ASSET MANAGEMENT GROUP
Technical report

ISSN 1174 3085

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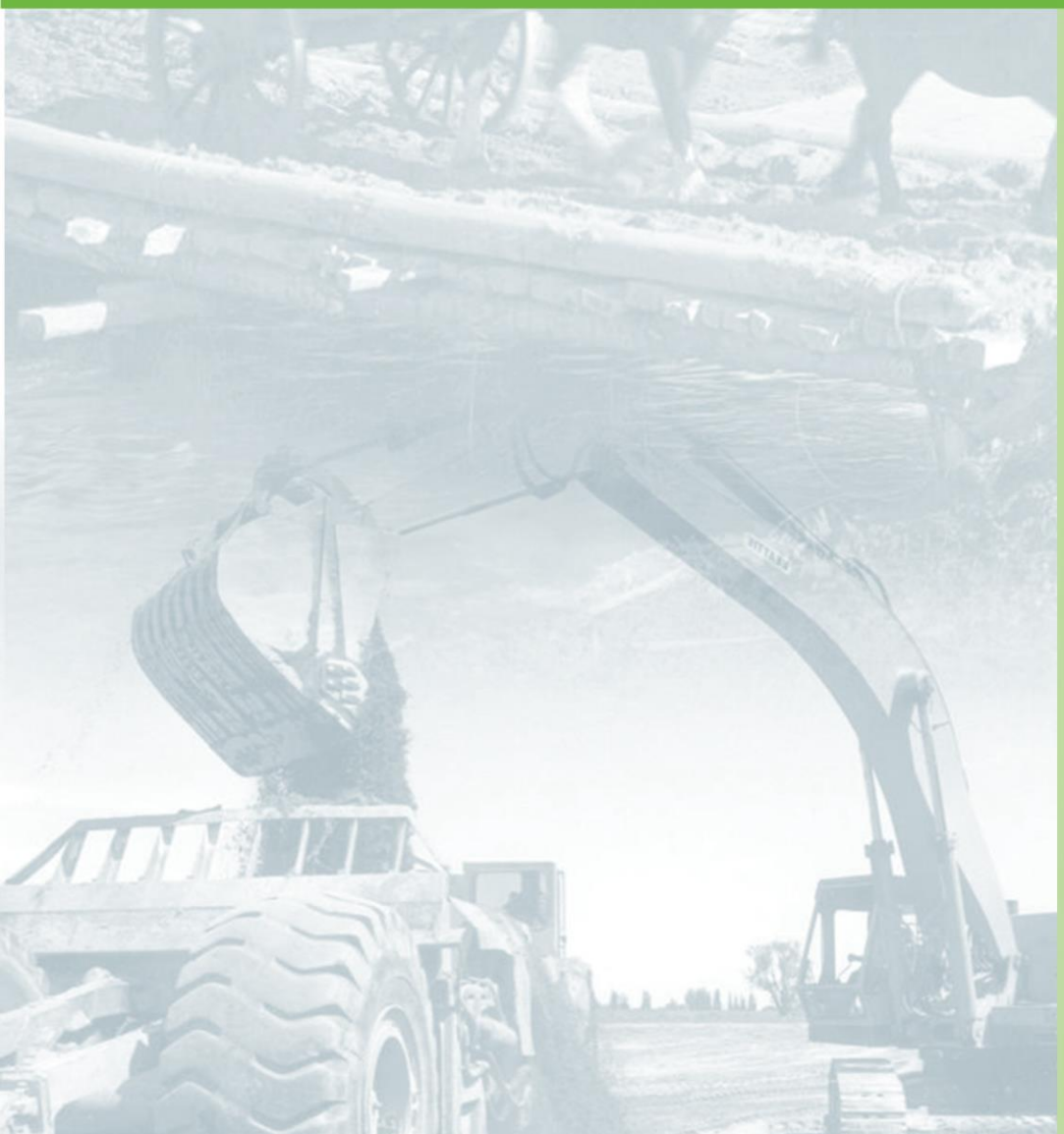

Taranaki Tsunami Inundation Analysis Update 2017

Prepared for
Taranaki Civil Defence Emergency Management Group

Final

June 2017
AM 17/08
HBRC Plan Number 4936

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SAFEGUARDING YOUR ENVIRONMENT + KAITIAKI TUKU IHO

Asset Management Group
Technical Report

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Engineering Section

Taranaki Tsunami Inundation Analysis Update 2017

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June 2017
AM 17/08
HBRC Plan Number 4936

Taranaki Tsunami Inundation Analysis

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Taranaki Tsunami Inundation Analysis: Update 2017

1 Summary

In 2012, HBRC conducted a tsunami computer modelling exercise for the Taranaki coast using 2 m and 4 m waves. This 2017 updated report provides the results from additional model runs using a wave height of 10 m. The 10 m wave height is considered to have a return period of well beyond 2500 years, as the height is not reached in any of the tsunami hazard plots from the 2013 National Tsunami Hazard Model (Power, 2014). The decision to include such a wave height was in order to show inundation extents that covered any conceivable wave height, up to and including a value (10 m) that is easily visualised by the general public.

In addition, areas of the coast not covered in the 2012 study were examined using air photos and contours where available to identify the "Marine Threat Only" area. In areas not yet modelled using the 2-dimensional computer model, the GNS attenuation rule (Fraser, Power, 2013) was used to estimate inland inundation.

The results of the 10 m wave indicate there is infrastructure at risk from such an event in the Taranaki Region. While most places have a steeply rising coastal area which prevents any significant inland inundation, several places have low-lying areas which are susceptible to inundation. The specific areas at risk are identified in the accompanying GIS layers developed for this report. A set of maps for the region is also included as an appendix to this report.

The 2012 report provided the background to the method of analysis used for the computer modelling, and is not repeated in this report. The use of the GNS attenuation rule is described in this report.

It should be stressed that the information presented in this report relating in particular to the 10 m wave results are very extreme in nature, and should not be used by Local Authorities to delineate specific properties as being within the inundation area, and therefore subject the property to a notice on a Land Information Memorandum (LIM) indicating it is in a hazard zone.

2 Study Area

The area covered in the initial 2012 analysis is shown in Figure 1.

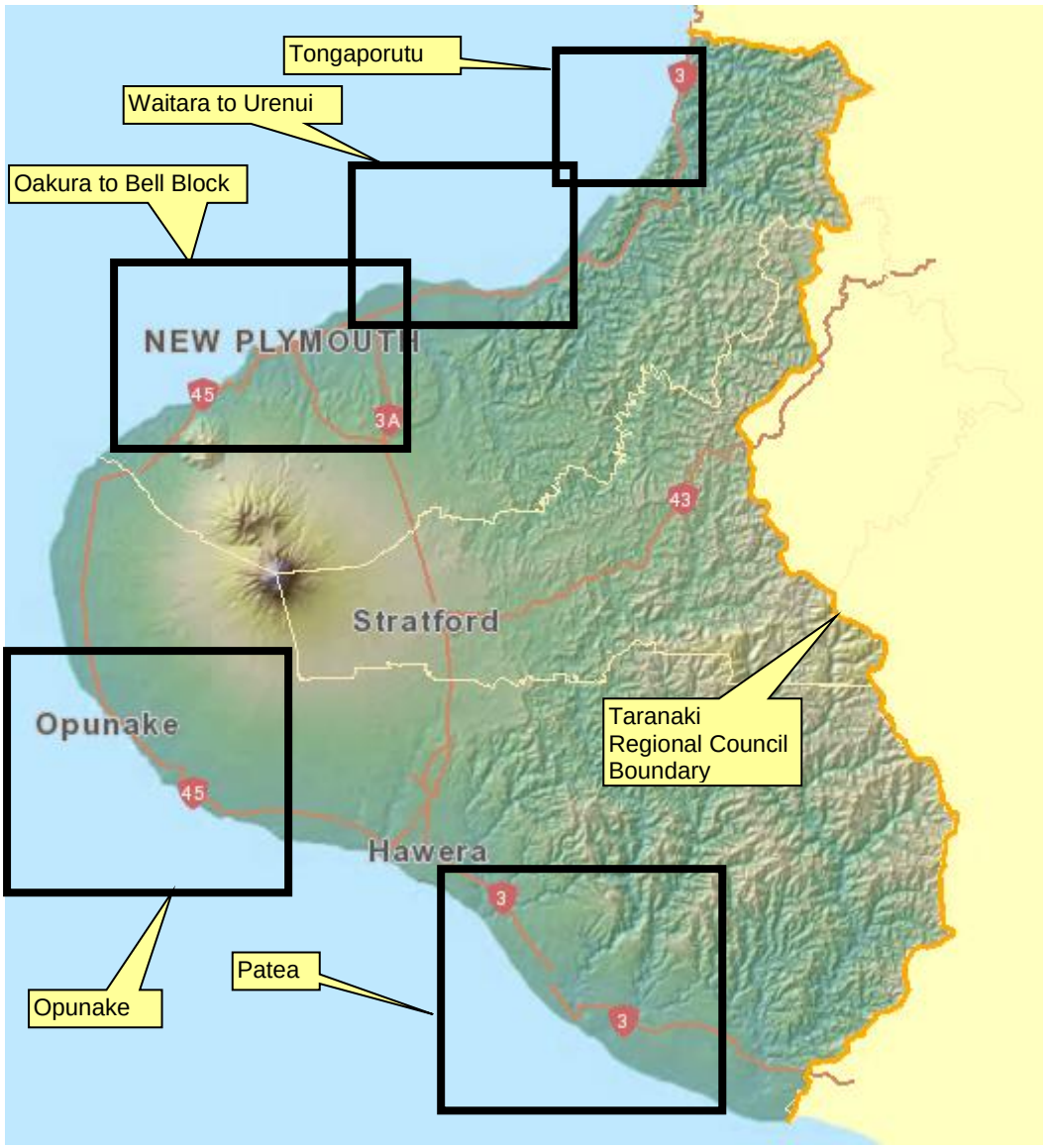

Figure 1: 2012 Study areas – Location where 2D models were created.

A computer model was made for each of the study areas, with the tsunami waves being applied at the boundaries.

The present study encompasses the entire coastline, as shown in Figure 2.

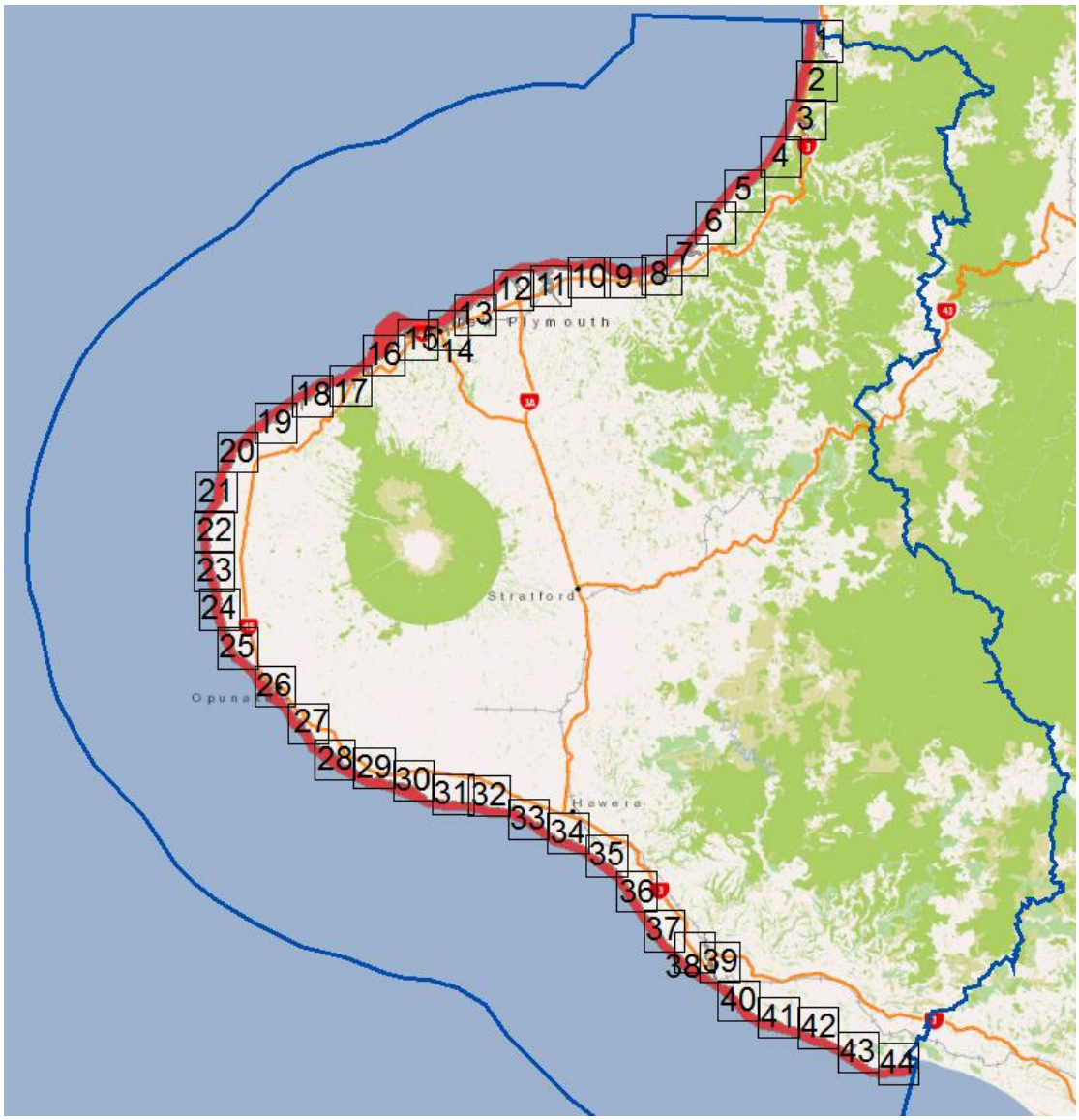

Figure 2: 2017 Study areas – map reference sheets

3 Wave Details

The wave patterns used in the models are shown in Figure 3.

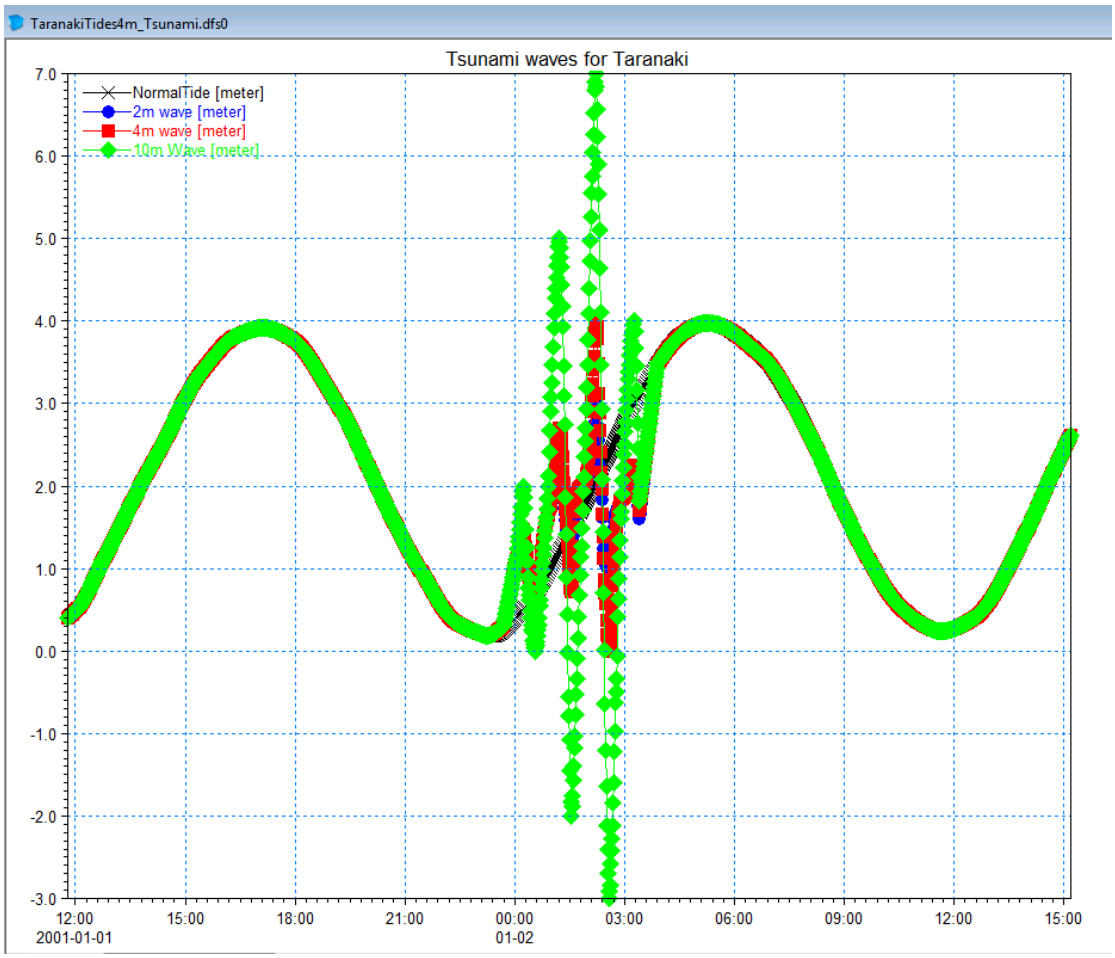

Figure 3: Tsunami Wave Patterns used in 2D model

The highest wave amplitudes were applied at mid-tide levels. The wave heights are applied such that the 2 m wave rises 1 m above and falls 1 m below the normal tide, the 4 m wave rises 2 m above and falls 2 m below the normal tide, and the 10 m wave rises 5 m above and falls 5 m below the normal tide. The timing between the peak and the trough was set to 20 minutes. This was based on anecdotal evidence from recently occurring tsunami from Indonesia, Chile, Samoa and Japan. These waves were applied to the offshore boundary.

4 GNS Attenuation Rule

The attenuation rule was developed by GNS (2009, Leonard et. al, and 2013, Fraser S., Power W.). The rule has been shown to provide reasonably accurate representation of inland inundation from tsunami based waves. The application is as follows:

For a given shoreline wave height, the wave height was added to a mid tide value (in this case 2 m), then the following attenuation rules were applied:

- The potential runup height attenuates at a rate of 1 m for every 200 m horizontal inland for flow direct from the coast.

- The potential runup height attenuates at a rate of 1 m for every 400 m horizontal inland for flow up a significant river.
- The potential runup height attenuates at a rate of 1 m for every 50 m horizontal inland for flow over land away from a significant river.

The application of these rules was by a manual method using contours (where available) while estimating where the attenuation line would intersect the appropriate ground contour.

5 Results

In 2012 the computer model results were used to create three evacuation zones, according to the Ministry of Civil Defence and Emergency Management Guidelines (MCDEM 2008). The zones recommended by MCDEM are:

Red Zone: Shore exclusion zone that can be designated off limits in the event of any expected tsunami.

Orange Zone: Includes the area to be evacuated in most if not all distant and regional-source official warnings, from sources more than 1 hour of travel time.

Yellow Zone: Should cover all maximum credible tsunami, including the highest impact events.

The additional information included in this report is based on a 10 m wave, which was chosen as an extreme upper limit. This wave height is shown in the maps attached to the appendix in purple.

A sample map is shown in Figure 4.

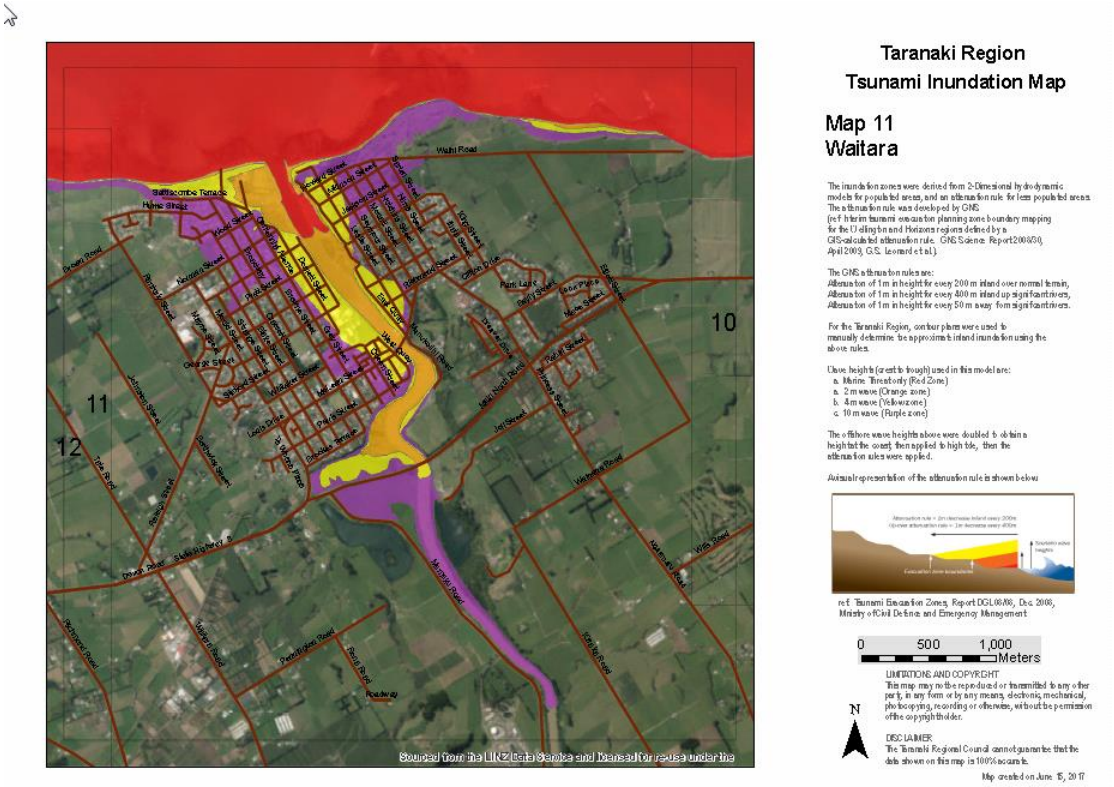

Figure 4: Sample Tsunami inundation map

6 Limitations and Accuracy

The results presented in this report are based on computer models which provide an output based on the input parameters chosen. While care and research has gone into selecting the input parameters, there are many unknown variables which could alter the parameters and produce slightly different results in terms of inundation depths, extents and timing of the waves. The scenarios examined and the range of parameters chosen have given a broad spectrum of results, including extremely severe scenarios which may have return periods of many thousands of years. It should be stressed that the overall accuracy of such modelling results is limited; however the model results do represent plausible scenarios which provide an indication of the severity of the possibility of tsunami waves hitting this particular coastline.

