15 August 2023
Job No: 1089673.0000

Western Bay Of Plenty District Council
Private Bag 12803
Tauranga Mail Centre
Tauranga 3143

Attention: James Abraham

Dear James

Waihi Beach Flood Hazard Categorisation

1 Introduction

Tonkin & Taylor Ltd (T+T) have previously built a hydrological/hydraulic flood model for Waihi Beach that has been used for various purposes, including informing the District Plan flood hazard layers, and identifying potential capital works projects for Western Bay of Plenty District Council's (WBOPDC) Long Term Plan. T+T are currently in the process of updating this flood model and preparing an updated flood masterplan for Waihi Beach in response to recent rainfall events, particularly the 29 May 2023 rainfall event.

WBOPDC have requested that T+T categorise flood hazard for a number of selected properties in Waihi Beach that are owned by WBOPDC and were recently flood-affected (refer Figure 1.1 for locations). This report summarises the flood hazard categorisation for these properties based on the latest set of flood model results.

This report supersedes the T+T report titled '*Waihi Beach Flood Hazard Categorisation'* dated 26 July 2023.

Tonkin & Taylor Ltd | Level 1, Mid City, 1 Devonport Road, Tauranga 3110, New Zealand
PO Box 317, Tauranga 3140 P +64-7-571 7360 F +64-9-307 0265 E tga@tonkintaylor.co.nz

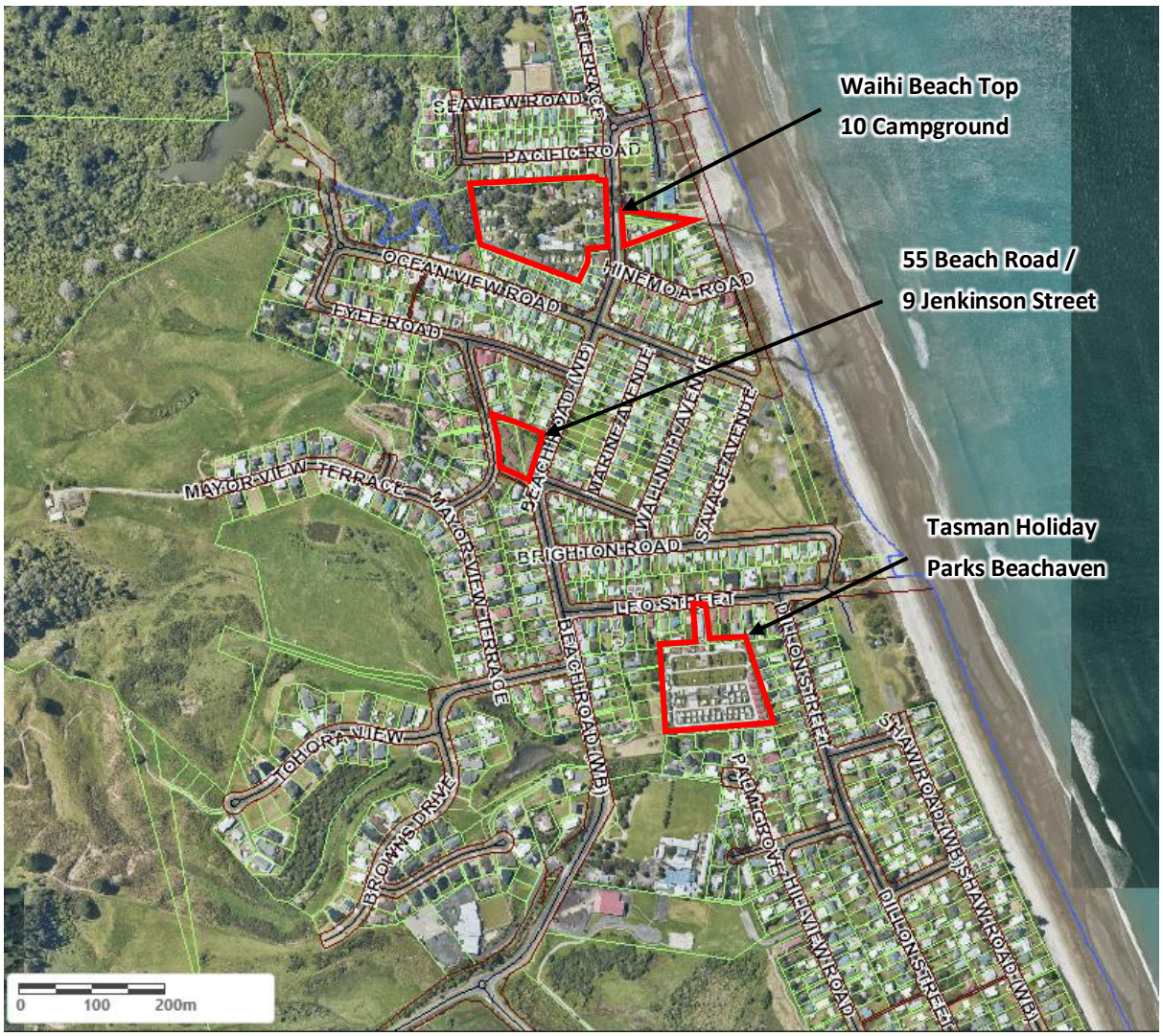


Figure 1.1: Location of properties of interest (Source: WBOPDC GIS Viewer)

2 Methodology

2.1 Flood model results

The flood model results that were used to categorise flood hazard are from the latest version of T+T's TUFLOW flood model for Waihi Beach. A model build report for the latest version of the model has not yet been published because T+T and WBODPC are currently using observations from recent flood events to validate the model. As such the results presented in this report should be taken as draft results.

