



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

**Republic of Marshall Islands**



Republic of Marshall Islands



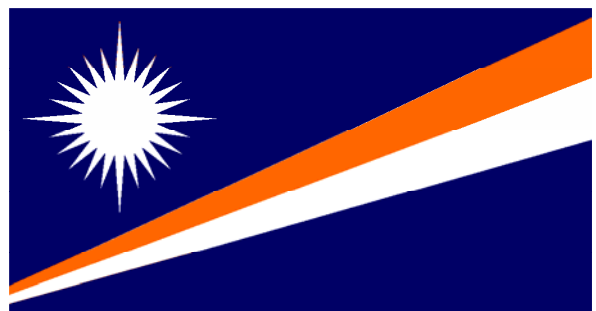
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# SOPAC Member Countries National Capacity Assessments: Tsunami Warning and Mitigation Systems

**REPUBLIC OF  
MARSHALL ISLANDS  
25 – 28 May 2009**



**SOPAC**



## Document Control

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## Acronyms

AM	Amplitude Modulated
AFTN	Aeronautical Fixed Telecommunications Network
AGD	Australian Attorney-General's Department
AISR	Aeronautical Information System Replacement
ATWS	Australian Tsunami Warning System
AusAID	Australian Agency for International Development
Bureau	Australian Bureau of Meteorology
COFA	Compact of Free Association
CROP	Council of Regional Organisations in the Pacific
CSO	Chief Secretary's Office
DRM	Disaster Risk Management
EMA	Emergency Management Australia
EMWIN	Emergency Managers Weather Information Network
EOPs	Emergency Operation Plan
EVI	Environmental Vulnerability Index
EWS	Early Warning System
FEMA	Federal Emergency Management Agency
FM	Frequency Modulated
FSM	Federated States of Micronesia
GA	Geoscience Australia
GIS	Geographic Information Systems
GOES	Geostationary Operational Environmental Satellites
HAZMAT	Hazardous Materials
HF	High Frequency
ICG	Intergovernmental Coordination Group
ICT	Information and Communication Technology
IDA	International Deployment of Accelerometers
IFRC	International Federation of Red Cross and Red Crescent Societies
INMARSAT	International Maritime Satellite Communication System
IOC	Intergovernmental Oceanographic Commission
IOM	International Organisation for Migration
IRIS	Incorporated Research Institutions for Seismology
ISDR	International Strategy for Disaster Reduction
ITIC	International Tsunami Information Center
ITSU	ICG for the Tsunami Warning System in the Pacific (old name)
ITU	International Telecommunication Union
JATWC	Joint Australian Tsunami Warning Centre
LLRM	Local Level Risk Management
LRIT	Long Range Identification and Tracking system
Mw	Moment Magnitude
NAP	National Action Plan
NDC	National Disaster Committee
NEMCO	National Emergency Management Co-ordination Office
NEOC	National Emergency Operations Centre
NGOs	Non Government Organisations

## Acronyms (Continued...)

NOAA	National Oceanic and Atmospheric Administration
NTA	National Telecommunications Authority
NTC	National Tidal Centre
OCS	Office of the Chief Secretary
PEACESAT	Pan Pacific Education and Communication Experiments by Satellite
PGSP	Pacific Governance Support Program
PICs	Pacific Island Countries
PIFS	Pacific Islands Forum Secretariat
PTWC	Pacific Tsunami Warning Center
PTWS	Pacific Tsunami Warning and Mitigation System
RANET	RAdio and InterNET for the Communication of Hydro-Meteorological Information for Rural Development
RICS	Rural Internet connectivity Systems
RMI	Republic of the Marshall Islands
RSS	Really Simple Syndication
SDP	Strategic Development Plan
SMS	Short Message Service
SOPAC	Pacific Islands Applied Geoscience Commission
SOPs	Standard Operating Procedures
SPC	Secretariat of the Pacific Community
UN	United Nations
UNDAC	United Nations Disaster Assessment and Coordination
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
US	United States
USA	United States of America
USAID	United States Agency for International Development
USP	University of South Pacific
UTC	Coordinated Universal Time
V7AB radio	Local AM/FM Radio station on RMI
VSAT	Very Small Aperture Terminal
WFO Guam	Weather Forecast Office – Guam
WMO	World Meteorological Organization
WSO	Weather Service Office



## Section

# 1

## 1. Results Outline



# 1. Results Outline

## 1.1. Executive Summary

### **Relationship of this Project to the Republic of Marshall Islands Disaster Risk Management National Action Plan 2008 – 2018**

The Tsunami Capacity Assessment Project contributes to the Republic of Marshall Islands (RMI) Disaster Risk Management National Action Plan 2008 – 2018 (DRM NAP, D1) Action 4.3.1 “Assess the Early Warning System (EWS) capacity and information needs at national and local levels for all key hazards and links to international early warning systems”. This report aims to map to DRM NAP Actions that are anticipated to particularly assist RMI to improve management of the tsunami threat. The report also makes some specific recommendations suggesting improvements in RMI’s tsunami warning and mitigation system.

RMI and development partners are encouraged to consider tsunami in an all hazard approach. This will largely avoid the need to allocate resources to a hazard that is considered low risk in comparison to other hazards faced by RMI.

The Republic of the Marshall Islands (RMI) is comprised of 29 low-lying atolls and five islands of which 24 are inhabited (D1 & D2). Together these atolls form 70 square miles of land. The capital is situated on Majuro atoll in the southeast with a land area of 3.56 square miles. The islands are essentially coral caps, set on underwater dome volcanos rising from the ocean floor and surrounded by 700,000 square miles of ocean (D1). Over two thirds of the nations population of an estimated 57,000 is situated on Majuro and Kwajalein atolls, making these atolls among the most densely populated in the Pacific (D1 & D2).

RMI sea level gauges have detected tsunami events from various sources, the majority of which have been less than approximately 10 cm (4 inches) in amplitude (refer to Figure 4). A 8.1 Mw earthquake on the Kuril trench on the 13th January 2007 resulted in a recorded amplitude at Kwajalein Atoll of 0.11 m (0.36 feet) (NGDC Tsunami Database, 2010). On 15th November 2006 a 8.3 Mw earthquake, again on the Kuril trench, resulted in a recorded amplitude at Uliga (Majuro) of 0.08 m (0.26 feet) (NGDC Tsunami Database, 2010) (Refer to Figure 4). RMI Hazard Mitigation Plan (D4) states that “the incidence of Pacific-wide tsunamis has little affect on the Marshall Islands”. The Plan lists the 9 March 1957, 8 to 8.5 magnitude earthquake in the Aleutian Islands as causing “a minimal 3 meters [tsunami] for Kwajalein and Enewetok”. The Plan also states “of all the tsunamis researched in the last century, no tsunami has registered over 4 meters (May 22, 1960 - Chile 8.25 to 8.85 Earthquake) in RMI”.

RMI is located further from major subduction trenches capable of generating tsunami than many southwest Pacific Island Countries (PICs). The country generally has a greater lead time for warnings and thus appears in a lower hazard category (Pearce, 2008). Atolls can also be somewhat protected as they often have steep drop-offs in which ocean depths increase very rapidly with distance from the fringing reef therefore minimising tsunami shoaling (the process by which tsunami wave heights increase as they approach the shore) and subsequent inundation (Thomas, Burbidge, Cummins, 2007).

However, even relatively small tsunami, particularly when timed with high tides, may have a significant impact on communities on low lying atolls (Pearce, 2008). Even seemingly small changes in sea-level due to tsunami could adversely impact on day-to-day activities in RMI, such as unloading of fuel and water based tourism activities.

RMI is addressing tsunami warning or response capabilities as part of a multi-hazard approach under the DRM NAP (D1), but limited resources for the development of specific tsunami warning and response capabilities, coupled with uncertainties about the tsunami risk limits the extent to which this work has been progressed. Allocation of funding for any hazard group is usually related to level of risk.

The RMI DRM NAP (D1) states that “fortunately RMI is considered to be at low risk to earthquakes, volcanic eruptions and tsunamis”. This risk assessment included in the DRM NAP (D1) is based on the understanding that there is a very low likelihood of tsunami affecting RMI populations based on the lack of any known history of any significant tsunami events. However, RMI acknowledges that the consequences of a significant tsunami event (causing land inundation) could be very high and the country is therefore interested in developing a further understanding of their tsunami risk.

RMI has historically experienced extreme wave action associated with Typhoons as well as “wave trains” thought to most frequently occur due to high tides combined with wind patterns upwind of the islands which establish an unusually long and persistent wave-generating “fetch”. For example, in December 2008 long period swells generated from distant winds over the North Pacific, enhanced by shorter period waves generated locally by tropical depressions led to severe coastal flooding in RMI (Bureau, December 2008). This led to the declaration of a State of Emergency as large amounts of debris and approximately 500 displaced people created sanitation and health concerns in Majuro (UNOCHA Sit Reps, December 2008).

It is important that RMI takes steps now to improve ministry and community response to tsunami warning messages received from the Pacific Tsunami Warning Center (PTWC). The *National Capacity Assessment of Pacific Islands Applied Geoscience Commission (SOPAC) Member Countries: Tsunami Warning and Mitigation Systems* project aims to work in collaboration with the member countries of SOPAC to assess their capacity to receive, communicate and respond effectively to tsunami warnings. The Tsunami Capacity Assessment of the ability of RMI to receive, communicate and effectively respond to tsunami warnings took place in a workshop held from 25 – 28 May 2009 at the Marshall Islands Resort in Majuro.

The workshop was facilitated by a team of visiting experts and attended by some 50 RMI government representatives, community groups and the private sector to discuss key areas of tsunami warning and mitigation in RMI by completing a comprehensive questionnaire in session and via presentations, site visits and meetings.

As well as outlining RMI’s current status, strengths and opportunities for improvement with regard to tsunami warning and mitigation, a list of recommendations were formulated by the Visiting Assessment Team in consultation with national participants. The aim of these recommendations is to guide further capacity development programs to target improvements in RMI’s tsunami warning and mitigation system in the context of the DRM NAP (D1).

The workshop’s resulting recommendations reflected the priorities raised by RMI participants (Refer to Table 3). In addition to implementation of DRM NAP (D1) actions, very high priority recommendations made include:

- Strengthen National Emergency Management Co-ordination Office (NEMCO) staffing and other resources to progress mainstreaming of DRM in all sectors;
- In line with DRM NAP Objective 1.1, progress with the formalisation of the draft set of National DRM arrangements for RMI that was produced and submitted to NEMCO in June 2008. Subsequently progress with the review of legislation and national operational plans for specific hazards based on the formalised arrangements;
- Take advantage of opportunities provided by international and regional partnerships to build national capacity for research expertise in priority areas;
- Develop and include in procedures, a tsunami warning decision making matrix that is pre-agreed by key government stakeholders which outlines what action will be taken for each PTWC message;

- In line with DRM NAP Action 6.2.2, develop a tsunami risk profile for RMI;
- Implement DRM NAP Actions 9.1.1 to 9.3.1 to raise awareness of DRM amongst the public by taking a multi-hazard approach that includes tsunami;
- Strengthen community preparedness and response to disasters using applicable public awareness and education materials that have been adapted for RMI and translated into Marshallese;
- Include tsunami in an all hazards approach to integrating DRM in the school curriculum as per DRM NAP Action 9.3.1; and
- Complete a training needs analysis and development of a national training framework for DRM (including tsunami) in RMI in line with DRM NAP Objectives 1.3.2 and 1.3.3.

RMI workshop participants are encouraged to use this National Tsunami Capacity Assessment report to guide both national projects and aid funded projects to achieve targeted improvements in RMI'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 Australian Bureau of Meteorology (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 RMI'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 Table 2 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 RMI'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 with very few additional resources.

**Table 1: Priority ranking and resource intensity scale**

PRIORITY	RESOURCE INTENSITY
<b>Very High</b>	<b>Low</b> – Recommendation currently being progressed or could possibly be progressed within the capacity of existing in-country resources (funds and staff).
<b>High</b>	<b>Medium</b> – 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.
<b>Medium</b>	<b>High</b> – Recommendation would require a high level of additional staff and/or expertise and funds. External funding support is likely to be required.
<b>Low</b>	<b>Very High</b> – 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 for improving RMI's tsunami warning and mitigation system.**

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Very High	Agencies identified in the DRM NAP to develop their own capacity and readiness to implement respective actions as these form the basis of an effective multi-hazard warning system and mitigation. In particular, encourage agencies identified in the DRM NAP to implement respective actions in consultation with all stakeholders.	Low	Governance & Coordination	Multi-hazard	3
Very High	In line with DRM NAP Objective 1.1, progress with the formalisation of the draft set of National DRM arrangements for RMI that was produced and submitted to NEMCO in June 2008. Subsequently progress with the review of legislation and national operational plans for specific hazards based on the formalised arrangements.	Low	Governance & Coordination	Multi-hazard	5
Very High	RMI to take advantage of opportunities provided by international and regional partnerships to build national capacity for research expertise, in particular with regard to develop a tsunami risk profile for RMI.	Medium	Research Expertise	Multi-hazard	9
Very High	As tsunamis are a short lead time events, develop and include in procedures, a tsunami warning decision making matrix that is pre-agreed by key government stakeholders which outlines what action will be taken (community information and / or warning and evacuation) for each PTWC message received.	Medium	Tsunami Warnings	Tsunami specific	13

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Very High	In line with DRM NAP Action 3.2.1 and 3.3.3, support development, review or endorsement of National Emergency Operations Centre (NEOC) and ministry and private sector emergency response plans and Standard Operating Procedures (SOPs). Promote sharing and awareness of these procedures.	Medium	Tsunami Emergency Response (including evacuation)	Multi-hazard	17
Very High	Through implementation of the Actions under DRM NAP Objectives 6 and 8, consider actions to limit near-shore activities to safeguard and protect the environment, including the preservation of outlying reefs, which may mitigate the impact of tsunami.	Medium	Tsunami Hazard, Vulnerability, Risk and Mitigation	Multi-hazard	26
Very High	Strengthen community preparedness and response to disasters using applicable public awareness and education materials that have been adapted for RMI and translated into Marshallese.	Medium	Knowledge, Information, Public and Stakeholder Awareness and Education	Multi-hazard	30
Very High	Include tsunami in an all hazards approach to integrating DRM in the school curriculum as per DRM NAP Action 9.3.1.	Medium	Knowledge, Information, Public and Stakeholder Awareness and Education	Multi-hazard	32
Very High	Complete of a training needs analysis and development of a national training framework for DRM in RMI (including a training database to track progress) in line with DRM NAP Objectives 1.3.2 and 1.3.3. Tsunami should be included in this multi-hazard training approach.	Medium	Knowledge, Information, Public and Stakeholder Awareness and Education	Multi-hazard	36