7 Conclusion

A series of waves simulating tsunami events with 2 m, 4 m, and 10 m high waves were applied to computer models of areas around the Taranaki Coast. Inundation extents were generated from the models, which were plotted according to the guidelines from Ministry of Civil Defence and Emergency Management.

In general, there are many areas along the Taranaki Coast that would only suffer very localised threat and minor damage from even the largest plausible tsunami. Several areas that have river inlets, with infrastructure in low areas near the river edge would likely suffer more damage due to inundation.

8 References

Berryman, K., (2005) Review of Tsunami Hazard and Risk in New Zealand. Institute of Geological and Nuclear Sciences Ltd., report 2005/104.

Fraser, S., Power, W., (2013), Validation of a GIS-based attenuation rule for indicative tsunami evacuation zone mapping (report 2013/02), Institute of Geological and Nuclear Sciences Ltd., (GNS), Wellington, New Zealand.

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Depth contour polyline (Hydro, 1:350k - 1:1,500k – revised Mar. 6, 2012)
Depth contour polyline (Hydro, 1:90k - 1:350k - revised Feb. 25, 2012)

Leonard, G., et. al., (2008), Tsunami evacuation zones for Wellington and Horizons regions defined by a GIS-Calculated attenuation rule (report 2008/30), Institute of Geological and Nuclear Sciences Ltd., (GNS), Wellington, New Zealand.

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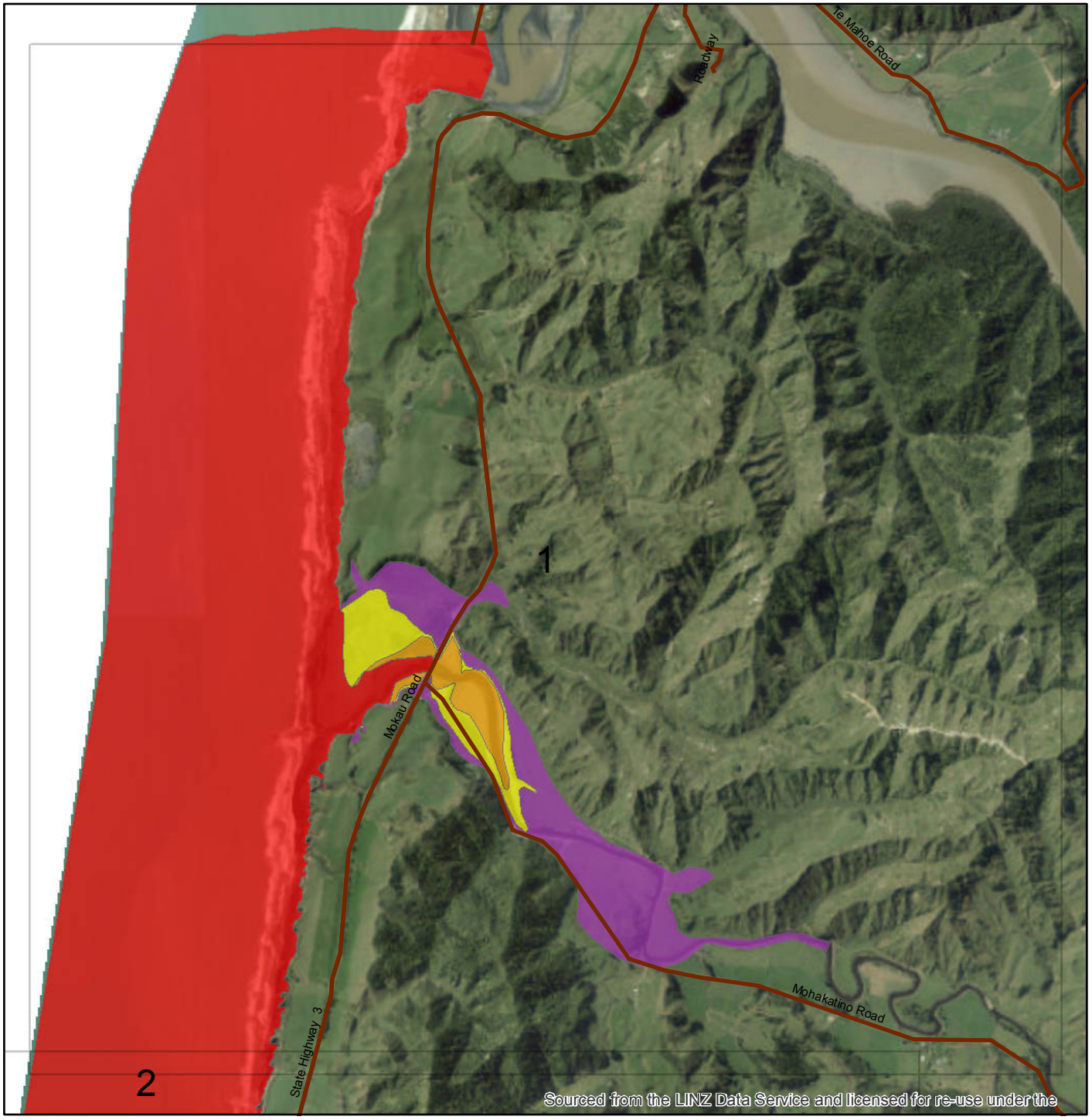
Ministry of Civil Defence and Emergency Management (MCDEM), 2010. Tsunami advisory and warning: supporting plan [SP01/09]. Wellington: 2011 GNS Science Miscellaneous Series 34 30

Power, W., (2014), Tsunami hazard curves and deaggregation plots for 20 km coastal sections, derived from the 2013 National Tsunami Hazard Model (report 2013/59), Institute of Geological and Nuclear Sciences Ltd., (GNS), Wellington, New Zealand.

Taranaki Region
Tsunami Inundation Map

Map 1
Mohakatina River



The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

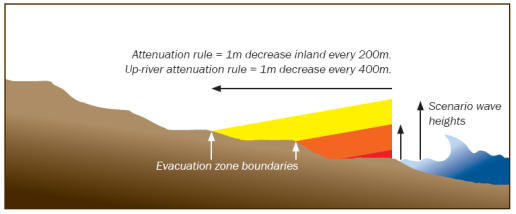
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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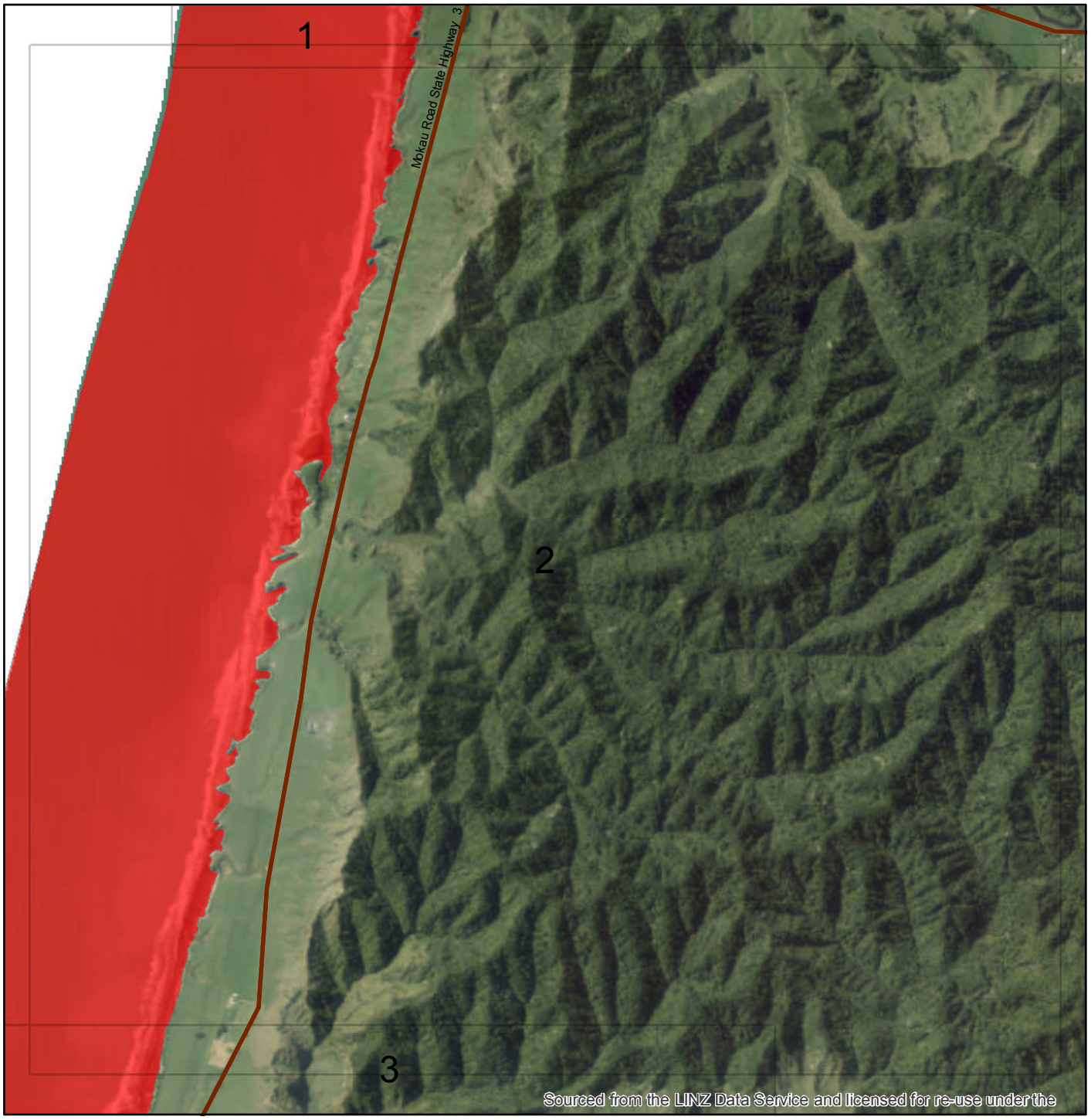
Map created on June 15, 2017



Taranaki Region
Tsunami Inundation Map

Map 2
Waikumera Point

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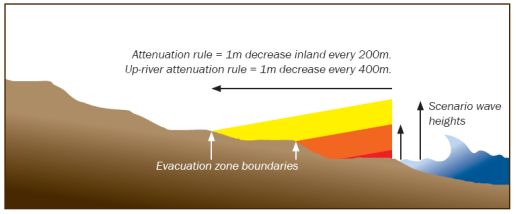

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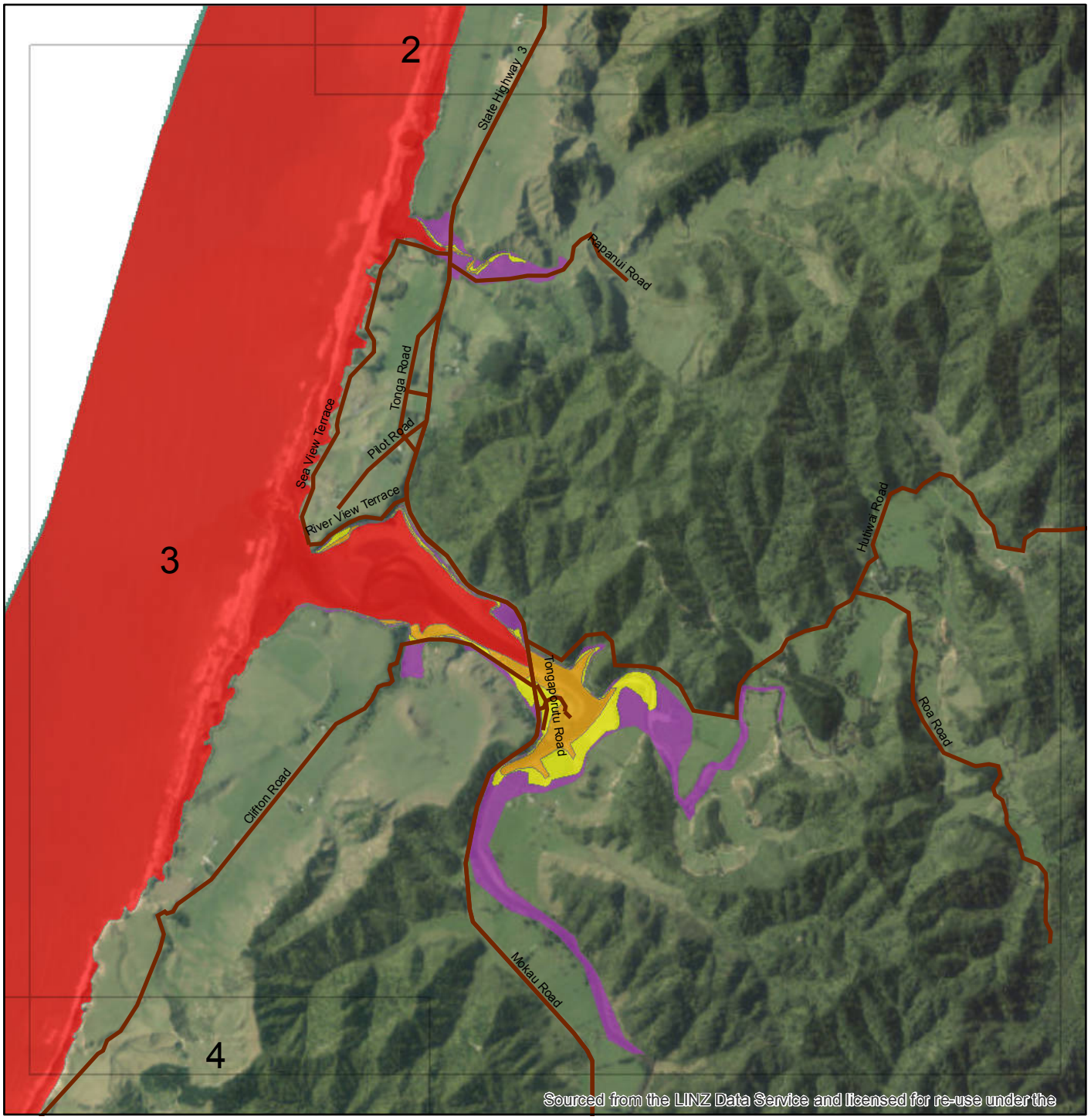

Taranaki Region
Tsunami Inundation Map

Map 3
Tongaporutu

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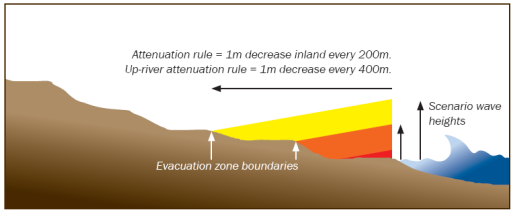

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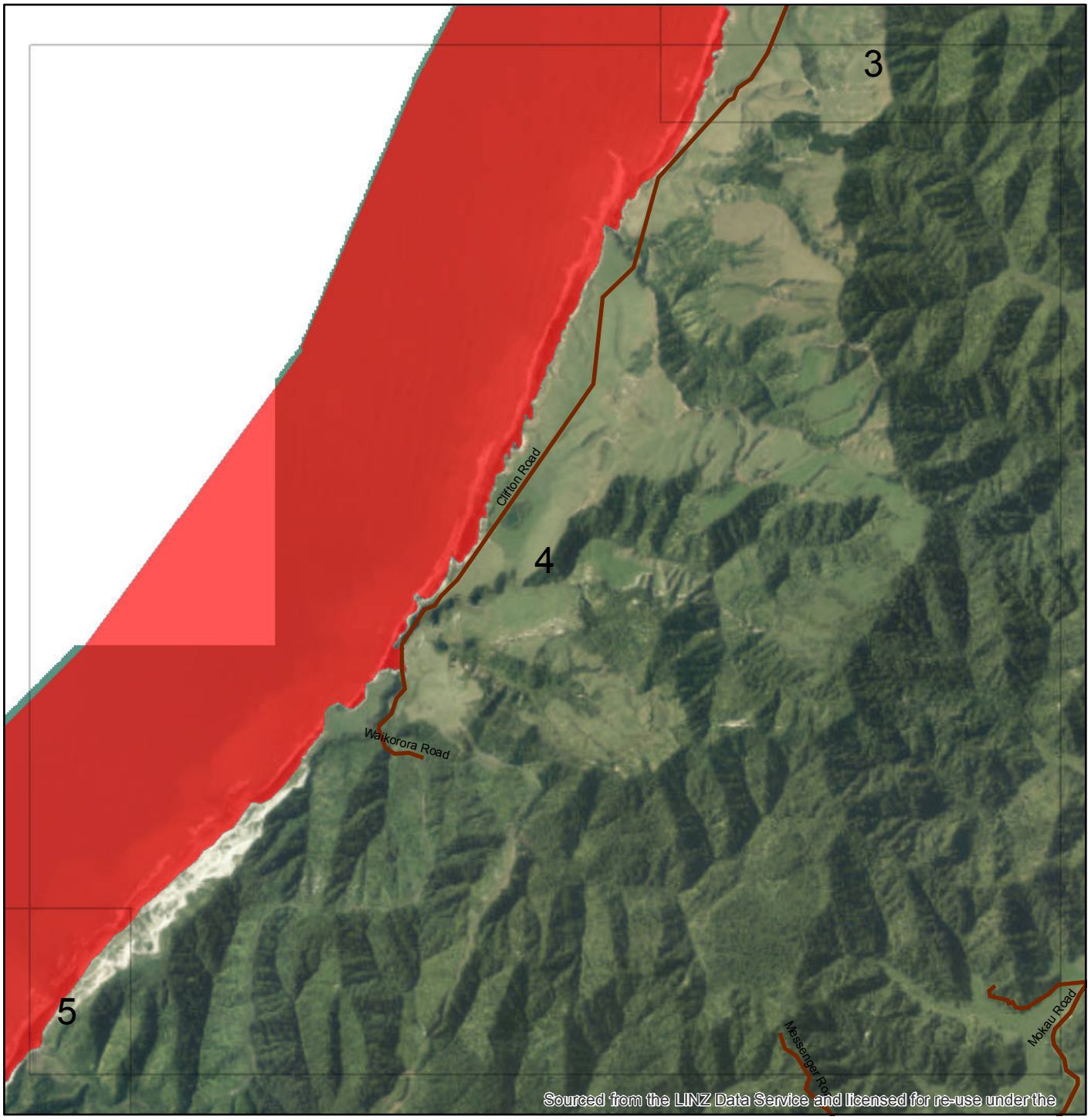

Taranaki Region
Tsunami Inundation Map

Map 4
Whitecliffs Walkway

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

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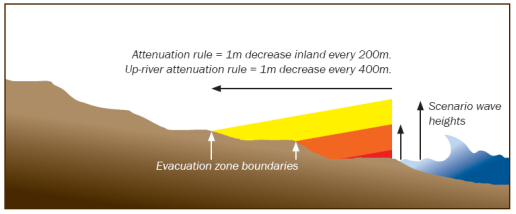

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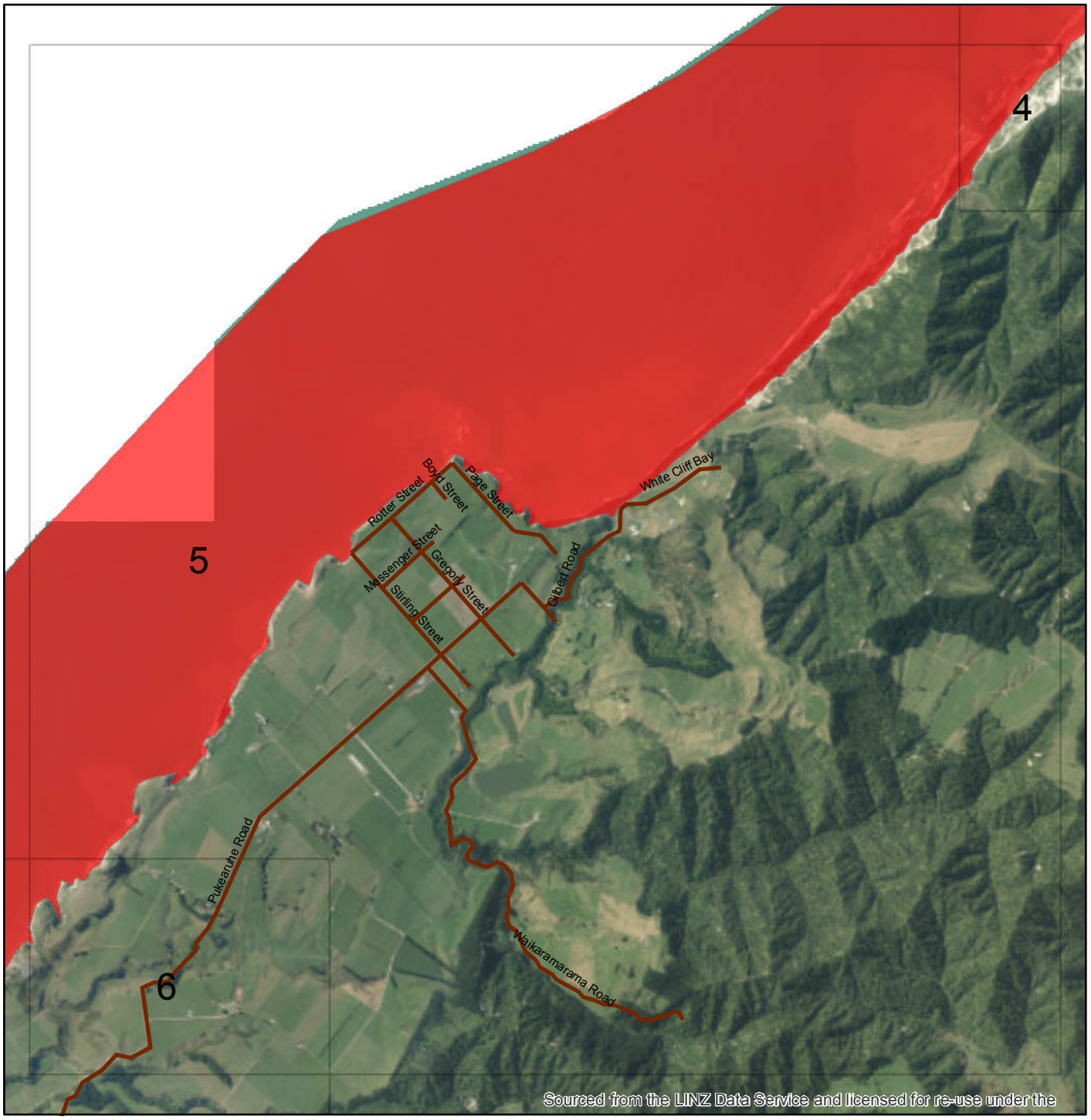

