



**SOPAC Member Countries
National Capacity Assessments:
Tsunami Warning and Mitigation Systems**

Kingdom of Tonga



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SOPAC



Section

1

1. Results Outline

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1.1. Executive Summary

Between the 29 May and 1 June 2007, a team of international experts led by the Australian Bureau of Meteorology (the 'Bureau') completed an assessment of the Kingdom of Tonga's tsunami warning and mitigation system. Tonga was the first of 14 countries to be assessed and as such was treated as a pilot assessment. This report is the result of that assessment visit. The report aims to better guide national and donor funding and projects towards targeted enhancements in Tonga's tsunami warning and mitigation system by outlining the strengths, opportunities for improvement and recommendations.

The initial receipt and forwarding of tsunami advisories produced by the Pacific Tsunami Warning Centre (PTWC) in Hawaii is the responsibility of the Tongan Meteorological Service (TMS). The National Emergency Management Office (NEMO) leads emergency planning and mitigation efforts and coordinates emergency response. Seismic detection throughout the Kingdom is the responsibility of Geosource Tonga. All three of these agencies have significant skills in their fields, but are resource limited. Enhancement of coordination between national agencies could improve the use of existing resources and significantly improve tsunami warning, response and mitigation. Tonga is well connected to international and regional forums to aid cooperation in tsunami warning and mitigation efforts.

In-country, Tonga is working towards improving the legislative and planning framework as well as coordinating efforts at a national and local level for disaster management. Tsunami will be incorporated into this planning in the interest of maintaining a multi-hazard approach. Tonga would benefit from working towards a strategic plan (e.g. Disaster Risk Management (DRM) National Action Plan (NAP)) to guide priorities for improvement of their tsunami warning and mitigation system. Preferably, these priorities would be based on a better understanding of the risk of tsunami and other hazards to Tonga.

A preliminary Tsunami Hazard Assessment of the Southwest Pacific was completed in 2007 by SOPAC and Geosciences Australia. This used deepwater tsunami propagation models to identify critical sources for Tonga. These models can be used as input into local inundation modelling to understand potential risk and impacts. However, high resolution bathymetry and topography data are needed to undertake tsunami inundation modelling to identify the tsunami risk faced by local Tongan communities. This type of data is currently only available for Tongatapu.

International tsunami information bulletins are received by Tonga and 24/7 arrangements are in place to disseminate national warnings to the Tongan population. However, national media operations, which are the main source of warning dissemination to the community, are not manned 24/7. Tonga's national tsunami warning system would benefit from improvements in last mile tsunami warning dissemination methods to the community (e.g. formalising the use of Church bells and Short Message Service (SMS) to alert then public). Technical system redundancies could also be significantly improved to ensure robustness (e.g. back-up power supplies, essential computing and communication equipment, etc). Although some seismic monitoring infrastructure exists in Tonga that could potentially be used for characterising locally generated tsunami, this data is generally not used in real time to inform the tsunami warning process nationally. The data is also not shared internationally to enhance PTWC warnings.

A draft tsunami response plan exists for Tonga. Finalisation and acceptance of this plan and regular, coordinated national testing exercises would be beneficial to enhance planning and preparedness. Whilst the community is already extremely resilient and prepared for other natural hazards, such as cyclones, further community preparedness and awareness is required for

tsunami. Tsunami evacuation plans for some population centres exist, but require significant consideration and improvement for implementation. Community (including media) awareness programs are conducted for other hazards within Tonga. Incorporation of tsunami into these programs is required to enhance the communities understanding of how to respond to a warning and how to react to locally felt earthquakes. Once the community is further educated about the tsunami threat from the nearby Tonga Trench, officials will need to advise the public when to take to avoid perceived 'false alarms'.

Tonga workshop participants are encouraged to use this National Tsunami Capacity Assessment report to guide both national projects and aid funded projects to achieve targeted improvement in Tonga's tsunami warning and mitigation system. In turn, this will assist in improving systems for other natural hazards. Contingent on the availability of human and financial resources, the Bureau and project partners will aim to work with potential donors to bring the findings of this project to their attention on a country and regional scale. This will be done in the hope of further capacity development projects being undertaken.

