



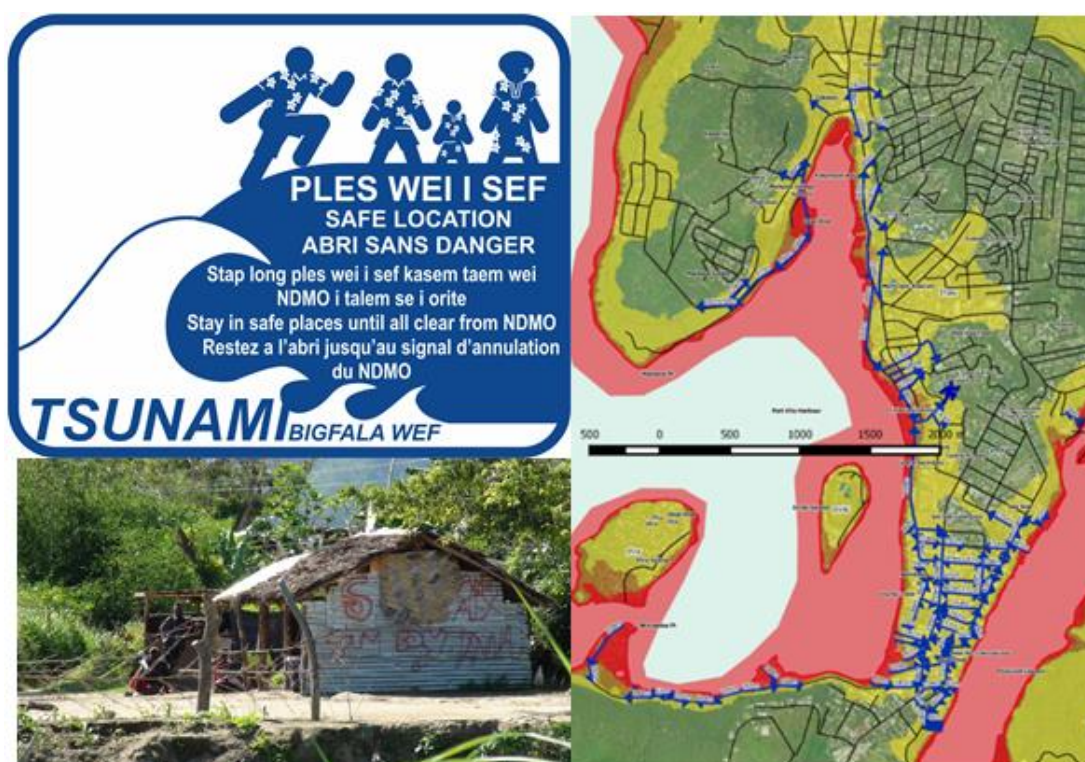
Report

Urban Risk Management Strategy: Risk Mapping and Planning for Urban Preparedness (Contract No. C.06)

Prepared for Vanuatu Meteorological and Geo-hazards Department

Prepared by Beca International Consultants Ltd (Beca), GNS Science and the National Institute of Water and Atmospheric Research (NIWA)

