loss risk for individual properties within Matata.

RAMMS does offer the opportunity to model the effect of mitigation works such as deflection or detentions bunds (as was reported in T&T (2009)). However to be effect, such protection works will need to be suburb-wide, as our previous experience with the modelling of such structures has shown that property-specific defences are likely to be overwhelmed by the sheer volume of debris contained within debris flows of the type experienced in 2005. The construction of impact resistant structures may be a more productive avenue of design enquiry for individual properties.

8 References

Australian Geomechanics Society, 2007. *Landslide Risk Management*. Australian Geomechanics, Vol. 42, No. 1, March 2007

Shearer, 2005a. *Matatā Recovery Project C – to collect information from Matatā residents describing their observations during the event*.

Shearer, 2005b. *Matatā Project D - to gather anecdotal and more formal historical records to identify and confirm previous significant flood events and land use practices in the catchments and confirm their effects on Matatā and the historical context of the recent event*.

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Tonkin & Taylor, 2013b. *Quantitative Landslide Risk Assessment, Matatā Escarpment*. Report dated November 2013.

Tonkin & Taylor, 2013a. *Quantitative Landslide Risk Assessment, Whakatāne and Ōhope Escarpments*. Report dated November 2013

9 Applicability

This report has been prepared for the benefit of Whakatane District Council with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
	
.....	.....
Kevin J. Hind	Nick Rogers
Engineering Geologist	Project Director

kjh

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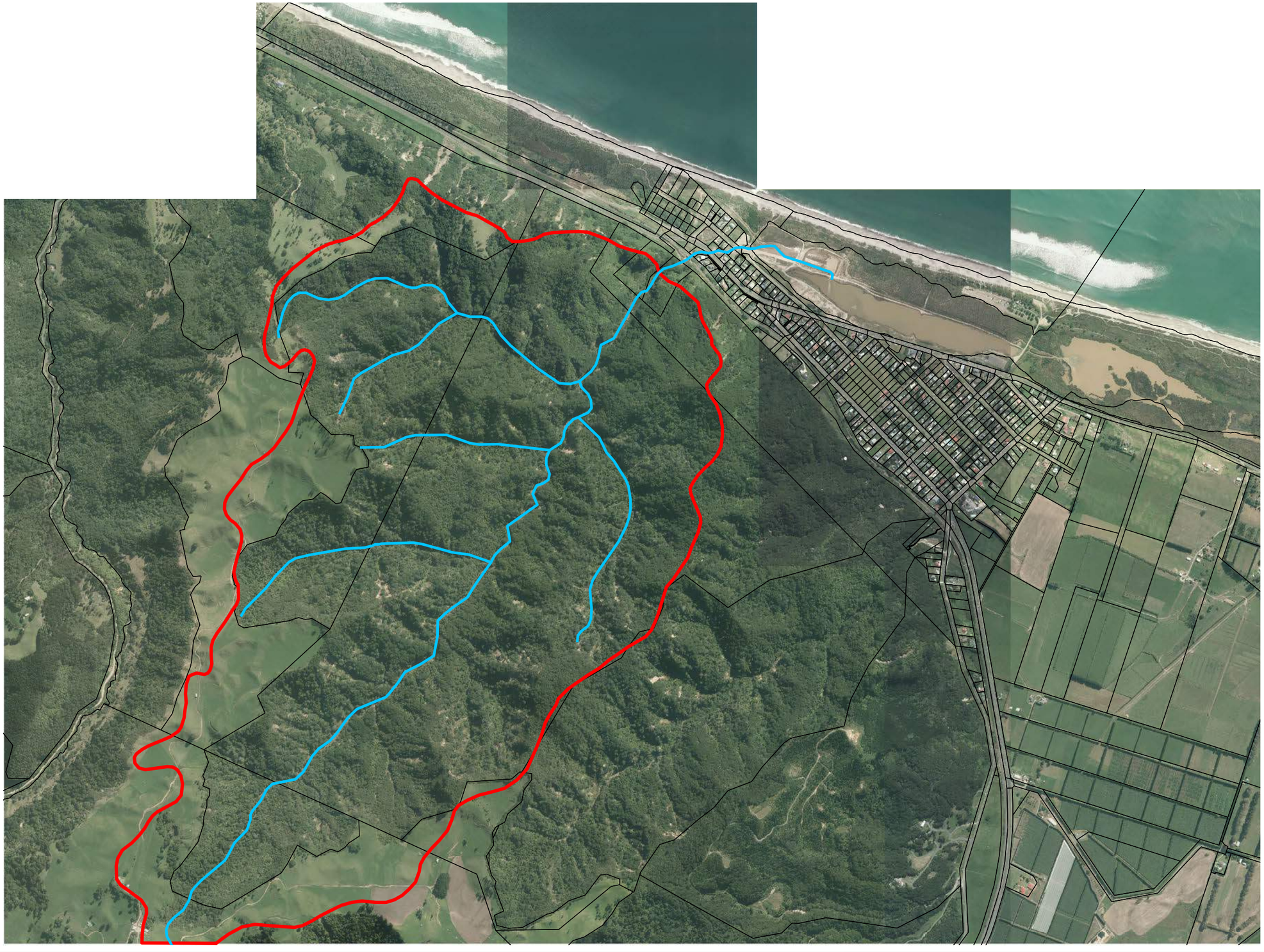
Appendix A: Figures



Notes: Aerial Imagery 2007 sourced from Terralink International (Copyright 2002-2005 Terralink International Limited and its licensors).

A3 SCALE 1:15,000

0 160 320 480 640 800 (m)

Legend

- Awatarariki Stream
- Watershed Boundary

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Awatarariki Stream catchment and town of Matata

FIGURE No.: Figure 1
Rev.: 0

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A3 SCALE 1:2,500

0 30 60 90 120 (m)

Legend

Creek

Awatarariki Stream

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Awatarariki Stream fanhead

FIGURE No. Figure 2

Rev. 0

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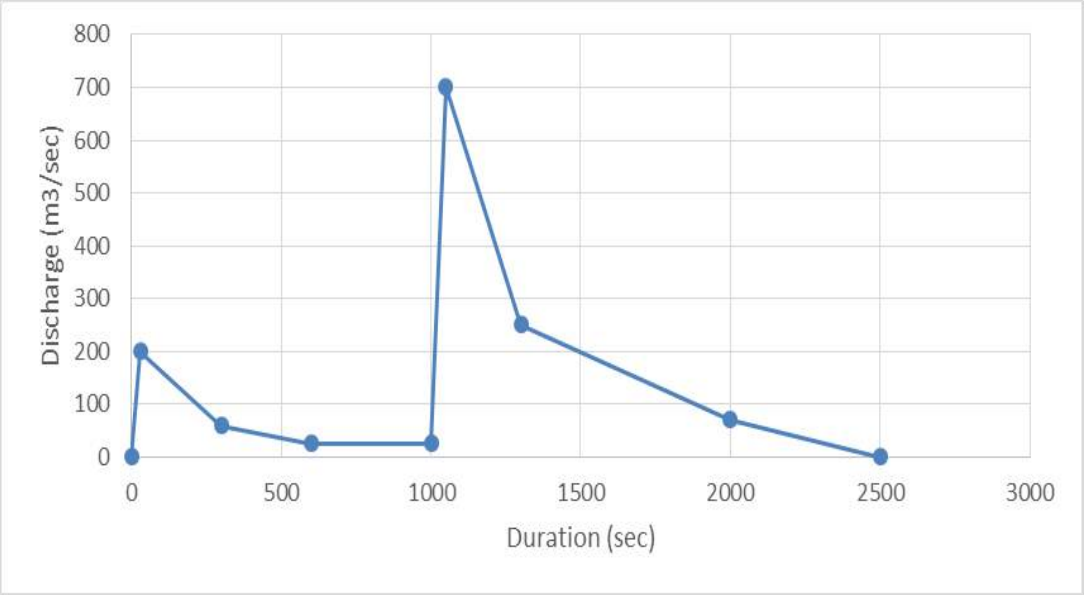


Figure 3: Debris flow hydrograph used to replicate the 2005 event (300,000m^3)

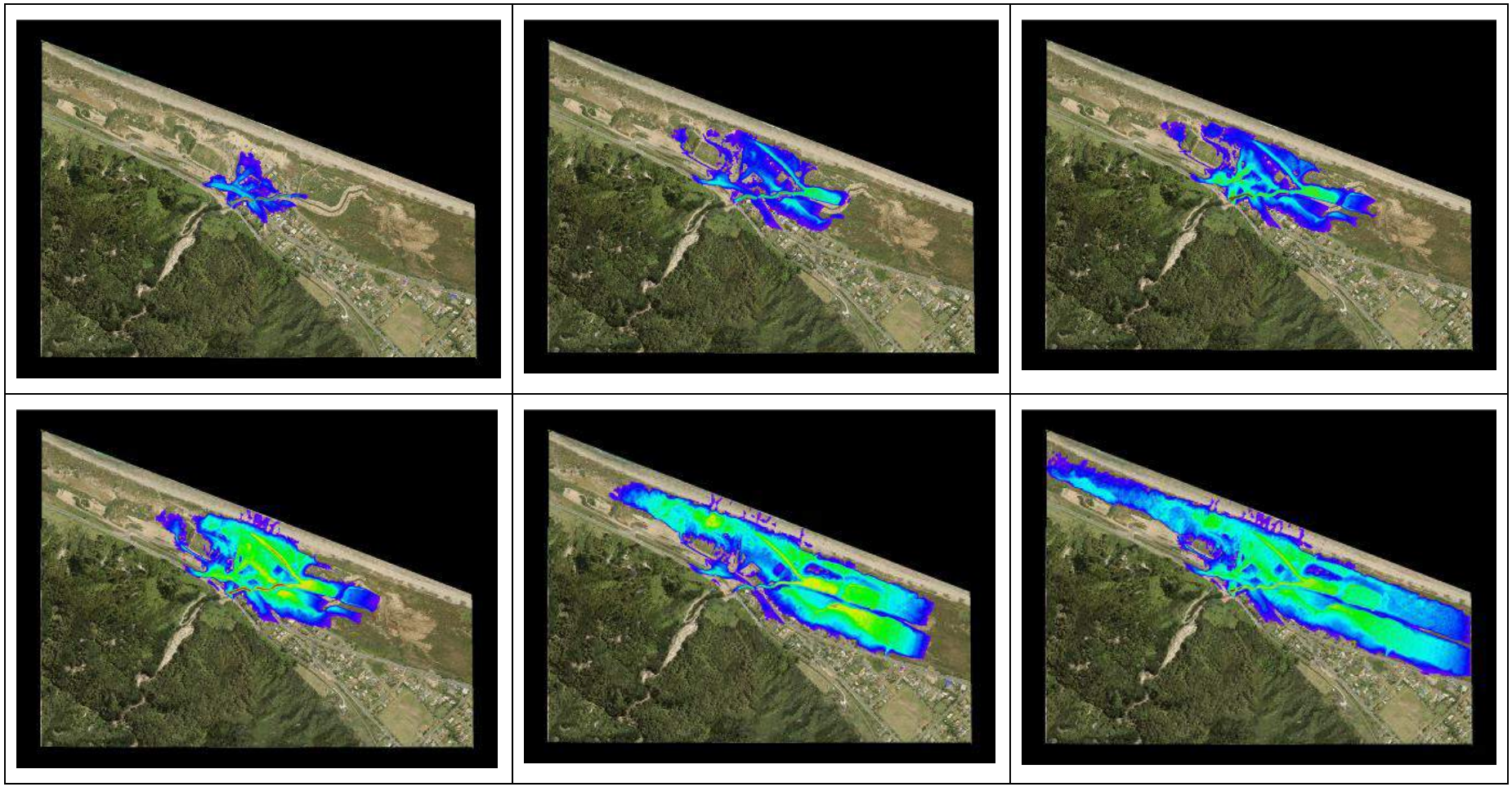
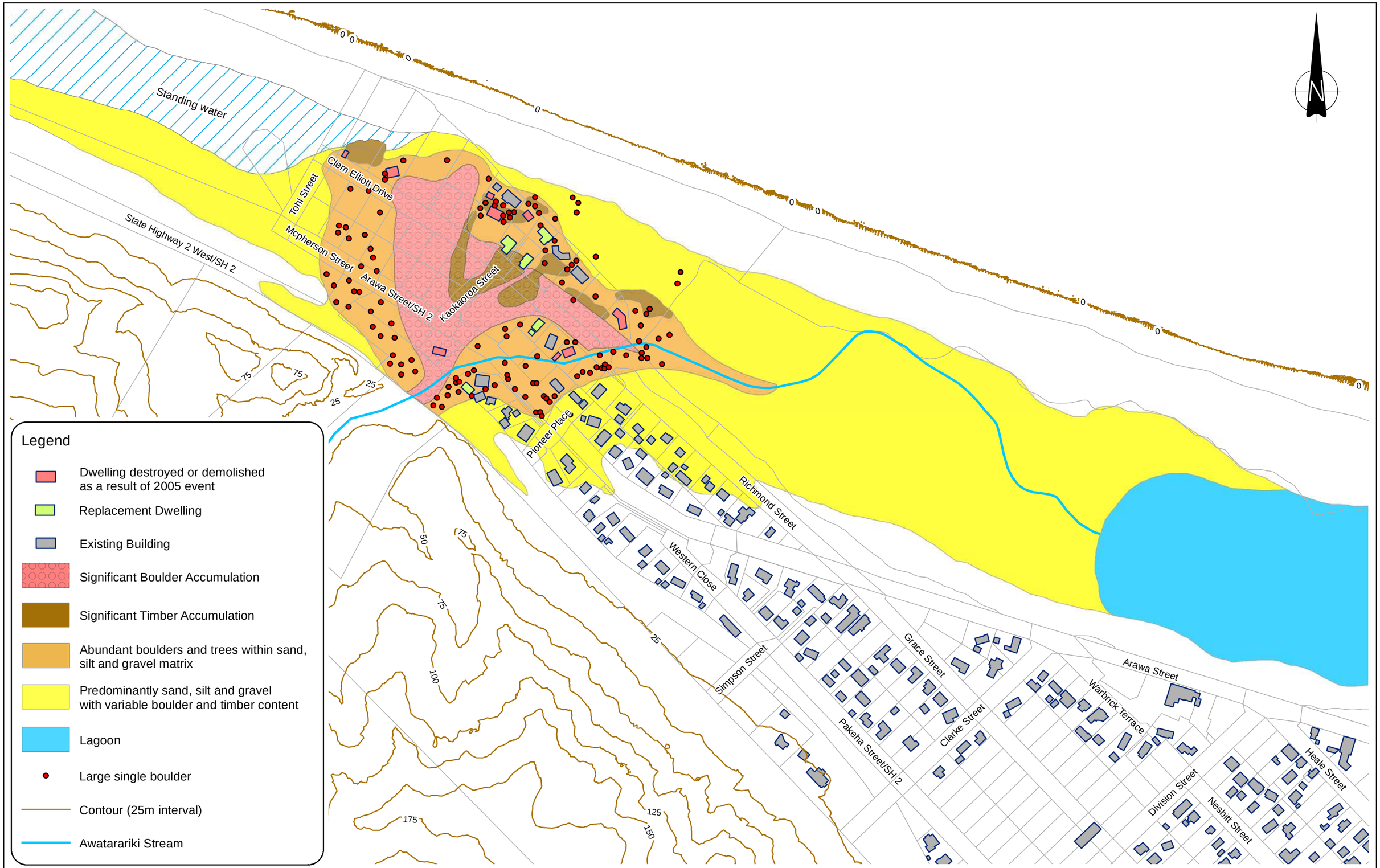


Figure 4: Example RAMMS outputs of a 300,00m^3, two-surge debris flow event



Legend

- Dwelling destroyed or demolished as a result of 2005 event
- Replacement Dwelling
- Existing Building
- Significant Boulder Accumulation
- Significant Timber Accumulation
- Abundant boulders and trees within sand, silt and gravel matrix
- Predominantly sand, silt and gravel with variable boulder and timber content
- Lagoon
- Large single boulder
- Contour (25m interval)
- Awatarariki Stream

A3 SCALE 1:4,000

0 50 100 150 200 (m)

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WHAKATANE DISTRICT COUNCIL
MATATA QLRA
Debris from 2005 event

FIGURE No.: Figure 5
Rev.: 0

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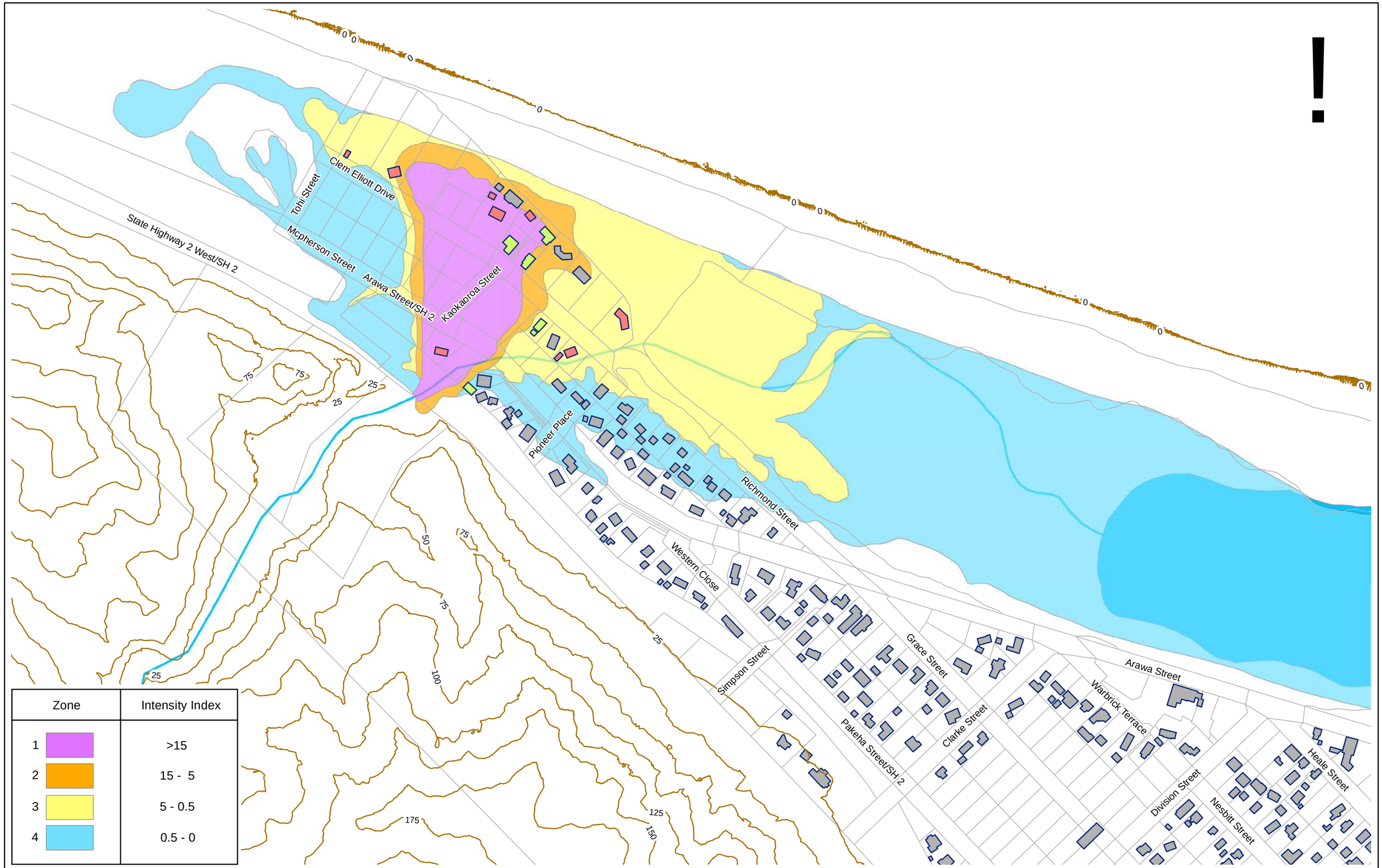
Figure 6: Decay in Debris Flow Intensity Index across the fanhead



Zone	Intensity Index
1	>15
2	15 - 5
3	5 - 0.5
4	0.5 - 0

A3 SCALE 1:4,000

0 50 100 150 200 (m)

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WHAKATANE DISTRICT COUNCIL
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Back analysis of 2005 event

