



Ministry for the
Environment
Manatū Mō Te Taiao

Planning for Development of Land on or Close to Active Faults

**A guideline to assist resource management
planners in New Zealand**

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Note: This version of Planning for Development of Land Around Active Faults does not contain the photographs and maps of the original. Where possible pictures and maps have been replaced by text for the benefit of those persons who do not have ability to view maps or photographs on the computer.

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1 Introduction

Controlling the development of land on or close to active faults is a Resource Management Act 1991 issue. These guidelines provide direction on land use planning approaches for land on or close to active faults. They aim to help local authorities minimise the hazard risk and the time it takes for individuals, communities, and the government to recover from a fault rupture.

The guidelines aim to assist planners, emergency managers, earth scientists, and people in the building industry to avoid or mitigate the fault rupture hazard.

It is hoped that use of these guidelines will help to avoid or mitigate the risks associated with building on or close to active faults. Different planning approaches are appropriate in different areas – councils can establish appropriate policies and criteria which are more or less restrictive than those represented here if necessary.

A working party of representatives from the Institute of Geological & Nuclear Sciences, Geological Society of New Zealand, New Zealand Society for Earthquake Engineering, BRANZ, Earthquake Commission and Ministry for the Environment developed these guidelines. Consultation took place with members from various local authorities. The collaborative approach drew together a range of expertise from professions that have an interest in land use issues and hazard risk reduction.

Note that these guidelines are only concerned with the avoidance and mitigation of risk arising from active fault rupture. They do not discuss other earthquake-related hazards, such as strong ground shaking, liquefaction, uplift, subsidence, landslide and tsunami.

1.1 Why we developed the guidelines

New Zealand's precarious location at the edge of two converging tectonic plates means we are subject to natural hazards like earthquake shaking, earthquake fault rupture, and land deformation. As these tectonic plates continue to move, New Zealand will continue to be subject to earthquake-related hazards.

In March 2001, the Parliamentary Commissioner for the Environment (PCE) released the report *Building on the Edge – The Use and Development of Land On or Close to Fault Lines*. The Commissioner's investigation arose following public concern that local authorities were not able to adequately manage the use and development of land on or close to active faults.

The PCE report focused on the Building Act 1991 and the Resource Management Act 1991 (RMA). It reached a number of key conclusions:

- There is no technology to prevent earthquake damage to buildings built across faults.
- Few territorial authorities identify and plan for seismic hazards, despite their responsibilities for subdivision and land use.
- Practical guidelines are urgently needed to reduce the risks associated with fault rupture.

Recommendation 1 (below) of the PCE report was the catalyst for the development of these guidelines:

The Ministry for the Environment [is] working together with the Institute of Geological and Nuclear Sciences and other interested organisations with structural and geotechnical expertise to develop best practice guidelines for territorial authorities in avoiding or mitigating seismic hazard through the district plan process.

We suggest that users of these guidelines also read the PCE report, to gain an overview of active fault and land use issues.

1.2 Summary of the contents

The first part of this guide (sections 2–9) focuses on the need for a risk-based approach to planning for land use on and near active faults. It recommends that councils:

- identify active faults in their district, with maps that are at the right scale for the purpose
- create fault hazard avoidance zones on their district planning maps
- evaluate the fault rupture hazard risk within each fault avoidance zone
- avoid building within fault hazard avoidance zones where possible
- mitigate the fault rupture hazard when building has taken place or will take place within a fault hazard avoidance zone.

The main elements of the risk-based approach are:

- the fault recurrence interval, which is an indicator of the likelihood of a fault rupturing in the near future
- the fault complexity, which establishes the distribution and deformation of land around a fault line
- the Building Importance Category, which indicates the acceptable level of risk of different types of buildings within a fault avoidance zone.

The second part of this report (sections 10–11) discusses the role of regional councils and territorial authorities in planning for fault rupture hazard. Section 11 describes how councils can take a risk-based approach to establishing resource consent categories for buildings within a fault hazard avoidance zone.

2 Principles for Planning Approaches

The information in this guide is based on the four over-arching principles below. However, past planning decisions have not always taken this approach. The principles recognise that a different planning approach is needed for an area that has not been developed (a greenfield site) and an area that has been developed or subdivided, or where there exists an expectation to build. Defining a greenfield site is something that each council needs to do. It may be an area where there is currently no expectation to build (eg, no zoning for intensive development) or may be an undeveloped area of a certain defined size (eg, < 20 acres).

2.1 Principle 1: Gather accurate active fault hazard information

Identifying and accurately locating hazards on planning maps is an essential step towards communicating hazard risk and mitigating hazards. Collecting information will often require specialised scientific knowledge and surveys. Maps showing the location of hazards around property boundaries must be developed at the right scale. Because the existence of a particular hazard may have a major effect on a decision to purchase or build on a property, all information on hazards should be as accurate as technology and resources permit.

2.2 Principle 2: Plan to avoid fault rupture hazard before development and subdivision

Building away from areas of fault rupture can avoid, or certainly mitigate, the fault hazard risk. For example, a new subdivision can be required to avoid building in an area of fault rupture (a *fault avoidance zone* in the district plan). This is the safest and most satisfactory long-term solution for current and later landowners and for the territorial authority. It can also be achieved for little or no extra cost (although it is recognised that loss of development opportunities are a cost to the developer).

2.3 Principle 3: Take a risk-based approach in areas already developed or subdivided

If land has already been subdivided and sites have been purchased, there is an expectation that building on these sites will be allowed. Planning for land use in a fault avoidance zone helps to avoid or mitigate the hazard risks caused by land-use intensification (such as urban infill) and inappropriate building.

These guidelines propose a risk-based approach, based on risk management standard AS/NZS 4360:1999. This standard takes into account the fault recurrence interval and fault complexity, and the Building Importance Category of the building proposed for the site.

This approach does not guarantee that a building will not suffer damage from fault rupture in an earthquake. It does establish that the risk of damage is sufficiently low to be generally accepted.

2.4 Principle 4: Communicate risk in built up areas subject to fault rupture

One of the most difficult problems concerning fault rupture hazard is dealing with urban areas where buildings have already been constructed on or close to an active fault. One of the clearest examples of this situation is the suburb of Thorndon in Wellington. Although the risk posed by building in such a location is obvious to us now, it was not clear when urban subdivision started in New Zealand in the 19th century.

The ideal approach in this situation would be to avoid further development in high-risk areas, to limit existing use rights to rebuild, and to limit the use of buildings.

The most realistic approach, however, is to accept the status quo whilst ensuring that:

- any further development and use of buildings is consistent with the level of risk posed
- district plan maps clearly show fault rupture hazard zones.

Non-regulatory approaches, such as hazard education programmes and incentives to retire at-risk land, would also ensure that landowners and building occupiers are made aware of the hazard, and the probability of future fault rupture.

3 Understanding Earthquakes and Active Faults

3.1 Introduction to terminology

A **fault** is a fracture in the Earth's crust. The opposite sides of the fracture are held together by pressure and friction, but as stress builds up a fault may suddenly rupture. In a large rupture, shock waves cause the earth to shake violently and produce an **earthquake**.

Earthquakes occur along a rupture referred to as a **fault plane**. The fault plane may extend some distance below the earth surface. The point at which the fault plane starts to rupture is known as the focus or origin. The location on the surface of the earth immediately above the focus is called the **epicentre**.

In a large earthquake, the fault rupture may extend up to the ground surface, and suddenly form a **fault scarp** (the disrupted land form created by the rupture). Because the fault plane is not always vertical, areas of surface faulting or fault scarp may occur some distance away from the epicentre of the earthquake that generated them.

All buildings close to the epicentre of a large shallow earthquake will be strongly shaken, and this shaking causes most of the earthquake damage. Any building sited across a fault scarp is likely to suffer more damage, especially if the foundations are offset.

Examples of damaging fault scarp displacement around New Zealand are not difficult to find. For example the 1987 Edgecumbe earthquake resulted in about 7km of surface rupture along the Edgecumbe fault, and up to 2m of vertical displacement of the ground surface at the fault (Beanland *et al* 1989). The 1929 Murchison earthquake resulted in over 4m of vertical displacement of the ground surface at the White Creek fault (Berryman 1980), creating a terrace which was insurmountable to traffic on a local road.

An **active fault** is a fault that has ruptured repeatedly in the past, and whose history indicates that it is likely to rupture again. An active fault creates a **fault hazard risk**. The level of that risk depends on the fault **recurrence interval** (section 7), **fault complexity** (section 8), and nature of development in the area.

New Zealand geological maps use a distinctive colour for faults that have moved in the last 120,000 years. This is generally regarded as the upper limit for a fault to be classified as active. Most of New Zealand's major active faults have been identified and mapped, at least on small-scale maps.

Faults may show horizontal offset, vertical offset, or a combination of the two. The following is a list of historic surface fault ruptures that have accompanied major earthquakes over the last 160 years:

1. 1848: the Awatere earthquake in Marlborough created strike slip displacement with a maximum surface offset of 7 metres
2. 1855: the Wairarapa earthquake created strike slip displacement with a maximum surface offset of 13 metres
3. 1888: the Hope earthquake in North Canterbury (Glenn Wye) created strike slip displacement with a maximum surface offset of 3 metres

4. 1929: the White Creek earthquake at Murchison created “reverse and strike slip” displacement with a maximum surface offset of 4 metres
5. 1931: the Napier earthquake created reverse and strike slip displacement with a maximum surface offset of 2 metres
6. 1934: the Pahiatua earthquake created a reverse displacement with a maximum surface offset of 4 metres
7. 1968: the Inangahua earthquake created a reverse displacement with a maximum surface offset of 1 metre
8. 1987: the Edgecumbe earthquake created a normal displacement with a maximum surface offset of 2 metres.

A map of active faults in New Zealand would show that faults with a fault rupture recurrence interval of less than 2000 years are:

- grouped in a series of short fault traces to the southwest of Turangi through the National Park area
- grouped in a broad band of fault traces running northeast from Taupo township through to the Bay of Plenty near Matata and Whakatane
- follow the mountain ranges of the lower North Island, through western Hawke’s Bay to the Huirau Ranges near Lake Waikaremoana
- follow a line north east from near Milford Sound along the Southern Alps, splitting into four or more branches near Otira with one branch following along the Wairau River valley, with others fanning out along alignments similar to the inland and seaward Kaikoura Ranges
- follow a line northeast from Lake Coleridge toward the northern end of Pegasus Bay.

A map of active faults in New Zealand would show that faults with a fault rupture recurrence interval of greater than 2000 years are:

In the North Island:

- scattered along the west coast of the lower North Island, with short traces visible running parallel, and inland from, the coast from Wellington to the Kapiti; traces along the foothills of the Tararua ranges and northern Manawatu / Rangitikei; and a series of short traces running from the coast up to 20km inland between Hawera and Wanganui;
- a short fault in Taranaki running from the coast, inland to near Rahotu, north of Opunake
- two short, inland, faults near Inglewood
- concentrated in a broad band of short traces running from Cape Kidnappers to Waipawa
- follow the eastern side of the Tararua Ranges, with two traces originating near Masterton and Carterton running northeast towards an area near Castlepoint

- in the eastern Bay of Plenty, running in several lengthy faults from near Lake Waikaremoana northwards to an area between Whakatane and Opotiki; and a series of short faults running from the coast, inland, between Opotiki and Te Kaha
- a series of short faults inland along the East Coast of the North Island, spread from an area inland of Waipiro southwest to Wairoa
- a lengthy fault running from the Firth of Thames inland towards an area west of Matamata
- a fault running from the southeastern edge of the Auckland urban area southwards to an area east of Pukekohe
- two faults running from parallel to Lake Wairarapa.

In the South Island:

- a series of more than six faults running approximately north-south, inland from Westport, the southern-most being from an area near Reefton to Ahaura, with the others running parallel to the coast inland from around Murchison as far north as Tadmor
- a series of faults forming an irregular line from an area near the Lewis Pass northwards towards Richmond
- a band of faults contained in an area between the Smyth Range, Mayfield, Puketa (south of Kaikoura) and Hanmer Springs
- a single fault running along the Awatere River valley
- an irregular dog-legged fault running from an area near Lake Pukaki southward through Twizel, Omarama and the Dunstan Mountains
- a fault running along the eastern edge of lake Wanaka, southwards in an irregular line towards an area near Lumsden
- a short fault on the east coast, running north-south from, approximately, the Teieri River mouth to the Tokomairiro River
- a short fault running north-south near Mosgiel
- a loose scattering of faults in an area around Cromwell, Clyde, Alexandra, Roxburgh and south of Naseby.

4 Taking a Risk-based Approach

4.1 Using a risk management standard

We recommend that councils use this risk-based approach, based on risk management standard AS/NZS 4360:1999, when they develop provisions for their district plans.