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Very High	Strengthen NEMCO staffing and other resources to progress mainstreaming of DRM in all sectors.	High	Governance & Coordination	Multi-hazard	2
Very High	Implement DRM NAP Actions 3.3.1 to 3.3.4, incorporating tsunami into planning, to improve tsunami emergency preparedness and response in RMI.	High	Tsunami Emergency Response (including evacuation)	Multi-hazard	16
Very High	In line with DRM NAP Action 6.2.2, develop a tsunami risk profile for RMI based on tsunami hazard studies completed for the Southwest Pacific Nations to date, tsunami numerical deep ocean modelling carried out by international agencies, research of previous inundation events and Geographic Information System (GIS) data (existing bathymetry and topography). Feed this into DRM NAP Action 6.2.3 to assess coastal hazard and vulnerability.	High	Tsunami Hazard, Vulnerability, Risk and Mitigation	Tsunami specific	22
Very High	Implement DRM NAP Actions 9.1.1 to 9.3.1 to raise awareness of DRM amongst the public by taking a multi-hazard approach that includes tsunami. National agencies to take a lead role in public awareness and education activities at national, local government and community levels, with the support of partners where needed.	High	Knowledge, Information, Public and Stakeholder Awareness and Education	Multi-hazard	27
Very High	Continue to progress a coordinated program of action focusing on key vulnerability and risk issues and on priority gaps by implementation of the DRM NAP to strengthen existing disaster response, preparedness and mitigation processes to embrace a whole of hazard approach to DRM. Use partnerships with technical and development partners to meet capacity needs.	Very High	Governance & Coordination	Multi-hazard	1

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
High	Ministry of Foreign Affairs consider RMI becoming a member of Intergovernmental Oceanographic Commission (IOC) to ensure RMI has a voice in determining IOC programs and activities of benefit nationally, as well as benefiting from IOC capacity building in marine science.	Low	Regional & International Coordination	Multi-hazard	7
High	RMI to enhance relationships with international and regional partners in providing access to earthquake and sea level monitoring systems and their data.	Low	Tsunami Monitoring Infrastructure	Tsunami Specific	10
High	Establish regular DRM educational broadcasts by NEMCO representative on radio V7AB.	Low	Knowledge, Information, Public and Stakeholder Awareness and Education	Multi-hazard	29
High	Raise awareness of tsunami warning products and response actions that must be taken for each message type amongst stakeholders and public. This is also relevant across other hazards as per DRM NAP 3.4.1.	Low	Knowledge, Information, Public and Stakeholder Awareness and Education	Tsunami specific	33
High	Consider participation in the Southwest Pacific Tsunami Working Group of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System.	Medium	Regional & International Coordination	Tsunami specific	8
High	Train and equip Majuro WSO for the technical role of sea level monitoring to better analyse the tsunami threat to RMI in real-time.	Medium	Tsunami Monitoring Infrastructure	Tsunami specific	11

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
High	Develop local procedures for evaluating and interpreting implications for RMI of PTWC messages using available scientific information (deep ocean tsunami models, sea level data, travel time software etc).	Medium	Tsunami Warnings	Tsunami specific	12
High	Prevent unnecessary public concern and reduce the possibility of false alarms through issuance of "No Threat" advice to the public for tsunami that are not expected to not impact on RMI.	Medium	Tsunami Warnings	Tsunami specific	14
High	<p>Review existing warning systems with a view to develop a disaster communications plan to meet the requirements of the DRM NAP Goal 4 and Act (1987, D3) and improve the interoperability of current communications infrastructure. Include consideration of:</p> <ul style="list-style-type: none"> <li>○ Various communication technologies and techniques, such as RANET (RAdio and InterNET for the Communication of Hydro-Meteorological Information for Rural Development), Chatty Beetle, EMWIN, RICS (Emergency Managers Weather Information Network) to ensure warnings reach communities on all islands;</li> <li>○ Training;</li> <li>○ 24x7 contact;</li> <li>○ System checks;</li> <li>○ Back-up options;</li> <li>○ Ongoing costs; and</li> <li>○ Maintenance.</li> </ul>	Medium	Communications	Multi-hazard	15

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
High	Incorporate evacuation routes and shelters into future plans for all hazards, including tsunami.	Medium	Tsunami Emergency Response (including evacuation)	Multi-hazard	18
High	Review national zoning and building codes based on hazard and risk maps produced in line with DRM NAP Goal 8.	Medium	Tsunami Hazard, Vulnerability, Risk and Mitigation	Multi-hazard	24
High	Including provision of training to the media on the tsunami warning system, how they will receive information and how this information should be communicated to the public. This training program could be delivered in a multi-hazard context.	Medium	Knowledge, Information, Public and Stakeholder Awareness and Education	Multi-hazard	31
High	Strengthen response support to outer islands and preparedness of these communities through consideration in national plans and implementation of DRM NAP Actions 3.5.1 and 3.5.2 (planning, exercising and awareness).	High	Tsunami Emergency Response (including evacuation)	Multi-hazard	20
High	Consider options to improve movement of boats/ships to deep water in the case of a tsunami event. This could potentially involve the expansion of current boat channels and additional boat ramps to improve access to deep water from the lagoons for marine evacuation.	High	Tsunami Emergency Response (including evacuation)	Tsunami specific	21

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
High	With international partners, conduct an inventory of available bathymetry and topography data (including that held by internal Government Ministries and Agencies) for RMI. If data is sufficient, conduct tsunami hazard and risk assessments using numerical inundation models of key population and infrastructure areas based on high resolution near-shore and lagoon bathymetric and topographic data noting the unique seabed topography of coral atolls.	Very High	Tsunami Hazard, Vulnerability, Risk and Mitigation	Multi-hazard (data inventory) Tsunami Specific (inundation modelling)	23
High	Commission a study to identify traditional knowledge and its application in DRM (including tsunamis) as per DRM NAP Action 1.4.3.	Medium	Knowledge, Information, Public and Stakeholder Awareness and Education	Multi-hazard	34
High	Develop and deliver a tsunami competency based training program to staff responsible for issuing tsunami warnings for RMI. This training should be developed based on operational SOPs.	High	Knowledge, Information, Public and Stakeholder Awareness and Education	Tsunami specific	35
Medium	Update and check the contact list of national stakeholders that are responsible for tsunami warning and mitigation.	Low	Governance & Coordination	Tsunami specific	4
Medium	Test disaster preparedness and response plans for both distant and locally generated tsunami, including at a national level and involvement in Pacific tsunami exercises. This is in line with DRM NAP Actions 3.3.4 and 3.5.2.	Medium	Tsunami Emergency Response (including evacuation)	Tsunami specific	19

Priority	Recommendation	Resource Intensity	Topic	Multi-hazard or tsunami specific	Recommendation Number In Table 4
Medium	<p>To facilitate planning and response, establish a national database to allow storage of and access to DRM information for RMI including:</p> <ul style="list-style-type: none"> <li>○ Post disaster assessments based on environmental, social, economic and physical impacts with respect to tsunami, typhoons and other disasters.</li> <li>○ Emergency response resources as outlined in DRM NAP Action 3.3.1.</li> <li>○ Critical infrastructure and lifeline support facilities.</li> <li>○ Integration with existing MapServer.</li> </ul>	Medium	Tsunami Hazard, Vulnerability, Risk and Mitigation	Multi-hazard	25
Medium	Consult with and provide copies of national disaster arrangements and the DRM NAP to outer island local governments and communities.	Medium	Knowledge, Information, Public and Stakeholder Awareness and Education	Multi-hazard	28
Medium	Implement DRM NAP Actions 1.4.1 and 1.4.2 to strengthen the capacity of key community groups and Non Government Organisations (NGOs) in RMI.	High	Governance & Coordination	Multi-hazard	6





Section

2

## 2. Project Background



## 2. Project Background

### 2.1. About the Project

The National Capacity Assessment of SOPAC Member Countries: Tsunami Warning and Mitigation Systems project aims to work in collaboration with the member countries of SOPAC to assess their capacity to receive, communicate and respond effectively to tsunami warnings. The Bureau is the lead implementing agency, in partnership with the Australian Attorney-General's Department (AGD), (formerly Emergency Management Australia (EMA)), SOPAC, and with the assistance of the IOC a division of the United Nations Educational, Scientific and Cultural Organization (UNESCO). The project is funded by the Australian Agency for International Development (AusAID) under the Pacific Governance Support Programme (PGSP). It is implemented under an agreement (Schedule 5 to the Record of Understanding 14304, June 2006) between AusAID and the Bureau. The fourteen SOPAC member countries participating in the project are the Cook Islands, the Federated States of Micronesia, Fiji, Kiribati, the Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Samoa, the Solomon Islands, Tonga, Tuvalu and Vanuatu.

### 2.2. Broad Project Aim

By undertaking an assessment of the capacity of individual nations to manage tsunami events, the project aims to better guide donor funding towards achieving targeted improvements in the tsunami warning and mitigation systems in the respective countries.

### 2.3. Key Project Output

The key deliverable of the project is a comprehensive set of reports, including one national report specific to each country, detailing the strengths and opportunities for improvement of the country with regard to tsunami warning and mitigation. The national report for each country also includes recommendations to address priority issues. These reports will then feed into a consolidated Regional report that will aim to identify common issues across the Region with regard to tsunami warnings and mitigation.

### 2.4. Project Methodology

National assessments in each SOPAC member country have been conducted by visiting teams including experts in the fields of tsunami warnings, emergency management, disaster risk reduction and data and warning communications. The visiting team meets with in-country experts during four-day workshop involving government agencies, the private sector, NGOs and regional and international organisations involved in tsunami and DRM.

The workshop aims to complete a questionnaire covering all aspects of tsunami warning and mitigation and gather information to support questionnaire responses. This information then feeds into the national report. Consultation with individual countries before completion of the report is an integral part of the report writing process.

The questionnaire for the PICs is a modified version of that used for the Indian Ocean equivalent project. The Indian Ocean questionnaire was jointly developed by UNESCO/IOC, SOPAC, the World Meteorological Organisation (WMO) and the International Strategy for Disaster Reduction (ISDR). Details of the Indian Ocean equivalent project can be found at

<http://www.ioc-tsunami.org/content/view/275/978/>

## 2.5. Underlying Policy Objectives of the Australian Tsunami Warning System Project

The Bureau in partnership with Geoscience Australia (GA) and AGD, has recently completed a four-year project to establish the Australian Tsunami Warning System (ATWS). One of the three policy objectives of the ATWS project was “To contribute to the facilitation of tsunami warnings for the South West Pacific” (DFAT, 2006). The Tsunami Capacity Assessment project and this report, contributes to the achievement of this policy objective. Also, as part of the implementation of the ATWS, Australia has and will continue to contribute to the facilitation of more effective tsunami advisory bulletins to Pacific Island nations through the provision of seismic and sea level observations to the PTWC in Hawaii.

## 2.6. Tsunami warnings in the Pacific

Tsunami messages for the Pacific Ocean are issued by the PTWC in Hawaii as the United States of America (USA) contribution to the PTWS. Individual countries are then responsible for using this advice to distribute national tsunami warnings to their communities. PTWC messages can be Tsunami Warnings, Tsunami Watches, Tsunami Advisories and Tsunami Information Bulletin/Statement. For the purpose of this report, products from the PTWC will be referred to generically as ‘tsunami messages’.

A full definition of each PTWC product products can be found at

[http://www.prh.noaa.gov/ptwc/about\\_messages.php](http://www.prh.noaa.gov/ptwc/about_messages.php)

## 2.7. International Tsunami Forums

Under the auspices of the IOC, the ICG/PTWS (formerly known as ICG for the Tsunami Warning System in the Pacific (ITSU)) was first convened in 1968 (IOC, 2009). This is an international cooperative effort involving many IOC Member States of the Pacific Region. The ICG/PTWS meets regularly to review progress and coordinate activities resulting in improvements of the service (IOC, 2009).

The Working Group on Tsunami Warning and Mitigation in the Southwest Pacific Ocean was formed at the ICG/PTWS-XXI meeting in Melbourne in early May 2006 with the aim of enhancing tsunami warning and mitigation in the Southwest Pacific Ocean. The membership of the working group is composed of representatives from IOC Member States and other countries in the region (as members and observers). SOPAC provides secretariat support. The Working Group is currently chaired by a representative of New Zealand, with vice-chairs from Fiji and Samoa.

The Working Group has a number of Terms of Reference and this project is directly relevant to the following Terms of Reference:

- To evaluate capabilities of countries in the Southwest Pacific Region for providing end-to-end tsunami warning and mitigation services;
- To ascertain requirements from countries in the Southwest Pacific Region for the tsunami warning and mitigation services;
- To facilitate capacity building and the sharing of tsunami information in the region;
- To support the further development of the virtual centre of expertise in a multi-hazards context within SOPAC in line with the Regional Early Warning Strategy; and
- To facilitate the inclusion of tsunami hazard and response information into curricula, and development and dissemination of education materials.





### 3. Country Background and the Tsunami Threat





## 3. Country Background and the Tsunami Threat

### 3.1. About the Marshall Islands

The Republic of the Marshall Islands is comprised of 29 low-lying atolls and five islands of which 24 are inhabited (D1 & D2). Together these atolls form 70 square miles of land. These are commonly categorised into two island chains Ratak (Sunrise) in the east and Ralik (Sunset) in the west (D1). The capital is situated on Majuro atoll in the southeast with a land area of 3.56 square miles. The islands are essentially coral caps, set on underwater dome volcanos rising from the ocean floor and surrounded by 700,000 square miles of ocean (D1). Over two thirds of the nations population of an estimated 57,000 is situated on Majuro and Kwajalein atolls, making these atolls among the most densely populated in the Pacific (D1 & D2). The rapid and largely unregulated growth of populations in urban centres has increased the population density of RMI by a factor of five in the past half century (D1).

RMI gained independence in 1986 and self governance in 1979 (D1). The Micronesian country is in a Compact of Free Association (COFA) with the United States (DFAT, 2009). Under the Amended Compact (2004), the United States will give RMI at least US\$57 million every year until 2023, including contributions to a jointly managed Trust Fund from which perpetual annual payouts will be drawn when the compact ends. The Marshall Islands will continue to have access to many US programs and services, including disaster response and recovery (D1 and DFAT, 2009). The United States has full authority and responsibility for security and defence of the Marshall Islands. RMI has full control of all other domestic and foreign policy and RMI citizens have access to favourable provisions for travelling to and working in the United States. Subsidiary government-to-government agreements of the Compact exist for the use of the lagoon and several islands on Kwajalein Atoll as well as settlement of all claims arising from the US nuclear tests conducted at Bikini and Enewetak Atolls from 1946 to 1958 (DFAT, 2009).

The Compact remains the main source of government revenue for RMI and the economy is primarily driven by this and government spending (D1, DFAT, 2009). External market and other forces can at times have a negative impact on RMI's financial stability (for example, increases in fuel prices). Important industries include copra, tuna processing, tourism, craft items from seashells, wood and pearls (D1). The developing tourism industry remains a hope for future added income (D1).

RMI has a semi-Westminster style constitution, adopted in 1979, with a Nitijela (Parliament) comprising 33 members, elected every four years by universal suffrage. Every inhabited atoll is represented, with Majuro with five members and Ebeye with three members having the largest representation (DFAT, 2009). While there are no formal political parties in the RMI, there are two political groupings, the Aleon Kein AD (AKA) and UDP. The President is elected from the Nitijela and appoints a cabinet from its members. There is also an advisory council of High Chiefs - the Council of Iroj (DFAT, 2009). The public service is headed by the Chief Secretary who is responsible to Cabinet for the direction and work of all Departments and offices (D1). Each inhabited island has a local council headed by a mayor who reports back to the Ministry of Internal Affairs quarterly. Administrative district centres, with their own locally appointed officials and police forces, are located at Majuro, Kwajalein, Jaluit and Wotje (D1).