FIGURE No. Figure 7

Rev. 0

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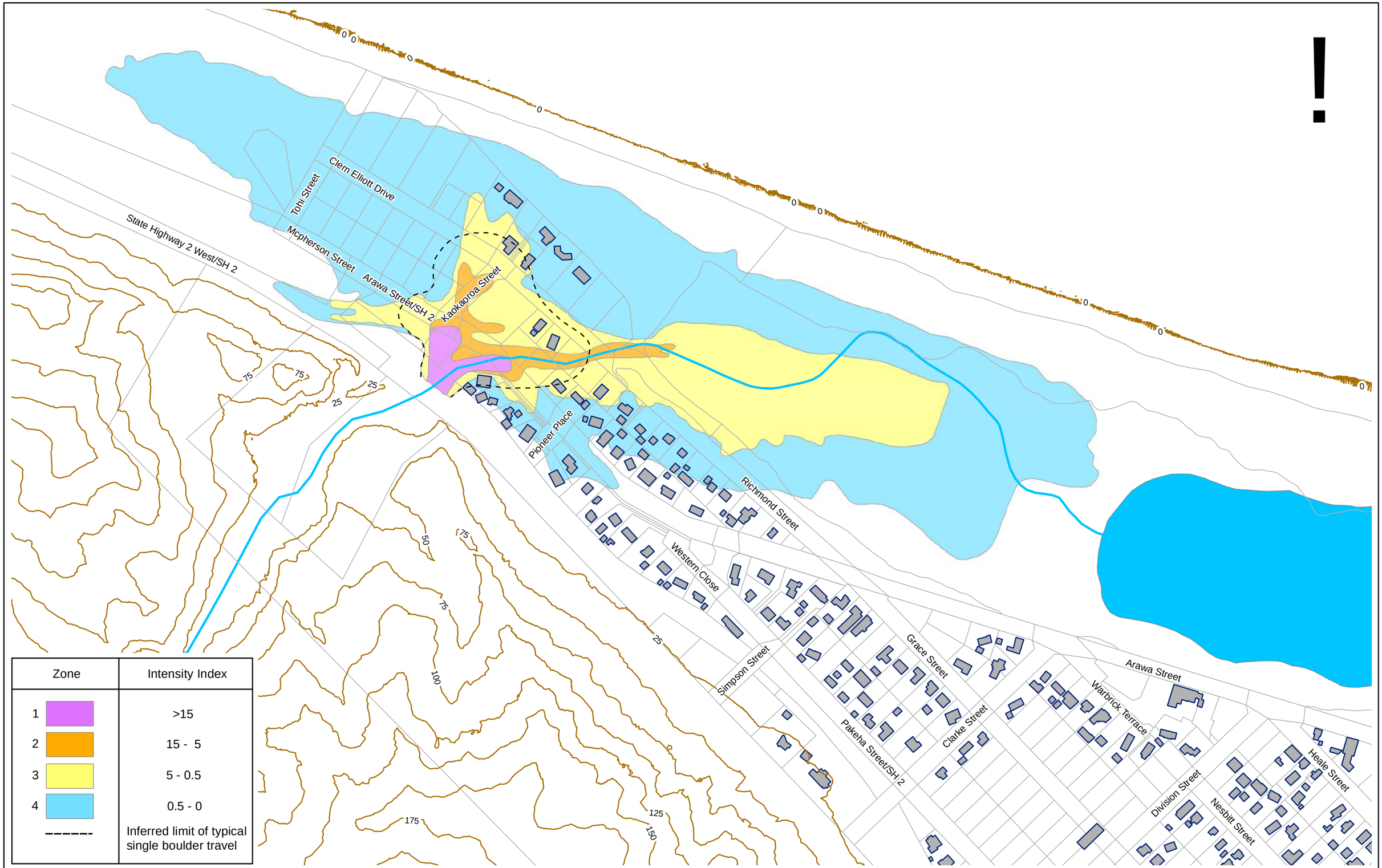

Zone	Intensity Index
1	>15
2	15 - 5
3	5 - 0.5
4	0.5 - 0
------	Inferred limit of typical single boulder travel

A3 SCALE 1:4,000

0 50 100 150 200 (m)

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WHAKATANE DISTRICT COUNCIL
MATATA QLRA
Debris Flow intensity
50,000 m^3 Event

FIGURE No.: Figure 8
Rev.: 0

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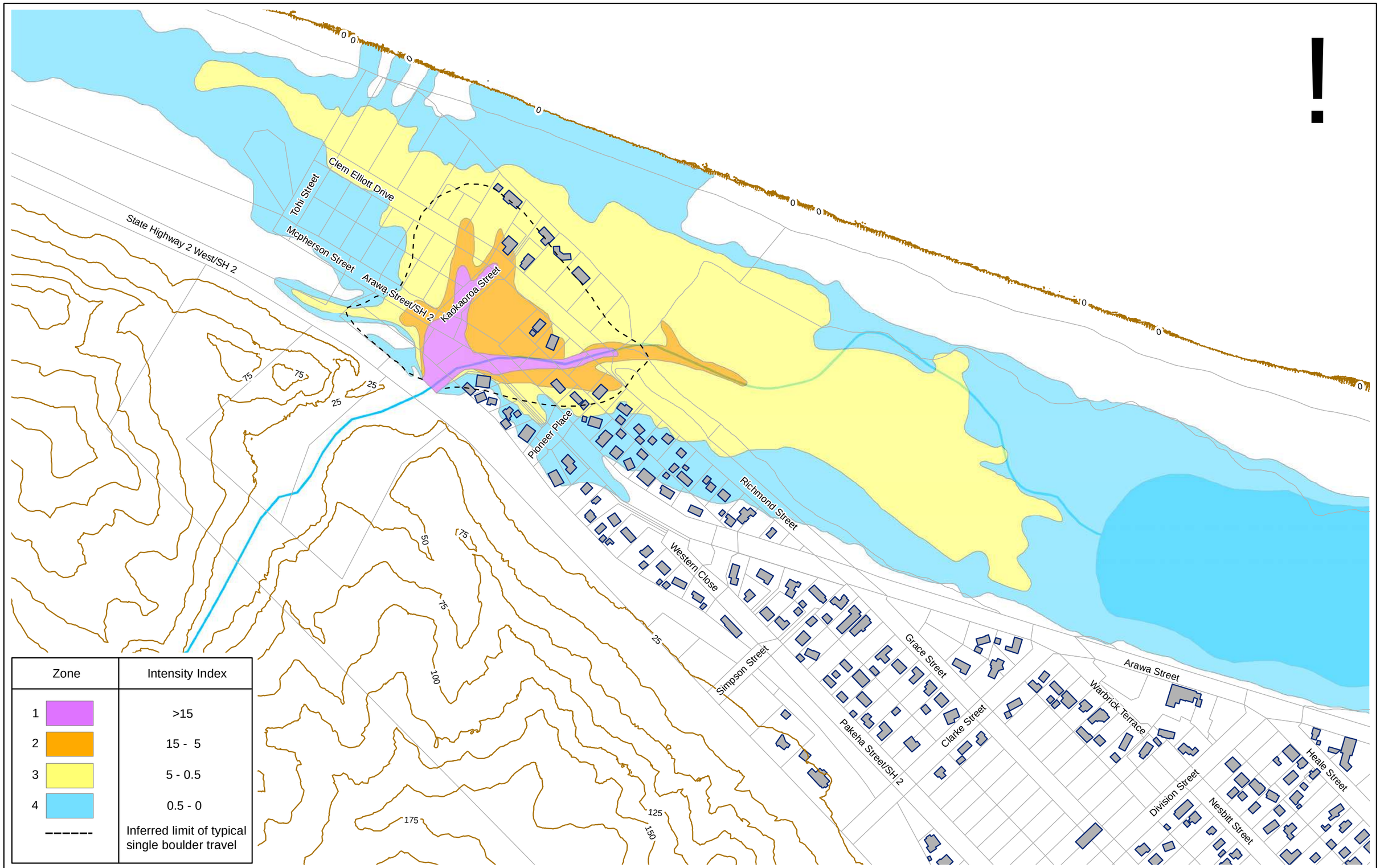

Zone	Intensity Index
1	>15
2	15 - 5
3	5 - 0.5
4	0.5 - 0
------	Inferred limit of typical single boulder travel

A3 SCALE 1:4,000

0 50 100 150 200 (m)

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SCALE (AT A3 SIZE)	1:4,000	
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WHAKATANE DISTRICT COUNCIL
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Debris Flow intensity
150,000 m^3 Event

FIGURE No. Figure 9

Rev. 0

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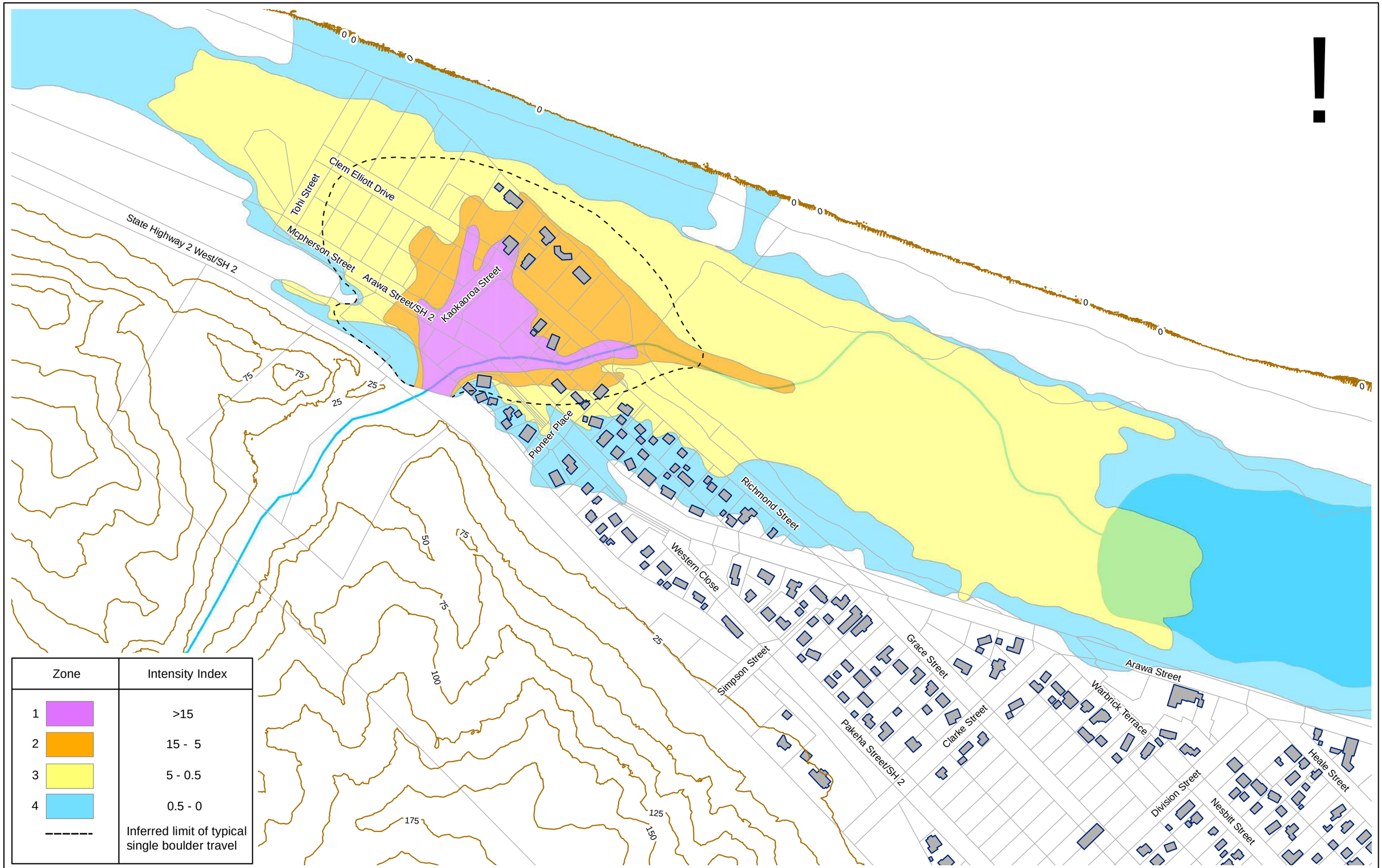

Zone	Intensity Index
1	>15
2	15 - 5
3	5 - 0.5
4	0.5 - 0
------	Inferred limit of typical single boulder travel

A3 SCALE 1:4,000

0 50 100 150 200 (m)

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WHAKATANE DISTRICT COUNCIL
MATATA QLRA
Debris Flow intensity
300,000 m^3 Event

FIGURE No. Figure 10 | Rev. 0

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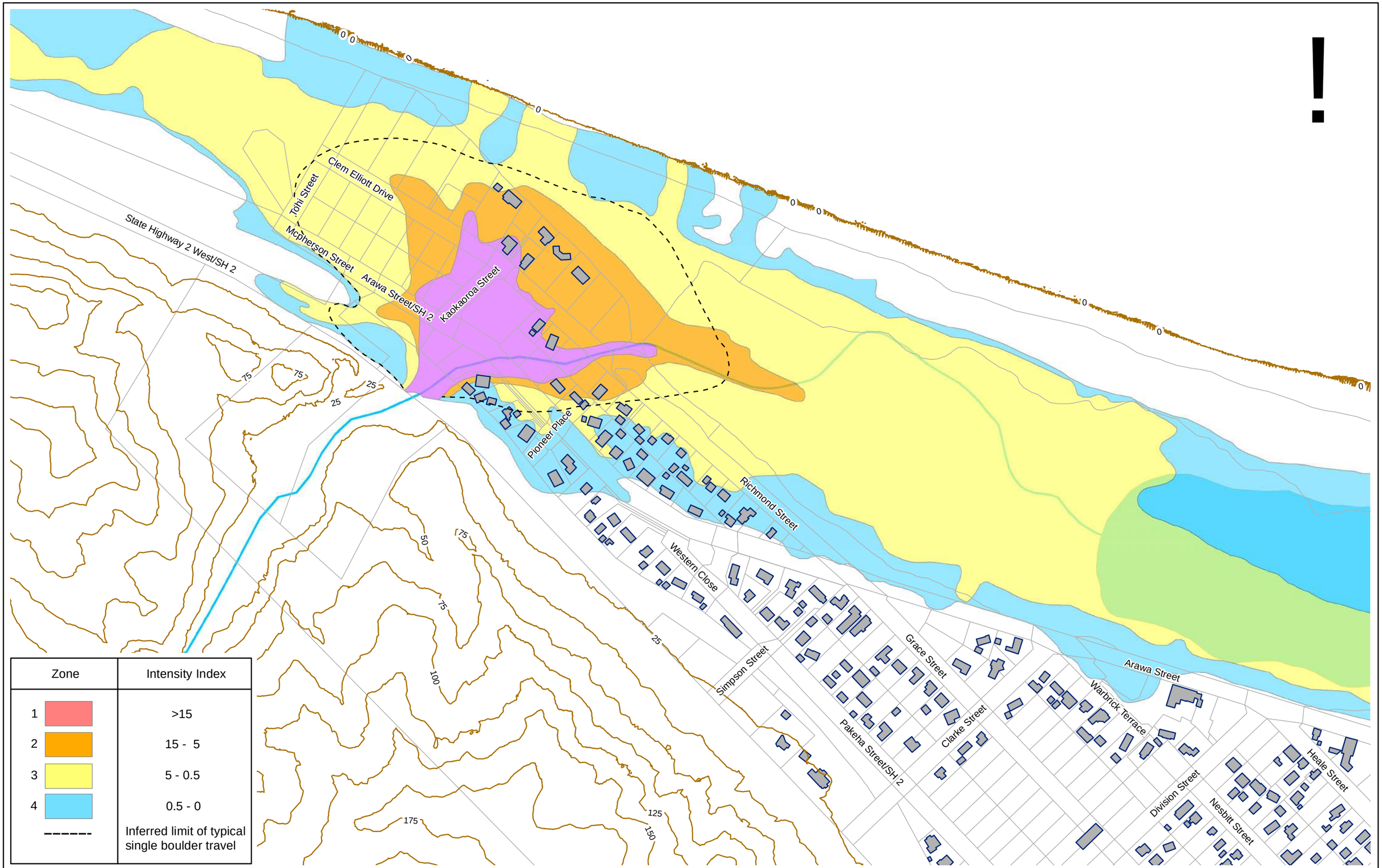

Zone	Intensity Index
1	>15
2	15 - 5
3	5 - 0.5
4	0.5 - 0
------	Inferred limit of typical single boulder travel

A3 SCALE 1:4,000

0 50 100 150 200 (m)

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MATATA QLRA
Debris Flow intensity
450,000 m^3 Event

FIGURE No. Figure 11

Rev. 0

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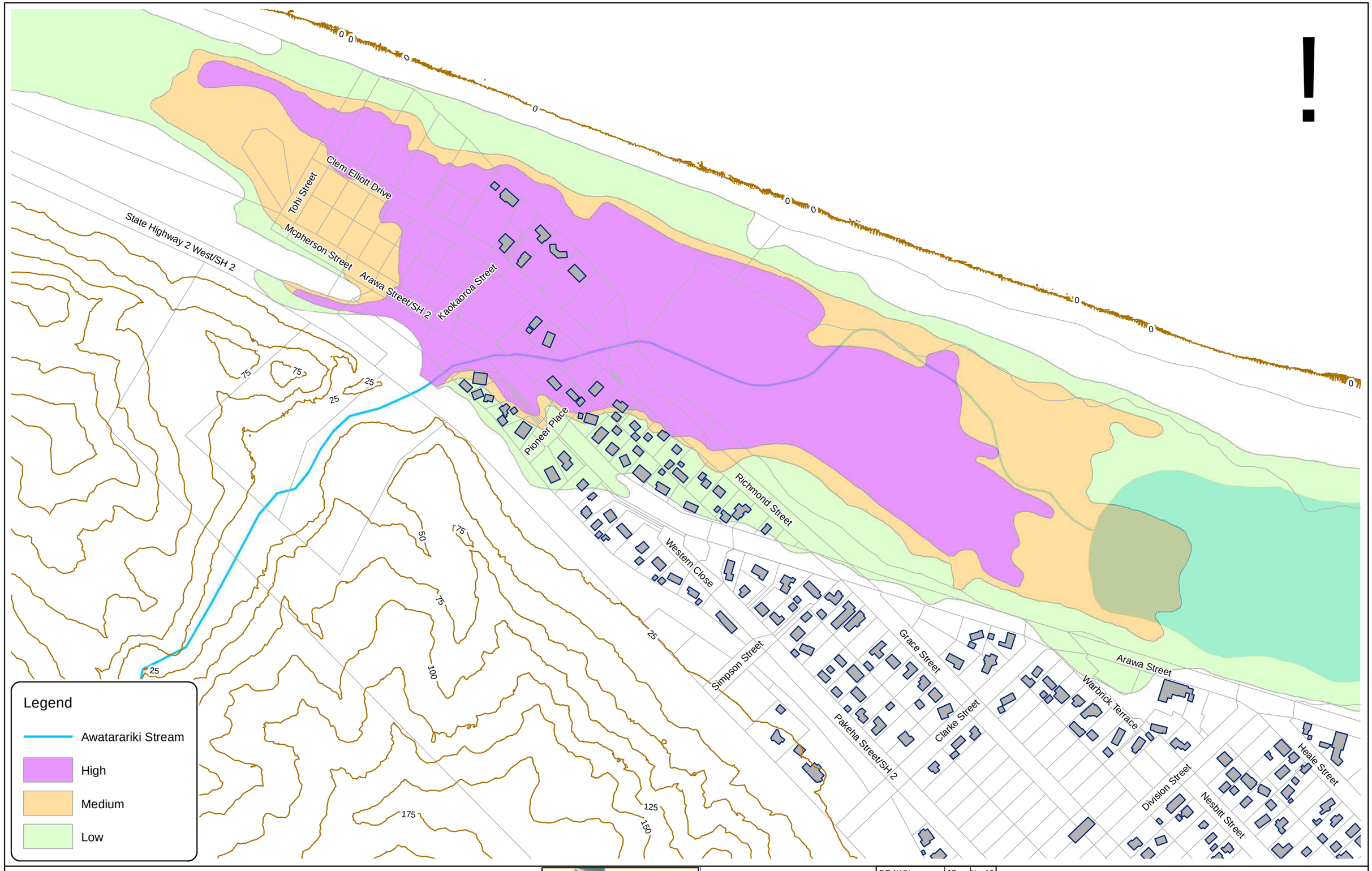

A3 SCALE 1:4,000

0 50 100 150 200 (m)

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WHAKATANE DISTRICT COUNCIL
MATATA QLRA
Debris flow hazard classification

