Report of Transnational Access Projects

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Project ID: TA2-542-1

Principal investigator: Trevor Allen, Geoscience Australia, *https://orcid.org/0000-0003-3420-547X*

Project team (if applicable): N/A

Project title: Drafting Best-Practice Guidelines for National-scale Seismic Hazard Models (NSHMs)

Project acronym: NSHM-BPG

Hosting installation: ETH Zurich

Hosting team: Dr Laurentiu Danciu, ETH Zurich

Period of access: 8-17 September 2025 and 15-19 June 2026

Report of activities:

This Transnational Access project enabled the visit of a Geoscience Australia official to meet and work with colleagues at ETH Zurich. Under this Project, the project investigator worked towards the development of "best-practice guidance" for National-scale Seismic Hazard Models (NSHMs). The guidance developed through this Project is intended to fill a gap for hazard modellers worldwide, and will provide clear and authoritative advice on the development of NSHMs.

Through this Transnational Access project, a draft manuscript was also developed. The manuscript, which will but submitted for publication, explores the application of a grading system for complying with NSHM best practice.

This placement was not intended to deliver the final guidance. However, the placement enabled the development of a solid foundation for the these guidelines, which will be the focus of ongoing collaborative work with the international seismic hazard modelling community.

Project outcomes:

Two workshops at international conferences:

- IAGA/IASPEI Joint Scientific Meeting 2025 (meeting summary below)
- 2026 Global Earthquake Model Conference: National seismic hazard workshop identifies common challenges - GEM Foundation

Geo-INQUIRE is funded by the European Commission under project number 101058518 within the HORIZON-INFRA-2021-SERV-01 call

As noted, the project has provided the framework for the development of NSHM best-practice guidelines, with the first draft expected to be completed by the end of 2026. Otherwise, the project has resulted in the development of a draft manuscript entitled “Best-Practise for Undertaking National Seismic-Hazard Models: A Graded Approach”. The principal investigator will, as the lead author, identify Geo-INQUIRE as a key enabler on publication.

Note: Data, products, software and publications resulting from TA activities must be publicly accessible under a CC-BY 4.0, GPLv3 or equivalent open license. No embargos beyond June 2026 are allowed. They must cite Geo-INQUIRE as the source of funding. Minimal citation: “*Geo-INQUIRE is funded by the European Union (GA 101058518)*”.

Summary of NSHM Guidelins Kick-off Workshop – 4 September 2025 – Lisbon

An introductory workshop to promote a structured and transparent framework for national-scale seismic-hazard models (NSHMs) was held on 4 September 2025 in conjunction with the IAGA / IASPEI Joint Scientific Meeting in Lisbon. The initiative is intended to provide community-based and globally accepted best practices to deliver outcomes that are applicable to government agencies, regulatory bodies, research institutions, infrastructure owners, and policymakers (hereafter referred to as *end users*). These guidelines are not intended to replace existing guidance or safety standards for site-specific hazard assessments published by international or national regulatory bodies.

This kick-off workshop was intended to discuss the key challenges facing developers of NSHM programs, and explored how such an initiative could be developed and evolve over time. Some of the key items that will be explored through these guidelines and presented to workshop delegates include:

1. Purpose and scope of the initiative
2. Governance, institutional framework, and responsibilities of NSHM programs
3. Technical framework for undertaking NSHMs
4. Model development and implementation
5. Hazard model outputs and interpretation
6. End-user needs and stakeholder engagement
7. Quality assurance and peer review
8. Triggers for model updates

Following the initial presentation, the core team opened the floor for questions and comments. These discussions followed several central themes, summarised below.

1.1.1 Responsibility

In some nations, there is no single agency or organisation that has the responsibility for the delivery of an authoritative NSHM. In these situations, it may be incumbent on national regulatory authorities to provide directives on which agency or research body has this responsibility. This may be one or more bodies. In making this decision, the regulatory authority must ensure that the selected body (or bodies) have the appropriate capacity and capability to undertake this role. If capability/capacity gaps exist, appropriate resources should be provided, and realistic milestones should be applied.

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1.1.2 Graded model approach

It was widely agreed amongst workshop participants that there was a wide variability in capability and capacity of model delivery agencies. To that end, the guidelines should provide a flexible graded approach for the planning and implementation of NSHMs, ensuring that the quality assurance level is commensurate with the "grade" of NSHM. Whilst all models that follow the proposed guidelines must meet minimum standards, the output of any individual model will have different confidence levels depending on availability and interpretation of indigenous data, explorational of model uncertainty and level of critical peer review. There is a need for these model grades to be clearly defined and communicated in the guidelines.

1.1.3 Quality assurance and model transparency

To ensure the endorsement of NSHMs by national regulators, it is important for the model developers to demonstrate a high level of quality assurance to end users. Workshop participants agreed that NSHMs should be well documented and have a transparent and reproducible development process and clearly defined roles for all participants, together with open access to fundamental data used to characterise the model.

A central tenet for the uptake of NSHMs is a rigorous independent peer review process by leading international experts in seismic hazard assessment. The level of peer review to which an NSHM is subjected will also be used to determine the grade to which the NSHM complies.

1.1.4 Interplay between national and site-specific studies

There was discussion on the use of NSHMs to provide a level of quality assurance for site-specific applications. Specifically, discussions focussed on the probability level to which an NSHM would be trusted. The ultimate level of assurance would be strongly dependent on the interrogation of indigenous earthquake data (including paleoseismic field investigations), model documentation and transparency, and the rigour of the independent peer review. At a minimum, sensitive assets that require design-level ground-motions with an annual exceedance probability (AEP) of 1/10,000 should characterise hazard sources (i.e., faults) in the Site Vicinity (~8 km from the Site Area). In these cases, absence of evidence of potentially capable faults should not be taken as evidence of absence and NSHMs may require augmentation for site-specific studies.

It was acknowledged that in some situations, a high-quality NSHM could provide more end-user assurance than a low-end PSHA by a consultant without peer review, particularly for infrastructure owners with few assets and limited resources to determine asset-specific hazard.

1.1.5 Other commentary

There was some discussion on the utility of the guidelines for providing advice on the assessment of hazard for secondary perils (e.g., tsunami). Whilst the focus of the present draft will be on earthquake vibratory hazards, there may be opportunities to extend the guidance for secondary perils and for probabilistic fault-displacement hazard assessments in the future.