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Executive Summary

1. This Urban Risk Management Strategy (the URMS or the Strategy) provides a response to the hazards, risks and urban growth trends identified for Vanuatu's two urban areas, the greater Port Vila Urban Area and Luganville. It is Stage 3 of the Risk Mapping and Planning for Urban Preparedness Project (the Project) being undertaken by the Vanuatu Meteorology and Geo-Hazards Department (VMGD) as part of the broader Mainstreaming Disaster Risk Reduction Project.
2. The URMS provides risk informed approaches to strengthen the formal physical planning framework and the informal (socio-political) system by incorporating risk information and risk reduction considerations into processes, policies and community activities. The Strategy has been prepared in four separate parts:
 - Part A** – Introduction, the existing situation and the response to risk
 - Part B** – The Institutional Response
 - Part C** – The Community Response including stakeholder participation and communications implementation
 - Part D** – The Costed Action Plan.
3. The URMS responds to the mapping and assessment of earthquake, wind, river flood, coastal inundation and tsunami hazards and risks undertaken during Stage 2 of the Project. The mapping and assessment is contained in the Hazard and Risk Maps and Geo-data Report (dated 8 December 2015) and generally shows that:
 - Some hazards are localised (river flood, coastal inundation): For these the most effective tools are to use risk sensitive Land Use Planning to reduce risk and to encourage development in lower risk areas.
 - Some hazards are widespread (wind, earthquake): For these, use building design (through codes) to reduce risk.
 - Some hazards have warning time (wind, flood, coastal inundation and tsunami): for these, early warning systems allow time to prepare and to evacuate.
4. An analysis of urban growth trends for the Greater Port Vila urban area and Luganville is contained in the *Urban Growth Trends Report* (dated 22 December 2015). The findings have been used to inform the Strategy and assist in identifying and prioritising urban areas requiring risk responses in order to treat potential risk. In particular, in Port Vila the areas experiencing the greatest population growth are located outside the municipal boundaries to the north-west and south-east of the city and some of these areas are subject to high and very high potential risk. In Luganville, the fast growing areas of Solway and Sarakata, as well as areas of existing dense residential settlement are located adjacent to the Sarakata River in areas subject to increased flooding risk.
5. This URMS provides a risk based approach to respond to the identified risks in greater Port Vila and Luganville. The approach is adapted from Dickson et al (2012) and the United Nations Office for Disaster Risk Reduction (UNISDR) Urban Risk Assessment Framework. The approach is centred on: understanding and quantifying the risks; mapping and assessing the risks; responding to the risks to increase resilience; and implementing and monitoring the risks. This Strategy forms the response to the identified risks.
6. Broadly, there are four risk treatment options available to respond to the identified risks:

- Prepare risk sensitive land use plans – this takes the form of changes to the existing land use planning system;
 - Develop risk resistant codes and standards - changes to existing development controls and building standards;
 - Community responses: providing education and resources to communities so that they can act on risks; and
 - Warning systems for certain hazards: to allow people to move away from hazards.
7. The selection of the tools to best address each of the risks depends on the extent to which the particular risk can be managed. For example, the selection of options to address seismic risk recognises that land use planning is of limited application except for two specific areas – where ground is susceptible to liquefaction and areas at risk of debris outflow from slope collapses. Instead, development controls that focus on strengthened new and existing buildings and building to withstand ground shaking are the most effective tools.
 8. Areas where there is potential for heavy or very heavy damage for particular risks require specific attention and need to be addressed on a case-by-case basis. A combination of institutional and community responses may be required depending on the location and nature of the potential risk. Areas in Port Vila and Luganville subject to such risks should be prioritised for community response plans.
 9. The current land use planning framework consists of legislation, national policy, development controls and other instruments. This framework provides a sound foundation to integrate land use planning responses which promote resilience in Vanuatu's urban areas however, the implementation of the existing legislation is weak. The Strategy identifies a number of changes to existing legislation, policy and practices with a focus on improving the tools already available to those making decisions and applying a consistent approach based on sound scientific information and analysis. In addition, measures to enhance performance/implementation of existing controls should be a parallel focus.
 10. Much of resilience springs from the actions of individuals and communities in the face of hazards. By providing the community with relevant information on the hazard (nature, location and frequency) and options for action, community response can be enhanced and community resilience increased.
 11. Existing Education, Information and Communication materials have been reviewed and the metadata has been consolidated into one spreadsheet for future use. The elements of messaging for the four Disaster Risk Reduction phases (being Reduction, Preparedness, Response and Recovery) has been scored and gaps in content have been identified. Key messages have been reviewed for all Project hazards and recommendations made for further work to fill the identified gaps. Comprehensive key messages have been developed for tsunami in this report because of the need to include them in tsunami evacuation maps being rolled out as part of this Project.
 12. The community-based process for rolling out response plans has been summarised, with details developed for tsunami evacuation mapping, including Standard Operating Procedures (SOPs) for the process and for the preparation of maps.
 13. A comprehensive Action Plan is provided in Part D of the Strategy that summarises the further work needed for all parts of this project, including the participation and communications elements, tsunami sign installation, the multi-hazard warning system, supporting implementation of the Urban Risk Management Strategy, and other actions especially extending hazard and risk modelling and assessment.