Taranaki Region
Tsunami Inundation Map

Map 5
Pariokariwa Point

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

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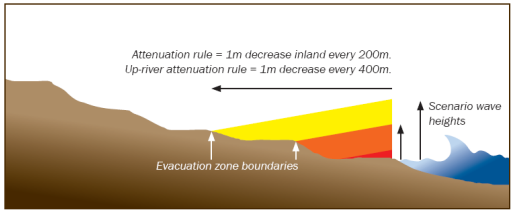

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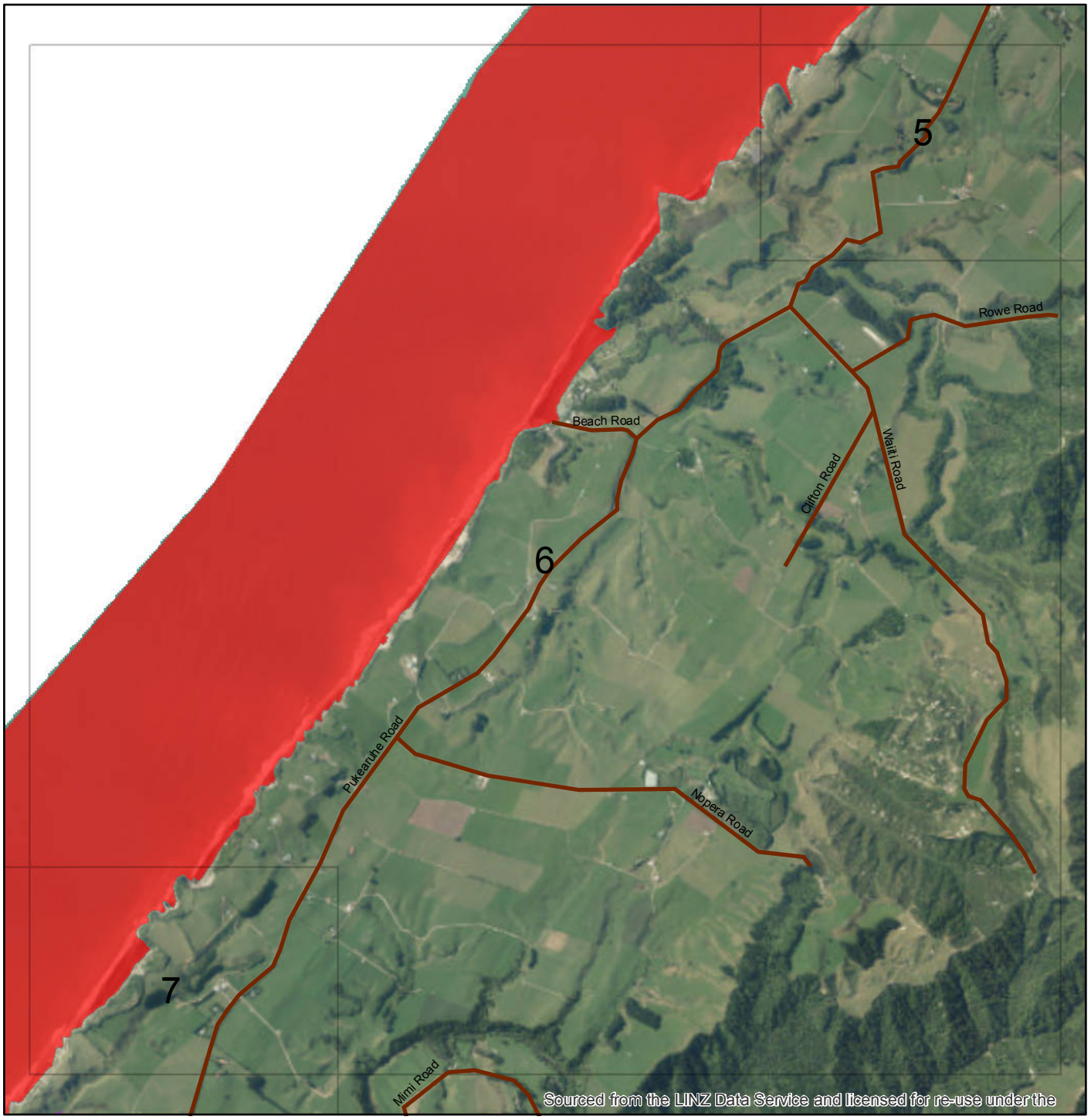

Taranaki Region
Tsunami Inundation Map

Map 6
Waiiti

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

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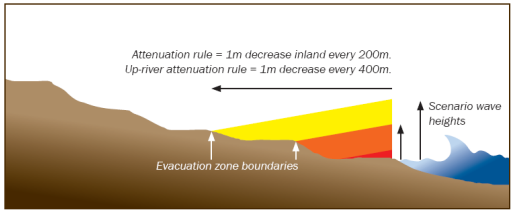
A visual representation of the attenuation rule is shown below.



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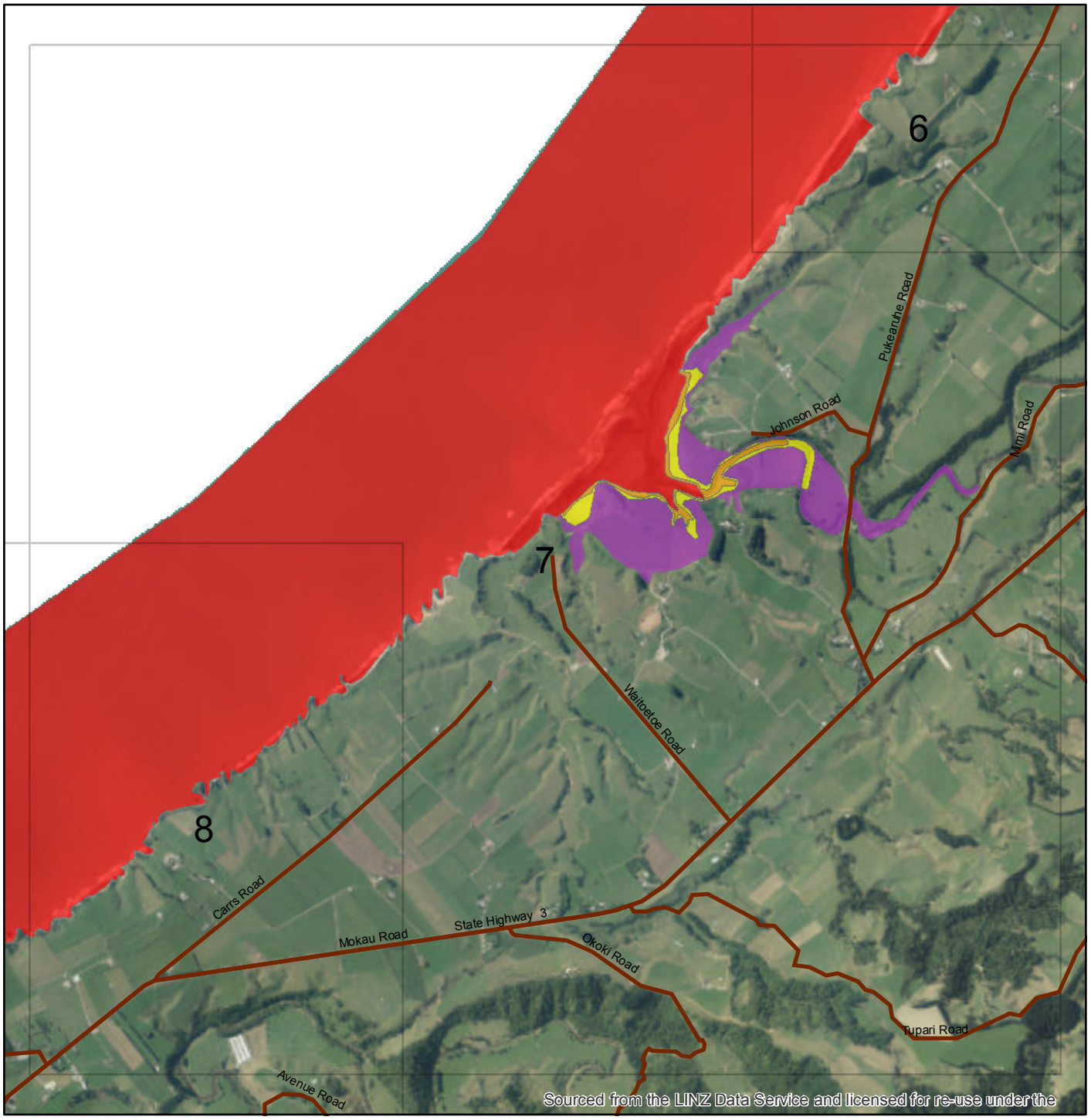

Taranaki Region
Tsunami Inundation Map

Map 7
Mimi River

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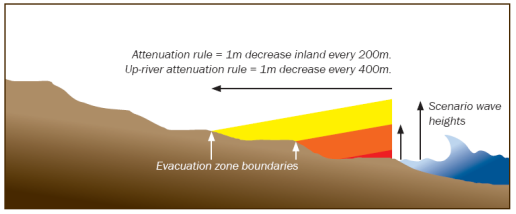

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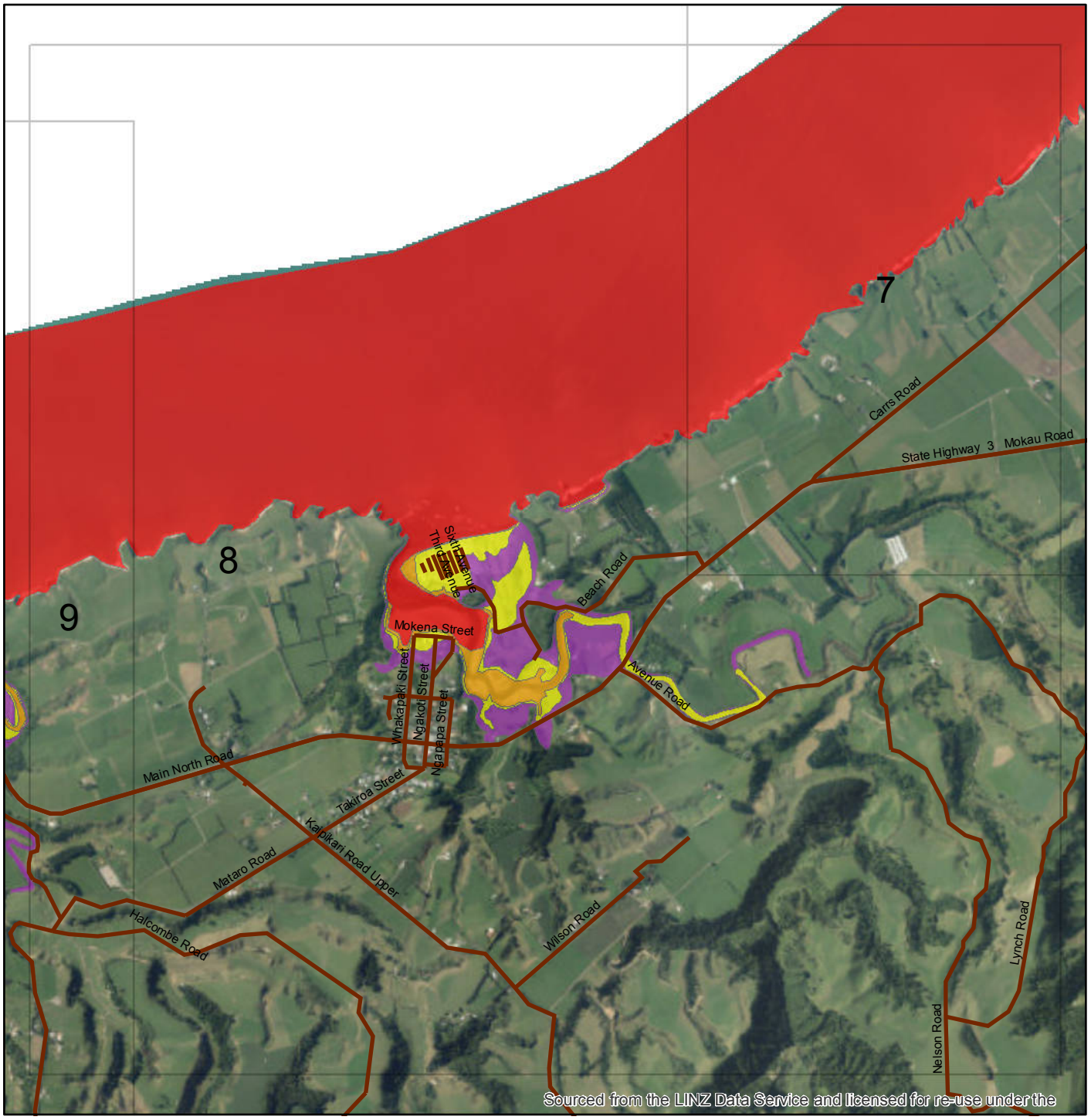

Taranaki Region
Tsunami Inundation Map

Map 8
Urenui

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

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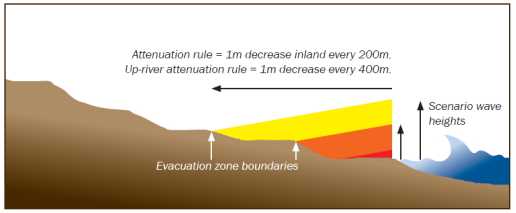

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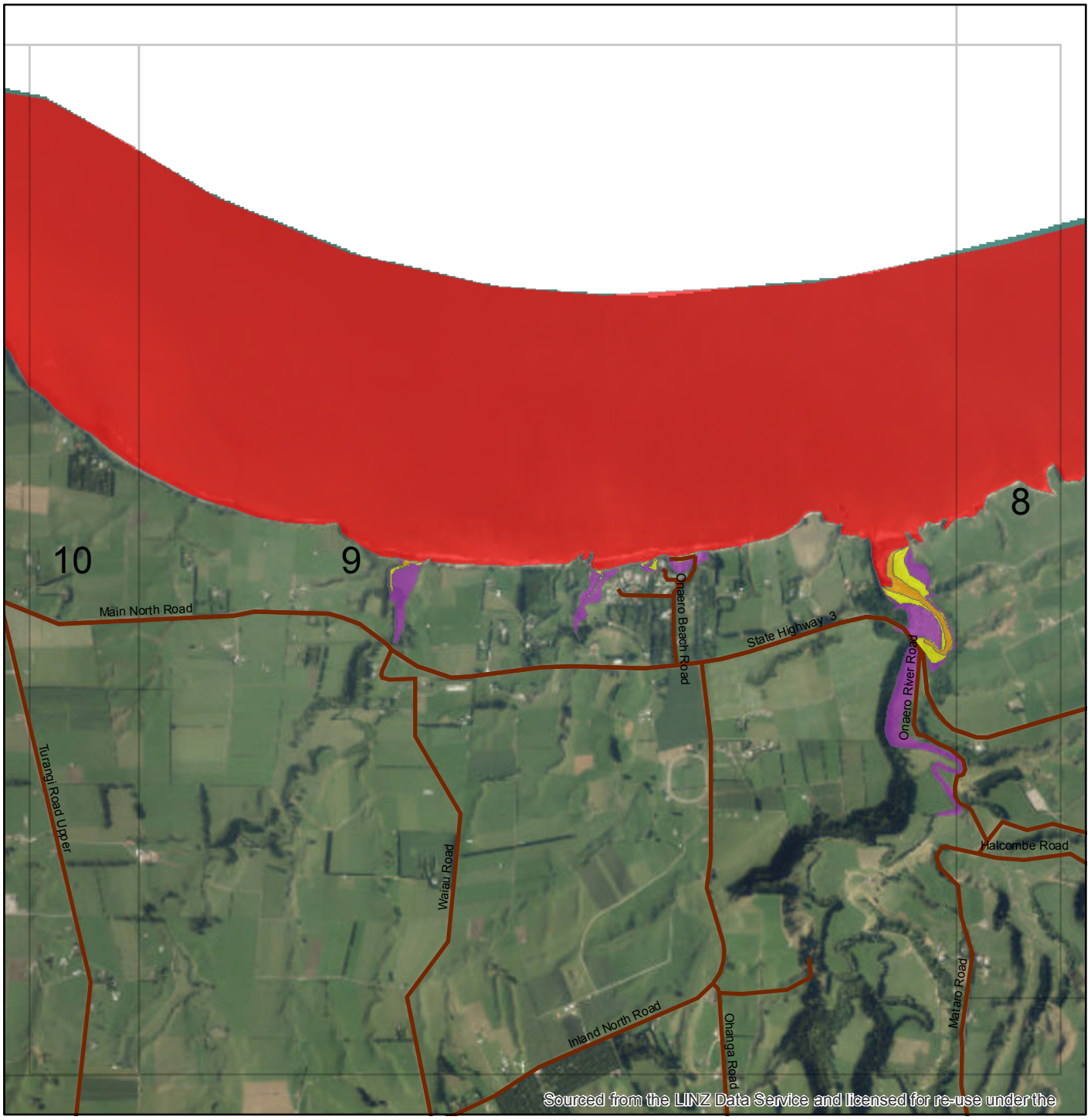
Taranaki Region
Tsunami Inundation Map

Map 9
Onaero



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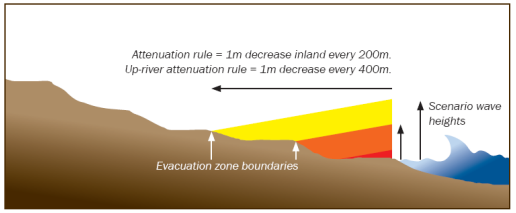
The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

0 500 1,000 Meters

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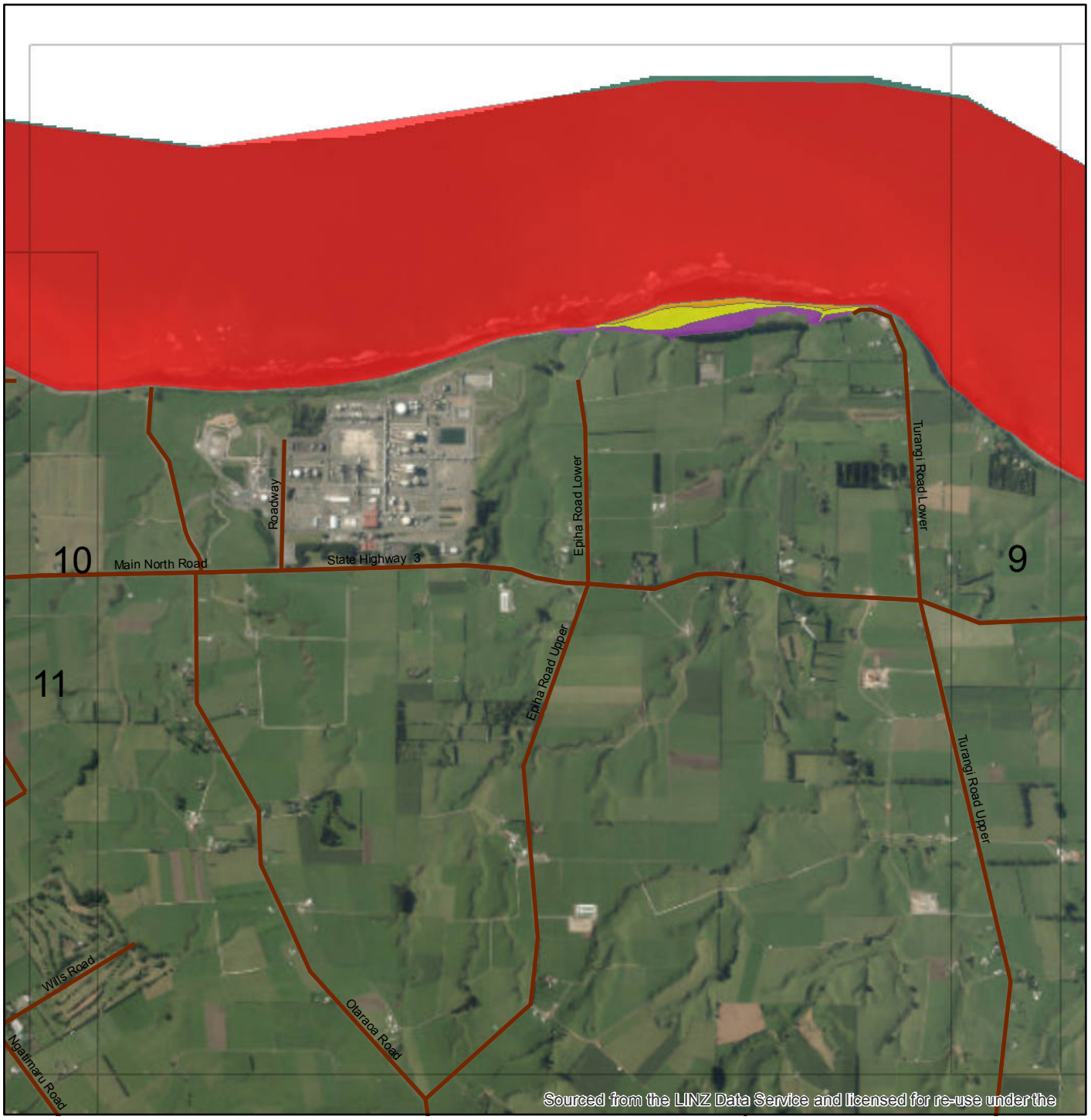
DISCLAIMER
The Taranaki Regional Council cannot guarantee that the data shown on this map is 100% accurate.