The model results discussed in Section 3 below are based on a present day 1% Annual Exceedance Probability (AEP) joint probability storm event. Joint probability refers to the combination of probability for rainfall depths and tide levels to coincide and these have been selected based on guidance in Bay of Plenty Regional Council's Hydrology and Hydraulic Guidelines. In the case of a 1% AEP joint probability storm event, we have considered a 1% AEP rainfall event with a 5% AEP tide level and a 5% AEP rainfall event with a 1% AEP tide level. Both the rainfall and tide boundary conditions are based on a 2015 climate scenario. The results of both combinations of rainfall/tide in these model runs are "enveloped" which results in the highest hazard level of the two model runs

being adopted for each grid cell. Appendix B includes additional flood hazard results for the following joint probability storm events:

- 50% AEP storm event (2015 climate)
- 10% AEP storm event (2015 climate)
- 1% AEP storm event (2130 climate)

2.2 Flood hazard categorisation

The University of New South Wales (UNSW) Water Research Laboratory has developed combined hazard vulnerability curves that are commonly used in floodplain management and emergency planning in Australia and New Zealand (refer UNSW Water Research Laboratory Technical Report 2014/07). These curves were developed by combining individual hazard curves developed in various other studies for the safety of people, vehicles and buildings. These UNSW curves have been used to classify flood hazard for the properties of interest to WBOPDC.

The UNSW classification has six classes, starting with the safe classification H1 (generally safe for vehicles, people and buildings) through to H6 (unsafe for vehicles and people and all building types considered vulnerable to failure). It considers depth-velocity product with a limiting flood depth and velocity for each category. The UNSW report does note that practitioners may need to refer to the individual stability relationships for vehicles, people and buildings where a particular analysis is focussed primarily on one of these aspects (e.g. route analysis for vehicle-based emergency evacuation should use the vehicle stability relationships). For completeness, a copy of the UNSW stability curves for each aspect i.e., people, vehicles and buildings is included as Appendix A.

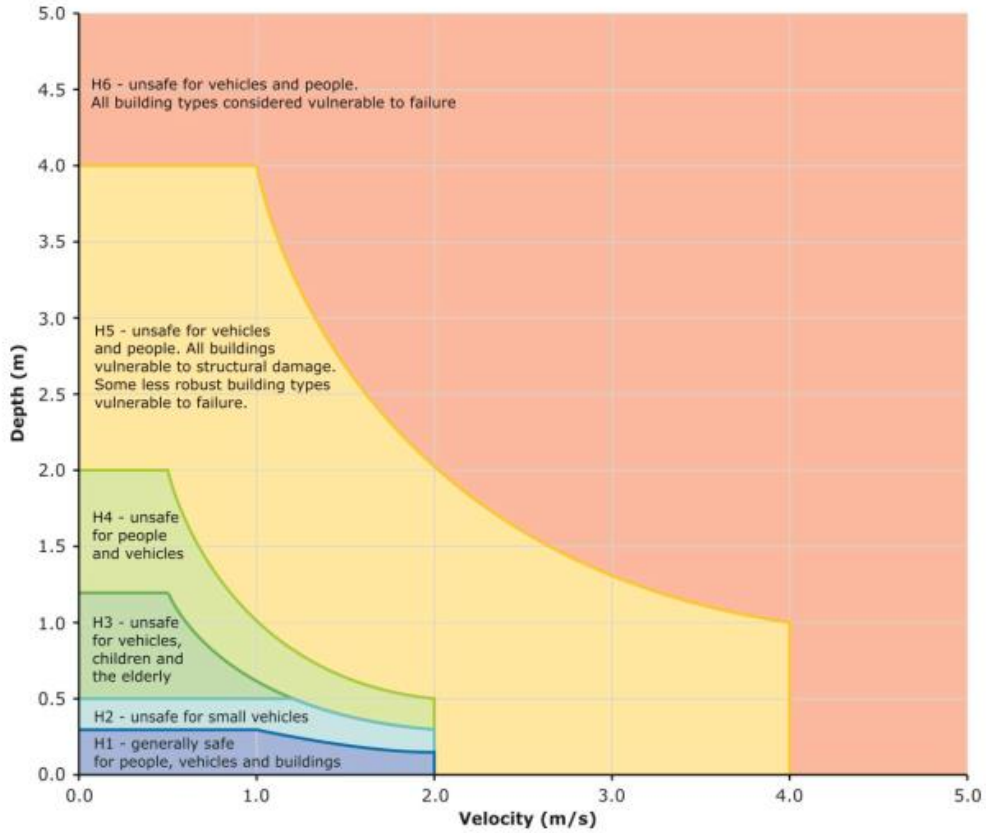


Figure 2.1: Combined flood hazard categorisation curves (Source: UNSW Water Research Laboratory Technical Report 2014/07)

3 Results

The following subsections present the flood hazard categorisation for each of the properties of interest by applying the UNSW combined stability curves to the latest flood model results. As discussed in Section 2, the results presented below are only for a 1% AEP present day storm event. A3 versions of Figure 3.1 - Figure 3.3 showing the flood hazard categorisation are included as Appendix B, along with flood hazard categorisation for other return periods.

3.1 Waihi Beach Top 10 Campground

The results for the Waihi Beach Top 10 Campground show the property is exposed to flood hazard varying between H5 and H6 in the immediate vicinity of One Mile Creek in a 1% AEP present day storm event (refer Figure 3.1). This includes some buildings exposed to H5 (all buildings vulnerable to structural damage, less robust building types vulnerable to failure) alongside One Mile Creek at the eastern end of the campground. The rest of the campground within the floodable area is generally exposed to flood hazard varying between H1 and H3 (unsafe for elderly, children and vehicles).