This risk-based approach combines the key elements of fault recurrence interval (section 7), fault complexity (section 8), and Building Importance Category (section 9).

Key points to remember about the fault recurrence interval, fault complexity, and Building Importance Category are:

- **Fault Recurrence Interval:** The longer the recurrence interval of an active fault, the lower the risk that the fault will rupture in the near future.
- **Fault Complexity:** A fault rupture with a wide and distributed deformation is lower risk than a narrow, well-defined fault line.
- **Building Importance Category:** The Building Importance Category shows the need for an assessment of the suitability of a building in a fault avoidance zone.

4.2 Summary of the steps

There are six steps involved in the recommended risk-based approach. Note that this approach depends upon accurate information and mapping of active faults. Identifying and mapping faults are part of the *Gathering information* stage of district plan preparation.

- Step 1:** Identify where the active faults are in the district. The Institute of Geological and Nuclear Sciences hold maps of these which can assist.
- Step 2:** Create “avoidance zones” around the active faults identified. Check to see whether the fault lies in a greenfield site or not, whether the area is already developed, and whether there is an expectation or not of future building.
- Step 3:** Identify the nature of the fault rupture hazard risk. To do this you need to ask what is the likelihood of rupture in the fault avoidance zone (ie, the *Fault recurrence interval*)? And what is the nature of the fault in the fault avoidance zone (ie, the *fault complexity*)?
- Step 4:** Analyse and evaluate the level of risk to subdivision and development. What is the proposed use of the site? What is the construction type proposed, and the nature of its response to fault rupture movement? (*Building Importance Category*).
- Step 5:** Treat the risk. What action should be taken to avoid or mitigate the risk within the fault avoidance zone?
- regulatory planning methods
 - non-regulatory methods

- limiting the risk posed by the building.

Step 6: Monitor and review. Is the council achieving the outcomes which it established? Is there new information that needs to be considered? Do changes need to be made to the council's district plan?

5 Mapping Active Faults

5.1 The importance of mapping

Faults must be accurately located, and mapped at a scale appropriate for end-use purposes to enable planners to make decisions about land use on or close to active faults.

Geologists with particular experience of mapping faults are the most appropriate professionals to investigate, locate and assess active faults. Engineers with recognised qualifications and experience in geotechnical engineering are also able to investigate faults.

Active faults are complex and often have multiple breaks. A number of methods and evaluative tools need to be used in investigation.

Once a fault has been accurately located and assessed, the fault features should be clearly marked out (for example, pegged) so they can be surveyed onto cadastral maps.

5.2 Required scale of fault maps

For planning purposes, faults should be mapped and classified at a minimum scale of 1:10,000. At present, few local authorities have mapped active faults to this scale, instead relying on existing fault maps for indicative purposes. This can create severe limitations for land use planning.

Most of New Zealand's major active faults are mapped on small-scale geological maps (such as 1:250,000 or 1:50,000 scale). This does not provide adequate detail for planning purposes, where detail to at least property boundary level is often required. Lines representing fault lines on maps of 1:250,000 scale could, for example, be the width of two or three residential sections if laid out on the actual ground (at 1:1 scale) and could end up being wider than the fault they represent.

A map should only be interpreted at the scale it is compiled at. Geological maps in New Zealand are often published at the 1:250,000 scale. If a 1:250,000 scale map is reproduced at a 1:10,000 scale (as it often is, especially on photocopiers) the fault will be inaccurately portrayed and its placement interpreted wrongly. The fault will appear much wider than it is in reality and the accuracy of the true alignment can be lost. A key mistake that can result is thinking that a fault intersects a particular property when it does not. Faults shown on planning maps at 1:10,000 scale must be compiled, and features located, at a scale consistent with the intended end use.

6 Fault Avoidance Zones

6.1 Definition

A **fault avoidance zone** is an area created by establishing a buffer zone either side of the known fault trace (or the identified likely fault rupture zone that appears on the land surface). These Guidelines recommend a minimum buffer zone of 20 metres either side of the known fault trace or likely fault rupture zone.

Twenty metres has been chosen because intense deformation and secondary ruptures are commonly experienced as a result of fault movement within this distance from the primary plane of the fault rupture. These effects can occur because near-surface weak materials deform instead of breaking cleanly, and structures built near an area of fault rupture can cause surface rupture to divert around them unpredictably. Twenty metres also represents a precautionary approach to ensure a level of safety in regard to the protection of life. However detailed fault studies which may be undertaken may show that fault deformation is less extensive than 20 metres from the end or edges of the fault trace allowing a reduction in the size of the fault avoidance zone.

Defining a fault avoidance zone on district planning maps, and supporting it with policies and methods (including rules) will allow a council to:

- restrict development within the fault avoidance zone
- take a risk-based approach to development in built-up areas.

The determination of the extent of a fault avoidance zone is closely related to *fault complexity* (refer section 8). A wide and complex likely fault rupture zone is likely to have a significant fault avoidance zone.

Displacement across a fault usually decreases with its distance from the fault trace. The fault avoidance zone can be reduced if a detailed fault study shows that the zone of intense deformation and secondary rupture is less than 20 metres from the likely fault rupture zone.

7 Fault Recurrence Interval

7.1 Definition

The **fault recurrence interval** is the average time between surface ruptures on a fault. The Institute of Geological and Nuclear Sciences consider it is the best measure to use when evaluating the hazard risk of an active fault.

Historical and geological evidence shows that faults rupture repeatedly along the same narrow fracture. For example, there is evidence of two major fault ruptures on the Wellington Fault within the last 700 years, each with a horizontal offset of about four metres. There is also evidence of a total offset of almost one kilometre on the Wellington Fault in the last 140,000 years, indicating at least 200 major earthquake ruptures during this time. Along the Wairarapa Fault, up to 130 metres has been displaced along the same fault scarp that first ruptured in 1855. This indicates that multiple surface ruptures have occurred in the same location along the same fault scarp.

Faults with short recurrence intervals are generally more likely to rupture in the near future than faults with a longer recurrence interval. It is important to remember that this is a statistical measurement only, and may not be an accurate predictor of future movement on a fault. For example, although the White Creek Fault has a long recurrence interval of more than 20,000 years it ruptured in the 1929 Murchison earthquake.

Detailed investigation, usually involving trenching, is needed to determine the fault recurrence interval.

Recurrence intervals of surface rupture on New Zealand faults range from several hundred years (for example, the Hope and Alpine faults) to tens of thousands of years (for example, the Waverly, Whitemans and White Creek faults).

Fault recurrence intervals can be divided into six **Fault Interval Classes**:

- I. Less than or equal to a recurrence every 2,000 years
- II. Recurrence between 2,000 and up to and including 3,500 years
- III. Recurrence between 3,500 and up to and including 5,000 years
- IV. Recurrence between 5,000 and up to and including 10,000 years
- V. Recurrence between 10,000 and up to and including 20,000 years
- VI. Recurrence between 20,000 and up to and including 125,000 years.

The fault recurrence interval measure can also be related to accepted levels of risk in the current Building Code. Appendix 1 gives details of most of New Zealand's known active faults, and indicates which regional council jurisdictions these faults fall within. It also gives a confidence rating of these faults' average recurrence intervals.

8 Fault Complexity

8.1 Definition

Fault complexity refers to the width and distribution of the deformed land around the fault trace.

Many faults appear to be simple, almost-straight linear features, on the ground surface with a narrow zone of deformation only a few metres wide. Sometimes they will take on the appearance on a terrace (such as that which can be seen along the Wellington fault at Totara Park, Upper Hutt) or a change in topographical alignment along a linear axis (such as along the Wairau fault in Marlborough where between 3 and 5 metres of lateral displacement can be seen).

Other faults appear less well defined, and have a complex distributed zone of deformation. The Ostler fault (in the MacKenzie Basin near Twizel) takes the form of an irregular crease with meanders, variable changes in vertical displacement in a band of land deformation which varies greatly in width either side of the fault.

Fault Complexity Classifications:

Faults can be grouped into a three-fold classification in regard to their complexity:

- Class A: **Well Defined:** a fault trace of limited geographic width, typically a few metres to a few tens of metres wide.
- Class B: **Distributed:** deformation is distributed over a broad geographic width up to hundreds of metres in width, sometimes with multiple fault traces, folds, or both.
- Class C: **Uncertain:** The location of the fault trace(s) is uncertain as it either has not been mapped in detail or it cannot be identified. This is typically a result of gaps in the traces(s) (ie, the fault takes on the appearance of being broken up into segments), or erosion or coverage of the traces(s).

Recent fault location studies (refer case studies section 12) have shown that certain faults can demonstrate all three levels of fault complexity at different parts of the fault. Variations on the three types of complexities discussed above may therefore be warranted.

9 Building Importance Category

9.1 Definition

It is not always possible to avoid building within a fault avoidance zone. Past land development decisions may have resulted in buildings being within a fault avoidance zone, or have given people an expectation that they are able to build there now. In addition, where the level of certainty is low regarding the fault location, its complexity and recurrence interval, it may be difficult to justify placing limits on any building in these areas.

Buildings within a fault avoidance zone, particularly buildings crossing active faults, are very likely to be damaged in a fault rupture. A **Building Importance Category** states the relative importance of assessing the suitability of a building within, or proposed for, a fault avoidance zone.

The categories are based on risk levels for building collapse according to the building type, use and occupancy. Category one is the least important; category four is most important.

Councils can use Building Importance Categories to make decisions about resource consents (section 11 of this document), and to require conditions on buildings within fault avoidance zones.

There are four **Building Importance Categories**, and one sub-category:

Category 1: Structures presenting a low degree of hazard to life or property.

Examples:

- Structure with a total floor area less than thirty square metres
- Farm buildings
- Isolated structures
- Towers in rural situations
- Fences
- Walls
- In-ground swimming pools.

Category 2a: Residential timber-framed construction

Examples:

- Timber-framed single-storey buildings.

Category 2b: Normal structures and structures not in other categories.

Examples:

- timber framed houses with a floor area of more than 300 square metres
- houses outside the scope of *NZS: 3604 Timber Framed Buildings*
- multi-occupancy residential, commercial (including shops), industrial, office and retailing buildings designed to accommodate less than 5000 people and also those less than 10,000 square metres gross area
- public assembly buildings, theatres or cinemas with a floor space of less than 1000 square metres
- car parking buildings.

Category 3: Structures that, as a whole, may contain people in crowds or have contents of high value to the community, or pose a risk to large numbers of people in close proximity.

Examples

- Emergency medical and other emergency facilities not designated as post-disaster facilities
- Buildings where more than 300 people can congregate in one area
- Buildings and facilities with primary school, secondary school or day care facilities with a capacity greater than 250 people
- Buildings and facilities with greater than 500 for colleges or adult education facilities
- Health care facilities with a capacity of 50 or more residents but not having surgery or emergency treatments facilities
- Airport terminals, principal railway stations, or other transport terminals with a capacity greater than 250 people
- Any occupancy with a capacity greater than 500 people
- Power generation facilities, water treatment and waste treatment facilities and other public utilities not included in Importance Category 4
- Buildings and facilities not included in Importance Category 4, containing hazardous materials capable of causing a hazard or hazardous conditions that do not extend beyond the boundaries of the property on which they are located.

Category 4: Structures with special post-disaster functions.

Examples:

- Buildings and facilities designated as essential facilities
- Buildings and facilities with special post-disaster functions
- Medical emergency or surgical facilities
- Emergency service facilities such as fire stations, police stations and emergency service vehicle garages
- Utilities required as backup for buildings and facilities of Importance Category 4
- Designated emergency shelters, emergency centres and ancillary facilities
- Buildings and facilities containing hazardous materials capable of causing a hazard, or hazardous conditions, beyond the site on which they are located.

The relationship between the fault recurrence interval and Building Importance Category in previously subdivided or developed areas, and in greenfield sites are as follows:

- For **Fault Recurrence Interval class I** areas (recurrences up to 2,000 years), **Building Importance Class 1** buildings are allowable in both developed (including previously subdivided) and greenfield areas.
- For **Fault Recurrence Interval class II** areas (recurrences between 2,000 years and up to 3,500 years), **Building Importance Class 1 and 2a** buildings are allowable in developed (including previously subdivided) areas, but only **Building Importance Class 1 buildings** are allowable in greenfield areas.
- or **Fault Recurrence Interval class III** areas (recurrences between 3,500 years and up to 5,000 years), **Building Importance Class 1, 2a and 2b** buildings are allowable in developed (including previously subdivided) areas, but only **Building Importance Class 1 and 2a** buildings are allowable in greenfield areas.
- For **Fault Recurrence Interval class IV** areas (recurrences between 5,000 years and up to 10,000 years), **Building Importance Class 1, 2a 2b and 3** buildings are allowable in developed (including previously subdivided) areas, but only **Building Importance Class 1, 2a and 2b** buildings are allowable in greenfield areas.
- For **Fault Recurrence Interval class V** areas (recurrences between 10,000 years and up to 20,000 years), **Building Importance Class 1, 2a 2b and 3** buildings are allowable in developed (including previously subdivided) areas and greenfield areas.
- For **Fault Recurrence Interval class VI** areas (recurrences between 20,000 years and up to 120,000 years), **ALL Building Importance Classes** are allowable in developed (including previously subdivided) areas and greenfield areas.

