

# PROJECT TECHNICAL MEMORANDUM FOR TASMAN DISTRICT COUNCIL

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**Correspondence Out No.:** 27950

**To:** Tasman District Council

**Project Technical Memo No.:** 1

**For the Attention of:** Glenn Stevens

**Project Stage:** Investigation

**Project:** Fault Rupture Risk Area Review

**Project Number:** 80507165

**Subject:** Review of Waimea Fault Location, Cushendall Rise to Champion Road, Richmond

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<b>Reviewed by:</b> Chris Robson	<b>Authorised by:</b> Leslie Lyall

## 1 Introduction and Scope

Tasman District Council requested that MWH carry out a review of the location of the Waimea Fault in the eastern part of Richmond covering the section between Cushendall Rise and Champion Road.

The Waimea Fault is an active reverse fault located along the toe of the Barnicoat Range and trends north-east to south-west. The fault is characterised by mostly vertical movement with only a minor amount of lateral movement. The Waimea Fault splits into two branches along much of the reviewed section, however these branches merge to become one fault zone south of Marlborough Crescent and to the north of Champion Road.

The objective of this review is to advise Council on the revised location of the Waimea Fault in the area defined so that Council can update the position of the Fault Rupture Risk Area (FRRA) shown as a hazard overlay in the Tasman Resource Management Plan (TRMP). The review covers the TRMP Maps 129, 130, 135 and 136.

The work was the subject of a Short Form Agreement for Consultant Engagement dated 21 September 2015. The agreed output includes providing 1:2,000 scale maps including the compilation of a revised geological envelope within which the available data indicates the two branches of the Waimea Fault lie.

## 2 Desktop Study

The desktop study carried out by MWH included the following:

- Review of geotechnical data including geotechnical reports from Council subdivision files (provided by Glenn Stevens) and from MWH files (both subdivision and residential)
- Review of relevant GNS reports<sup>1</sup>
- Review of available test pit logs, borehole logs and fault trench logs
- Review of published and unpublished geological maps
- Review of LiDAR topographical data
- Review of aerial photography and imagery (black and white aerial photographs, Googleearth and Top of the South)
- Review of geological outcrop information previously recorded on Council's GPS geo-referenced tablet by Paul Wopereis and Glenn Stevens in 2015
- Review of new outcrop data collected by Paul Wopereis in 2016 (this data was also added to the GPS geo-referenced tablet).

<sup>1</sup> Assessment of the location and paleoearthquake history of the Waimea-Flaxmore Fault System in the Nelson-Richmond area with recommendations to mitigate the hazard arising from fault rupture of the ground surface, GNS Science Consultancy report 2013/186, M.R. Johnston and A. Nicol, August 2013.

As part of the desktop study we also referenced the TRMP rules on the FRRA, Section 18.13 dated 31 January 2015. The rules state that construction of any habitable buildings within the FRRA requires a geotechnical report be prepared by an appropriately competent person in geology or geotechnical engineering with specialisation in earthquake risk assessment. Rule 18.13.3.1. (b) requires that the building or alteration is setback 10m from the surface position of the fault, however a setback of 5m is allowed where specific site investigations (defining the fault position) have been carried out and the investigations support this setback.

### 3 Geology

The basement sedimentary rocks (conglomerate, mudstone and siltstone) of the Richmond Group of Triassic age occur west of the Waimea Fault Eastern Branch and are uplifted by reverse movement on the fault system to form the Barnicoat Range. Clay-bound gravels of the Moutere Gravel Formation and the Port Hills Gravel Formation occur to the west of the Waimea Fault Western Branch. The Marsden Coal Measures Formation is sandwiched between the two fault branches in a band that is up to 300m wide. Marsden Coal Measures comprise mudstone, siltstone, sandy conglomerate, thin coal seams and rare quartzose sandstone. A thin band of Bishopdale Conglomerate occurs immediately to the west of the Waimea Fault Eastern Branch and comprises characteristically burgundy red coloured conglomerate and red silty clay. Red clay soils are indicative of this fault and have been used to infer the approximate fault position in some places where there is no outcrop. Detailed geology of the study area is recorded in the published geology maps<sup>2 3</sup>. GPS logged rock outcrop information has been previously supplied to Council by Paul Wopereis and has been plotted in the field on a tablet and transferred to a database by Glenn Stevens, Resource Scientist with Council.

