Hastings District Council

Whakatu Arterial Road

Natural Hazard Assessment

June 2014

Executive Summary

Purpose

This report describes the natural hazards that could potentially affect the operation of the Whakatu Arterial Link (WAL) and the potential for the WAL to exacerbate the effects of natural hazards on surrounding properties and the environment.

Potential Effects

The potential effects of natural hazards are severe damage to the WAL resulting in either short or long term closure of the route whilst clearance or reconstruction works are undertaken. New roading construction such as the WAL also has the potential to increase or prolong the effects from natural hazards such as flooding on surrounding properties if these are not managed in the design.

Assessments Undertaken

A review of existing reports and assessments of natural hazards in and around the Whakatu area was undertaken. NZTA Research Report 355A identifies five key natural hazards with a potential to result in significant disruption to the operation of the roading network, these being:

- Seismic Activity;
- Volcanic Activity;
- Flooding from weather events;
- Flooding and wave action due to tsunami; and
- Snow and ice.

Historical evidence has been used in the assessment of the likelihood and effects of these potential hazards on the Whakatu area.

Results of Assessments

There is a high risk of seismic activity and the design of the arterial road complies with current design practice to ensure the bridge and embankments can withstand the expected horizontal and vertical accelerations of a design seismic event.

Volcanic activity affecting the WAL is expected, however due to its distance from the volcanic areas the impact is limited to ash fall events of between 1 to 5 mm occurring within the next 100 years.

Research has shown that whilst tsunamis have occurred in the area, the last significant one being in 1960, the extent of the water inundation is not expected to reach as far as the alignment of the WAL.

Storm events are expected and the WAL stormwater drainage management system, consisting of swales, soakaways and positive drainage has been designed to safely discharge the effects of a predicted 1 in 100 year flood event without exacerbating the effects of the flood event on neighbouring properties, including horticultural plantations.

Due to the climate of the Hawke's Bay snow and ice are unlikely to be a problem.

Suggested Approach for Effects Identified

The WAL has been designed to withstand the expected natural hazard events of seismic activity and flooding in accordance with the design requirements of, amongst others:

- NZ Transport Agency's Bridge Design Manual 2013;
- New Zealand Standards NZS 1170.5.2004; and
- Hastings District Plan including the requirements of the Council's Natural Hazard Resource Units.

Overall, best practice road design has been adopted such the potential impacts of natural hazards have been taken into account. Further, the effects of natural hazards on adjacent properties will not be prolonged or exacerbated as a result of the construction of the road.

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1. Introduction

This report describes the natural hazards that could potentially affect the proposed Whakatu Arterial Link Link (WAL) between State Highway 2 (SH2) North and Pakowhai Road and how the risks of these hazards and their consequences on the road and surrounding properties are managed through the design of the arterial road.

The assessment has been carried out on the basis of the design specified in the Whakatu Arterial Project Description (GHD 2014a)

The higher risk or more likely natural hazards are flooding from heavy rain events, seismic activity and volcanic ash fall. Other natural hazards are tsunami and heavy snow falls. However, the risks of these occurring and affecting the WAL are considered to be very low. The area is flat and landslides, other than localised road embankment failures, are not considered a potential hazard at this location.

1.1 The Whakatu Arterial Project

The WAL will run between SH2 North and Pakowhai Road, providing a direct link between the Whakatu industrial area (via a link from Whakatu Road to the WAL) and Pakowhai Road, which leads to the Hawke's Bay Expressway.

The WAL will be a new two lane carriageway of approximately 3.5 kilometres in length and with a total construction foot print width of between 30 metres and 80 metres at the approaches to intersections. The road will be generally constructed off line and follows the Karamu Stream for much of its length.

The land traversed by the WAL is predominantly flat horticultural and agricultural land, with a section passing through the Whakatu Industrial Area. There are also some residential houses in the vicinity of the SH2/Napier Road intersection at the south eastern end of the project.

Construction of the project is expected to take around 18 months (or two construction seasons) with works carried out concurrently at various locations to optimise the construction process while seeking to minimise disruption to existing road users, land owners and the local community.

The specific comprehensive construction methodology will be identified by the contractor. The methodology must clearly state how they will ensure that the site is maintained in a safe and useable condition during the period of the work and any close down periods. This methodology will also demonstrate how the contractor will meet the environmental standards that may be identified in the environmental assessment and consenting process.

2. Natural Hazards Assessment

Natural hazards have the potential to either affect the safe operation of the WAL or result in the WAL leading to a worsening of the effects of the natural event on adjacent properties. The following natural hazards have been identified as having the potential to result in such adverse effects:

- Seismic Activity;
- Volcanic Activity;

- Flooding from weather events;
- Flooding and wave action due to tsunami; and
- Snow and ice.

This report identifies the relative risk of these hazards, their potential impacts on the arterial road and surroundings, and how these risks are mitigated through the design of the project.

2.1 Natural Hazard Identification

The NZ Transport Agency Research Report 355A – August 2008, “Engineering Life Lines and Transport, Should New Zealand Be Doing It Better?” details the relative risks of the five main natural hazards with respect to geographical area. The findings of the research with regard to levels of risk are shown on the natural hazards map in Figure 1 .