FIGURE No. Figure 12
Rev. 0

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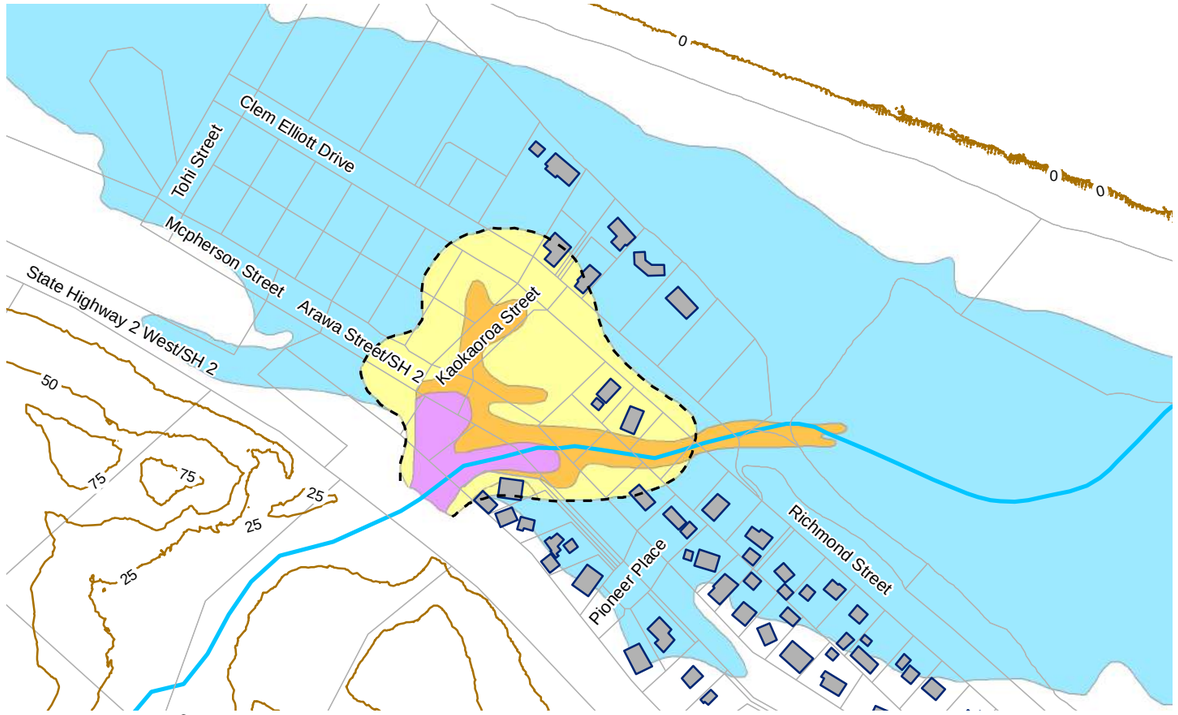
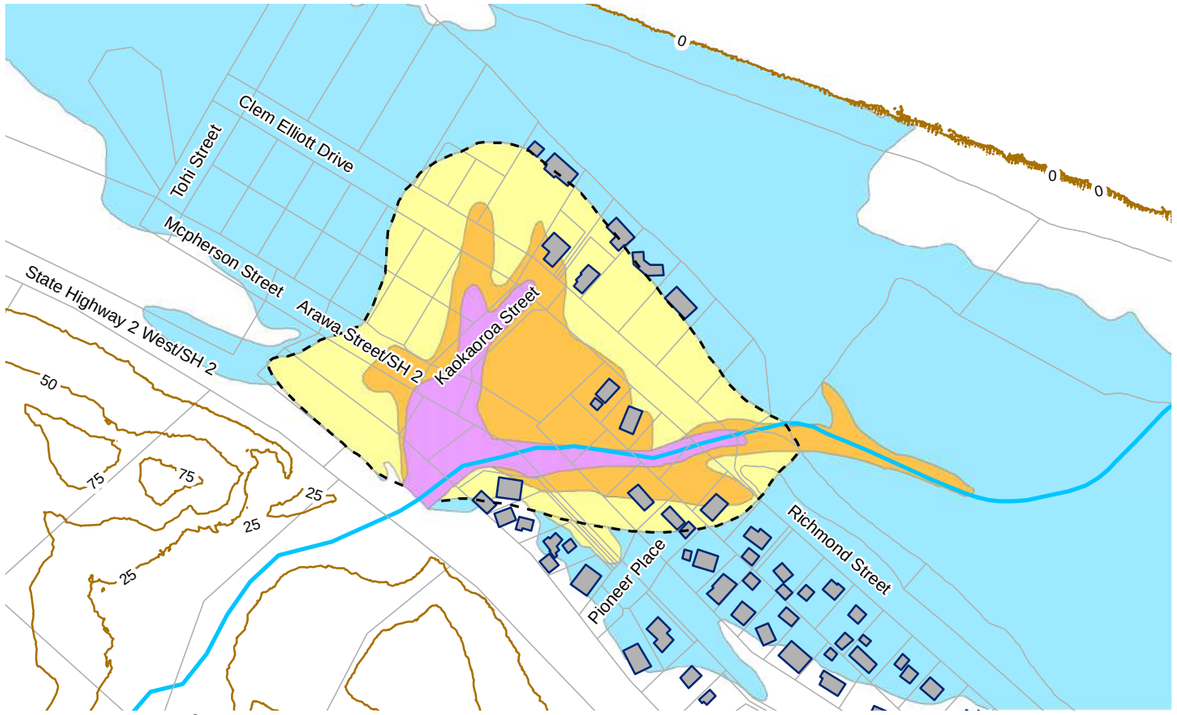
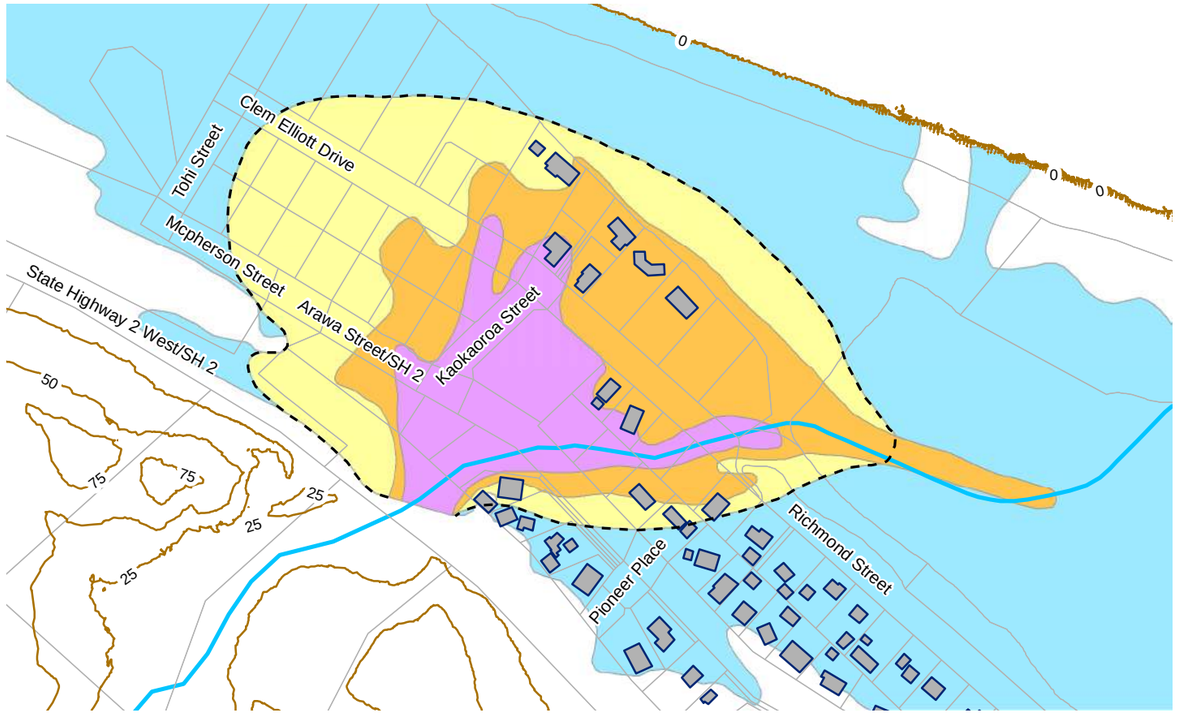


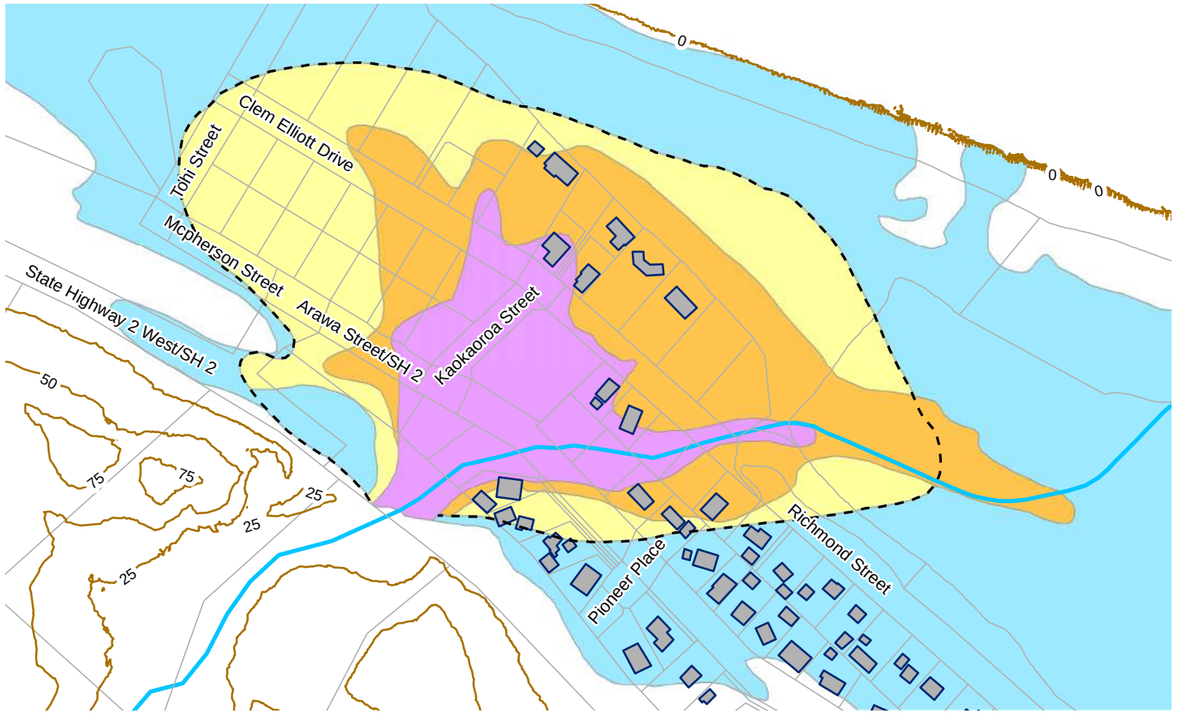
Case: 50,000 m^3 Event



Case: 150,000 m^3 Event



Case: 300,000 m^3 Event



Case: 450,000 m^3 Event

A3 SCALE 1:4,000

0 50 100 150 200 (m)

Legend

	P (S:H)	V (D:T)
	1.00	0.75
	1.00	0.20
	0.20	0.05
	0.05	<0.01

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Assumed vulnerability to fatal injury

FIGURE No. Figure 13
Rev. 0

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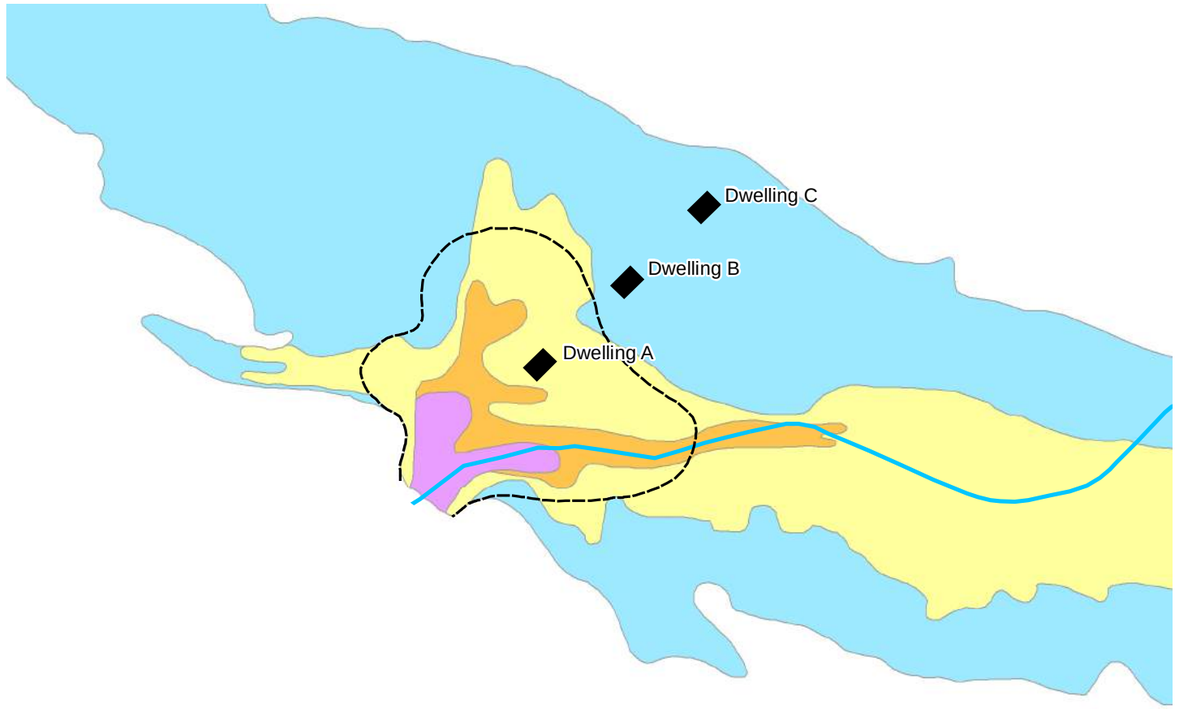
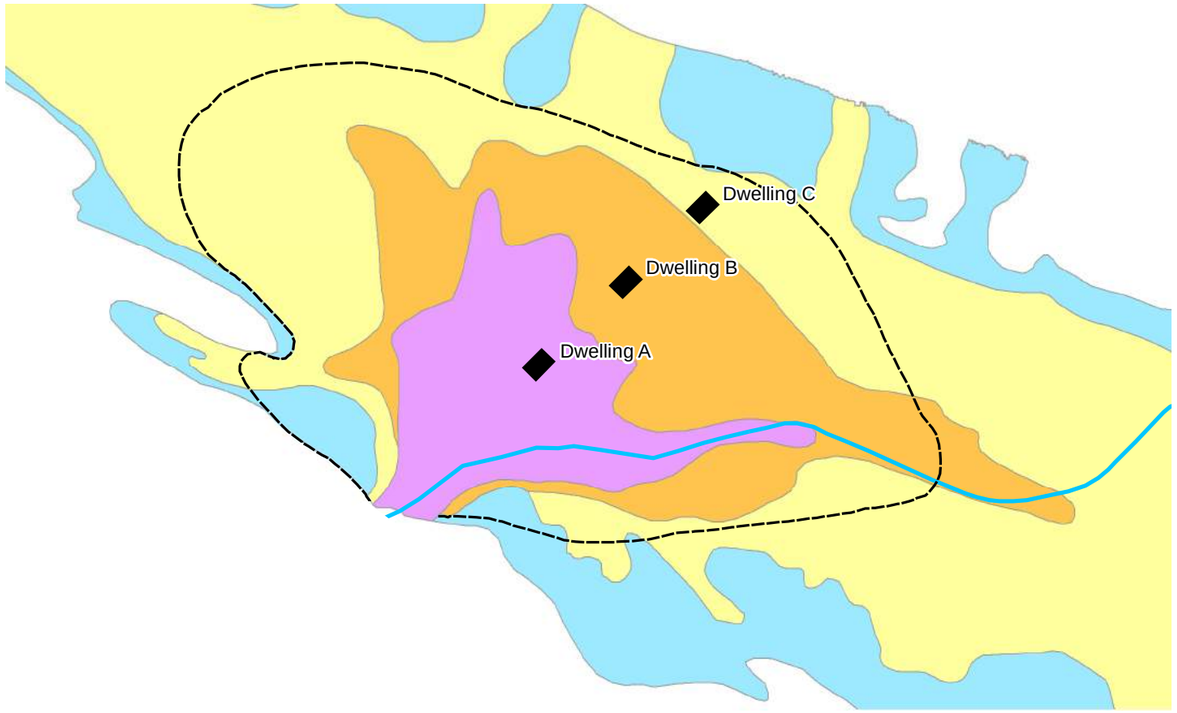


Case1: Small Volume - Short Return Period Event
Hazard to example dwellings

Dwelling A: Debris flow intensity Zone 3 + single boulder impact zone
Debris Type: predominantly sand, silt and gravel with occasional boulder extending to the limit indicated.
Inferred structural damage: generally minor with some localized significant damage possible from isolated boulder impact.
Inferred human vulnerability: moderate to low, fatality is possible but unlikely (5%).

Dwelling B: Debris flow intensity Zone 4
Debris Type: predominantly silt and lader water.
Inferred structural damage: generally insignificant but some flood damage possible to lower storey.
Inferred human vulnerability: low, fatality is unlikely(<1%).

Dwelling C: Debris flow intensity Zone 4
Debris Type: predominantly silt and lader water.
Inferred structural damage: generally insignificant but some flood damage possible to lower storey.
Inferred human vulnerability: low, fatality is unlikely(<1%).



Case1: High Volume - Long Return Period Event
Hazard to example dwellings

Dwelling A: Debris flow intensity Zone 1
Debris Type: mass boulder and tree deposition.
Inferred structural damage: complete destruction.
Inferred human vulnerability: extreme, significantly possibility of fatality (75%).

Dwelling B: Debris flow intensity Zone 2
Debris Type: abundant boulders and trees within a matrix of sand, silt and gravel.
Inferred structural damage: severe to moderate damage, some houses knocked off their foundations.
Inferred human vulnerability: moderate, fatality is a possibility (20%).

Dwelling C: Debris flow intensity Zone 3 + single boulder impact zone
Debris Type: predominantly sand, silt and gravel with occasional boulder extending to the limit indicated.
Inferred structural damage: generally minor with some localized significant damage possible from isolated boulder impact.
Inferred human vulnerability: moderate to low, fatality is possible but unlikely (5%).

A3 SCALE 1:4,000
0 50 100 150 200 (m)

Zone	Intensity Index
1	>15
2	15 - 5
3	5 - 0.5
4	0.5 - 0
-----	Boulder limit

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FIGURE No.	Figure 14	Rev. 0

WHAKATANE DISTRICT COUNCIL
MATATA QLRA
Variation of hazard and risk with location and event magnitude

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A3 SCALE 1:4,000

0 50 100 150 200 (m)

Legend

$1x10^{-4}$ Annual Loss of Life Risk

Location Plan

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WHAKATANE DISTRICT COUNCIL
MATATA QLRA
Individual Loss of Life Risk
Shorter Return Periods Assumed

FIGURE No. Figure 15
Rev. 0

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A3 SCALE 1:4,000

0 50 100 150 200 (m)

Legend

1x10-4 Annual Loss of Life Risk

Location Plan

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WHAKATANE DISTRICT COUNCIL
MATATA QLRA
Individual Loss of Life Risk
Longer Return Periods Assumed