Map created on June 15, 2017

Taranaki Region
Tsunami Inundation Map

Map 10
Motunui



The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

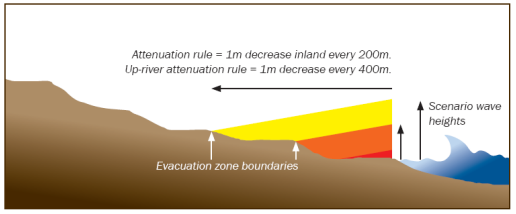
For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:

- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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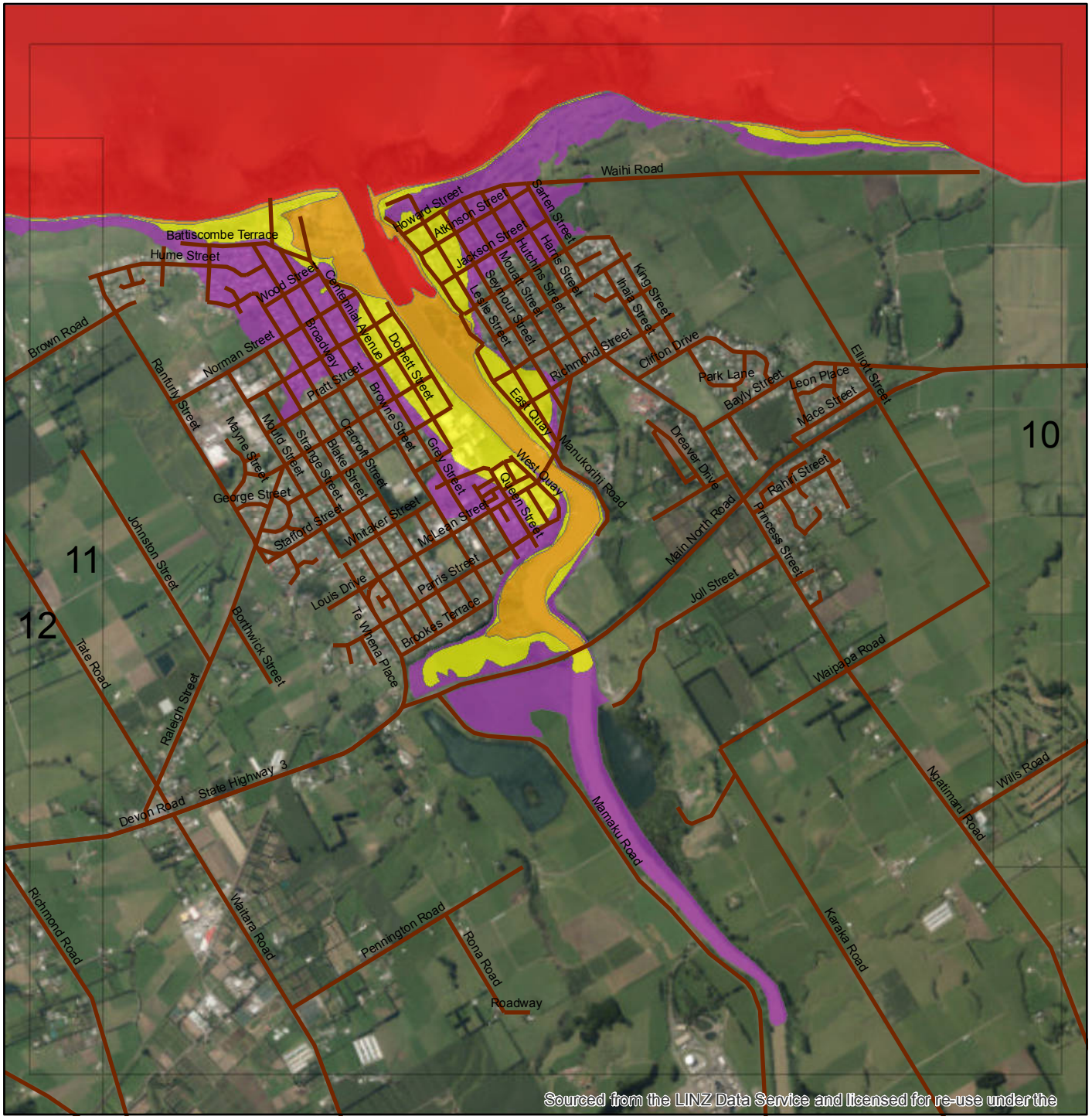
Map created on June 15, 2017



Taranaki Region
Tsunami Inundation Map

Map 11
Waitara

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

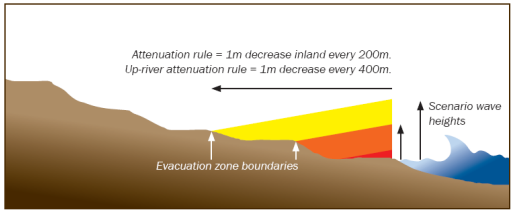
For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:

- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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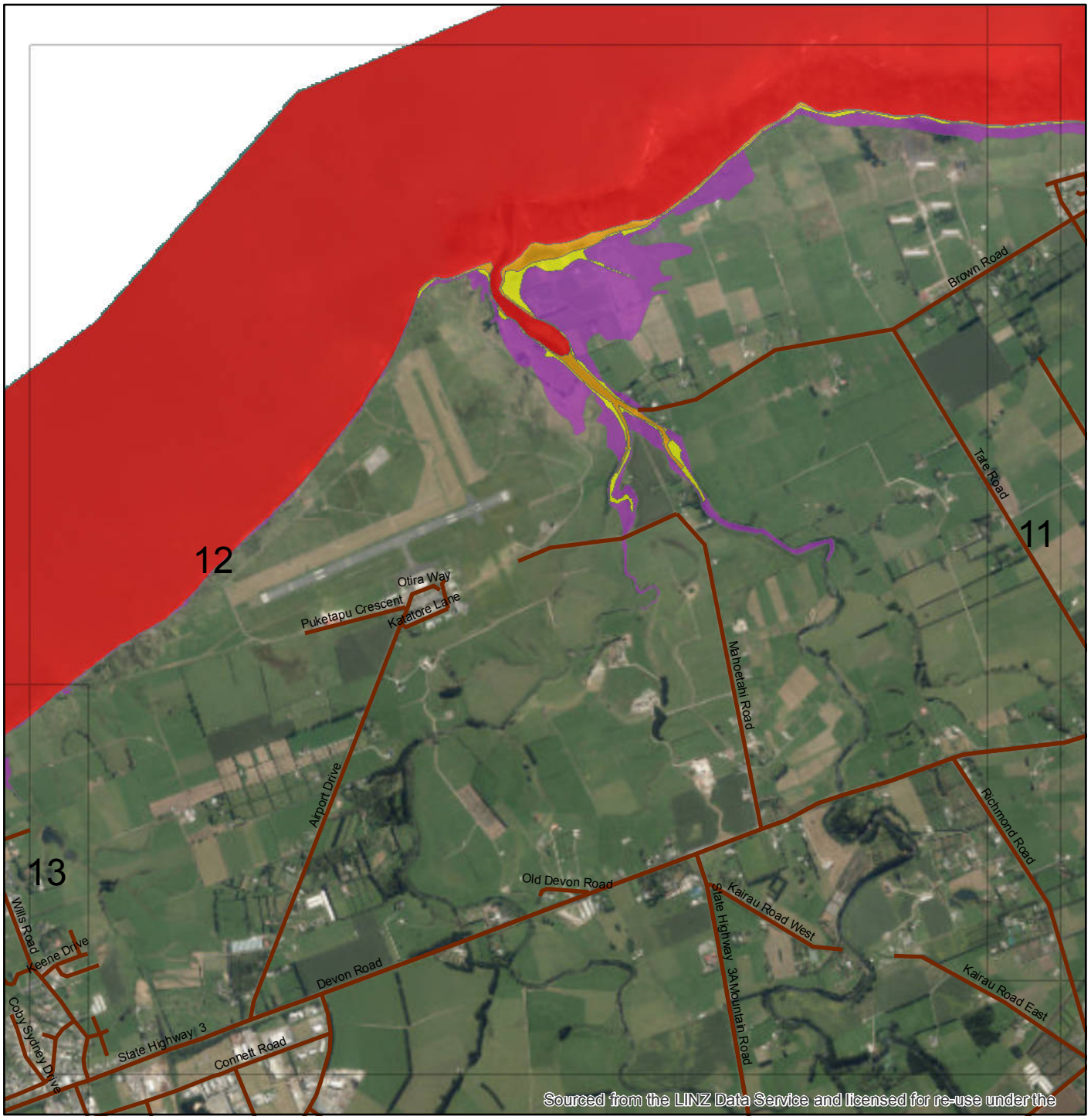
Map created on June 15, 2017



Taranaki Region
Tsunami Inundation Map

Map 12
Waiongana Stream

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

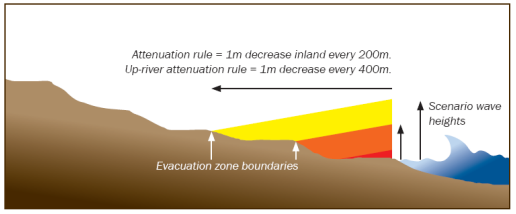
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

0 500 1,000 Meters

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DISCLAIMER
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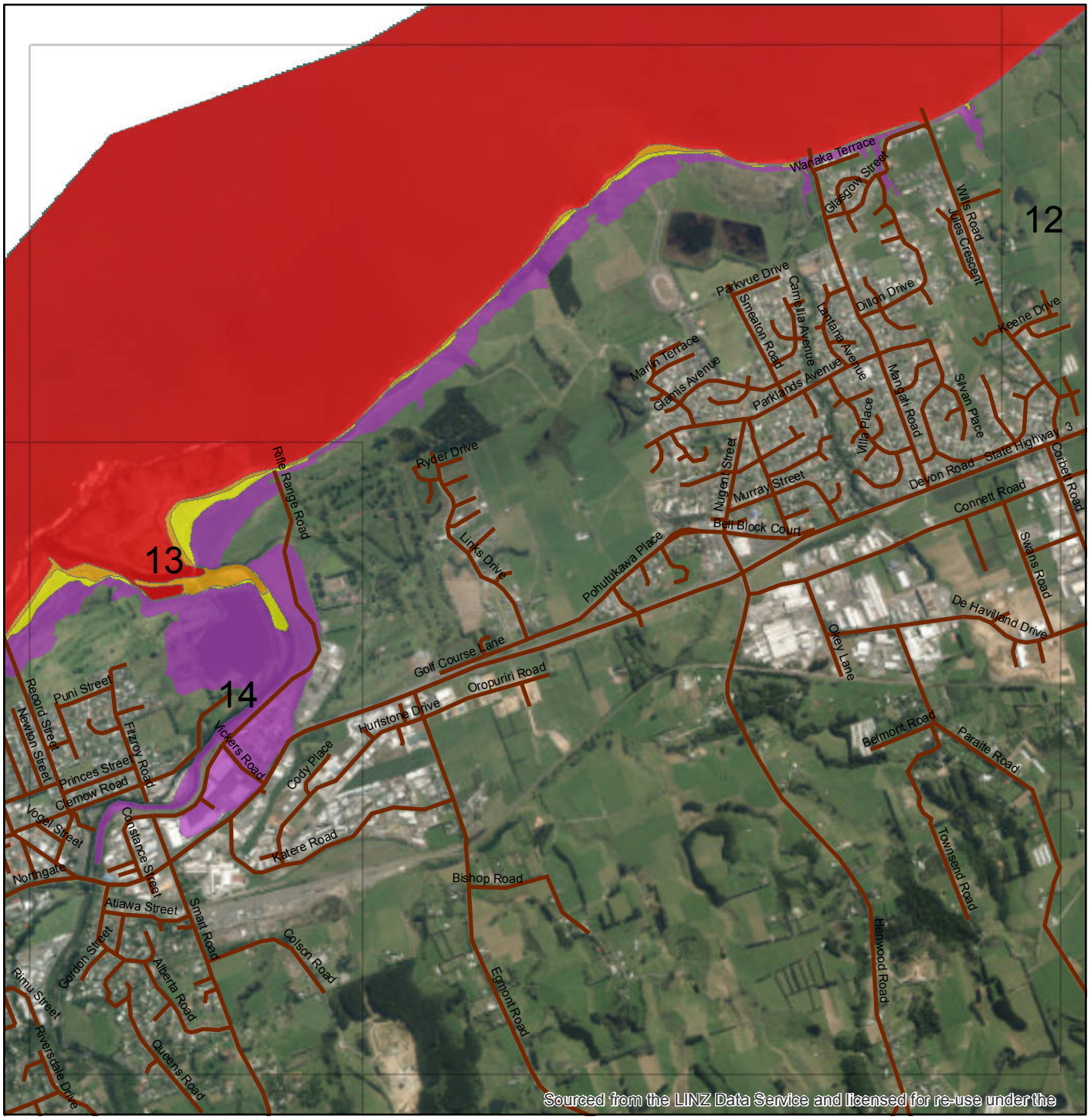
Map created on June 15, 2017

Taranaki Region
Tsunami Inundation Map

Map 13
Waiwhakaiho River



The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

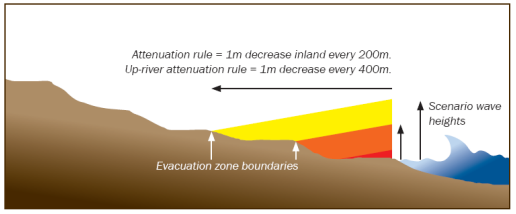
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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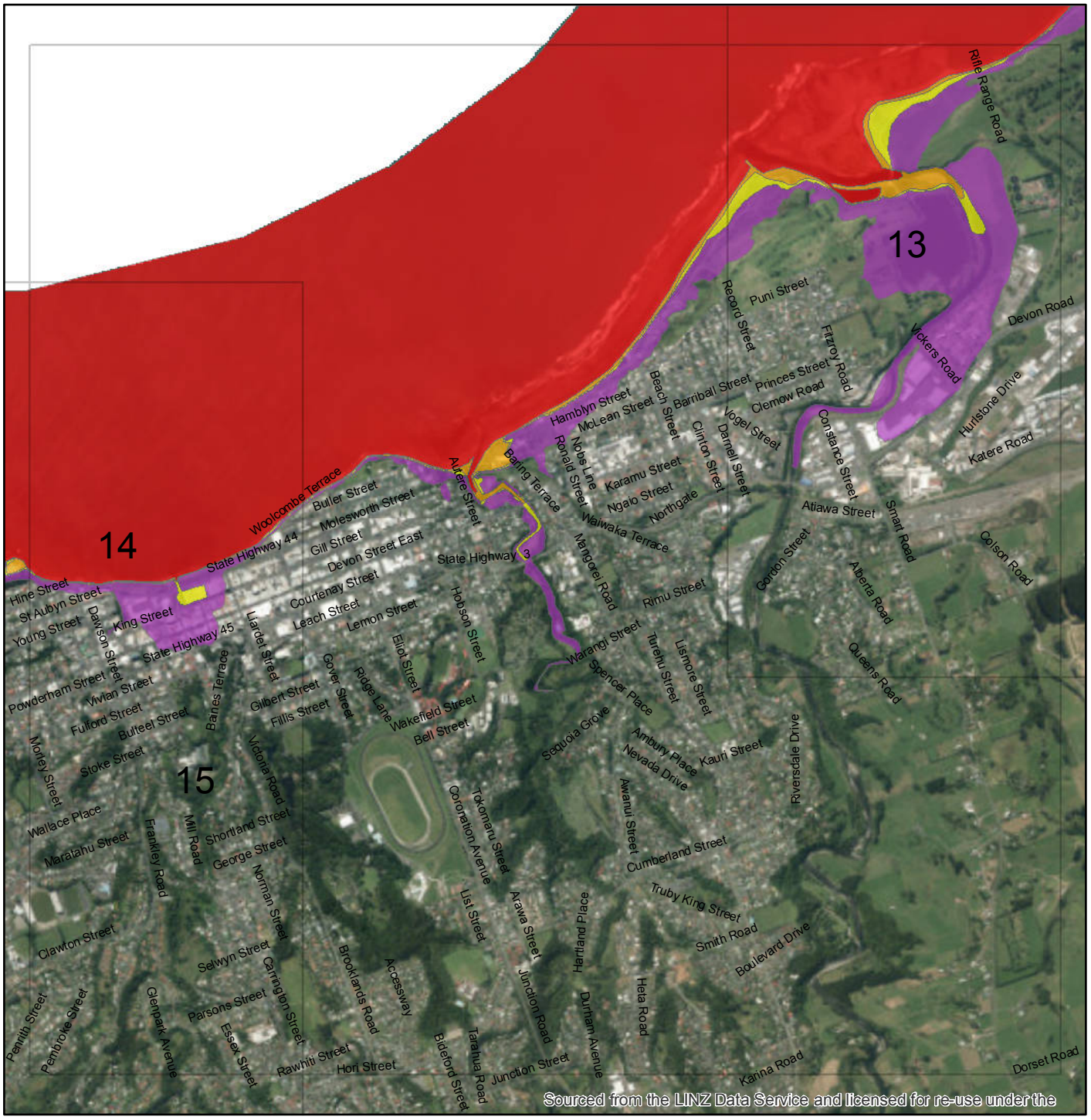
Map created on June 15, 2017



Taranaki Region
Tsunami Inundation Map

Map 14
New Plymouth

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

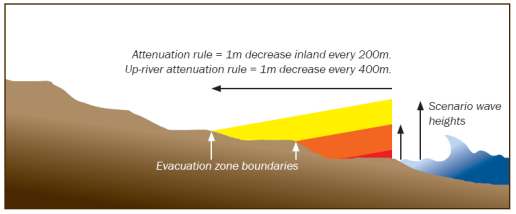
For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:

a. Marine Threat only (Red Zone)
b. 2 m wave (Orange zone)
c. 4 m wave (Yellow zone)
d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

0 500 1,000 Meters

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Map created on June 15, 2017

Taranaki Region
Tsunami Inundation Map

Map 15
Port Taranaki

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

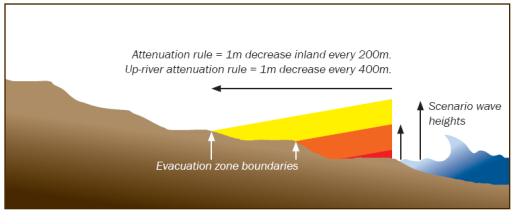
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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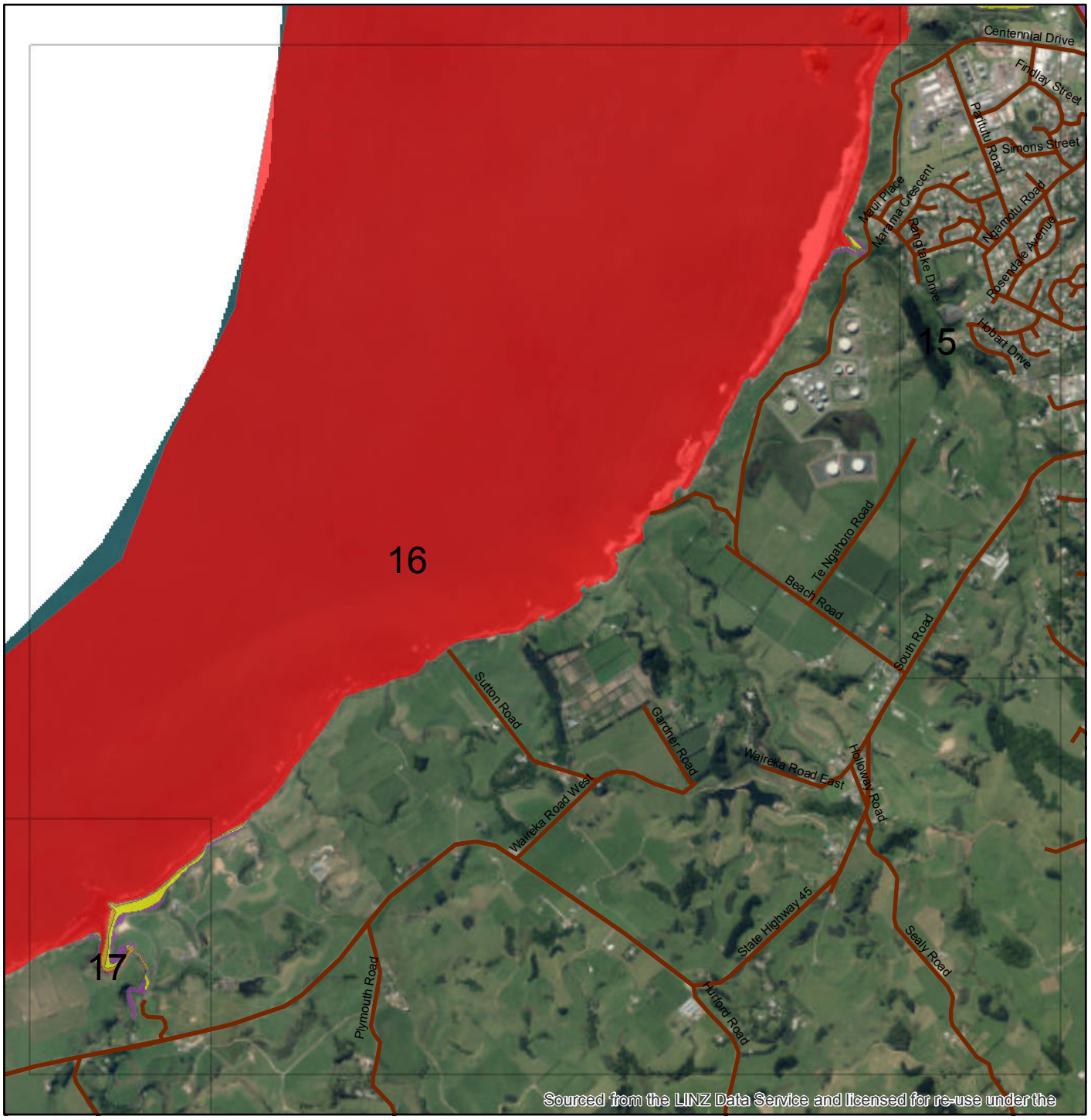
Map created on June 15, 2017