Note: Faults with recurrence intervals of greater than 125,000 years are not considered to be active.

10 Planning for Fault Rupture Hazard

10.1 The Resource Management Act and the Building Act

Councils need to take a strategic and prepared response to fault rupture hazard in regional policy statements and district plans. A combination of controls through the Resource Management Act (RMA) and the Building Act can avoid or mitigate the effects of fault rupture hazard.

The Resource Management Act 1991 covers land use issues such as the location of a building and the effects of its intended use (amongst others), while the Building Act contains provisions that set legal requirements for a building's construction and the safety and integrity of the structure.

Under the Building Act, all building work must comply with the mandatory Building Code 1992. The Building Code sets out a series of minimum performance criteria for buildings. The council must be satisfied that the criteria of Clause B1 of the Building Code will be met before it issues a building consent. However:

- no guidance is available to councils to help them decide whether a design will comply with Clause B1
- no existing technology will prevent damage to buildings sited across a fault, meaning significant damage can occur even if the Building Code is complied with.

Therefore, relying solely on the Building Act to address the adverse effects of fault rupture is not effective. Councils need to consider and develop a proactive policy response in their district plans, with the Building Act being one of the methods that can avoid or mitigate the risk.

Using controls under the Resource Management Act 1991 and Building Act are just part of a council's response to managing hazards. Protecting essential infrastructure and undertaking civil defence emergency management planning are also required under other Acts, such as the Civil Defence Emergency Management Act 2002.

10.2 Responsibilities under the Resource Management Act

Under the Resource Management Act 1991, both regional councils and territorial authorities have responsibilities for natural hazards. Sections 30 and 31 reflect the fact that some natural hazards are best managed at a regional council level, and others at a territorial authority level.

Section 30 of the Resource Management Act 1991 lists the functions of **regional councils**. They include "the control of the use of land for the purpose of... the avoidance or mitigation of natural hazards". Within the broad scope of their functions regional councils are required to:

- prepare a **regional policy statement**, which helps to set the direction for the management of all resources across the region
- produce **regional plans** where appropriate

- co-ordinate investigations into natural hazards, and maintain information about hazards of regional significance
- integrate the approaches to manage the risk posed by fault rupture, and work with the territorial authorities as to who will do what.

Section 31 of the Resource Management Act 1991 says that **territorial authorities** are responsible for, among other things, “the control of any actual or potential effects of the use, development, or protection of land, including for the purpose of the avoidance or mitigation of natural hazards ...”.

Within the broader scope of their functions territorial authorities are required to:

- prepare a **district plan**, the primary document for setting out district wide policies and managing the effect of land use, including through the control of subdivision
- gather information on hazards associated with land use.

Generally, provisions in the regional policy statement should set out what approach the district plan will take. The district plan should contain the specific policies to address hazard risk, and any controls concerning land use and fault rupture.

10.3 Agreement among councils

Regional councils and territorial authorities must agree on their respective responsibilities for managing hazards under the Resource Management Act 1991. It is not effective for councils in the same region and subject to the same hazards to work independently.

The way that councils work together to reach agreement will depend on the issues and resources within each district in a region. Councils can reach agreement:

- during the regional policy statement development process
- by consulting during plan or policy statement preparation
- through a Memorandum of Understanding (MOU).

The issues that need to be agreed on include:

- who will be the key information provider (and what this information is)
- who will identify and map hazards
- who will carry out education and communication campaigns
- who will be responsible for planning and responding to hazards (under the Resource Management Act 1991 as well as a Civil Defence response)
- who will develop and implement specific hazard mitigation plans for particular hazards

- who will be responsible for writing objectives, policies, and rules in plans.

Section 62(1)(i)(i) of the Resource Management Act 1991 says that a regional policy statement must state “the local authority responsible in the whole or any part of the region for specifying the objectives, policies, and methods for the control of the use of land to avoid or mitigate natural hazards or any group of hazards”. If the regional policy statement does not clarify these responsibilities, then they default to the regional council.

However, territorial authorities issue building consents, and control the subdivision of land and most land uses. District plans are usually the best place to control land use to avoid or mitigate fault rupture hazard.

10.4 Role of the regional policy statement

One of the matters which need to be contained in a regional policy statement is to identify the regional council’s and territorial authority’s agreed responsibilities for planning for fault hazards.

The regional policy statement should therefore:

- state clearly which council (regional or district) has the primary responsibility for dealing with fault rupture
- be quite specific as to what each will do.

For example: the regional council will co-ordinate hazard investigation, and the district councils will develop objectives, policies and methods to control use of land to avoid or mitigate fault rupture hazard.

In one of its objectives Environment Waikato recognises the need for the regional and district councils to agree on their roles:

- *“The roles of all relevant agencies for the management of natural hazards in the Waikato Region clearly identified and their responsibilities consistently implemented”* (Waikato Regional Policy Statement)

The Greater Wellington Regional Council (GWRC) spells out the division of responsibilities in a table contained in its Regional Policy Statement. In it, the GWRC:

- takes responsibility for developing objectives, policies and rules for the coastal marine area
- takes responsibility for developing objectives, policies and rules for the beds of river and lakes
- takes primary responsibility for the development of objectives for other land with secondary responsibility allocated to territorial authorities in the region
- takes shared responsibility (with territorial authorities) for the development of policies for other land in its region

- takes secondary responsibility for the development of rules for other land in its region (territorial authorities have primary responsibility).

10.5 Provisions in a regional policy statement

A regional policy statement also:

- provides an overview of the resource management **issues** facing the region
- sets region-wide **objectives** and **policies**
- identifies the **methods** to be used across the region to address the objectives and implement the policies.

Regional policy statement provisions tend to be reasonably generic (for example, by considering all natural hazards within the same objective or policy). However, a regional council can be more specific if it wishes, and can set a clear policy direction for the districts to follow. The regional policy statement can identify fault rupture hazard as an issue across the region, and then state the objectives and policies that explain how the issue will be addressed.

Regional policy statements also tend to have similar **objectives**. The objective is usually to avoid or mitigate the adverse effects of natural hazards on life, property and the environment.

For example:

- *“To avoid or mitigate the adverse effects of natural hazards upon human life, infrastructure and property, and the natural environment”* (horizons.mw Regional Policy Statement)
- *“Any adverse effects of natural hazards on the environment of the Wellington Region are reduced to an acceptable level”* (Wellington Regional Policy Statement)
- *“To avoid or mitigate natural hazards within the Taranaki region by minimising the net costs or risks of natural hazards to people, property and the environment of the region”* (Taranaki Regional Policy Statement)

Environment Waikato also seeks to increase public resilience to natural hazards:

- *“The adverse effects associated with natural hazards minimised, the resilience of the community and public awareness of the causes and potential effects of natural hazards events increased”*

Policies in regional policy statements vary, but can be grouped into the following categories:

- raising awareness
- improving knowledge
- imposing planning controls, especially with respect to high risk areas
- preparing for hazard events and Civil Defence response.

10.6 Role of the district plan

The district plan should contain the specific policies to address fault rupture hazard risk, and any controls concerning land use and fault rupture.

Section 75(2)(b) of the Resource Management Act 1991 states that a district plan must “not be inconsistent” with the regional policy statement.

Before developing and adopting objectives, policies, and methods for the district plan, councils need to:

- gather information about fault rupture hazards
- assess the risk of fault rupture hazard
- identify and assess earthquake and fault rupture issues.

Plan provisions need to be appropriate to the community’s circumstances. No one policy response to fault rupture hazard will work for all communities within New Zealand. The issues and objectives between districts affected by active faults may be similar, but the methods (or mix of methods) used to address the risk will often be different.

10.7 Gathering information

The first step is to determine whether there are any active faults in the district.

Information can be gathered from:

- the regional council, especially hazard information and hazard maps (the territorial authority might create more detailed maps after assessing the active faults in the district)
- geotechnical information provided as part of resource consent applications
- data gathered from site-specific investigations
- Crown Research Institutes, such as the Institute of Geological and Nuclear Sciences
- private companies involved in the geology, earthquake engineering, and geotechnical professions.

The data may be very general in nature, incomplete, or contain conflicting conclusions. Initial information gathering may show the need for further studies. Data also needs to be kept up to date – section 35(5)(j) of the Resource Management Act 1991 requires councils to keep records of natural hazards that are sufficient for the local authority to discharge its functions effectively.

The cost of obtaining fault data can be expensive and prohibitive for smaller councils. Cost sharing between neighbouring councils and agreements with the regional council may help.

The most hazardous faults in the district need to be accurately located, surveyed and mapped in enough detail to provide accuracy at property boundary level (a scale of 1: 5000 to 1: 10,000). This enables the development of appropriate objectives, policies, and methods.

It is not feasible to map all faults in the district, and not always possible to know where they are. Highest priority needs to be given to faults with recurrence intervals of less than 5000 years, and faults closest to urban areas or set aside for future urban development.

10.8 Assessing the risk

Having identified active faults in its district, the council needs to define a fault avoidance zone around each active fault in the district planning maps. It then needs to assess the fault hazard risk within each fault avoidance zone.

The main elements that determine the risk of fault hazard are the fault recurrence interval and the fault complexity.

The likely displacement along active faults is also important. Vertical and horizontal displacement along the fault plane will result in more damage during a fault rupture.

In assessing the fault hazard risk, the council should also take account of:

- community values and expectations (what the community wants and what it does not want)
- which areas of the district are, or are likely to be, under pressure for development
- what infrastructure already exists near faults (buildings, network utilities etc) and the value of that infrastructure
- what level of risk the community is prepared to accept or not accept (in practice, it is easier to define what the community will not accept).

Risk assessment requires an understanding of the likely magnitude or consequences of events, and the risks of injury or loss of life and damage to property and investment. It also requires consideration of the cost of clean-up or repair or replacement of damaged property or services after the event.

10.9 Identifying the issues

Gathering information and assessing the risk will determine whether the risk is a significant issue that the community wants addressed. If so, the issue needs to be included in the district plan, and a policy response developed (objectives, policies, and methods, including rules, to address the issue) to help to avoid or mitigate the fault hazard risk.

10.10 Developing objectives and policies

Many district councils take an ‘all-hazards’ approach to developing hazard-related objectives and policies in their plans. This provides simplicity and may be acceptable for an overall hazard objective and some policies. However, a hazard-specific approach is likely to be more effective and easier to implement.

When formulating policies, it is important to focus on the effects that need to be addressed to achieve the objective, and to state how those effects are going to be dealt with.

As in regional policy statements, **objectives** in district plans tend to relate to the territorial authority's statutory function for natural hazards prescribed in section 31 of the Resource Management Act 1991 – to avoid or mitigate adverse effects of the use of land for the purpose of avoiding or mitigating natural hazards.

For example:

- *“The avoidance, remedying or mitigation of the adverse effects of natural hazards on the environment”* (Objective 14.3.1 of the Upper Hutt District Plan);
- *“To avoid or reduce the risk to people and their property from natural hazards associated with seismic action, landslides, flooding and coastal hazards”* (Objective in Section 14H 1.1.1 of the Hutt City Proposed District Plan); and
- *“To avoid or mitigate the adverse effects of natural and technological hazards on people, property and the environment”* (Objective 4.2.7 of the Wellington City District Plan).

The Tasman District Council takes a different approach. Its objective (subject to appeal) is:

- *“Management of areas subject to natural hazard, particularly flooding, instability, coastal and river erosion, inundation and earthquake hazard to ensure that development is avoided or mitigated, depending on risk”* (Objective 13.1.0 of the Tasman Proposed Resource Management Plan).

A less common objective seeks to ensure that land use activities do not increase or worsen the effects of the natural hazard:

- *“Activities and development do not create, accelerate, displace, or increase the effects of a natural hazard”* (Objective 31.2.2 of the Proposed Taupo District Plan)
- *“Safe land use practices which do not increase the risk of adverse effects from natural hazards on the environment, people and their property”* (Objective 11.2.3 of the South Waikato District Plan).