The climate of RMI is tropical oceanic, cooled year-round by the northeast trades which are interrupted during the summer months by the movement of the Intertropical Convergence Zone locally across the area (D2). From January to March, the climate is drier. The northern islands are cooler than the southern atolls, and receive less rainfall (D2). Typhoons are rare, although March, April, October and November can be stormy. One of the outstanding features of the climate is the extremely consistent temperature regime. The range between the coolest and warmest months average less than 1 degree F. The average annual rainfall on Majuro is about 131 inches (D2).

A geographic analysis of key social, environment and economic statistics of the Marshall Islands can be found in D6.

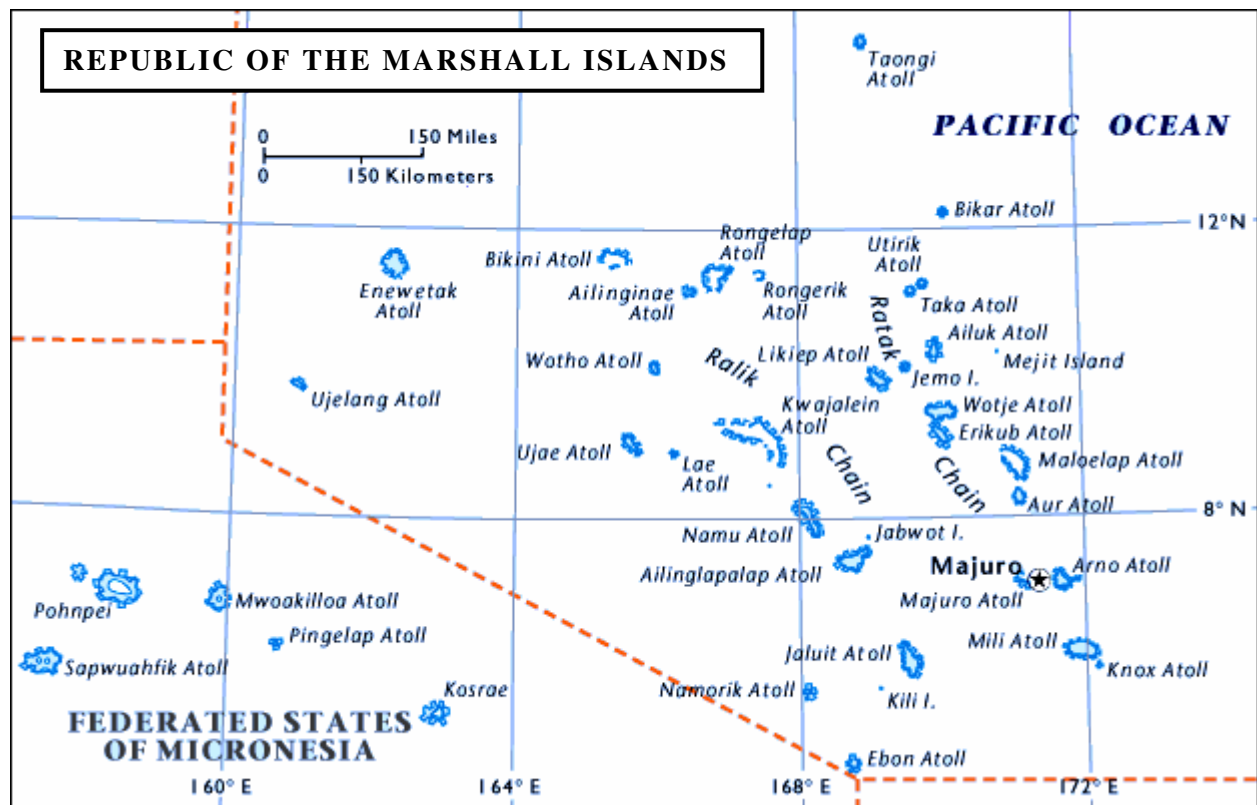


Figure 1: Republic of the Marshall Islands (Source: D1)

## 3.2. Tsunami Threat Sources and Tsunami History in the Marshall Islands

An overview of potential tsunami threat sources and tsunami history in RMI is outlined below. This information should be treated as general background and does not attempt to provide a comprehensive picture of tsunami hazard and vulnerability and associated risk for RMI. Such a study is outside the scope of this project.

The RMI DRM NAP (D1) states that “fortunately RMI is considered to be at low risk to earthquakes, volcanic eruptions and tsunamis”. The Marshall Islands has historically experienced extreme wave action associated with typhoons as well as “wave trains” thought to most frequently occur due to high tides combined with wind patterns upwind of the islands which establish an unusually long and persistent wave-generating “fetch”. For example, in December 2008 long period swells generated from distant winds over the North Pacific, enhanced by shorter period waves generated locally by tropical depressions led to severe coastal flooding in RMI (Bureau, December 2008). This led to the declaration of a State of Emergency as large amounts of debris and approximately 500 displaced people created sanitation and health concerns in Majuro (UNOCHA Sit Reps, December 2008).

RMI sea-level gauges have detected tsunami events from various sources, the majority of which have been less than 10cm in amplitude (refer to Figure 4). A 8.1 Mw earthquake on the Kuril trench on the 13th January 2007 resulted in a recorded amplitude at Kwajalein Atoll of 0.11m (NGDC Tsunami Database, 2010). On 15th November 2006 a 8.3 Mw earthquake, again on the Kuril trench, resulted in a recorded amplitude at Uliga (Majuro) of 0.08m (NGDC Tsunami Database, 2010) (Refer to Figure 4). Marshall Islands’ Hazard Mitigation Plan (D4) states that “the incidence of Pacific-wide tsunamis has little affect on the Marshall Islands”. The Plan lists the March 9, 1957, 8 to 8.5 magnitude earthquake in the Aleutian Islands as causing “a minimal 3 meters [tsunami] for Kwajalein and Enewetok”. The Plan also states “of all the tsunamis researched in the last century, no tsunami has registered over 4 meters (May 22, 1960 - Chile 8.25 to 8.85 Earthquake) in RMI”.

RMI is located further from major subduction trenches capable of generating tsunami than many southwest PICs. The country generally has a greater lead time for warnings and thus appears in a lower hazard category (Pearce, 2008). Atolls can also be somewhat protected as they often have steep drop-offs in which ocean depths increase very rapidly with distance from the fringing reef therefore minimising tsunami shoaling (the process by which tsunami wave heights increase as they approach the shore) and subsequent inundation (Thomas, Burbidge, Cummins, 2007).

However, even relatively small tsunami, particularly when timed with high tides, may have a significant impact on communities on low lying atolls (Pearce, 2008). Even seemingly small changes in sea-level due to tsunami could adversely impact on day-to-day activities in RMI, such as unloading of fuel and water based tourism activities.

Thomas, Burbidge and Cummins (2007) completed *A Preliminary Study into the Tsunami Hazard faced by Southwest Pacific Nations*. Scenarios for an 8.5 Moment Magnitude (Mw) and 9.0 Mw earthquakes were used to investigate normalised offshore (to a notional depth of 50 metres) wave amplitudes for tsunami caused by earthquakes along subduction zones (Refer Figure 2). In this study, the RMI maximum amplitude for all tide gauges for all Mw 9 tsunami was 110cm with the most significant source region being the Kuril and Mariana trenches (amplitude greater than 75cm at 50m depth or single most significant source region if no amplitude exceeds 75cm). For a Mw 8.5 tsunami the maximum amplitude reduced to 40cm with the New Hebrides trench 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 most of the model output points in the RMI have a maximum amplitude of between 1 and 2 metres with the hazard dominated by the Kurils trench, with smaller contributions from the Mariana and Ryukyu trenches. At a return period of 100 years the maximum amplitudes vary from 0.2 to 0.4 metres (Thomas & Burbidge, 2009). The GA studies are supported by investigation of the Bureau’s own deep ocean model-based tsunami prediction system (refer to Figure 3) with tsunami travel times to RMI from these sources varying between 3.5 to 4 hours from the Mariana trench, 4 to 5 hours from the New Hebrides trench and 5 to 6 hours from the Kurils trench.

Regardless of the current perceived level of risk, RMI receives tsunami warnings from the PTWC. Within their multi-hazard framework, RMI will need to plan for tsunami warnings and events, with particular consideration of low lying atolls as well as processes that may be impacted upon by tsunami, however small, such as unloading of fuel.



Figure 2a: The subduction zones (in orange) of the Pacific Ocean

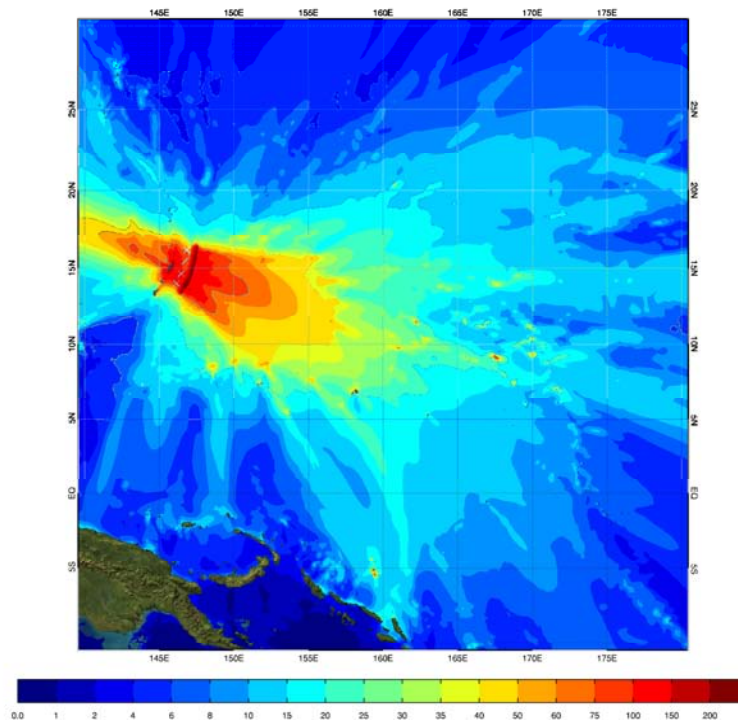


Figure 2b: The location of Republic of the Marshall Islands and other PICs in relation to regional and local subduction zones (in orange)



**About the computer scenarios (Figure 3a and 3b):**

- The scenarios come from a **deep ocean** tsunami model developed for use in the Joint Australian Tsunami Warning Centre (JATWC, operated by the Australian Bureau of Meteorology and Geoscience Australia).
- These scenarios are intended as an indication of the locations of the largest waves from individual earthquakes. These scenarios end offshore, where the water is 20 metres deep. Therefore, they cannot be relied upon as a useful indication of precise tsunami behaviour and impacts on the land. Impacts on the land will be influenced by coastal features and near shore bathymetry (the underwater equivalent of topography) that are not considered in these models. Only further detailed inundation modelling (using high resolution near shore bathymetry data) would accurately describe the potential localised impacts of tsunami on the land.
- These scenario examples represent the maximum amplitude tsunami that can be expected for a magnitude (Mw) 8.5 event. Amplitude is defined as half the wave height.
- Neither of these scenarios match any previous real events exactly.



**Figure 3a:** Maximum amplitude tsunami from magnitude 8.5 Mw earthquake scenario on the Mariana Trench showing tsunami energy beamed towards RMI (Source: Scenario 282c of MOST model from T2 database, Greenslade, Simanjuntak and Allen, 2009).

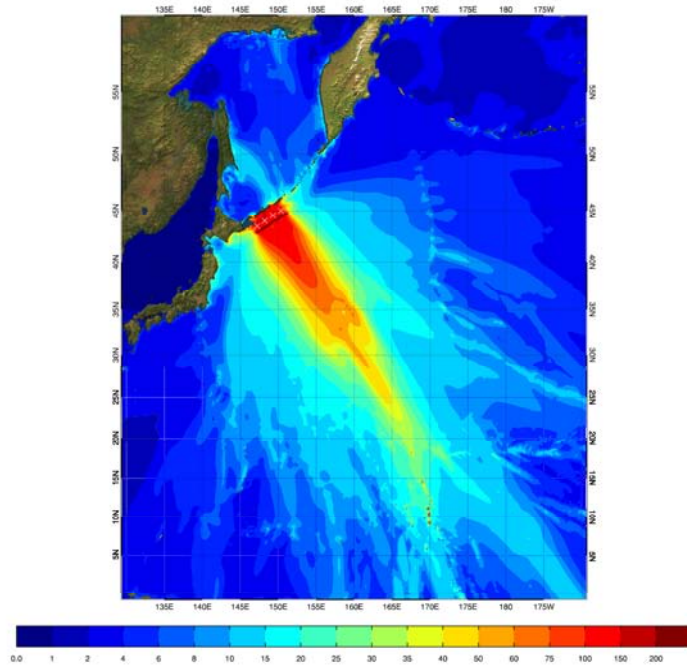
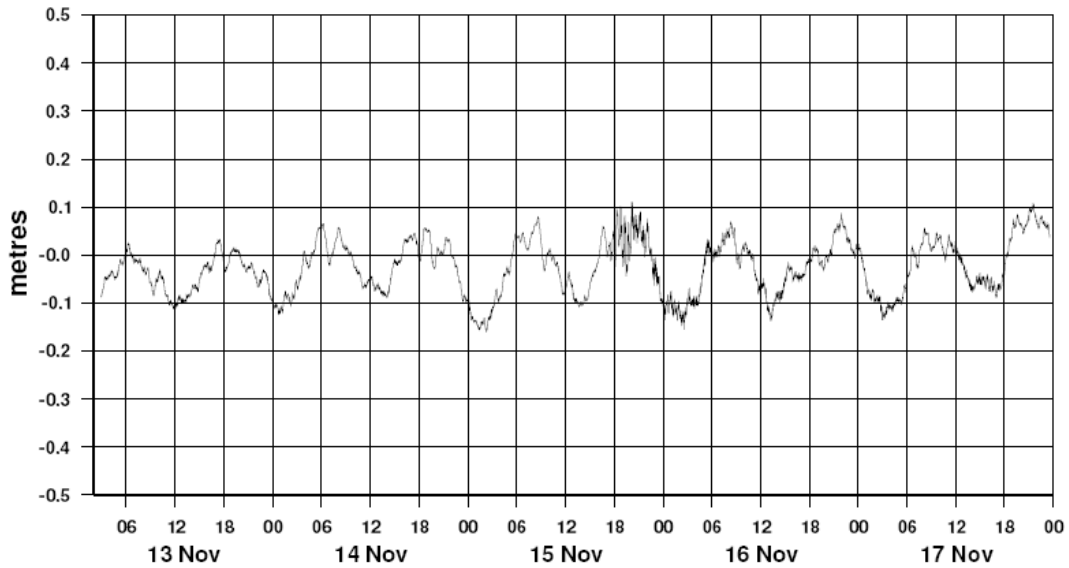


Figure 3b: Maximum amplitude tsunami from magnitude 8.5 Mw earthquake scenario on the southern Kuril Trench showing tsunami energy beamed towards RMI (Source: Scenario 318c of MOST model from T2 database, Greenslade, Simanjuntak and Allen, 2009).