Taranaki Region
Tsunami Inundation Map

Map 16
Tapuae Stream

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

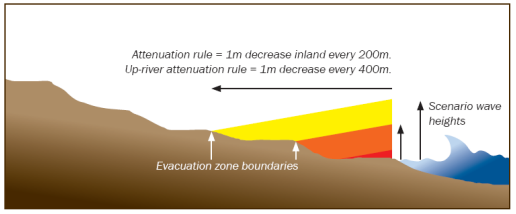
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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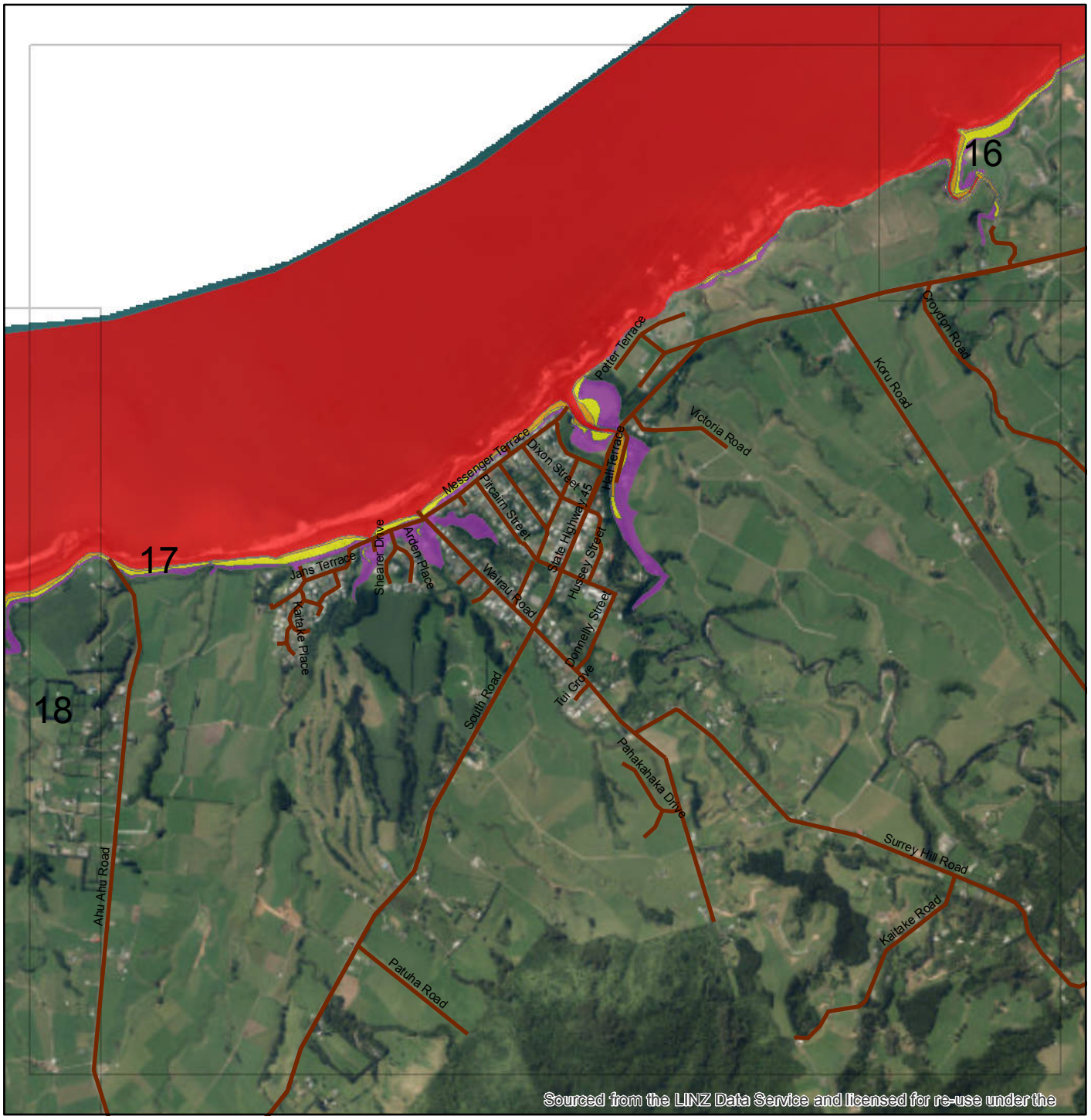
Map created on June 15, 2017



Taranaki Region
Tsunami Inundation Map

Map 17
Oakura

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

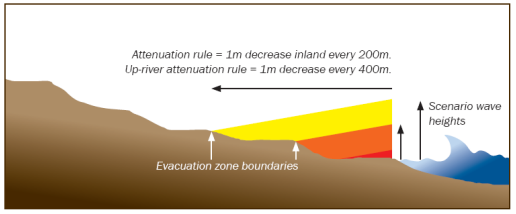
For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:

a. Marine Threat only (Red Zone)
b. 2 m wave (Orange zone)
c. 4 m wave (Yellow zone)
d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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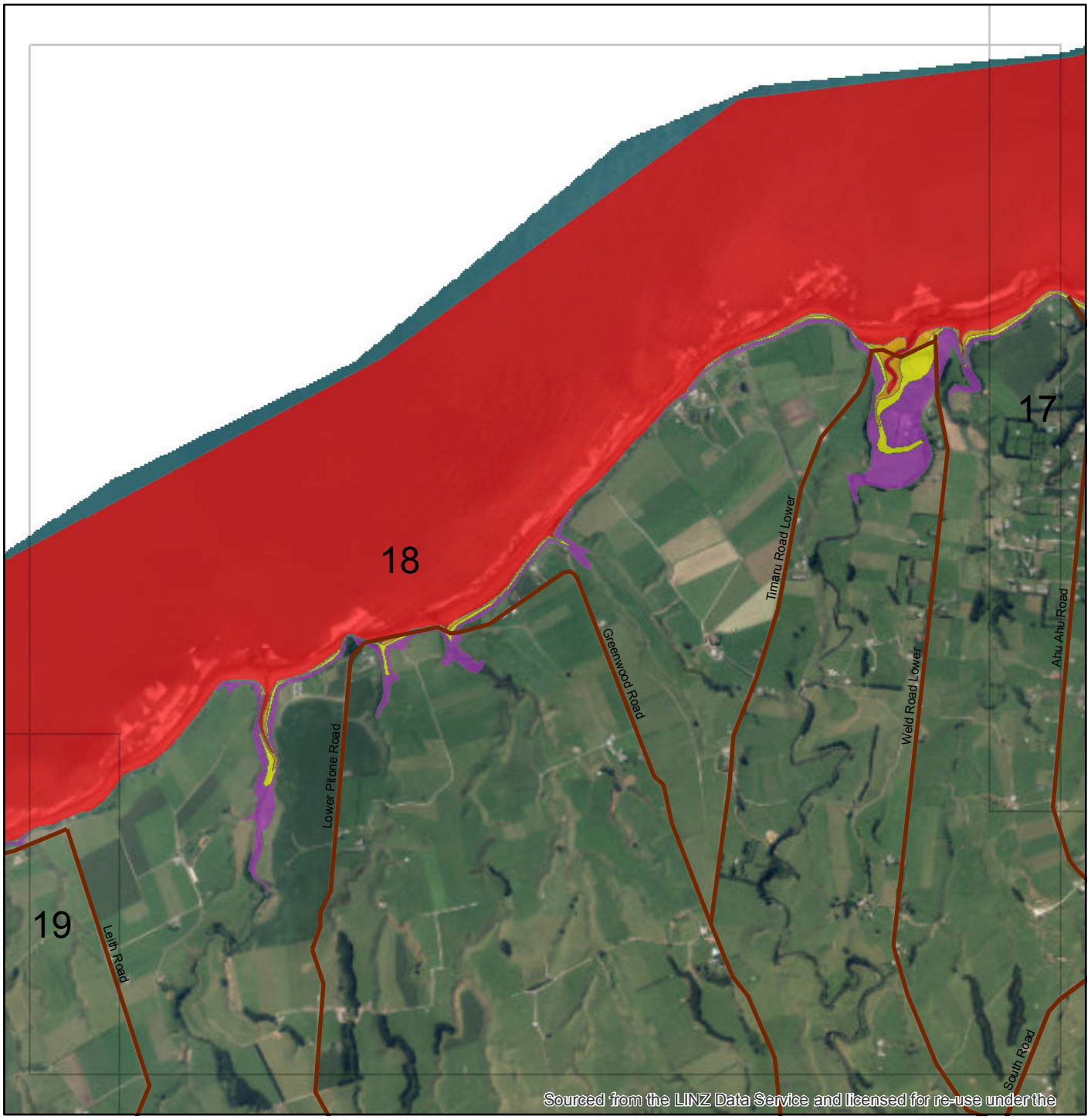
Map created on June 15, 2017

Taranaki Region
Tsunami Inundation Map

Map 18
Timaru Stream



The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

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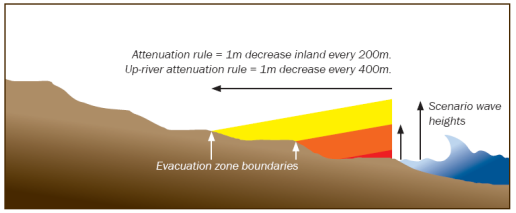
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



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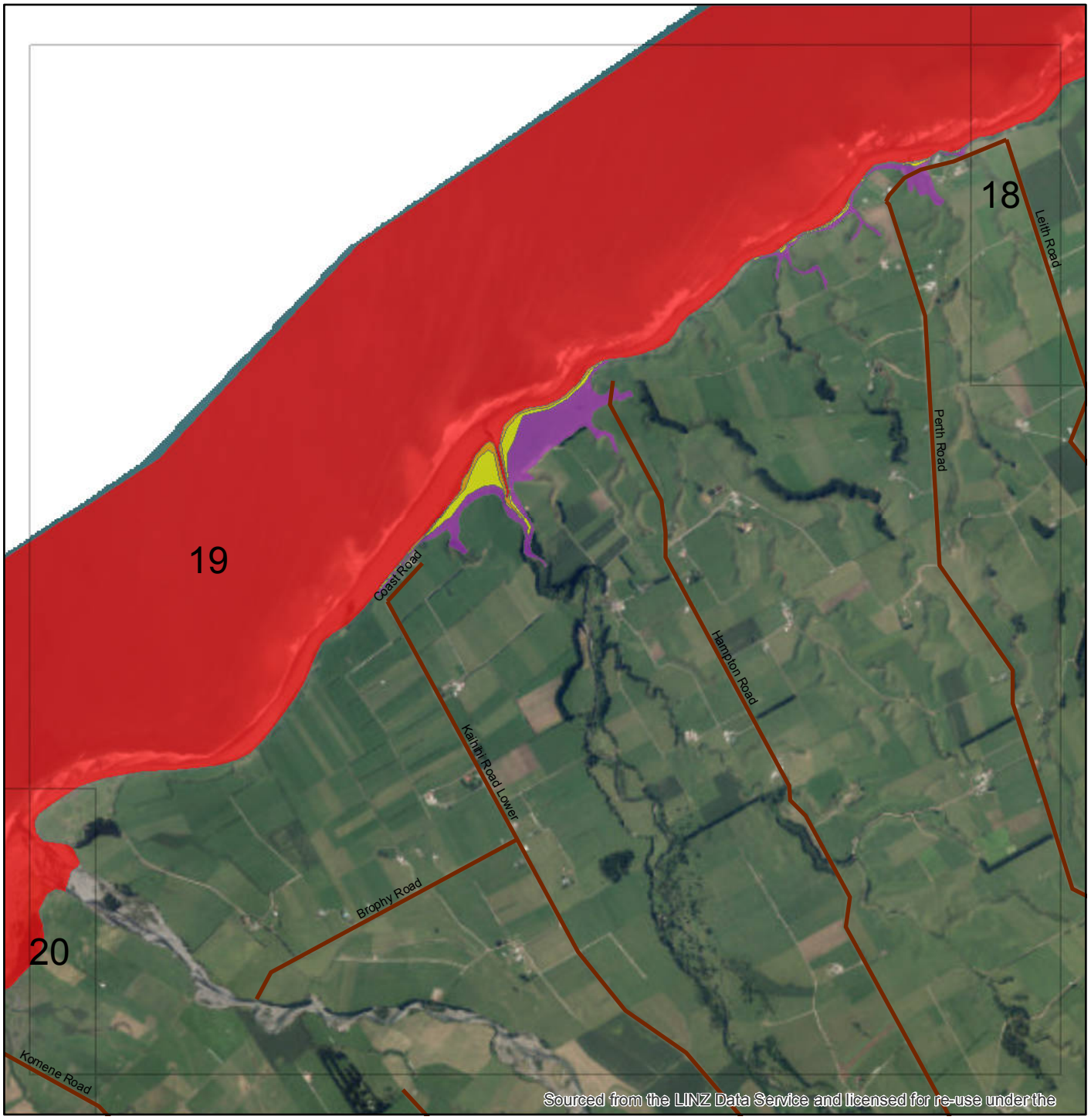


Taranaki Region
Tsunami Inundation Map

Map 19
Kaihihi Stream

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

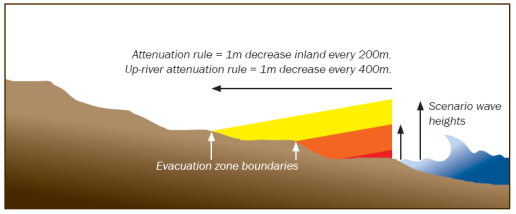
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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Map created on June 15, 2017

Taranaki Region
Tsunami Inundation Map

Map 20
Paora Road

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

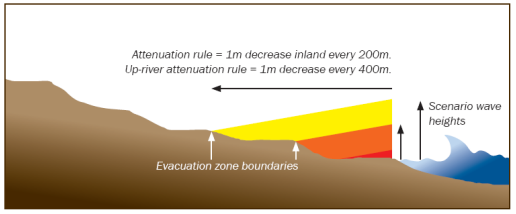
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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Map created on June 15, 2017

Taranaki Region
Tsunami Inundation Map

Map 21
Warea River

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

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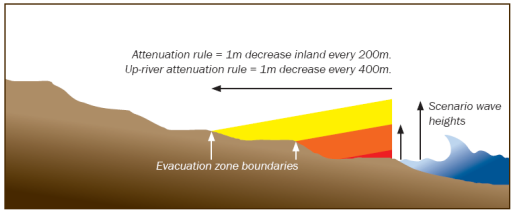
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

0 500 1,000 Meters

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Map created on June 15, 2017

Taranaki Region
Tsunami Inundation Map

Map 22
Cape Egmont

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

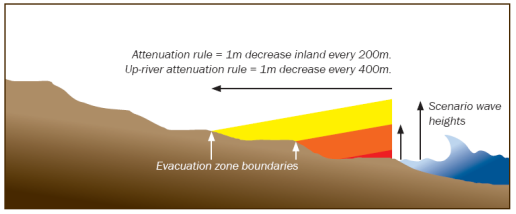
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



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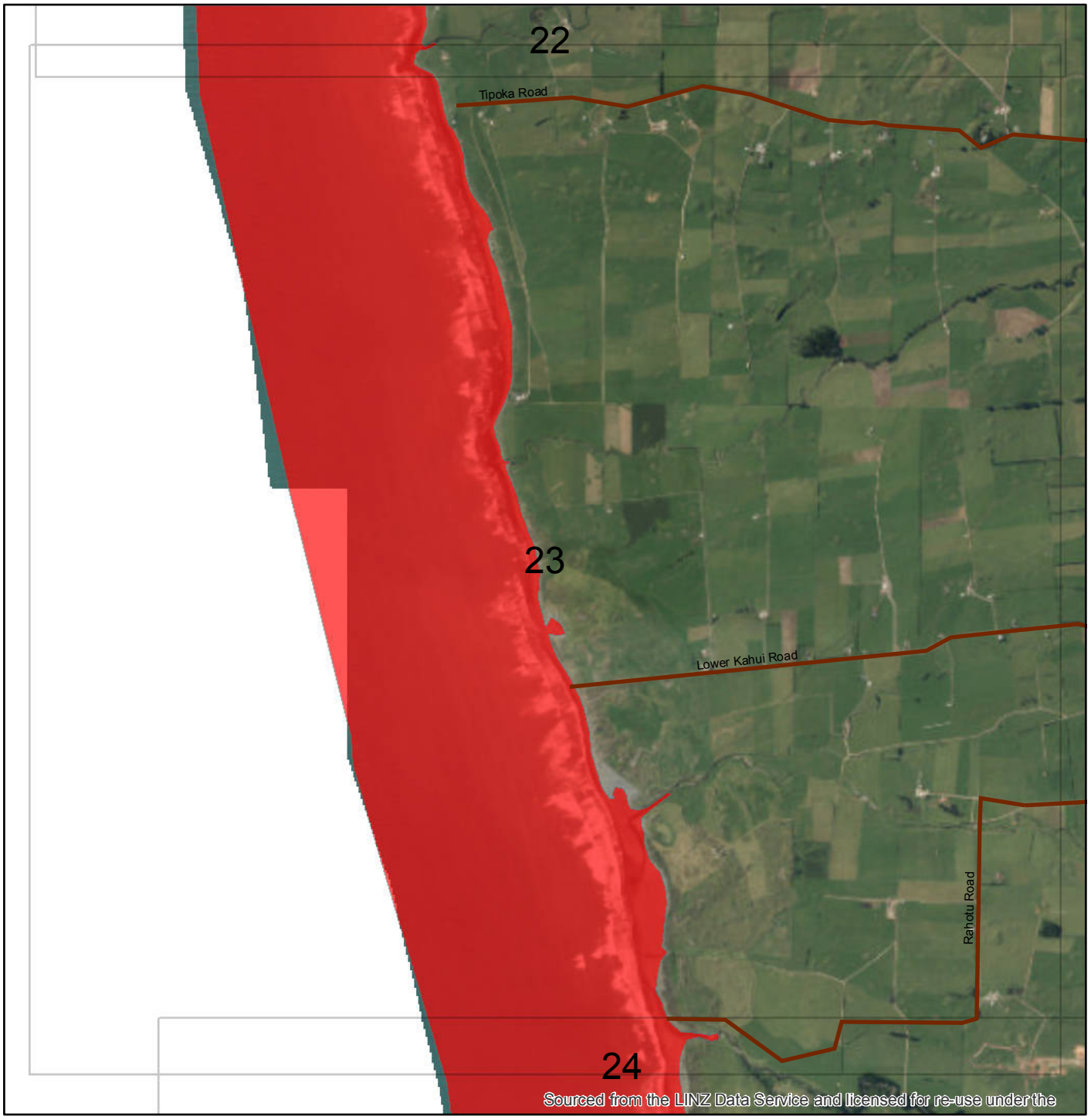


Taranaki Region
Tsunami Inundation Map

Map 23
Pungaereere Stream

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

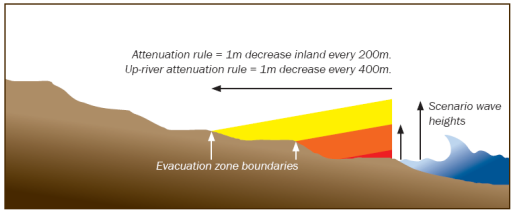
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

0 500 1,000 Meters

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DISCLAIMER
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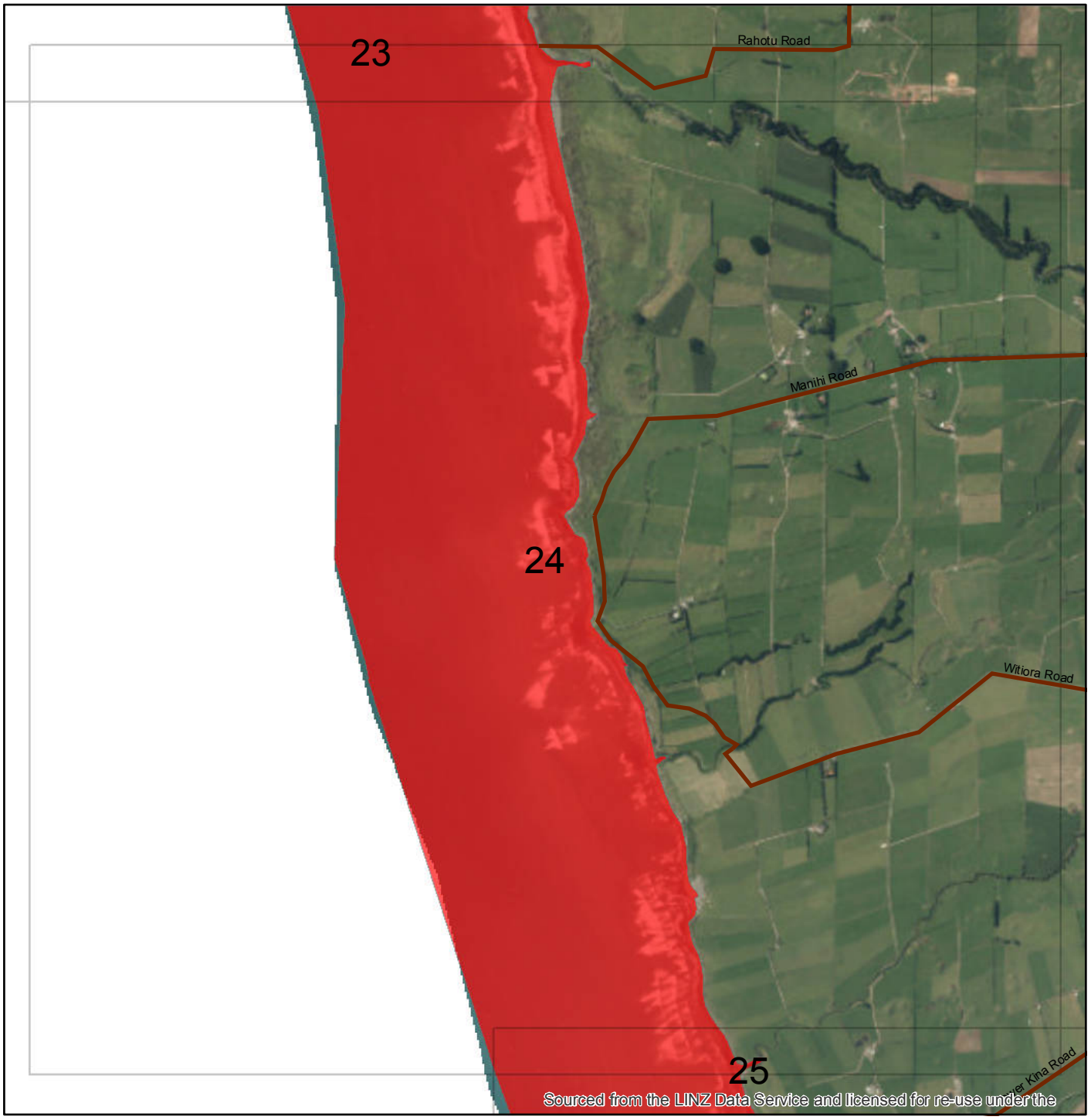
Map created on June 15, 2017



