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Republic of Palau

National Tsunami Support Plan



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FOREWORD

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ACRONYMS

NDRMF	National Disaster Risk management Framework
NEC	National Emergency Committee
NEMO	National Emergency Management Office
NEOC	National Emergency Operation Center
IOC	Intergovernmental Oceanographic Commission
PTWC	Pacific Tsunami Warning Center
PTWS	Pacific Tsunami Warning System
SMS	Short Message Service
SOP	Standard Operating Procedure
TV	Television
USGS	US Geological Survey
NWS	National Weather Service
Mw	Magnitude
EQ	Earthquake
ETA	Estimated Time of Arrival
JMA	Japan Meteorological Agency
BPS	Bureau of Public Safety
NWPTAC	Northwest Pacific Tsunami Advisory Center

DEFINITIONS

“Regional Tsunami” refers to tsunami from a source less than 1000 km (621 miles) from Palau.

“Response agency” means the agencies which are tasked with responding to emergency situations under the Palau National Disaster Risk Management Framework 2010.

“Response agency plan” means the Agency’s Emergency Response & Business Continuity Plan.

“Tsunami” refers to a series of travelling waves of extremely long length generated by earthquakes occurring below or near the ocean floor, volcanic eruptions, meteorites and landslides.

“Tsunami Watch” is issued to alert the public of an event which may later impact the watch area. The watch area may be upgraded to a warning or canceled based on updated information and analysis. Therefore, the public should prepare to take action. Watches are normally issued based on seismic information without confirmation that a destructive tsunami is underway.

“Tsunami Warning” refers to a bulletin containing warning issued for a potentially destructive tsunami expected to affect Palau. It will generally require evacuation. A tsunami warning is issued when a potential tsunami with significant widespread inundation is imminent or expected. Warnings alert the public that widespread, dangerous coastal flooding accompanied by powerful currents is possible and may continue for several hours after arrival of the initial wave. Appropriate actions to be taken may include the evacuation of low-lying coastal areas, and the repositioning of ships to deep waters when there is time to safely do so. Warnings may be updated, adjusted geographically, downgraded, or canceled. To provide the earliest possible alert, initial warnings are normally based only on seismic information.

“Cancellation of Watch/Warning” refers to the cancellation of a tsunami watch/warning which has been issued earlier.

“All Clear” message is issued to inform people that the threat or hazard has now passed and it is safe to return home. However, all safety precautions should be taken when moving back.



INTRODUCTION

1.1 Plan Purpose

The purpose of this Plan is to explain in detail the mitigation, preparedness, warning, response and recovery arrangements for tsunami event that might affect the Republic of Palau.

1.2 Plan Context

The development of this plan is a requirement under Section 3.15 of the National Disaster Risk Management Framework 2010.

1.3 Plan Objectives

This National Tsunami Plan aims to achieve the following:

- To ensure correct and timely issuance and dissemination of warnings to all threatened communities.
- To ensure all communities and response agencies are prepared and ready to respond to a tsunami event.
- To minimize the impact of tsunami hazards in Palau
- To ensure a safe and quick recovery after a tsunami event

Methods for achieving these objectives include but not limited to:

- Fulfillment of roles and responsibilities outlined in this Plan and the National Disaster Risk management Framework
- Agreed strategies, activities and programs at all levels
- Response agency plans and activities
- Community-based programs supported by response agencies
- Frequent and constant simulations or exercises

Achievement of these objectives is to be monitored by the NEMO in collaboration with the National Weather Service.

1.4 Plan Development and Review

This plan has been produced under the leadership of NEMO and endorsed by the National Emergency Committee (NEC).

The plan is to be reviewed annually and following each major tsunami event that may affect Palau. Responsibility for the review of this plan rests with the NEMO.

TSUNAMI RISK PROFILE

Palau's NDRMF 2010 lists tsunami as a low level risk under the natural hazards profile. A number of small tsunami events (generally less than 3.94 inches (10 cm) in amplitude) have been recorded in the past.

Since 1970, there are records of eight tsunami that have reached Palau, although no devastation has been observed. Thomas, Burbidge and Cummins (2007) completed A Preliminary Study into the Tsunami Hazard faced by Southwest Pacific Nations. Scenarios for an Mw 8.5 and Mw 9.0 earthquakes were used to investigate normalised offshore (to a notional depth of 50 meters or 164.04 ft.) wave amplitudes for tsunami caused by earthquakes along subduction zones (Refer Figure 1).