The use of a specific earthquake objective is rare. Examples include:

- *“To minimise the risk from earthquakes to the wellbeing and safety of the community”* (Objective C12.1 of the Porirua City District Plan)
- *“To minimise the risks of earthquakes affecting people and property in the District as far as practicable”* (Objective 5 in Section 3.2 of the Matamata Piako Proposed District Plan).

In low-risk areas, the objective may instead seek to improve knowledge of potential risk:

- *“Increase Council and community understanding of the earthquake risk and associated natural hazard”* (Objective 8.3.1 of the Waimakariri Proposed District Plan).

Policies in district plans generally fall into the same groupings as in regional policy statements, but are at a more detailed level. Essentially, policies can specify:

- collection of information, development of a hazards register or database, and identification of at-risk areas
- provision of information and advice, to raise public awareness and to encourage good practices
- inclusion of controls in plans, so that activities are located and designed to avoid or mitigate adverse effects in at-risk areas
- required standards for emergency responses and essential services following an earthquake event.

For example:

- *“To develop a database on natural hazards including implementing a hazards identification system for risk assessment”* (Policy 15.2 of the Masterton District Plan)
- *“Promote community awareness of natural hazards to encourage avoidance of adverse effects of hazards”* (Policy 5 in Section C.15.1 of the Kapiti Coast District Plan)
- *“In areas of known susceptibility to natural hazards, activities and buildings are to be designed and located to avoid, remedy, or mitigate, where practicable, adverse effects of natural hazards on people, property and the environment”* (Policy 14.4.2 of the Upper Hutt District Plan)
- *“To provide warnings and emergency response systems for areas at risk from or affected by natural hazards”* (Policy 13.1.6 of the Tasman Resource Management Plan).

Hutt City has a policy specific to fault rupture in its plan:

- *“That the area at risk from fault rupture causing permanent ground deformation along the Wellington Fault be managed by the Wellington Fault Special Study Area to address the effects of subdivision and development on the safety of people and their property”.*

South Waikato acknowledges the importance of working with the regional council on hazard issues in its district plan policies:

- *“To work with Environment Waikato to develop measures to ensure that land use practices do not cause or promote natural hazards”* (Policy 11.3.6 of the South Waikato District Plan).

10.11 Developing methods

Although it is not practical or possible to eliminate fault rupture hazard risk completely, doing nothing is not an option. Methods should be developed specifically to address the effects of fault rupture.

The plan needs to contain methods that address different aspects of the risk: what is the likelihood of the hazard occurring? What are the consequences? Does the risk need treating?

District plan rules are not necessarily the only option – a mixture of rules and other methods can be adopted. The exact makeup will vary, depending on the level of risk and the outcome of the section 32 analysis (see below).

Methods can become more permissive as the risk of fault rupture decreases, for example by:

- allowing a greater range of buildings to be located in an area of fault rupture
- allocating a less restrictive consent activity category
- relying more on the Building Act for controls
- relying more on non-regulatory approaches such as education and advocacy.

10.12 Non-regulatory methods

Non-regulatory methods are good for encouraging people to avoid putting themselves at risk. One of the more important things a council can do is communicate the risk to the community.

Some of the non-regulatory methods available to councils include:

- purchasing at-risk land for passive recreational purposes
- exchanging at-risk land with land that can be put to some other purpose
- allowing greater development rights if land is retired or covenanted
- taking at-risk land as a condition of subdivision consent (reserves contribution)
- using financial incentives (for example, rates relief on at-risk land if it is not built upon)

- promoting and helping fund the use of covenants (privately or through the QEII National Trust) for the voluntary protection from development of open space on private land
- educating to raise awareness of the risk and to encourage people to locate buildings away from the fault rupture hazard
- using the Building Act to ensure that structures are safe and will remain intact throughout the life of the building
- including fault hazard information in Land Information Memoranda (LIM) and Project Information Memoranda (PIM) reports.

Fault avoidance zones still need to be clearly identified on district plan maps if non-regulatory methods are used. This ensures that risk is communicated, and that landowners and building occupiers can be made aware of the hazard.

10.13 Regulatory methods (rules)

Building within a fault avoidance zone should be discouraged wherever possible. Even when a fault has a long recurrence interval, the chance exists that the fault may move during the lifetime of a building.

Rules in the district plan can allow development in a fault avoidance zone only if resource consent is granted. This approach is suitable for well-defined faults, or distributed faults that have been accurately located. Section 11 describes how the fault recurrence interval, fault complexity, and Building Importance Category can be used to establish resource consent categories.

Rules need to be based upon risk. The approach used in built-up areas should differ from the approach used in a greenfields area. In greenfields areas it is much easier to require a subdivision to be planned around the likely fault rupture zone and buffer zone (ie, the fault avoidance zone). In built-up areas, buildings may have been established without the knowledge of the risk posed by fault rupture. The community may have an expectation to continue living there and be prepared to live with the risk despite the potential for damage.

Existing use rights under the Resource Management Act 1991 also mean that when an existing building over a fault is damaged or burnt down, or requires rebuilding for whatever reason, it can be rebuilt, even once the risk has been realised.

The district plan may have to include provisions to ensure that the risk is not increased by intensified land use (such as urban infill) or by new building on sites not already occupied. It can also require geotechnical investigations and appropriate earthquake-resistant design where appropriate.

Some councils have taken a precautionary approach to fault rupture.

For example:

- *“To take a precautionary approach to development in suspected risk areas until further information on the extent and nature of earthquake risk becomes available”* (Policy P1 in Section 3.2.2.5 of the Matamata Piako Proposed District Plan).

The council can also require a report, including certification from an appropriately qualified person, stating that the land is suitable for the activities anticipated.

Nelson City Council has the following rule:

- *“Construction or alteration of a building within the Fault Hazard Overlay is permitted if:*
 - a) in the case of any site where a fault trace is identified and can be precisely located by reference to the Council conditions book, subdivision files, site files, or GIS database, buildings are set back 5 metres from the fault trace”* (Rule REr.71.1 of the Nelson Proposed Resource Management Plan).

The faults identified in Nelson City have low activity and long recurrence intervals. However, Nelson City Council considered that it was best to design new subdivisions in such a way that avoided buildings being built on faults.

10.14 Section 32 analysis

Before a council adopts any objective, policy, rule, or other method, it has a duty under section 32 of the Resource Management Act 1991 to consider alternatives.

Essentially, the council is required to evaluate the costs and benefits of its proposed objective, policy, or method.

Section 32 ensures that the proposed provisions are necessary, and that accurate data has been used to carry out the evaluation.

It means that a council cannot simply adopt the approach of a neighbouring council – it must first justify its reasoning. Any response the council chooses to take has to be supported by the community and backed up by a section 32 analysis.

10.15 Cross-boundary issues

Natural hazards do not stop at local authority boundaries. It is important to consider how the plan will co-ordinate with the plans of territorial authorities that share the same hazards, to ensure that provisions are integrated across councils.

10.16 Monitoring

The plan needs to specify measurable outcomes that will ensure that issues are addressed, and objectives and policies achieved.

These can be measured by looking at:

- number of houses being built on at-risk land
- type of houses being built (construction and use)
- land subject to active faults being set aside/purchased
- the level of awareness of the community and their acceptance of risk-based plan provisions.

If monitoring shows that the provisions are not reducing fault rupture hazard risk, councils need to revise the provisions. If new information becomes available, councils need to review the level of acceptable risk, and revise the provisions.

Advances in scientific information and technology will affect existing data held by councils, and create new data that needs to be considered for incorporation into planning policy. Councils need to identify new information and this should happen on an ongoing basis, to ensure plan provisions are kept up to date, and ensure decisions based on the most accurate data.

Regional and district plan reviews are a good time to consider new information and data relating to active faults. A programme of consultation should accompany any changes to hazard information gained by the council.

To measure the effectiveness of policies and methods contained in plans, section 35(2A) of the Resource Management Act 1991 requires that the results of plan monitoring be made available to the public every five years. Keeping communities informed about the hazards they face, and changes to existing fault knowledge is important because it not only lets them know what is going on in terms of plans development, but raises awareness of hazards in the community.

10.17 Does your district plan need amending?

In deciding whether to amend a district plan, the council responsible for it first has to decide whether there are active faults within their territorial authority boundaries. If there are none, then there is no need to amend the district plan. Information on the location and type of faults to be found in New Zealand is contained on the website: <http://data.gns.cri.nz/af/index.jsp>

If there are active faults within a council's territorial authority boundaries the next step is to check the district plan to see whether it contains specific provisions in regard to the use and development of land on or close to active faults. If there are no such provisions, then it is strongly recommended that a plan change or variation be prepared (using the risk-based approach to plan provisions) that will avoid or mitigate effects of or on development located on or close to active faults.

If the district plan contains risk-based provisions that will avoid or mitigate effects of or on development located on or close to active faults then there is no need to change the plan. However if provisions are contained in a district plan in regard to active faults, but do not take a risk-based approach, amending the district plan to incorporate the risk-based approach is recommended.

11 Taking a Risk-based Approach to Resource Consents

11.1 Determining consent categories

Determining consent categories for buildings within a fault avoidance zone involves evaluating the fault recurrence interval, fault complexity, and Building Importance Category alongside the risk the community is prepared to accept.

Differing types of buildings will be placed into different resource consent activity categories, based upon the risk. The council needs to be satisfied that the risk is not significant, or that appropriate mitigation measures have been taken, before granting resource consent.

As the risk increases, the consent category should become more restrictive, and the range of matters the council needs to consider will increase. The council needs to set requirements for the bulk, location and foundations of any structure, so it can impose the consent conditions that will avoid or mitigate the adverse effects of fault rupture.

If the overall risk is low, the provisions contained in plans may be more permissive and make use of the permitted or controlled activity consent categories. If the risk is high, then planning provisions in plans become more restrictive and greater use made of discretionary and non-complying activity consent categories.

A rule may require resource consent for a new building, but with a requirement that a geotechnical report be included with the application (confirming that the building will be located at least 20 metres from an area subject to fault rupture, or that necessary engineering precautions have been taken).

For example:

- *“For all structures and buildings, an engineering report will be required to confirm that the Wellington Fault is not within 20.0m of any proposed structure or building; or that the necessary engineering precautions have been taken”* (Standard 14H 2.1.1.2 to Rule 14H 2.1 of the Hutt Proposed District Plan).

Each council will want to apply the resource consent activity status categories that suit its own circumstances. *The key is to ensure that the council has the ability to address the fault rupture hazard risk properly when assessing a resource consent application.* The matters over which the council can reserve control or restrict its discretion include:

- the proposed use of the building
- site layout, including building setback and separation distance
- building height and design
- construction type (for resource management purposes)
- financial contributions (for example, reserves contributions).

Tables 11.1 and 11.2 show an example of resource consent activity status for proposed buildings within a fault hazard avoidance area. The activity status will depend on the Building Importance Category, the fault recurrence interval, and the fault complexity.

Table 11.1: Resource consent activity status for greenfield sites

Building importance category	1	2a	2b	3	4
Fault complexity	Activity status				
Fault recurrence interval class I less than or equal to 2000 years					
A – Well defined	Permitted	<i>Non-complying</i>	<i>Non-complying</i>	<i>Non-complying</i>	Prohibited
B – Distributed	Permitted	<i>Discretionary</i>	<i>Non-complying</i>	<i>Non-complying</i>	Non-complying
C – Uncertain ⁼	Permitted	<i>Discretionary</i>	<i>Non-complying</i>	<i>Non-complying</i>	Non-complying
Fault recurrence interval class II greater than 2000 but less than or equal to 3500 years					
A – Well defined	Permitted	<i>Non-complying</i>	<i>Non-complying</i>	<i>Non-complying</i>	Prohibited
B – Distributed	Permitted	<i>Discretionary</i>	<i>Non-complying</i>	<i>Non-complying</i>	Non-complying
C – Uncertain ⁼	Permitted	<i>Discretionary</i>	<i>Non-complying</i>	<i>Non-complying</i>	Non-complying
Fault recurrence interval class III greater than 3500 to but less than or equal to 5000 years					
A – Well defined	Permitted	Permitted*	<i>Non-complying</i>	<i>Non-complying</i>	Non-complying
B – Distributed	Permitted	Permitted	<i>Discretionary</i>	<i>Discretionary</i>	Non-complying
C – Uncertain ⁼	Permitted	Permitted	<i>Discretionary</i>	<i>Discretionary</i>	Non-complying
Fault recurrence interval class IV greater than 5000 but less than or equal to 10,000 years					
A – Well defined	Permitted	Permitted*	Permitted*	<i>Non-complying</i>	Non-complying
B – Distributed	Permitted	Permitted	Permitted	<i>Discretionary</i>	Non-complying
C – Uncertain ⁼	Permitted	Permitted	Permitted	<i>Discretionary</i>	Non-complying
Fault recurrence interval class V greater than 10,000 but less than or equal to 20,000 years					
A – Well defined	Permitted	Permitted*	Permitted*	Permitted*	Non-complying
B – Distributed	Permitted	Permitted	Permitted	Permitted	Non-complying
C – Uncertain ⁼	Permitted	Permitted	Permitted	Permitted	Non-complying
Fault recurrence interval class VI greater than 20,000 but less than or equal to 125,000 years					
A – Well defined	Permitted	Permitted*	Permitted*	Permitted*	Permitted*
B – Distributed	Permitted	Permitted	Permitted	Permitted	Permitted**
C – Uncertain ⁼	Permitted	Permitted	Permitted	Permitted	Permitted**

Note: Faults with a recurrence interval of greater than 125,000 years are not considered active.