1.2. Recommendations (including priority and resource intensity)

Table 2 outlines the priority and resource intensity for recommendations made to improve Tonga's tsunami warning and mitigation system. Both the priority and resource intensity are based on the consensus of the visiting Tsunami Capacity Assessment Team after discussions held within the Tsunami Capacity Assessment Workshop. It is recognised that these rankings may not reflect the opinions of all individuals involved in the workshop as priorities vary depending on personal responsibilities and areas of interest. Each recommendation is important in its own right to achieve holistic improvements in Tonga's tsunami warning and mitigation system.

The priority ranking and resource intensity scale used as a basis for allocating a priority and resource intensity to each recommendation is explained in Table 1. The Very High priority recommendations should be seriously considered as requiring urgent completion. Low resource intensity recommendations are considered the 'low-hanging fruit' that are achievable by Tonga with very few additional resources.

Table 1: Priority ranking and resource intensity scale

PRIORITY	RESOURCE INTENSITY
Very High	Low – Recommendation currently being progressed or could possibly be progressed within the capacity of existing in-country resources (funds and staff).
High	Medium – Recommendation could be progressed by existing staff or with a low to moderate number of additional staff and/or expertise and a moderate level of additional in-country funds. May or may not require external funding.
Medium	High – Recommendation would require a high level of additional staff and/or expertise and funds. External funding support is likely to be required.
Low	Very High – Recommendation would require a very high level of additional staff and funds. External funding support will be required.

Table 2: Priority and anticipated resource intensity for completion of recommendations made to improve Tonga's tsunami warning and mitigation system.

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Very High	Review of DRM related legislation and National Disaster Management Plan (NDMP) to facilitate finalisation of agency roles and responsibilities in relation to tsunami and other hazards.	Low	Authority and Coordination	Multi-hazard	1
Very High	Establishment of a formal national tsunami management consultative committee, on which key agencies, organisations, and at-risk communities are represented to lead development of tsunami response plans and procedures for Tonga. Once these plans are endorsed, include tsunami warning and mitigation topics under the three National Emergency Management Committee (NEMC) working groups, ensuring all key agencies are involved and a mechanism developed to link the work of these groups to communities and vice versa.	Low	Authority and Coordination	Tsunami specific	2
Very High	Continue to demonstrate the benefits of DRM to Government, to facilitate commitment to the DRM agenda in order to deliver tangible benefits to the community.	Low	Authority and Coordination	Multi-hazard	4
Very High	Continue to build the credibility of Tonga's national tsunami warning provider with the public through actions such as on air broadcasts for TMS staff both routinely (to raise awareness) and during an event. The impact of the warning can be amplified by hearing it direct from an expert. In this regard closer relations between the TMS and the Tonga Broadcasting Commission (TBC) and Tonga Communication Corporation (TCC) should be pursued to facilitate effectiveness of warning dissemination.	Low	Tsunami warnings	Multi-hazard	14

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Very High	Finalisation of the draft Tonga Tsunami Response Plan (2007) including mitigation, preparedness, response (including evacuation) and recovery.	Low	Tsunami Emergency Response (including evacuation)	Tsunami specific	22
Very High	<p>Development of improved 'last mile' warning methods. This should include an evaluation of different warnings methodologies which would be best used in the Tongan context. Ideally, multiple mediums should be used, some of which are technology infrastructure independent (such as church bells). Technology options include:</p> <ul style="list-style-type: none"> • Implementing a broadcast option for SMS text warnings • Using 24/7 manned Coastal Marine Radio Station with identified capability of operating out of hours on public frequencies. 	Low – High (depending on action taken)	Tsunami warnings	Multi-hazard	15
Very High	Analysis of adequate staffing at TMS needs to be undertaken to allow the office to maintain 24/7 arrangements for tsunami and other warnings. The analysis should then support requests to the National Government for increased funding.	Medium	Tsunami warnings	Multi-hazard	11