FIGURE No. Figure 16

Rev. 0

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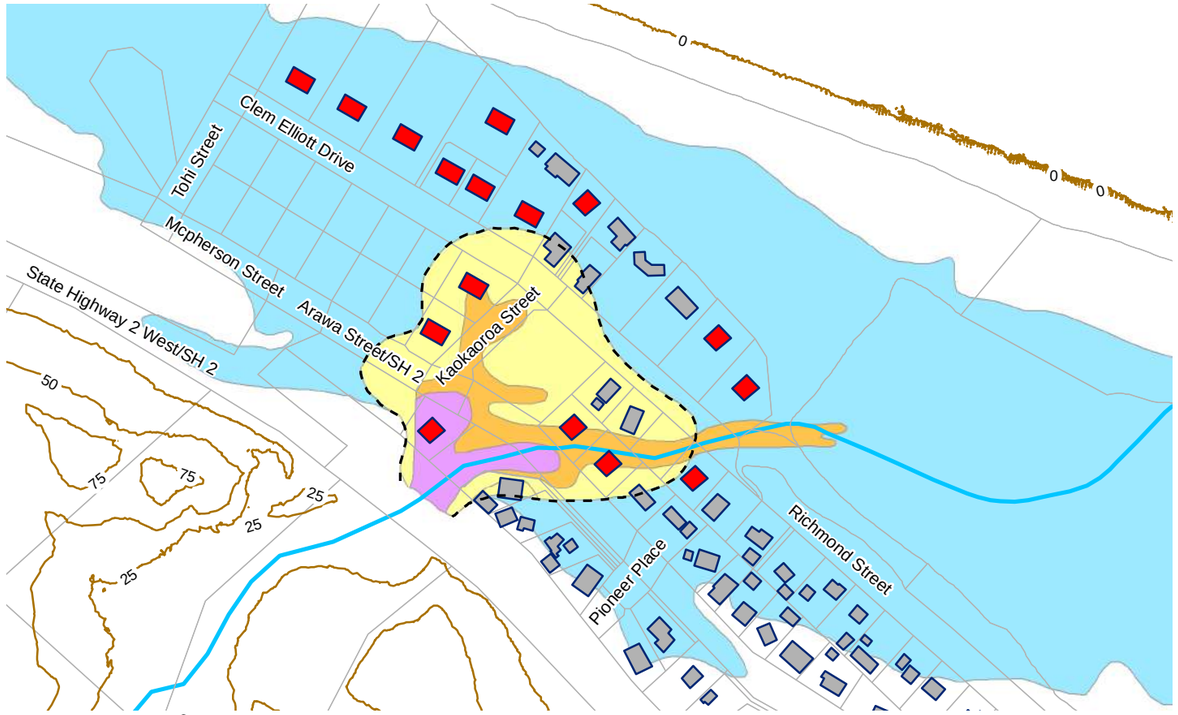
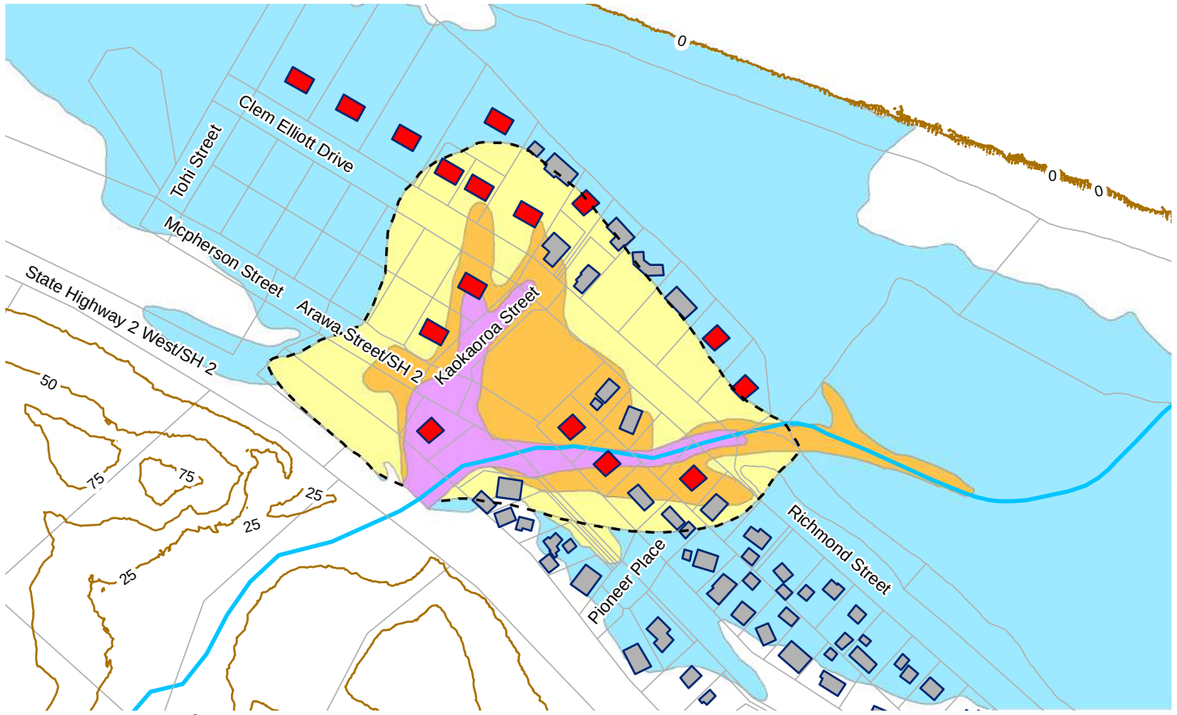
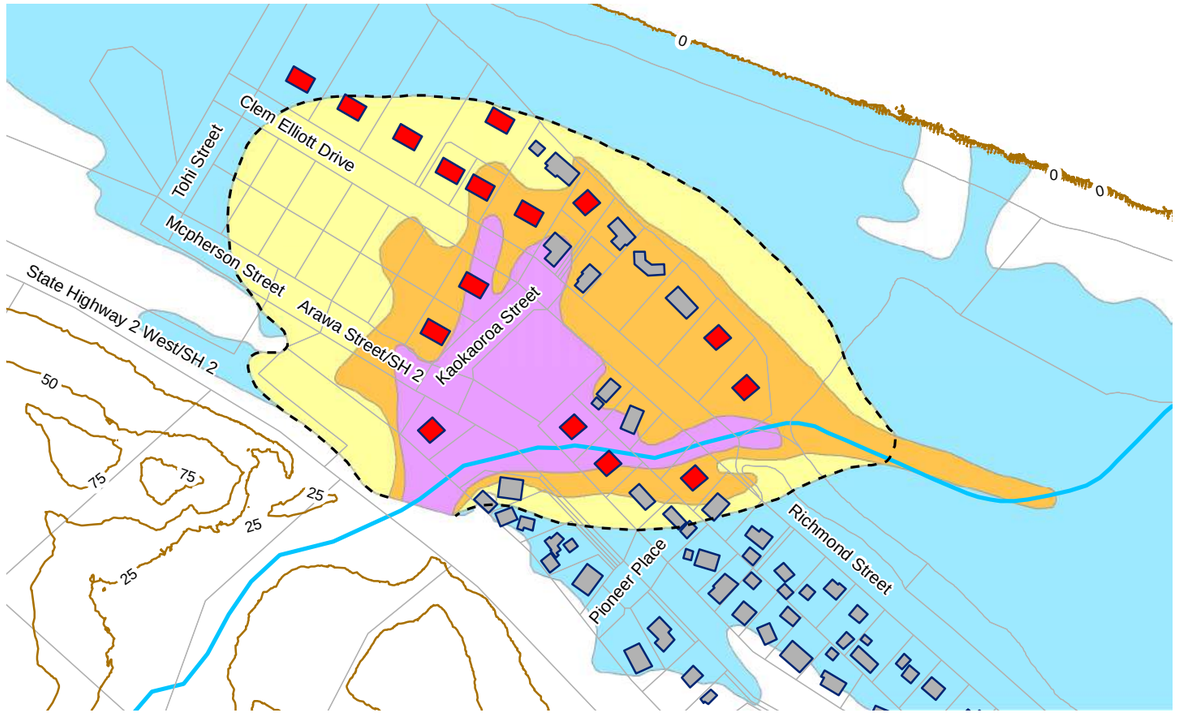


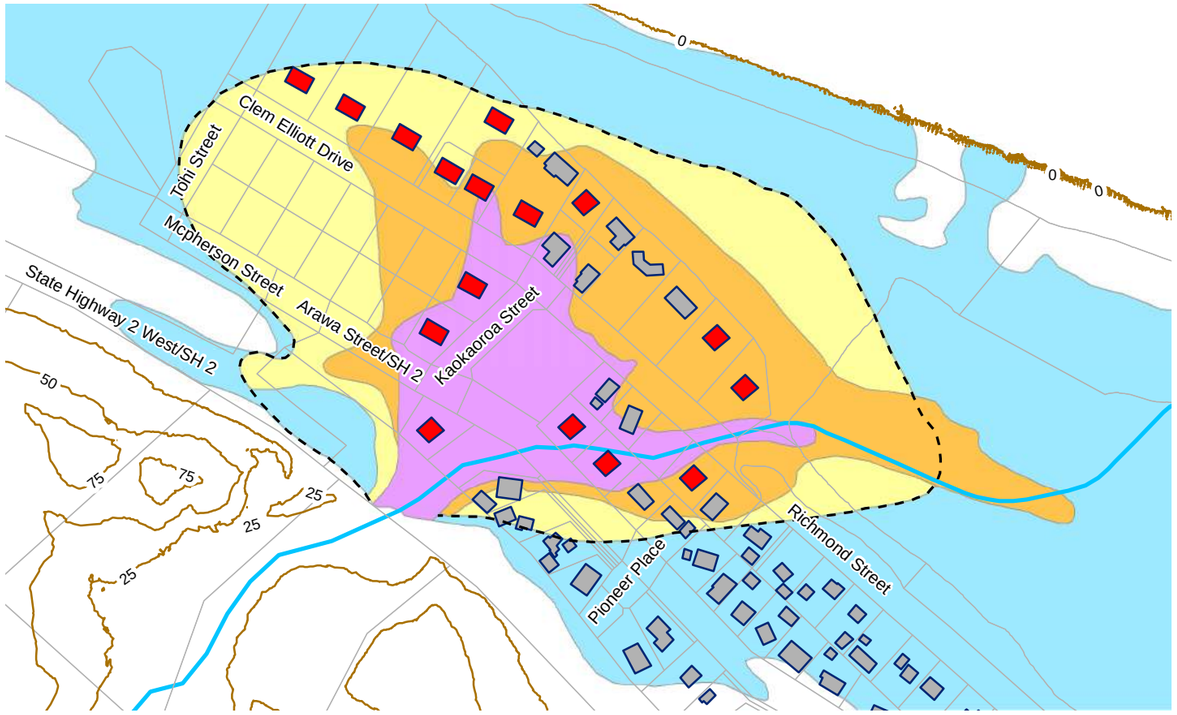
Case: 50,000 m^3 Event



Case: 150,000 m^3 Event



Case: 300,000 m^3 Event



Case: 450,000 m^3 Event

A3 SCALE 1:4,000

0 50 100 150 200 (m)

Legend

- Existing Structure
- Assume future structure
- Risk Zone 1
- Risk Zone 2

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DRAWN	JC	Nov.13
CHECKED	KJH	Jul.15
APPROVED	KJH	Jul.15

ARCFILE: 29115.1000-F17.mxd
SCALE (AT A3 SIZE): 1:4,000
PROJECT No.: 29115.1000
FIGURE No.: Figure 17
Rev.: 0

WHAKATANE DISTRICT COUNCIL
MATATA QLRA
Assumed residential layout for societal risk

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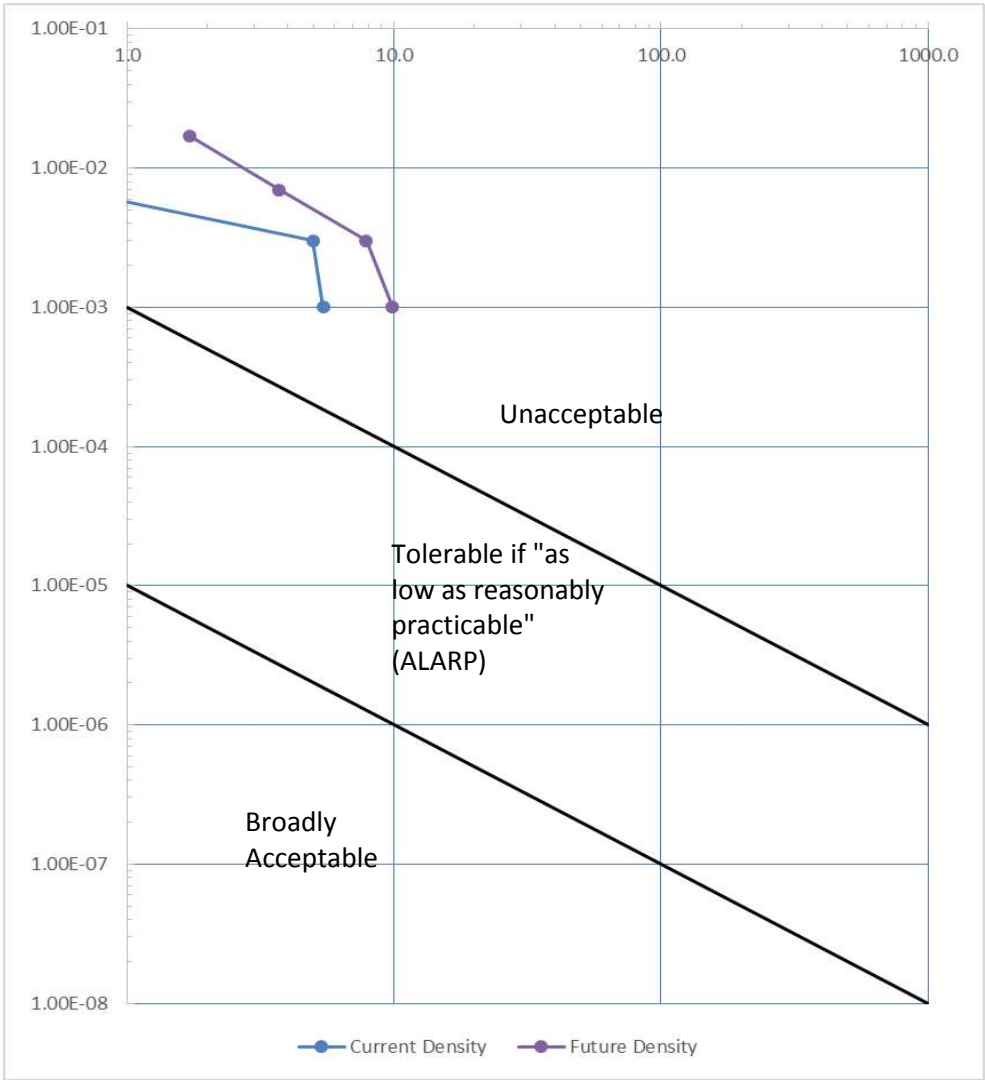
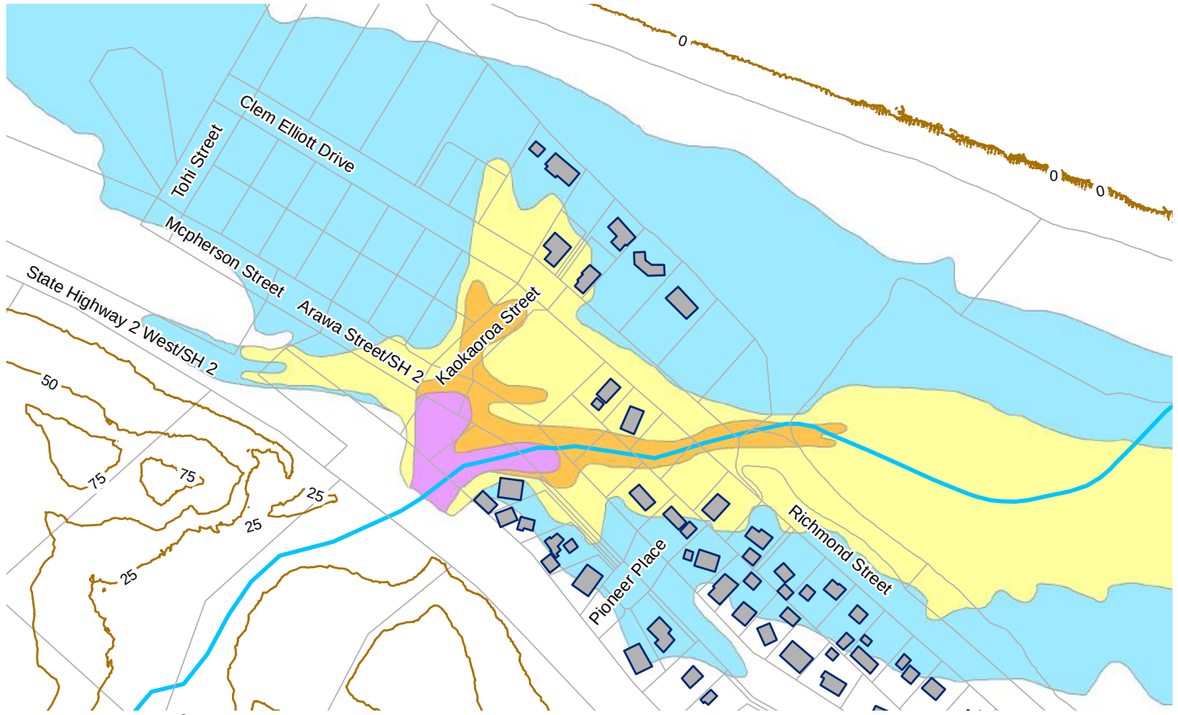
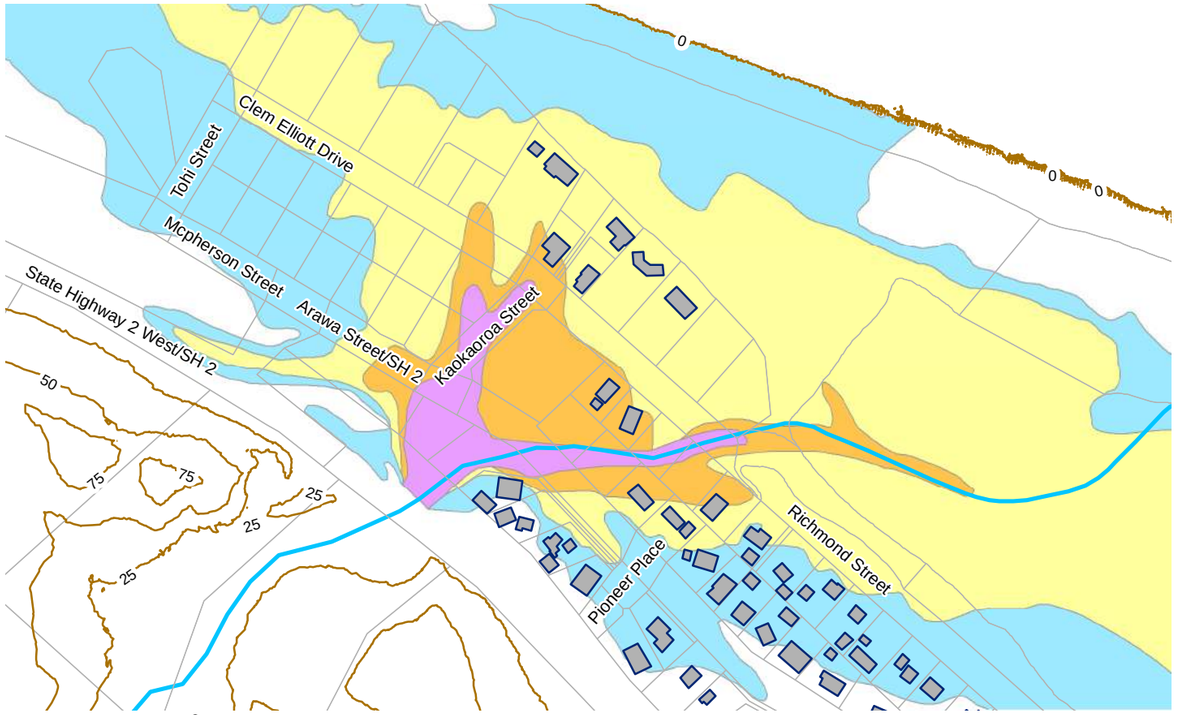


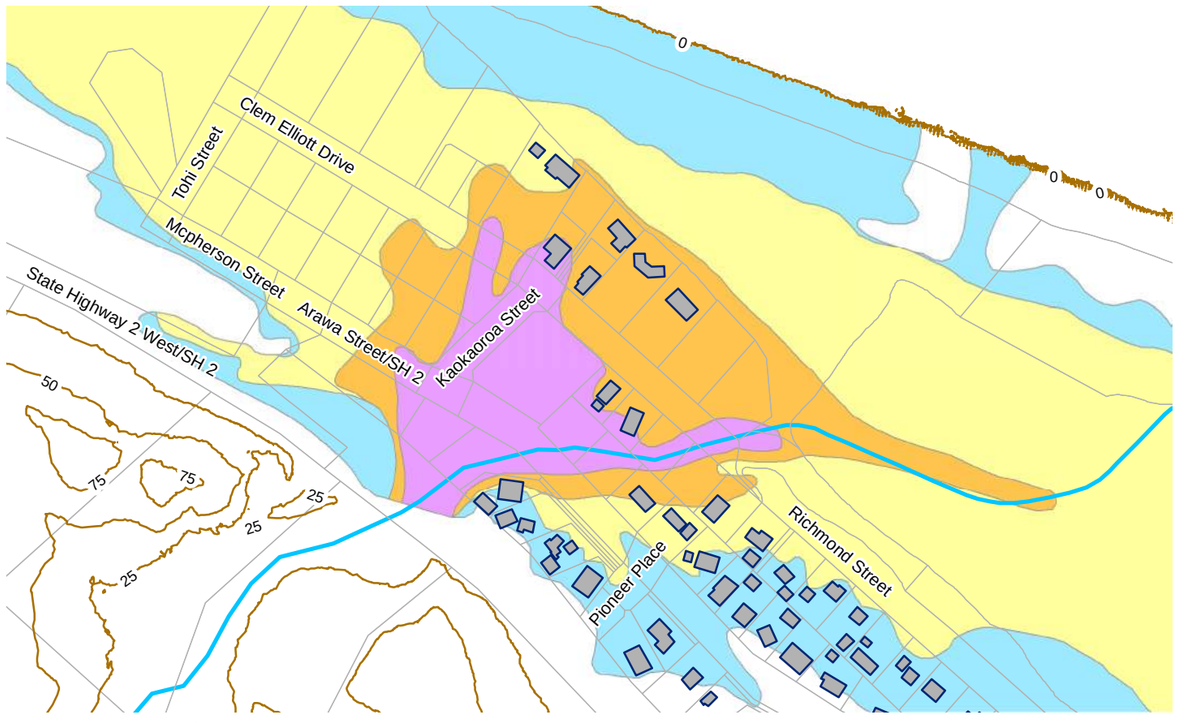
Figure 18: F-N Curve for Matatā. Commonly adopted acceptance criteria (AGS, 2007) are indicated.