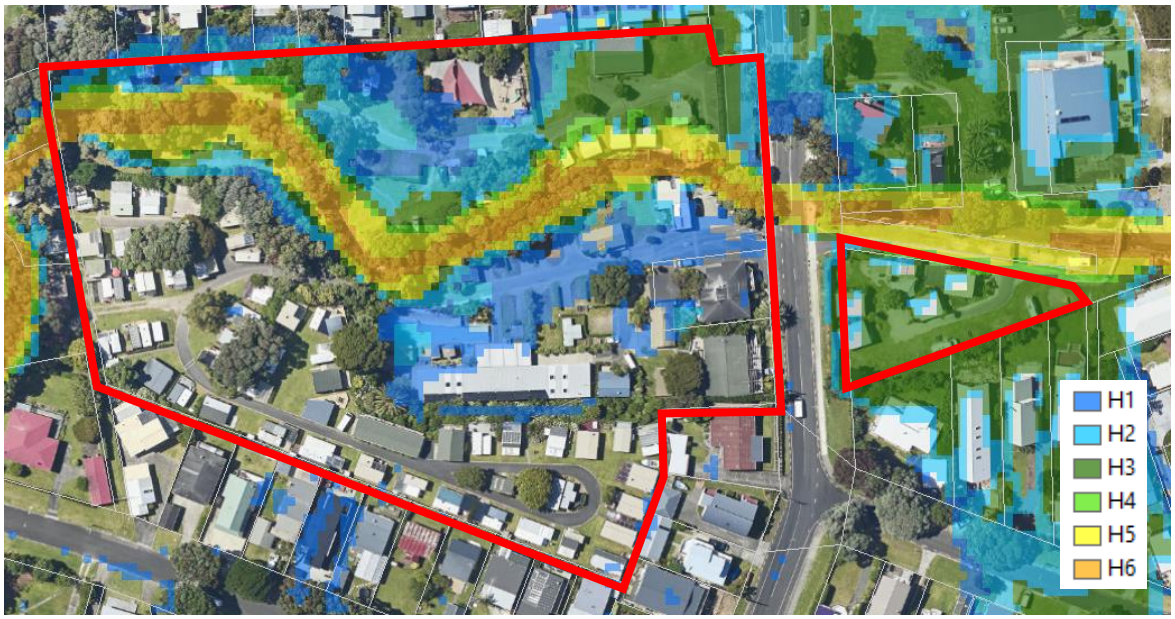


Figure 3.1: Top 10 Campground flood hazard categorisation for a 1% AEP present day storm event (property boundary in red)

3.2 Tasman Holiday Parks Beachaven

The results for the Tasman Holiday Park Beachaven Campground show the property is generally exposed to flood hazard varying between H1 and H3 in a 1% AEP present day storm event (refer Figure 3.2). The area exposed to a flood hazard of H3 (unsafe for elderly, children and vehicles) is the western portion of the site. Flood hazard within and immediately adjacent to the drain that runs alongside the western boundary of the site does get as high as H4.