Figure 1 Subduction zones in the Pacific Ocean

In this study, Palau's maximum amplitude for all tide gauges for all Mw 9 tsunami was 240cm or 94.49 inches with the most significant source regions being the Philippines, Mariana, Ryukyu, Nankai and New Guinea trenches (amplitude greater than 75cm at 50m (29.53 inches at 164.04 feet) depth or single most significant source region if no amplitude exceeds 75cm or 29.53 inches). For a Mw 8.5 tsunami the maximum amplitude reduced to 130cm or 51.18 inches with the Philippines and New Guinea trenches being the most significant source region. Although these values are less than many of the southwest PICs, it is not possible to assert that tsunami of these amplitudes are not of concern without a more detailed study involving inundation modelling (Thomas, Burbidge & Cummins, 2007).

A further study completed by Thomas and Burbidge (2009) attempts to answer the question "Which Pacific nations might experience offshore amplitudes large enough to potential result in hazardous inundation, what are the probabilities of experiencing these amplitudes and from which subduction zones might these tsunami originate".

The report states that, for a 2000 year return period maximum amplitude of between 2.3 meters or 7.55 feet to 2.7 meters or 8.86 feet could be expected near Tobi, Fanna and Sonsorol and to 3.5 meters or 11.48 feet for some model output points on the west coast of Babeldaob and Koror. At this return period the hazard originates almost exclusively from the Philippines Trench and a small contribution from the New Guinea trench. At a return period of 100 years the maximum amplitudes near Tobi, Fanna and Sonsorol are approximately 0.3 meters or 11.81 inches (Thomas & Burbidge, 2009), increasing to 0.5 meters or 1.64 feet on the western coast of Babeldaob.

The Geoscience Australia studies are supported by investigation of the Bureau's deep ocean model-based tsunami prediction system. Tsunami travel times from the New Guinea trench are short (less than one to two hours) and the Philippines trench (approximately one hour). Long distance sources including the Kuril Islands, Russia, Alaska and South America can also impact on Palau with travel times of approximately 6 hours from the Kuril trench to greater than 10 hours from South America. A significant warning window exists for tsunami generated by these more remote sources.

The land mass of Palau sits atop the bathymetric feature commonly known as the Palau-Kyushu Ridge which extends south of Palau to many hundreds of kilometers to the north (Palau, 2009). In general the geomorphologic structure of Palau is not conducive to severe impacts from tsunami, particularly the northern states. The steep oceanic walls and barrier reefs potentially provide some protection from tsunami impacts. However, there are some specific considerations that should be noted. Geographically the southern states are isolated and relatively low-lying. This makes impacts from a tsunami more likely than in the larger northern islands, and the ability to provide assistance more limited. Low-lying farming land has been flooded during king tides in the past.

Economically Palau is highly dependent on tourism for its trade balance. In addition to Palau's coastal way of life, much of this tourism relates to water activities such as diving and snorkeling. Typically, significant currents are associated with tsunami, even for small events. Local currents may be two or three times greater than those experienced under normal conditions. This should be taken into consideration when assessing the risk of small events to marine activities. People in the water during a tsunami are at significant risk due to associated high currents event with small tsunami.

TSUNAMI AWARENESS, EDUCATION AND PREPAREDNESS

3.1 Awareness

It is the responsibility of the NEMO to coordinate public awareness of the tsunami threat and safety in collaboration with the key agencies such as National Weather Service, Bureau of Public Safety, Education, State, NGO, media and others. This is to be consistently organized to reach all communities.

3.2 Education

The Ministry of Education shall ensure that earthquake and tsunami sciences, safety and preparedness are incorporated in the school curriculum at appropriate levels. This should be done from an “all hazards” approach.

3.3 Signage

The NEMO in collaboration with the State and Hamlet Councils shall erect appropriate sign on high risk areas to create awareness to the general public. All signs must be in strategic locations and in languages that can be understood by majority of the population.

3.4 Evacuation maps

The NEMO, State and Hamlet Councils shall facilitate preparation of the Tsunami Evacuation Maps. The evacuation maps must show the safe zones and evacuation routes where people can converge and wait for the ALL CLEAR.

3.5 Safe zones

State and Hamlet Councils and individual communities shall prepare appropriate facilities and amenities in their demarcated safe zones to accommodate the needs of people while they are waiting for the ALL CLEAR. Facilities include well maintained space and shelter. Amenities include water, toilet and some lighting.