- * The activity status is permitted, but could be controlled or discretionary because the fault location is well defined.
- ** Although the activity status is permitted, care should be taken in locating BIC 4 structures on or near known active faults. Controlled or discretionary activity status may be more suitable.
- = Where the fault trace is uncertain, specific fault studies may provide more certainty on the location of the fault. Moving the fault into the distributed or well defined category would allow a reclassification of the activity status and fewer assessment criteria.

Italics show that the activity status is more flexible. For example, where *discretionary* is indicated, controlled activity status may be considered more suitable.

Table 11.2: Resource consent activity status for developed and already subdivided sites

Building importance category	1	2a	2b	3	4
Fault complexity	Activity status				
Fault recurrence interval class I less than or equal to 2000 years					
A – Well defined	Permitted	<i>Non-complying</i>	<i>Non-complying</i>	<i>Non-complying</i>	Non-complying
B – Distributed	Permitted	<i>Discretionary</i>	<i>Non-complying</i>	<i>Non-complying</i>	Non-complying
C – Uncertain ⁼	Permitted	<i>Discretionary</i>	<i>Non-complying</i>	<i>Non-complying</i>	Non-complying
Fault recurrence interval class II greater 2000 but less than or equal to 3500 years					
A – Well defined	Permitted	Permitted*	<i>Non-complying</i>	<i>Non-complying</i>	Non-complying
B – Distributed	Permitted	Permitted	<i>Discretionary</i>	<i>Non-complying</i>	Non-complying
C – Uncertain ⁼	Permitted	Permitted	<i>Discretionary</i>	<i>Non-complying</i>	Non-complying
Fault recurrence interval class III greater than 3500 but less than or equal to 5000 years					
A – Well defined	Permitted	Permitted*	Permitted*	<i>Non-complying</i>	Non-complying
B – Distributed	Permitted	Permitted	Permitted	<i>Discretionary</i>	Non-complying
C – Uncertain ⁼	Permitted	Permitted	Permitted	<i>Discretionary</i>	Non-complying
Fault recurrence interval class IV greater than 5000 but less than or equal to 10,000 years					
A – Well defined	Permitted	Permitted*	Permitted*	Permitted*	Non-complying
B – Distributed	Permitted	Permitted	Permitted	Permitted	Non-complying
C – Uncertain ⁼	Permitted	Permitted	Permitted	Permitted	Non-complying
Fault recurrence interval class V greater than 10,000 but less than or equal to 20,000 years					
A – Well defined	Permitted	Permitted*	Permitted*	Permitted*	Non-complying
B – Distributed	Permitted	Permitted	Permitted	Permitted	Non-complying
C – Uncertain ⁼	Permitted	Permitted	Permitted	Permitted	Non-complying
Fault recurrence interval class VI greater than 20,000 but less than or equal to 125,000 years					
A – Well defined	Permitted	Permitted*	Permitted*	Permitted*	Permitted*
B – Distributed	Permitted	Permitted	Permitted	Permitted	Permitted**
C – Uncertain ⁼	Permitted	Permitted	Permitted	Permitted	Permitted**

Note: Faults with a recurrence interval of greater than 125,000 years are not considered active.

* The activity status is permitted, but could be controlled or discretionary because the fault location is well defined.

** Although the activity status is permitted, care should be taken in locating BIC 4 structures on or near known active faults. Controlled or discretionary activity status may be more suitable.

= Where the fault trace is Uncertain, specific fault studies may provide more certainty on the location of the fault. Moving the fault into the Distributed or Well Defined category would allow a reclassification of the activity status and fewer assessment criteria.

Italics – show that the activity status is more flexible. For example, where *discretionary* is indicated, controlled activity status may be considered more suitable.

Note that the restricted discretionary category has not been shown in Tables 11.1 and 11.2 but may be considered more effective than the non-complying activity status as it allows for targeted assessment criteria to be developed.

11.2 Exercises

Example 1

A developer with a *Greenfield site* proposes to build a *Building Importance Category 2a* structure (a typical New Zealand wood-framed house) within a fault avoidance zone. The fault through this zone has a *Fault Recurrence Interval Class* of III (>3500 to ≤5000 years) and the *Fault Complexity* is A (well defined).

Q: What type of resource consent would have to be applied for?

A: _____¹

Example 2

A philanthropist decides to make use of a spare plot of land she owns to build an art gallery to display local work. The site is located within a densely built-up inner city suburb in a fault avoidance zone. The proposed art gallery will have a floor area of 700m² (refer to section 9.1 of this report to determine the *Building Importance Category*). The *Fault Recurrence Interval Class* is III and the *Fault Complexity* is B.

Q: What type of resource consent would have to be applied for?

A: _____²

Example 3

The philanthropist decides to move the proposed gallery to the country, where she owns 20 hectares of undeveloped rural land. The proposed location is within a fault avoidance zone where the *Fault Recurrence Interval Class* is II and the *Fault Complexity* is C?

Q: What type of resource consent would have to be applied for?

A: _____³

Example 4

A local health care facility is proposed that will accommodate up to 60 elderly patients who will live at the facility (refer to section 9.1 of this report for the *Building Importance Category*). The proposed site is in a rural area that has recently been subdivided into five-acre blocks, and is within a fault avoidance zone. A well-defined active fault with a 4000-year fault recurrence interval runs through the site.

Q: What type of resource consent would have to be applied for?

A: _____⁴

11.3 Answers

- 1 Permitted* activity (but a district plan may want to make this activity controlled or discretionary given that the *Fault Complexity* is well defined).
- 2 Permitted. The building is a *Building Importance Class 2b* structure (defined as either a retail building less than 10,000m², or a public assembly building less than 1000m²) to be located where the *Fault Recurrence Interval* is greater than 3500 but less than 5000 years (Class III) and the *Fault Complexity* is distributed (B).
- 3 Non-complying activity. The activity is proposed where the *Fault Recurrence Interval* is greater than 2000 but less than 3,500 years (Class II), the *Fault Complexity* is uncertain (C) and the building is a *Building Importance Class 2b* structure (defined as either a retail building less than 10,000m², or a public assembly building less than 1000m²). The activity is classed Non-complying as the site allows for alternative siting of the gallery outside the fault avoidance zone – which would reduce the risk to life and property.
- 4 Non-complying activity. The *Fault Recurrence Interval Class* is III (greater than 3000 but less than 5000 years), the *Fault Complexity* is A (well defined) and the building is a *Building Importance Class 3* (a health care facility with a capacity of 50 or more residents but does not have surgery or emergency treatment facilities).

11.4 Assessment criteria

Where there are rules in a district plan limiting development in a Fault Avoidance Zone, the district plan needs to include assessment criteria that make clear what the council will consider when assessing resource consents. Matters may include:

- the risk to life, property and the environment posed by the natural hazard
- the likely frequency and magnitude of movement
- the type, scale and distribution of any potential effects from the natural hazard
- the effects of ground shaking and ground displacement caused by earthquakes
- the distance of any proposed structure from the fault (as shown on either the district plan map, or from a site-specific study locating the fault trace)
- the degree to which the building, structural or design work to be undertaken can avoid or mitigate the effects of the natural hazard
- the accuracy and reliability of any engineering and geotechnical information (eg, the extent to which such a report shows how the risk of building failure following fault rupture can be reduced to minimise the effects of the fault rupture on the safety of occupants and neighbours).

If the council has not located the fault trace, and the developer does not wish to locate it, the developer needs to prove that the building is resilient enough to withstand fault rupture.

11.5 Assessment of Environmental Effects requirements

An applicant lodging a resource consent application to build on or near an active fault is required by section 88 of the Resource Management Act 1991 to provide an adequate Assessment of Environmental Effects (AEE) with any application. The district plan needs to spell out what is required of the resource consent applicants.

An AEE should:

- consider alternatives
- provide a risk analysis
- identify the hazard
- show mitigation measures.

12 Case Studies – Implementing the Guidelines

This section examines how two territorial authorities within the Wellington Region, Wellington City Council (WCC) and Kapiti Coast District Council (KCDC), have used these guidelines when reviewing active fault hazard provisions in their district plans. The case studies are preceded by an explanation of the unique tectonic setting in the Wellington region to help explain the fault rupture hazard.

12.1 The Wellington Region's Tectonic Environment

Both Wellington City Council and Kapiti Coast District Council sit within the Wellington region; the jurisdiction of Greater Wellington – The Regional Council. The tectonic environment within the Wellington region is very active given its location astride the constantly moving Pacific and Australian plates. As a result, a large number of active faults of varying complexity and recurrence interval classifications are present within the region.

The most active fault in the region (ie, the one with the shortest recurrence interval) is the **Wellington Fault** which extends northwards from the Cook Strait (its most southernmost known location) past the south Wellington shoreline, through Wellington and the Hutt Valley and through the Tararua Range to the Manawatu River. At this point, the name of the fault changes but continues north to the Bay of Plenty coastline.

The **Wairarapa Fault**, the source of the great 1855 Wairarapa earthquake, extends northeastward along the base of the eastern flank of the Tararua Ranges. With a recurrence interval of about 1500 years, it is a Class 1 active fault. Its average slip rate of just under 10mm/year means it is moving faster than the Wellington Fault. Past surface rupturing earthquakes on the Wairarapa Faults have resulted in up to 10 metres or more of lateral slip at the fault trace, with regional uplift and tilting east of the fault.

The **Ohariu Fault** extends approximately 70km north-northeastward from offshore of the Wellington south coast, through Porirua to Waikanae (Heron *et al.* 1998, Begg & Johnston 2000) and probably continues a further 60 km northwards as the **Northern Ohariu Fault** to just south of Palmerston North (eg, Van Dissen *et al.* 1999, Palmer and Van Dissen. 2002). The **Gibbs Fault** is less constrained than the Ohariu and Northern Ohariu faults, but is thought to branch off the Ohariu Fault near MacKays Crossing and extend 30km north north-east to within 3-4 kms of the **Otaki Forks Fault** which passes through Kapiti Coast District hill country to the east for about 10-15 kms. Little is known about the **Southeast Reikorangi Fault** which most likely extends from the Gibbs Faults about 20km in the hills east of Kapiti Coast (Van Dissen *et al.* 2003).

12.1.1 Fault Rupture in the Region

In the Wellington region, the Wairarapa fault is the only fault that has ruptured in historical times (during the 1855 magnitude 8 Wairarapa earthquake). The most known recent surface fault rupture on the Wellington Fault occurred about 400 years ago (Van Dissen and Berryman, 1996) and on the Ohariu Fault about 1000 years ago (Litchfield *et al.* 2004).

It is estimated that the Wellington Fault is capable of generating earthquakes in the order of magnitude 7.5 with a 10 percent probability of it rupturing in the next 50 years. Such a rupture could move the ground along the fault horizontally by 4-5 metres and vertically by about 1 metre (Froggatt & Rhodes 1996, Van Dissen & Berryman 1996).

The Ohariu fault is capable of an earthquake about magnitude 7.5 with expected fault rupture of 3-5 metres of right-lateral displacement at the ground surface with lesser and more variable vertical displacement (Heron *et al.* 1998). The Northern Ohariu Fault, Gibbs Fault and Otaki Forks Fault are all capable of generating earthquakes magnitude 7+ and metre-scale surface rupture displacements (Litchfield *et al.* 2004, Van Dissen *et al.*, 2003).

The region's most active faults (Wellington, Wairarapa and Ohariu) all have varying *fault complexity* at stages along the fault meaning that while parts of these faults are well-defined, other parts are distributed or the location is uncertain. Finding the fault location can be difficult in some areas due to two key reasons: fault traces have been removed by natural processes (landslide, weather, and coastal); and/or the intensity of urban development has obscured the fault trace.

12.2 The Wellington City Council

Wellington City Council's District Plan Change 22 amended the Hazard (Fault Line) Area for the Wellington Fault on district plan maps, and amended a number of district plan provisions relating to the fault hazard.