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Very High	<p>Consideration should be given to boosting the resources available to the NEMO, including:</p> <ul style="list-style-type: none"> Physical resources (computers, whiteboards, field radios etc.); Adequate staff resources to allow for leave, sickness etc.; Progressing the NEMO to 24/7 on call operations, including a mechanism for receiving emergency calls and warnings and subsequently activating the National Emergency Operations Centre (NEOC); and Information management system software and data displays. 	Medium	Tsunami Emergency Response (including evacuation)	Multi-hazard	23
Very High	Develop evacuation plans for Nuku'alofa and other coastal communities, based on risk assessment, Geographic Information System (GIS) information and evacuation modelling (if possible). This plan should be supported by an evacuation centre management plan, the production of evacuation maps and community consultation and communication of resulting plans.	Medium	Tsunami Emergency Response (including evacuation)	Tsunami specific	24
Very High	Tsunami plans and arrangements, once finalised, should be exercised at least at the strategic level on an annual basis. Full deployment exercises should be conducted (with the intention that they expose gaps and shortcomings) on a twice-yearly basis.	Medium	Tsunami Emergency Response (including evacuation)	Tsunami Specific	26

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Very High	<p>Establish a comprehensive, structured tsunami public awareness program to improve the awareness and preparedness of the Tongan population. Where possible, this program should:</p> <ul style="list-style-type: none"> • Be conducted in an multi-hazard approach; • Be integrated into existing programs (e.g. Natural Disaster Week) and educational frameworks such as school curriculum, vocational education and training; • Be based on scientific data including risk assessment and modelling; • Ensure the delivery methodologies follow best practice in Tonga (e.g. what has worked for other hazards?); • Be developed across agencies to include consideration of all components of tsunami warning and mitigation within Tonga; • Be evaluated to gauge its success; • Take advantage of material already developed by Regional and International bodies, including visual tools; and • Identify the key messages and target audiences for each activity. 	Medium (depending on scale)	Public and Stakeholder Awareness and Education	Tsunami specific	32
Very High	Make locally monitored seismic information available in real-time to international community through global networks.	High	Tsunami Monitoring Infrastructure	Tsunami specific	10

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
High	The effectiveness of the warning message could be improved by the addition of local content from other agencies. E.g., pre-prepared and agreed messages to the community regarding significant residual currents and tides when cancellations are issued.	Low	Tsunami warnings	Tsunami specific	13
High	Issuance of no threat advice to the public concerning small (felt) earthquakes as well as tsunami in the region, which do not have the potential to threaten Tonga. This will help prevent unnecessary public concern as awareness of threat and risk increases, and will reduce possible false alarms associated with felt earthquakes.	Low	Tsunami warnings	Tsunami specific	16
High	Ensure radio transceivers and satellite phones are accessible and operational 24/7 for the receipt of warnings.	Medium	Communications	Multi-hazard	19
High	Transfer of existing hazard and vulnerability database established in Ministry of Land, Survey, Natural Resources and Environment (MLSNRE) (GeoSource Tonga) into a decision making tool for relevant Government departments.	Medium	Tsunami Hazard, Vulnerability, Risk & Mitigation	Multi-hazard	28
High	Continue formulation of DRM structures and plans on the outer islands and district level that are formalised by legislation and involve the relevant District and Town Officers and other community members. Set-up of reporting arrangement between these remote committees and agencies with National responsibilities such as the NEMO.	Medium	Authority and Coordination	Multi-hazard	3
High	Investigate options for enforcement of the building code which would increase the overall level of the building standard and, as a result, make buildings more resilient to hazards such as earthquakes and tsunami.	Medium	Tsunami Hazard, Vulnerability, Risk & Mitigation	Multi-hazard	30