Taranaki Region
Tsunami Inundation Map

Map 24
Moutoti Stream

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

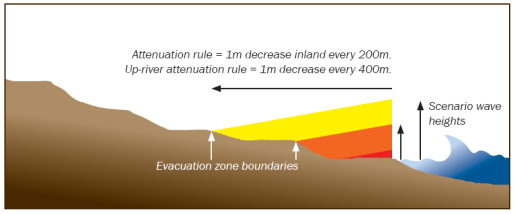
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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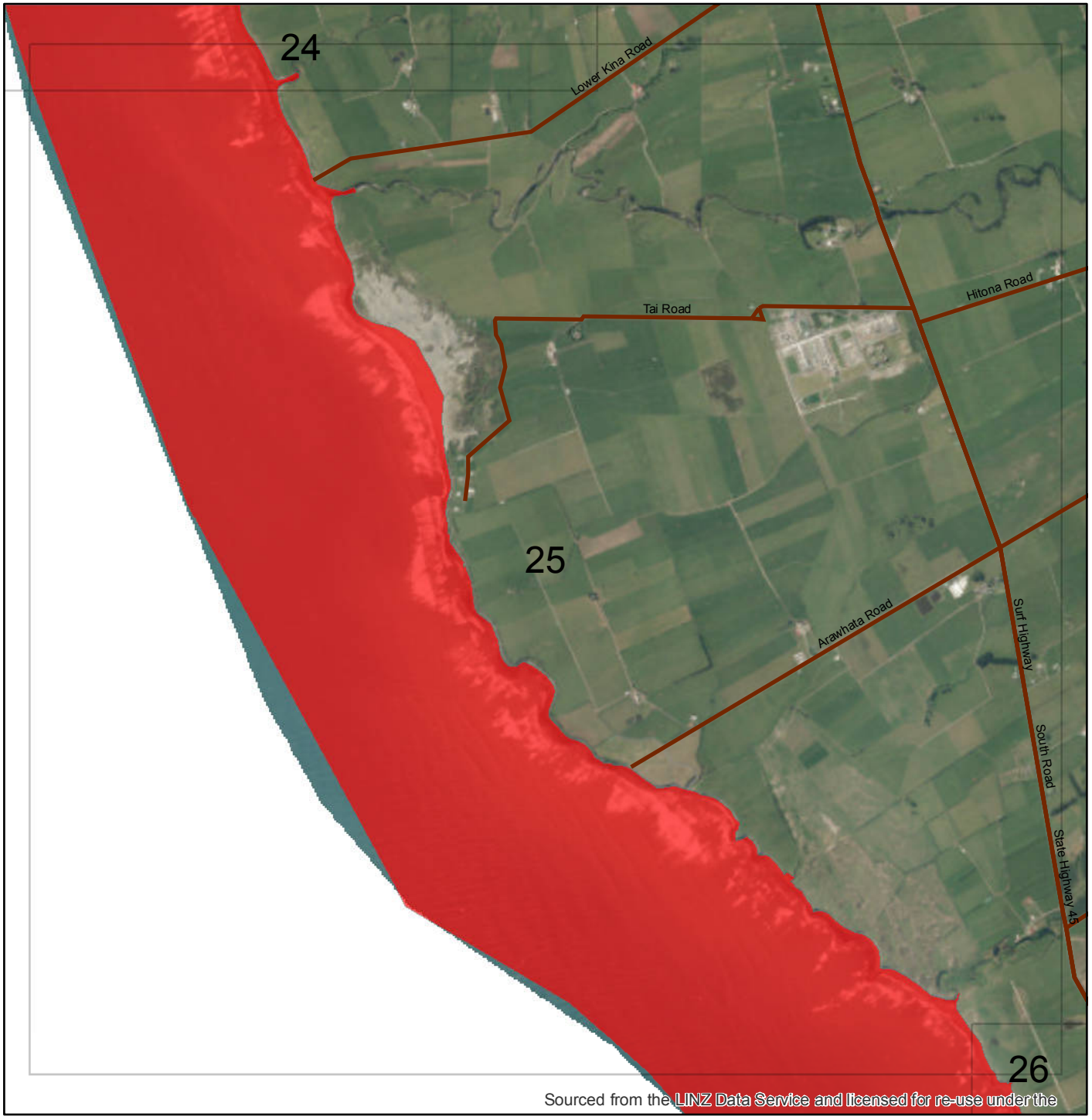
Map created on June 15, 2017



Taranaki Region
Tsunami Inundation Map

Map 25
Arawhata Stream

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

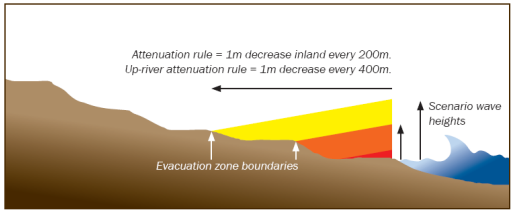
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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Map created on June 15, 2017

Taranaki Region
Tsunami Inundation Map

Map 26
Opunake

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

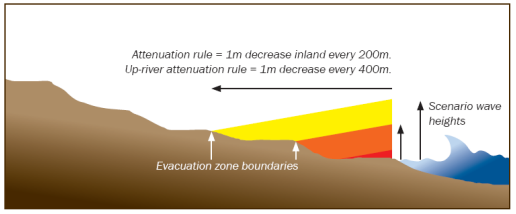
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

0 500 1,000 Meters

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Map created on June 15, 2017

Taranaki Region
Tsunami Inundation Map

Map 27
Punehu Stream

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

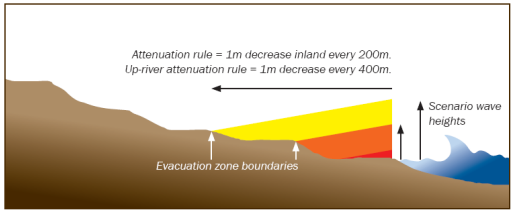
For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:

- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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Map created on June 15, 2017

Taranaki Region
Tsunami Inundation Map

Map 28
Oeo Stream

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

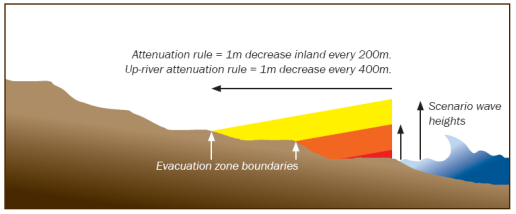
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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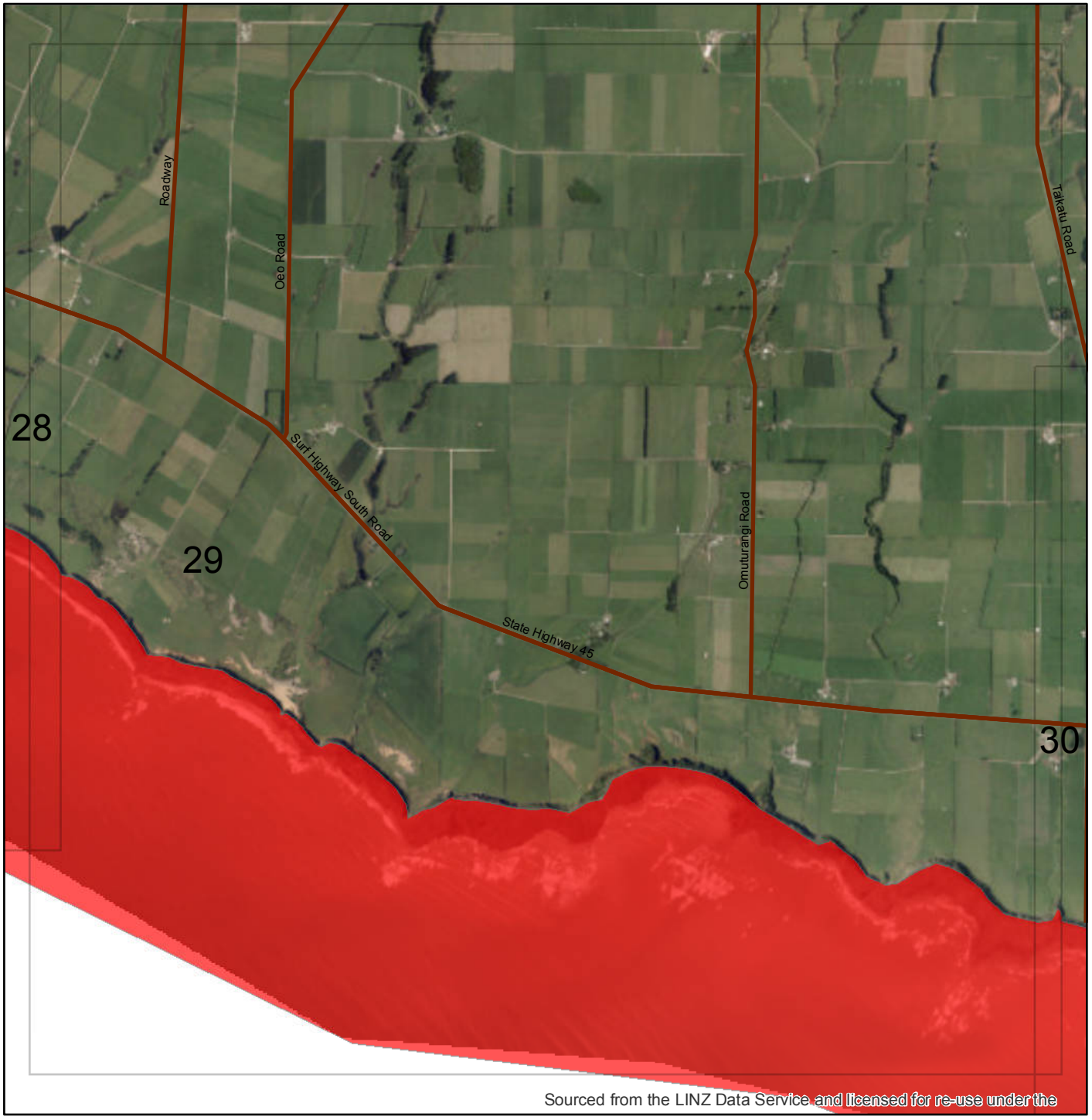


Taranaki Region
Tsunami Inundation Map

Map 29
Rawa Stream

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

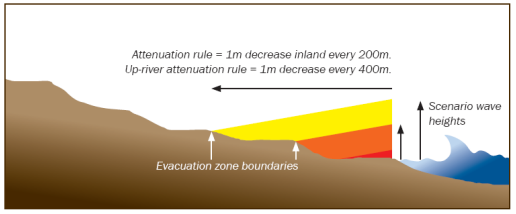
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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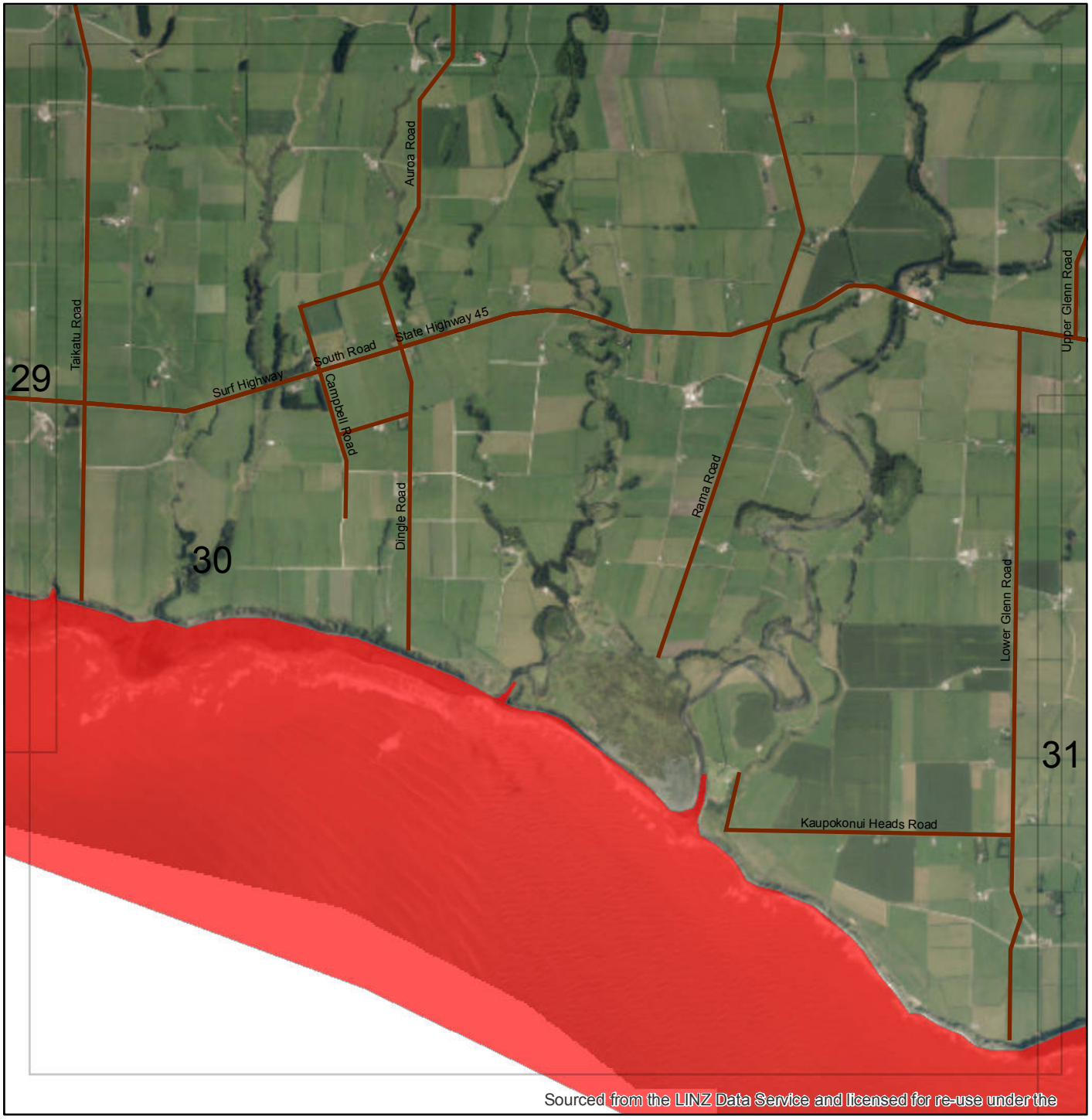


Taranaki Region
Tsunami Inundation Map

Map 30
Kaupokonui Stream

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

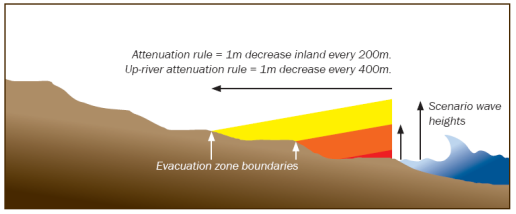
For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:

- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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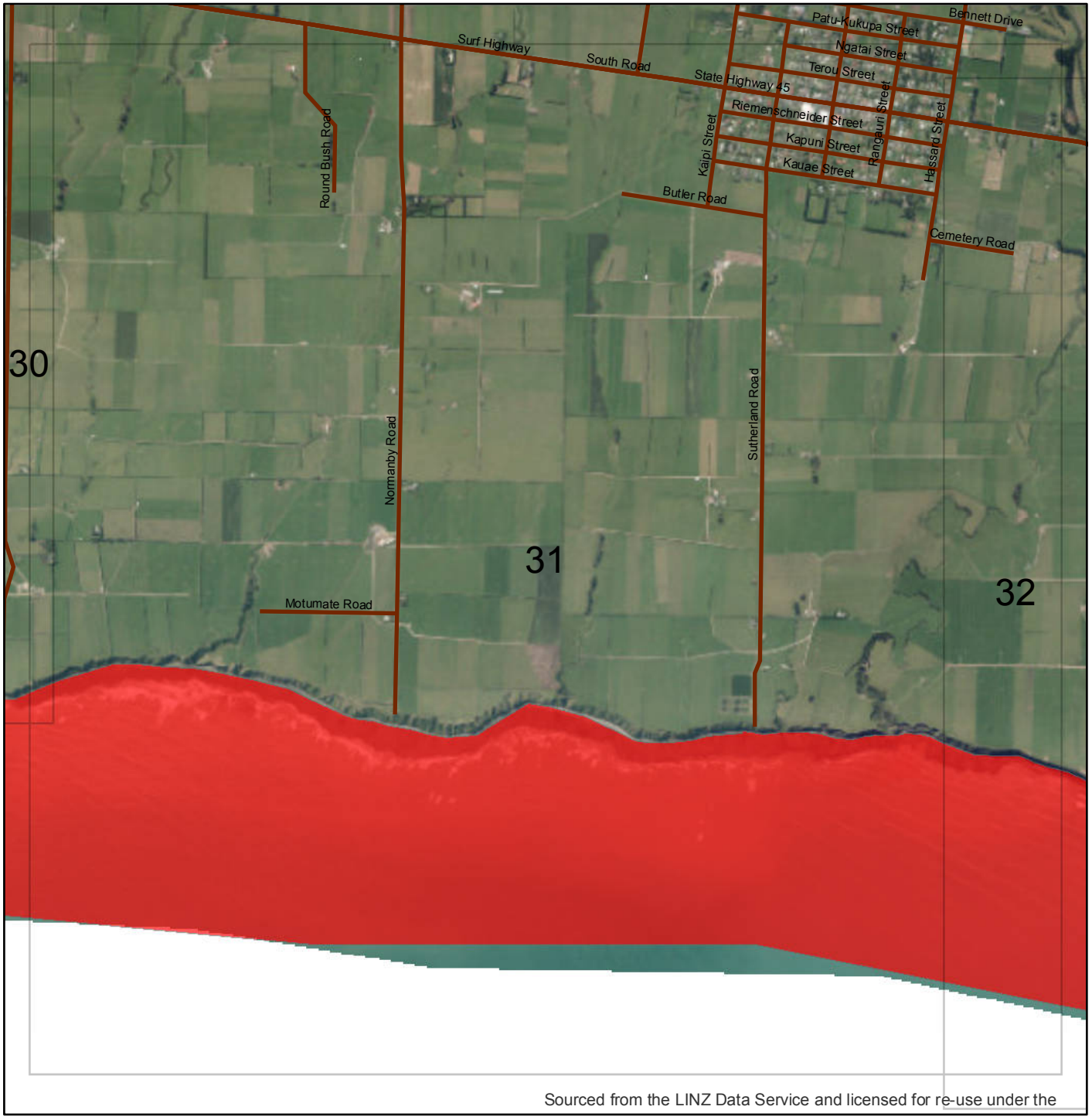
Taranaki Region
Tsunami Inundation Map

Map 31
Motumate Stream



The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

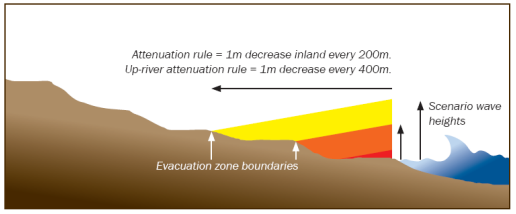
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