**ULIGA, MAJURO, MARSHALL ISLANDS**

LAT 7° 6.5' N LONG 171° 22.3' E

ONE MINUTE RESIDUALS TO 23:33 17 NOV 2006 UTC



National Tidal Centre - Bureau of Meteorology

Produced 01:36 20 Nov 2006 UTC

Figure 4: Tsunami detected at Majuro, RMI from an Mw 8.3 event on 15<sup>th</sup> Nov 2006 11:14UTC source in the Kuril Islands with amplitude of less than 10cm.

**MARSHALL ISLANDS TSUNAMI CAPACITY ASSESSMENT REPORT**





## 4. The Marshall Islands Tsunami Capacity Assessment



## 4. The Marshall Islands Tsunami Capacity Assessment

### 4.1. Date and Location

The Tsunami Capacity Assessment of the ability of RMI to receive, communicate and effectively respond to tsunami warnings took place from 25 – 28 May 2009 at the Marshall Islands Resort in Majuro, RMI.

### 4.2. Visiting Assessment Team and Participants

The Visiting Assessment Team was made up of those outlined in Annexure 2. The focal point in RMI for the completion of the project was Mr Clement Capelle, Director, NEMCO. Mr. Jorelik Tibon, Deputy Chief Secretary from the Office of the President. A full list of workshop participants can be found in Annexure 1.

### 4.3. Workshop Summary

For a copy of the full agenda for the workshop see Annexure 3.

#### **4.3.1. Day 1 (Monday 25 May, 2009)**

The plenary workshop session was opened by Deputy Chief Secretary Jorelik Tibon. The Honourable Minister in Assistance to the President, Ruben Zackhras, was also present. Participants were then welcomed by Visiting Assessment Team Leader Chris Ryan who also introduced the Tsunami Capacity Assessment Project.

After morning tea Litea Biukoto (Hazard Assessment Advisor, SOPAC) presented to participants on tsunami science and the tsunami hazard in relation to RMI. Reginald White, Jorelik Tibon and Clement Capelle then presented on the tsunami warning and mitigation system in RMI.

After lunch focus groups were held on RMI priorities for implementing an effective tsunami warning and mitigation system. Workshop participants then worked through the Tsunami Capacity Assessment Questionnaire until the close of the meeting at 5pm.

#### **4.3.2. Day 2 (Tuesday 26 May 2009)**

On the morning of the second day, Dennis Herrmann, Data Communications Expert from the visiting Tsunami Capacity Assessment Team, presented to participants on communications requirements for tsunami warnings. After this presentation, participants then worked through the Tsunami Capacity Assessment Questionnaire until lunch.

After lunch the Tsunami Capacity Assessment Team undertook to visit a number of RMI agencies and locations to gain a better understanding of RMI, its agencies and equipment and how this relates to the country's tsunami warning and mitigation system. Visits included:

- **RMI Weather Service Office (RMI WSO)** - The team visited the RMI WSO. Mr Reginald White (Meteorologist In-Charge) hosted the visit and provided detailed information on the WSO's operations and its relationship with the USA and neighbouring islands, namely Guam.
- **Laura** – The team visited Laura located of Island which is the main ground water lens for the island of Majuro.
- **Rita** - The team visited Rita which is located at the other end of island of Majuro.
- **Majuro Sea-Level Gauge** - Dennis Herrmann, Data Communications Expert from the visiting Tsunami Capacity Assessment Team, visited the Majuro sea-level gauge at the main pier.

#### ***4.3.3. Day 3 (Wednesday 27 May 2009)***

On the morning of the third day, Andrew Lea, Emergency Management Expert from the visiting Assessment Team, presented to participants on emergency coordination, planning and community awareness for tsunami. This was followed for the remainder of the day by participants working through the Tsunami Capacity Assessment Questionnaire.

#### ***4.3.4. Day 4 (Wednesday 27 May 2009)***

The fourth day saw the visiting Assessment Team make a preliminary summary presentation of RMI strengths, needs, preliminary recommendations, priority review and next steps for enhancement of the country's tsunami warning and mitigation system. This was followed by feedback and questions from RMI participants.

The workshop was then closed by the Assessment Team Leader Chris Ryan and the Hon. Ruben R. Zackhras, Minister in Assistance to the President.

#### 4.4. Workshop Photos (Marshall Islands, May 2009)



Tsunami Capacity Assessment Workshop group photo



Tsunami Workshop participants work through the questionnaire in session



Tsunami Workshop participants work in Focus Groups to establish RMI priorities for tsunami warning and mitigation system enhancement





The Majuro Fire and Police stations



Tsunami Workshop Participants visit RMI WSO



RMI Sea Patrol, Maritime Surveillance



Looking towards Majuro Port



Main road between airport and Majuro with 1 metre raised sea barrier



Majuro sea level gauge



## 5. Assessment Results

**MARSHALL ISLANDS TSUNAMI CAPACITY ASSESSMENT REPORT**



## 5. Assessment Results

### 5.1. Status of Key System Components

The Tsunami Capacity Assessment Workshop results are summarised below in Table 3 in which the status of key components of RMI tsunami warning and mitigation system are outlined (as at the date the Tsunami Capacity Assessment Workshop was held in May 2009, updates between then and the publication of this report are as marked).

**Table 3: Summary of current status of key components of RMI tsunami warning and mitigation system as at May 2009 (updates since then as marked)**

#### Rating

Yes - fully realised
Partially realised
No - not realised

Key Component	Rating	Comment
<b>Authority, Coordination and NGO Role</b>		
Legislation in place for tsunami warnings and response	<b>Yes</b>	Disaster Assistance Act (D3, 1987) covers all hazards. Needs to be updated to reflect advances in DRM from the NAP and review of National DRM arrangements. .
Tsunami coordination committee or effort at a National and local level	<b>Yes</b>	National Disaster Committee (NDC) empowered by legislation to coordinate all emergency situations including tsunami.
Agency responsibilities clearly defined	<b>Yes</b>	WSO, NEMCO and NDC have clear national roles. Island Mayors have clear local responsibilities. Will be further clarified and documented as part of the DRM NAP implementation, review of National DRM arrangements and operational plans for specific hazards.

Key Component	Rating	Comment
<b>Authority, Coordination and NGO Role (Continued...)</b>		
<p>NGOs and Red Cross Society have a defined role in tsunami warning dissemination, preparedness and awareness and emergency response</p>	<p><b>Partially</b></p>	<p>Transition for DRM assistance implementation under the COFA from Federal Emergency Management Agency (FEMA) to United States Agency for International Development (USAID) is complete, but not generally recognised.</p> <p>NGOs generally do not have a recognised formal role to support disaster response and preparedness. The Act (D3, 19987) requires NGOs to support emergencies under Office of the Chief Secretary (OSC).</p> <p>NGOs (International Federation of Red Cross and Red Crescent Societies (IFRC), Salvation Army etc.), are based in Majuro and generally play an advocacy role and other assorted services.</p> <p>Civil Society Organisations (Churches, Woman's Groups etc.) undertake a range of roles and may assist with dissemination of warning information and advice.</p>
<b>International and Regional Cooperation</b>		
<p>Country represented at an international and regional level to aid cooperation in tsunami warning and mitigation efforts</p>	<p><b>Partially</b></p>	<p>COFA with USA provides WSO and link to PTWC and RMI qualifies for disaster preparedness, response and recovery programs.</p> <p>RMI not a member of IOC and participation in the Southwest Pacific Tsunami Working Group of the ICG PTWS is ad hoc.</p> <p>RMI is a member of Council of Regional Organisations in the Pacific (CROP) agencies and has a number of other interactions with regional and international partners.</p>
<b>Priorities</b>		
<p>Priorities established for implementation of tsunami warning and mitigation system at a National level</p>	<p><b>Yes</b></p>	<p>Implementation of priorities identified in this capacity assessment could be realised under the NAP implementation. NAP Task Force has been established.</p> <p>High priority discussion group topics in the Tsunami Capacity Assessment Workshop include:</p> <p><b>Emergency Response Planning</b></p> <ul style="list-style-type: none"> <li>• Strengthen two way communications between Majuro and outer islands</li> <li>• Assess availability of evacuation shelters and advise community (multi-hazard)</li> <li>• Implement use of siren/bell alert systems for tsunami and similar events</li> <li>• Improving capacity to getting help to islands</li> </ul>

Key Component	Rating	Comment
<b>Priorities (Continued)</b>		
<p><i>Continued</i></p> <p>Priorities established for implementation of tsunami warning and mitigation system at a National level</p>	<p><i>Continued</i></p> <p><b>Yes</b></p>	<p><b>Community Awareness</b></p> <ul style="list-style-type: none"> <li>• Collection, printing, publishing (in local language) and distribution (including outer islands) of available material explaining tsunami and advice on actions to take (within multi-hazard approach)</li> <li>• Improve community radio to support community awareness</li> <li>• Make national (and other relevant) plans available to outer islands and local communities to raise understanding of arrangements</li> </ul> <p><b>Risk Assessment and Warning Dissemination</b></p> <ul style="list-style-type: none"> <li>• Research into frequency and potential impact of tsunami on RMI communities with risk and inundation modelling.</li> <li>• Access to existing modelling</li> </ul> <p><b>Interagency Cooperation</b></p> <ul style="list-style-type: none"> <li>• Regional response plan</li> <li>• Develop RMI exercises</li> <li>• Greater level of NAP awareness and ownership by agencies (annual workshops to discuss areas for joint implementation)</li> <li>• All agencies need their own sub-plans or SOPs that support the national plans to improve coordination</li> </ul>
<b>Multi-hazard Approach</b>		
<p>Tsunami warning capabilities are being established within a multi-hazard framework</p>	<p><b>Yes</b></p>	<p>Despite the relative low risk, there is acceptance that tsunami needs to be factored into plans within a multi-hazard approach. Determination of tsunami risk for RMI is seen to be an initial priority.</p> <p>Tsunami will be addressed in a multi-hazard approach as per the DRM NAP.</p>
<b>Research Expertise</b>		
<p>Active research is being undertaken within the country for seismology and tsunami to strengthen the tsunami warning and mitigation system</p>	<p><b>No</b></p>	<p>No active research identified.</p> <p>It is recognised that research specific to RMI is needed, but would need external support.</p>
<b>Tsunami monitoring infrastructure</b>		
<p>Existence of seismograph stations and integration of real time data from these stations into the tsunami warning process</p>	<p><b>Partially</b></p>	<p>One seismic station is in operation on Kwajalein Atoll as part of the global seismic network. This data is not used in real-time within RMI. This station is operated by IRIS/IDA (Incorporated Research Institutions for Seismology/ International Deployment of Accelerometers, 8.8019 167.6130 0.0, Status: Opened, Date Opened: 19991116).</p>

Key Component	Rating	Comment
<b>Tsunami monitoring infrastructure (Continued...)</b>		
Existence of sea level stations and integration of real time data from these stations into the tsunami warning process	<b>Yes</b>	<p>Majuro sea-level gauge is part of the PTWC network. Sea-level data is used by PTWC in real-time to refine warning decisions.</p> <p>University of Hawaii operates a sea-level gauge at Delap, which has a 15-minute reporting frequency.</p> <p>Another sea-level gauge is in place on Kwajalein, supported by PTWC.</p> <p>Data is accessible by WSO for download/viewing using TideTool but need resources/capacity to effectively use.</p>
Sharing of seismic and sea level data internationally to facilitate improvement of PTWC tsunami messages for the region	<b>Yes</b>	All data is available to PTWC.
<b>Warnings</b>		
Nation receives PTWC messages	<b>Yes</b>	PTWC messages are received at WSO Majuro, who relays the information to NEMCO by telephone and e-mail.
24/7 operational staff at warning receipt and dissemination location	<b>Yes</b>	At least one person on duty at all times at WSO Majuro. Extra staff on duty during tsunami and other hazard events.
Disseminate national tsunami warnings as guided by a Standard Operating Procedure	<b>Partially</b>	<p>WSO has tsunami SOPs. NEMCO and NDC do not have tsunami specific SOPs but can apply existing SOPs to multi-hazards.</p> <p>Majuro WSO acknowledges receipt of the message to PTWC and notifies NEMCO. For watches and warnings the information is escalation to the Chief Secretary and President. Majuro WSO seeks sea-level data confirmation from PTWC as well as a local readout that a tsunami has been generated before any warning is issued. The NDC is convened. WSO and NEMCO translate warnings from technical into layman terms. The Ministry of Internal Affairs translate warnings into Marshallese for public radio broadcast. NDC advise Cabinet to issue warning and evacuation Presidential order. This is relayed to appropriate agencies and the public.</p>
System redundancies in place for receipt of PTWC messages and dissemination of National warnings	<b>Partially</b>	<p>Weather Forecast Office (WFO) Guam is back-up notification source.</p> <p>No redundancies available for national warning dissemination.</p>
Redundant 24/7 methods available for dissemination of warnings to community (e.g. public radio, sirens etc.)	<b>No</b>	<p>Local radio is not 24/7. No sirens or other system in place.</p> <p>Several different methods are required to reach the community, including word of mouth.</p>

Key Component	Rating	Comment
<b>Warnings (Continued...)</b>		
Effective warning dissemination to remote communities	<b>Partially</b>	Local Amplitude Modulated (AM) radio coverage includes outer islands, but does not operate after midnight.
Communications coverage of whole country that is effectively utilised for the dissemination of tsunami warning messages	<b>Partially</b>	Local radio coverage includes the whole country. Telephone system is restricted to only the major islands. High Frequency (HF) e-mail (RANET) is available to island mayors' offices. Very Small Aperture Terminal (VSAT) trials are being progressed to Likiep and Ailinglaplap Atolls. Plan to improve interoperability of current systems is required.
Issue of marine tsunami warnings and guidance for vessels, harbours and ports	<b>No</b>	WSO advises Port Authority of tsunami warnings. Tsunami warnings are currently not issued for marine vessels, harbours and ports.
<b>Emergency Response and Evacuation</b>		
Disaster preparedness and emergency response system has been reviewed and opportunities for improvement and training identified	<b>Yes</b>	DRM NAP (D1, 2007) provided a complete review and plan, and was approved by Cabinet in April 2009. NAP task force has been established.
Tsunami emergency response, evacuation and recovery plan exists	<b>Partially</b>	Multi-hazard national plans exist, but no specific tsunami plan at present.
The designated agency for evacuation is identified and have authority by law	<b>Yes</b>	Under the Disaster Assistance Act (D3, 1987) Section 1007 Cabinet can instruct local authorities to carry out evacuations. NEMCO would be responsible for implementing and coordinating voluntary evacuations (on behalf of NDC and Cabinet) where lead responsibilities have not already been authorised under a plan. In general, Police have a lead role in implementing evacuation orders.
Plans have been made for safe evacuation of population centres including aspects such as maps, routes and signage	<b>No</b>	Pending the results of future risk assessment, authorities intend to develop evacuation plans as part of the DRM NAP (D1, 2007). There are no plans to use tsunami-specific signage at this stage.
Procedures are tested and exercised to improve the response through better planning and preparedness	<b>Partially</b>	Government departments carry out exercises in their areas of responsibility, and participate in international exercises, such as Pacific Wave, on an opportunity basis.