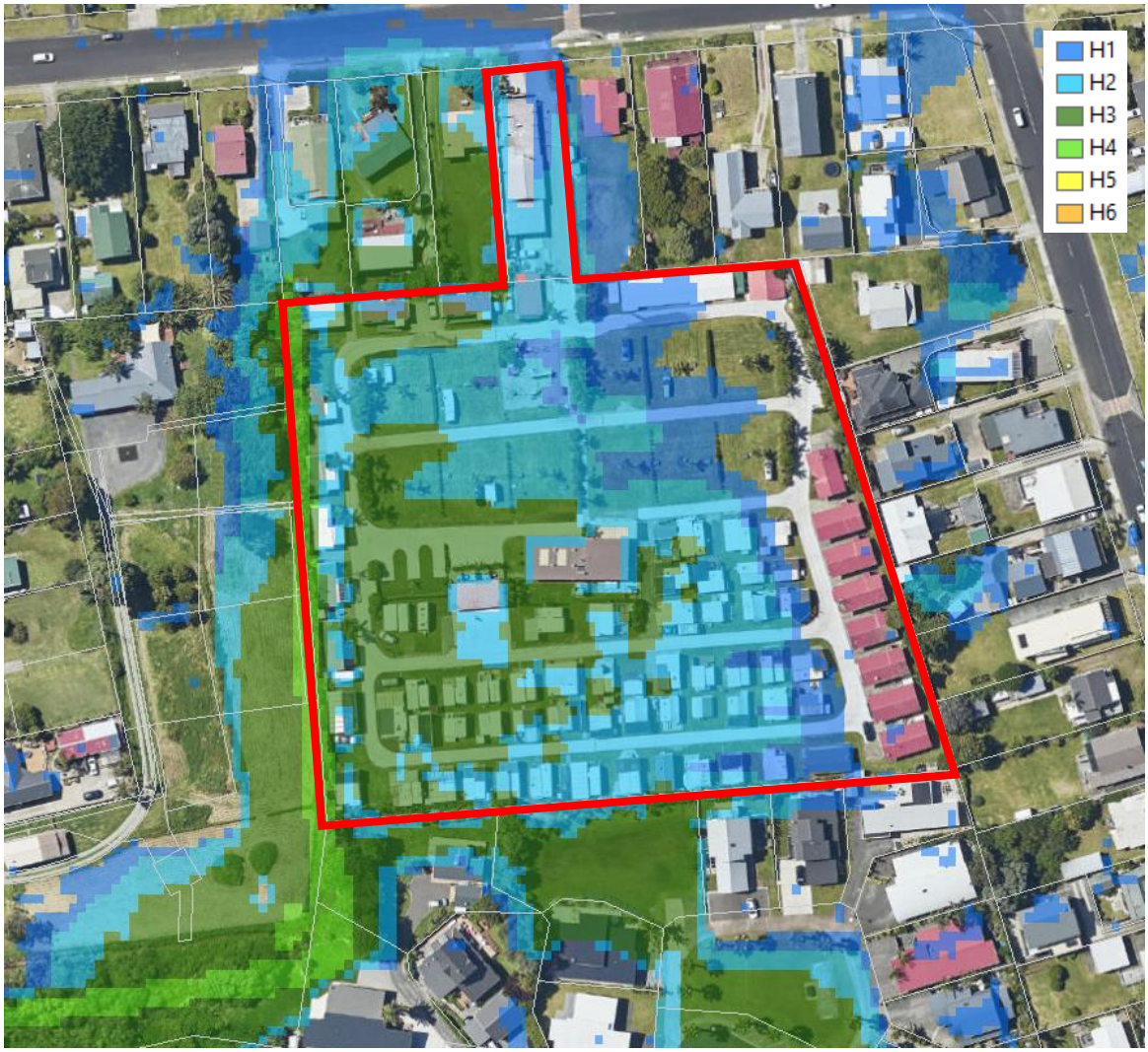


Figure 3.2: Tasman Holiday Park Beachaven flood hazard categorisation for a 1% AEP present day storm event (property boundary in red)

3.3 55 Beach Road/9 Jenkinson Street

The results for the 55 Beach Road/9 Jenkinson Street show the properties are generally exposed to flood hazard varying between H2 and H4 in a 1% AEP present day storm event (refer Figure 3.3). The buildings are exposed to flood hazard as high as H3 (unsafe for elderly, children and vehicles) and the north-eastern corner of the property is exposed to a flood hazard as high as H4 (unsafe for all people and vehicles).

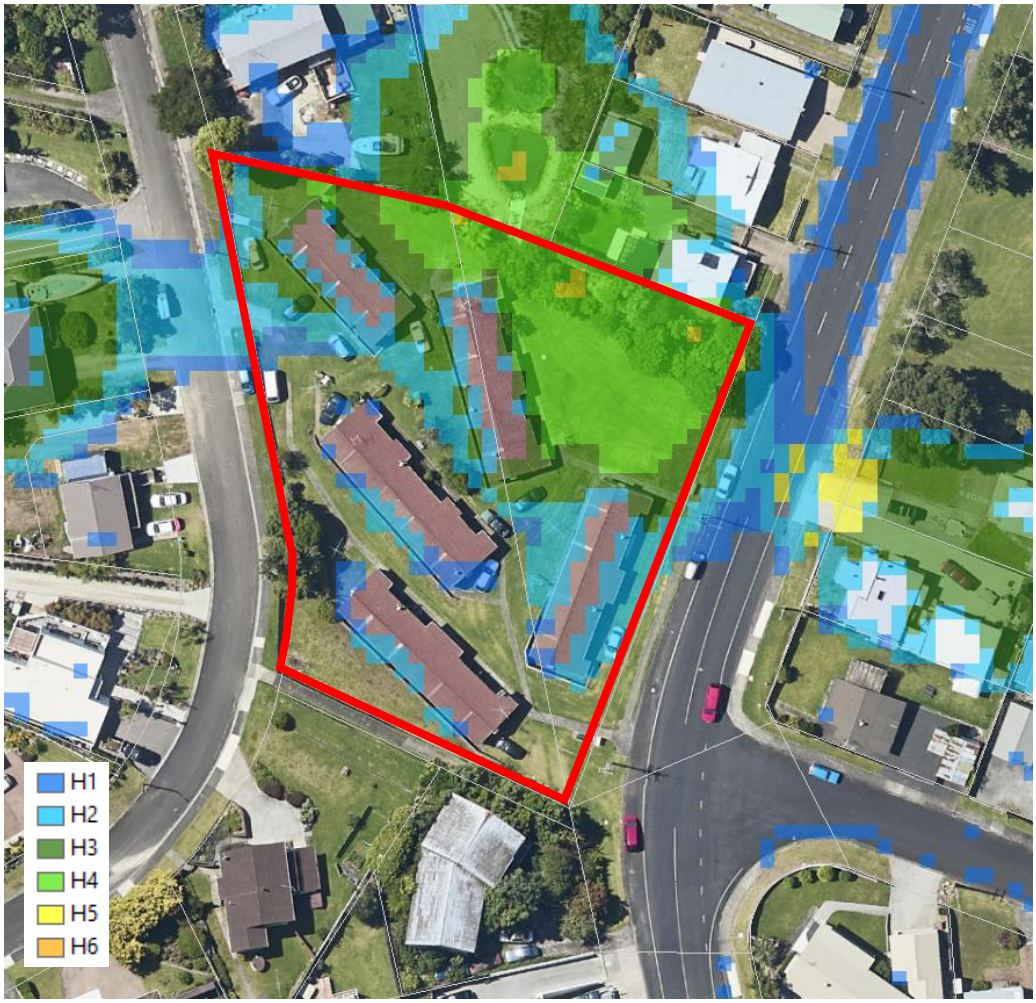


Figure 3.3: 55 Beach Road/9 Jenkinson Street flood hazard categorisation for a 1% AEP present day storm event (property boundary in red)

4 Summary

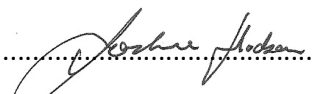
WBOPDC have requested that T+T categorise flood hazard for a number of selected properties in Waihi Beach that are owned by WBOPDC and were recently flood-affected. The results for a 1% AEP present day storm event are presented within this report. A3 versions of Figure 3.1 - Figure 3.3 are provided in the attached flood hazard maps along with flood hazard flood hazard categorisation results for other return periods (Appendix B). The 1% AEP present day storm event results show all three properties have considerable areas where the flood hazard is classified as H3 (unsafe for elderly, children and vehicles) or higher. For the Top 10 Campground, the flood hazard gets as high as H6 (buildings vulnerable to failure) in the immediate vicinity of One Mile Creek.