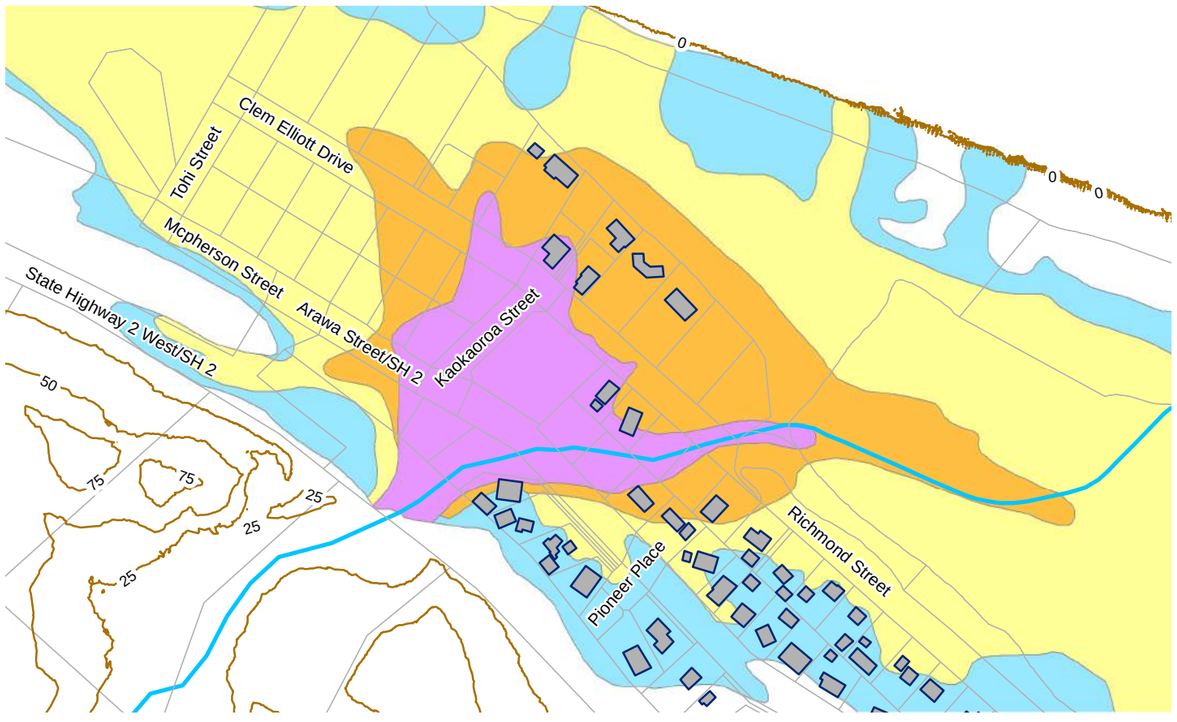
Case: 50,000 m^3 Event



Case: 150,000 m^3 Event



Case: 300,000 m^3 Event



Case: 450,000 m^3 Event

A3 SCALE 1:4,000

0 50 100 150 200 (m)

Legend

- Catastrophic
- Major to medium
- Medium to minor
- Insignificant

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CHECKED	KJH	Jul.15
APPROVED	KJH	Jul.15

ARCFILE 29115.1000-F19.mxd
SCALE (AT A3 SIZE) 1:4,000
PROJECT No. 29115.1000

WHAKATANE DISTRICT COUNCIL
MATATA QLRA
Assumed vulnerability of dwellings to damage

FIGURE No. Figure 19
Rev. 0

Path: L:\29115\29115.100\Working Materials\GIS\MXD\20131120\29115.1000-F19.mxd Date: 27/11/2013 Time: 11:23:35 a.m.

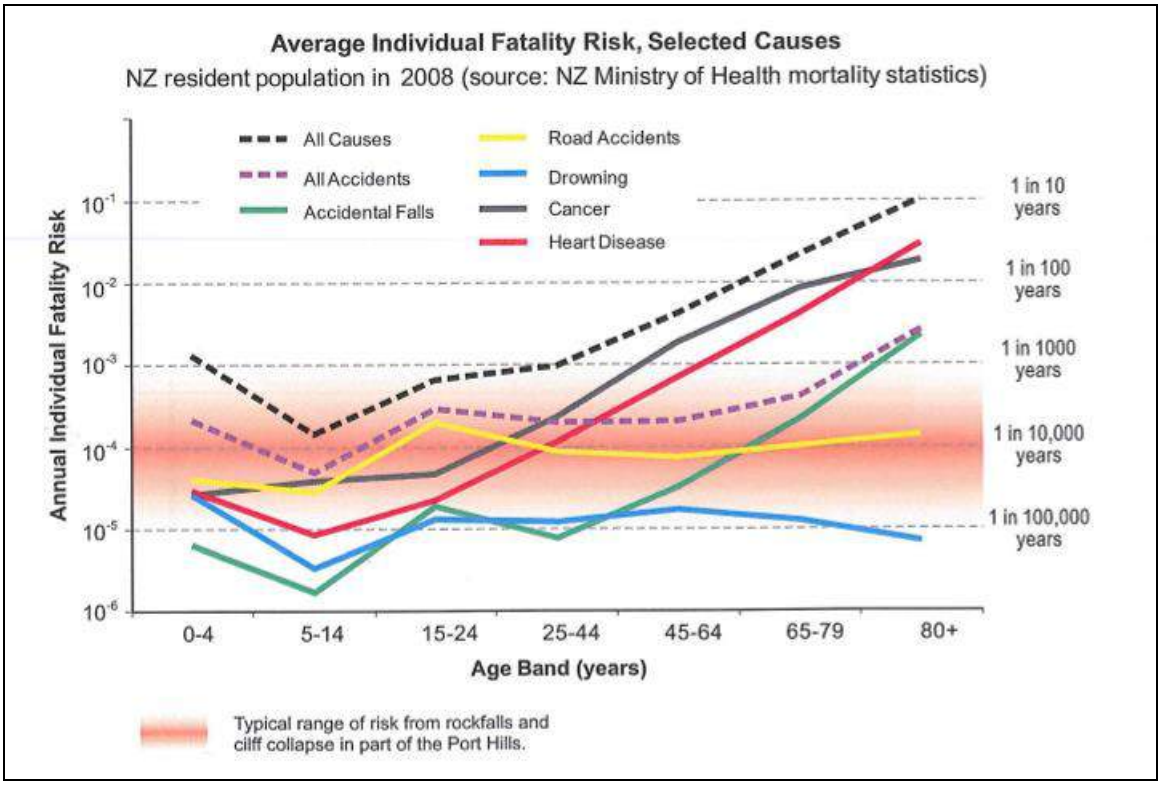


Figure 20: *Comparison of Individual Fatality Risk for Different Hazards in New Zealand (Source: GNS, 2012)*

Appendix B: Summary of some observations of the 18 May 2005 event (Shearer, 2005a)

Selected accounts by residents of the 18 May 2005 event (source: Shearer, 2005a)

Observer	Observation
David Potter	Very low flows in the Waitepuru stream at 1545 on Wednesday, but by 1645 it was in full flood. His father and his grandfather also experienced this phenomenon of flow stopping before the flood came and attributed it to earth dams forming in the stream gullies and eventually giving way. He saw a massive wave coming over the railway line at about 1700, about 3metres above the railway line.
Kay Fergusson	Noted the Awatarariki Stream very high at 0800 on Wednesday. Twenty minutes later water over the bridge and then went down again. Rain continued all day and she kept an eye on the stream but it did not appear to be coming up. Rain eased off at 1600. At 1630 she took the dog for a walk. Water in stream started to rise but no rain. The water rose 1m in 5-6 minutes. She saw a wall of water 1.5m to 2m feet high split two ways near the Reserve. She ended up waist deep in floodwaters. There were logs first then boulders.
Wayne Maloney	Water began to spill over onto his property shortly after 1710. The stream continued to move to the east across his property, probably due to the presence of a large Pohutukawa close to the original path of the stream that had by this time a tremendous amount of rubbish backed up against it. At the height of the flood the stream was flowing in waves, with the waves well above the banks of the stream. He was able to time the passage of several large objects flowing down the stream and maintains that they travelled approximately 100 metres in 3 seconds, as judged by the time they passed the house and the time they reached two large gum trees at the bottom of his driveway. He did not observe any reduction in stream flow prior to the flood. His estimate is that the water in the stream would be 30 feet (say 10 metres) deep and water on his front lawn was approximately 3 metres deep. Thirty to forty minutes after the flood, the stream was back to its usual trickle but in a different stream bed.
Neville Harris's	He was on his balcony when the stream came over the railway line and then demolished the railway bridge and much of the roadway. He confirms what others had suspected and that was that there were two waves of water, the first at about 1700 (but NH does not wear a wristlet watch) lasted about 20-30 minutes. Then the flow dropped off but after a few minutes, went up again. He has been up the stream since the flood and found the spot where there was a massive slip a couple of hundred feet high and the same wide. The two phases to the flood tells him there was another blockage further up the valley.

Appendix C: Photographs of the effects of the 18 May 2005 Event

Tonkin+Taylor

Job No: 29115.3000
2 October 2015

Whakatane District Council
14 Commerce Street
Whakatane 3120

Attention: Jeff Farrell

Dear Jeff

Awatarariki Debris Flow Peer Review Workshop

Further to the Awatarariki debris flow workshop held at Tonkin + Taylor's Auckland office on 17 September 2015, we are pleased to be able to provide the following information as requested.

Risk Overlay Map

Annualised Loss of Life Risk contours for shorter return period events (Figure 15 in T+T, 2015[1]) have been overlain on the debris distribution plan (Figure 4 in T+T, 2015). This is attached.

Note that areas of "significant timber accumulation" were expanded. The original Figure 4 essentially showed where large timber accumulations were located beyond the large debris field which consists of both boulders and timber. The reason for this minor edit was to better match the distribution see in aerial photographs.

Parameter Sensitivity

The annualised Loss of Life Risk contours presented in T+T (2015) were in the form of shorter return periods and longer return periods assigned to each event magnitude. These effectively bracket the range of Loss of Life Risk for the fanhead, with a "best estimate" of risk represented by some intermediate value. The other potential variables in the risk calculation were fixed on what were considered to be best estimates.

In order to determine the effect that choosing alternative input parameters could have on the outcome of the risk analyses, a Monte Carlo simulation was undertaken in which the shorter and longer return period risk calculation spreadsheets were replaced by a single spreadsheet in which the input parameters were chosen at random from distributions of potential values. A normal distribution was chosen in each case.

The mean and standard deviations of the distributions are presented in Table 1, together with the approximate minimum, mean and maximum values. A small number of lookup errors were found in the original spreadsheets affecting the distal low risk areas on the fringe of the debris flows. These errors, which have now been fixed, were 2 or more orders of magnitude less that the contribution to

[1] Tonkin + Taylor (2015). Supplementary Risk Assessment, Debris Flow Hazard, Matata, Bay of Plenty. Report prepared for Whakatane District Council dated July 2015.

Tonkin & Taylor Ltd | 105 Carlton Gore Rd, Newmarket, Auckland 1023, New Zealand
PO Box 5271, Wellesley St, Auckland 1141 P +64-9-355 6000 F +64-9-307 0265 E akl@tonkintaylor.co.nz

total risk from the high risk zones and therefore did not affect the distribution of the Loss of Life Risk contours.

The Monte Carlo simulation was run by generating input parameters and output for a single risk calculation. The outputs of this analysis was saved and the process repeated. A total of 100 analyses were undertaken.

The spreadsheet and the outputs can be seen on the spreadsheet attached to this letter.

Table 1: Distribution of Risk Input Parameters

Return Period (yrs)	Mean	Std Dev	Random Value	Min	Mean	Max
50,000m^3	75	10	77	45	75	105
150,000m^3	175	30	203	85	175	265
300,000m^3	350	60	280	170	350	530
450,000m^3	750	100	657	450	750	1050
	%	%	%	%	%	%
$P_{(T:S)}$	75	2	77	69	75	81
P(S:H) Zone 1	100			100	100	100
V(D:T) Zone 1	75	5	86	60	75	90
P(S:H) Zone 2	100			100	100	100
V(D:T) Zone 2	20	2	22.5	14	20	26
P(S:H) Zone 3	20	2	18.1	14	20	26
V(D:T) Zone 3	5	1	4.4	2	5	8
P(S:H) Zone 3	5	1	4.0	2	5	8
V(D:T) Zone 3	5	1	4.9	2	5	8
P(S:H) Zone 4	10	2	13.9	4	10	16
V(D:T) Zone 4	5	1	4.8	2	5	8
P(S:H) Zone 4	1	0.1	1.0	1	1	1
V(D:T) Zone 4	1	0.01	1.0	1	1	1

The results of the analyses are as expected, with the most common risk estimate essentially being the median or intermediate value between the risk values calculated for the shorter and longer return periods. This reflects the overriding importance of return period on the outcome of the result compared to other parameters such as vulnerability which have a much more restricted range of possible values.

To assess the effects that the Monte Carlo simulation may have had on the outcome of the risk analysis, the following assessment was made:

- The most seaward properties on the fanhead (No. 8 to 18 Clem Elliot Drive) all fall within the Risk Zone G1 based on where the properties are located within the debris field of each of the four different volume events;
- The calculated $R_{(LOL)}$ for area G1 is 1.13 x 10^{-3} and 4.8 x 10^{-4} for the shorter and longer return periods respectively. The 1 x 10^{-3} annualised $R_{(LOL)}$ contour passes through these properties for the shorter return periods. The properties lie between the 10^{-3} and 10^{-4} contours for the longer return period (approximately 3 x 10^{-3});

- The range of R(LOL) calculated for the G1 location using the Monte Carlo simulation was $5x10^{-4}$ to 1×10^{-3}, with a mean value of 7×10^{-4}. These closely match those risk values developed from the stand alone shorter and longer return periods.
- The range of risk values does not include a single value in the range of 10^{-5} i.e. regardless of the input values adopted, all properties within the Clem Elliot Drive area have a R(LOL) in excess of 10^{-4}. The 10^{-5} risk value does not lie on the histogram of results.

See attachments:

1) Figure 29115.3000-F1
2) Risk calcs rev4.xls

Yours sincerely

Kevin J. Hind
Project Director, PEngGeol

2-Oct-15
p:\29115\29115.3000\workingmaterial\kjh.debrisworkshop.02102015.docx

Peer Review: Awatarariki debris-flow-fan risk to life and retreat-zone extent

M.J. McSaveney, T.R.H. Davies

We have reviewed the annual individual fatality risk calculations and map produced by Tonkin & Taylor dated September 2015. These have acknowledged uncertainties caused by the paucity of event records and the consequent difficulty in assigning return periods to event magnitudes. Nevertheless, we accept that this work is based on the best available information and is sufficiently fit for purpose.

I. The attached accompanying map shows the minimum retreat zone we recommend. This is based on the Tonkin & Taylor map of the distribution of annual individual fatality risk on the fan as calculated based on the RAMMS modelling, and also on the distribution of boulders and large woody debris deposited by the 2005 event. The distribution of boulders and large woody debris is matched closely by the area delineated by the 10^{-5} annual individual fatality risk, so we recommend using the latter to delineate the minimum retreat area.

II. The fatality risk map uses information calculated through a sophisticated numerical model which, although one of the best available, necessarily incorporates a number of simplifying assumptions (for example, that the behaviour of a debris flow carrying boulders and trees can be represented by a single homogeneous fluid). These assumptions result in uncertainties that are difficult to quantify. For this reason, we do not rely on the model results alone in choosing the extent of the area to be retreated from, and place much significance on the boulder distribution that occurred in the 2005 event. The individual fatality risk used in Christchurch for earthquake rockfall hazard zoning was 10^{-4} per year, but there, the zones were based primarily on observed boulder distributions which introduced much lower modelling uncertainty than is available at Awatarariki, and on a more robustly determinable event occurrence frequency. We recommend a conservative approach here, which is to use the estimated 10^{-5} per year fatality risk (as indicated by the Tonkin & Taylor risk calculations) as the minimum extent of the area to be retreated from. This is not to imply that we recommend adopting a limit of 10^{-5} per year fatality risk, but is to be more certain of having included the 10^{-4} per year limit.

III. Although there were no fatalities in the 2005 event, the presence of boulders and trees deposited by that event was a widely recognised serious threat to life. The lack of fatalities in 2005 may simply have been the result of luck, and/or the time of day when the event occurred. It may also be that the return period of the 2005 event has been overestimated: in addition to the tendency for boulders and large woody debris to travel further on the Awatarariki fan than models predict, there may also be a tendency for debris flows to increase in volume in the upper catchment more than we expect. Either or both of these could result in overestimation of the 2005-event return period, with consequent underestimation of the overall fatality risk.

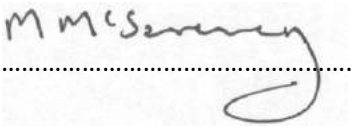
IV. We emphasise that the area outside this recommended minimum retreat zone is not free of risk to life from debris flows; a poorly quantified residual risk remains beyond the estimated 10^{-5} per year risk line. This residual fatality risk could be further reduced by extending the retreat zone, but this may be societally contentious.

V. The retreat zone will need on-going maintenance to ensure that changes within it over time due to further debris flows, other natural causes and alternative land uses do not further

increase the risk to life on or near the fan. We note that the fan area includes infrastructure overseen by other authorities, and there is a clear need for all stakeholders to coordinate their activities on the fan with risks to others in mind.

VI. Within the recommended zone for retreat, there is no physical mitigation of the high fatality risk that would be faced by a permanent resident who might chose to remain under "existing use" provisions, and there remains a substantial fatality risk even for visitors to the area. To provide for self-management of the risk to people in the retreat zone, we recommend that Council consider the viability of providing a debris-flow warning system that can alert people to an imminent danger of a debris flow in Awatarariki Stream, and may allow them to seek shelter or evacuate if they are able to do this safely and quickly. A variety of warning systems are in use in similar situations overseas with varying degrees of success (e.g. Hong Kong, Taiwan, Japan). We note that road users and rail traffic also are vulnerable to future debris flows irrespective of other users of the land. While risks to road and rail users have not been calculated herein or by Tonkin & Taylor, we suggest that an early-warning system should also be capable of reducing the fatality risks to road users and rail traffic from a debris flow on the Awatarariki fan.

VII. Last, the Tonkin & Taylor risk analysis was made for the area under residential use, and in our opinion the high fatality risk to residents there from debris flows makes such residential use unsafe. Future alternative uses of the land, which will be largely council land, are for Council to decide, with due consideration of the existing unmitigated hazards and the risks that they pose to potential users.



……M.J. McSaveney
Scientist Emeritus
GNS Science

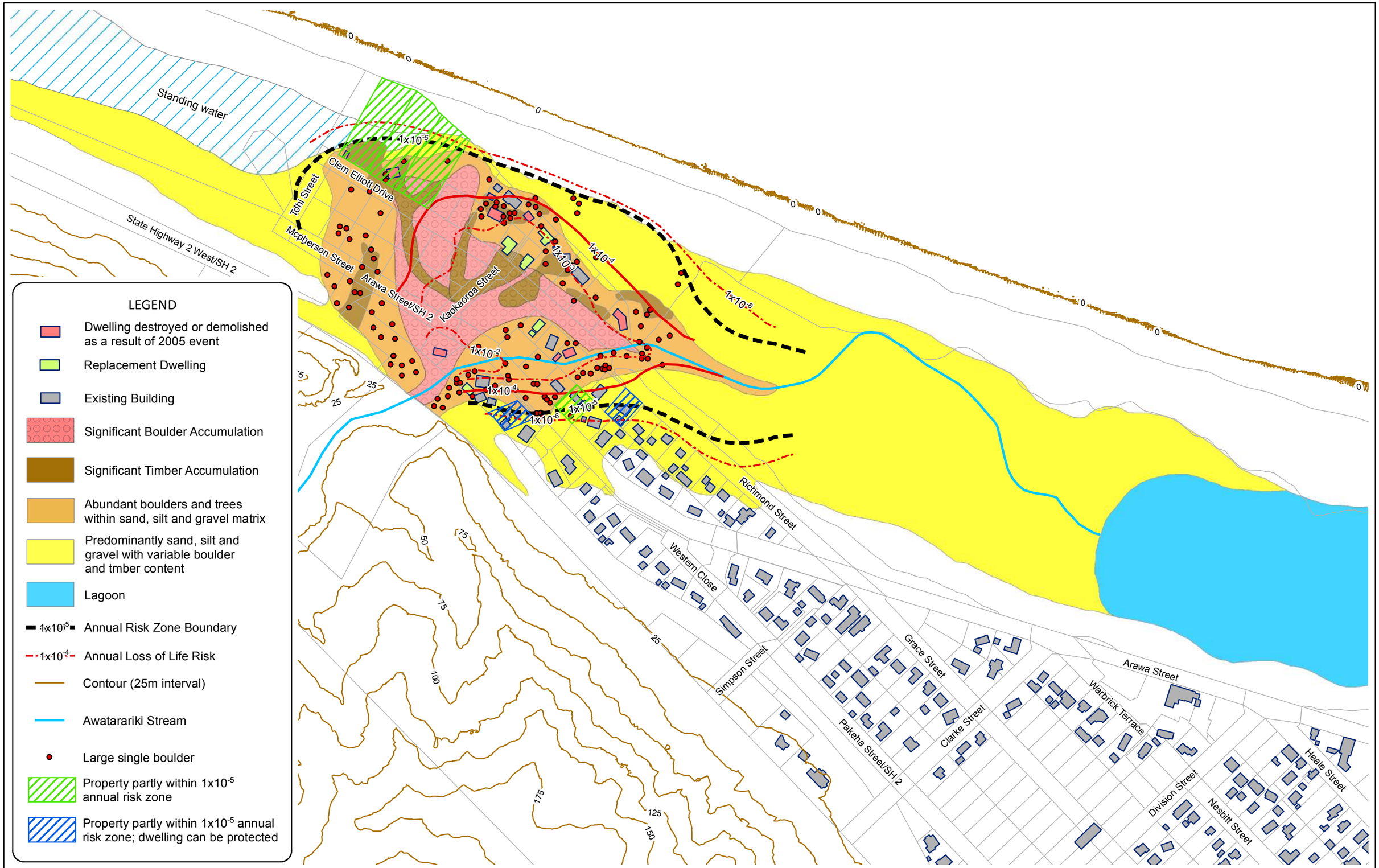
……T.R.H. Davies
Professor
Department of Geological Sciences
University of Canterbury

17 November 2015

One attachment:

Awatarariki Fan risk distribution and suggested retreat zone boundary.