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Terms and Abbreviations

Abbreviation	Description
CDC	Community Disaster Committee
EIC	Education, Information and Communication
DRR	Disaster Risk Reduction (Reduction, Preparedness, Response and Recovery)
GIS	Geographic Information System. Software designed to capture, store, manipulate, analyse, manage, and present spatial or geographical data (data with a geographic component).
Hazard vs Risk	A hazard is a dangerous phenomenon, substance or human activity that could cause loss of life, injury, property damage, loss of livelihood, or social or economic disruption. Risk only occurs when a hazard is present at a location where there are people or property that are vulnerable to that hazard.
LiDAR	Light Detection and Ranging. A remote sensing method that uses light to measure distance and provides very accurate elevation data.
MDRR	Mainstreaming Disaster Risk Reduction Project. The aim of MDRR is that disaster risk reduction becomes a routine part of national policies, planning processes and decision making at every level and across all sectors.
NAB	National Advisory Board on Climate Change
NGO	Non-Government Organisation
PCRAFI	Pacific Catastrophic Risk Assessment and Financing Initiative.
SOPs	Standard Operating Procedures
URMS	Urban Risk Management Strategy
VMGD	Vanuatu Meteorology and Geo-Hazards Department.

STRATEGY PART A: THE CONTEXT AND APPROACH

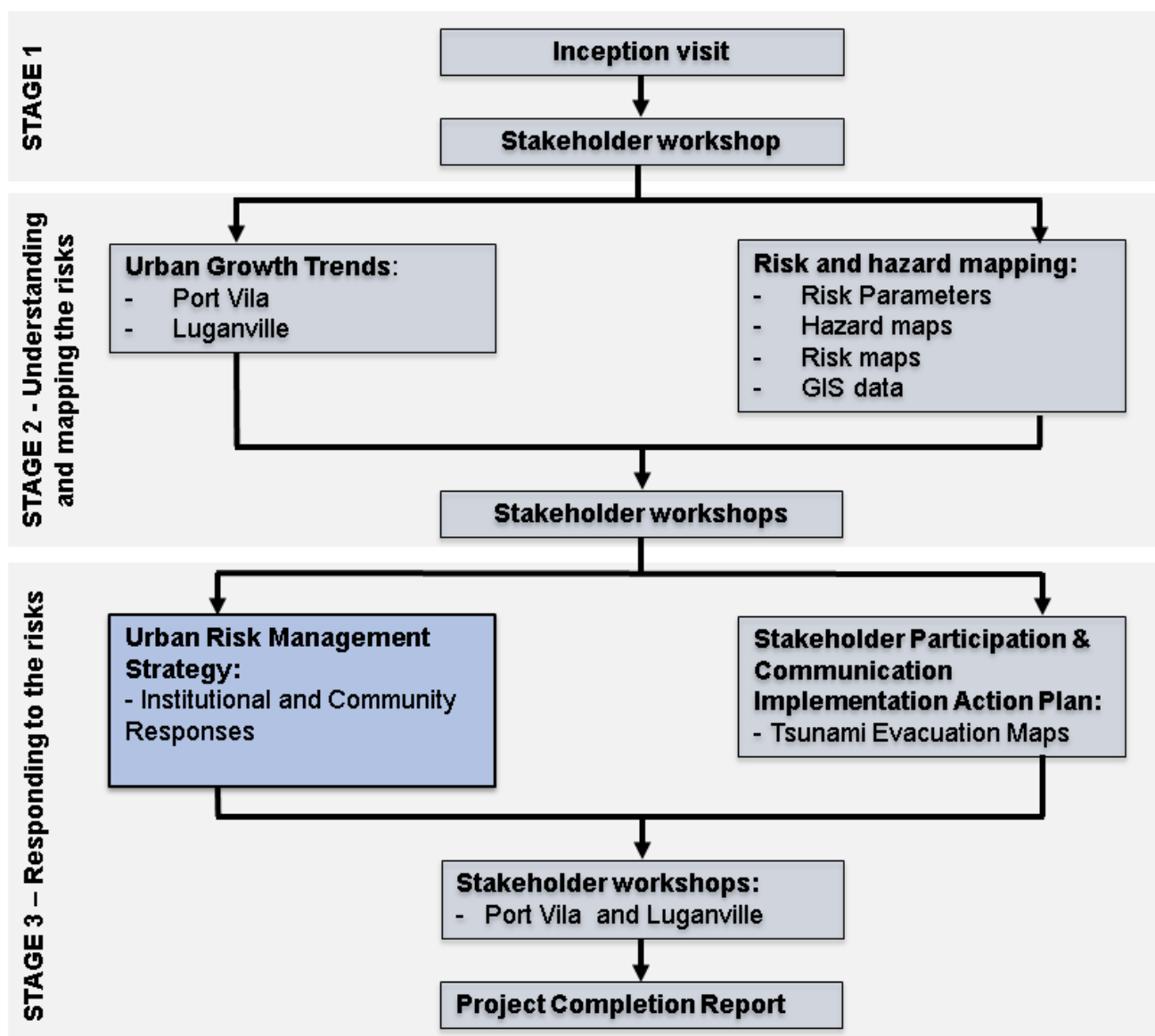
1 Introduction to the Strategy

1.1 The purpose of the Urban Risk Management Strategy

This Urban Risk Management Strategy (the URMS or the Strategy) provides a response to the hazards, risks and urban growth trends identified for Vanuatu's two urban areas, the greater Port Vila Urban Area and Luganville.

The Strategy is Stage 3 of the Risk Mapping and Planning for Urban Preparedness Project (the Project) being undertaken by the Vanuatu Meteorology and Geo-Hazards Department (VMGD) as part of the broader Mainstreaming Disaster Risk Reduction Project. The figure below shows how the Strategy fits into the overall Project.

Figure 1-1: Risk Mapping and Planning for Urban Preparedness Project Components



The purpose of this Strategy is to provide risk informed approaches to strengthen the formal physical planning framework and the informal (socio-political) system by incorporating risk information and risk reduction considerations into processes, policies and community activities. It draws on international risk reduction practice to provide practical measures to assist communities, the Port Vila and Luganville local government and the Vanuatu national government to respond to the risks identified in Stage 2 of the Project.

