

The Queensland State Earthquake Risk Assessment: preparing for the next Great Quake

Jane Sexton¹

1. Queensland Fire and Emergency Services, Level 2, Hudson Road, Albion Queensland

Abstract

Queensland's earthquake hazard is low in comparison to other areas in Australia; however, the potential consequences could be catastrophic for communities, the economy and environment. Queensland Fire and Emergency Services (QFES) is committed to an all-hazards, comprehensive approach to disaster management and is proactive in planning for low probability high consequence events such as earthquake.

The Queensland Emergency Risk Management Framework (QERMF) has been developed to inform risk-based planning across the emergency management sector in Queensland. The 2019 Queensland State Earthquake Risk Assessment and companion Tsunami Guide for Queensland were developed to support the implementation of the QERMF at the local and district level.

Following an independent review of the QERMF, these resources are being updated to reflect advances in earthquake risk science, stakeholder feedback and community experiences in managing disaster risk. Whilst these resources are targeted for application in Queensland, much of the information can be generalised for application nationally. This aspect is particularly applicable given the announcement of the National Disaster Risk Reduction Package project "Disaster Risk Information Portal". This project uses the QERMF as the basis for managing disaster risks in Victoria, Western Australia and Tasmania. Acknowledging this broader application, QFES welcomes feedback on these resources to strengthen the evidence base to underpin disaster management planning across Australia.

Keywords: earthquake risk, risk-based planning.

1 Background

The Queensland State Earthquake Risk Assessment (SERA) and the Tsunami Guide for Queensland (TGQ) (* Queensland Fire and Emergency Services, 2019) were developed to inform the development of risk-based disaster management and business continuity plans in support of the application of the Queensland Emergency Risk Management Framework (QERMF).

The QERMF is being refreshed as part of its continuous improvement and to reflect the recommendations of an independent review. Consequently, Queensland Fire and Emergency Services (QFES) is updating these two resources to reflect stakeholder feedback and ensure the information is current.

It is acknowledged that these low probability events typically feature lower in the ranking for priority hazards assessed by Local and State disaster management groups, however, these events have the potential for high consequences.

The update is planned to occur throughout this financial year with the aim of achieving the following objectives:

1. To ensure stakeholders are provided with up-to-date, end-user focused products to support all levels of Queensland's disaster management arrangements.
2. To provide stakeholders with resources they can tangibly apply in the ongoing development of Local, District and State Disaster Management Plan(s).
3. To increase the knowledge base of earthquake and tsunami with stakeholders at all levels of Queensland's disaster management arrangements.
4. To support ongoing partnerships with other agencies and organisations within the state and national contexts.
5. To increase awareness of other 'low probability, high consequence' hazards and encourage Local, District and State planning across prevention, preparedness, response and recovery.

2 Review

Since these two resources were published, key data and information has become available:

- The Royal Commission into the National Natural Disaster Arrangements Recommendations (* Commonwealth of Australia, 2020)
- QFES After Action Review following the Jan 15 tsunami triggered by the Hunga Tonga Hunga Ha'apai volcano
- Tsunami Evacuation Mapping for Queensland
- Geoscience Australia's Earthquake Scenario Selector Tool (for planning purposes)
- Finalisation of the Bushfire and Natural Hazards CRC Project "Cost-effective mitigation strategy for building related earthquake risk" (* Wehner et al, 2020)
- Update to the National Seismic Hazard Assessment (* Allen et al, 2020)
- Queensland State Disaster Risk Report 2021/22 (* Queensland Fire and Emergency Services, 2022).

A short overview on how these items relate to the update is outlined below.

2.1 Royal Commission into the National Natural Disaster Arrangements Recommendations

A number of recommendations from the Royal Commission are relevant here, in particular:

- **Recommendation 4.4** Features of the National Disaster Risk Information Services Capability

The National Disaster Risk Information Services Capability should include tools and systems to support operational and strategic decision making, including integrated climate and disaster risk scenarios tailored to various needs of relevant industry sectors and end users.