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
High	Conduct a needs analysis for replacement of critical older communications equipment and communication redundancies and schedule into budget / funding plan where possible.	Medium – High (depending on needs)	Communications	Multi-hazard	21
High	<p>Ensure system redundancies are in place by undertaking a critical path analysis. Some steps may include:</p> <ul style="list-style-type: none"> • Define the parameters that determine success (e.g. a warning issued within x minutes) • Determine the elements that are critical to the success of the warning process (e.g. staff resources) • Determine what items contribute to the success of these individual elements (e.g. Meteorologist to analyse the warning information and issue the warning) • Determine how to ensure redundancies are in place for each item (e.g. back up arrangements for critical staff, on call staff arrangements) <p>This process can be repeated for hardware, software etc.</p>	Medium – Very High (depending on action taken)	Tsunami warnings	Multi-hazard	17
High	Include a training needs analysis for key front line agencies involved in tsunami warning and response in the National Tsunami Plan. In the plan, identify a strategy for development and implementation of competency based training including participating in training courses provided by regional and international organisations. In particular, training of NEMO's communications staff member is required to enable system maintenance.	High	Public and Stakeholder Awareness and Education	Tsunami specific	31

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
High	Because the need to issue a tsunami warning occurs relatively infrequently it is important that a clear set of Standard Operating Procedures (SOPs) are provided to all operators in the warning centre and response agencies. The SOPs should be succinct and clear to enable users to follow instantly. The TC Operations Procedures would provide a basis.	High	Tsunami warnings	Tsunami specific	12
High	As High Frequency (HF) and Very High Frequency (VHF) radios and satellite phones used only in analogue voice mode, recommend implementation of digital modes for exchange of data via radio to automate dissemination of warnings.	High	Communications	Multi-hazard	18
High	Real time seismic monitoring and evaluation of local tsunamigenic earthquakes at office responsible for 24/7 tsunami warning.	Very High	Tsunami Monitoring Infrastructure	Tsunami specific	9
High	Acquire the necessary baseline data for population centres as part of a multi-hazard mapping activity. This will include acquiring high resolution topography (Light Detection and Ranging (LiDAR)) data particularly of low-lying populated areas as well as high resolution bathymetry data to assist in multi-hazard assessments, modelling and mapping (e.g. storm surge, tsunami, climate change).	Very High	Tsunami Hazard, Vulnerability, Risk & Mitigation	Multi-hazard	29
High	Seek international and regional support with inundation modelling for coastal communities on Tongatapu and other vulnerable islands to underpin response and evacuation planning. Include training in use of inundation modelling to develop national capacity in risk assessments and response planning.	Very High	Tsunami Hazard, Vulnerability, Risk & Mitigation	Tsunami Specific	27

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
High – Medium	Conduct post tsunami event reviews in-country and feed into reviews coordinated for the Southwest Pacific region using existing structures such as the PTWS and the PTWS Southwest Pacific Tsunami Working Group.	Low	Regional and International Coordination	Tsunami specific	6
Medium - High	Continue to utilise existing expertise and output from organisations such as Intergovernmental Coordination Group (ICG) of the PTWS, Pacific Islands Applied Geoscience Commission (SOPAC), Pacific Disaster Risk Management Partnership Network, near neighbours etc. and developing formal hazard research partnerships between relevant agencies as appropriate.	Low	Research Expertise	Multi-hazard	8
Medium	DRM and tsunami information should be shared both regionally and internationally through existing mediums such as Pacific Disaster Net.	Low	Regional and International Coordination	Multi-hazard	7
Medium	Develop and maintain a central database of satellite phone numbers of critical agencies and posts.	Low	Communications	Multi-hazard	20
Medium	Continue relationship building with the media by providing information sessions on topics such as the science of tsunami, how to interpret the warnings and what the community should do when they hear the warning.	Low	Public and Stakeholder Awareness and Education	Tsunami specific	33
Medium	Continue engagement by Tonga in the Pacific Tsunami Warning and Mitigation System (PTWS) Southwest Pacific Tsunami Working Group and communication back to key agencies in-country regarding the outcomes of the meeting.	Medium	Regional and International Coordination	Tsunami specific	5

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Medium	Tonga Fire Authority expands the current Memorandum of Understanding (MoU) with South Australia Metropolitan Fire Service (SAMFS) to include Urban Search and Rescue (USAR) and confined space rescue equipment and training (Category 1 USAR).	Medium	Tsunami Emergency Response (including evacuation)	Multi-hazard	25