5 Applicability

This report has been prepared for the exclusive use of our client Western Bay Of Plenty District Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

Report prepared by:



Joshua Hodson
Senior Water Resources Engineer

Authorised for Tonkin & Taylor Ltd by:

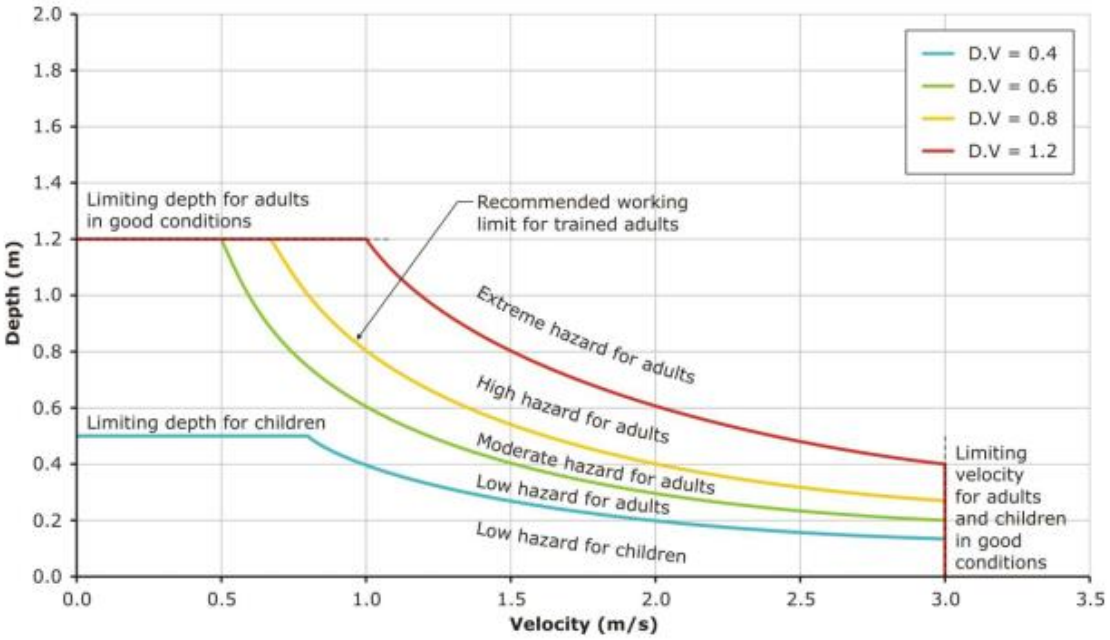
Reuben Hansen
Project Director

15-Aug-23
t:\tauranga\projects\1089673\issueddocuments\20230815 waihi beach flood hazard categorisation\20230815 waihi beach flood hazard categorisation.docx

Appendix A Stability curves

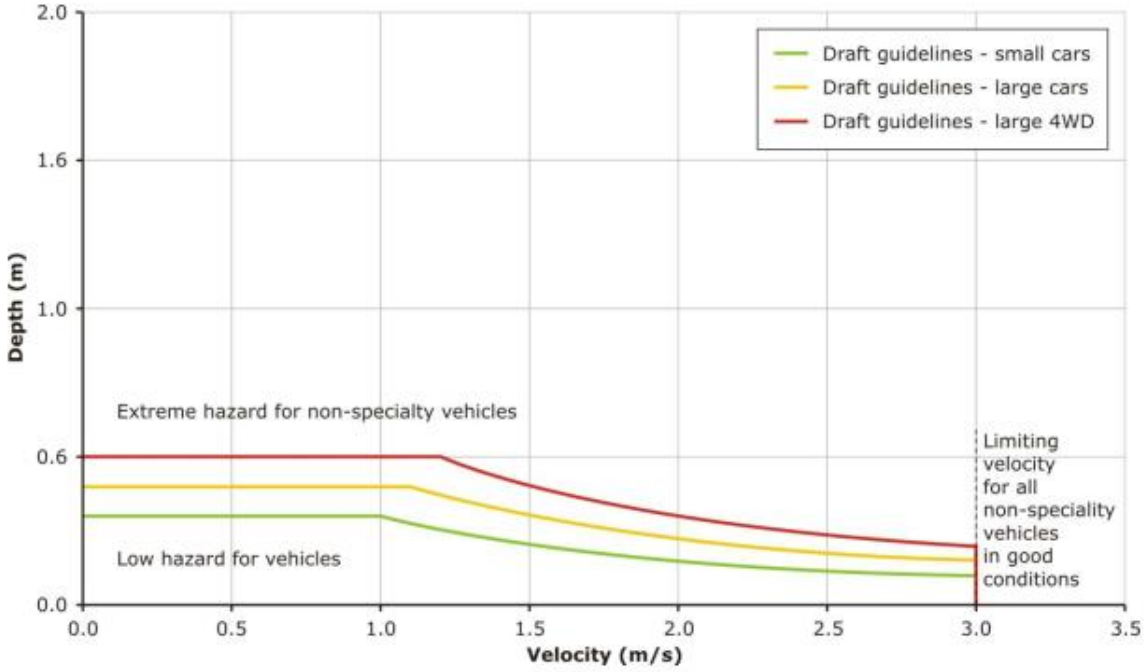
Curves below sourced from UNSW Water Research Laboratory Technical Report 2014/07