12.2.1 Background

In 2001, the Wellington Emergency Management Office (WEMO) engaged the Institute of Geological and Nuclear Sciences (GNS) to assess the impact on property from an earthquake along the Wellington fault. The work by GNS uncovered the fact that the Wellington City district plan maps depicting the Wellington Fault did not reflect GNS's understanding of the fault location.

The district plan team engaged the Institute of Geological and Nuclear Sciences to undertake a Wellington Fault location review to provide up to date information on the location of the urban section of the Wellington Fault from Aotea Quay to the lower Karori Reservoir (including the port, railway yards and the parts of the suburbs of Thorndon, Northland, Kelburn and Karori). Wellington City Council decided to concentrate the fault location investigation solely on the Wellington Fault (although they were also aware of the other active faults in the district these were not considered as high risk as the Wellington Fault). The findings of the Institute of Geological and Nuclear Sciences report highlighted inaccuracies in the existing Hazard (Fault Line) Area as shown on district plan maps and as a result identified two new updated fault hazard zones:

1. **Likely fault rupture hazard zone:** The area containing the likely position of the Wellington Fault, and the zone within which the fault is likely to rupture (but not across its entire width). The width of the zone varies from approximately 10 to 50 metres.
2. **Recommended fault rupture hazard zone:** The width of this zone ranges from 50 to 90 metres as it includes the recommended (as per the Guidelines) 20 metre buffer zone either side of the *likely fault rupture hazard zone*. In its report, the Institute of Geological and Nuclear Sciences recommended that this *recommended fault rupture hazard zone* be used for district planning purposes as it accommodates uncertainties in the location and width of the *likely fault rupture hazard zone*.

12.2.2 Properties Affected

The Wellington Fault location review identified 665 properties within the new *recommended fault rupture hazard zone* (some properties straddle both the *likely fault rupture zone* and the *recommended fault rupture hazard zone* or buffer zone). Of these 665 properties, there were 244 more properties than currently identified on the planning maps. Approximately 35 properties were removed from the fault rupture hazard zone.

12.2.3 Justification for Plan Change

In light of the new information from the Wellington Fault location review, the Wellington City Council decided to look at whether a district plan change was justified to reflect the findings.

In addition to learning that the planning maps depicted the Wellington Fault in the wrong location, the district plan team recognised that the current district plan fault hazard zone provisions were not proving to be effective. A review of the existing plan provisions (which has been developed as part of the district plan review in 1999) showed that they were not achieving their intention (eg, multiple unit developments had been approved and built in areas identified in the district plan as active fault zones). Although the district plan policies reflected the intention to limit development in these areas, the rules were not explicit enough and the planning team decided they were in need of updating.

Clearer information requirements for developers were also needed and planners needed to have better assessment criteria to use when assessing resource consent applications for development in the fault rupture hazard zone.

12.2.4 Public Information Process

Prior to initiating Plan Change 22, the Wellington City Council undertook an extensive public consultation campaign to clearly communicate the findings of the Wellington Fault location review. Affected property owners and occupiers were targeted to gauge initial responses. Less than two weeks after receiving the final Institute of Geological and Nuclear Sciences report Wellington City Council undertook the following:

- letters were sent to over 700 property owners affected by the fault rupture hazard zones
- an information centre was established on Tinakori Road (ie, close to the affected properties)
- a public meeting was held.

Over 70 people visited the information centre during its three days of opening. An estimated 65 people attended the public meeting. The Institute of Geological and Nuclear Sciences scientists who worked on the Wellington Fault location review attended the public meeting along with Wellington City Council staff. Institute of Geological and Nuclear Sciences's role was to explain the science behind the hazard zones, and Wellington City Council staff outlined the plan change process. A facilitator was used to help manage the questions that followed the main presentations.

Key issues raised by the public at the information centre and public meeting related to:

- the 20m buffer zone and whether there was scope to change this
- the nature of information included on Land Information Memoranda
- requests that no new significant buildings be built in the fault hazard area, whereas others were concerned about the level of existing regulation in the Plan
- the impact on house values, insurance premiums and council rates
- expectations about compensation where the fault hazard zone now covered a property
- whether or not property owners were now required to strengthen their homes.

12.2.5 The Plan Change

A number of options were considered when recommending the final Plan Change 22 which included “do nothing” and reducing the buffer zone around the likely fault rupture hazard zone. The final recommendations included:

- Amend the existing planning maps to re-align the Hazard (Fault Line) Area to reflect the Institute of Geological and Nuclear Sciences recommendations which suggested a 20 metre buffer area either side of the *likely fault rupture hazard zone*
- Delete reference to NZS4203:1992 and replace with definitions of ‘light roof’ and ‘light wall cladding’ (from NZS 3604:1999 (Timber Framed Buildings))
- Allow for only one residential unit as a Permitted Activity in the Hazard (Fault Line) Area
- Provide for multi-unit developments to be assessed as a Discretionary (Unrestricted) Activity (this would have the effect of allowing appropriate assessment criteria to be developed for use by resource consent planners unlike a Non-Complying Activity status)
- Amend the explanation of the hazard policies to include specific reference to earthquake hazards, and that the damage caused by such hazards can be reduced with mitigation measures
- Provide assessment criteria to give planners more scope when determining the effects to a specific site from fault rupture including the opportunity to obtain geotechnical and engineering information
- Provide for geotechnical reports and engineering design reports to be supplied as part of any resource consent in the hazard area.
- Changes to other associated rules in the plan.

12.2.6 Issues raised by submitters

Following notification, Plan Change 22 received eleven submissions and four further submissions. The majority of the submitters opposed aspects of the Plan Change or sought amendments. Issues raised by submitters included:

- a) The width of the 20m buffer zone
- b) Whether a whole property was affected by the hazard zone rules, or only land within the Hazard (Fault Line) Area
- c) The requirement to provide geotechnical and engineering design reports with any resource consent in the Hazard (Fault Line) Area
- d) The proposed change to reduce the number of permitted residential units to one per site
- e) The impact of this information on property values, insurance premiums and compensation.

Of these, the first two points were considered the most significant but all are discussed below:

a) The width of the 20m buffer zone

Both the Guidelines and the Institute of Geological and Nuclear Sciences report recommend a minimum 20 metre buffer zone. Public concerns were mostly related to this additional 20 metre zone rather than the narrower *likely fault rupture hazard zone* - suggesting that residents accepted the risk of living on the fault. Those residents not within the *likely fault rupture hazard zone* however, questioned the necessity of their inclusion within the buffer zone.

It was decided, that if a smaller buffer zone (ie, less than 20 metres) was put in place it would not resolve the fundamental problem that there would always be some properties *just within the zone* that would argue to be taken out of the zone. Wellington City Council acknowledged that the science of accurately locating fault rupture areas will continue to improve with new technology, and better understanding of the hazard itself. If relevant information became known as site specific geotechnical investigations were carried out this may allow Wellington City Council to narrow the fault rupture hazard zone even further.

b) Whether a whole property was affected by the hazard zone rules, or only land within the Hazard (Fault Line) Area.

As with any type of zoning that does not strictly adhere to property boundaries, issues arose over interpretation of properties that:

- i) had a boundary aligned with a line of the hazard zone
- ii) were partially within the hazard zone
- iii) had a right of way or similar within the fault rupture hazard zone.

The Wellington City Council was required to make decisions on these situations in relation to whether or not the hazard information would be included in a Land Information Memoranda (LIM) report; however the interpretations could easily apply to resource consent decisions. In scenario (i) planning staff assessed this property as being *out* of the hazard zone. In scenario (ii) the hazard information had to be included in a Land Information Memoranda (LIM), but the rules in the plan only apply to that portion of the land covered by the hazard area. Likewise with scenario (iii), the information had to be included in a Land Information Memoranda (LIM), but an extra note was included on that Land Information Memoranda (LIM) explaining it was only the Right of Way (ROW) affected by the hazard area and not the building itself.

Notes were put on **property files** for those properties where interpretation of the fault rupture hazard zone lines was unclear (as in the scenarios above) to provide clarity for property owners and planners assessing development proposals. In most cases, the planner will be able to interpret whether or not a property is in the hazard zone from the planning maps.

c) Requirement to provide geotechnical & engineering reports

The requirement for geotechnical and engineering reports as part of a resource consent application was objected to by a utility company on the grounds that:

- such structures were designed to withstand ground-shaking events
- that the structures are small in comparison to other structures (such as houses)
- the potential environmental impacts are minor.

The requirement for geotechnical and engineering reports were part of Plan Change 22 as they allow for ground conditions (which can vary from site to site) to be assessed and also provide Wellington City Council with information about how a fault rupture event may affect a certain development. It was agreed that as the focus of the rules was on structures where people live, work and play. Therefore there no need for utility structures to be subject to the requirement to provide geotechnical and engineering reports.

d) Limiting residential units to one per site

Although the district plan already permitted only one residential unit per site in most of the area covered by the hazard zone (ie, Thorndon), other areas of Wellington where two units per site were currently permitted, were affected by a rule in the Plan Change.

The rule does not prevent landowners from building more than one dwelling on a site but outlines what is permitted as of right without requiring resource consent. The assessment criteria, geotechnical and engineering requirements, developed as part of Plan Change 22, will allow Wellington City Council the opportunity to gather the information needed to assess any proposals in the hazard area that require a resource consent.

e) Property values, Insurance Premiums and Compensation

While some property owners accepted the hazard risk by living in the area, others were concerned about the impact of a hazard zone on property values and insurance premiums.

Although difficult to accurately confirm, there has been no evidence to suggest that the fault hazard zone has affected property prices in the past; similarly insurance premiums have not reflected any increase due to the risk identified in the fault rupture hazard zone. Even if it had been proven that property values decreased as a direct result of the fault hazard zone,

Wellington City Council had not prohibited any development along the fault allowing people to still make reasonable use of their land. No compensation would be required.

12.2.7 Council hearing and decision-making process

The hearing for Plan Change 22 was held in February 2004 and attended by three submitters. The hearing was notable for the level of detail that the Hearings Committee went into in order to establish the appropriateness of the hazard zone in areas that were contested by submitters. One submitter bought along their own geotechnical advisor, which helped to raise the level of the debate about the accuracy of the hazard zones. The Committee found itself in a position of weighing the evidence from its District Planning Team geotechnical advisors against the expert bought in by the submitter. As a consequence of this debate between the experts, the Committee decided that there was enough evidence to narrow the fault rupture hazard area at two specific locations as argued by the submitter's expert. The Committee considered that it was ultimately better to narrow the *fault rupture hazard area* based on good quality information, rather than to reduce the 20m buffer area to appease submitters. Upon reflection, these changes were agreeable to Institute of Geological and Nuclear Sciences also, and consequently the hazard zones were revised for the decision.

Plan Change 22 received no appeals.

Plan Change 22 resulted in planning map inaccuracies being fixed with properties that were no longer within the fault rupture hazard zone removed from the zone and no longer be subject to the rules for the Hazard (Fault Line) Area. Similarly, properties not currently within the fault rupture hazard area, but included in the fault rupture hazard zone recommended by Institute of Geological and Nuclear Sciences became subject to the Hazard (Fault Line) Area rules.

12.2.8 Key lessons

- Once Wellington City Council had the findings of the Institute of Geological and Nuclear Sciences report they **acted quickly by initiating an extensive public consultation campaign** that included the information centre, a public meeting and media liaison. A lot of questions the public had related to science and geotechnical issues which were able to be answered by the Institute of Geological and Nuclear Sciences staff who attended the meeting, and who had written the Wellington Fault location review report. As a result, **very few written submissions were received** on the proposed Plan Change 22. Of those that were received, they were all very focused and did not generally cover issues that could not be resolved in the plan change process. Wellington City Council considered that because of their well executed public campaign the submissions received were far more manageable than anticipated.
- The **information requirements**, developed as part of the plan change for inclusion within the district plan, needed to be explained clearly for both the planner (to request the right information) and the developer (to provide the right information). The cost of these requirements needed to be considered and should be met by the developer.
- If a council requires **geotechnical and engineering information** then it is important to have staff who can explain what is needed and interpret the information when it is received. The Wellington City Council now has a staff member who has expertise in geotechnical matters.
- It is important for **assessment criteria** to be very clear as it gives the consent planner a good basis when assessing an application and reasoning to refuse consent if necessary.

12.3 The Kapiti Coast District Council

The Kapiti Coast District is the fastest growing area in the Wellington Region (with a population growth rate of approximately 2% per annum) and is traversed by five known active faults – the Ohariu, Northern Ohairu, Gibbs, Otaki Forks and South East Reikorangi. The Ohairu and Northern Ohariu faults are two of the more significant earthquake generating faults in the Wellington Region, and they both pass through areas of urban, semi-urban and rural development.