3.6 Mass Notification Systems

The NEMO is responsible for installation of appropriate forms of mass notification such as sirens in strategic locations especially where large number of population are residing. It will also be responsible for the activation of the mass notification systems.

TSUNAMI OBSERVATIONS AND WARNINGS

4.1 Authority to Issue Warnings

According to Section 3.10.6 of the National Disaster Risk Management Framework (2010), the “official” source of warnings is the National Weather Service which will be interpreting the tsunami warning products and in close consultation with the NEMO issue a watch or warning for Palau. NEMO will not issue any advisories/warnings without recommendations from the National Weather Service first.

4.2 Sea Level Observations - Tide Gauge & DART Buoys

There is one tide gauge located at Palau which the NWS can access real time data. Tide Gauge and DART Buoy data is also accessible from Internet using the Tide Tool software provided to NWS.

4.3 Issue of Tsunami Warning and Advisories

4.3.1 Regional Advisories

Under the Intergovernmental Oceanographic Commission (IOC) Pacific Tsunami Warning and Mitigation System (PTWS), the Pacific Tsunami Warning Centre (PTWC) in Hawaii as well as the Japan Meteorological Agency (JMA) provides tsunami warning products to all Pacific countries and the national agencies will analyze and decide whether to issue or not to issue warnings. NWS is the main agency to receive the PTWC tsunami warning products because of its 24/7 capability.

PTWC Product Type	PTWC EQ Magnitude	Country's Alert Level	Estimated Time of Wave Arrival (ETA) at Country's Coast	Emergency Response Action
THREAT MESSAGE	H > 1 m	WARNING	ETA < 3 hrs. (*)	EVACUATE TSUNAMI EVACUATION ZONES
THREAT MESSAGE	H > 1 m	WATCH	3 (*) < ETA < 6 hrs.	Prepare to evacuate
INFORMATION STATEMENT	H > 1 m	INFORMATION	ETA > 6 hrs.	Monitor event alert EM stakeholders
INFORMATION STATEMENT	H < 1 m			NO ACTION
MESSAGE	H > 1 m at distant coastline	To be determined from a disaster tsunami threat: PTWC message number 1	ETA > 3 hrs. (*)	Monitor event, alert EM stakeholders

4.3.2 National Warning

The NWS will determine the level of threat of a potential tsunami to Palau from the products that will be provided by PTWC based on the following criteria:

