



# 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.

## NORMAL VS TSUNAMI WAVES



### Normal waves

- Causes:** wind, weather, tides, and currents
- Time between waves:** 5-20 seconds
- Distance between waves:** 100-200 metres
- Speed:** Moves relatively slowly on the ocean (8-100 km per hour) and stops when it reaches land.
- Water movement:** only the top layer of water moves.



### Tsunami waves

- Causes:** seafloor or coastal earthquake, underwater landslide or volcanic activity
- Time between waves:** 10 minutes to 2 hours
- Distance between waves:** 100-500 km
- Speed:** moves at the speed of a jet plane on the ocean (800-100km per hour) and keeps going at the speed of a car on land (30km per hour).
- Water movement:** the whole water column – the water from surface all the way to the seafloor moves.

## TSUNAMI WAVES CAUSE DAMAGE BECAUSE THEY ARE...

**Very fast:** even once a tsunami reaches land it keeps going, moving across land at the same speed as a car (around 30km per hour) so you can't outrun it.

**Powerful:** waves have lots of energy and can damage or destroy buildings and carry vehicles and boats.

**More than one wave:** the largest wave may happen several hours after the first wave and there can be more than one set of waves.

**Impossible to out-run:** even once a tsunami wave reaches land it keeps going, moving across land at roughly the speed of a car.

**Able to come inland/upstream and travel up slopes:** their power and speed means they can come much further inland or up hills than a regular wave.

**Full of other things:** as the wave travels it picks up things in its path like trees, vehicles or bits of buildings which can cause damage as they are moved by the wave.

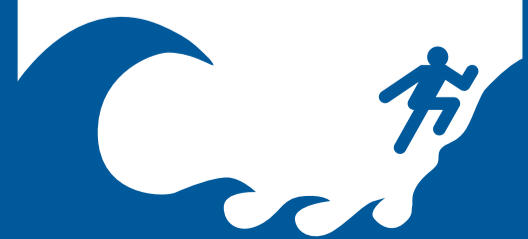
### DID YOU KNOW...



Even smaller tsunami waves are powerful and can be dangerous.

## DON'T FORGET

**Long or Strong  
GET GONE**





# WHERE DO TSUNAMI COME FROM?

## CAUSES OF TSUNAMI



EARTHQUAKES



VOLCANOES



LANDSLIDES

## SOURCES OF TSUNAMI

- 1 Distant**  
Generated more than 3 hours away, (e.g. Chile).
- 2 Regional**  
Generated 1-3 hours away (e.g. the Kermadec Trench to the north of New Zealand).
- 3 Local**  
Generated less than an hour away from the New Zealand coast. There may only be a few minutes warning.



### DID YOU KNOW



Tsunami waves can travel up streams and rivers and a long way inland (Tsunami waves travelled 3km inland in Thailand and 6km in Banda Aceh).

### DID YOU KNOW



The largest wave may happen several hours after the first waves arrive. There could be more than one series of waves. The danger period can continue for many hours.

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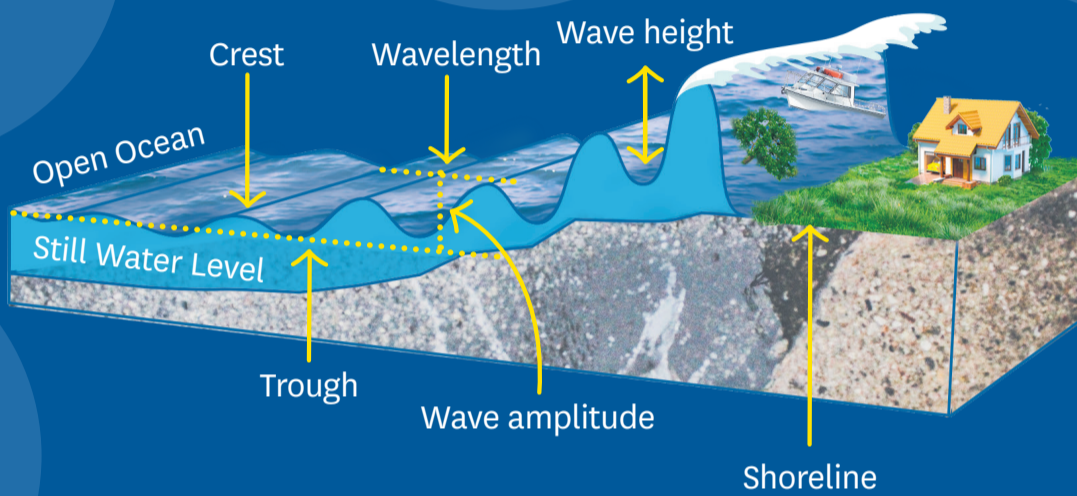


# HOW A TSUNAMI HAPPENS

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 1000km 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.