The Strategy identifies proactive measures to mitigate and manage current and future risks in the most hazard prone areas and vulnerable communities in greater Port Vila and Luganville and sets out an action plan for implementation of these measures (See **Part D – Costed Action Plan**).

The Strategy has been prepared in four separate parts:

Part A Introduction, the existing situation and the response to risk

Part B The Institutional Response

Part C The Community Response including stakeholder participation and communications implementation

Part D The Costed Action Plan

The Strategy has been structured this way to allow parts to be easily separated out and provided to the agency responsible for implementing/overseeing the actions; that is the Department of Local Administration for the Institutional Response actions and the VMGD and the National Disaster Management Office (NDMO) for Community Response actions.

The Strategy uses a number of risk related terms including hazard, risk, return period and risk reduction. These terms are explained in boxes throughout the document using easily understood terminology. The intention is that these terms can be picked up for use in policies and public information.

What is a hazard?

A hazard is a dangerous phenomenon, substance or human activity that could cause loss of life, injury, property damage, loss of livelihood, or social or economic disruption.

What is risk?

Risk occurs when a hazard is present at a location where there are people or property that are vulnerable to that hazard.

There are a number of urban areas around the world that have responded to risks similar to those experienced by greater Port Vila and Luganville. Throughout the Strategy, brief case studies have been included which show how other communities have responded to risks. The case studies provide ideas that may be appropriate for the management of risks in urban areas.

1.2 Mapped Hazards and Risks

Stage 2 of the Project (see Figure 1-1) identified hazards and assessed the risks posed by these hazards. The hazards assessed were:

- seismic (including ground shaking amplification, liquefaction and landslide susceptibility);
- wind
- river flood;

- coastal inundation; and
- tsunami.