Previous fault trenching on the Waimea Fault carried out near Mt Heslington Road, Brightwater in 2005 has radio-carbon dated the last rupture of the fault as having occurred between 5,000 and 5,900 years ago and has recorded three fault rupture events within the past 18,000 years<sup>4</sup>. This indicates an earthquake recurrence interval of approximately 6,000 years, although this figure is based on the last three earthquake events only.

GNS Science report 2013 /186 (*reference 1*) states that earthquakes on the Waimea Fault have an indicated magnitude of 6.5 – 7.4, with an average vertical slip per event of 1.2m and an average slip rate of 0.2mm/year. Additional detail on Waimea Fault trenching investigations is provided in the GNS report.

### 4 Plans of Fault Zone Envelope

Based on our desktop study of available geotechnical information and observed geology we have produced a series of five plans of a geological envelope which contains the fault zone. The plotted fault zone envelope on each sheet encompasses the fault zone plus the required 10m habitable building setback on each side of the fault zone. In areas of greater geological confidence (i.e. a greater density of data) a 5m habitable building setback on each side of the fault is encompassed within the plotted fault zone and in these cases the total width is narrower.

The MWH plans in this report are plots from Top of the South website using the LiDAR topography and have 1m contours, streets and property boundaries/numbers plotted. The fault zone envelope boundaries have been carefully hand drawn and transposed from 1:2,000 scale field sheets onto the five Top of the South topographic map sheets, which are attached to this technical memorandum. Aerial photographs and imagery was also used as a check on the correct plotting of the boundaries and we have also plotted the fault zone envelope on the Top of the South aerial photograph plans. Where subdivision or residential geotechnical site plans were available these were converted to 1:2,000 scale to allow for correct locations of test pits, boreholes and fault trenches which assisted in the study. These geotechnical site plans and geotechnical reports are held in MWH files, but are available for Council use if required.

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<sup>2</sup> Johnston, M.R. (1979) "Geology of the Nelson Urban Area" 1:25,000 scale map, NZ Geological Survey.

<sup>3</sup> Johnston, M.R. (1982) "Part sheet N27 Richmond Geology Map", 1:50,000 scale map, NZ Geological Survey

<sup>4</sup> Fraser, J.G. (2005) "Paleoseismic Investigation of the Waimea-Flaxmore Fault System, Nelson Region" unpublished M.Sc. thesis, University of Canterbury.

Figure 1 is a plan showing the existing FRRA and the revised area which could become the updated FRRA. The plan also shows the locations where geological exposures was recorded by GPS and plotted on a tablet in the field.

The following rationale provides details for each sheet on how the fault zone envelope was plotted by MWH. Note that both the topographic sheets and the aerial photograph sheets have property boundaries and the property numbers referred to in the description below. These sheets are attached in the Appendix to this report.

#### 4.1 Sheet 1a

This sheet is the northern-most of the 5 sheets and covers the area between the eastern end of Champion Road and Saxton Creek.

The Waimea Fault splits into two branches west of Saxton Creek. Outcrops of Marsden Coal Measures occur between the fault branches, Richmond Group rock outcrops to the east of the East Branch and Port Hills Gravels exposures to the west of the West Branch constrain the position of the two fault branches. Recent slips that have occurred since 2011 have provided new exposures of red clays and conglomerate which has helped constrain the location of the Waimea Fault East Branch. Test pitting carried out on Rick and Sarah Griffin's property at 205 Champion Road in October 2013 has constrained the location of the Waimea Fault West Branch, which is approximately located to the south-east of the house at 221 Champion Road. Outcrops on slopes in the vicinity of the Champion Road Reservoir show that the concrete reservoir tank at 226 Champion Road is situated between the two branches of the Waimea Fault.