7. As the waves move they carry debris (like trees, rocks, boats, vehicles or bits of building) that cause damage.

6. When the wave reaches shore it travels inland on gentle slopes or flat land or pushes uphill on steep slopes, travelling at speeds similar to a fast car.

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.

## THE IMPACT OF TSUNAMI WAVES



1m  
Threat is mainly coastal. Some turbulence and strong currents.



1-3m Potentially lethal  
Some damage to fragile coastal stuff like wooden buildings, machines and electrics.



3-5m Potentially lethal  
Lots of damage and inundation. Damage to concrete buildings and coastal roads, pipes, electrical networks etc.



5m+ Potentially lethal  
Lot of serious damage and inundation. Buildings, roads, bridges, pipes and wires washed away.

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# WHAT'S THE BIG DEAL?

All of New Zealand's coastline is at risk of tsunami. They have the potential to cause more damage than earthquakes or volcanoes.

## THE RING OF FIRE

New Zealand is part of the Pacific 'ring of fire' - the tectonic plate boundaries that surround the Pacific. The tectonic plates are constantly moving. Pressure builds up between the plates and is sometimes released as very large earthquakes, like the Boxing Day earthquake in 2004 and the Tohoku earthquake in Japan in 2011. These quakes can generate tsunami that travel from the earthquake site to New Zealand.

Fault lines and plate boundaries near New Zealand could produce large earthquakes. A powerful earthquake where the Pacific and the Australian Plates meet could result in a 15m high tsunami striking Northland and Great Barrier Island, parts of the East Coast of the North Island and Wairarapa. Southland and the West Coast also have fault lines that could produce large earthquakes.

### DID YOU KNOW



GNS Science research after the 2011 Japan tsunami shows fault lines near New Zealand could produce much larger earthquakes than previously thought.

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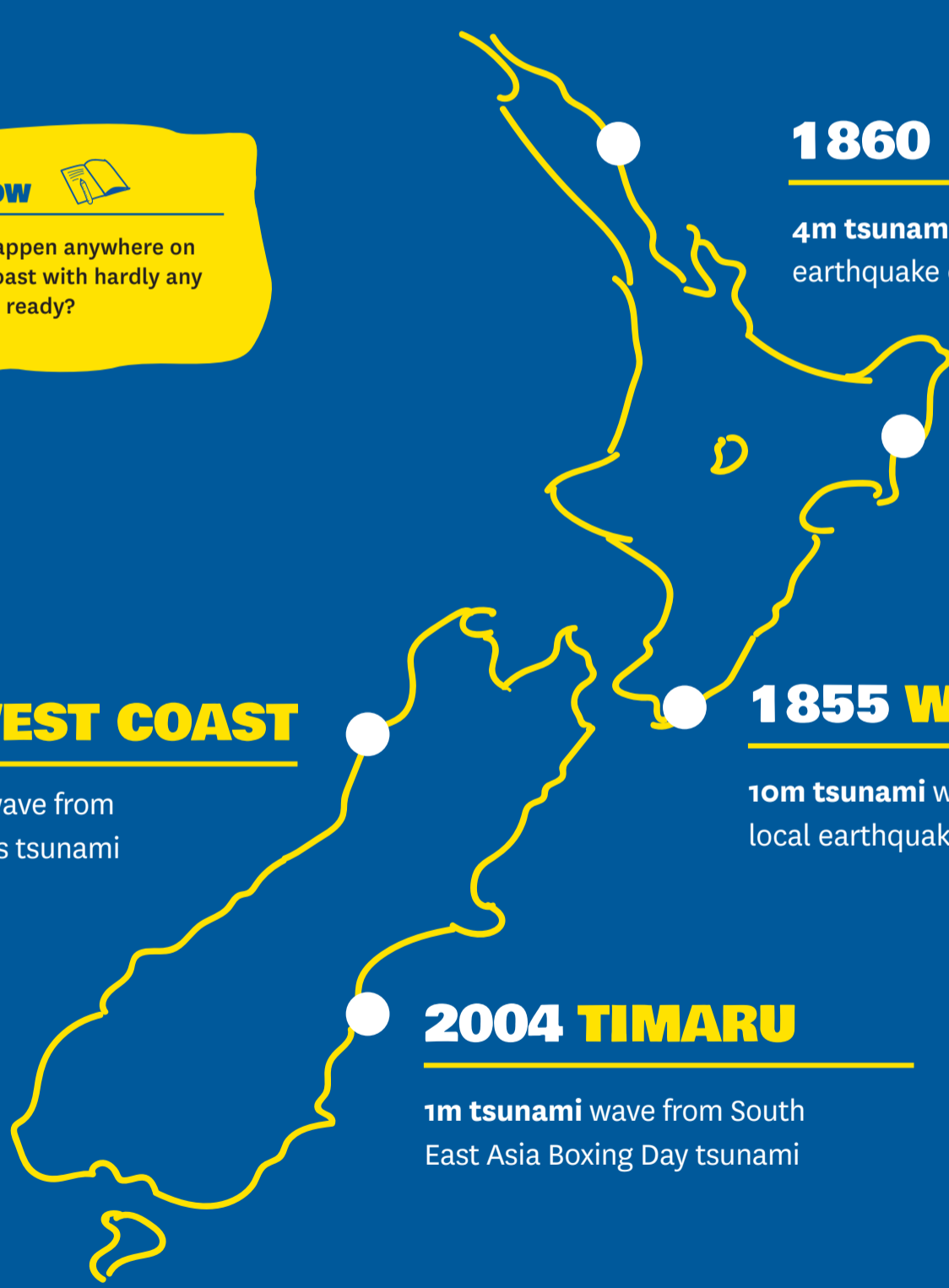
# IT HAPPENS HERE....

