[FREQUENTLY ASKED QUESTIONS]

Preparedness

What should I do if an earthquake occurs?

In a long or strong earthquake drop, cover, hold and get gone. If you are at the coast, move immediately to the nearest high ground, or as far inland as you can. Walk or bike if possible. Do not wait for official warnings. Every step counts.

How can I prepare for an event like this?

It might sound overwhelming, but there are simple things we all must do to be prepared.

1. Make a plan with whanau and friends about what you'll do in an emergency: www.happens.nz/make-a-plan/
2. Practice your drop, cover and hold and your tsunami hīkoi/walk to high ground or inland by foot or bike.
   www.shakeout.govt.nz
   www.eastcoastlab.org.nz/getinvolved/tsunami-hikoi/
3. Get involved in local community resilience planning in your area. Contact your local Civil Defence Group to get started.

Where can I find out if I'm in a tsunami evacuation zone?

Visit your Civil Defence Emergency Management group website to check out if you live, work, or play in a tsunami evacuation zone: www.civildefence.govt.nz/get-ready/get-tsunami-ready/tsunami-evacuation-zones/

The science

What is an earthquake?

An earthquake is the shaking of the Earth's surface due to movement of a fault. They are caused by the release of pressure between two tectonic plates. As plates push against each other, the rocks along the boundary become stressed and eventually release this pressure in the form of an earthquake. Earthquakes are known to sometimes cause a lot of damage, and aftershocks can cause even more damage.

What is a fault?

A fracture in the rock that makes up the earth's crust.

Why do earthquakes occur in New Zealand?

Earthquakes in New Zealand occur because it is located on the boundary of two of the world's major tectonic plates – the Pacific Plate and the Australian Plate.

These plates push together, causing one to slowly grind over, under or alongside the other. As the brittle crust gives way under the pressure, a fault ruptures and an earthquake occurs.

What are seismic waves/seismic energy?

When an earthquake occurs, the shockwaves of released energy that shake the Earth and temporarily turn soft rock, such as clay, into jelly (liquefaction) are called seismic waves. Seismic waves are usually generated by movements of the Earth's tectonic plates but may also be caused by explosions, volcanoes and landslides.

What is ground velocity and ground shaking?

Ground velocity is a measure of how quickly the ground moved from its original location to its new location.

Ground shaking is the movement of the earth due to the release of seismic energy. Ground shaking varies depending on the location and direction of fault rupture, rock type and topography of an area. These all affect the way seismic waves travel through the ground. If an earthquake generates enough shaking intensity, built structures can be damaged and landsliding can occur.

What is liquefaction?

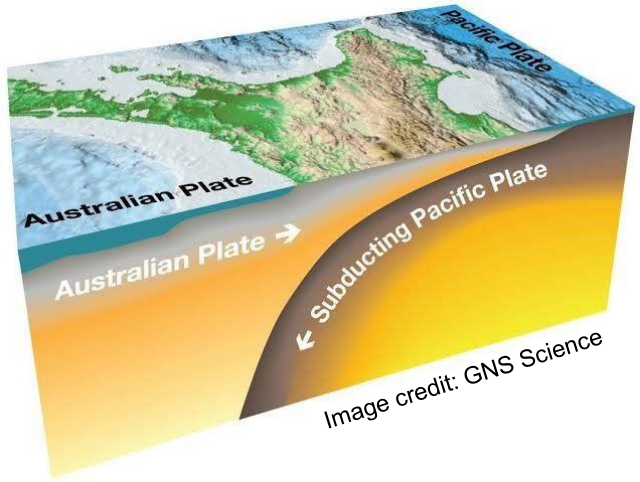
Liquefaction is a process that temporarily turns firm ground into a liquid. Liquefaction occurs during an earthquake in silty and sandy soil layers below the ground water table. Fine sand, silt and water moves up under pressure through cracks and other weak areas of the near surface soils to erupt onto the surface. When this happens, the soil behaves like a liquid and can cause major damage to buried pipe networks, roads and buildings and other structures.