#### 4.2 Sheet 1

This sheet covers the area between Champion Road and Drysdale Close.

The location of the Waimea Fault West Branch on this sheet is well constrained by test pits, fault trenches and boreholes (investigations by Tonkin & Taylor Limited) and therefore a narrower fault zone envelope is plotted because the fault location is known to a greater level of certainty. A fault scarp at 144 Champion Road has vertically offset the Champion Road fan deposits by 1.5m and defines the approximate location of the Waimea Fault West Branch which is hidden beneath the fan gravels. This scarp was investigated by trenching in 2014 and is evidence of vertical movement on this fault branch during the Holocene Period i.e. during the past 12,000 years. Further west another trench logged by Tonkin and Taylor Ltd (T&T) above 134 Champion Road has accurately defined the location of this fault branch. Detailed geotechnical investigations (including test pits and particularly boreholes) by T&T on the St Leger Group property south-east of Highland Drive have constrained the position of the Waimea Fault West Branch. Also test pits by T&T near the eastern end of Drysdale Close have identified the Waimea Fault West Branch as being located on the boundary between Lots 6, 8 and Lot 10 Drysdale Close, thereby enabling a narrow fault zone envelope to be plotted.

The location of the Waimea Fault East Branch is well constrained by test pits and fault trenches at 208 and 216 Champion Road and therefore has been plotted as a relatively narrow envelope. The fault is well exposed on the cut batter of the road leading up to the new Richmond East High Level Reservoir Tank as well as in the bed of the south branch of Saxton Creek and in a test pit exposure near the western boundary of 216 Champion Road. Optically stimulated luminescence (OSL) dating carried out in 2013 at the fault exposed in the road cut batter has revealed that the Waimea Fault East Branch has had no movement in the past 40,000 years. To the west of 216 Champion Road in the St Leger Group property the fault zone is characterised by a band of reddish clays and the fault zone envelope has been plotted with more width to allow for the greater spacing between outcrops. At the western part of Sheet 1 the fault enters the property of the Griffin Family Trust to the south-east of Drysdale Close and the fault zone envelope is plotted 14m wide as there are a large number of test pits which have identified the fault or constrained the location in a narrow band. The fault is characterised here by a band of red sheared clays up to 4m wide.

#### 4.3 Sheet 2

This sheet covers the area between Drysdale Close and Reservoir Creek to the south of Cropp Place.

The location of the Waimea Fault West Branch is well constrained by test pits and fault trenches south of 41 and 43 Park Drive and then trends south-westwards to run between 24 Angelus Avenue and 48a Selbourne Avenue (based on test pit logs which record Marsden Coal Measures on Lot 48a and Moutere Gravels on Lot 24). The fault zone envelope is shown as a wider zone near the northern boundary of 55 Selbourne Avenue where two boreholes logged by Golder Associates in 2004 have constrained the fault location (BH1 on the driveway west of the 55 Selbourne Avenue house recorded Marsden Coal Measures Formation and BH2 near the south boundary of 26 Angelus Avenue recorded weathered gravels inferred to be Port Hills Gravel Formation). This wide fault zone envelope continues southwest to cross through the lower part of Cropp Place. Marsden Coal Measures sandstone was exposed during the construction of Cropp Place (Dr. Mike Johnston pers. comm.). The fault zone envelope then crosses to the west of Reservoir Creek where its location is constrained by exposures of Moutere Gravels and Marsden Coal Measures above the driveway of 25b Marlborough Crescent at the western part of the sheet.