Following a comprehensive review of all the known fault traces in the district, the Kapiti Coast District Council is now in the process of reviewing and updating its district plan provisions for the development and subdivision of land on or close to active faults.

Plan Change 64 (Fault traces), while not yet complete, will seek to update the GIS and District Plan maps by more accurately depicting the locations of faults traces, as well as amending the supporting package of objectives, policies, rules and standards in the district plan.

12.3.1 Background

In November 2000, Kapiti Coast District Council notified a proposed plan change that sought better planning and management of development on or close to the active faults in the district. The plan change however, was withdrawn after submissions highlighted that further research was needed to more accurately define the fault trace locations in the district.

In 2003 Kapiti Coast District Council, along with Greater Wellington – the Regional Council, commissioned Institute of Geological and Nuclear Sciences to carry out a comprehensive study of the known active fault traces in the Kapiti Coast District.

Although Kapiti Coast District Council already had some data regarding the location and type of fault generated features for some parts of the district, the information had been gathered in a piecemeal and site specific manner, and was basically confined to small sections of the Ohariu and Gibbs faults only. In addition, the accuracy of the information was in some cases limited to +/- 100 metres. A fault trace study was therefore necessary to improve the existing information held by Kapiti Coast District Council and improve the detail and accuracy of fault trace locations on the district plan maps.

12.3.2 Current planning for fault rupture

The Kapiti Coast District Plan currently contains provisions in the rural and residential zones restricting the construction of buildings within 20 metres of an earthquake fault trace shown on district plan maps. Any building proposal falling within 20 metres of a fault trace requires Controlled Activity resource consent and conditions are usually applied to ensure appropriate engineering requirements are included in the building design in order to avoid, remedy or mitigate any adverse effects resulting from ground rupture.

12.3.3. Findings

The Institute of Geological and Nuclear Sciences report presented a comprehensive study of all known active fault traces in Kapiti. The locations were mapped into GIS to allow for incorporation into the Council's GIS system and onto the district plan planning maps. The findings were presented in a way compatible with the process set out in these guidelines.

Institute of Geological and Nuclear Sciences established Fault Avoidance Zones (this is the same as the terminology in these guidelines, whereas Wellington City Council used the term *fault rupture hazard zone*) based on fault locations and complexity (*well defined, distributed, and uncertain*). A Fault Avoidance Zone includes the fault rupture hazard zone, and the buffer zone.

Due to the particular fault trace complexities in Kapiti, Institute of Geological and Nuclear Sciences found it necessary to expand upon these categories to include:

- *Well defined*: fault rupture is well defined and of limited geographic width
- *Well defined - extended*: a well defined fault had either been buried or eroded over short distances but its position is tightly constrained
- *Distributed*: fault rupture can be constrained to lie within a relatively broad geographic width (tens to hundreds of metres) typically as multiple fault traces and/or folds
- *Uncertain – constrained*: areas where the location of the fault rupture is uncertain because evidence has been eroded or buried but where the location can be constrained to within a reasonable geographic extent (eg, within 300 metres)
- *Uncertain: poorly constrained* where the fault trace was too uncertain to be within 300 metres, usually because deformation has been buried or eroded or the fault features are widely spaced and/or very broad.

Fault Avoidance Zones are defined along all the faults based on the rupture complexity of the particular fault, and the precision to which its location can be constrained. The Fault Avoidance Zones identified range in width from about 40m (*well defined*) to greater than 300m (*uncertain-poorly constrained*).

The Institute of Geological and Nuclear Sciences report also provided examples of resource consent activity classes appropriate to different Fault Avoidance Zones based on the fault *recurrence interval, fault complexity* and *building importance category*. This approach is consistent with the Guidelines and was included in order to provide assistance in drafting the district plan rules relating to fault traces.

12.3.4 Public consultation

As soon as Kapiti Coast District Council received the Institute of Geological and Nuclear Sciences report and considered its findings, planning staff set about putting into action a public consultation process that would advise landowners affected by the report findings and seek feedback to assist the council with preparing a plan change.

Letters were sent to all landowners in September 2003, along with an Information Sheet summarising the fault trace study results and the implications. A large number of responses were received, including 32 written comments, which raised a raft of concerns including:

- The effect of the new information on property value, insurance premiums and insurance policy coverage
- The nature and extent of fault trace information included on Land Information Memoranda
- Expectations for compensation where the fault trace hazard now covers a property, as well as a reduction in council rates

- Concerns regarding existing houses built on or very close to a fault – what can landowners do to reduce risk and damage? Should owners be strengthening their homes?
- Greenfield areas should not be treated any differently to areas that are already developed
- The approach proposed is overly conservative and risk adverse, especially in areas where risk is uncertain (ie, *uncertain-unconstrained* areas)
- The building importance categories identified are defective (no provision for 2-3 story timber framed houses within scope of NZS 3604)
- Concerns regarding the accuracy of information – How was it gathered? How accurate is it? Why did Kapiti Coast District Council not already have accurate information for the whole of the district?

12.3.5 Towards a Plan Change

Kapiti Coast District Council is currently dealing with the concerns raised by submitters and deciding on the scope and content of Plan Change 64. District plan maps will be updated with the new fault trace information supplied by Institute of Geological and Nuclear Sciences and amendments made to the supporting objectives, policies, rules and standards in the district plan.

For example:

- amending the relevant objectives and policies within the Natural Hazards chapter to include specific reference to earthquake fault trace hazards
- including the opportunity within the rules and standards to obtain geotechnical and engineering information as part of any resource consent within a Fault Avoidance Zone
- amending other relevant rules and standards in the plan.

The plan change will reflect the Institute of Geological and Nuclear Sciences report findings and the approach set out in the Guidelines, but will be adapted to the Kapiti Coast situation, and to the District Plan structure. The comments already received from landowners will also be taken into account in the drafting of new provisions.

The **complexity of the nature of faults** in Kapiti raises issues in terms of the provisions to be included in the District Plan. The challenge includes drafting provisions which cover:

- five different faults, all with slightly different faulting characteristics
- five different Fault Avoidance Zones reflecting different levels of certainty
- greenfield versus already developed land
- the different types of structure/building that could be erected (temporary structures, single or multiple-storied timber dwellings, through to more significant structures and buildings)
- and because of these differences, the potential for several different categories of resource consent.

The emphasis is on making the district plan provisions, particularly the rules and standards, as straightforward as possible to aid understanding by landowners, developers and decision makers.

In order to facilitate robust decision-making whilst the plan change is being developed, and to ensure the Council meets its obligations in terms of providing the most up to date information available, the GIS layer supplied by Institute of Geological and Nuclear Sciences as part of the study has been incorporated into the Council's GIS system.

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Appendix 1: Classification of Faults

This list provides an interim classification of most of New Zealand's on-land active faults, based on fault recurrence interval.

Fault Avoidance Interval Class: Less than 2000 years (RI Class I).

- Alfredton Fault:** This fault is located in the Wellington and Manawatu-Wanganui Regional Council areas. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; fault-specific slip rate and single-event displacement; and indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Alpine Fault:** This fault is located in the Southland, West Coast and Tasman Regional Council areas. There is a high level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; fault-specific slip rate and single-event displacement; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Amberly Fault:** This fault is located in the Canterbury region. There is a medium level of confidence in its classification which is based on analysis of fault-specific slip rate and single-event displacement; and an Indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Aorangi – Ngpotiki:** This fault is located in the Wellington region. There is a medium level of confidence in its classification which is based on analysis of an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Aratiatia Fault:** This fault is located in the Waikato region. There is a medium level of confidence in its classification which is based on analysis of an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Awatere Fault:** This fault is located in the West Coast, Canterbury and Marlborough regions. There is a high level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; fault-specific slip rate and single-event displacement; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Braemar Fault:** This fault is located in the Bay of Plenty region. There is a low level of confidence in its classification which is based on analysis of comparisons with other, similar, faults.

- Clarence Fault:** This fault is located in the West Coast, Canterbury and Marlborough regions. There is a high level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; fault-specific slip rate and single-event displacement; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Dreyers Rock Fault:** This fault is located in the Wellington and Manawatu-Wanganui region. There is a low level of confidence in its classification which is based on analysis of comparisons with other, similar, faults.
- Edgecumbe Fault:** This fault is located in the Bay of Plenty region. There is high level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Fyffe Fault:** This fault is located in the Canterbury region. There is a low level of confidence in its classification which is based on analysis of comparisons with other, similar, faults.
- Hanmer Fault:** This fault is located in the Canterbury region. There is a low level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates; and analysis of comparisons with other, similar, faults.
- Highlands Fault:** This fault is located in the Waikato and Bay of Plenty Regional Council areas. There is a medium level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Hope Fault:** This fault is located in the West Coast and Canterbury Regional Council areas. There is a high level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; fault-specific slip rate and single-event displacement; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Jordan Thrust Fault:** This fault is located in the Canterbury region. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; fault-specific slip rate and single-event displacement; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Kaiapo Fault:** This fault is located in the Waikato Regional Council area. There is a medium level of confidence in its classification which is based on analysis of an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.

Kakapo Fault:	This fault is located in the Canterbury Regional Council area. There is a high level of confidence in its classification which is based on analysis of an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Karioi Fault:	This fault is located in the Manawatu-Wanganui region. There is a medium level of confidence in its classification which is based on analysis of an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates; and comparisons with other, similar, faults.
Kekerengu Fault:	This fault is located in the Canterbury region. There is a high level of confidence in its classification which is based on analysis of an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Kelly Fault:	This fault is located in the Canterbury region. There is a low level of confidence in its classification which is based on analysis of comparisons with other, similar, faults.
Kowhia Fault:	This fault is located in the Canterbury region there is a low level of confidence in its classification which is based on analysis of comparisons with other, similar, faults.
Lake Ohakuri:	This fault is located in the Waikato region. There is a low level of confidence in its classification which is based on analysis of comparisons with other, similar, faults.
Maleme (incl. Rehi):	These faults are located in the Waikato region. There is a high level of confidence in its classification which is based on analysis of an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Matata Fault:	This fault is located in the Bay of Plenty region. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and comparisons with other, similar, faults.
Mohaka Fault:	This fault is located in the Manawatu-Wanganui and Hawke's Bay regions. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Mount Grey Fault:	This fault is located in the Canterbury region. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and comparisons with other, similar, faults.
National Park Fault:	This fault is located in the Manawatu-Wanganui region. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.

Ngangiho Fault:	This fault is located in the Waikato region. There is a high level of confidence in its classification which is based on analysis of an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Ohakune Fault:	This fault is located in the Manawatu-Wanganui region. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; fault-specific slip rate and single-event displacement; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Orakeikorako Fault:	This fault is located in the Waikato region. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
Paeroa Fault:	This fault is located in the Waikato and Bay of Plenty regions. There is a high level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; fault-specific slip rate and single-event displacement; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Patoka Fault:	This fault is located in the Hawke's Bay region. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
Porters Pass Fault:	This fault is located in the Canterbury region. There is a medium level of confidence in its classification which is based on analysis of Fault-specific sequence of dated surface ruptures; fault-specific slip rate and single-event displacement; and an Indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Poutu Fault:	This fault is located in the Waikato region. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; fault-specific slip rate and single-event displacement; and comparisons with other, similar, faults.
Puketerata Fault:	This fault is located in the Waikato region, there is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
Rangiora Fault:	This fault is located in the Hawke's Bay region. There is a high level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and fault-specific slip rate and single-event displacement.
Raurimu Fault:	This fault is located in the Manawatu-Wanganui region. There is a medium level of confidence in its classification which is based on analysis of an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.

- Rotoitipaku Fault:** This fault is located in the Bay of Plenty region. There is a high level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures.
- Shawcroft Road Fault:** This fault is located in the Manawatu-Wanganui region. There is a low level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates; and comparisons with other, similar, faults.
- Snowgrass Fault:** This fault is located in the Manawatu-Wanganui region. There is a low level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and comparisons with other, similar, faults.
- Tumunui Fault:** This fault is located in the Waikato and Bay of Plenty Regional Council areas. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Waihi Fault:** This fault is located in the Manawatu-Wanganui and Waikato Regional Council areas there is a medium level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates; and comparisons with other, similar, faults.
- Waipukaka Fault:** This fault is located in the Manawatu-Wanganui region. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures.
- Wairarapa Fault:** This fault is located in the Wellington and Manawatu-Wanganui Regional Council areas. There is a high level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; fault-specific slip rate and single-event displacement; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Wairau Fault:** This fault is located in the Marlborough and Tasman Regional Council areas. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; fault-specific slip rate and single-event displacement; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Wellington Fault:** This fault is located in the Wellington and Manawatu-Wanganui Regional Council areas. There is a high level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; fault-specific slip rate and single-event displacement; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.