What is a hypocentre?

The hypocentre is the point within the earth where an earthquake rupture starts. The epicentre is the point directly above it at the surface of the Earth.

What is a subduction zone?

A subduction zone is a type of fault, where two tectonic plates meet, and one plate subducts (dives) under the other. Subduction zones develop a type of fault that are responsible for the largest earthquakes and tsunami in the world.



The Hikurangi subduction zone is New Zealand's largest fault, where the Pacific plate dives under the Australian plate. It runs along the East Coast of the North Island. A large earthquake in the zone could lead to a large tsunami.

What is a tsunami?

A tsunami is a series of powerful waves with strong currents. They are mostly caused by underwater or coastal earthquakes, and sometimes by underwater landslides or volcanic eruptions.

Not all earthquakes will generate a tsunami, and earthquakes are not the only sign of a tsunami, so it is critical to know what to do if you are near the coast.

How is a tsunami created?

1. An event like an underwater earthquake happens. The movement forces a lot of water to move very quickly.
2. The whole water column (the water from surface all the way to the seafloor) moves at speeds of up to 1000 km per hour away from the earthquake location.
3. Because of the way tsunami are caused, they produce multiple waves (like the ripples you get when you drop a stone into water).
4. As the front edge of the wave gets to shallower water it slows. However, the back of the wave in the deeper water is still moving fast so the water 'piles up', and the tsunami wave height grows as it reaches the coast.
5. Sometimes it looks like the water sucks down and away from the coast, then rushes back in with enormous speed and force. Sometimes there is no 'sucking out'. This depends on if the high part (crest) or the low part (trough) of the wave reaches the coast first.
6. When the wave reaches shore, it travels inland on gentle slopes or flat land and pushes uphill on steep slopes, travelling at speeds similar to a fast car.
7. As the waves move they carry debris (like trees, rocks, boats, vehicles, or bits of building) that cause damage.

Why do tsunami waves grow in height as they approach land?

As the front edge of the tsunami wave gets to shallower water it slows. However, the back of the wave in the deeper water is still moving fast so the water 'piles up', and the tsunami wave height grows as it reaches the coast.

How are tsunami evacuation zones created?

In general, they are based on scientific modelling of different tsunami sources and the areas that could be impacted by tsunami. Some regions have sources of tsunami very close to the coast, other regions face greater risk from tsunami that travel from across the Pacific.

The evacuation zones consider the direction and size of possible tsunami and different scenarios. This means if you get out of the zones you are safe from tsunami waves, no matter what the scenario. We can also get smaller, but still dangerous tsunami. In these cases, if there is time, warnings for different zones such as only the beaches and marine area can be issued. For distant source tsunami (e.g. from generated by an earthquake in Chile) we will have time to issue warnings for more specific areas can issue warnings for smaller areas.

Risk

When will the Hikurangi subduction zone rupture?

Scientists cannot predict earthquakes. Thousands of earthquakes occur every year in New Zealand, so all of us need to be prepared. That is why it is important to:

1. Practice your drop, cover and hold and your tsunami hīkoi/walk to high ground or inland by foot or bike. www.shakeout.govt.nz www.eastcoastlab.org.nz/getinvolved/tsunami-hikoi/
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How long has this risk been known?

We have known for some time that the Hikurangi subduction zone can produce large earthquakes and tsunami. Recent research and lessons from the Kaikoura earthquake indicate an earthquake in this zone may be more likely than was first thought.

Teams of international scientists are studying the Hikurangi subduction zone so they can better understand the risk it poses to New Zealand.

If the Hikurangi Subduction Zone ruptures, will it affect other faults?

An earthquake can redistribute stress onto other faults, but it is impossible to accurately predict how a Hikurangi Subduction Zone earthquake might trigger other seismic activity.

The Hikurangi Response Plan

What is being done to plan for an event on the Hikurangi subduction zone?

