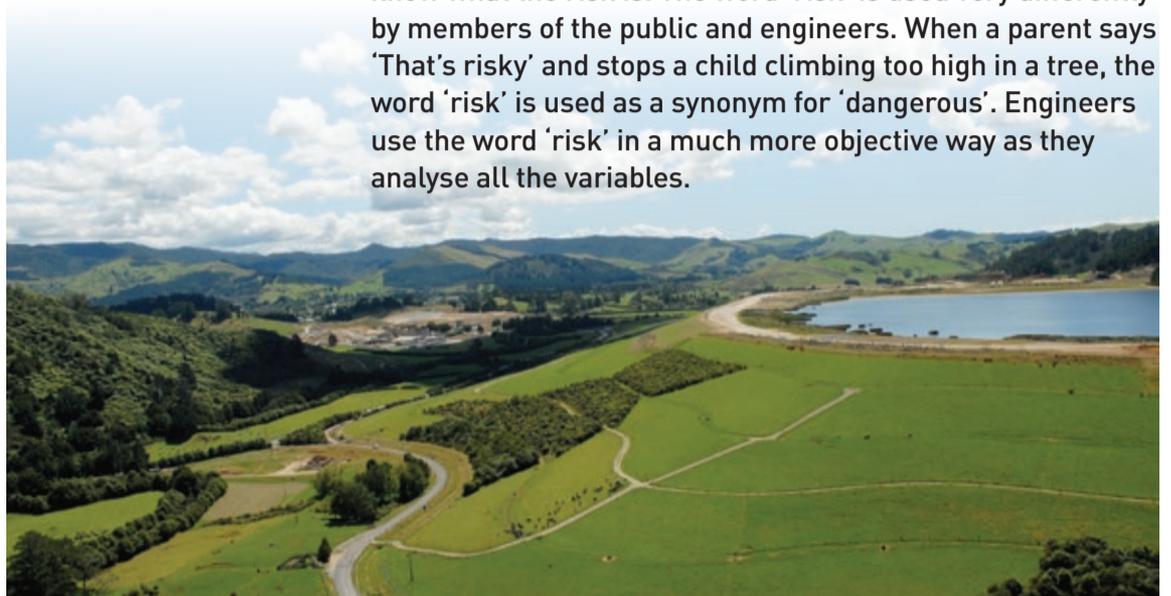


# EARTHQUAKES & Impoundments

**What do we mean by 'risk'?**

Risk assessment procedures consider the *hazards*, how *likely* they are to occur, and identify *actions* required to lessen the risk. As an

example, there is the likelihood of a very large earthquake happening off the coast of Chile every 50 to 100 years. It is predicted that such an earthquake would create tsunami waves travelling across the Pacific Ocean, hitting New Zealand's East Coast and inundating coastal land. Do we decide to evacuate all inhabited areas on the east coast of New Zealand because of this risk? No, but we do make preparations such as installing tsunami warning sirens, having Civil Defence practices, or knowing the best route to take to higher ground. In this case the likelihood is low, and we minimise the high consequence by taking appropriate action.



The earthquake off the East Coast in the early morning of 24 November was recorded by our vibration monitors. Five of our recording devices logged the event.

Whenever an event like this happens, we naturally ask ourselves "What if the 'big one' happened here?" We want to know what the risk is. The word 'risk' is used very differently by members of the public and engineers. When a parent says 'That's risky' and stops a child climbing too high in a tree, the word 'risk' is used as a synonym for 'dangerous'. Engineers use the word 'risk' in a much more objective way as they analyse all the variables.

**What if an earthquake happens here?**

**The risk of an earthquake breaching the Waihi tailings impoundments**

is considered to be extremely low. In designing the project, the risks have been identified and, where possible, have been minimised or 'engineered out'.

- The embankments forming the tailings impoundments are of 'downstream construction' which is the safest form of construction. The slopes are gentler than necessary due to the availability of large quantities of rock from the Martha Mine open pit.
- The foundations are solid, based on bedrock which is present at shallow depth.
- The tailings themselves consolidate with time, and even if the tailings did liquefy this has no impact on the stability of the embankments which retain the tailings.



## How do you DESIGN AND BUILD FOR 'RISK'?

Structures such as our two tailings impoundments come under the provisions of the Building Act. Design criteria are based on national and international guidelines. Earthquake design levels for large impoundments are related to the potential consequences of failure.

Earthquake design loads are affected by three main factors:

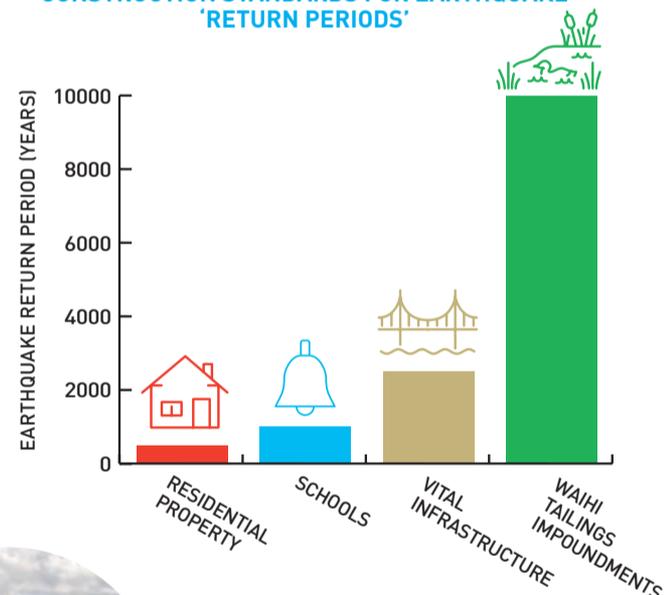
- earthquake magnitude
- distance and depth of earthquake from the site
- frequency of occurrence of earthquakes of different magnitudes.

Just as a '100 year storm' describes the size of a storm, not how often it happens, an earthquake with a 'return period' of 10,000 years would be significantly larger than one with a return period of 500 years. It is not how often it happens, but how big it is.

Our tailings impoundments are designed to withstand earthquake loads with a return period of 10,000 years. In 2007 the Institute of Geological and Nuclear Sciences (GNS) provided updated estimates of 10,000-year ground motions for design of the tailings impoundments at Waihi.

In comparison, normal buildings, including residential houses, are designed for earthquake ground motions with an average return period of 500 years. Structures that may contain large numbers of people including schools are designed for 1,000 years, and structures with special post-disaster functions (e.g., hospitals, fire and police stations) and vital infrastructure such as state highway bridges are designed for a return period of 2,500 years.

CONSTRUCTION STANDARDS FOR EARTHQUAKE 'RETURN PERIODS'



Moresby Avenue office  
**HOURS OVER HOLIDAY PERIOD**

Our Administration Office at Moresby Avenue will be closed at the end of the business day on Friday 20 December and will reopen on Monday 6 January 2020.

The Community Engagement Line  
**0800 WAIHIGOLD**

will be available 24 hours a day throughout the holiday period.