Key Component	Rating	Comment
<b>Emergency Response and Evacuation (Continued...)</b>		
Land use policies and building codes are in place to mitigate against the tsunami hazard	<b>Partially</b>	Building guidelines apply only to government structures. Marshall Islands Development Bank lending policies intend to mitigate against tsunami and storm surge hazard. Increased costs related to stricter building codes are problematic.
<b>Tsunami hazard, vulnerability and risk</b>		
Completion of studies to assess the tsunami hazard in the country or Region	<b>Partially</b>	Country – No. Planned as part of the DRM NAP (D1, 2007) implementation, in line with DRM NAP Action 6.2.2. NAP Goal 6 (Sustainable development of the coastal area) and 8 (linking zoning and building codes to vulnerability to disasters) will specifically address land use issues to reduce vulnerability to all known hazards Region – Yes. A “Preliminary Study into the Tsunami Hazard faced by Southwest Pacific Nations” (Thomas, Burbidge and Cummins, 2007) and a “Probabilistic Tsunami Hazard Assessment of the Southwest Pacific Nations” (Thomas and Burbidge, 2009) have been completed. These included RMI.
Local risk assessments have been completed for at risk communities	<b>No</b>	As above
Adequate data exists and local inundation modelling has been completed for population centres	<b>Yes</b>	Some high resolution bathymetry exists for Majuro Atoll (refer D5) that has multi-use potential. The lack of good topographical and bathymetric data has meant that no tsunami inundation studies have been completed.
<b>Public and Stakeholder Awareness, Education and Training</b>		
Measures have been taken to ensure the public understand and take action in the event of a tsunami warning being issued	<b>No</b>	Planned as part of the DRM NAP implementation, subject to risk assessment.
Community level education and preparedness programs exist for tsunami	<b>No</b>	Community capacity building is identified as an important aspect of the DRM NAP.
Training programs for the National media exist for natural hazard and tsunami	<b>No</b>	No in-country programs, except for general guidance on how to provide public information effectively during emergency situations. A UNESCO program is available.
Training programs exist for officials involved in tsunami warning and response	<b>Partially</b>	DRM training is currently ad hoc and the DRM NAP outlines the need for gap analysis and planning in this area. Training for staff to issue tsunami warnings as well as training for the media is required.

## 5.2. Case Study – Tsunami System Operation in the Marshall Islands for the April 2007 Solomon Islands Tsunami Event

Throughout the Tsunami Capacity Assessment Questionnaire completed in RMI, the country's response to the Solomon Islands event of April 2007 was reviewed. The aim of this review was to gain an understanding of the operation of the system in a real time event.

**Event Details:** Solomon Islands – Magnitude 8.1, 45km south-southeast of Gizo (Solomon Islands), 20:39:56 Coordinated Universal Time (UTC), Sunday 1 April 2007 (2 April, 8.39am Majuro local time)

RMI was specifically warned by PTWC in Tsunami Bulletin Number 002 issued at 2132 UTC, 1 April 2007 (2 April, 9.32am Majuro local time). The warning was changed to “advisory only” in Tsunami Bulletin Number 003 issued at 2239 UTC (10.39am Majuro local time) until the tsunami warning for the event was cancelled in Tsunami Bulletin Number 008 issued at 0405 UTC, 2 April 2007 (2 April, 4.05pm Majuro local time)

For this event the PTWC bulletin was received in RMI. The warning was received by RMI WSO from PTWC via EMWIN and an internet Really Simple Syndication (RSS) feed, 52 minutes after the earthquake, 2 hours and 50 minutes before the arrival of the potential tsunami. At the time of the event no national tsunami response plan was in place. Alert protocols from WSO to NEMCO and other key authorities were activated per the WSO manual SOPs. These SOPs worked well in informing the NDC who were in the process of being convened when the warning was downgraded by PTWC before any public release of information was made. No tsunami warning was therefore issued nationally by RMI. The public did not consider themselves at risk. Most were not aware of the incident, particularly in the outer islands. Those who were aware were not concerned.

In the event of a tsunami watch being issued for RMI by PTWC, WSO and NEMCO do monitor gauges on Majuro and Kwajalein and can access information via PTWC. This is done using the desktop monitoring software, TideTool which has been developed by PTWC to view gauge data.



### 5.3. Strengths, Opportunities for Improvement and Recommendations to Progress the Tsunami Agenda in the Marshall Islands

Based on the discussions during the workshop with in-country participants and the supporting documentation collected during the visit, the visiting team formulated the following strengths, opportunities for improvement and recommendation under key topics which they believe will progress the tsunami agenda in RMI.

**Table 4 – Strengths, opportunities for improvement and recommendations under key topics**

<b>5.3.1. Governance and Coordination</b>	
<b>Strengths:</b>	<b>Opportunities for Improvement:</b>
<ul style="list-style-type: none"> <li>• Clear reporting channel from WSO to NEMCO and CSO.</li> <li>• Disaster Assistance Act (D3, 1987) assigns clear responsibilities. It provides Cabinet with powers (proclamation of state of disaster etc.) during disasters.</li> <li>• DRM NAP (D1, 2007) which maps to the country's Strategic Development Plan (SDP) and provides comprehensive strategy and priorities for all-hazard approach. National Implementation Task Force overseen by the CSO.</li> <li>• Standard Hazard Mitigation Plan adopted by NDC in 2005.</li> <li>• A Review of Disaster and Mitigation Plan Arrangements and alignment with the Pacific Framework for Action 2005 – 2015 took place in 2005 (D15) and identified areas of improvement. These plans have since been reviewed.</li> <li>• NDC responsible for all hazards (Chaired by the Chief Secretary, who is also the Disaster Coordinator, and made up of Ministry Secretaries). Makes recommendations to Cabinet and operational response decisions that are implemented by NEMCO.</li> <li>• Mayors and Councils provide coordination at the local level. Mayors have statutory powers to support disaster management.</li> <li>• NGOs (IFRC, Salvation Army etc.), are based in Majuro and generally play an advocacy role and other assorted services. The Act (D3, 19987) requires NGOs to support emergencies under CSO.</li> <li>• Civil Society Organisations (Churches, Woman's Groups etc.) undertake a range of roles and may assist with dissemination of warning information and advice.</li> </ul>	<ul style="list-style-type: none"> <li>• Implementation of the DRM NAP (D1, 2007).</li> <li>• Responsible agencies for DRM NAP Actions need to progress actions in consultation with all stakeholders.</li> <li>• National DRM arrangements for RMI have been reviewed and are awaiting formalisation.</li> <li>• It is planned to review the Disaster Assistance Act to incorporate changes flowing from the DRM NAP and review of national DRM arrangements.</li> <li>• DRM NAP Objective 1.4 aims to review, develop and strengthen the capacity of community groups and NGOs in RMI, particularly in support of local-level disaster risk management.</li> <li>• The current National Disaster Management Plan (D7, 1997 Revised Edition) identifies the need for operational support plans and department and organisation emergency response plans.</li> </ul>



***Governance and Coordination (Continued)*****Recommendations:**

1. Continue to progress a coordinated program of action focusing on key vulnerability and risk issues and on priority gaps by implementation of the DRM NAP to strengthen existing disaster response, preparedness and mitigation processes to embrace a whole of hazard approach to DRM. Use partnerships with technical and development partners to meet capacity needs.
2. Strengthen NEMCO staffing and other resources to progress mainstreaming of DRM in all sectors.
3. Agencies identified in the DRM NAP to develop their own capacity and readiness to implement respective actions as these form the basis of an effective multi-hazard warning system and mitigation. In particular, encourage agencies identified in the DRM NAP to implement respective actions in consultation with all stakeholders.
4. Update and check the contact list of national stakeholders that are responsible for tsunami warning and mitigation.
5. In line with DRM NAP Objective 1.1, progress with the formalisation of the draft set of National DRM arrangements for RMI that was produced and submitted to NEMCO in June 2008. Subsequently progress with the review of legislation and national operational plans for specific hazards based on the formalised arrangements.
6. Implement DRM NAP Actions 1.4.1 and 1.4.2 to strengthen the capacity of key community groups and NGOs in RMI.

***5.3.2. Regional and International Coordination*****Strengths:**

- Well connected to international and regional organisations.
- COFA with USA provides:
  - WSO with strong ties to PTWC through NOAA NWS (Pacific Regional Office) and backup arrangements from Guam. Note – RMI is not currently a WMO member.
  - RMI qualifies for disaster preparedness, response and recovery programs for the USA government managed through USAID.
- Membership of CROP agencies and a number of other interactions with regional and international partners.
- Strengthened through the recent COFA, United Nations Disaster Assistance and Coordination (UNDAC) will respond to disasters upon request from RMI Government or the United Nations (UN) resident.
- RMI is a member of the UN and Pacific Islands Forum.

**Opportunities for Improvement:**

- RMI is not currently a member of the IOC
- Pacific Wave exercise participation would have been improved with greater notice.
- Become involved in the Southwest Pacific Tsunami Working Group.

***Regional and International Coordination (Continued...)*****Recommendations:**

7. Ministry of Foreign Affairs consider RMI becoming a member of IOC to ensure RMI has a voice in determining IOC programs and activities of benefit nationally, as well as benefiting from IOC capacity building in marine science.
8. Consider participation in the Southwest Pacific Tsunami Working Group of the ICG PTWS.

***5.3.3. Research Expertise*****Strengths:**

- COFA with USA provides technical expertise. National Oceanic and Atmospheric Administration (NOAA) partners provide research capacity and support to RMI.
- The Act (1987, D3) makes provision for “studies of disaster prevention methods”.
- Regional partners (such as SOPAC) assist in research of priority issues within the country. For example, SOPAC conducted studies in 2006 and 2007 to review alternative marine aggregate options in Majuro lagoon.

**Opportunities for Improvement:**

- Development of in-country scientific expertise is required.
- No active in-country research in seismology or tsunami identified.

**Recommendations:**

9. RMI to take advantage of opportunities provided by international and regional partnerships to build national capacity for research expertise, in particular with regard to develop a tsunami risk profile for RMI.

**5.3.4. Tsunami Monitoring Infrastructure**

<b>Strengths:</b>	<b>Opportunities for Improvement:</b>
<ul style="list-style-type: none"> <li>• Sea level gauges in operation in three locations. Majuro (Australian Bureau of Meteorology, National Tidal Centre (NTC)), Kwajalein (NOAA), Delap (University of Hawaii).</li> <li>• Seismic instrumentation in operation at Kwajalein Atoll as part of the global seismic network. This station is operated by IRIS/IDA (8.8019 167.6130 0.0, Status: Opened, Date Opened: 19991116).</li> <li>• Robust links to PTWC.</li> <li>• Data is shared internationally.</li> </ul>	<ul style="list-style-type: none"> <li>• Regional sea level gauge network is developing and data is becoming more accessible.</li> <li>• Data is accessible by WSO for download/viewing using TideTool but need resources/capacity to effectively use.</li> </ul>
<b>Recommendations:</b>	
<ol style="list-style-type: none"> <li>10. RMI to enhance relationships with international and regional partners in providing access to earthquake and sea level monitoring systems and their data.</li> <li>11. Train and equip Majuro WSO for the technical role of sea level monitoring to better analyse the tsunami threat to RMI in real-time.</li> </ol>	

**5.3.5. Tsunami Warnings**

<b>Strengths:</b>	<b>Opportunities for Improvement:</b>
<ul style="list-style-type: none"> <li>• Robust, redundant links to PTWC with messages received by Majuro WSO, NEMCO and WFO Guam.</li> <li>• Well-resourced 24/7 facility at Majuro WSO which Reports to the CSO.</li> <li>• Fail-safe arrangements with 24x7 Guam WFO acting as back-up to Majuro WSO, contacting Majuro WSO who in turn check with NEMCO to see that the messages have been received.</li> <li>• SOPs and Emergency Operation Plans (EOPs) (not collected) for tsunami are in place at Majuro WSO. For process refer to Table 3.</li> <li>• WSO receive PTWC messages via e-mail and NOAA data feed. Guam WFO also provide backup via phone and e-mail.</li> <li>• WSO has an updated contact list of NEMCO, NDC members. NEMCO contacts Local Governments (Mayors) and other stakeholders as deemed necessary using landline, cellular phones and handheld radios.</li> <li>• WSO contact synoptic stations in outer islands for observations. Cancellations are based on this and PTWC advice by WSO and NEMCO.</li> </ul>	<ul style="list-style-type: none"> <li>• PTWC warnings do not distinguish between small islands and coasts with continental shelf effects.</li> <li>• Mechanisms to provide warning and information at community level are not well developed.</li> <li>• Limited in-country capacity to evaluate PTWC messages and provide national advice to the community.</li> <li>• The relatively informal and unstructured processes that are in place to get permission to issue a warning may impact on warning and evacuation time for tsunami. Pre-agreed processes and templates would be beneficial.</li> <li>• Tsunami warnings are currently not issued for marine vessels, harbours and ports.</li> <li>• Populations at risk of an approaching tsunami from Marinarua or Solomon Trenches will need to be alerted and take action within about 3 hours.</li> </ul>
<b>Recommendations:</b>	
<ol style="list-style-type: none"> <li>12. Develop local procedures for evaluating and interpreting implications for RMI of PTWC messages using available scientific information (deep ocean tsunami models, sea level data, travel time software etc).</li> <li>13. As tsunami are a short lead time events, develop and include in procedures, a tsunami warning decision making matrix that is pre-agreed by key government stakeholders which outlines what action will be taken (community information and / or warning and evacuation) for each PTWC message received.</li> <li>14. Prevent unnecessary public concern and reduce the possibility of false alarms through issuance of “No Threat” advice to the public for tsunami that are not expected to not impact on RMI.</li> </ol>	

### 5.3.6. Communications

Strengths:	Opportunities for Improvement:
<ul style="list-style-type: none"> <li>• Basic communication infrastructure is well established (refer D14 and Annexure 7).</li> <li>• <b>Update March 2010</b> - WSO have NTA links and RICS site installed. NOAA NWS are upgrading the EMWIN and LRIT (both receive only satellite based weather station)</li> <li>• The Act (1987, D3) requires the disaster plan to include means for “rapid and efficient communication in times of disaster”.</li> <li>• The public switch on their radios and listen to V7AB (25,000 watt AM RMI government Radio Station (D2)) for information and advice. This station operates within the National Disaster Plan, and under certain conditions declared by the RMI Government, can go to 24 hour per day operation, such as typhoon conditions. Frequency Modulated (FM) stations also exist.</li> <li>• Manual mechanisms, such as Police door-to-door knocking and megaphones, can also be used.</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of redundant communication systems to disseminate warnings to the public outside of ‘office hours’. A system such as the RANET Chatty Beetle or a RICS satellite alert system could be considered for rural and remote communities.</li> <li>• Communication links to outer islands are incomplete. For example, AM radio only operates from 6.00am to 11.30pm.</li> <li>• Proposal for extension of cellular network to other islands.</li> <li>• Planned fibre-optic link to Guam. <b>Update March 2010</b> - (installed and set to go online April)</li> <li>• Plans for VSAT trials to some outer islands (Pilot projects in Likiep (funded by International Telecommunications Union (ITU)) and Ailinglaplap (funded by Pacific Islands Forum Secretariat (PIFS)/ Secretariat of the Pacific Community (SPC)). <b>Update March 2010</b> - Likiep completed and online.</li> <li>• In country capacity and capability is limited (hardware, software, human resources, licences, ongoing costs, servicing and maintenance, land availability to locate infrastructure).</li> <li>• Interoperability of current communications infrastructure requires improvement.</li> <li>• Information and Communication Technology (ICT) projects are not being supported by monopoly Telecommunications Operator (D14). Liberalisation and enhanced / reviewed telecommunications legislation required (D14).</li> <li>• Short Message Service (SMS) from PTWC can not be relied upon (compatibility issues and delays)</li> <li>• No satellite phones on remote islands. Databases of satellite phone numbers within Ministries but no central database held.</li> <li>• Many small boat operators did not have radio communications (D2).</li> </ul>

**Communications (Continued...)****Recommendations:**

- 15.** Review existing warning systems with a view to develop a disaster communications plan to meet the requirements of the DRM NAP Goal 4 and Act (1987, D3) and improve the interoperability of current communications infrastructure. Include consideration of:
- Various communication technologies and techniques, such as RANET, Chatty Beetle, EMWIN, RICS to ensure warnings reach communities on all islands;
  - Training;
  - 24x7 contact;
  - System checks;
  - Back-up options;
  - Ongoing costs; and
  - Maintenance.