The natural hazards map is a coarse generalisation and the actual risks can vary within the areas shown on the map. The following sections describe each of the natural hazard events and their potential harm on the operation of the arterial road and potential effects on surrounding properties.

Figure 1 Risk of Natural Hazards (NZTA Research Report 355A)

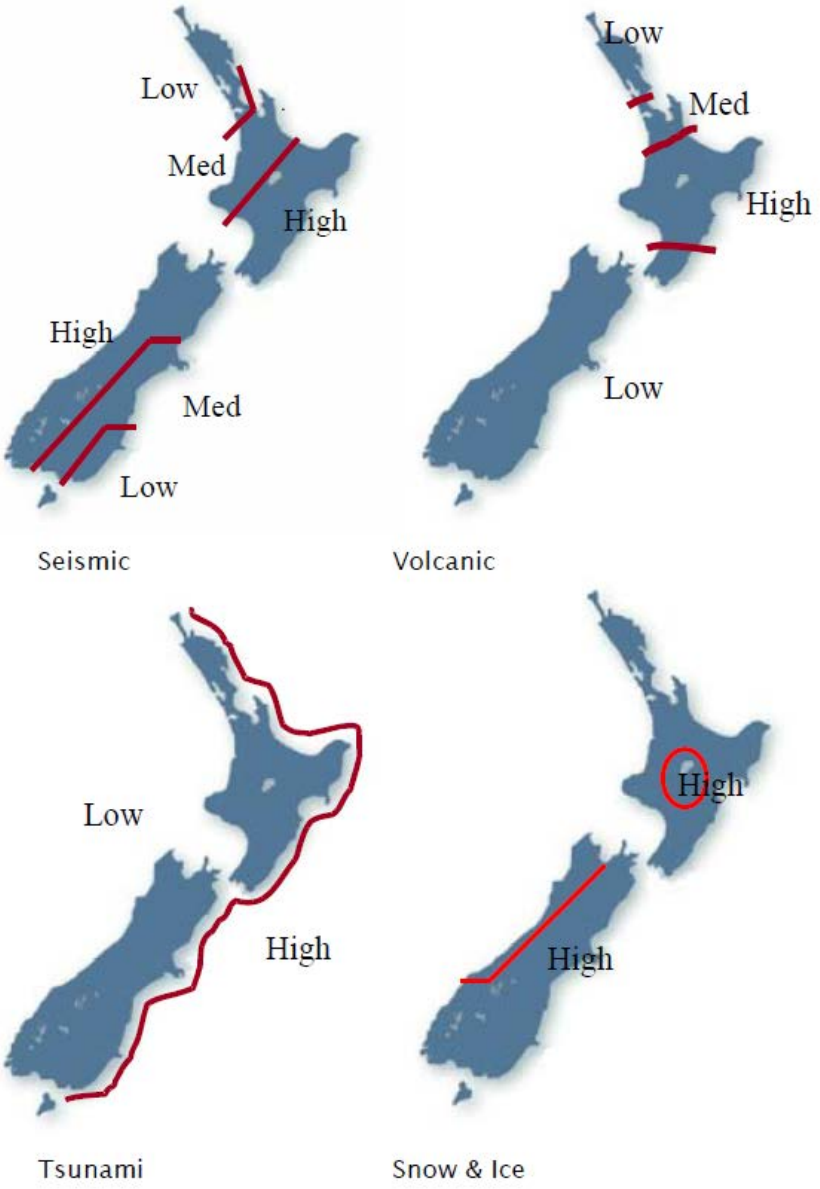

Figure 8.7 Maps showing where a significant natural hazard event is relatively more likely to occur in NZ.

2.2 Seismic Activity

The Hastings area is considered to be one of the more active seismic areas in New Zealand. In addition to the NZTA Research Report 355A, New Zealand Standard NZS 1170.5.2004 (Table 3.3) shows Hastings to have a seismic hazard factor (Z) of 0.39 which puts Hastings among the more seismic hazardous areas of New Zealand.

The Operative Hastings District Plan (Section 12.3) shows the WAL as being in an area of high risk of liquefaction. During liquefaction the pore water pressure in sands and gravels increases until the water is ejected to the surface and the ground settles. If not properly designed for, this can cause differential settlement and rotation of bridge piers, abutments and embankment failures.

As a consequence of the road being in a location of one of the most earthquake prone areas of New Zealand, the designs of the WAL embankments and Karamu Stream bridge are designed

to withstand the horizontal and vertical accelerations that can be expected during earthquake loading, together with withstanding the effects of liquefaction.

The bridge and road retaining structures are designed in accordance with the recently published NZ Transport Agency Bridge Design Manual 2013 which specifically includes updated design requirements that take account of the latest research on seismic design.

The road embankments are also designed to withstand expected seismic activity as specified in the NT Transport Agency's Bridge Design Manual.

The contractor appointed to construct the project is expected to make allowances for seismic activity in their risk assessments and prepare a construction management plan accordingly.