- **Recommendation 6.5** Multi-agency national-level exercises

Australian, state and territory governments should conduct multi-agency, national-level exercises, not limited to cross-border jurisdictions. These exercises should, at a minimum:

- assess national capacity, inform capability development and coordination in response to, and recovery from, natural disasters, and
- use scenarios that stress current capabilities.
- **Recommendation 11.1** Responsibility for local government disaster management capability and capacity

State and territory governments should take responsibility for the capability and capacity of local governments to which they have delegated their responsibilities in preparing for, responding to, and recovering from natural disasters, to ensure local governments are able to effectively discharge the responsibilities devolved to them.

These recommendations align with the intent of these resources, that is, to support the local and district disaster management planning. There are current activities underway in Queensland utilising this resource to inform discussion exercises in key areas in Queensland. As the QERMF is implemented in its updated version across the State, this resource will assist those local governments develop emergency plans for earthquake and tsunami.

2.2 QFES After Action Review 2022

An observation from the 2022 tsunami triggered by the Hunga Tonga Hunga Ha'apai volcano, was that there is uncertainty in responsibilities and procedures in relation to tsunami. Given both tsunami and earthquake are low probability events with the potential for high consequence, it is likely that the same observation will be true for earthquake. Clearly, the processes for these events will be different, given that earthquakes have no warning.

Another observation from the 2022 tsunami event was the lack of awareness of the information that exists for tsunami. In line with above, it is expected that there is equally a low level of awareness of earthquake information.

QFES have taken steps to address this lack of awareness hosting webinars for Tsunami Risk in Queensland and Earthquake Risk in Queensland. These webinars have been recorded and published on the Queensland Government Disaster Management website (* <https://www.disaster.qld.gov.au/qermf/Pages/Assessment-and-plans.aspx>) as a permanent resource for local and district disaster managers.

2.3 New data and information developed since 2019

There are numerous examples of new data and information developed since 2019 which relate to the update; Tsunami Evacuation Mapping for Queensland, Geoscience Australia's Earthquake Scenario Selector Tool, Bushfire and Natural Hazards CRC Project "Cost-effective mitigation strategy for building related earthquake risk", and the Queensland State Disaster Risk Report 2021/22.

In response to recommendations from a desktop tsunami exercise in Queensland, QFES developed the **Tsunami Evacuation Areas for Queensland** in collaboration with local government (* <https://www.qfes.qld.gov.au/prepare/tsunami/evacuation-areas>). This resource applies the national guidance of evacuating to 10m height, 1km inland. This state-wide mapping included tsunami modelling where available through local government, however it was not available at the time to support the development of the TGQ. Consideration can now be given to how this mapping can be used to transition the TGQ to a tsunami risk assessment

in a similar way to the SERA. Further tsunami modelling activities are underway in Queensland and will be incorporated into the update.

Whilst the **Earthquake Scenario Selector Tool** was referenced in the 2019 SERA, there was no guidance provided for disaster managers on how to use the tool to support a risk assessment or to support their local planning. This guidance will now also be included within the update.

The research conducted through the Bushfire and Natural Hazards CRC project “**Cost-effective mitigation strategy for building related earthquake risk**” developed an evidence base to inform decision making on the mitigation of the seismic risk posed by the most vulnerable Australian buildings subject to earthquakes. This evidence base supports cost-effective and economically justifiable decisions by building owners and government officials on all matters concerning seismic strengthening of existing and design of new buildings. While the focus of this project was on buildings, many of the project outputs are also relevant for other Australian infrastructure such as bridges, roads and ports. The Bushfire and Natural Hazards CRC project also included a utilisation project in the City of York in Western Australia (* Wehner, et al. 2020) which also provides insights for application in Queensland.

The **2021/22 State Disaster Risk Report** provides an assessment of State-wide risk for ten hazards, two compound or cascading hazards, and a range of risk drivers. Importantly, the report provides forward projections of disaster risk where possible, based on best-available climate projections, largely thanks to the Department of Environment and Science. The report advises decision-makers at all levels to consider the changing nature of risk due to climate change, and to adjust their long-term disaster risk reduction planning where appropriate. Earthquake ranked as 9th highest priority in the State with tsunami ranking 10th. This represents a reduction for earthquake from 5th highest priority in the 2017 State Natural Hazard Risk Assessment (Queensland Fire and Emergency Services, 2017). This is due largely to the inclusion of additional hazards (particularly pandemic and infectious plant or animal disease). Tsunami had not been previously included, highlighting QFES’ commitment to increasing the awareness of low probability, high consequence hazards.