**5.3.7. Tsunami Emergency Response (including evacuation)**

<b>Strengths:</b>	<b>Opportunities for Improvement:</b>
<ul style="list-style-type: none"> <li>• Close link between local government and community.</li> <li>• Flexible disaster legislation suitable for multi-hazard response with good emergency powers.</li> <li>• The Act (1987, D3) allows for Cabinet to “direct or compel the evacuation of all or part of the population from any stricken or threatened area”. The Act also allows Cabinet to prescribe routes, modes of transportation and destinations in connection with evacuation.</li> <li>• NEMCO would be responsible for implementing and coordinating voluntary evacuations (on behalf of NDC and Cabinet) where lead responsibilities have not already been authorised under a plan. In general, Police have a lead role in implementing evacuation orders.</li> <li>• Some generic (multi-hazard) evacuation locations and buildings have been identified.</li> <li>• RMI participate in international tsunami warning exercises such as Pacific Wave. Airport emergency exercises are completed regularly.</li> <li>• The Mayors Offices are the focal point for emergency coordination (where available). The Mayor determines where local emergency coordination will take place.</li> </ul>	<ul style="list-style-type: none"> <li>• Limited safe evacuation routes and planning.</li> <li>• Buildings able to be used as tsunami shelters are insufficient for the population.</li> <li>• Scope exists for further testing and exercising of tsunami arrangements (from agency to community level) when plans are put in place. More notice for international tsunami exercises is required.</li> <li>• Funding availability limits RMI ability to undertake exercises. Exercising is currently completed on an opportunity basis (for example, external funding).</li> <li>• Department and organisation SOPs require preparation or updating on acceptance of revised national DRM arrangements.</li> <li>• Adequately located and equipped NEOC required.</li> <li>• Support preparedness at the local government / community level through projects such as the United Nations Development Program (UNDP) funded Local Level Risk Management (LLRM) project targeted at developing community focused risk management action plans at an Outer Island Pilot Site (2009)</li> </ul>

<b><i>Tsunami Emergency Response (including evacuation) (Continued...)</i></b>	
<b>Strengths (Continued...):</b>	<b>Opportunities for Improvement (Continued...):</b>
<ul style="list-style-type: none"> <li>• RMI, USA, UN arrangements for disaster management are outlined in D12.</li> <li>• US Coast Guard from Honolulu and Guam provide search and rescue support services to the RMI Government, based on requests for assistance (D2).</li> <li>• Various SOPs exist (in draft or accepted form) for departments, organisations and the NEOC.</li> </ul>	<ul style="list-style-type: none"> <li>• (Refer above)</li> </ul>
<b>Recommendations:</b>	
<p><b>16.</b> Implement DRM NAP Actions 3.3.1 to 3.3.4, incorporating tsunami into planning, to improve tsunami emergency preparedness and response in RMI.</p> <p><b>17.</b> In line with DRM NAP Action 3.2.1 and 3.3.3, support development, review or endorsement of NEOC and ministry and private sector emergency response plans and SOPs. Promote sharing and awareness of these procedures.</p> <p><b>18.</b> Incorporate evacuation routes and shelters into future plans for all hazards, including tsunami.</p> <p><b>19.</b> Test disaster preparedness and response plans for both distant and locally generated tsunami, including at a national level and involvement in Pacific tsunami exercises. This is in line with DRM NAP Actions 3.3.4 and 3.5.2.</p> <p><b>20.</b> Strengthen response support to outer islands and preparedness of these communities through consideration in national plans and implementation of DRM NAP Actions 3.5.1 and 3.5.2 (planning, exercising and awareness).</p> <p><b>21.</b> Consider options to improve movement of boats/ships to deep water in the case of a tsunami event. This could potentially involve the expansion of current boat channels and additional boat ramps to improve access to deep water from the lagoons for marine evacuation.</p>	

**5.3.8. Tsunami Hazard, Vulnerability, Risk and Mitigation**

<b>Strengths:</b>	<b>Opportunities for Improvement:</b>
<ul style="list-style-type: none"> <li>• Objectives under NAP have multi-hazard considerations, implementing relevant activities should enhance tsunami warning mechanisms.</li> <li>• Under the current Act (1987, D3) the Ministry of Public Works is responsible for identifying and reducing the dangers associated with land use and construction of structure on vulnerable location. The NDC can then recommend to Cabinet that local land use regulations be overridden to protect public safety.</li> <li>• The Act requires the NDC to identify areas particularly vulnerable to disasters, making recommendations for zoning, building or other land use controls.</li> <li>• Disaster Preparedness Mitigation Assessment completed in 2003 through US Army Pacific.</li> <li>• The new COFA arrangement includes funds disbursed to USAID for mitigation activities in RMI.</li> <li>• Some existing mitigation efforts for storms and surge may assist with tsunamis. For example, sea walls, typhoon resistant structures.</li> <li>• Some high resolution bathymetry exists (refer D5) that has multi-use potential.</li> <li>• An Environmental Vulnerability Index (EVI) Country Profile Review of RMI was completed in 2003 (D9). This included tsunami based on international databases. Tsunami was listed as an area of good environmental resilience.</li> <li>• Preliminary and probabilistic tsunami hazard studies of the Southwest Pacific Nations, including RMI, have been completed by GA.</li> </ul>	<ul style="list-style-type: none"> <li>• International research programmes may lead to better understanding of tsunami risk and behaviour around small atolls.</li> <li>• Hazard and risk assessments including numerical modelling to identify areas at risk thus target disaster risk reduction activities (such as tsunami signage which will not be implemented until the risk is better understood).</li> <li>• Certain critical infrastructure and lifeline support facilities are identified in Disaster Preparedness and Mitigation Assessment (2003) by US Army Pacific. Opportunity to be updated and considered in future plans.</li> <li>• DRM NAP Action 6.2.2 aims to map high risk coastal areas, including critical facilities, evacuation areas, shelters, power generation and transmission etc. This could include tsunamis.</li> <li>• Liaising with NOAA to obtain bathymetry mapping.</li> <li>• NAP Goals 6 (Sustainable development of the coastal area) and 8 (linking zoning and building codes to vulnerability to disasters) will specifically address land use issues to reduce vulnerability to all known hazards, including development of new building codes accompanied by public awareness of benefits. Difficult due to costs and limited land availability.</li> <li>• The lack of good topographical and bathymetric data has meant that no tsunami inundation studies have been completed.</li> <li>• Need to inventory data that is available in RMI with the respective Government Ministries and Agencies.</li> </ul>
<b>Recommendations:</b>	
<p><b>22.</b> In line with DRM NAP Action 6.2.2, develop a tsunami risk profile for RMI based on tsunami hazard studies completed for the Southwest Pacific Nations to date, tsunami numerical deep ocean modelling carried out by international agencies, research of previous inundation events and GIS data (existing bathymetry and topography). Feed this into DRM NAP Action 6.2.3 to assess coastal hazard and vulnerability.</p> <p><b>23.</b> With international partners, conduct an inventory of available bathymetry and topography data (including that held by internal Government Ministries and Agencies) for RMI. If data is sufficient, conduct tsunami hazard and risk assessments using numerical inundation models of key population and infrastructure areas based on high resolution near-shore and lagoon bathymetric and topographic data noting the unique seabed topography of coral atolls.</p>	



***Tsunami Hazard, Vulnerability, Risk and Mitigation (Continued...)*****Recommendations (Continued...)**

- 24.** Review national zoning and building codes based on hazard and risk maps produced in line with DRM NAP Goal 8.
- 25.** To facilitate planning and response, establish a national database to allow storage of and access to DRM information for RMI including:
  - Post disaster assessments based on environmental, social, economic and physical impacts with respect to tsunami, typhoons and other disasters.
  - Emergency response resources as outlined in DRM NAP Action 3.3.1.
  - Critical infrastructure and lifeline support facilities.
  - Integration with existing MapServer.
- 26.** Through implementation of the Actions under DRM NAP Objectives 6 and 8, consider actions to limit near-shore activities to safeguard and protect the environment, including the preservation of outlying reefs, which may mitigate the impact of tsunami.

**5.3.9. Knowledge, Information, Public and Stakeholder Awareness and Education**

<b>Strengths:</b>	<b>Opportunities for Improvement:</b>
<p><b>Public Awareness</b></p> <ul style="list-style-type: none"> <li>• Some experience with sea inundation during surge events and general awareness of tsunami due to international media coverage.</li> <li>• Success in developing hazard awareness in relation to drought through the public education system.</li> <li>• Story telling about the sea, ocean navigation, typhoons, heat waves, protecting crops as well as some discussion in schools. Also covered in traditional songs, dance and crafts. Could be further enhanced to build resilience through DRM NAP Goal 7.</li> </ul> <p><b>Training and Capacity Building</b></p> <ul style="list-style-type: none"> <li>• NEMCO plays a key role in training and education for DRM.</li> <li>• Mayors, Church leaders, land owners, NGOs etc do consult with communities about risk avoidance including drought, storm surge etc.</li> <li>• Bachelor of Science in Meteorology is a five year program at the University of Hawaii. Arrangement between RMI Government and NOAA National Weather Service.</li> </ul>	<p><b>Public Awareness</b></p> <ul style="list-style-type: none"> <li>• Presently no community education/preparedness programs for tsunami and tsunami is not included in school curricula. These are planned as part of the DRM NAP but funding is required.</li> <li>• Existing international and regional public education programs and resources (NOAA, Bureau, SOPAC, International Tsunami Information Center (ITIC)) could be adapted for RMI.</li> <li>• Perception that tsunami cancellations are false alarms.</li> <li>• Would like to use local community meetings, brochures, school visits / lessons learned, tsunami exercises involving communities, a regular NEMCO coordinated radio program.</li> </ul> <p><b>Training and Capacity Building</b></p> <ul style="list-style-type: none"> <li>• Training and capacity building requirements have been identified through the DRM NAP process but need resources (and in some cases technical expertise) to be implemented.</li> <li>• No media training programs are currently in place in relation to tsunami. NEMCO/CSO has provided some general awareness to the media on the best way to communicate to the public in times of a disaster.</li> <li>• Require assistance dealing with secondary hazards such as the disposal of chemical, medical wastes (HAZMAT) following typhoons etc.</li> </ul>
<b>Recommendations:</b>	
<p>27. Implement DRM NAP Actions 9.1.1 to 9.3.1 to raise awareness of DRM amongst the public by taking a multi-hazard approach that includes tsunami. National agencies to take a lead role in public awareness and education activities at national, local government and community levels, with the support of partners where needed.</p> <p>28. Consult with and provide copies of national disaster arrangements and the DRM NAP to outer island local governments and communities.</p> <p>29. Establish regular DRM educational broadcasts by NEMCO representative on radio V7AB.</p> <p>30. Strengthen community preparedness and response to disasters using applicable public awareness and education materials that have been adapted for RMI and translated into Marshallese.</p> <p>31. Including provision of training to the media on the tsunami warning system, how they will receive information and how this information should be communicated to the public. This training program could be delivered in a multi-hazard context.</p> <p>32. Include tsunami in an all hazards approach to integrating DRM in the school curriculum as per DRM NAP Action 9.3.1.</p>	

***Knowledge, Information, Public and Stakeholder Awareness and Education (Continued...)*****Recommendations (Continued...):**

- 33.** Raise awareness of tsunami warning products and response actions that must be taken for each message type amongst stakeholders and public. This is also relevant across other hazards as per DRM NAP 3.4.1.
- 34.** Commission a study to identify traditional knowledge and its application in DRM (including tsunami) as per DRM NAP Action 1.4.3.
- 35.** Develop and deliver a tsunami competency based training program to staff responsible for issuing tsunami warnings for RMI. This training should be developed based on operational SOPs.
- 36.** Complete of a training needs analysis and development of a national training framework for DRM in RMI (including a training database to track progress) in line with DRM NAP Objectives 1.3.2 and 1.3.3. Tsunami should be included in this multi-hazard training approach.

## 5.4. Additional Workshop Benefits

In addition to this report, additional benefits of the Tsunami Capacity Assessment Workshop in RMI were:

- Facilitation of working relationships between agencies and organisations involved in tsunami warning and mitigation within RMI;
- Exchange of information on national activities and capabilities within RMI; and
- Enhanced working relationships between RMI participants, the Bureau, Australian Tasmania State Emergency Services, SOPAC and the IOC.

## 5.5. Next Steps

RMI will receive three key material outcomes from the Tsunami Capacity Assessment project:

1. The completed questionnaire in electronic format with scanned copies of all supporting documentation collected in-country;
2. A comprehensive National Report in a standard format which aims to summaries information collected from the visits and is consumable for non-technically minded recipients (this document); and
3. A copy of the final regional Report which will outline common themes across the region.

At the agreement of the country, project results will be posted on the Bureau website and on Pacific Disaster Net.

Once approved by the country the Bureau will facilitate dissemination of reports to regional and international donors and other stakeholders to ensure maximum exposure of results. 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 to facilitate further capacity development projects being undertaken based on the results of this project.

RMI workshop participants are encouraged to use this National Tsunami Capacity Assessment report to guide both national projects and aid funded projects to achieve targeted improvements of RMI tsunami warning and mitigation system. In turn, this will assist in improving systems for other natural hazards.