2.3 Volcanic Activity

The main effect of volcanic activity is the deposition of volcanic ash (and rocks) on the surrounding countryside, making driving difficult and hazardous.

The WAL lies approximately 100 kilometres from the nearest volcanic region of Mt Ruapehu and Mt Tongariro. Mt Ruapehu erupts approximately every 50 years, with the last major eruption occurring in 1995. The last major eruption event of Mt Tongariro occurred in 2012, and before then in 1896. The effects of these eruptions on Hastings District have been limited to ash fallout and have not had any significant effect on infrastructure in the district.

There is evidence of the Taupo, Okataina and Taranaki volcanic areas having a significant impact on the Hastings area within the last 20,000 years. The WAL is too distant from these volcanic regions and volcanoes for near source effects, such as lava flows, to be a risk. The fallout of volcanic ash in the event of a major eruption is, however, expected.

The scale and probability or frequency of ash fall out on the Hastings District from the surrounding volcanic regions is given in Table 1 below.

Ash Depth	Return Period
1 mm	20 years
1-5 mm	100 years
50 – 100 mm	1,000 years

Table 1 Volcanic Activity, Ash Depths and Return Periods

Source: Hawkes Bay Emergency Management Group Website (2013).

Ash fallouts of 1 to 5 millimetres in depth can conceal road markings and make driving difficult, as was the case in the 1995 eruption of Mt Ruapehu. Such effects are however only temporary and would not affect the long term stability or operation of the road.

2.4 Tsunami Risk

Tsunamis caused either by near or far away off-shore earthquakes have the potential to cause considerable damage and destroy infrastructure, such as road embankments and bridges. The most damage occurs on flat low lying coastal areas.

The WAL lies on relatively flat low lying ground approximately 6 kilometres from the sea shore. A return period of a major tsunami causing significant damage is expected once in every 900 years for the Hawke's Bay Region. The last tsunami in the area causing damage occurred in 1960.

The alignment of the road is outside the edge of the expected extent of a (worst case) 10 metre tsunami wave triggered by a local earthquake, as shown on the Hawke's Bay Regional Council's Tsunami Hazard Maps. Waves triggered by earthquakes further afield in South America are less severe and hence also not expected to reach the road.

2.4.1 Flooding from Severe Storms or Prolonged Rainfall

The WAL lies within the Heretaunga Plains which in the past has served as a flood plain with frequent flooding. Cyclones are not uncommon to Hawke's Bay, bringing strong winds and heavy rain that causes flooding. Irrigation and flood protection measures have however reduced the extent of flooding in modern times. The existing river and flood control works protect the area from 1 in a 100 year storm (flood) events, with the exception of the Karamu Flood area at the northern end of the WAL which is expected to flood in a 1:50 year flood event.

The construction of infrastructure has the potential to adversely affect drainage patterns and result in increased flooding to land and properties.

The new bridge is designed to accommodate a flow rate of 135 cubic metres a second which is sufficient for a 1 in a 100 year average rainfall intensity (ARI) event. The Hawke's Bay Regional Council is also widening the flood plain for the Karamu Stream which will provide additional help to alleviate any effects of flooding from major storm events in the area.

The WAL road drainage systems will be designed to cater for a ten minute high intensity rainfall event. The drainage systems consist of positive drainage to the Karamu Stream along with swales and settlement ponds. The design prevents additional water from the WAL during a design storm event from exacerbating flood water in neighbouring properties.

Erosion and sediment control measures are set out in the Erosion and Sediment Control Plan. (GHD 2014h). The approach to stormwater management is set out in the Stormwater Management Plan (GHD 2014g).

2.4.2 Karamu Stream Flood Area

The northern end of the WAL from immediately north of Whakatu Road to its intersection with Pakowhai Road falls within an area identified in the Operative Hastings District Plan as being within the Flooding Resource Management Unit's Karamu Sub Area. This area is shown to be subject to flooding during a 1 in 50 year flood event and as such building is restricted in this area.

The District Plan requirements for the Karamu RMU relate to buildings and do not include any special conditions for roading.

2.5 Snow and Ice

The WAL is not in an area of high risk for snow and ice causing disruption or damage to infrastructure. The road is in a coastal area and heavy snow falls and severe icing are not expected to occur. The road will be designed to ensure surface water is able to run off therefore reducing the risk of significant ice build-up in the winter months.

3. Conclusion

The design of the arterial road complies with current design practice, guidelines and standards including:

- NZ Transport Agency's Bridge Design Manual 2013;
- New Zealand Standards NZS 1170.5.2004 (earthquake design); and
- Operative Hastings District Plan including the requirements of the Council's Natural Hazard Resource Management Units.

The design of the WAL also ensures that the proposed road will not exacerbate the effects of natural hazards on surrounding properties. The construction of the road is not expected to result in any increase in local flooding and will be built to withstand design flood events.

4. Basis of Report

This report has been prepared by GHD for Hastings District Council and may only be used and relied on by Hastings District Council for the purpose agreed between GHD and the Hastings District Council as set out in Section 1 of this report.

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