The outline of the recommended minimum retreat zone is marked by the heavy dashed line (**----**).



LEGEND

- Dwelling destroyed or demolished as a result of 2005 event
- Replacement Dwelling
- Existing Building
- Significant Boulder Accumulation
- Significant Timber Accumulation
- Abundant boulders and trees within sand, silt and gravel matrix
- Predominantly sand, silt and gravel with variable boulder and tmber content
- Lagoon
- $1x10^{-5}$ Annual Risk Zone Boundary
- $1x10^{-4}$ Annual Loss of Life Risk
- Contour (25m interval)
- Awatarariki Stream
- Large single boulder
- Property partly within $1x10^{-5}$ annual risk zone
- Property partly within $1x10^{-5}$ annual risk zone; dwelling can be protected

A3 SCALE 1:4,000

0 0.05 0.1 0.15 0.2 (km)

N

Location Plan

Tonkin+Taylor

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www.tonkintaylor.co.nz

DRAWN	JC	Oct.15
CHECKED		
APPROVED		
ARCFILE	29115.3000-F1(10.2).mxd	
SCALE (AT A3 SIZE)	1:4,000	
PROJECT No.	29115.3000	
FIGURE No.	Figure 1.	Rev. 0

WHAKATANE DISTRICT COUNCIL

MATATA QLRA

Debris distribution from 2005 event and predicted annual loss of life risk

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Appendix 4 - High, Medium and Low Risk Areas

Awatarariki Debris Flow Risk Area

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Scale: 1:3,088

Date of issue: 10/08/2017

Author: CB

N

Appendix 5 – Regional Policy Statement Analysis

Appendix 5

Analysis of the Regional Policy Statement on Natural Hazards for Proposed Debris Flow Hazard Management on the Awatarariki Fanhead.

Policy		**Applicability**
Objective 31	Avoidance or mitigation of natural hazards by managing risk for people's safety and the protection of property and lifeline utilities	The proposed debris flow hazard management on the Awatarariki fanhead will avoid or mitigate natural hazards by managing risk for people's safety and and the protection of property. Risk is managed through the adoption of prohibited activity status rules in both the Regional and District Plans. Road and rail corridors are exempted as lifeline utilities with functional need to remain at this location.
Policy NH 1B: Taking a risk management approach	Take a risk management approach to control the use, development and protection of land to avoid or mitigate natural hazards by assessing the level of risk according to the likelihood of natural hazards occurring and their potential consequences.	A risk management approach to control the use, development and protection of land to avoid or mitigate natural hazards has been taken for the Awatarariki Fanhead. The approach focuses on the presence and level of the risk rather than the presence and likelihood of the hazard.
Policy NH 2B: Classifying risk	Classify risk according to the following three-category risk management framework as detailed in Appendix L: 1 High natural hazard risk being a level of risk beyond what should be tolerated. 2 Medium natural hazard risk being a level of risk that exceeds the Low level but does not meet the criteria for High risk. 3 Low natural hazard risk being the level of risk generally acceptable.	A three-tier risk framework consistent with the policy has been applied to the Awatarariki Fanhead following the RPS direction. Areas classified as having High natural hazard risk are proposed to be reduced to at least Medium risk, if not lower.
Policy NH 3B: Natural hazard risk outcomes	By the application of Policies NH 4B and NH 12A, achieve the following natural hazard risk outcomes at the	In the areas identified as being subject to high risk from debris flow hazards, a voluntary retreat land purchase proposal and plan rules are proposed to

Policy		Applicability
	natural hazard zone scale*: (a) In natural hazard zones subject to High natural hazard risk reduce the level of risk from natural hazards to Medium levels (and lower if reasonably practicable); and (b) In natural hazard zones subject to Medium natural hazard risk reduce the level of risk from natural hazards to be as low as reasonably practicable; and (c) In natural hazard zones subject to Low natural hazard risk maintain the level of risk within the Low natural hazard risk range.	move existing residential development out of harm's way and to prevent any inappropriate future development. The level of risk to life and property is such that reduction of the risk needs to occur as quickly as possible. However, for practical reasons of cost and process, this is likely to take several years to achieve. In the areas identified as being subject to medium risk from debris flow hazards, plan rules are proposed to reduce risk by controlling re-development and ensuring risk is reduced to as low a level as is reasonably practicable. In the areas identified as being subject to low risk from debris flow hazards information and monitoring will be used to maintain the level of risk.
Policy NH 4B: Managing natural hazard risk on land subject to urban development	Require a Low natural hazard risk to be achieved on development sites after completion of the development (without increasing risk outside of the development site) by controlling the form, density and design of: (a) Greenfield development; (b) Any urban activity within the existing urban area that involves the construction of new and/or additional buildings or reconstruction of or addition to existing buildings (including any subdivision associated with such activities); and (c) Rural lifestyle activities; except that a Low level of risk is not required to be achieved on the development site after completion of the	In the areas identified as having medium and low risk, new and/or additional buildings or reconstruction of or addition to existing buildings and subdivision may occur over time. In the areas identified as being subject to medium risk from debris flow hazards, plan rules are proposed to reduce risk by controlling re-development and ensuring risk is reduced to as low a level as is reasonably practicable. In the areas identified as being subject to low risk from debris flow hazards information and monitoring will be used to maintain the level of risk.

Policy		Applicability
	development where the development site is located within a natural hazard zone of Low natural hazard risk and that natural hazard zone will maintain a Low level of natural hazard risk after completion of the development.	
Policy NH 5B: Avoiding increasing and encouraging reducing natural hazard risk in the coastal environment	Despite Policies NH 3B, NH 4B and NH 12A, ensure that on any land within the coastal environment that is potentially affected by coastal erosion or coastal inundation over at least the next 100 years: (a) no land use change or redevelopment occurs that would increase the risk from that coastal hazard; and (b) land use change or redevelopment that reduces the risk from that coastal hazard is encouraged.	While the Awatarariki Fanhead is in the coastal environment, the debris flow hazard is not a coastal hazard.
Policy NH 6B: Exemptions from the natural hazard risk management approach	Policies NH 3B, NH 4B, NH 5B and NH 12A, do not apply to the establishment, operation, maintenance and upgrading of activities that have more than low natural hazard risk or which are located in high and medium risk natural hazard zones if the activity: (a) Has a significant social, economic, environmental or cultural benefit to the community it services, or is a lifeline utility; and (b) Has a functional need for the location. In the circumstances described in (a) and (b) above, risk management measures (including industry standards, guidelines or procedures) must be applied to reduce risk to life and property to be as low as reasonably practicable. Infrastructure should be located away from coastal hazard risk where practicable.	The road and rail corridors that pass over the Awatarariki fanhead are exempt from Policies NH 3B, NH 4B, NH 5B and NH 12A as they are lifeline utilities that have a functional need for their current location as there is no practicable alternative location available.

Policy		Applicability
Policy NH 7A: Identifying areas susceptible to natural hazards	Identify natural hazards and the locations where those natural hazards could affect people, property and lifeline utilities by mapping hazard susceptibility areas for the following natural hazards: (a) Volcanic activity (i) pyroclastic and lava flow; (ii) landslip, debris flow and lahar; (iii) ash fall; (iv) geothermal hazard; and (v) caldera unrest. (b) Earthquake (i) liquefaction and lateral spreading; (ii) fault rupture; (iii) landslide and rock fall; and (iv) tsunami6. (c) Coastal/marine processes (i) coastal erosion; and (ii) coastal inundation. (d) Extreme rainfall (i) landslip and debris flow/flood; and (ii) flooding. Hazard susceptibility mapping may be undertaken in stages allowing for prioritisation of effort taking into account demand for land use change or intensification.	The spatial extent of debris flow hazards and the locations where those hazards could affect people, property and lifeline utilities have been identified and mapped. These maps form the basis of the proposed plan changes.
Policy NH 8A: Assessment of natural hazard risk at the time of plan development	Assess natural hazard risk by: (a) Defining natural hazard zones within hazard susceptibility areas; and (b) Determining the level of natural hazard risk within each natural hazard zone by undertaking a	Natural hazard zones have been defined within hazard susceptibility areas. The level of natural hazard risk within each natural hazard zone has been determined by undertaking a risk analysis in accordance with Appendix L.

Policy		Applicability
	risk analysis using the methodology set out in Appendix L; and (c) Classifying natural hazard risk within each natural hazard zone as either High, Medium or Low natural hazard risk using the methodology set out in Appendix L.	Appendix L allows use of a default methodology in the RPS or use of a recognised risk assessment methodology included in a regional, city or district plan or recognised in the consideration of a resource consent application. This may include risk assessment methodologies incorporated in Regulations or industry codes of practice. In this case, the assessment of risk has been undertaken using the Australian Geomechanics Society, 2007. Landslide Risk Management, Australian Geomechanics. This is a recognised risk assessment methodology (RRAM) in the RPS Natural Hazard Risk Assessment User Guide[1]. This methodology is proposed to become part of the regional and district plan policy framework through a Schedule 1 Plan Change process. Natural hazard risk has been classified using this methodology within as either High, Medium or Low within the natural hazard zone.
Policy NH 12A: Managing natural hazard risk through regional, city and district plans	Promote the natural hazard risk outcomes set out in Policy NH 3B by: (a) Providing for plans to take into account natural hazard risk reduction measures including, where practicable, to existing land use activities, and, where necessary, (b) Controlling the location, scale and density of the subdivision, use, development and protection of land and land use change in city, district and regional plans. (c) Ensuring that regional, city and district plan provisions provide a high degree of certainty for the	Plan changes are proposed that consider natural hazard risk reduction measures including existing land use activities. This will occur through control of residential activity in high risk and medium risk areas under both the regional plan and district plan. This includes prohibition of residential activities in high risk areas and targeted risk reduction for redevelopment in medium risk areas. A restricted discretionary activity status will provide appropriate certainty to enable risk reduction

[1] 4.3 Risk methodologies deemed to comply Natural Hazard Risk Assessment User Guide Regional Policy Statement for the Bay of Plenty (Undated)

Policy		Applicability
	establishing and maintaining of essential risk reduction works and other measures.	measures to be applied appropriately, whilst ensuring risk to other properties is not increased.
Policy NH 13C: Allocation of responsibility for natural hazard identification and risk assessment	Require the natural hazard identification and risk assessment approach described in Policies NH 1B, NH 2B and NH 7A to NH 10B above to be given effect to by: (a) Regional council undertaking area-based natural hazard susceptibility mapping in accordance with Policy NH 7A for: (i) Hazards related to volcanic activity; (ii) Hazards related to earthquakes; (iii) Tsunami; (iv) Coastal erosion and coastal inundation; and (v) Flooding from natural water courses outside urban areas with reticulated stormwater networks. (b) Regional council undertaking area-based natural hazard risk analysis and evaluation in accordance with Policy NH 8A for: (i) Hazards related to volcanic activity; (ii) Liquefaction; and (iii) Tsunami. (c) City and district councils undertaking area-based: (i) Natural hazard susceptibility mapping in accordance with Policy NH 7A for those hazards listed in Policy NH 7A that are not listed in (a) above; and (ii) Natural hazard risk analysis and evaluation in accordance with Policy NH 8A for those hazards listed in Policy NH 7A that are not listed in (b) above.	The district council has undertaken area-based natural hazard susceptibility mapping in accordance with Policy NH 7A for debris flows; and natural hazard risk analysis and evaluation in accordance with Policy NH 8A for debris flow hazards.
Policy NH 14C: Allocation of responsibility for land use control for natural hazards	The Bay of Plenty Regional Council, city and district councils shall be responsible for specifying objectives, policies and methods, including any	The District Council has proposed new District Plan objectives and policies and rules, and other methods to manage risks.

<table>
<tr><th>Policy</th><th></th><th>Applicability</th></tr>
<tr><td></td><td>rules, for the purpose of the control of the use of land for the avoidance or mitigation of natural hazards as set out in the table below.
<table>
<tr><th></th><th>Responsibility for developing objectives and policies</th><th>Responsibility for developing any rules</th><th>Responsibility for developing methods other than rules</th></tr>
<tr><td>Land except land in the coastal marine area</td><td>City and district councils and Bay of Plenty Regional Council</td><td>City and district councils*</td><td>City and district councils and Bay of Plenty Regional Council</td></tr>
<tr><td>Land in the coastal marine</td><td>Bay of Plenty Regional Council</td><td>Bay of Plenty Regional Council</td><td>Bay of Plenty Regional Council</td></tr>
</table>
* Under section 30(1)(c)(iv) of the Act, the Regional Council has the function to control land use for the avoidance or mitigation of natural hazards. The Act allows the Regional Council to exercise that function in such a way as to override any existing use rights available under section 10(4) of the Act. The allocation of responsibilities under this policy does not remove the right of the Regional Council to exercise its functions and powers in that regard. Should it choose to do so, any such provisions will be subject to a plan or plan change</td><td>The District Council will request that the Regional Council exercise its function to control land use for the avoidance or mitigation of natural hazards, and do so in such a way as to override existing use rights under section 10(4). The District Council will do this through proposing new objectives, policies and rules in the Regional Plan for the area on the Awatarariki Fanhead of high risk to life and property, assisting in the enabling of retreat of susceptible activities from this area.</td></tr>
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Policy		Applicability
	process under Schedule 1 to the Act.	

Appendix 6 - Summary of key decisions, actions and engagement since the 2005 debris flow event

Date	Event	Outcome
18 May 2005	Debris flow event	
June 2005	McSaveney, M.J, Beetham, R.D & G. S. Leonard (2005) *The 18 May 2005 debris flow disaster at Matatā: Causes and mitigation suggestions,* GNS. Davies, T (2005) *Debris flow emergency at Matatā, New Zealand, 2005, inevitable events, predictable disaster*, University of Canterbury.	
August 2005	Tonkin and Taylor Ltd, *The Matatā Debris Flows 18 May 2005: Preliminary Infrastructure and Planning Options Report* presented 11 options for consideration: Option A1: Retreat from the hazard, and limit development on fanhead ($1.5M; 60 properties in area exposed to future debris flows and floods; 0 properties protected). Option A1a: As for A1, but including specific property works to raise floors above likely debris flow levels ($2.3M; 60 properties in area exposed to future debris flows and floods; approximately 20 houses raised). Option A2: Debris dam in catchment and debris flood channel on fanhead beside existing Awatarariki Stream watercourse ($3.7M; 3 properties required for works; 57 properties protected). Option A2a: As for Option A2 with flood channel for high flow diversion to far western lagoon ($4.7M; up to 11 properties required for works; 49 properties protected). Option A3: Debris dam in catchment and debris flood channel on fanhead beside realigned Awatarariki Stream watercourse ($3.6M; 4 properties required for works; 56 properties protected). Option A4: Debris flow bund and debris flood channel beside existing Awatarariki Stream watercourse ($2.3M; 4 properties required for works; 36 properties in area exposed to debris flows; 20 properties protected). Option A5: Debris flow bund and debris flood channel on fanhead beside Awatarariki Stream watercourse ($2.6M; 5 properties required for works; 27 properties in area exposed to debris flows; 28 properties protected) Option A6: Debris dam in catchment and debris flood channel on fanhead beside new western Awatarariki Stream watercourse ($3.7M; 6 properties required for works; 54 properties protected). Option A7: Debris flow bund and debris flood channel on fanhead beside new western Awatarariki Stream watercourse ($2.7M; 10 properties required for works; 12 properties in area exposed to debris flows; 38 properties protected). Option A8: New Awatarariki stream path cut through ridge, and debris flow bund on fanhead with new debris flood channel ($3.1M-$7.6M; 11 properties required for works; 14 properties exposed to debris flows; 35 properties protected). 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 $9.0M; no private properties required for works; no properties in area exposed to debris flows; 60 properties protected).	Option A2 selected as preferred option to manage debris flow risk from future events due to having lowest discounted cost and lowest disbenefits.
August 2006	WDC application to the Department of Building and Housing for a determination under the Building Act 2004: • Are existing dwellings on the fanhead dangerous in terms of s121 of the BA due to being situated in a debris flow and inundation flood path; and	Determination 2006/119 concluded: • A storm with a return period of 500 years is likely to cause injury or death

Date	Event	Outcome
	• If the buildings are deemed to be dangerous, should the Council exercise is power under section 124 of the Act to require the buildings to remain unoccupied until mitigation works are undertaken to reduce the danger?[1]	• A storm with a return period of 200 years might be likely to cause injury or death • A storm of 200 years does not constitute "ordinary course of events" and therefore the houses are not dangerous in terms of s121 and may be occupied
2007….	Flood protection works downstream of escarpment carried out.	
2007 - 2008	A range of debris detention structures in the upper catchment were presented to the Matatā community for consultation. The community expressed concerns about the structures proposed, including the potential impact upon culturally important sites.	A flexible ring net system proposed by T&T in conjunction with Geobrugg A G of Switzerland was approved by the Council on 23 July 2008.
2009-2011	Design work and peer review undertaken on flexible ring net system.	
August 2011	Following numerous landslides, a project brief was prepared for a 2-stage project to identify landslide risk from the Whakatāne and Ōhope escarpments as a key input into development of natural hazard objectives, rules and policies for incorporating into the District Plan.	T&T engaged to carry out work.
March 2012	Due to poor ground conditions and escalating costs of structure, T&T recommended the project be comprehensively reviewed.	Alan Bickers engaged to review the project.
20 June 2012	Brookfields legal advice on: • Legal and insurance implications for landowners and the Council from the issuing of building consents and reconstruction of houses since 2005 event. • Identify implications on any resource consents and/or conditions of resource consent already issued for associated disaster mitigation projects at Matata if the detention dam does not proceed. • Identify the implications for the Council and for affected landowners of re-zoning the land on the fanhead. • What was the responsibility of the Regional Council for upper catchment management?	
July 2012	Alan Bickers report recommended that the ring net design be abandoned and WDC not pursue any further upstream options. Bickers also concluded: • No reasonable possibility of constructing a debris detention structure upstream of the escarpment due to community objections, particularly those of tangata whenua. • If WDC takes no action, regard must be given to the possible planning, legal and financial consequences including carrying out a District Plan Change to create a hazard zone in which development is prohibited.[2] • Fundamental constraints of any downstream options are the restrictions presented by the railway bridge and SH2 road bridge. • A detailed feasibility study of the 4 identified downstream options is the next logical step if a "no action" strategy is not acceptable.	In December 2012, the Council resolved to not proceed with an engineering solution to manage the debris flow hazard for residential properties on the Awatarariki fanhead and to investigate and develop a planning framework to manage the hazard. The Council decision formally recognised that the properties known to be at risk from the debris flow hazard from the Awatarariki Stream catchment would continue to be exposed to levels of risk associated with that hazard in the future.

[1] BOPRC submission on the determination application included *"….. the current level of risk at the subject properties from dangerous discharge events is higher than is normally acceptable for dwellings in New Zealand."*
[2] ES4.3

Date	Event	Outcome
October 2012	Peer review contracts with GNS and GHD in place for Whakatāne and Ōhope landslide hazard and risk assessments (Stage 2 – c/f August 2011 notes).	
12 December 2012	Tom Krawczyk report to Projects and Services Committee, included Domain Environmental Ltd report on behalf of Matatā Project Management Team *Matatā Debris Flow Management – The Way Forward for the Matatā Governance Group*. The report contained preliminary MCA analysis of potential fanhead engineering and planning options. Engineering options included Chute to Sea ($10M + $200K/yr. maintenance) and Deflection Bund ($5.6M + $300k/yr. maintenance) – concepts and costings by Aecom – see 20 December 2015 entry.	Committee resolved to: • Abandon engineering options for the Awatarariki Stream. • Develop 2 planning options (information-based, and event-based).
20 December 2012	Aecom final report *Matatā Project – Provisional Cost Estimates* - reviewed engineering concepts and costings for Chute to Sea and Deflection Bund.	Incorrect peak debris flow input parameter used. Refer Tim Davies engineering assessment 21 September 2015.
12 February 2013	Council Forum – presentation on natural hazard risk management in a planning policy context (Dick Beetham, Kevin Hind, Craig Batchelar, Jeff Farrell). Purpose of the Forum was to: • Understand the Council's statutory obligations relating to natural hazards. • Share knowledge on natural hazard risk management within NZ and overseas. • Provide update on Whakatane/Ohope Landslide Project. • Consider natural hazard planning risk framework for Matata and District wide. • Receive guidance on a consistent policy approach to natural hazard risk management across the District.	
April 2013	Contracts in place for landslide and debris flow hazard and risk assessments at Matatā.	T&T engaged to undertake work, GHD engaged to undertake peer review Boffa Miskell engaged to provided RMA input.
June 2013	Final version of Whakatāne and Ōhope quantitative landslide risk assessment received.	
August 2013	T&T engaged to undertake Awatarariki debris flow risk assessment.	
July 2013 -	WDC participation on working parties to BOPRC RPS natural hazard provisions.	
9 July 2013	Marty, David & Julie meeting with Clem Elliott Drive residents at Rob & Marilyn Pearce's house.	Followed an earlier meeting that reported residents that there was no feasible engineering solution for the Awatarariki debris flow hazard and the landslide project already underway for Whakatāne/Ōhope was being extended to cover Matatā. The Matatā study also includes debris flows as one type of landslide. The purpose of this meeting is to provide Clem Elliot residents an update on the outcomes of that study, before it went to Council.
30 July 2013	Letter from Marty reporting that the Council had considered the QLRA study for Matatā on 11 July and enclosing copies of a summary report and a consultation preference slip.	
14-21 August 2013	One-on-one meetings at Matatā Tennis Club and WDC on Landslide and Debris Flow Hazards (QLRA report).	
August 2013	GHD engaged to undertake peer review.	
20 August 2013	Letter to landowners advising that their property will be included in the debris flow risk assessment of Awatarariki fanhead properties. Included invitation to contact me with any queries.	