The boundaries of the study areas were determined by the available hazard data, most noticeably the extent of the LiDAR data. The area covered by flood hazard modelling was more limited than the other hazard assessments; being confined to the Mele Catchment in Port Vila and the Sarakata River in Luganville. Figure 1-2 and Figure 1-3 show the study areas.

Figure 1-2: Greater Port Vila study area showing the municipal boundary and extent of LiDAR.

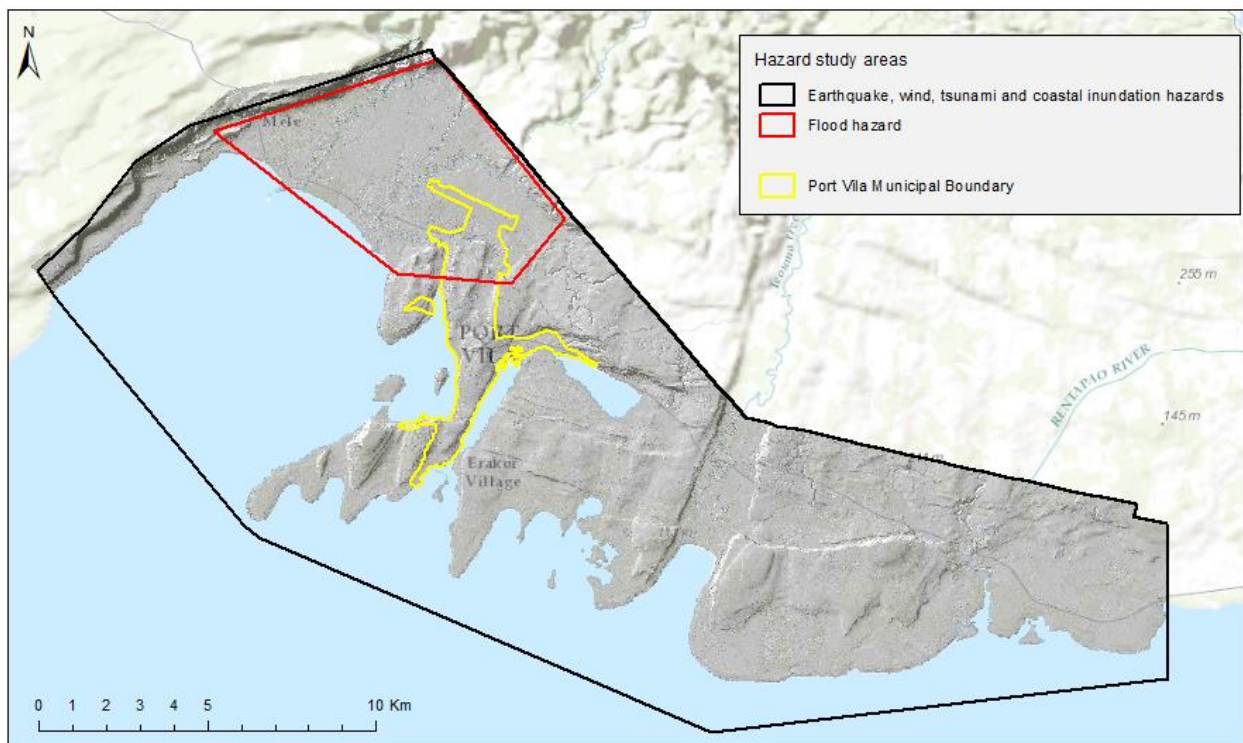
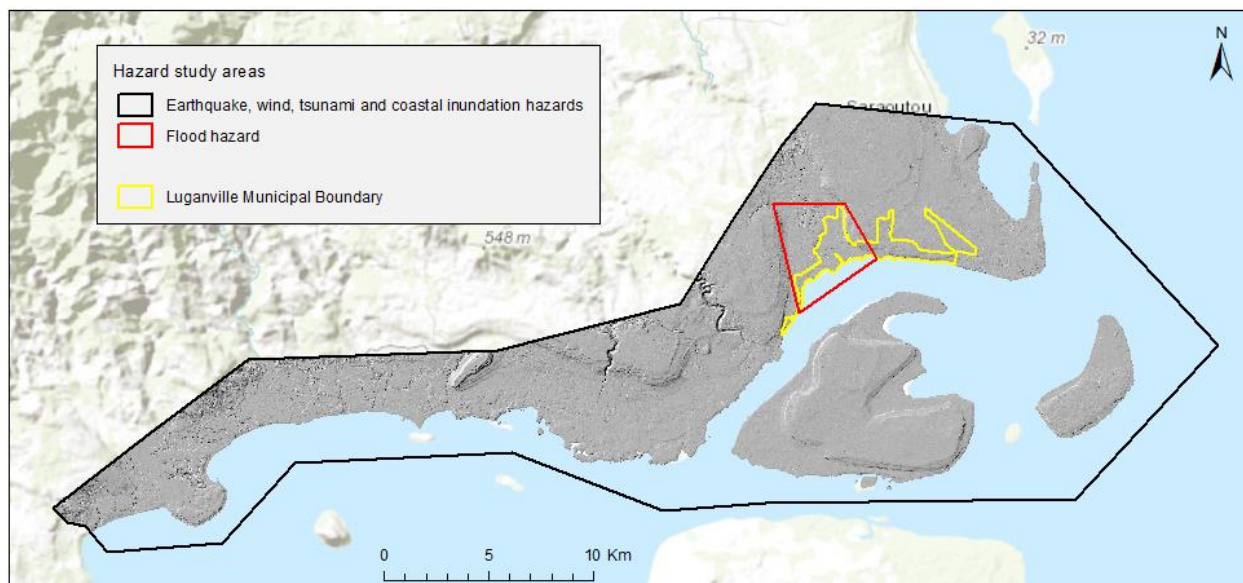