- West Whangamata:** This fault is located in the Waikato Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Whakaipo Fault:** This fault is located in the Waikato Regional Council area. There is a medium level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Whakatane (South):** This fault is located in the Bay of Plenty Regional Council area. There is a low level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates; and comparisons with other, similar, faults.
- Whangamata Fault:** This fault is located in the Waikato Regional Council area. There is a medium level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Wharekaurau Fault:** This fault is located in the Waikato Regional Council area. There is a medium level of confidence in its classification which is based on comparisons with other, similar, faults.
- Whirinaki Fault:** This fault is located in the Waikato Regional Council area. There is a medium level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Fault Avoidance Interval Class: Between 2,000 and 3,500 years (RI Class II).***
- Akatore Fault:** This fault is located in the Otago Regional Council area. There is medium level of confidence in its classification based on analysis of fault-specific sequence of dated surface ruptures; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Ashley-Crust Fault:** This fault is located in the Canterbury Regional Council area. There is low level of confidence in its classification based on analysis of fault-specific sequence of dated surface ruptures; and comparisons with other, similar, faults.
- Awaiti Fault:** This fault is located in the Bay of Plenty Regional Council area. There is low level of confidence in its classification based on comparisons with other, similar, faults.
- Barber Fault:** This fault is located in the Waikato Regional Council area. There is low level of confidence in its classification based on analysis of fault-specific sequence of dated surface ruptures.
- Carterton Fault:** This fault is located in the Wellington Regional Council area. There is medium level of confidence in its classification based on analysis of fault-specific sequence of dated surface ruptures.

Cross Creek Fault:	This fault is located in the Wellington Regional Council area. There is a low confidence in its classification based on comparisons with other, similar, faults.
Elliott Fault:	Located in the Canterbury and Marlborough regions. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and comparisons with other, similar, faults.
Fidget Fault:	This fault is located in the Canterbury region. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
Fowlers Fault:	This fault is located in the Canterbury region. There is a low level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and comparisons with other, similar, faults.
Fox's Peak Fault:	This fault is located in the Canterbury region. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures.
Hihitahi Fault:	This fault is located in the Manawatu-Wanganui Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
Irishman's Creek:	This fault is located in the Canterbury Regional Council area. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Kerepehi Fault:	This fault is located in the Wellington Regional Council area. There is a high level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; fault-specific slip rate and single-event displacement; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Lake Heron Fault:	This fault is located in the Canterbury Regional Council area. There is a medium level of confidence in its classification which is based on analysis of an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Little Rough Ridge:	This fault is located in the Otago Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
Long Valley Fault:	This fault is located in the Otago Regional Council area. There is a medium level of confidence in its classification which is based on analysis of an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.

Makuri Fault:	This fault is located in the Manawatu-Wanganui Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
Masterton Fault:	This fault is located in the Wellington Regional Council area. There is a high level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; fault-specific slip rate and single-event displacement; an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates; and comparisons with other, similar, faults
Mokonui Fault:	This fault is located in the Wellington Regional Council area. There is a low level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates; and comparisons with other, similar, faults.
Mt Hutt-Mt Peal:	This fault is located in the Canterbury Regional Council area. There is a low level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Northern Ohariu:	This fault is located in the Wellington and Manawatu-Wanganui Regional Council areas. There is a low level of confidence in its classification which is based on an analysis of fault-specific slip rate and single-event displacement; an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates; and comparisons with other, similar, faults
Ngapouri Fault:	This fault is located in the Manawatu-Wanganui and Bay of Plenty Regional Council areas. There is a medium level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Oaonui Fault:	This fault is located in the Taranaki Regional Council area. There is a medium level of confidence in its classification which is based on analysis of Fault-specific sequence of dated surface ruptures.
Ohariu Fault:	This fault is located in the Wellington Regional Council area. There is a low level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; fault-specific slip rate and single-event displacement; and indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Onepu Fault:	This fault is located in the Bay of Plenty Regional Council area. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and comparisons with other, similar, faults.

- Orakonui Fault:** This fault is located in the Wellington Regional Council area. There is a medium level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Ostler Fault:** This fault is located in the Canterbury Regional Council area. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and fault-specific slip rate and single-event displacement.
- Otakiri Fault:** This fault is located in the Bay of Plenty Regional Council area. There is a low level of confidence in its classification which is based on a comparison with other, similar, faults.
- Pa Valley Fault:** This fault is located in the Manawatu-Wanganui Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Raetihi Fault:** This fault is located in the Manawatu-Wanganui Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Raggedy Range:** This fault is located in the Otago Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Ranfurly Fault:** This fault is located in the Otago Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Rotohauhau Fault:** This fault is located in the Waikato and Bay of Plenty Regional Council areas. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Ruahine Fault:** This fault is located in the Manawatu-Wanganui and Hawke's Bay Regional Council areas. There is a low level of confidence in its classification which is based on analysis an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates; and comparisons with other, similar, faults.
- Saunders Road Fault:** This fault is located in the Manawatu-Wanganui Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Silver Road Fault:** This fault is located in the Hawke's Bay Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Te Teko Fault:** This fault is located in the Bay of Plenty Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.

- Te Weta Fault:** This fault is located in the Waikato Regional Council area. There is a medium level of confidence in its classification which is based on analysis of an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Thorpe-Poplar:** This fault is located in the Waikato Regional Council area. There is a medium level of confidence in its classification which is based on analysis of indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Torlesse Fault:** This fault is located in the Canterbury Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Vernon Fault:** This fault is located in the Marlborough Regional Council area. There is a low level of confidence in its classification which is based on analysis of an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates; and comparisons with other, similar, faults.
- Waikaremoana:** This fault is located in the Hawke's Bay and Bay of Plenty Regional Council areas. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Waimana Fault:** This fault is located in the Bay of Plenty Regional Council area. There is a medium level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Waiohau Fault:** This fault is located in the Bay of Plenty Regional Council area. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Waipiata Fault:** This fault is located in the Otago Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Weber Fault:** This fault is located in the Manawatu-Wanganui Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.

Fault Avoidance Interval Class: Between 3,500 and 5,000 Years (RI Class III)

- Akatarawa Fault:** This fault is located in the Wellington Regional Council area. There is a low level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates; and comparisons with other, similar, faults.

Blue Lake Fault:	This fault is located in the Otago Regional Council area. There is a low level of confidence in its classification which is based on analysis an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Cheeseman Fault:	This fault is located in the Canterbury Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
Dry River Fault:	This fault is located in the Wellington Regional Council area. There is a medium level of confidence in its classification which is based on analysis of an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates; and comparisons with other, similar, faults.
Gibbs Fault:	This fault is located in the Wellington Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
Glendevon Fault:	This fault is located in the Hawke’s Bay Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
Hossack Road:	This fault is located in the Waikato Regional Council area. There is a low level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Huangarua Fault:	This fault is located in the Wellington Regional Council area. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Hundalee Fault:	This fault is located in the Canterbury Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
Inglewood Fault:	This fault is located in the Taranaki Regional Council area. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures.
Kaiwara Fault:	This fault is located in the Canterbury Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
Kaweka Fault:	This fault is located in the Hawke’s Bay Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.

Kidnappers (East):	This fault is located in the Hawke’s Bay Regional Council area. There is a medium level of confidence in its classification which is based on analysis of an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Kidnappers (West):	This fault is located in the Hawke’s Bay Regional Council area. There is a medium level of confidence in its classification which is based on analysis of an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Lees Valley Fault:	This fault is located in the Canterbury Regional Council areas. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and comparisons with other, similar, faults.
Lindis Pass Fault:	This fault is located in the Canterbury and Otago Regional Council areas. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
London Hill Fault:	This fault is located in the Marlborough District Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
Martinborough Fault:	This fault is located in the Wellington Regional Council area. There is a medium level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Maunga Fault:	This fault is located in the Manawatu-Wanganui region. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
Moumahaki Fault:	This fault is located in the Taranaki Regional Council areas. There is a low level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Mount Thomas:	This fault is located in the Canterbury region. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
Ngakuru Fault:	This fault is located in the Waikato region. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
Norfolk Fault:	This fault is located in the Taranaki region. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.

- North Rough Ridge:** This fault is located in the Otago region. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Omihi Fault:** This fault is located in the Canterbury region. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Oruawharo Fault:** This fault is located in the Hawke’s Bay and Manawatu-Wanganui Regional Council areas. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Otaraiia Fault:** This fault is located in the Wellington region. There is a low level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates; and comparisons with other, similar, faults.
- Poulter Fault:** This fault is located in the Canterbury and West Coast Regional Council areas. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Pukerua Fault:** This fault is located in the Wellington region. There is a low level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates; and comparisons with other, similar, faults.
- Raukumara Series:** This series of faults is located in the Gisborne District Council area. There is a low level of confidence in its classification which appears to be based on comparisons with other, similar, faults.
- Ruataniwha Fault:** This fault is located in the Hawke’s Bay Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Shepherds Gully Fault:** This fault is located in the Wellington Regional Council area. There is a low level of confidence in its classification which is based on analysis of fault-specific slip rate and single-event displacement; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Tukituki Fault:** This fault is located in the Hawke’s Bay region. There is a low level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Waimea-Flaxmere Fault:** This fault is located in the Nelson and Tasman Council areas. There is a low level of confidence in its classification which appears to be based on comparisons with other, similar, faults.

Waipukurau-Poukawa: This fault is located in the Hawke's Bay Regional Council area. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.

Waitawhiti Fault: This fault is located in the Manawatu-Wanganui region. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.

Whakatane (North): This fault is located in the Bay of Plenty region. There is a medium low of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and comparisons with other, similar, faults.

Fault Avoidance Interval Class: Between 5,000 years and 10,000 years (RI Class IV).

Awahokomo Fault: This fault is located in the Canterbury region. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.

Bidwell Fault: This fault is located in the Wellington region. There is a low level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates; and comparisons with other, similar, faults.

Big River Fault: This fault is located in the West Coast Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.

Blackball Fault: This fault is located in the Wellington West Coast Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.

Cardrona Fault: This fault is located in the Wellington Otago Regional Council area. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.

Dalgety Fault: This fault is located in the Canterbury Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.

Dunstan Fault: This fault is located in the Otago region. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; fault-specific slip rate and single-event displacement; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.

- Esk Fault:** This fault is located in the Canterbury Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Fern Gully Fault:** This fault is located in the Canterbury region. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; fault-specific slip rate and single-event displacement; and an indicative determination of recurrence interval based on fault-specific slip rate constraints.
- Fernside Fault:** This fault is located in the Gisborne District Council area. There is a low level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates; and comparisons with other, similar, faults.
- Giles Creek Fault:** This fault is located in the West Coast Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Hog Swamp Fault:** This fault is located in the Marlborough District Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Horohoro Fault:** This fault is located in the Waikato and Bay of Plenty Regional Council areas. There is a high level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Hyde Fault:** This fault is located in the Otago region. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Kirkliston Fault:** This fault is located in the Canterbury region. There is a low level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Lowry Peak Fault:** This fault is located in the Canterbury region. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Mangaoranga Fault:** This fault is located in the Wellington and Manawatu-Wanganui Regional Council areas. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.

- Mangatete Fault:** This fault is located in the Waikato region. There is a medium level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Moonlight Fault:** This fault is located in the Southland and Otago Regional Council areas. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Nevis Fault:** This fault is located in the Otago region. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; fault-specific slip rate and single-event displacement; and comparisons with other, similar, faults.
- Nukumarū Fault:** This fault is located in the Taranaki region. There is a low level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Paparoa Range Fault:** This fault is located in the West Coast region. There is a low level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates; and comparisons with other, similar, faults.
- Poukawa (North) Fault:** This fault is located in the Hawke’s Bay Regional Council area. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures.
- Punaruḡu Fault:** This fault is located in the Waikato and Bay of Plenty Regional Council areas. There is a medium level of confidence in its classification which is based on analysis of fault-specific sequence of dated surface ruptures; and indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- Quartz Creek Fault:** This fault is located in the Canterbury Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Rostreivor Fault:** This fault is located in the Canterbury Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Rotokohu Fault:** This fault is located in the West Coast Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Rough Creek:** This fault is located in the West Coast Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.

- Southland Series:** This fault series is located in the Southland region. There is a low level of confidence in its classification which appears to be based on comparisons with other, similar, faults.
- Springbank Fault:** This fault is located in the Canterbury Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.
- Waitotara Fault:** This fault is located in the Taranaki Regional Council area. There is a low level of confidence in its classification which is based on an indicative determination of recurrence interval based on fault-specific slip rate constraints and rupture length estimates.
- West Culverden Fault:** This fault is located in the Canterbury Regional Council area. There is a low level of confidence in its classification which is based on comparisons with other, similar, faults.