The location of the Waimea Fault East Branch is well constrained by numerous test pits and fault trenches across the hillside property of Griffin Family Trust to the south of Park Drive and is plotted as a 14m wide envelope. The fault zone envelope crosses through the Council Reserve below 11, 27 and 23 Cropp Place (where recently mapped outcrops and the location of red clays constrain its position) and then crosses 37 Cropp Place (where fresh exposures of Marsden Coal Measures in a small tributary branch of Reservoir Creek have constrained the fault location). On the slope west of Reservoir Creek the location of the fault is positioned to the south of the abandoned Cambrian Coal Mine (located approximately 60m south-east of the house at 25b Marlborough Crescent) and is constrained by test pits logged by Swanney Geotechnical and Civil Engineering at 25b Marlborough Crescent, which identified Richmond Group rocks to the south of the fault and Marsden Coal Measures to the north of the fault (test pits are located south of the house on the lot).

#### **4.4 Sheet 3**

This sheet covers the area between Cresswell Place and Marlborough Crescent.

The fault zone envelope on this sheet is plotted as a single zone because it appears likely the two branches of the fault have merged to become one fault or that the band of Marsden Coal Measures is very narrow. The fault zone envelope is shown as a wider zone due to less outcrop information and due to a lack of test pit or borehole data. Outcrops of Richmond Group indurated sedimentary rocks and andesite of the Park Volcanics to the south constrain the southern positions of the fault zone envelope and it is likely that the Waimea Fault is located on or near a prominent break of slope to the south of the properties on Marlborough Crescent (where the slope noticeably steepens), which also has several groundwater seepages associated with it. Near the western edge of the sheet the fault zone envelope has been narrowed near the north-eastern corner of 13 Cresswell Place where the position is constrained between observed Richmond Group sedimentary rock outcrops at the house building platform and Moutere Gravels observed in pole holes of a timber retaining wall on the north boundary of the lot.

#### **4.5 Sheet 4**

This sheet covers the western part of the study area between Barrington Place and Cushendall Rise.

The fault zone envelope is shown as a single zone due to the fact the Marsden Coal Measures are very narrow as indicated by outcrops and test pit logs in the vicinity of Valhalla Drive. The fault zone envelope is shown as a narrow zone where it has been identified by GEOadvice Ltd in two fault trenches at 45 Kihilla Road and in a cut batter opposite 10 Valhalla Drive. Further west the fault position is constrained by test pit data and outcrop mapping carried out by Soils and Foundations Limited at 4 Valhalla Drive and at lots on Cushendall Rise.

## **5 Discussion**

The plans of the fault zone envelope provided by MWH and the information in this technical memorandum are intended to assist Council in the revision of the FRR hazard overlay for the TRMP.

The specific boundaries of the revised FRRA will need to be decided by Council.

Geological data derived from test pits, borehole and outcrops has been previously supplied to Council. Copies of field sheets have also previously been supplied to Council.

## 6 Recommendations

We make the following recommendations:

- When new information from future geotechnical investigations and from newly exposed outcrops (due to excavations, erosion or slips) becomes available then Council should revise the FRRA boundaries in light of this data.
- Where geotechnical investigations reveal new exposures of the Waimea Fault then these exposures should be surveyed so that the fault position can be accurately recorded by Council.

## 7 Limitations

*This Project Technical Memorandum has been prepared for the benefit of the Tasman District Council. No liability is accepted by this company or any employee or sub-consultant of this company with respect to its use by any other person.*

*This disclaimer shall apply notwithstanding that the Project Technical Memorandum may be made available to the Nelson City Council and other persons for an application for permission or approval or to fulfil a legal requirement.*

*Data from subdivision geotechnical reports and geotechnical reports held in Council files has been used to assist in compiling the plans attached to this technical memorandum. MWH cannot verify the accuracy of this data.*

*The interpretations as to likely subsurface conditions and geology contained in this report are based on the site observations and field investigations at discrete locations as described in this report. MWH accepts no liability for unknown adverse ground conditions.*

## 8 Attachments

- Sheets 1a, 1, 2, 3, 4 Topographic Plans with Waimea Fault Zone Envelope (5 sheets)
- Sheets 1a, 1, 2, 3, 4 Aerial Photograph Plans with Waimea Fault Zone Envelope (5 sheets)
- Index Sheet for Plan Locations
- Figure 1 Waimea Fault Zone and Geology