Figure 1-3: Greater Luganville study area showing the municipal boundary and extent of LiDAR



Section 2.1 of this Strategy summaries the risk assessment process and outcomes for greater Port Vila and Luganville. A set of individual hazard and risks maps has been prepared as well as combined risk maps covering the two study areas (See Appendix B and C for the overview plans for each hazard and combined risk). A hard copy of the overview hazard and risk maps as well as a digital set of all the maps has been provided to each of the project stakeholders. All the data that sits behind the maps has been placed on the VMGD server and is available to any government department.

It is anticipated that this data will also be made available to the public in the future in a simplified form to allow individuals to consider and respond to risks.

Action: Make hazard and risk data and maps available across local and national government departments.	Make hard copy and pdf copies of selected hazard and risk data and maps available across local and national government departments to assist with decision making. Prepare summary guidance on how to use the maps.
Action: Make hazard and risk information available to other stakeholders.	Make hazard and risk information available to other stakeholders (eg. developers, non-government organisations, financial institutions and the public) through existing platforms like the National Advisory Board web portal and other mechanisms.

1.3 The key elements of this Strategy

This Strategy draws on the Sendai Framework for Disaster Risk Reduction. This framework was endorsed by the member states at the Third United Nations World Conference on Disaster Risk Reduction in Sendai, Japan, in March 2015. It is the successor instrument to the Hyogo Framework for Action. The goal of the Sendai Framework is to:

“Prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience” (UNISDR 2015).

The framework acknowledges four priorities for action:

- Understanding disaster risk
- Strengthening disaster risk governance to manage disaster risk
- Investing in disaster risk reduction for resilience
- Enhancing disaster preparedness for effective response, and to build back better in recovery, rehabilitation and reconstruction.

This Project aligns with the Sendai Framework goal and has in part fulfilled, or could be used to fulfil, some of the steps required under the priority action areas at a local level. Underpinning this Strategy is the concept of resilience.

Resilience

Resilience is the ability to prepare and plan for, absorb and recover from, and more successfully adapt to adverse events – often more simply put as being able to “bounce back”.