Thresholds for people stability in floods



/

Thresholds for vehicle stability in floods



Thresholds for building stability in floods

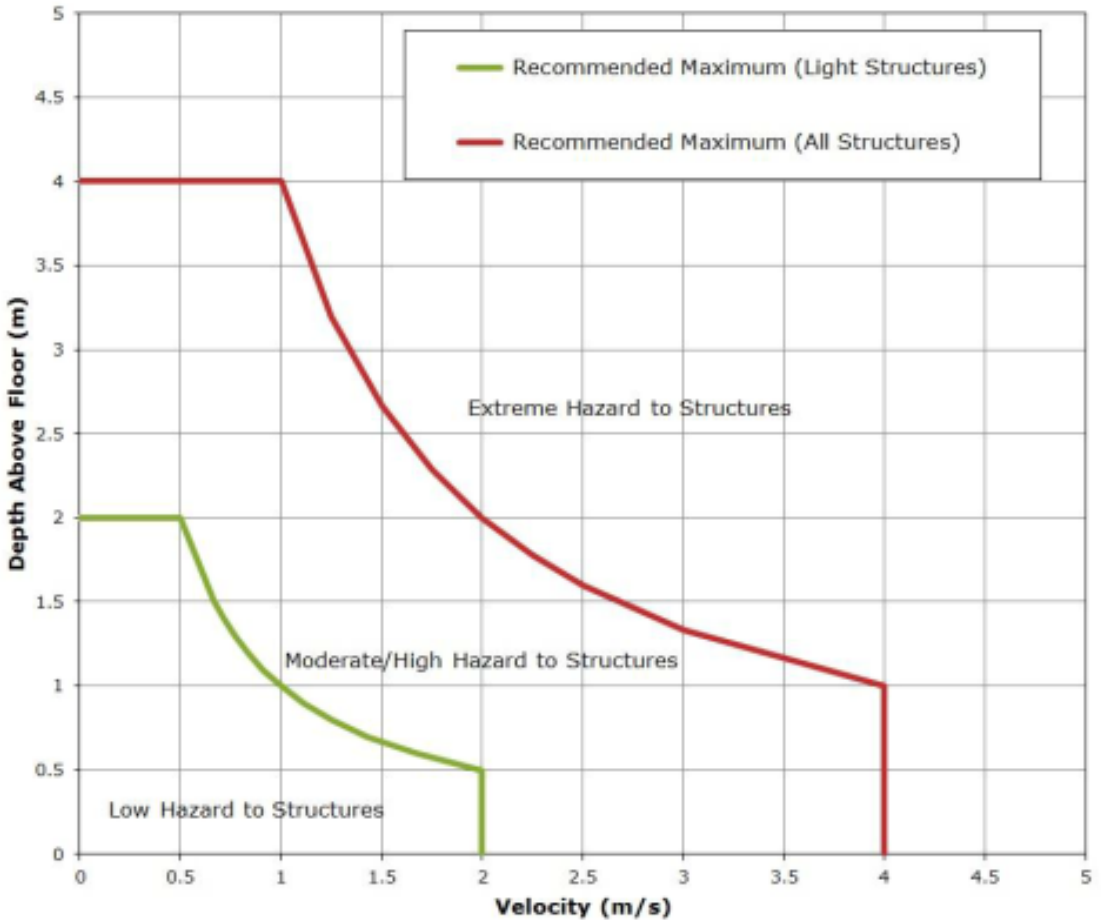


Figure 5-3: Proposed thresholds for building stability in floods

Appendix B Flood Hazard Maps

Pacific Rd

Beach Rd

Ocean View Rd

DRAFT

LEGEND

Property boundaries

Hazard Category

H1

H2

H3

H4

H5

H6

Eagle Technology, Land Information New Zealand

Notes:

A3 SCALE 1:1,000

0 0.01 0.02 0.03 0.04 0.05 (km)

Tonkin+Taylor

105 Carlton Gore Rd, Newmarket, Auckland
www.tonkintaylor.co.nz

DRAWN	JTIH	Aug.23
CHECKED		
APPROVED		

ARCFILE: Flood hazard waihi beach .mxd

SCALE (AT A3 SIZE): 1:1,000

PROJECT No.: 1089673.0000

WESTERN BAY OF PLENTY DISTRICT COUNCIL

Waihi Beach Flood Hazard Categorisation

50% AEP Storm Event, 2015 Climate

FIGURE No.: Figure B1

Rev.: 0

Path: T:\Tauranga\Projects\1089673\WorkingMaterial\Waihi Beach Flood Hazard Categorisation\Flood hazard waihi beach .mxd Date: 10/08/2023 Time: 2:07:58 pm

Pacific Rd

Beach Rd

Ocean View Rd

DRAFT

Eagle Technology, Land Information New Zealand

LEGEND

Property boundaries

Hazard Category

H1

H2

H3

H4

H5

H6

Notes:

A3 SCALE 1:1,000

0 0.01 0.02 0.03 0.04 0.05 (km)

Tonkin+Taylor

105 Carlton Gore Rd, Newmarket, Auckland
www.tonkintaylor.co.nz

DRAWN	JTIH	Aug.23
CHECKED		
APPROVED		

ARCFILE: Flood hazard waihi beach .mxd

SCALE (AT A3 SIZE): 1:1,000

PROJECT No.: 1089673.0000

WESTERN BAY OF PLENTY DISTRICT COUNCIL

Waihi Beach Flood Hazard Categorisation

10% AEP Storm Event, 2015 Climate

FIGURE No.: Figure B2

Rev.: 0

Path: T:\Tauranga\Projects\1089673\WorkingMaterial\Waihi Beach Flood Hazard Categorisation\Flood hazard waihi beach .mxd Date: 10/08/2023 Time: 2:07:43 pm