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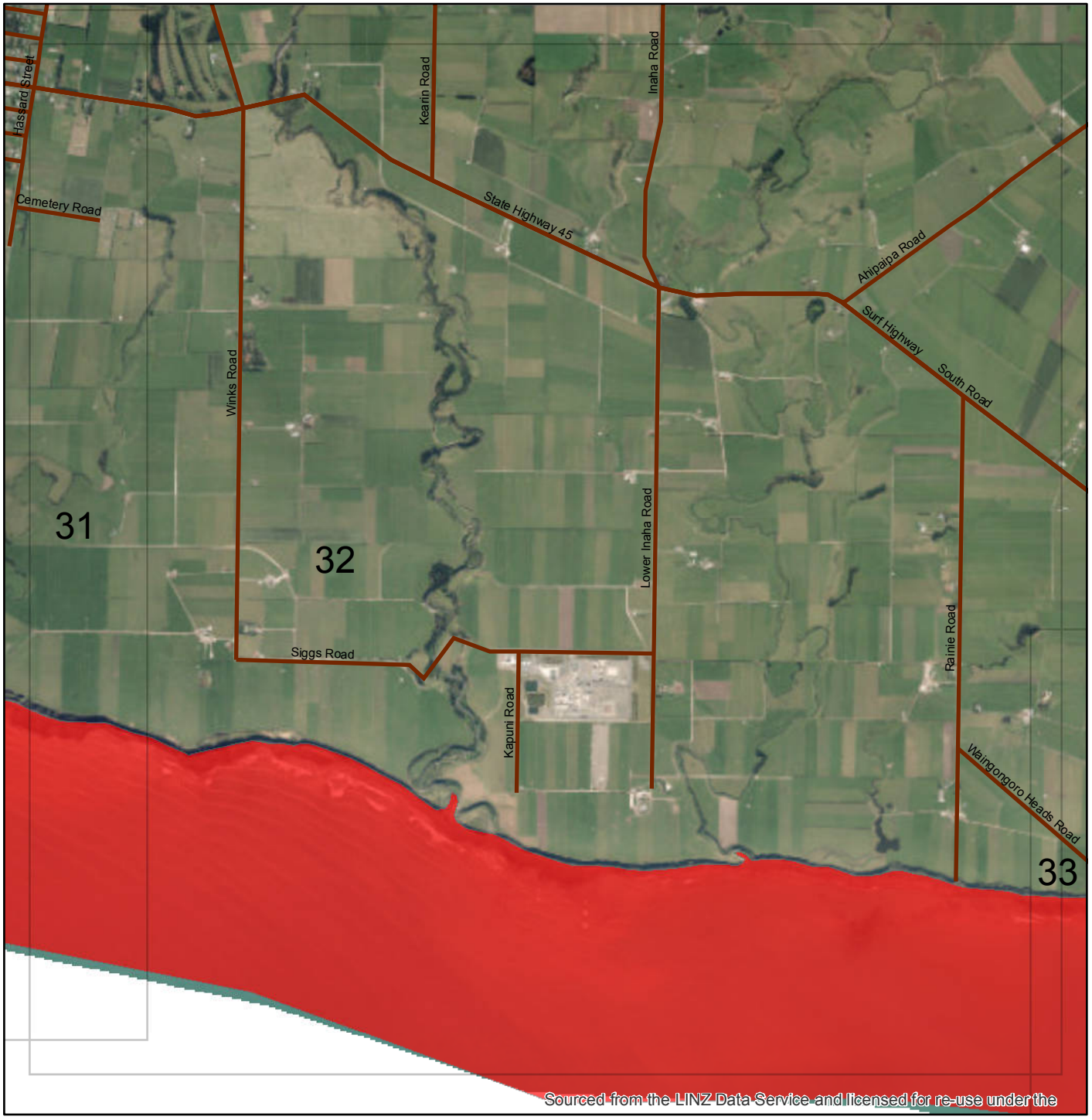


Taranaki Region
Tsunami Inundation Map

Map 32
Kapuni Stream

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

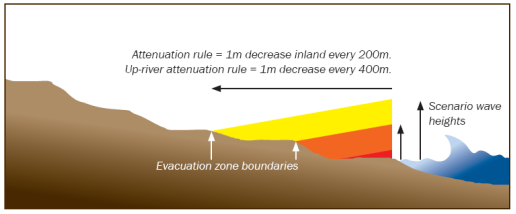
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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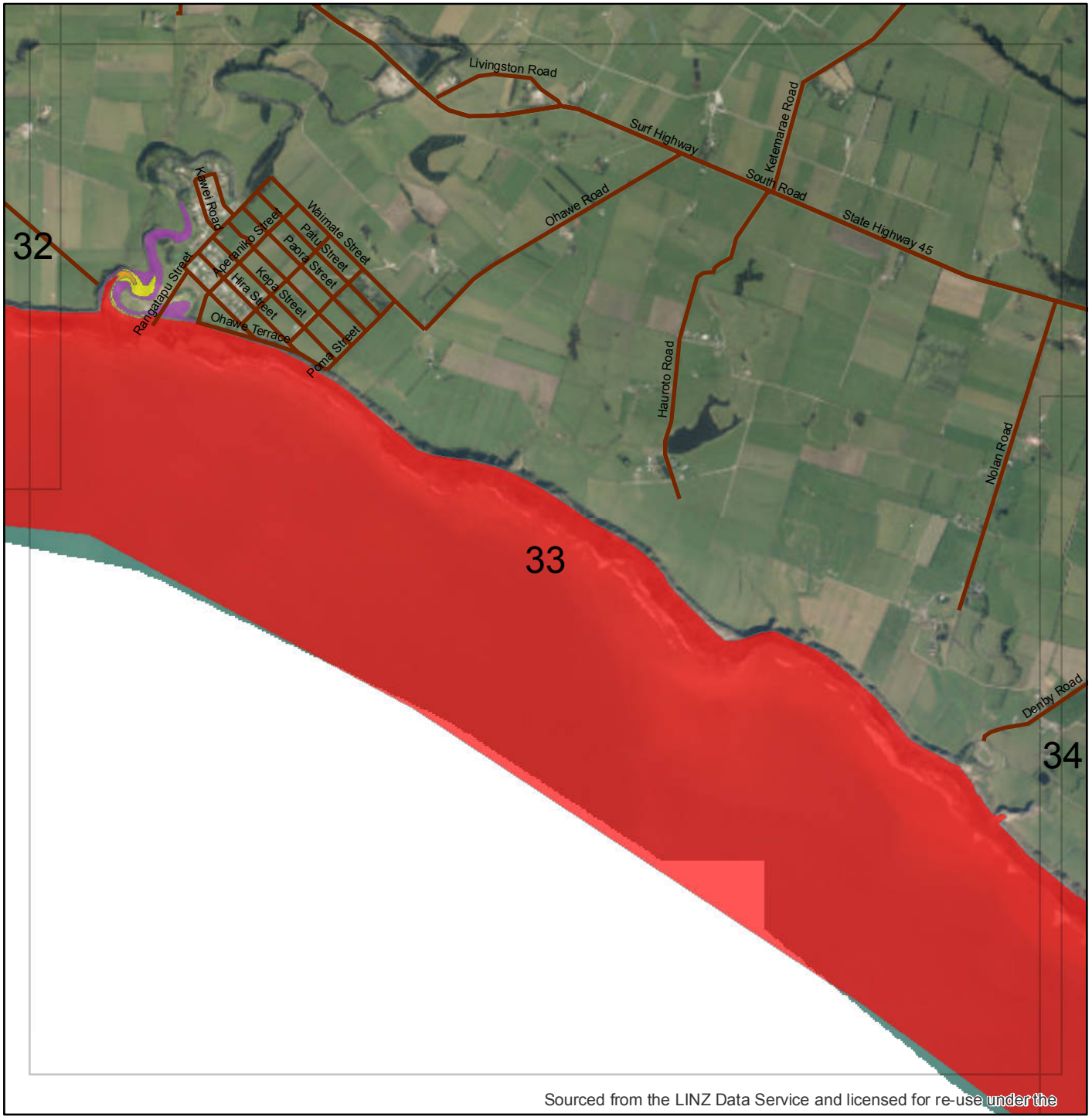
Map created on June 15, 2017

Taranaki Region
Tsunami Inundation Map

Map 33
Waingongoro Stream



The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

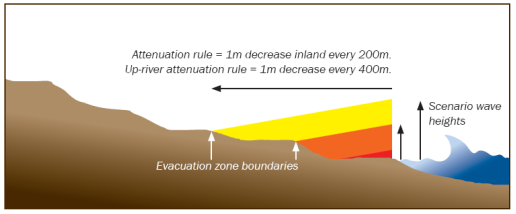
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



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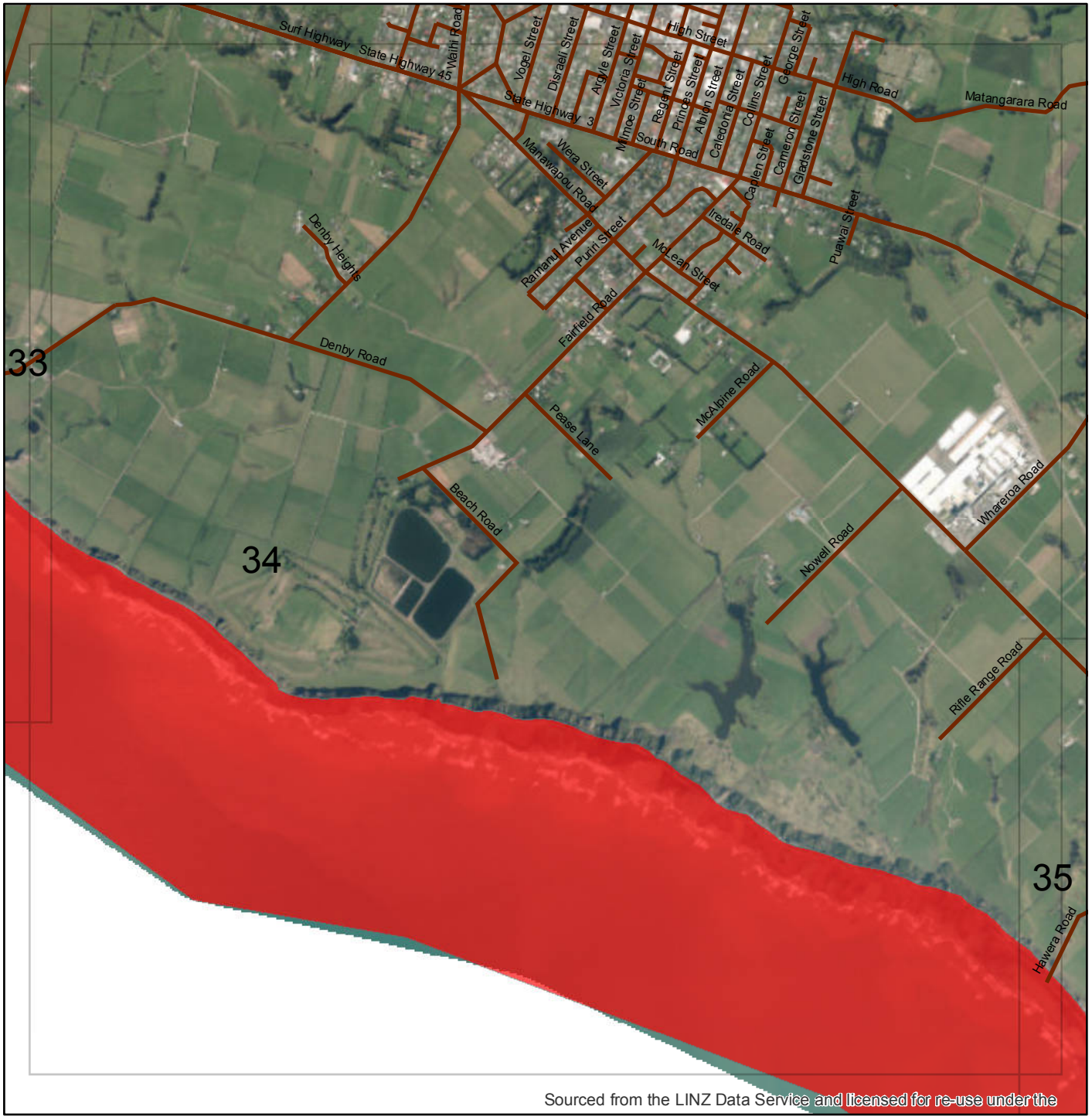


Taranaki Region
Tsunami Inundation Map

Map 34
Coast at Hawera

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

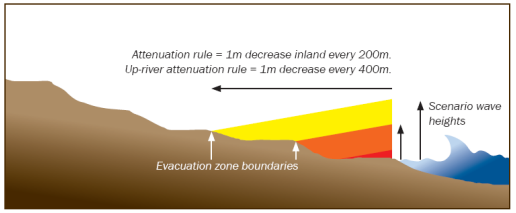
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

0 500 1,000 Meters

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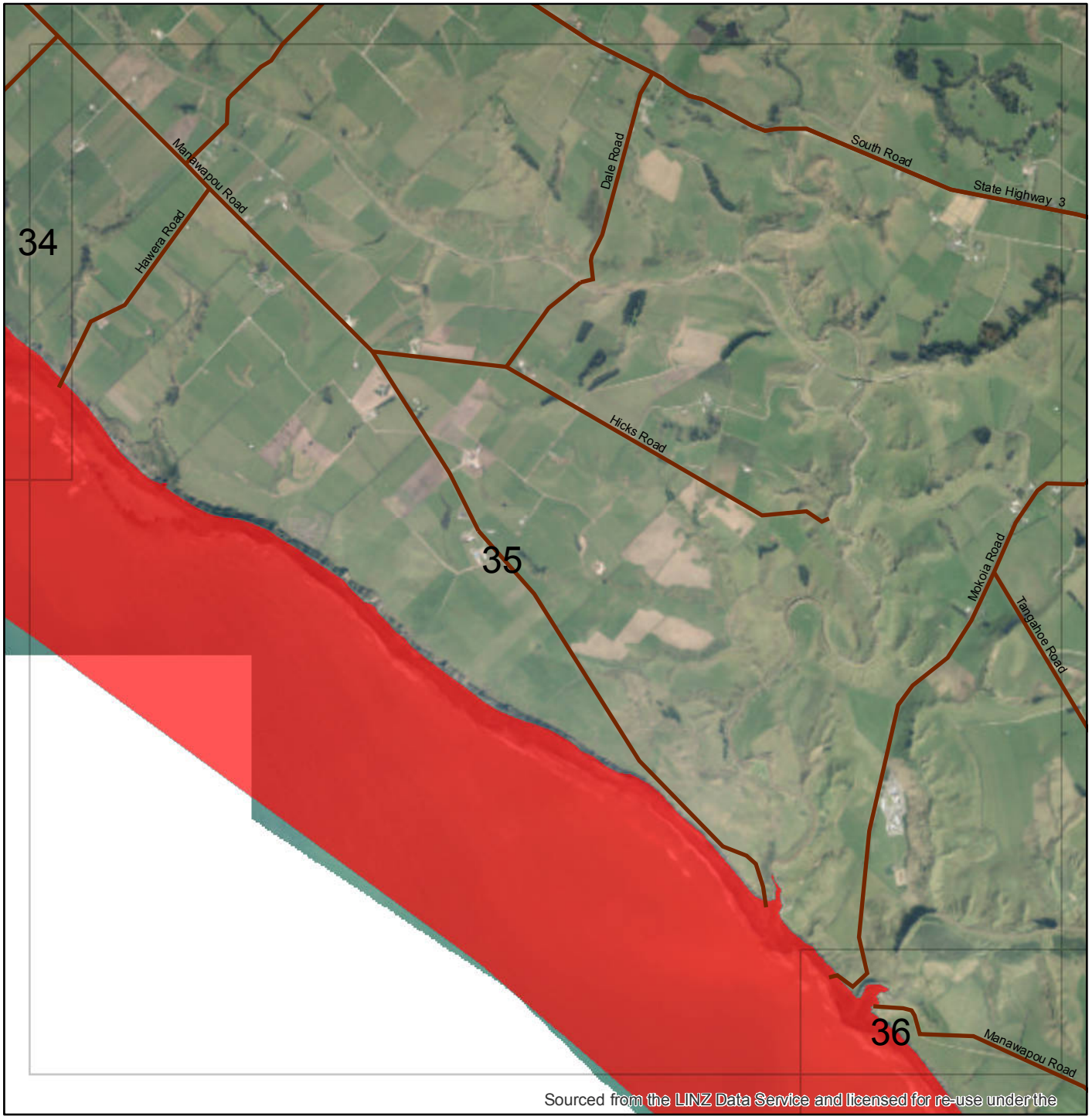
Map created on June 15, 2017



Taranaki Region
Tsunami Inundation Map

Map 35
Tangahoe River

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

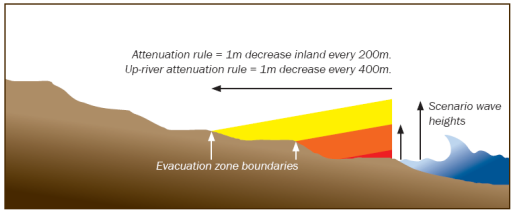
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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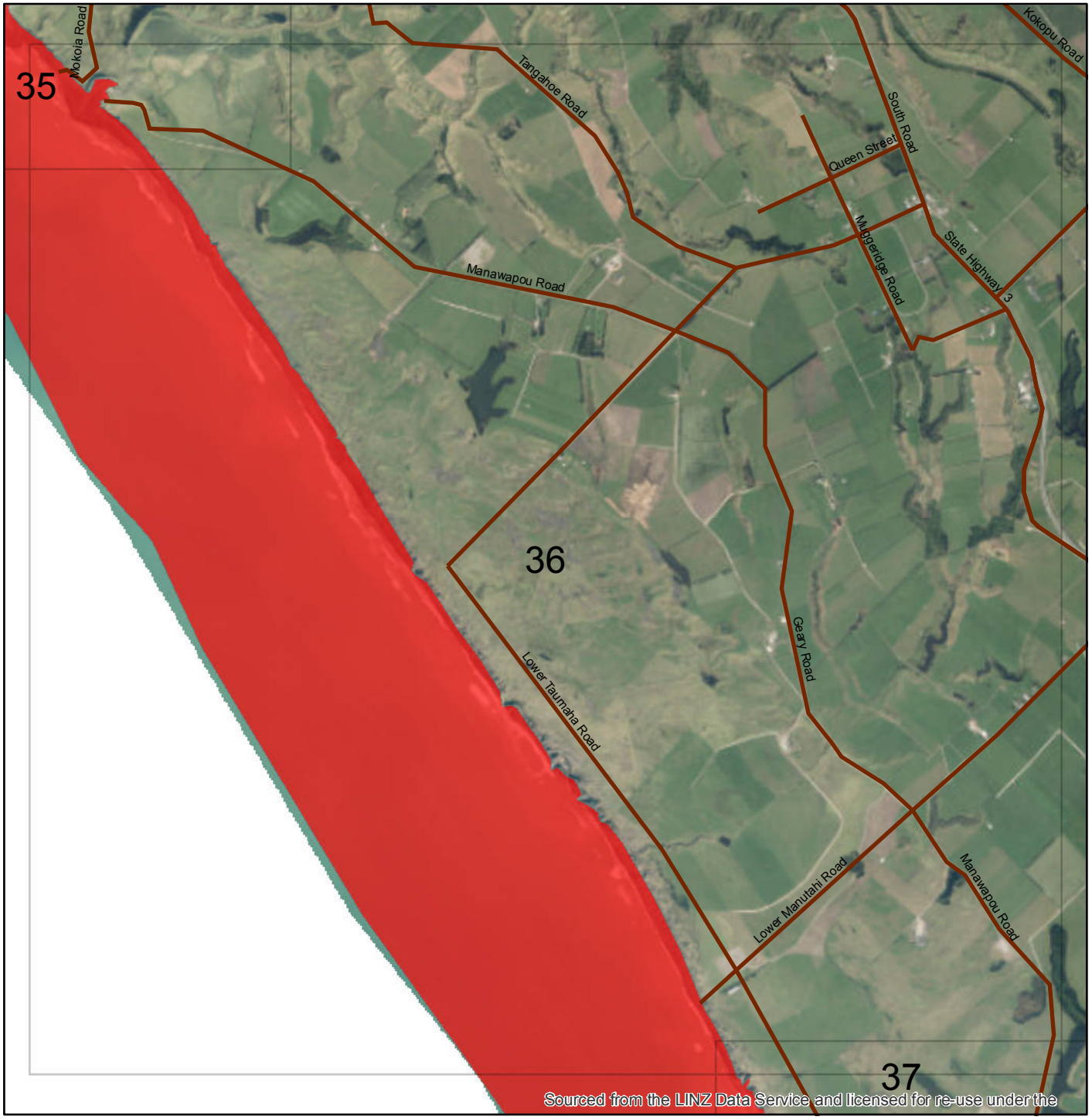
Map created on June 15, 2017



Taranaki Region
Tsunami Inundation Map

Map 36
Waikaikai Stream

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
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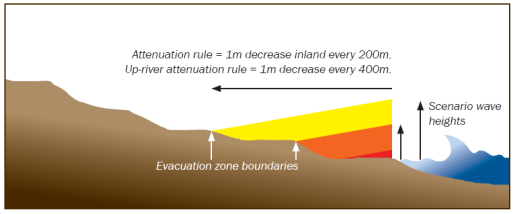
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

0 500 1,000 Meters

N

DISCLAIMER
The Taranaki Regional Council cannot guarantee that the data shown on this map is 100% accurate.

Map created on June 15, 2017

Taranaki Region
Tsunami Inundation Map

Map 37
Kaikura Stream

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

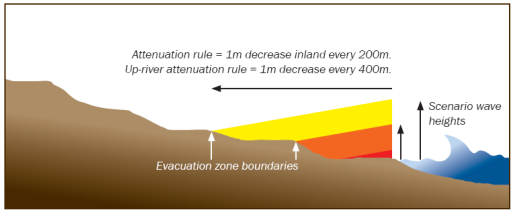
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

0 500 1,000 Meters

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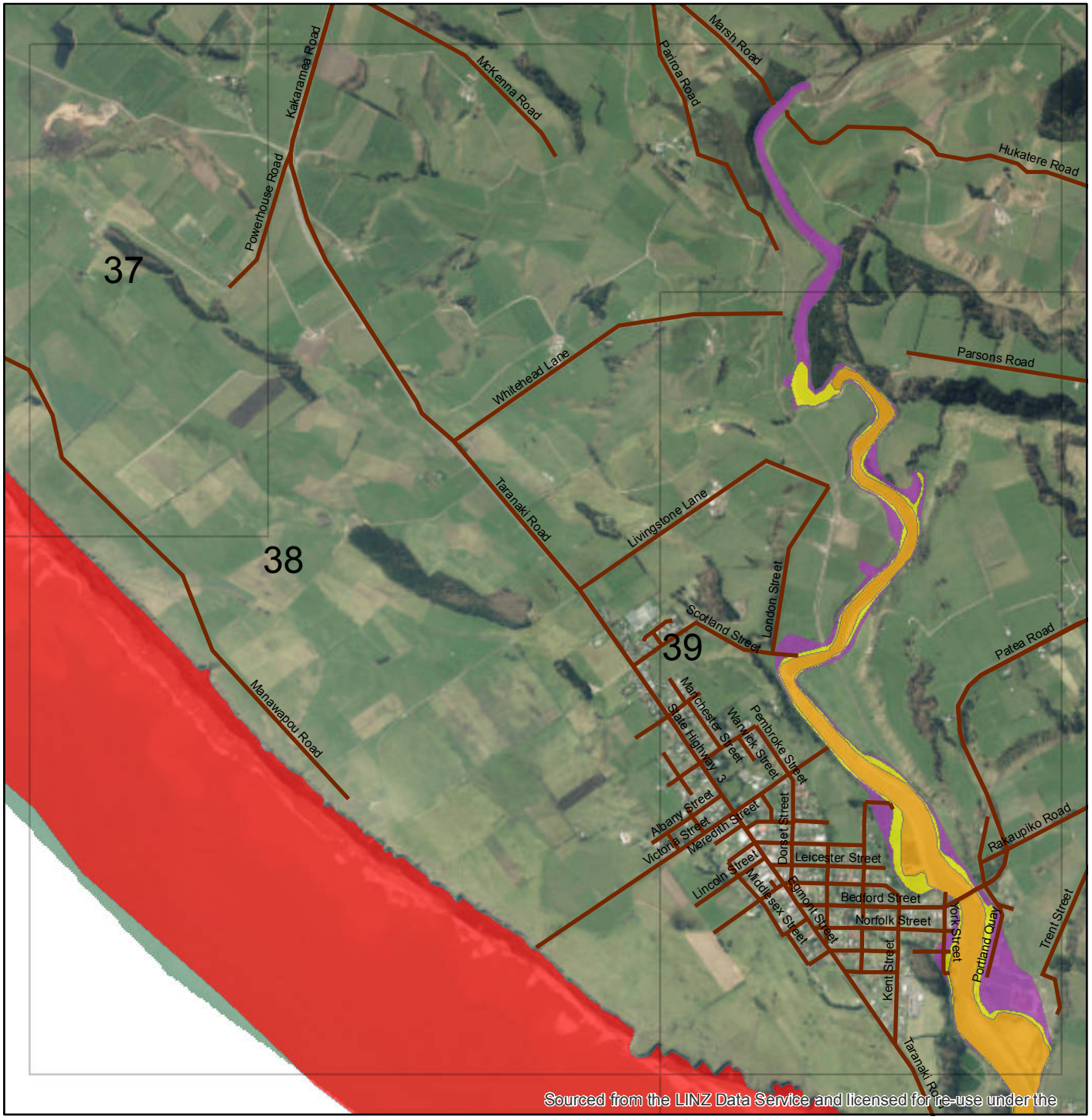

Taranaki Region
Tsunami Inundation Map

Map 38
Patea Part 1 of 2

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

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Attenuation of 1 m in height for every 50 m away from significant rivers.