2.4 Update to the National Seismic Hazard Assessment

Acknowledging the limited experience and awareness of earthquakes in Queensland, the current SERA promotes earthquake risk assessments based on similar events that have occurred elsewhere in Australia. For the SERA, the assessment draws on the 1989 Newcastle event and the 1918 Great Queensland Quake. As a result, the SERA assigns probabilities of these magnitude events to each source zone in Queensland, which in turn can then be aligned to local government area boundaries. These probabilities are used within the implementation of the QERMF as local governments undertake risk assessments. The next update of the NSHA will revise these probabilities due to continuing updates to the earthquake catalogue, in addition to developing hazard information at a more localised level which will be more directly relevant for application at a community level. Further, it will allow direct comparison with the scenarios available through the Earthquake Scenario Selector Tool.

3 Improvement opportunities

QFES have identified high level opportunities for improvement to the documents. In addition to the incorporation of new data and research as highlighted above, these include:

- Inclusion of a case-study to apply the QERMF.

- a. A key finding of the Independent Review of the QERMF was that the methodology was too complex. Providing a use-case enables the replication at another location and for other scenarios. The use-case could draw on a scenario from the Earthquake Scenario Selector Tool which provides nationally credible scenarios for planning purposes.
- Plain language revision of the earthquake description.
- Incorporation of relevant insights or lessons from relevant earthquake and tsunami events, reviews and exercises. This may include risk treatments applied post-event.
 - a. Including this information promotes a culture of learning which may assist local government to target risk treatments.
- Outline of the products and services from the National Earthquake Alert Centre (NEAC).
 - a. Given the low probability and high consequence nature of earthquakes, it is likely there remains uncertainty in responsibilities and procedures for earthquake, and what information is available through the NEAC.
- Inclusion of a section to outline the volcanic hazard source potential for tsunami in the region.
 - a. The TGQ includes a general description of the sources for tsunami, however, it is particularly relevant given the 2022 Hunga Tonga Hunga Ha'apai volcanic eruption and subsequent tsunami to include regional information on volcanic sources which could lead to tsunami impacting Queensland.
- Better align the QLD SERA and TGQ in terms of structure.

QFES recognises that this list is not exhaustive and welcomes suggestions from the broader earthquake hazard and engineering community on what areas can be further improved upon.

The key focus for this update is achieving value for the intended audience of local and district disaster managers, however, there is wider value to the broader community that assist those managers in executing their responsibilities under the Queensland Disaster Management Arrangements.

4 References

Allen, T. I., J. D. Griffin, M. Leonard, D. J. Clark, and H. Ghasemi (2020). The 2018 National Seismic Hazard Assessment of Australia: quantifying hazard changes and model uncertainties, *Earthq. Spectra* 36, 5-43, doi: 10.1177/8755293019900777.

Commonwealth of Australia (2020). Royal Commission into National Natural Disaster Arrangements, Final Report, 594 pp.

Queensland Fire and Emergency Services (2017). State Natural Hazard Risk Assessment. Queensland Fire and Emergency Services, Brisbane, 92 pp. <https://www.disaster.qld.gov.au/qermf/Pages/Assessment-and-plans.aspx>

Queensland Fire and Emergency Services (2019). Queensland State Earthquake Risk Assessment. Queensland Fire and Emergency Services, Brisbane, 39 pp. <https://www.disaster.qld.gov.au/qermf/Pages/Assessment-and-plans.aspx>

Queensland Fire and Emergency Services (2019). Tsunami Guide for Queensland. Queensland Fire and Emergency Services, Brisbane, 21 pp. <https://www.disaster.qld.gov.au/qermf/Pages/Assessment-and-plans.aspx>

- Queensland Fire and Emergency Services (2022). Queensland 2021/22 State Disaster Risk Report. Queensland Fire and Emergency Services, Brisbane, 252 pp.
<https://www.disaster.qld.gov.au/qermf/Pages/Assessment-and-plans.aspx>
- Wehner, M., H. Ryu, M. Griffith, M. Edwards, N. Corby, I. Mohanty, J. Vaculik, and T. Allen (2020). Earthquake mitigation of WA regional towns York case study: final report, Bushfire and Natural Hazards CRC Report TBC, 190 pp.