In the last two hundred years, there have been at least three tsunami that were more than 10 metres high at New Zealand's coast. There have also been several smaller tsunami. Plus, Māori mythology speaks of large tsunami. Some were caused by distant earthquakes some by underwater quakes not far off the coast. For the close ones, there's very little warning before they arrive.

### DID YOU KNOW



Tsunami could happen anywhere on New Zealand's coast with hardly any warning. Are you ready?



## 1860 EAST COAST

4m tsunami waves after a massive earthquake off the coast of Chile

## 1947 GISBORNE

10m tsunami waves after a local earthquake

## 1855 WAIRARAPA

10m tsunami waves after a local earthquake

## 2007 WEST COAST

1.1m tsunami wave from Solomon Islands tsunami

## 2004 TIMARU

1m tsunami wave from South East Asia Boxing Day tsunami

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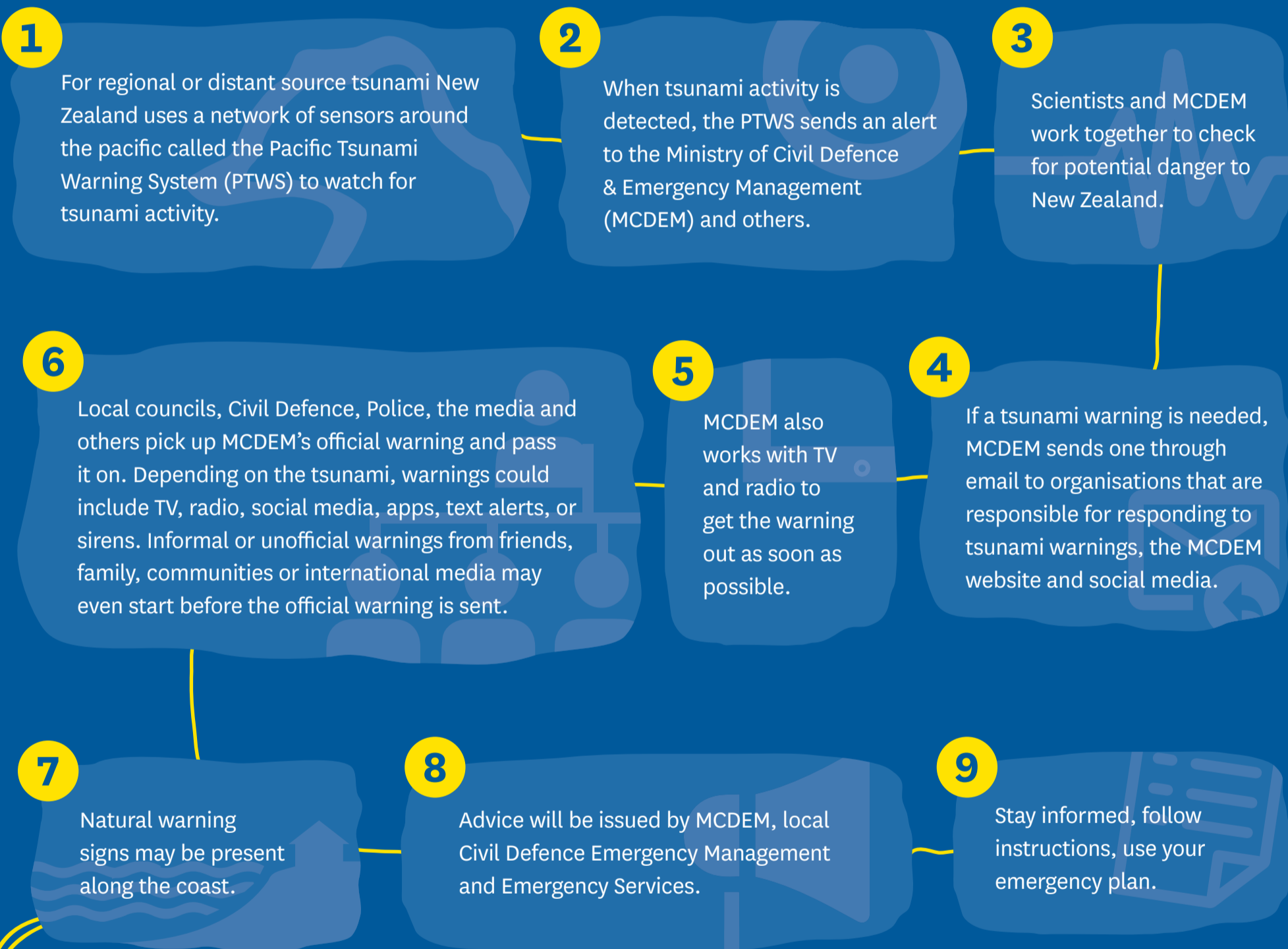
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# HOW TSUNAMI WARNINGS WORK