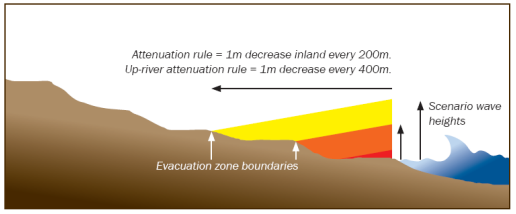
For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:

- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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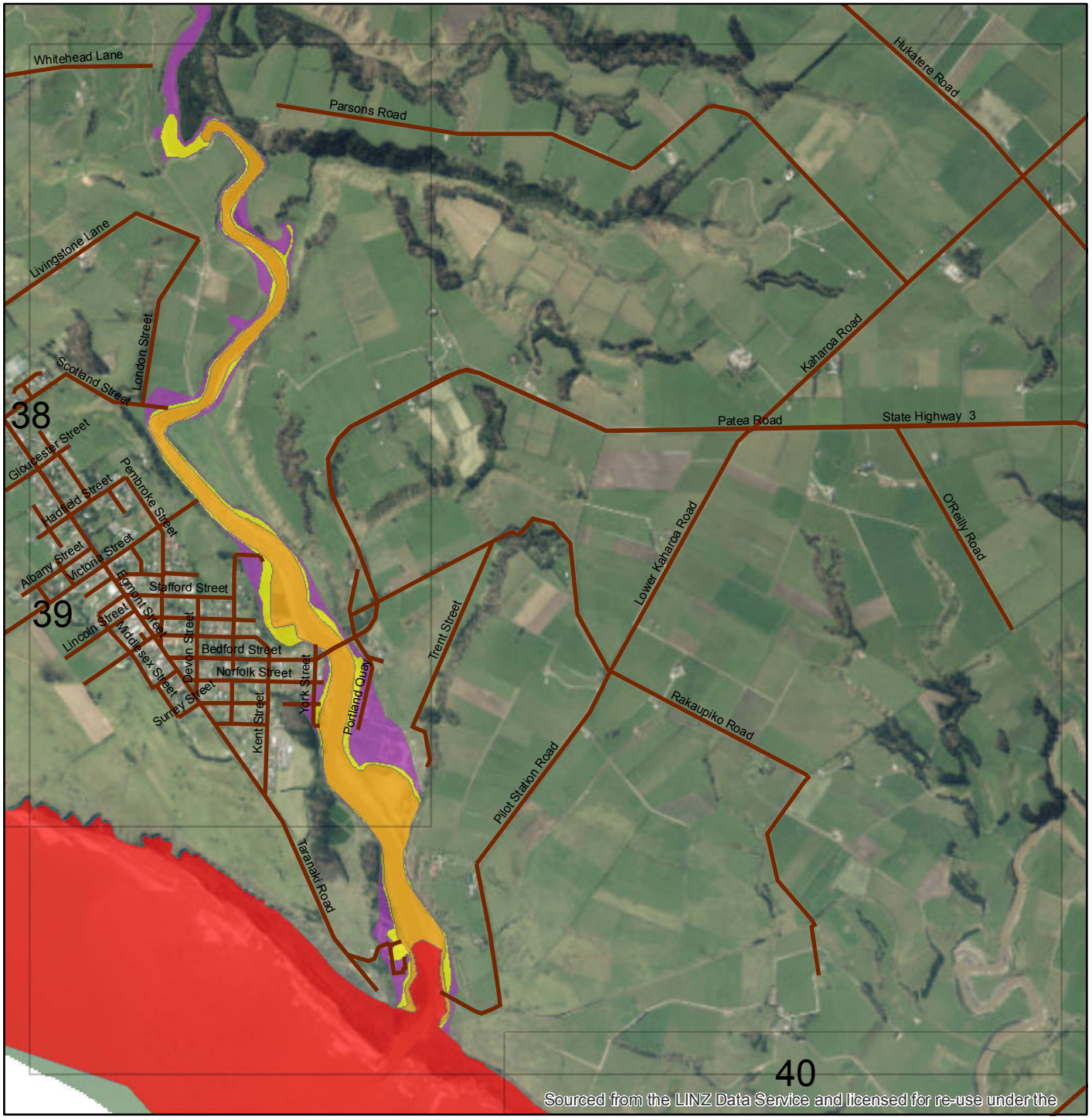
Map created on June 15, 2017



Taranaki Region
Tsunami Inundation Map

Map 39
Patea Part 2 of 2

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

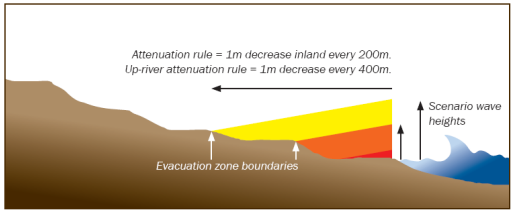
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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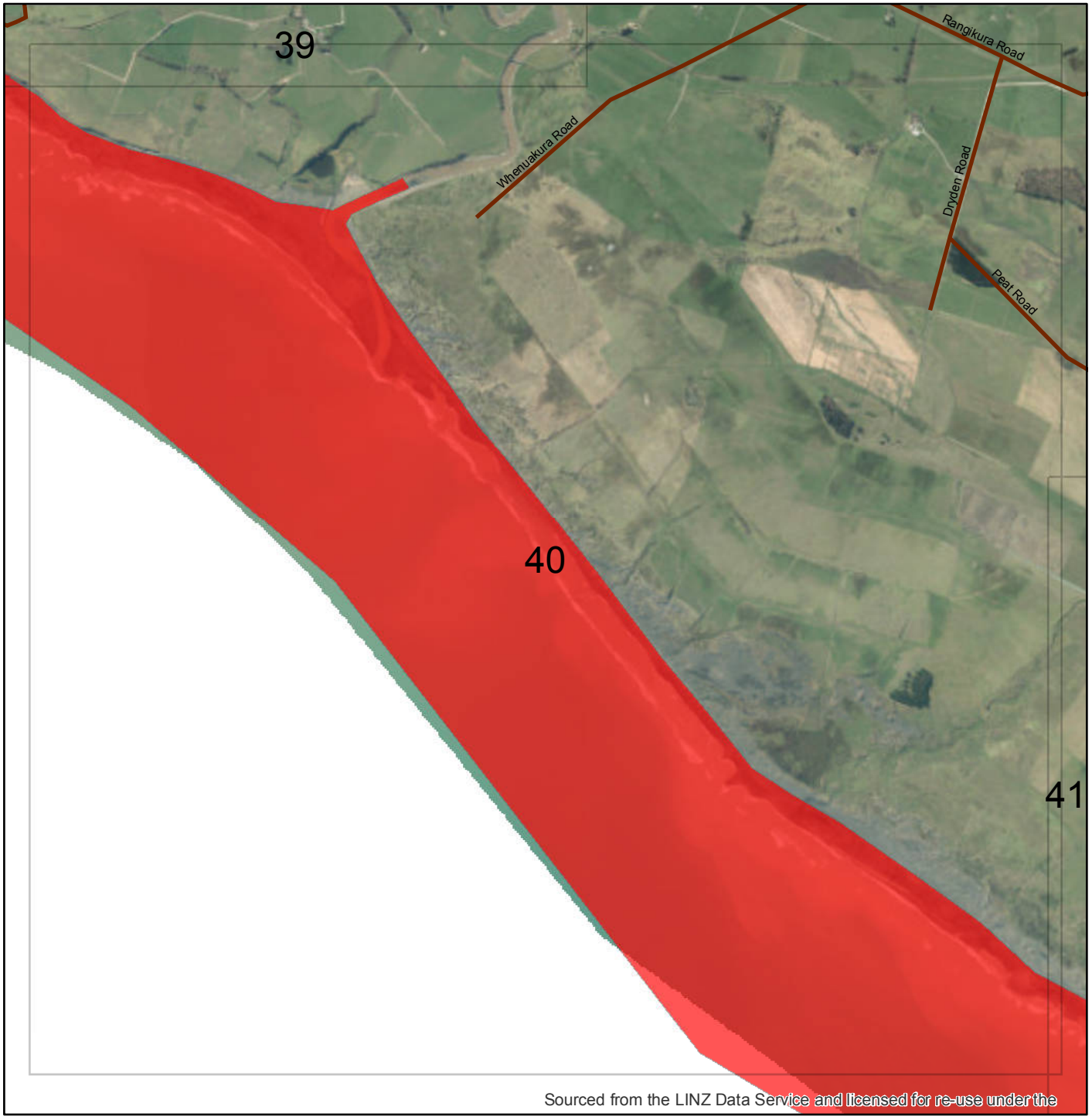


Taranaki Region
Tsunami Inundation Map

Map 40
Whenuakura River

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

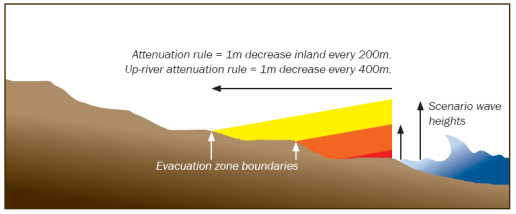
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

0 500 1,000 Meters

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Map created on June 15, 2017

Taranaki Region
Tsunami Inundation Map

Map 41
Waipipi Road

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

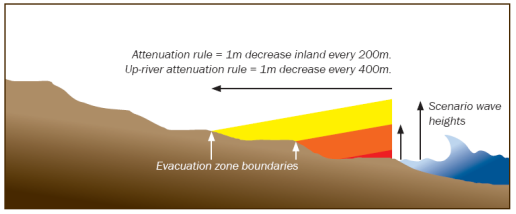
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

0 500 1,000 Meters

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Map created on June 15, 2017

Taranaki Region
Tsunami Inundation Map

Map 42
Waverly Beach Road

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

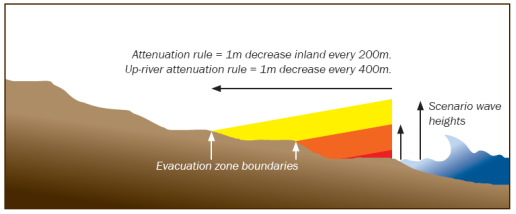
The GNS attenuation rules are:
Attenuation of 1 m in height for every 200 m inland over normal terrain,
Attenuation of 1 m in height for every 400 m inland up significant rivers,
Attenuation of 1 m in height for every 50 m away from significant rivers.

For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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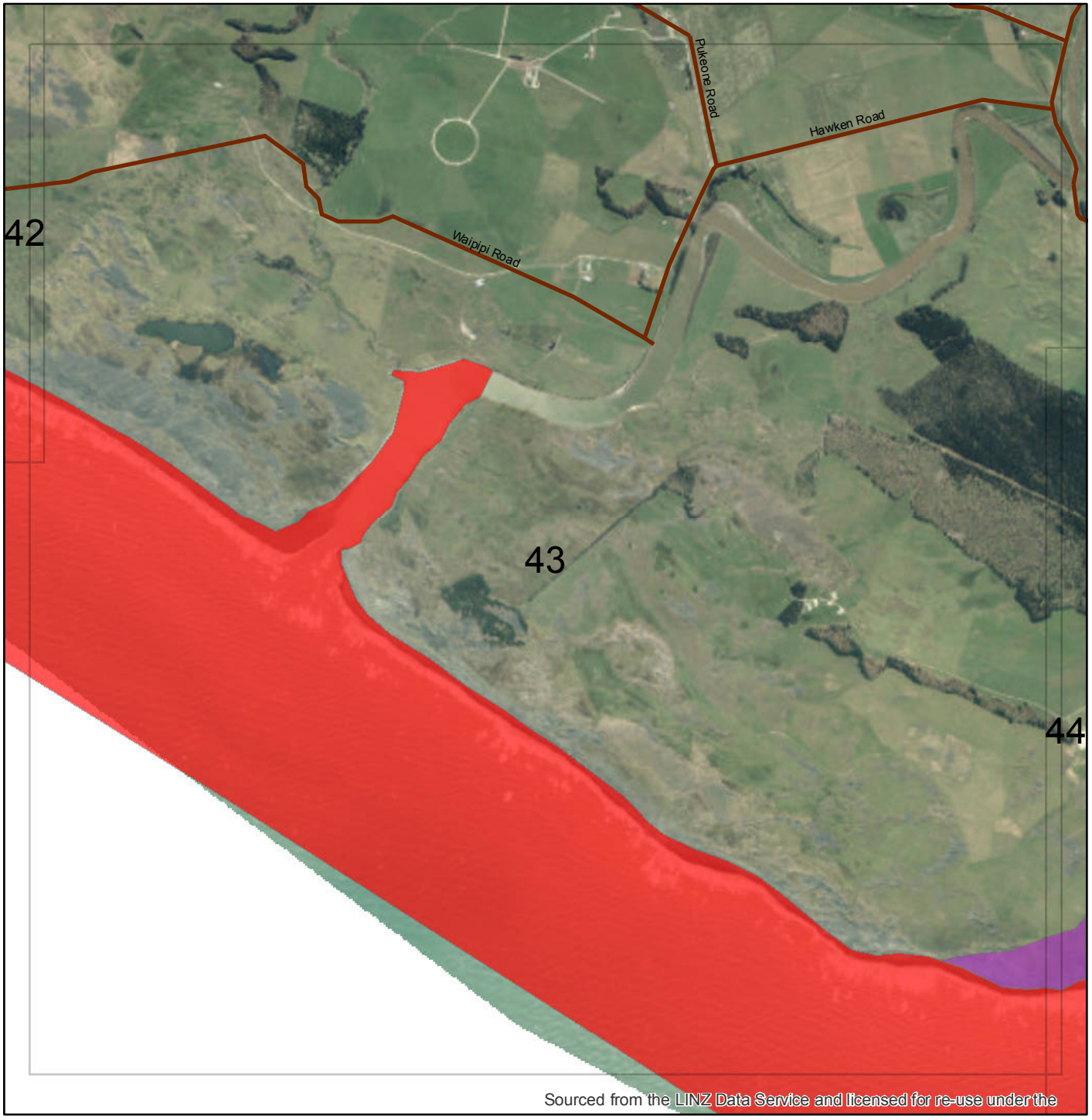
Map created on June 15, 2017



Taranaki Region
Tsunami Inundation Map

Map 43
Waitotara River

The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

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Attenuation of 1 m in height for every 50 m away from significant rivers.

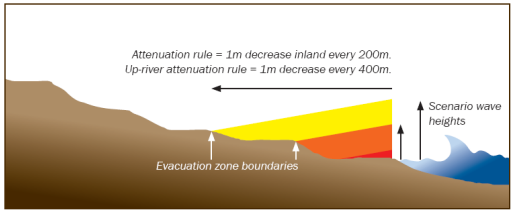
For the Taranaki Region, contour plans were used to manually determine the approximate inland inundation using the above rules.

Wave heights (crest to trough) used in this model are:

a. Marine Threat only (Red Zone)
b. 2 m wave (Orange zone)
c. 4 m wave (Yellow zone)
d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

0 500 1,000 Meters

N

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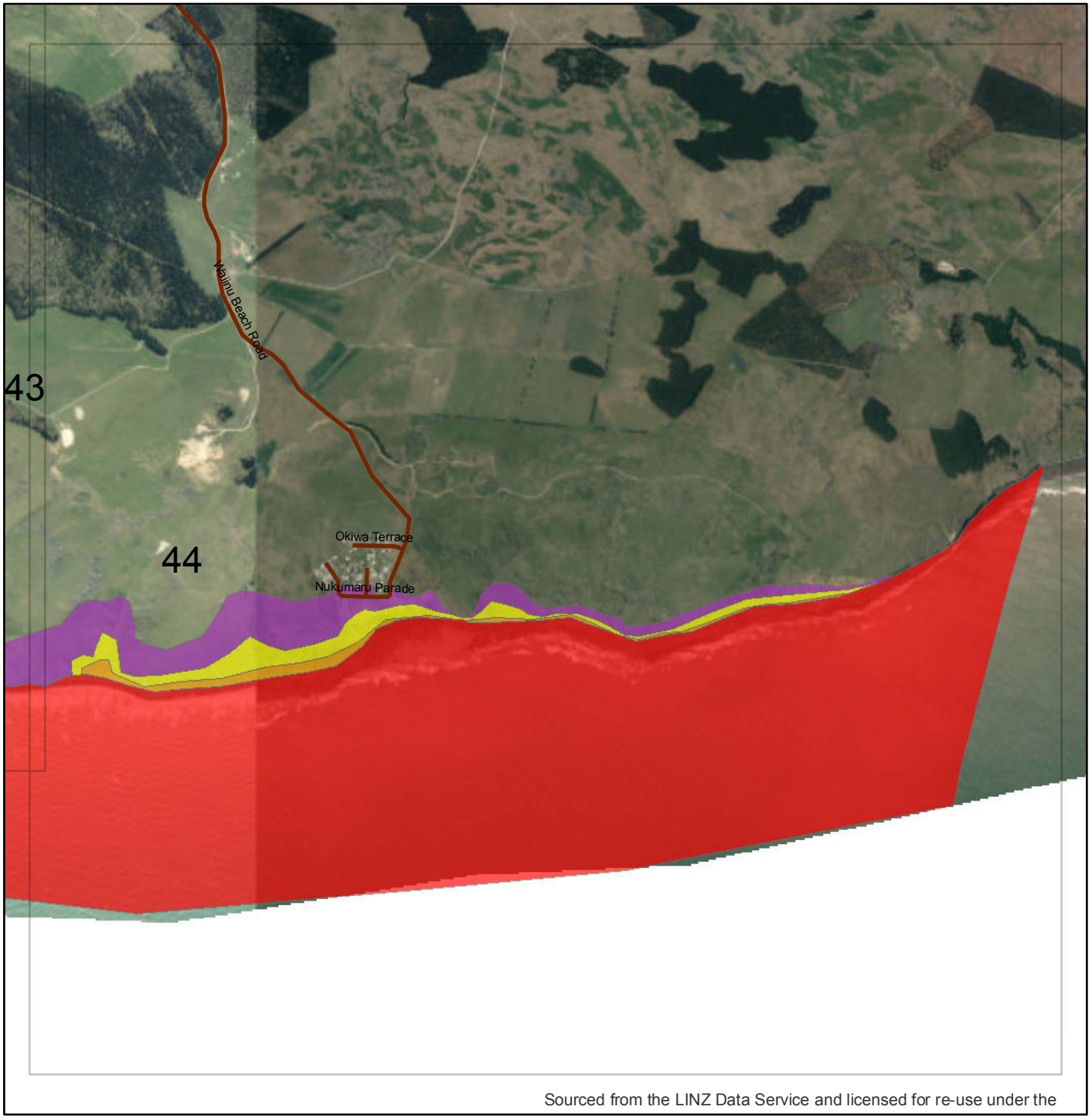
Map created on June 15, 2017

Taranaki Region
Tsunami Inundation Map

Map 44
Waiinu Beach



The inundation zones were derived from 2-Dimesional hydrodynamic models for populated areas, and an attenuation rule for less populated areas. The attenuation rule was developed by GNS (ref. Interim tsunami evacuation planning zone boundary mapping for the Wellington and Horizons regions defined by a GIS-calculated attenuation rule. GNS Science Report 2008/30, April 2009, G.S. Leonard et. al.).

The GNS attenuation rules are:
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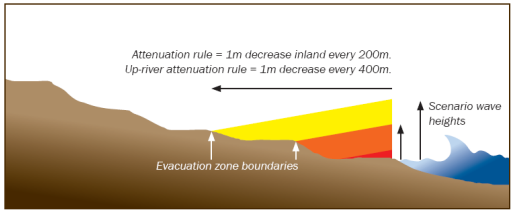
Wave heights (crest to trough) used in this model are:
- a. Marine Threat only (Red Zone)
- b. 2 m wave (Orange zone)
- c. 4 m wave (Yellow zone)
- d. 10 m wave (Purple zone)

The wave heights were applied to mid tide, then the attenuation rules were applied.

A visual representation of the attenuation rule is shown below.



ref. Tsunami Evacuation Zones, Report DGL 08/08, Dec. 2008, Ministry of Civil Defence and Emergency Management

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