Pacific Rd

Beach Rd

Ocean View Rd

DRAFT

Eagle Technology, Land Information New Zealand

LEGEND

Property boundaries

Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

Notes:

A3 SCALE 1:1,000

0 0.01 0.02 0.03 0.04 0.05 (km)

Location Plan

Tonkin+Taylor

105 Carlton Gore Rd, Newmarket, Auckland
www.tonkintaylor.co.nz

DRAWN	JTIH	Aug.23
CHECKED		
APPROVED		

ARCFILE: Flood hazard waihi beach .mxd

SCALE (AT A3 SIZE): 1:1,000

PROJECT No.: 1089673.0000

WESTERN BAY OF PLENTY DISTRICT COUNCIL

Waihi Beach Flood Hazard Categorisation

1% AEP Storm Event, 2015 Climate

FIGURE No.: Figure B3

Rev.: 0

Path: T:\Tauranga\Projects\1089673\WorkingMaterial\Waihi Beach Flood Hazard Categorisation\Flood hazard waihi beach .mxd Date: 10/08/2023 Time: 2:07:21 pm

Pacific Rd

Beach Rd

Ocean View Rd

DRAFT

LEGEND

Property boundaries

Hazard Category

H1

H2

H3

H4

H5

H6

Eagle Technology, Land Information New Zealand

Notes:

A3 SCALE 1:1,000

0 0.01 0.02 0.03 0.04 0.05 (km)

Tonkin+Taylor

105 Carlton Gore Rd, Newmarket, Auckland
www.tonkintaylor.co.nz

DRAWN	JTIH	Aug.23
CHECKED		
APPROVED		

ARCFILE: Flood hazard waihi beach .mxd

SCALE (AT A3 SIZE): 1:1,000

PROJECT No.: 1089673.0000

WESTERN BAY OF PLENTY DISTRICT COUNCIL

Waihi Beach Flood Hazard Categorisation

1% AEP Storm Event, 2130 Climate

FIGURE No.: Figure B4

Rev.: 0

Path: T:\Tauranga\Projects\1089673\WorkingMaterial\Waihi Beach Flood Hazard Categorisation\Flood hazard waihi beach .mxd Date: 10/08/2023 Time: 2:07:05 pm

Jenkinson St

Beach Rd

DRAFT

Eagle Technology, Land Information New Zealand

LEGEND

Property boundaries

Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

Notes:

A3 SCALE 1:500

0 0.0055 0.011 0.0165 0.022 0.0275 (km)

Location Plan

Tonkin+Taylor

105 Carlton Gore Rd, Newmarket, Auckland
www.tonkintaylor.co.nz

DRAWN	JTIH	Aug.23
CHECKED		
APPROVED		
ARCFILE	Flood hazard waihi beach .mxd	
SCALE (AT A3 SIZE)	1:500	
PROJECT No.	1089673.0000	

WESTERN BAY OF PLENTY DISTRICT COUNCIL

Waihi Beach Flood Hazard Categorisation

50% AEP Storm Event, 2015 Climate

FIGURE No. Figure B5

Rev. 0

Path: T:\Tauranga\Projects\1089673\WorkingMaterial\Waihi Beach Flood Hazard Categorisation\Flood hazard waihi beach .mxd Date: 10/08/2023 Time: 2:06:38 pm

Jenkinson St

Beach Rd

DRAFT

Eagle Technology, Land Information New Zealand

LEGEND

Property boundaries

Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

Notes:

A3 SCALE 1:500

0 0.0055 0.011 0.0165 0.022 0.0275 (km)

Tonkin+Taylor

105 Carlton Gore Rd, Newmarket, Auckland
www.tonkintaylor.co.nz

DRAWN	JTIH	Aug.23
CHECKED		
APPROVED		
ARCFILE	Flood hazard waihi beach .mxd	
SCALE (AT A3 SIZE)	1:500	
PROJECT No.	1089673.0000	

WESTERN BAY OF PLENTY DISTRICT COUNCIL

Waihi Beach Flood Hazard Categorisation

10% AEP Storm Event, 2015 Climate

FIGURE No. Figure B6

Rev. 0

Path: T:\Tauranga\Projects\1089673\WorkingMaterial\Waihi Beach Flood Hazard Categorisation\Flood hazard waihi beach .mxd Date: 10/08/2023 Time: 2:06:24 pm

Jenkinson St

Beach Rd

DRAFT

Eagle Technology, Land Information New Zealand

LEGEND

Property boundaries

Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

Notes:

A3 SCALE 1:500

0 0.0055 0.011 0.0165 0.022 0.0275 (km)

Tonkin+Taylor

105 Carlton Gore Rd, Newmarket, Auckland
www.tonkintaylor.co.nz

DRAWN	JTIH	Aug.23
CHECKED		
APPROVED		

ARCFILE: Flood hazard waihi beach .mxd

SCALE (AT A3 SIZE): 1:500

PROJECT No.: 1089673.0000

FIGURE No.: Figure B7

Rev.: 0

WESTERN BAY OF PLENTY DISTRICT COUNCIL

Waihi Beach Flood Hazard Categorisation

1% AEP Storm Event, 2015 Climate

Path: T:\Tauranga\Projects\1089673\WorkingMaterial\Waihi Beach Flood Hazard Categorisation\Flood hazard waihi beach .mxd Date: 10/08/2023 Time: 2:06:04 pm