Date	Event	Outcome
5 September 2013	Media release – landslide hazard management consultation making good progress. Also, advised debris flow risk assessment of Awatarariki fanhead to be undertaken.	
11 September 2013	One-on-one meetings at Matatā Tennis Club on Landslide and Debris Flow management.	
23 September 2013	Meeting with Anthony Olson (CEO of Ngāti Rangitihi) on Landslide Management and Debris Flow management at Matatā.	
4 October 2013	Letter from Marty to all property owners identified in the QLRA of Whakatāne, Ōhope and Matatā escarpments and Matatā debris flow risk area identifying feedback from the community. Invitation to contact Violet Hape to arrange an appointment to meet/discuss queries with a project team member.	
November 2013	T&T draft report *Supplementary Risk Assessment – Awatarariki Debris Flow Hazard, Matatā* received.	
2 December 2013	Letter from David Bewley to Hema and Pearce correcting error in classification of risk in 30 July 2013 letter.	
4 December 2013	Council Forum - Landslide and Debris Flow Hazards: • Risk Management Framework. • Landslide Risk Reduction. • LGA Strategy; • District Plan Changes. • Awatarariki Fanhead Strategy.	
9 December 2013	Media Release – include Matatā in Whakatāne an Ōhope Study; includes options for fanhead, reference of DP Change, and subject to any change required under the RPS, existing dwellings would not be affected.	
11 December 2013	Draft *Supplementary Risk Assessment – Awatarariki Debris Flow Hazard, Matatā: Issues and Options* and draft *Awatarariki Fanhead Strategy – Issues and Options* presented to the Policy Committee	The Committee resolved to consult with the Awatarariki fanhead property owners and encouraged property owners to provide feedback.
18 December 2013	Draft *Supplementary Risk Assessment – Awatarariki Debris Flow Hazard, Matatā* presented to WDC Policy Committee and draft *Awatarariki Fanhead Strategy – Issues and Options* presented to the Policy Committee.	Council resolved to continue with current approach and wait for new BOPRC RPS natural hazard provisions to be finalised before proceeding further.
18 December 2013	Letter from Marty confirming Policy Committee meeting and providing draft Awatarariki Fanhead Strategy and inviting property owners to contact Violet Hape to arrange 1 on 1 meetings.	
21 January 2014	One-on-one meetings at Matatā Tennis Club on Draft Awatarariki Fanhead Strategy.	
February 2014	BOPRC Technical Experts Workshop for Variation 2 RPS.	Purpose of meeting: a sound technical basis for robust natural hazards risk management policy that will lead to management of land use and associated activities.
21 February 2014	Letter from David Bewley to Awatarariki fanhead property owners reminding owners to provide submission on the Issues and Options report. Invitation to contact Violet Hape for any further information.	
2 July 2014	WDC application to the Ministry of Business, Innovation and Employment for a determination under the Building Act 2004:	Determination 2016/034 concluded that based on the high probability for loss of life, non-compliance with the Building Code clauses and a lack of any

Date	Event	Outcome
	• Whether or not it is reasonable for the Building Consent Authority (BCA) to grant a waiver or modification of the Building Code under section 72(c) of the Building Act 2004 for building consent applications for dwellings on land that is subject to debris flow and debris flood natural hazards.	mitigating features for the proposed buildings, that it is not unreasonable for a waiver to be granted under s72.
28 August 2014	Brookfields legal advice – historic and future liability.	Identified need to take steps to act on the hazard and risk information known to it to reduce that risk, and failure in duty by not doing so.
22 September 2014	Letter from David following up a discussion with some residents of Clem Elliott Drive responding to issues raised at the meeting and offering to pay for an advocate.	Stimpson & Co subsequently engaged.
23 October 2014	BOPRC presentation to WDC on Proposed Change 2 to the RPS.	Overall purpose of Change 2 id to guide those preparing regional, city and district plans and considering resource consent applications in managing land use and associated activities according to the level of natural hazard risk they are subject to high, medium, or low.
18 November 20214	ICNZ released *Action Required to Protect NZ from Natural Hazards* – a 15-point action plan to reduce social and economic impact of natural hazards in NZ. Also, indicated annual costs of $1.6 billion (just under 1% GDP) from natural disasters.	
November 2014	Notes from property owner briefing meetings – Craig Batchelar	
3 March 2015	David Stimpson report to WDC and landowners on stakeholder audit. Confirms Consensus Development Group proposal including landowner representatives.	Creation of CDG.
March – June 2015	Work with Consensus Development Group over four day long meetings. The Group: • Identified the need for collective definitive research to be undertaken to clarify the boundary between acceptable loss of life risk and unacceptable loss of life risk on the Awatarariki fan head and recommended GNS review and refine the debris flow risk assessment modelling by T&T; • Agreed that a high debris flow risk to the community exists; • Noted that individuals vary widely in their personal tolerance to risk with some wanting to take individual responsibility for accepting the risk; • Recognised the Council is legally bound to consider the risk to all people, including the young, the elderly, and visitors; • Considered the following range of options: • Stay, accept the risks and allow further building on all sites; • Stay, with works to protect existing buildings only; • Status quo (existing homes stay with existing use rights but no/uncertain further development and risk of legal action); • Mitigation of risks with works on each private dwelling (i.e. either a collective plan across all sites to raise floor levels and strengthen foundations, or a plan pursued by individual site owners or sets of site owners by mutual agreement);	See 'Awatarariki Option Summary from all SDG Meetings' and David Stimpson Report and PowerPoint presentation to Council 3 June 2015. + D Stimpson 3 report back to landowners and Council – 3 March 2015 + communiques to landowners: Communique 1 – 3 March 2015. Communique 2 – 24 April 2015(?) Communiques 3 – 7 May 2015

Date	Event	Outcome
	• Channel out to sea; • Bund to protect the east; • Managed full retreat over time; • Managed voluntary retreat over time. • Agreed that engineering options are likely to be unaffordable (recognising that 2 of the members were parties to a Building Act determination that is an option still being tested); • Considered and provided feedback on a preliminary settlement agreement proposal; • Identified urgent work regardless of the long-term solution. This includes: • Establishment of improved escape routes; • Investigation of early warning systems; • Investigation of rates relief. • Noted that while it is accepted that landowners and the Council are likely to continue for some time to disagree on the detailed content of a way forward, it was noted that a solution requires early agreement between Council and landowner at least on the process to be followed; • Invited Council officers to prepare the details of a proposed settlement process and to report this to WDC, BOPRC, and landowners; • Noted that funding and other details will be critical to acceptance but support the proposed process suggested.	
3 March 2015	David Stimpson report to WDC and landowners on stakeholder audit. Confirms Consensus Development Group proposal including landowner representatives.	Creation of CDG
18 March 2015	NZ is a signatory to the Sendai Framework for Disaster Risk Reduction 2015-2030 in Sendai, Japan. The SFDRR places increasing emphasis on disaster risk management, as opposed to disaster management, with risk reduction and strengthening resilience being anticipated outcomes achieved through involving communities and making prevention and reduction of disaster risk a primary responsibility of signatory governments.	As a signatory to the SFDRR the Government has committed NZ to reduce levels of risk that have been identified as being unacceptably high.
5 May 2015	Aecom (James Hughes and Justine Bennett) Draft Matatā debris flow risk assessment to test proposed RPD assessment methodology.	Despite invalid inputs, risk assessment conclusion was ‘High Risk’.
25 June 2015	Letter from the Mayor to property owners which included a copy of the report going to the Policy Committee on 2 July 2015.	
2 July 2015	The Policy Committee considered a report on the work of the CDG and a proposed plan moving forward. Some of the property owner members of the CDG presented to the Committee – Neville Harris, Marilyn Pearce, Greta Nicholson, Bob Martin.	The Committee made a number of resolutions that included: • **THAT** the Committee confirms that planning-based options continue as the focus of investigation during the process of developing a settlement framework to mitigate debris flow risks on the Awatarariki Fanhead, Matatā ; and • **THAT** the Committee acknowledges that a “do minimum” option is not the preferred outcome from the process of

Date	Event	Outcome
		developing a settlement framework to mitigate debris flow risks on the Awatarariki Fanhead, Matatā; and • **THAT** staff progress the development of a voluntary managed retreat option as part of the process of developing a settlement framework to mitigate debris flow risks on the Awatarariki Fanhead, Matatā; and • **THAT** the Committee notes that a voluntary managed retreat option for the Awatarariki Fanhead in Matatā is contingent upon securing funding support across all three levels of government (including Whakatāne District Council, Bay of Plenty Regional Council, and Central Government); and • **THAT** the Committee acknowledges that a threshold of 90% of landowners to a settlement agreement is considered necessary before any formal approach to regional and central government can be considered; and • **THAT** the Committee approves the commissioning of the following work with a view to having the work completed by the end of October 2015: a) Definition of hazard lines at Awatarariki at a property boundary level; b) Definition of current market valuations of properties potentially affected at Awatarariki; c) Investigation of early warning systems and escape routes; d) Initiate informal approaches to Bay of Plenty Regional Council and central government for the funding of a managed voluntary retreat at Awatarariki; e) A review of the rating circumstances for each property owner on the Awatarariki Fanhead going back to 2005; f) Investigation of solutions to the hazard of right hand turning traffic from SH2 into Kaokaoroa Street.
August-Dec	Develop work stream briefs and implement.	
21 Sept 2015	Tim Davies assessment of the effectiveness and cost of Chute to Sea option in reducing debris flow risk.	Confirmed Chute to Sea not a viable engineering solution
25 Sept 2015	Briefing paper to WDC Mayor and CE and BOPRC Chairperson and CE by Ken Tarboton, Sarah Stewart and Jeff Farrell. The purpose of this briefing is to provide information on: • the history and issues leading to the current preferred option of a voluntary managed retreat from the Awatarariki fanhead;	Briefing included statement that the allocation of responsibilities under the RMA reflects the distribution of powers, that existing uses are unaffected by new district rules but not regional rules. Also, confirmed:

Date	Event	Outcome
	• planning implications and related roles and responsibilities in relation to the Awatarariki Fanhead.	• the risk-based approach used by WDC is consistent with RPS direction. • that Proposed Change 2 would oblige both BOPRC and WDC to consider options for reducing high natural hazard risk. • the need to act.
2 October 2015	Project briefing to Anne Tolley (included briefing on Integrated Wastewater project).	
8 October 2015	Update report to Policy Committee on all work streams.	
15 October 2015	Update letter to property owners advising 8 work streams being developed (subsequently 10 work streams by 2017).	
10 November 2015	Opus report on Work stream 3 – Escape Routes. Report Identified best option for residents of properties on the east side of the Awatatarariki Stream is to evacuate through Arawa Street and Richmond Street. For residents in the Clem Elliott Drive area, recommendation was to open Clem Elliott Drive to Tohi Street to McPherson Street to high ground by the SH2 by-pass. Estimate of cost $30,000.	
12 November 2015	Presentation to BOPRC councillors on the Awatarariki debris flow risk management programme and the integrated wastewater project.	
17 November 2015	Tim Davies and Mauri McSavaney *Peer Review: Awatarariki debris-flow-fan risk to life and retreat zone extent.*	Review recognised area subject to high risk, recognised limitations with the T&T risk modelling that underestimated the loss of life risk and recommended extending the minimum area of retreat from the modelled 10^{-4} annualised loss of life line to the modelled 10^{-5} line.
19 November 2015	Opus report on Work stream 6 – Right Turning Bay. Report concluded: • Basic Right turn bay widening (Diagram E) is warranted based upon existing traffic numbers but the current crash risk and low probable crash reduction means that this treatment is unlikely to be a high priority for funding by the Transport Agency. • A short right turn bay is warranted based upon predicted traffic volumes if the subdivided lots were to have dwellings constructed on them. Again, the low predicted crash reduction means this treatment is unlikely to be a high priority for funding by the Transport Agency.	
10 December 2015	Nichola Litchfield, Chris Massey and Mauri McSaveney of GNS advise that, given the velocity and volume of potential debris flows in the Awatarariki catchment and the risk to residents and road and rail users, it is unlikely that an early warning system based on detecting a debris flow once it initiates would be effective. GNS highlight the challenges with developing a system including establishing alert and warning thresholds, uncertainties associated with its operation, a high level of false alarms, hardware and software development and maintenance, necessity of built in redundancy required for a warning system that people and agencies will rely on, and the high cost of developing and maintaining a system.	Independent expert evidence that an early warning system in this situation is highly likely to be ineffective.
19 February 2016	Letter to property owners including report to be presented to Policy Committee on 23 February 2016 updating work stream progress.	Work undertaken to date reconfirms that residents are exposed to a very high loss of life risk from future events. Further work on the hazard and risk modelling has also highlighted the need to increase the geographical area where retreat is recommended to satisfactorily mitigate the loss of life risk.

Date	Event	Outcome
		The report recommends that Council staff proceed with a project plan and budget to establish a western escape route for residents and progress the work being undertaken to address variations in the application of rates remissions; and voluntary managed retreat options.
23 February 2016	Report to Policy Committee providing an update on all work streams.	The Committee resolutions included: • **THAT** in regard to Work stream 1 (Review Hazard and Risk Line Definition) the geographical area of the fanhead for retreat from debris flow risk be the area bounded by the black hatched lines in Figure 1 Quantitative Debris Flow Risk Assessment on page 39 of the agenda; and • **THAT** in regard to Work stream 3 (Escape Routes) staff develop a project plan and project budget to establish an additional escape route for Clem Elliott Drive residents through the designated unformed public road to the west; and • **THAT** in regard to Work stream 4 (Early Warning Systems) the development of a debris flow early warning system not be pursued at this point in time due to the uncertainties around the effectiveness of the system; and • **THAT** in regard to Work stream 6 (Right Turning Hazard) the New Zealand Transport Authority be provided with a copy of the Opus report on the hazard to east bound traffic through west bound traffic turning right into Kaokaoroa Street from State Highway 2; and • **THAT** staff progress Work stream 2 – Property Valuations; and • **THAT** staff progress Work stream 7 - development of a voluntary managed retreat option.
1 March 2016	Media release following Policy Committee meeting. Includes statement "Mr Farrell also noted that the proposed debris flow risk reduction strategy was founded on voluntary retreat, which meant residents had a choice to remain."	
16 May 2016	Letter updating property owners on progress of each work stream (increase to 10 with District Plan Change and Legal QA)	
May and June 2016	Telfer Young Ltd (undertake valuations), John Reid (peer reviewer and review Work stream 2 – Rates), and The Property Group (Acquisition Strategy) contracted.	
23 June 2016	Letter updating property owners on pending valuations and peer review process	
30 June 2016	Legal QA brief finalised	
6 July 2016	Governance Group presentation on Acquisition Strategy and Voluntary Retreat proposal.	

Date	Event	Outcome
15 July 2016	Briefing to Megan Woods, MP.	
25 July 2016	Determination 2016/034 received.	Confirmed that building consents for new dwellings should not be issued due to high debris flow risk.
25 July 2016	Work stream 5 – valuation peer review – preliminary report from John Reid received	
28 July 2016	Council meeting considered voluntary retreat framework and approval to construct alternative escape route from Clem Elliott Drive	Council resolutions included: • **THAT** construction of an alternate vehicular escape route using unformed sections of Clem Elliott Drive and Tohi Street proceed once agreement with KiwiRail over the relocation of the vehicular barrier on the State Highway Heavy Traffic Bypass and associated fencing and Outline Plan approval have been obtained; • **THAT** the Council adopts the Acquisition Strategy prepared by The Property Group Ltd and dated July 2016 as the basis for developing Voluntary Retreat Proposals to owners of the 35 private properties in the high debris flow risk area as detailed in Table 1 of the Acquisition Strategy; • **THAT** owners of the 35 properties in the high debris flow risk area be provided with copies of the Acquisition Strategy; • **THAT** the Council continues to engage with the Government and the Bay of Plenty Regional Council over funding arrangements to enable Voluntary Retreat from the high debris flow risk area to be realised; • **THAT** staff prepare for Council consideration a Plan Change to the natural hazard provisions of the Proposed District Plan.
28 July 2016	Letter to property owners reporting outcome of the Council meeting and indicating an indicative voluntary retreat proposal will be provided in mid-September, that funding for any formal offer is conditional upon support from Government and BOPRC. A copy of Council report was included.	
1 August 2016	Media release – voluntary retreat package for debris flow properties progressing.	
22 August 2016	Work stream 5 – Rates Remission Review – final report received from John Reid	
4 October 2016	Letter Marty Grenfell to Mary-Anne McLeod covering legal opinions, project timeframes, risk modelling, valuations, and seeking to do a presentation before BOPRC early in the new triennium.	
11 October 2016	Letter Marty to Anne Tolley (copied to Doug Leeder and Mary-Anne) updating project progress – valuations and timeframes.	
14 October 2016	Update letter to property owners explaining delay in receiving valuations, the extent of the valuations will be provided, explanation of voluntary retreat formula and revised timeframes. Invitation to contact me if any queries.	
31 October 2016	Memorandum from The Property Group confirming the methodology for calculation of the Base Value in the voluntary retreat proposal formula.	Recommendation to use 2016 current market value without recognition of the hazard.

Date	Event	Outcome
10 November 2016	Report to Council updating work stream progress including RPS now operative and receipt of MBIE determination.	Council resolutions included: • **THAT** the Council approves the release of indicative voluntary retreat proposal offers to owners of the 35 private properties in the high debris flow risk area, as detailed in Table 1 of the Acquisition Strategy; and • **THAT** owners of the 35 properties in the high debris flow risk area be provided with copies of The Property Group Ltd memorandum '*Methodology to Determine the Base Value for Awatarariki Fanhead Voluntary Retreat Offers*', dated 31 October 2016; and • **THAT** the Council continues to engage with the Government and the Bay of Plenty Regional Council over funding contributions to enable Voluntary Retreat from the high debris flow risk area to be realised
10 November 2016	Public Excluded Report to Council reporting Work stream 2 (Valuations) outputs, the TPG recommendation around the Base Value component of the voluntary retreat formula, and seeking approval to present indicative voluntary retreat proposal offers to individual property owners.	Council resolutions included: • **THAT** the Council approves the release of indicative voluntary retreat proposal offers to owners of the 34 private properties in the high debris flow risk area, as detailed in Table 1 of the Awatarariki Fanhead, Matatā Acquisition Strategy, The Property Group, July 2016 as set out below with the correction that the property at 99 Arawa Street, Matatā should be shaded to denote it as a public property:
December 2016	Present and discuss indicative voluntary retreat proposal offers to property owners at individual face-to-face meetings at their properties (or other location convenient for them). Proposal offer letter included an invitation to contact me if any queries. Attachments to the indicative offers were: 1. Market Valuation Overview Report, TelferYoung (Tauranga) Ltd (Note: valuation details for individual properties have been redacted for privacy purposes) 2. Market Valuation Report, TelferYoung (Tauranga) Ltd, or for vacant sections, Desktop Assessment, TelferYoung (Tauranga) Ltd 3. Methodology to Determine the Base Value for Awatarariki Fanhead Voluntary Retreat Offers, The Property Group Ltd, 31 October 2016 4. Mitigation of Debris Flow Risk – Awatarariki Fanhead, Matatā – Update Report to Whakatane District Council, 10 November 2016 Letter also included a non-binding registration of interest form for property owners to complete indicating whether or not they wished to participate further in a voluntary retreat proposal or not.	
December 2016	Outline Plan approval granted to undertake works to construct additional escape route for Clem Elliott Drive residents.	
15 December 2016	Update report to Council on the IBC including PowerPoint presentation and seeking permission to engage formally with BOPRC and Government to finalise the IBC and seek formal recognition of funding partnership.	Council resolutions included:

Date	Event	Outcome
		• **THAT** the Council notes the progress of the Awatarariki Fanhead Indicative Business Case; • **THAT** the Council agrees to the objectives and key concepts of the Draft Indicative Business Case as outlined in the report; and • **THAT** the Council agrees to formally engage with the Bay of Plenty Regional Council and central government to further develop the Draft Indicative Business Case, particularly in relation to funding arrangements with key partner agencies.
23 January 2017to 3 February 2017	Follow up phone calls to property owners who had not returned registrations of interest/decline to participate forms.	23 (68%) of landowners provided registrations of interest. 21 (91%) were in support of continuing. 2 (9%) declined (one being Māori Trust who agree with proposal but want to retain land as a Māori Reservation). 11 (32%) property owners did not respond.
22 February 2017	Letter from the Mayor to Anne Tolley seeking request to arrange a meeting with Ministers of Finance, Civil Defence, Environment, Building and Construction.	
12 April 2017	Letter to property owners advising of District Plan Change proposal and included discussion document. Included invitation to contact Shane on the Plan Change or me on the voluntary retreat package.	
21 April 2017	Presentation to BOPRC councillors focusing on the District Plan Change and the need for a Regional Plan Change.	
26 June 2017	Letter to property owners providing: feedback on the indicative voluntary retreat proposal process; update on the engagement with BOPRC; advice of proposal to lodge a Plan Change Request to the Regional Land and Water Plan; and advice of 29 June Policy Committee meeting with an invite to attend and speak. Invitation to contact me with any queries.	
17 May 2017	Briefing update Anne Tolley.	
17 July 2017	Update letter from Shane on Plan Changes. Included invitation to contact Shane on the Plan Change or me on the voluntary retreat package.	
19 July 2017	Briefing update Anne Tolley, Nathan Guy, and Doug Leeder.	
2 August 2017	Letter inviting property owners to drop in sessions or 1 on 1 meetings to discuss District and Regional Plan Change discussion documents. Invitation to contact Shane or Alice with any queries.	