Emergency managers are building a coordinated emergency response plan- The Hikurangi Response Plan. This plan will set out how regional responding agencies, including Civil Defence, will respond to a large earthquake and tsunami on the Hikurangi subduction zone. The response plan will span the five CDEM Groups identified as being the first to experience the impact of a Hikurangi subduction zone rupture: Bay of Plenty, Tairāwhiti (Gisborne), Hawke's Bay, Manawatu-Wanganui and Wellington.

The response plan is being developed collaboratively with input from Local Government, Central Agencies (Ministry of Health, Te Puni Kōkiri etc.), Civil Defence and some of New Zealand's top scientists. Infrastructure providers, emergency services, hospital and health, non-government organisations, university experts and representatives of communities and key business sectors are also involved in the process.

Civil defence emergency management plans already exist for tsunami and earthquake events. The co-ordinated nature of the Hikurangi Response Plan recognises that impacts would span several regions, and so CDEM Groups must plan together to ensure any future response is as coordinated and effective as possible.

The credible scenario

Why has the scenario been prepared?

To develop the HRP, scientists have developed a credible planning scenario which will help us determine response priorities and resource requirements. Because the Hikurangi subduction zone is so complex, there are any number of ways it could rupture.

While scientists from GNS Science cannot predict how the fault might behave, they have chosen a magnitude 8.9 scenario as being a serious and credible basis for the plan.

The magnitude 8.9 scenario is used to model how the ground would shake, and how a tsunami would affect communities along the coast. The scenario shows many areas in New Zealand being affected.

Is this a worst-case scenario?

No. Based simply upon the length and width of the subduction zone, the Hikurangi subduction zone could rupture in an earthquake greater than magnitude 8.9 but scientists cannot be certain if the whole subduction zone would rupture in one earthquake.

The last subduction zone earthquake that probably ruptured most of the Hikurangi subduction zone (i.e. from Cook Strait to near Gisborne) was about 800-900 years ago, and probably had a magnitude between 8 and 9, based on the latest geological evidence.

Why choose such a big event for the scenario?

Scientists wanted to choose a serious, credible scenario so that a robust plan could be formed. An event of this size is possible where

most of the Hikurangi subduction fault ruptures, but there are many other ways that the fault could rupture too.

Will this modelling change current tsunami evacuation zones?

Many factors are involved in calculating tsunami evacuation zones. Scientific models consider how different types of tsunami events inundate the coastline. The shape of the sea floor and the coast and the origin and size of the tsunami are all important.

If you live, work or play near the coast, you should check your tsunami evacuation zones on your local CDEM group website. This will have the most recent information.

What is the frequency of the large subduction earthquakes (M8-9) on the Hikurangi subduction zone?

The last earthquake that probably ruptured the most of the Hikurangi subduction zone (i.e. from Cook Strait to near Gisborne) was about 800-900 years ago, and probably had a magnitude between 8 and 9, based on the latest geological evidence.

In total, there have been between 6 and 10 Hikurangi subduction zone earthquakes over the last 7000 years. The last one was about 500 years ago, and it appears to have mostly impacted the southern part of the subduction zone (Wellington and Wairarapa). Earthquakes that affect parts (but not all) of the east coast have recurrence intervals that vary from 350 to 1700 years. Geological evidence is not precise enough to give us the recurrence interval of magnitude 8.9 earthquakes, like the HRP credible scenario.

What is the difference between frequency, RI and return period?

The frequency, or how often an earthquake occurs, is often described in terms of a recurrence interval on a fault and a return period of ground shaking.

Recurrence interval = the average time between surface-rupturing earthquakes on a fault, in years.

Return period = the average frequency that a site will sustain ground-shaking of a given intensity or greater. The ground shaking can come from earthquakes on multiple faults and is best expressed as a probability (e.g., 1/100 or 1% in any year).

Want more information?

Visit www.eastcoastlab.org.nz to access information and learn more about exciting research taking place on the Hikurangi subduction zone