Section

6

## 6. Annexure



## 6. Annexure

### 6.1. Annexure 1 – Record of Contacts

Organisation	Position	First Name	Last Name	Phone	Email
Public Safety	Police Commissioner	Mr. George	Lanwi		<a href="mailto:glanwi@natmar.net">glanwi@natmar.net</a>
Ministry of Internal Affairs	Secretary	Mr. Wilbur	Heine	625-8718	<a href="mailto:wilburheine@yahoo.com">wilburheine@yahoo.com</a>
Public Service Commission	Chairman	Mr. Cent	Langidrik		<a href="mailto:pscrmi@ntamar.net">pscrmi@ntamar.net</a>
Ministry of Education	Secretary	Ms. Biram	Stege		<a href="mailto:secmoe@ntamar.net">secmoe@ntamar.net</a>
Ministry of Public Works	Secretary	Mr. Smith	Ysawa		<a href="mailto:sysawa@hotmail.com">sysawa@hotmail.com</a>
Ministry of Foreign Affairs	Secretary	Mr. Kino S	Kabua		<a href="mailto:Kino.kabua@ntamar.net">Kino.kabua@ntamar.net</a>
Office of Environmental Planning and Policy Coordination	Director	Mr. Yumiko	Crisotomo		<a href="mailto:Yumiko.cristotomo@gmail.com">Yumiko.cristotomo@gmail.com</a>

Organisation	Position	First Name	Last Name	Phone	Email
RMI Environmental Protection Authority	General Manager	Mr. John	Bungitak		<a href="mailto:eparmi@ntamar.net">eparmi@ntamar.net</a>
Ministry of Finance	Secretary of Finance	Mr. Jefferson	Barton	625-7420	<a href="mailto:jbarton@ntamar.net">jbarton@ntamar.net</a> , <a href="mailto:secfin@ntamar.net">secfin@ntamar.net</a>
Office of the President	Chief Secretary	Mr. Casten	Nemra		<a href="mailto:cnemra@ntamar.net">cnemra@ntamar.net</a>
Marshall Islands Marine Resources Authority	Director	Mr. Glen	Joseph		<a href="mailto:gjoseph@mimra.com">gjoseph@mimra.com</a>
Nitjela	Clerk	Mr. Joe	Riklon		<a href="mailto:clerknitijela@gmail.com">clerknitijela@gmail.com</a>
National Telecommunications Authority	General Manager	Mr. Tony	Muller		<a href="mailto:Tony.muller@ntmar.net">Tony.muller@ntmar.net</a>
RMI Ports Authority	Director	Mr. Jack	Chung-Gum		<a href="mailto:rmiports@ntamar.net">rmiports@ntamar.net</a>
RMI Weather Service	Meteorologist In-Charge	Mr. Regginald	White	625-5705 or 3214	<a href="mailto:Reginald.white@noaa.gov">Reginald.white@noaa.gov</a>
Ministry of Resources & Development	Secretary	Mr. Thomas, jnr	Kijiner		<a href="mailto:tkijiner@gmail.com">tkijiner@gmail.com</a>
College of the Marshall Islands	President	Dr. Wilson	Hass		<a href="mailto:wghess@pivot.net">wghess@pivot.net</a>



Organisation	Position	First Name	Last Name	Phone	Email
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Ministry of Health	Secretary	Ms. Justina	Langidrik		<a href="mailto:jusmoh@ntamar.net">jusmoh@ntamar.net</a>
WUITME	President	Ms. Daise	Momotaro		<a href="mailto:Alik_momotaro@yahoo.com">Alik_momotaro@yahoo.com</a>
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Cabinet	Minister in Assistance to President	Ruben R.	Zackhras	692-455-0471	<a href="mailto:rzackhras@gmail.com">rzackhras@gmail.com</a>
Ministry of Research and Development	Chief of Agriculture and Quarantine	Mr. Henry	Capelle	692-4554920	<a href="mailto:capellehenry@gmail.com">capellehenry@gmail.com</a>
Public Safety, Ministry of Internal Affairs	Police Captain	Mr. Remen	Bakol	625-866/3233	
Public Safety, Ministry of Internal Affairs	Captain	Mr. Jacob	Peter	625-8666/ 528-4890	
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Organisation	Position	First Name	Last Name	Phone	Email
Public Safety, Ministry of Internal Affairs	Captain	Morson	Riklon	625-3233/8666	
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Ministry of Health	Office of the Chief Secretary	Antonio	Elui	625-3234	
Kili / Bikini / Esit Local Government	Councilman	Fred	Johnson	325-3177	
National Police	Police Captain	Herson	Aloka	625-8666/3233	<a href="mailto:pscanta@mar.net">pscanta@mar.net</a>
Ministry of Education	Assistant Secretary for AFHR	Richard A.	Bruce	625-5262/5261/6684	<a href="mailto:rbruce@rmimoe.net">rbruce@rmimoe.net</a>
Ministry of Internal Affairs	Director Broadcast	Antari	Elbon	625-8411	<a href="mailto:V7ab@ntamar.net">V7ab@ntamar.net</a>

Organisation	Position	First Name	Last Name	Phone	Email
xxx	xxx	Wallace	Peter	625-8718	<a href="mailto:Wep_61@yahoo.com">Wep_61@yahoo.com</a>
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National Telecommunications Authority	MINTA (Transmission)	Barry	Paul	625-9222	
Ministry of Public Works	Assistant Secretary	Imang	Chong Gum	455-7967	<a href="mailto:Imang57@yahoo.com">Imang57@yahoo.com</a>
RMI Environmental Protection Authority	WQ Monitor Lab Chief	Abraham	Hicking	625-3035	<a href="mailto:ahicking@ntamar.net">ahicking@ntamar.net</a>
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President & Cabinet	IT Officer	Earlie C	Bing	625-3445	<a href="mailto:ecbing@ntamar.net">ecbing@ntamar.net</a>
Air Marshall Islands	Assistant General Manager	Yuri	Maddision	625-4433	<a href="mailto:yurimad@hotmail.com">yurimad@hotmail.com</a>
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Ministry of Internal Affairs	MIMA Pres	Jeimata N.	Kabua	455-5820	
Ministry of Internal Affairs	Assistant Secretary	Peter	Wallace	625-8718	
Directorate of Civil Aviation	Aviation Inspector, Safety	Norman	Splittstoesson	247-3889	
University of the South Pacific	Banner Operator	Noatia	Siofilisi	625-7279	<a href="mailto:Siofilisi_n@usp.ac.fj">Siofilisi_n@usp.ac.fj</a>
Marshall Islands Chamber of Commerce	President	Hirobo	Lokebetang	455-9446	<a href="mailto:mirrooms@ntamar.net">mirrooms@ntamar.net</a>
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Office of the President	Deputy Chief Secretary	Jorelik	Tibon	625-5150	<a href="mailto:jortibon@yahoo.com">jortibon@yahoo.com</a>

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Ministry of Resources and Development	Acting Secretary	Rebecca	Lorennij	625-3206	
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Public Works	Chief Admin	Weiner	Kattil	625-8911	
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University of the South Pacific	Sraff	Hotia	Siofilisi		

## 6.2. Annexure 2 – The Visiting Assessment Team

Team Position	Name	Position within Organisation	Organisation	Contact Details
Natural Hazards Expert	Chris Ryan	Head, National Meteorological & Oceanographic Centre, and Co-Director, Joint Australian Tsunami Warning Centre	Australian Bureau of Meteorology	<a href="mailto:c.ryan@bom.gov.au">c.ryan@bom.gov.au</a> Ph: +61 3 9669 4030 Fax: +61 3 9662 1222
Intergovernmental Oceanographic Commission (IOC)	Masahiro Yamamoto	Senior Advisor, Tsunami Unit	IOC	<a href="mailto:m.yamamoto@unesco.org">m.yamamoto@unesco.org</a> Ph: +33 1 45 68 39 60 Fax: +33 1 45 68 58 10
Trip Logistics Coordinator	Pina Soccio	Administration Officer, Weather Services Branch	Australian Bureau of Meteorology	<a href="mailto:p.soccio@bom.gov.au">p.soccio@bom.gov.au</a> Ph: +61 3 9669 4575 Fax: +61 3 9669 4695
Data Communications Expert	Dennis Herrmann	National Program Manager, Communications	Australian Bureau of Meteorology	<a href="mailto:d.herrmann@bom.gov.au">d.herrmann@bom.gov.au</a> Ph: +61 3 9669 4224 Fax: +61 3 9669 4128
Emergency Management Expert	Andrew Lea	Director, State Emergency Service (Tasmania)	Department of Police and Emergency Management	<a href="mailto:andrew.lea@ses.tas.gov.au">andrew.lea@ses.tas.gov.au</a> Ph: +61 3 623 02702 Fax: +61 3 623 49767
SOPAC Representative	Litea Biukoto	Advisor, Hazard Assessment	Pacific Islands Applied Geoscience Commission	<a href="mailto:litea@sopac.org">litea@sopac.org</a> Ph: +679 338 1377 Fax: +679 337 0040

## 6.3. Annexure 3 – Agenda, Marshall Islands Tsunami Capacity Assessment Workshop

## National Capacity Assessment of Marshall Islands' Tsunami Warning and Mitigation System

## WORKSHOP AGENDA 25 May – 28 May 2009

DAY 1: Monday 25 <sup>th</sup> May 2009				
SESSION 1: OPENING CEREMONY AND INTRODUCTORY PRESENTATIONS				
LOCATION: MARSHALL ISLANDS RESORT HOTEL			CHAIR: Chris Ryan, Visiting Assessment Team	
Time	Item	Questionnaire Reference	Duration	Participation
9.00 – 9.30am	<b>Welcome Address</b> <ul style="list-style-type: none"> <li>Opening Address - Deputy Chief Secretary Jorelik Tibon</li> <li>Welcome – Majuro Mayor Titus Langrine</li> </ul> Chris Ryan – Team Leader, Visiting Assessment Team	NA	0.5hrs	Open
9.30 – 10.00am	<b>Presentation –</b> <ul style="list-style-type: none"> <li>Introduction to the tsunami capacity assessment project.</li> </ul> <b>Presenter:</b> Chris Ryan – Team Leader, Visiting Assessment Team	NA	0.5hrs	Open
10.00 – 10.30am	<b>Opening Morning Tea</b>	NA	0.5hrs	Open
10.30 – 11.00am	<b>Presentation –</b> <ul style="list-style-type: none"> <li>Tsunami science and the tsunami hazard in relation to the Marshall Islands</li> </ul> <b>Presenter:</b> Litea Biukoto - Advisor – Hazard Assessment SOPAC	NA	0.5hrs	Open

Time	Item	Questionnaire Reference	Duration	Participation
11.00 – 12.30pm	<b>Presentations –</b> <ul style="list-style-type: none"> <li><i>Tsunami warning and mitigation systems in the Marshall Islands</i></li> </ul> <i>Presenter: Reginald White, Jorelik Tibon and Clement Capelle</i>	NA	1.5hrs	Open
12.30 – 1.30pm	Lunch	NA	1hr	Open
<b>SESSION 2: ORGANISATIONS, COMMITTEES, LEGISLATION, STRATEGY AND COOPERATION</b>				
<b>LOCATION: MARSHALL ISLANDS RESORT HOTEL</b>		<b>CHAIR: Chris Ryan Team Leader, Visiting Assessment Team</b>		
1.30 – 2.30pm	<b>Focus Groups</b> <ul style="list-style-type: none"> <li><i>Marshall Islands priorities for implementing an effective tsunami warning and mitigation system</i></li> </ul>	Section 4	1hr	Open
2.30 – 3.30pm	<b>Capacity Assessment – Organisations, Committees and Legislation</b>			
	<ul style="list-style-type: none"> <li><i>Organisations involved in tsunami warning and mitigation in the Marshall Islands</i></li> </ul>	Section 2, Part A	1hr	Open
	<ul style="list-style-type: none"> <li><i>Tsunami warning and mitigation coordination committees at National, and village level in the Marshall Islands</i></li> </ul>	Section 2, Part B		
	<ul style="list-style-type: none"> <li><i>Legislation relevant to tsunami warnings and emergency response</i></li> </ul>	Section 2, Part C		
3.30 – 4.00pm	Afternoon tea	NA	0.5hrs	Open
4.00 – 5.00pm	<b>Capacity Assessment – Strategy, International and Regional Cooperation, All Hazards Approach</b>			
	<ul style="list-style-type: none"> <li><i>Disaster risk reduction strategy in the Marshall Islands</i></li> </ul>	Section 2, Part D	1 hr	Open
	<ul style="list-style-type: none"> <li><i>International and Regional cooperation for tsunami warning and mitigation in the Marshall Islands</i></li> </ul>	Section 2, Part E & F		
	<ul style="list-style-type: none"> <li><i>All-hazards approach</i></li> </ul>	Section 2, Part E & F		
5.00pm	<b>CLOSE</b>	Section 3		



**DAY 2: Tuesday 26<sup>th</sup> May 2009****SESSION 3: RESEARCH, MONITORING AND WARNING****LOCATION: MARSHALL ISLANDS RESORT HOTEL****CHAIR: Chris Ryan, Team Leader, Visiting Assessment Team**

Time	Item	Questionnaire Reference	Duration	Participation
9.00 – 9.30am	<b>Opening Presentation:</b> <ul style="list-style-type: none"> <li><i>Tsunami Warnings &amp; Communication</i></li> </ul> <b>Presenter:</b> Dennis Herrmann – Data Comms Expert – Visiting Assessment Team	NA	0.5hrs	Open
9.30 – 11.30am	<b>Capacity Assessment – Research, Monitoring, Warning and Emergency Response</b>			
9.30 – 10.00am	<b>Research and development expertise</b>	Section 5	0.5hr	Open
10.00 – 10.30am	<b>Tsunami monitoring including:</b> <ul style="list-style-type: none"> <li><i>Tsunami monitoring infrastructure (seismic network, sea-level network and utilisation of satellites for data communication)</i></li> <li><i>Case Study – Use of this monitoring infrastructure for the 1 April 2007 Solomon Islands Event</i></li> </ul>	Section 6, Part A, B, C & Case Study – Monitoring Systems	0.5hrs	Open
10.30 - 11.00am	<b>Morning Tea</b>	NA	0.5hrs	Open
11.00 – 1.00pm	<b>Tsunami warning system in the Marshall Islands including:</b> <ul style="list-style-type: none"> <li><i>International communication cooperation</i></li> <li><i>National tsunami warning centre</i></li> <li><i>Receipt of advisories from PTWS</i></li> <li><i>Procedures for dissemination of tsunami warnings Nationally, once received from PTWS</i></li> </ul>	Section 7, Part A, B, C, D, E, F, G, Case Study – Tsunami Advisory Messages and Warnings & Part H	2hrs	Open

Time	Item	Questionnaire Reference	Duration	Participation
	<p><b><i>Tsunami warning system in the RMI <u>continued</u>:</i></b></p> <ul style="list-style-type: none"> <li><i>Issuing warnings for marine vessels, harbours and ports</i></li> <li><i>Case Study – Receipt of international advisories and dissemination of warnings nationally for the [event to be confirmed]</i></li> <li><i>CONCLUSION – Strengths and weaknesses of tsunami warnings</i></li> </ul>	<i>As above</i>	<i>As above</i>	<i>As above</i>
1.00 – 2.00pm	Lunch	NA	0.5hr	Open
<b>SESSION 4: SITE TOURS</b>				
<b>LOCATION: Marshall Islands Weather Service Office &amp; Emergency Operations Center</b>				
2.00 – 5.00pm	<ul style="list-style-type: none"> <li><i>Marshall Islands Weather Service Office</i></li> <li><i>Emergency Operations Center</i></li> </ul>	NA	3.0hrs	Relevant Agencies & Assessment Team

**DAY 3: Wednesday 27<sup>th</sup> May 2009****SESSION 5: TSUNAMI EMERGENCY RESPONSE, MITIGATION AND PREPAREDNESS****LOCATION: MARSHALL ISLANDS RESORT HOTEL****CHAIR: Chris Ryan, Team Leader, Visiting Assessment Team**