PALAU TSUNAMI WARNING FLOW CHART

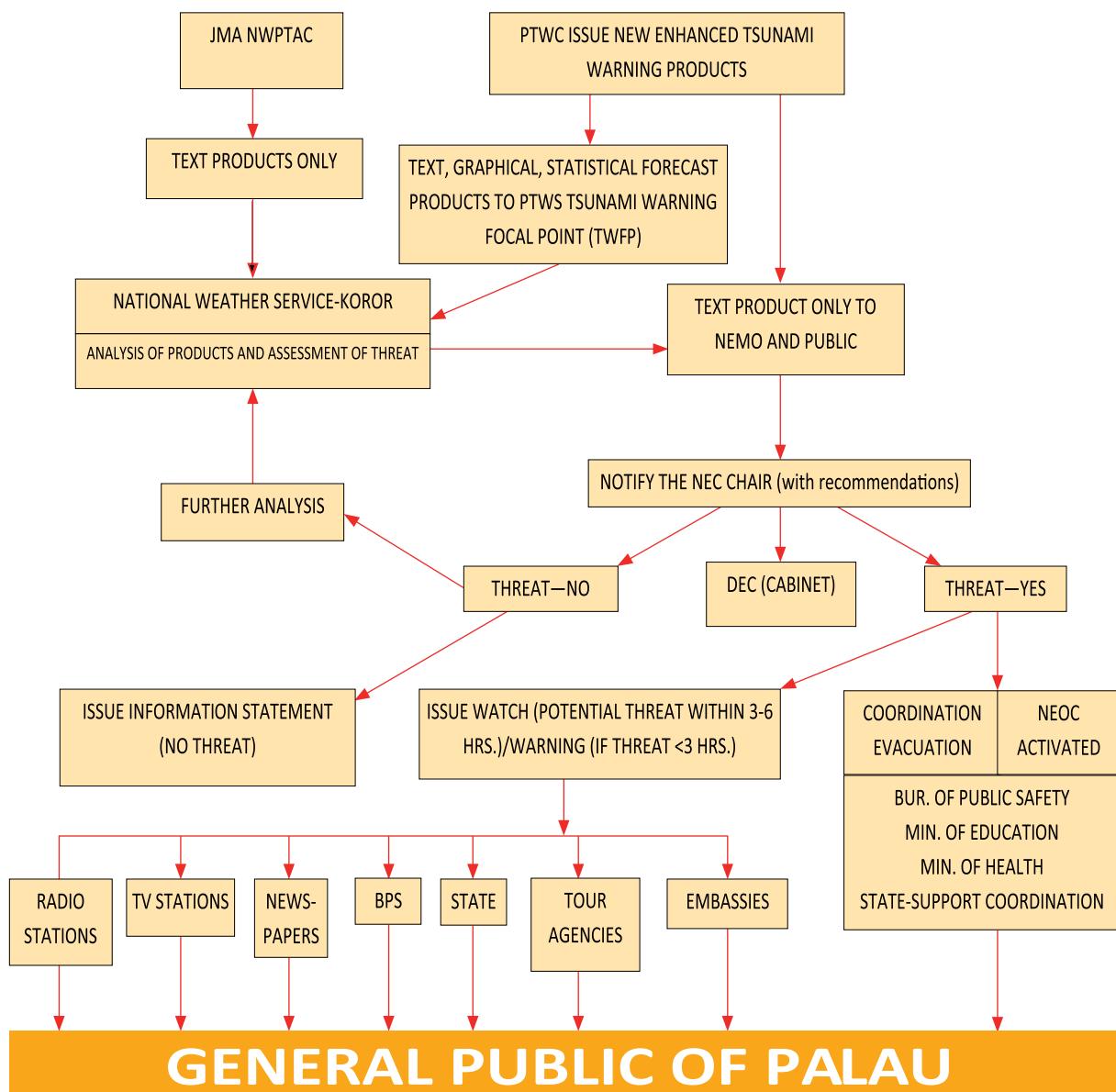


Figure 2: Palau Tsunami Warning Flow Chart.

4.4 Warning Dissemination

Warnings to the public will be disseminated through the most effective means to the media (TV, Radio, SMS and runners). These include:

- Facsimile
- Email
- SMS
- Cell Phones
- Radio stations
- Police Officers

- Chatty Beetle
- Social Media (Facebook, Twitter, etc.)

4.5 Warning Response

Response to warnings will be coordinated by NEMO which will ensure activation of State and other response agencies.

Upon receipt of warnings:

Governors are required to activate their State Disaster Management Committees plan.

- State and Hamlet Disaster committee's representatives are required to activate their Disaster Plan.
- Heads of Government Ministries are required to activate their Agency Response Plan.
- School Principals are required to activate their School Evacuation Plan.
- Private Sectors are required to activate their Business Continuity Plan.

4.6 Tsunami Warning Cancellation and All Clear Message

NEMO in collaboration and recommendation with the NWS will issue a "Warning Cancellation Message" once it is ascertained that tsunami threat no longer exists. This ALL CLEAR message will inform the general public that the threat is over and it is safe for people to return home or to working places.

4.7 Evacuation

NEMO will issue instructions to evacuate from tsunami high risk areas. The Bureau of Public Safety will control movement of people and traffic to safe zones. All evacuees **MUST NOT** return to their homes unless an "All Clear" notice is given indicating that it is safe to return home.

RECOVERY ARRANGEMENTS

After any tsunami event, the response and recovery provisions of the National Disaster Risk Management Framework, 2010 will be applicable.

Appendix I

Agency roles and responsibilities in Tsunami preparedness, response and recovery

Matrix on Agency roles and responsibilities in Tsunami preparedness, response and recovery