Jenkinson St

Beach Rd

DRAFT

Eagle Technology, Land Information New Zealand

LEGEND

Property boundaries

Hazard Category

H1

H2

H3

H4

H5

H6

Notes:

A3 SCALE 1:500

0 0.0055 0.011 0.0165 0.022 0.0275 (km)

Tonkin+Taylor

105 Carlton Gore Rd, Newmarket, Auckland
www.tonkintaylor.co.nz

DRAWN	JTIH	Aug.23
CHECKED		
APPROVED		

ARCFILE: Flood hazard waihi beach .mxd

SCALE (AT A3 SIZE): 1:500

PROJECT No.: 1089673.0000

FIGURE No.: Figure B8

Rev.: 0

WESTERN BAY OF PLENTY DISTRICT COUNCIL

Waihi Beach Flood Hazard Categorisation

1% AEP Storm Event, 2130 Climate

Path: T:\Tauranga\Projects\1089673\WorkingMaterial\Waihi Beach Flood Hazard Categorisation\Flood hazard waihi beach .mxd Date: 10/08/2023 Time: 2:05:42 pm

Leo St

Dillon St

Beach Rd

DRAFT

Eagle Technology, Land Information New Zealand

LEGEND

Property boundaries

Hazard Category

H1

H2

H3

H4

H5

H6

Notes:

A3 SCALE 1:1,000

0 0.01 0.02 0.03 0.04 0.05 (km)

Tonkin+Taylor

105 Carlton Gore Rd, Newmarket, Auckland
www.tonkintaylor.co.nz

DRAWN	JTIH	Aug.23
CHECKED		
APPROVED		

ARCFILE: Flood hazard waihi beach .mxd

SCALE (AT A3 SIZE): 1:1,000

PROJECT No.: 1089673.0000

WESTERN BAY OF PLENTY DISTRICT COUNCIL

Waihi Beach Flood Hazard Categorisation

50% AEP Storm Event, 2015 Climate

FIGURE No.: Figure B9

Rev.: 0

Path: T:\Tauranga\Projects\1089673\WorkingMaterial\Waihi Beach Flood Hazard Categorisation\Flood hazard waihi beach .mxd Date: 10/08/2023 Time: 2:06:26 pm

Leo St

Beach Rd

Dillon St

DRAFT

LEGEND

Property boundaries

Hazard Category

H1

H2

H3

H4

H5

H6

Eagle Technology, Land Information New Zealand

Notes:

A3 SCALE 1:1,000

0 0.01 0.02 0.03 0.04 0.05 (km)

Location Plan

Tonkin+Taylor

105 Carlton Gore Rd, Newmarket, Auckland
www.tonkintaylor.co.nz

DRAWN	JTIH	Aug.23
CHECKED		
APPROVED		

ARCFILE: Flood hazard waihi beach .mxd

SCALE (AT A3 SIZE): 1:1,000

PROJECT No.: 1089673.0000

WESTERN BAY OF PLENTY DISTRICT COUNCIL

Waihi Beach Flood Hazard Categorisation

10% AEP Storm Event, 2015 Climate

FIGURE No.: Figure B10

Rev.: 0

Path: T:\Tauranga\Projects\1089673\WorkingMaterial\Waihi Beach Flood Hazard Categorisation\Flood hazard waihi beach .mxd Date: 10/08/2023 Time: 2:08:45 pm

Leo St

Beach Rd

Dillon St

DRAFT

Eagle Technology, Land Information New Zealand

LEGEND

Property boundaries

Hazard Category

H1

H2

H3

H4

H5

H6

Notes:

A3 SCALE 1:1,000

0 0.01 0.02 0.03 0.04 0.05 (km)

Tonkin+Taylor

105 Carlton Gore Rd, Newmarket, Auckland
www.tonkintaylor.co.nz

DRAWN	JTIH	Aug.23
CHECKED		
APPROVED		

ARCFILE: Flood hazard waihi beach .mxd

SCALE (AT A3 SIZE): 1:1,000

PROJECT No.: 1089673.0000

WESTERN BAY OF PLENTY DISTRICT COUNCIL

Waihi Beach Flood Hazard Categorisation

1% AEP Storm Event, 2015 Climate

FIGURE No.: Figure B11

Rev.: 0

Path: T:\Tauranga\Projects\1089673\WorkingMaterial\Waihi Beach Flood Hazard Categorisation\Flood hazard waihi beach .mxd Date: 10/08/2023 Time: 2:09:02 pm

Leo St

Beach Rd

Dillon St

DRAFT

LEGEND

Property boundaries

Hazard Category

H1

H2

H3

H4

H5

H6

Eagle Technology, Land Information New Zealand

Notes:

A3 SCALE 1:1,000

0 0.01 0.02 0.03 0.04 0.05 (km)

Tonkin+Taylor

105 Carlton Gore Rd, Newmarket, Auckland
www.tonkintaylor.co.nz

DRAWN	JTIH	Aug.23
CHECKED		
APPROVED		

ARCFILE: Flood hazard waihi beach .mxd

SCALE (AT A3 SIZE): 1:1,000

PROJECT No.: 1089673.0000

WESTERN BAY OF PLENTY DISTRICT COUNCIL

Waihi Beach Flood Hazard Categorisation

1% AEP Storm Event, 2130 Climate

FIGURE No.: Figure B12

Rev.: 0

Path: T:\Tauranga\Projects\1089673\WorkingMaterial\Waihi Beach Flood Hazard Categorisation\Flood hazard waihi beach .mxd Date: 10/08/2023 Time: 2:09:21 pm