What kinds of tsunami warnings can be used and how much time you'll have depends on the source, size and location of the tsunami. Here's how it works;



## DID YOU KNOW



Local source tsunami can arrive before official warnings can go out, So you need to know what natural and informal warnings to look for.

## DON'T FORGET

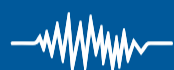
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# TYPES OF TSUNAMI WARNINGS

**Don't wait to act**, if you experience any of these warnings evacuate immediately inland or to higher ground:

## NATURAL



### A long earthquake

A long (more than a minute) or strong (makes it hard to walk or stand up) earthquake



### Sea level change

A sudden rise or fall in sea level



### Unusual noises

Unusual noises from the sea (noises like jet planes or trains)

## OFFICIAL

Ask your local council what types of warning systems are used in your area. Ways to warn people include:



TV



Apps



Radio



Social media, website and email



Text alerts



Sirens and PA systems

## INFORMAL

Warnings may come from friends, neighbours, your community or international media. If they seem trustworthy, consider evacuating.



Friends, neighbours and the public

Check the accuracy of the warning once you have evacuated or en route if it won't slow you down. You can check the warnings via NZ TV/radio broadcasts, local Civil Defence and emergency services.

### DID YOU KNOW



A system of sensors across the Pacific called the Pacific Tsunami Warning System allow the Ministry of Civil Defence & Emergency Management to watch for tsunami activity.

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# TSUNAMI SURVIVAL

Any part of New Zealand's coast could be affected by tsunami. Here's what to do before, during and after a tsunami.

## BEFORE A TSUNAMI

- Know the tsunami risk for where you are. Contact your local council or Civil Defence Emergency Management group to find out.
- Know the natural warning signs (a long or strong earthquake, a change in sea level or a strange noise from the ocean).
- Know, and subscribe to, the warning systems for where you are (could be things like text alerts, apps, social media, website updates).
- Make a plan with those you care about.
- Plan and practice your evacuation route.
- Have a getaway kit.



## DURING A TSUNAMI WARNING

- If you see any of the natural warning signs, move inland or to higher ground immediately.
- If you receive an official warning, follow the instructions.
- If evacuating, grab your getaway kit, family and pets (if they're with you) and follow instructions.
- If evacuating, try to walk or cycle, not drive.
- If you do not have time to move to higher ground or inland, go to an upper storey of a sturdy building.
- Do not go sightseeing. Never go to look for a tsunami.

## AFTER A TSUNAMI

- Listen to the radio, watch TV or check social media for instructions.
- Do not return to the evacuation zones until given the all-clear.
- Be aware that there may be more than one wave and that later waves may be bigger than the first. It may not be safe for up to 24 hours, or longer.
- Be careful re-entering homes or buildings as they may be damaged.
- Look for, and report, broken utility lines to appropriate authorities.

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