Agencies	Roles	Resources	
	Preparedness	Response	Recovery
National Weather Service	<ul style="list-style-type: none"> Maintain EWS procedure and Policies Conduct awareness on the scientific aspects of tsunami Conduct research with the use of seismic , GPS and bathymetry data to understand the risk of tsunami and promote tsunami wave modelling Provide scientific information for the preparation of evacuation maps and identification of evacuation zones Set up, run and maintain the national seismic network for rapid earthquake detection and tsunami early warning Maintain 24/7 tsunami monitoring and warning centre 	<ul style="list-style-type: none"> Conduct threat assessment and issue recommendation to NEMO Continue monitoring the tsunami threat and provide further advisories or warning 	<ul style="list-style-type: none"> Conduct technical assessment of the impact – run up heights, wave actions for future use
State Authority	<ul style="list-style-type: none"> Establish the State Disaster Management Committee Establish the State Emergency Operation Centre (EOC) Develop SOP for EOC Conduct community awareness Record traditional knowledge within the State Coordinate the development of the community disaster plan Coordinate with NEMO the conduct of table top and operation exercise in the community Coordinate training of key personnel in the province on tsunami 	<ul style="list-style-type: none"> Following up on the activation of the EOC Collate updates from the hamlets and transmit to NEMO Coordinate evacuation in hamlets Communicate the cancellation of the warning 	<ul style="list-style-type: none"> Provide personnel to be part of the damage assessment teams Coordinate collection of Initial Damage Assessment reports from hamlets Canvas support for assistance from local communities

Agencies		Roles			Resources
	Preparedness	Response	Recovery		
PNCC	<ul style="list-style-type: none"> Maintain emergency communication Allocations of emergency call numbers e.g. 112 Work with stakeholders in developing 24/7 emergency response call centre Ensure mobile coverage in all islands 	<ul style="list-style-type: none"> Activate PNCC Emergency Plan. Mass media messaging. DTV Emergency Alert system. Remote communication station setup. 	<ul style="list-style-type: none"> Ensure timely clearance of short term radio frequencies application from International response agencies 	<ul style="list-style-type: none"> GSM VHF Radio DTV EAS Mass TXT SATCom 	
Education	<ul style="list-style-type: none"> Integrate DRR in the school curriculum Develop Emergency In Education curriculum Enforce development of school tsunami safety plans Enforce conduct of school safety drills Facilitate establishment of school disaster committee Set aside budget for recovery phase on school fees subsidy Strengthening communication links with school principals Facilitate identification of potential relocation sites for schools around coastal areas 	<ul style="list-style-type: none"> Activate school safety plans Close the school Conduct initial education rapid assessment Set up temporary learning space in affected areas 	<ul style="list-style-type: none"> Relocate schools around coastal areas after a tsunami Retrofitting of classroom buildings 		
NEMO	<ul style="list-style-type: none"> Training and awareness at all levels (National, State, Hamlets) Develop DRM policies and operational guidelines (NDRMF, NEOC SOP, Hazard support plans Strengthening of State and community communication network Strengthening of the NEOC Develop a rapid assessment toll for tsunami 	<ul style="list-style-type: none"> Coordinate relief response with other agencies Lead the conduct of damage assessment – ISO, IDA, DSA Preparation and dissemination of STREP Dissemination of warning and information through media Organise media briefing Provides logistic support to ground operations Organise briefing for NEC 	<ul style="list-style-type: none"> Coordinate recovery task force committee 		
Agriculture					

Agencies	Roles			Resources
	Preparedness	Response	Recovery	
Health	<ul style="list-style-type: none"> Convene the MOH Emergency Operation Center (EOC) Establish and implement MOH ICS structure for Prep & Response Phase Activate Hospital Evacuation Plan (if directed by NEC) Identify Alternate Care Sites (ACS) Coordinate training of key personnel on tsunami Conduct Hazard Vulnerability Assessment (HVA) for MOH Work with NEMO to finalize a Mass Fatality Plan 	<ul style="list-style-type: none"> Evacuate Hospital Secure Hospital buildings and grounds Provide medical personnel/nurse to shelters (according to NEC directions) Open Alternate Care Sites (ACS) Dissemination of MOH actions (re: clinic closures etc.) and ACS information to general public 	<ul style="list-style-type: none"> Implement MOH ICS structure for Recovery Phase Conduct public health assessments of affected areas, with focus on general public health/ environmental health/behavioral health needs Mobilize Public Health Response teams that include medical and public health personnel to bring services to most affected areas Ensure the dissemination of public health tips/ recommendations for food safety, water safety, injury prevention, general hygiene, to general public Provide staff to assist in IDA of MOH buildings and structures Confirmation of dead victims 	
Public Works				
Finance & Planning				
Bureau of Public Safety				
Chamber of Commerce				
Tourism Operators				
Airport Authority				
PRCS				
Domestic Affairs				
Foreign Affairs				
Blue Bay Petroleum				
IP & E Petroleum				
MEDIA & INFORMATION				
OTV				
Radio Stations				
Newspapers				