Appendix 7 – Proposed District Plan Change

Whakatane District Plan Changes

Chapter 3 Zone Descriptions, Activity Status, Information Requirements and Criteria for Resource Consents

Add the following new Policy Area in Section 3.2

3.2.5 Awatarariki Debris Flow Policy Area

The Awatarariki Debris Flow Policy Area means the land susceptible to debris flow hazards and identified on the Planning Maps as either high medium, or low risk.

The risk areas are:

a. **Awatarariki High Risk Debris Flow Policy Area**: The High Risk area includes land that is subject to a high risk to life and property from debris flows due to the likelihood of future debris flows and the potential for such flows to contain high impact boulders and woody debris, combined with the volume, density, and velocity of any future flow. Existing residential uses should retreat from the High Risk area because other forms of risk mitigation cannot practicably reduce the high likelihood of loss of life. There is also a risk to life for visitors to the area. Urban activities are prohibited in the High Risk area, with other activities only allowed where they relate to transitory recreational use of open space;
b. **Awatarariki Medium Risk Debris Flow Policy Area**: The Medium Risk area includes land that is subject to risk to life and property from debris flows, but is beyond the area where previous debris flows have contained high impact boulders and woody debris. Development is allowed only where a risk assessment establishes that the level of risk is reduced to a level that is as low as reasonably practicable.
c. **Awatarariki Low Risk Debris Flow Policy Area**: The Low Risk area includes land that is subject to risk to property from debris flows, but is beyond the areas where previous debris flows have contained high impact boulders and woody debris. There is potential for flows, predominantly containing sand, silt and gravel, with variable boulder and timber content.

Amend Section 3.7.25 Natural Hazard Effects as follows:

d. In relation to erosion, falling debris or slippage, and debris flows, the need for ongoing conditions aimed at avoiding, remedying or mitigating future potential adverse effects, and any need for registration of covenants on the lot's Certificate of Title. The Council will have regard to the siting of buildings or building platforms, and the specific design of buildings or other structures to avoid, remedy or mitigate the effect of the hazard;

Chapter 18 Natural Hazards

Section 18.1 Objectives and Policies

Add the following new Policies under Objective Haz1:

Policy 18

To assess the natural hazard risk from Debris Flows on the Awatarariki fanhead at Matatā by undertaking a risk analysis using the methodology set out in the Australian Geomechanical Society – Landslide Risk Management 2007.

Policy 19

a. To reduce the level of natural hazard risk in the Awatarariki High Risk Debris Flow Policy Area from high to medium levels (and lower if reasonably practicable);
b. To reduce the level of natural hazard risk in the Awatarariki Medium Risk Debris Flow Policy Area from medium to as low as reasonably practicable.
c. To maintain the level of natural hazard risk in the Awatarariki Low Risk Debris Flow Policy Area to within the low natural hazard risk range.

Section 18.2 Rules

Add the following new Rules under 18.2.6 Falling Debris and Debris Flows

18.2.6.3	Within the area shown as **Awatarariki High Risk Debris Flow Policy Area** on Planning Map 101A Matatā the following activities are Permitted Activities:
	a) The construction of structures and the use of land for passive recreation, including the construction and maintenance of public pedestrian and cycle tracks, interpretative and directional signs, fencing, pedestrian stiles, gates, bollards and associated barriers, seating, landscaping, gardens and grassed areas and rubbish and/or recycling bins;
	b) Activities operating in accordance with, or that are provided for in, an approved Reserve Management Plan under the Reserves Act 1977.
	c) The erection of new, and the minor upgrading and maintenance of, existing network utilities and related structures in a public;
	d) Demolition and/or removal of a building or structure;
	e) The removal of network utilities;
	f) Vegetation clearance;
	g) The erection of fencing, signage, a viewing platform and other minor structures, associated with the development of a commemorative reserve on Lot 20 DP 306286; h) Activities operating in accordance with Section 18(2) of the Reserves Act 1977 on the Te Kaokaoroa Historic Reserve (Allotment 373 Town of Richmond)
18.2.6.4	Within the area shown as **Awatarariki High Risk Debris Flow Policy Area** on Planning Map 101A Matatā the following activity is a Restricted Discretionary Activity:
	a) Earthworks

	In assessing an application for a Restricted Discretionary Activity for earthworks in the **Awatarariki High Risk Debris Flow Policy Area** the Council shall restrict its discretion to:
	a) Whether the activity will avoid causing any increased risk to other activities, and any buildings and their occupants on any other site, from a debris flow;
	b) Whether the activity will appropriately address the accidental discovery of koiwi or other taonga, including giving effect to any protocols agreed with mana whenua.
18.2.6.5	Within the area shown as **Awatarariki High Risk Debris Flow Policy Area** on Planning Map 101A Matatā any activity, other than those are a Permitted Activity under Rule 18.2.6.3 or a Restricted Discretionary Activity under Rule 18.2.6.4, is a Prohibited Activity.
18.2.6.6	Within the area shown as **Awatarariki Medium Risk Debris Flow Policy Area** on Planning Map 101A Matatā the following activities are Permitted Activities:
	a) Residential activities and associated buildings and structures within the existing building or structure envelope, including the footprint as lawfully established before 31 December 2017;
	b) Demolition and/or removal of a building or structure.
18.2.6.7	Within the area shown as **Awatarariki Medium Risk Debris Flow Policy Area** on Planning Map 101A Matatā all activities are a Restricted Discretionary Activity unless the activity is listed as a Permitted Activity by Rule 18.2.6.6, or a discretionary, non-complying or prohibited activity in Section 3.4.1 Activity Status Table.

Section 18.4 Assessment Criteria For Restricted Discretionary Activities

Add the following new Rules

18.4.2	**Awatarariki Medium Risk Debris Flow Policy Area**
18.4.2.1	**Council shall restrict its discretion to**
	a) Whether the design and layout of the activity will reduce the risk to the activity, and any building and its occupants from a debris flow, to a level that is as low as reasonably practicable;
	b) Whether the activity will avoid causing any increased risk to other activities, and any buildings and their occupants on any other site, from a debris flow.
	An application for Restricted Discretionary Activity in the Awatarariki Medium Risk Debris Flow Policy Area shall not be notified, or served on affected persons.

Add a new line to the activity status table 3.4.1.1 to be:

61	Activities in the Awatarariki Medium, High and Low Risk Debris Flow Policy Areas	See Rules 18.2.6.3 – 18.2.6.7

In the Activity Status table 3.4.1.1 add a “Pr” with a superscript number to all of the activities in the Coastal Protection column with the following footnote

> In the Awatarariki High Risk Debris Flow Policy Area this activity is a Prohibited Activity

In the Activity Status table 3.4.1.1 add an “RD” with a superscript number to activities 1,2,4,5,6,7,9,10,11,12,16,17, and 30 in Residential column with the following footnote

> In the Awatarariki Medium Risk Debris Flow Policy Area this activity is a Restricted Discretionary Activity

Add definitions to Chapter 21 Definitions

> **Awatarariki High Risk Debris Flow Policy Area** means land on the Awatarariki fanhead that is subject to a high risk to life and property from debris flows.
>
> **Awatarariki Medium Risk Debris Flow Policy Area** means land on the Awatarariki fanhead that is subject to a medium risk to life and property from debris flows.
>
> **Awatarariki Low Risk Debris Flow Policy Area** means land on the Awatarariki fanhead that is subject to low risk of life and property damage from debris flows.

Amend Advice Note: to 18.2.6.2 as below.

> **Council** is undertaking an assessment of landslide and debris flow risks in the vicinity of the escarpments at Whakatāne, Ōhope, and Matatā. This work is intended to provide the community with a better understanding of the nature and extent of these hazards and the risks they may present. Council has completed the debris flow risk assessment for the Awatarariki fanhead at Matatā and has included a Natural Hazard Policy Area on the Awatarariki fanhead. It is likely that the District Plan maps and rules that control land use and subdivision in areas affected by landslide and debris flow hazards in areas apart for the Awatarariki fanhead at Matatā, will need to be changed once the risk assessment has been completed. Any changes to the District Plan will be subject to a public submission process under the Resource Management **Act**.
>
> If you own land in close proximity to the escarpments at Whakatāne, Ōhope, and Matatā and are potentially affected by landslide and debris flow hazards, the **Council** will provide information to you on the risk assessment when this becomes available. If you are planning to purchase land or to undertake any development in the vicinity of the escarpments at Whakatāne, Ōhope, and Matatā you are advised to contact the **Council** at an early stage to obtain the latest information.

Add the following to Other Method to 18.7.1

> Anyone planning to purchase land or undertake development in this area is advised to contact the Bay of Plenty Regional Council to determine if there are any regional rules that would affect their development.
>
> The area shown as Awatarariki Low Risk Debris Flow Policy Area on Planning Map 101A Matatā has been assessed as having a Low risk to life and property from debris flows from the Awatarariki catchment. While this is an acceptable level of risk, anyone planning to purchase land or undertake development in this area is advised to contact Council to obtain the latest information, and to then evaluate the risk. The debris flood in this area, resulting from a debris flow from the Awatarariki catchment, will be further assessed as part of the district wide

susceptibility modelling of flooding that will occur in the next 3 years. It is possible that the outcome of that assessment will result in controls being placed on land use and/or subdivision.

Add a requirement, as m. in Rule 3.5.1.1 as follows:

o. within the Awatarariki Medium Risk Debris Flow Policy Area (AMRDFPA);

i. Unless the **Council** otherwise determines that some other assessment is appropriate, an application for resource consent for an extension to a building, a new building, or any other new structure within the AMRDFPA, shall include a report on its suitability, prepared by a **Chartered Professional Engineer experienced in natural hazard management,** confirming that the extension, building or other new structure will reduce the risk to the activity, and any building and its occupants from a debris flow, to a level that is as low as reasonably practicable, and will avoid causing any increased risk to other activities, and any buildings and their occupants on any other site, from a debris flow.

Add a new definition of **Chartered Professional Engineer experienced in natural hazard management** as follows:

Chartered Professional Engineer experienced in natural hazard management means a person who is a chartered Professional Engineer who holds expertise and qualifications in natural hazard risk assessment.

Planning Maps

Amend Planning Map 101A Matatā to show:

- Awatarariki High Risk Debris Flow Policy Area
- Awatarariki Medium Risk Debris Flow Policy Area
- Awatarariki Low Risk Debris Flow Policy Area

Amend Planning Map 101B Matatā to show:

- Coastal Protection Zone underlying the Awatarariki High Risk Debris Flow Policy Area

Coastal Hazards

- 2060 ERZ
- 2100 ERZ
- CERZ
- 103.3m MIRZ
- 103.6m MIRZ
- 104.0m MIRZ
- 104.1m MIRZ
- 104.55m EIRZ
- 104.7m EIRZ
- Variable EIRZ
- Variable ERZ Levels

Landscape Natural and Cultural Features

- Significant Specimen Tree
- Esplanade
- Water Body
- Cultural & Built Heritage
- Cultural & Built Heritage
- Outstanding Natural Feature and Landscape
- Significant Amenity Landscape
- Significant Indigenous Biodiversity Site

Area Specific Overlays

- Bird Nesting Vehicle Restriction Area
- Edgecumbe Dairy Manufacturing Site
- Edgecumbe Dairy Manufacturing Site Noise Contour Line
- Awakeri Quarry Buffer
- Mill Waste Contaminated Site - Indicative Location
- Whakatāne Board Mill
- Kawerau Geothermal Exploration Area
- Overland Flow Paths
- High Debris Flow Risk
- Medium Debris Flow Risk
- Low Debris Flow Risk

WHAKATĀNE District Council

CCS21 - 106.8

CH84 extends along the dunes from Pikowai Stream to the mouth of the Awa O Te Atua River (Tarawera River mouth)

BS71A

L1

CCS20 -

BS71A

BS.7 A

L8

BS102 B

Matatā 101A

WHAKATĀNE DISTRICT PLAN MAPS

0 140 280 Metres

1:7,000

Date: 28/08/2017

N

Features

- Amenity Building Line
- Pedestrian Street
- Restricted Vehicle Access
- Road Widening
- National Grid Centre Line
- Gas Transmission Pipeline Corridor
- Coastal Environmental Line
- Railway Corridor Buffer
- Designation
- Statutory Acknowledgements
- Key Urban Space
- 12m Height Restriction
- 300 m oxidation pond buffer
- Strand Character Area
- WHK River Greenway concept
- Omeheu Spray Irrigation Scheme
- Minginui Access Road
- State Highway
- Limited Access Road
- District Arterial Roads

Natural Hazard

- Natural Hazard
- Natural Hazard (NHaz4)

Planning Zones

- Business Centre
- CPZ
- Commercial
- Community and Cultural
- Education
- Industrial
- Large Format Retail
- Light Industrial
- Residential
- Urban Living
- Mixed Use
- Active Reserve
- Deferred Residential
- Rural Coastal
- Rural Foothills
- Rural Ohiwa
- Rural Plains

WHAKATĀNE District Council

N Date: 28/08/2017 1:7,000

0 137.5 275

Metres

WHAKATĀNE DISTRICT PLAN MAPS

Matatā 101B

Appendix 8 - Proposed Regional Plan Change

DRAFT PROPOSED

Plan Change XX to the

Regional Natural Resources Plan (Natural Hazards)

Management of Debris Flows Hazards on the Awatarariki Fanhead at Matata

November 2017

Bay of Plenty Regional Council

PO Box 364

Whakatāne 3158

New Zealand

Plan Change XX – Natural Hazards

The Natural Hazards provisions are included in the Bay of Plenty Regional Natural Resources Plan as a separate chapter. Policies, methods, and rules are identified by the unique identifier "NH".

NH: Natural Hazards

Management of Debris Flows Hazards on the Awatarariki Fanhead at Matata

Objective

NH 04 Avoidance or mitigation of debris flow hazard by managing risk for people's safety on the Awatarariki Fanhead.

Policies

NH P6 To assess the natural hazard risk from Debris Flows on the Awatarariki fanhead at Matatā by undertaking a risk analysis using the methodology set out in the Australian Geomechanics Society – Landslide Risk Management 2007.

NH P7 To reduce the level of natural hazard risk associated with debris flow on the Awatarariki Fanhead by ensuring existing residential land uses retreat from the high risk hazard area as soon as reasonably practicable.

NH P8 To ensure existing residential land uses retreat from the high risk hazard on the Awatarariki Fanhead by extinguishing existing use rights that would otherwise enable those residential land uses to continue.

Rules

NH R71 **Prohibited - Residential Activities subject to High Risk Debris Flow on the Awatarariki Fanhead at Matata after 31 March 2021**

From 31 March 2021, the use of land for a residential activity is a prohibited activity on any property listed below in Table NH3.

Glossary **Meaning of "Residential Activity" and "Property"**

For the purposes of Rule R71

- "residential activity" shall mean the use of land or buildings by people for living accommodation whether permanent or temporary and includes, but is not limited to, any dwellings, apartments, boarding houses, hotels, hostels, motels, camping grounds, mobile homes, caravans, tents, and accommodation for seasonal workers.
- "property" shall mean, as applicable to the context, the parcel of land described in Table NH3.

Table NH3

Legal Description	**Physical Address**
Lot 1 DPS 46347	16, 16A, 18, 18A Clem Elliott Drive, Matata
Lot 2 DP 308147	14B Clem Elliott Drive, Matata
Lot 1 DP 308147	14A Clem Elliott Drive, Matata
Lot 3 DP 308147	12B Clem Elliott Drive, Matata
Lot 4 DP 308147	12A Clem Elliott Drive, Matata
Allot 322 TN OF Richmond	10 Clem Elliott Drive, Matata
Allot 323 TN OF Richmond	8 Clem Elliott Drive, Matata
Lot 1 DPS 54496	7 Clem Elliott Drive, Matata
Lot 2 DPS 54496	5 Clem Elliott Drive, Matata
Lot 2 DPS 4869	23 Richmond Street, Matata
Lot 3 DPS 4869	21 Richmond Street, Matata
Allot 360 TN OF Richmond	5 Pioneer Place, Matata
Allot 361 TN OF Richmond	6 Pioneer Place, Matata
Allot 362 TN OF Richmond	7 Pioneer Place, Matata
Lot 4 DPS 4869	96 Arawa Street, Matata
Lot 5 DPS 4869	94 Arawa Street, Matata
Lot 2 DP 306286	104 Arawa Street, Matata

To incorporate into the Natural Resources Plan User Guide – The Management of Debris Flows Hazards on the Awatarariki Fanhead at Matata

Issue

There is a high natural hazard risk to life and property (as defined in accordance with Appendix L of the Regional Policy Statement) from debris flows for some residential activities in the Awatarariki Fanhead natural hazard zone at Matata.

Explanation/Intent

Susceptibility and risk from debris flows in the Awatarariki fanhead natural hazard zone have been carefully studied and assessed in a series of peer-reviewed reports undertaken since a major debris flow event in May 2005. A debris flow is a significant threat to life and property on the Awatarariki fanhead due to the potential for large boulders and woody debris in any debris flow, combined with the expected volume, density, and velocity of any future flow.

Regional Policy Statement Policy NH 2B states that high natural hazard risk within a natural hazard zone should not be tolerated and requires a response to reduce risk. The Awatarariki Fanhead is a natural hazard zone that includes residential land that is subject to a high risk to life and property from debris flows. It is recommended that existing residential uses retreat from the area because other forms of risk mitigation cannot practicably reduce the high likelihood of loss of life.

The nature of the hazard is such that it is not practicable to reduce the current high risk to a moderate or low level using engineered protection or other measures. Evacuation using an early warning system of an event also does not reduce the risk to an acceptable level. The preferred outcome for the area subject to high risk is therefore to retreat from the area and to move residential activities out of harm's way.

The Whakatane District Council's Awatarariki Debris Flow Risk Management Programme is a unified approach to managing the loss-of-life and property damage risks from future debris flows within the Awatarariki Stream catchment. The Programme includes hazard and risk modelling, escape routes, warning systems, and a managed voluntary retreat strategy for the Awatarariki High Risk Debris Flow Policy Area under the District Plan, in addition to regulatory measures under the Building Act and Resource Management Act.

Design of Rules

Regional Policy Statement Policy NH 14C identifies that the Bay of Plenty Regional Council, city and district councils are responsible for specifying objectives, policies and methods, including any rules, for the control of the use of land for the avoidance or mitigation of natural hazards. City and district councils have primary responsibility for controlling land use and they also control subdivision for the avoidance or mitigation of natural hazards. The Bay of Plenty Regional Council has the power to set land use rules to address natural hazard risk to existing land uses.

Rules in the District Plan prohibit land use activities in the high risk area except for activities associated with clearance of the land and on-going use as public reserve. However, District Plan rules are ineffective in reducing debris flow risk from high to medium (or less) because existing use rights under Section 10 of the Act continue to apply and allow residential land uses to continue.

A Regional Council can control the use of land for avoidance or mitigation of natural hazards under a Regional Plan rule. Existing use rights do not apply to land uses controlled by a Regional Plan.

Rules in the Regional Natural Resources Plan prohibit residential uses within the Awatarariki high risk area. These rules remove existing use rights for existing residential activities. The rules recognise that there is the potential for the level of risk to remain high if there is incomplete implementation of the managed voluntary retreat strategy. The prohibition applies only to sites that are currently in residential use and/or have existing use rights under section 10 of the Act enabling a previous use to re-establish.