Time	Item	Questionnaire Reference	Duration	Participation
9.00 – 9.30am	<b>Opening Presentation:</b> <ul style="list-style-type: none"> <li>Emergency Coordination and Planning, Community Awareness</li> </ul> <b>Presenter:</b> Andrew Lea, State Emergency Service – Tasmania, Australia	NA	0.5hrs	Open
9.30 – 10.30am	<b>Emergency response to tsunami in the Marshall Islands</b> <ul style="list-style-type: none"> <li>Assessing the capacity of the disaster management system in the Marshall Islands and identifying training needs</li> <li>Emergency response and recovery plans</li> <li>Evacuation (including evacuation legislation)</li> </ul>	Section 8, Part A, B & C	1hr	Open
10.30 – 11.00am	<b>Morning Tea</b>	NA	0.5hrs	Open
11.00 – 12.30pm	<b>Emergency response to tsunami in the RMI <u>continued</u>:</b> <ul style="list-style-type: none"> <li>GIS use for emergency response</li> <li>Testing and exercising</li> <li>Consideration of critical infrastructure</li> <li>Tsunami mitigation efforts</li> <li>The role of NGOs in tsunami warning and mitigation</li> <li>Case Study – Preparedness and response for the 1 April 2007 Solomon Islands Event</li> </ul>	Section 8, Part D, E, F, G, H & Case Study – Preparedness and Response	1.5hrs	Open
12.30 – 1.30pm	<b>Lunch</b>	NA	1hr	Open

Time	Item	Questionnaire Reference	Duration	Participation
<b>SESSION 6: TSUNAMI HAZARD, VULNERABILITY, RISK AND COMMUNITY AWARENESS</b>				
1.30 – 5.00pm	<b>Capacity Assessment – Hazard, Vulnerability, Risk and Community Awareness</b>			
1.30 – 2.30pm	<p><b><i>Tsunami hazard, vulnerability and risk studies in the Marshall Islands:</i></b></p> <ul style="list-style-type: none"> <li>• <i>Post tsunami surveys</i></li> <li>• <i>Tsunami hazard, vulnerability and numerical modelling studies</i></li> <li>• <i>Community participation in assessing the tsunami risk</i></li> </ul>	Section 9, Part A, B, C, D, E, F	1hr	Open
2.30 – 3.00pm	<b>Afternoon Tea</b>	NA	0.5hrs	Open
3.00 – 5.00pm	<p><b><i>Public and stakeholder awareness and education regarding tsunami in the Marshall Islands including:</i></b></p> <ul style="list-style-type: none"> <li>• <i>Assessment of public awareness</i></li> <li>• <i>The role of public awareness in understanding warnings and taking action</i></li> <li>• <i>Public awareness and education programs</i></li> <li>• <i>Media education programs</i></li> <li>• <i>Tsunami memorials and museums</i></li> </ul>	Section 10, Part A, B, C, D	2hrs	Open
5.00pm	<b>CLOSE</b>			

**DAY 4: Thursday 28<sup>th</sup> May 2009****SESSION 6: PRESENTATION OF PRELIMINARY ASSESSMENT FINDINGS****LOCATION: MARSHALL ISLANDS RESORT HOTEL****CHAIR: Chris Ryan, Team Leader, Visiting Assessment Team**

Time	Item	Questionnaire Reference	Duration	Participation
10.00 – 11.00am	<p><b>Preliminary summary presentation</b></p> <ul style="list-style-type: none"> <li>• <i>Marshall Islands strengths, needs, preliminary recommendations, priority review and next steps</i></li> </ul> <p><b>Presenter: Chris Ryan – Team Leader</b></p> <p><b>Questions and Feedback</b></p> <p><i>From the Marshall Islands participants on preliminary summary presentation and the assessment process in general</i></p>	NA	1hr	Open
11.00 - 11.30am	<p><b>ACKNOWLEDGEMENTS AND CLOSE</b></p> <ul style="list-style-type: none"> <li>• <i>Close Workshop:</i></li> <li>• <i>Chris Ryan – Team Leader, Visiting Assessment Team</i></li> <li>• <i>Hon. Ruben R. Zackhras – Minister in Assistance to the President</i></li> </ul> <p><b>MORNING TEA</b></p>	NA	0.5hrs	Open

## 6.4. Annexure 4 – Supporting Documents Log

Ref.	Document Name	Copy Obtained (Y/N)	Format (H = Hard Copy) (E = Electronic)
D1	Republic of Marshall Islands – National Action Plan for Disaster Risk Management (2007)	Y	E
D2	Needs Analysis and Strategic Directions for Meteorological Services in Republic of the Marshall Islands (2000)	Y	E
D3	Disaster Assistance Act (1987)	Y	E
D4	Marshall Islands Hazard Mitigation Plan (1997 Revised Edition)	Y	E
D5	Kruger, J. and Kumar, S. 2008: High-Resolution Bathymetric survey of Majuro, Republic of Marshall Islands. EU EDF 9 – SOPAC Project Report 117. Pacific Islands Applied Geoscience Commission: Suva, Fiji.	Y	E
D6	A Geographical Analysis of Key Social, Environment and Economic Statistics of the Marshall Islands (UNDP and The Marshall Islands Economic Policy, Planning and Statistics Office based on 1999 census information)	Y	E
D7	Marshall Islands National Disaster Management Plan (1997 Revised Edition)	Y	E
D8	Tsunami Capacity Assessment Opening Address, Team Leader, Chris Ryan (2009)	Y	E
D9	Pratt, C.R. and Mitchell, J. 2003. EVI (Environmental Vulnerability Index) Country Profile Review – Marshall Islands. SOPAC Miscellaneous Report 522.	Y	E
D10	Office of the President news item – National Capacity Assessment of the Marshall Islands	Y	E
D11	Spennemann, D. H. R Non-traditional Settlement Patterns and Typhoon Hazard on Contemporary Majuro Atoll, Republic of the Marshall Islands. Environmental Management Vol. 20, No. 3, pp. 337-348.	Y	E
D12	RMI mechanisms for coping with disasters.	Y	E

Ref.	Document Name	Copy Obtained (Y/N)	Format (H = Hard Copy) (E = Electronic)
	Presentation for the Regional Pacific Humanitarian Team (PHT) Workshop Nadi, Fiji (2-4 December 2009)		
D13	Presentation – Development of a Disaster Risk Management NAP, The RMI Experience	Y	E
D14	Presentation – Communications infrastructure in Marshall Islands within a DRM context	Y	E
D15	RMI A Review of Disaster and Mitigation Plan Arrangements (RIS Consulting, 2005)	Y	E
D16	RMI National Action Plan for Disaster Risk Management, Progress Report, February 2009	Y	E
D17	Memorandum to all RMI Ministerial Secretaries re: National Capacity Assessment of the Marshall Islands Tsunami Warning and Mitigation System (25-28 May 2009) plus invitation	Y	E

## 6.5. Annexure 5 – Definitions

### Used in reports for SOPAC Member Countries National Capacity Assessment: Tsunami Warning and Mitigation Systems

Source: United Nations, International Strategy for Disaster Reduction, 2009

#### Capacity

A combination of all the strengths and resources available within a community, society or organization that can reduce the level of risk, or the effects of a disaster.

*Capacity may include physical, institutional, social or economic means as well as skilled personal or collective attributes such as leadership and management. Capacity may also be described as capability.*

#### Capacity building

Efforts aimed to develop human skills or societal infrastructures within a community or organization needed to reduce the level of risk.

*In extended understanding, capacity building also includes development of institutional, financial, political and other resources, such as technology at different levels and sectors of the society.*

#### Disaster

A serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources.

*A disaster is a function of the risk process. It results from the combination of hazards, conditions of vulnerability and insufficient capacity or measures to reduce the potential negative consequences of risk.*

#### Disaster risk management

The systematic process of using administrative decisions, organization, operational skills and capacities to implement policies, strategies and coping capacities of the society and communities to lessen the impacts of natural hazards and related environmental and technological disasters. This comprises all forms of activities, including structural and non-structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse effects of hazards.

#### Disaster risk reduction (disaster reduction)

The reduction of disaster risks and adverse impacts of natural hazards, through systematic efforts to analyse and manage the causes of disasters, including through avoidance of hazards, reduced social and economic vulnerability to hazards, and improved preparedness for adverse events



## Early warning

The provision of timely and effective information, through identified institutions, that allow individuals exposed to a hazard, to take action to avoid or reduce their risk and prepare for effective response.

*Early warning systems include of three primary elements: (i) forecasting of impending events; (ii) processing and dissemination of warnings to political authorities and population; and (iii) undertaking appropriate and timely actions.*

## Emergency management

The organization and management of resources and responsibilities for dealing with all aspects of emergencies, in particularly preparedness, response and rehabilitation. *Emergency management involves plans, structures and arrangements established to engage the normal endeavours of government, voluntary and private agencies in a comprehensive and coordinated way to respond to the whole spectrum of emergency needs. This is also known as disaster management.*

## Geographic information systems (GIS)

Analysis that combine relational databases with spatial interpretation and outputs often in form of maps. A more elaborate definition is that of computer programmes for capturing, storing, checking, integrating, analysing and displaying data about the earth that is spatially referenced.

*Geographical information systems are increasingly being utilised for hazard and vulnerability mapping and analysis, as well as for the application of disaster risk management measures.*

## Hazard

A potentially damaging physical event, phenomenon and/or human activity, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.

*Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydrometeorological and biological) and/or induced by human processes (environmental degradation and technological hazards). Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterised by its location, intensity, frequency and probability.*

## Land-use planning

Branch of physical and socio-economic planning that determines the means and assesses the values or limitations of various options in which land is to be utilized, with the corresponding effects on different segments of the population or interests of a community taken into account in resulting decisions.

*Land-use planning involves studies and mapping, analysis of environmental and hazard data, formulation of alternative land-use decisions and design of a long-range plan for different geographical and administrative scales.*

*Land-use planning can help to mitigate disasters and reduce risks by discouraging high-density settlements and construction of key installations in hazard-prone areas, control of population density and expansion, and in the siting of service routes for transport, power, water, sewage and other critical facilities.*

## Mitigation

Structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards.

### Natural hazards

Natural processes or phenomena occurring in the biosphere that may constitute a damaging event.

*Natural hazards can be classified by origin namely: geological, hydrometeorological or biological. Hazardous events can vary in magnitude or intensity, frequency, duration, area of extent, speed of onset, spatial dispersion and temporal spacing.*

### Preparedness

Activities and measures taken in advance to ensure effective response to the impact of hazards, including the issuance of timely and effective early warnings and the temporary removal of people and property from a threatened location.

### Prevention

Activities to provide outright avoidance of the adverse impact of hazards and means to minimize related environmental, technological and biological disasters.

*Depending on social and technical feasibility and cost/benefit considerations, investing in preventive measures is justified in areas frequently affected by disasters. In the context of public awareness and education, related to disaster risk reduction changing attitudes and behaviour contribute to promoting a "culture of prevention".*

### Public awareness

The processes of informing the general population, increasing levels of consciousness about risks and how people can act to reduce their exposure to hazards. This is particularly important for public officials in fulfilling their responsibilities to save lives and property in the event of a disaster.

*Public awareness activities support changes in behaviour leading towards a culture of prevention. This involves public information, dissemination, education, radio or television broadcasts and the use of printed media, as well as, the establishment of information centres and networks and community and participation actions.*

### Recovery

Decisions and actions taken after a disaster with a view to restoring or improving the pre-disaster living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce disaster risk.

*Recovery (rehabilitation and reconstruction) affords an opportunity to develop and apply disaster risk reduction measures.*

**Relief / response**

The provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short-term, or protracted duration.

**Resilience / resilient**

The capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures.

**Risk**

The probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human induced hazards and vulnerable conditions.

*Conventionally risk is expressed by the notation*

*Risk = Hazards x Vulnerability*

*Some disciplines also include the concept of exposure to refer particularly to the physical aspects of vulnerability.*

*Beyond expressing a possibility of physical harm, it is crucial to recognize that risks are inherent or can be created or exist within social systems. It is important to consider the social contexts in which risks occur and that people therefore do not necessarily share the same perceptions of risk and their underlying causes.*

**Risk assessment/analysis**

A methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that could pose a potential threat or harm to people, property, livelihoods and the environment on which they depend.

*The process of conducting a risk assessment is based on a review of both the technical features of hazards such as their location, intensity, frequency and probability; and also the analysis of the physical, social, economic and environmental dimensions of vulnerability and exposure, while taking particular account of the coping capabilities pertinent to the risk scenarios.*

**Structural / non-structural measures**

Structural measures refer to any physical construction to reduce or avoid possible impacts of hazards, which include engineering measures and construction of hazard-resistant and protective structures and infrastructure.

*Non-structural measures refer to policies, awareness, knowledge development, public commitment, and methods and operating practices, including participatory mechanisms and the provision of information, which can reduce risk and related impacts.*

## **Vulnerability**

A set of conditions and processes resulting from physical, social, economic, and environmental factors, which increase the susceptibility of a community to the impact of hazards.

## 6.6. Annexure 6 – References

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## 6.7. Annexure 7 -Summary of Marshall Islands Communication System

Although interoperability could be improved, basic communication infrastructure is well established in RMI (refer D14 for further details). These systems include:

- Ministry of Health, Education RANET HF system (can be used for all hazards). Voice and data enabled. Single point on each island for access.
- Education and information via PEACESAT (Pan Pacific Education and Communication Experiments by Satellite) Hawaii. Used as communications back-up. Set up in MIR, Hospital, Ebeye, Guam, Federated States of Micronesia (FSM) and Palau. Send and receive.
- Rural Internet Connectivity Systems (RICS) supported by SPC and PIFS
- Satellite phones (mostly Iridium except Internal Affairs who have International Maritime Satellite Communication System (Inmarsat)). Communications back-up for both send and receive mostly voice but some have internet.
- University of the South Pacific (USP) Satellite Network. Intended for educational purposes and is two way.
- EMWIN direct from Geostationary Operational Environmental Satellites (GOES) satellite at WSO. WSO also has a RICS (thanks to BOM) and soon they will have (as well as Palau/Chuuk/Yap/Pohnpei) a Long Range Identification and Tracking system (LRIT). Currently being installed. LRIT works off G.O.E.S and MESat (Japanese) until 2014-2015 when Japan will drop all direct broadcast services causing a problem for many remote sites.
- Aeronautical Fixed Telecommunications Network (AFTN) replaced by a system provided by the USA called Aeronautical Information System Replacement (AISR, internet based)
- Internet (RSS feeds)
- Landlines, Majuro mobile phone system, National Telecommunications Authority (NTA) GSM to remote islands (Jaluit, Rongelap, Wotje, Kili, Ebeye).
- To inform the community FM and AM radio are used (AM only in remote islands), Short Single Band High Frequency Radio (SSB HF), NTA HF channel 8113kHz (calling frequency)
- The public will switch on their radios and listen to V7AB (25,000 watt AM RMI government Radio Station (D2)) for information and advice. This station operates within the National Disaster Plan, and under certain conditions declared by the RMI Government, can go to 24 hour per day operation, such as typhoon conditions.
- Redundant communication links to Majuro WSO.
- Manual mechanisms, such as Police door-to-door knocking and megaphones, can also be used.







## 7. CD Attachment



## 7. Attachment 1 – CD of Supporting Documents

- a. Assessment Questionnaire
- b. Supporting Documents
- c. Presentations