For a community to be resilient, it needs to know what risks and hazards it is exposed to and develop response plans to address those risks and hazards. Resilient communities are those that can adapt, respond and be quick to recover so that they are environmentally, socially and economically sustainable.

The concept of resilience can be used in Vanuatu to guide the development of the country at both a national and local level. For example it can be the cornerstone to investment decision-making in infrastructure and guide an urban settlements policy. This strategy therefore focuses on integrating resilience across statutory and non-statutory mechanisms to address risk.

The key elements of this Strategy are:

Item	Detail	Report reference
A summary of the existing situation	Outlines the existing situation in regard to the planning framework, observed urban development trends (drawing on Urban Growth Trends Report) and the existing risks as mapped in Stage 2 of the Project.	Part A
A framework for responding to Urban Risk	Sets out a risk based framework to respond to risks in greater Port Vila and Luganville including areas of localised heavy and very heavy risk.	Part A
Institutional responses	Sets out institutional responses to address risk including recommendations relating to: • Suggested policies and legislative amendments to improve risk resilience • Changes to the Draft Development Control and Zoning Plan for Port Vila and the Final Development Control and Zoning (Master) Plan for Luganville • Suggested policies and legislative amendments to improve risk resilience • Building codes and other development controls • Non-statutory mechanisms.	Part B
Community responses	Summarises the community responses to address risk in a Draft Stakeholder Participation and Communications Implementation Action Plan including: • A written assessment of current education and communication materials. • A draft set of key messages • A suite of practical communication approaches for each key message and target audience	Part C
Costed Action Plan	Provides a 5 year prioritised and costed work-plan for institutional and community response recommendations.	Part D

The first three sections of this Strategy (being Part A) examine the context for a response to the identified risks. This includes the approach to risk management and the urban risk assessment and urban growth trends for Port Vila and Luganville. The remaining sections of the strategy focus on the institutional and community response to the risks.

The appendices attached to this Strategy are intended to be standalone documents that can be used to assist stakeholders in managing risks. These include:

- A Guidance note for using the hazard and risk maps (**Appendix A**);
- Example risk assessment sheets for Council staff (**Appendix D**);
- Tsunami Evacuation Maps and Signs (SOP 11) (**Appendix G**); and
- Creating tsunami evacuation maps in QGIS (SOP 12) (**Appendix H**).

1.4 Links to maps, Urban Growth Trends and warning activities

This Strategy should be read in conjunction with three other reports that comprise the activities of the MDRR project. These reports are summarised below.

1.4.1 Hazard and Risk Maps and Geo-data Report

A full discussion of the hazards and mapping for the Project is provided in the *Hazard and Risk Maps and Geo-data Report*, dated 8 December 2015. It sets out the assembled the hazards for the Port Vila and Luganville study areas. Maps for the severity of each of these hazards were prepared for various mean return periods ranging from 10 to 2500 years depending on the particular hazard. Following compilation of the hazard data, an urban risk assessment was undertaken and risk maps were produced for each hazard for the various return periods.

A summary of the relevant findings of this report are contained in Section 2.1.

1.4.2 Urban Growth Trends Report

An analysis of urban growth trends for the Greater Port Vila urban area and Luganville can be found in the *Urban Growth Trends Report*, dated 22 December 2015. That analysis examined the historical growth trends, existing urban development, the legislative framework and the key drivers that are directing growth in the urban areas.

A summary of the relevant finding for this Strategy are contained in Section 2.2.

1.4.3 Warning system

The development of a multi-hazard warning system has been documented by VMGD.

1.5 Stakeholder engagement

Development of this Strategy has involved input from several key stakeholders. These included:

- Physical Planning Unit within the Department of Local Administration
- Port Vila Municipal Council
- Shefa Provincial Council
- Luganville Municipal Council

- Sanma Provincial Council
- Financial institutions
- A selection of Non-Government Organisations (NGOs)

The recommendations of the URMS, and particularly the preliminary Action Plan accompanying the Strategy, was discussed with a broader set of key stakeholders at a workshop in Port Vila held on 29 February 2016 and a workshop in Luganville on 2 March 2016.

The recommendations relating to the land use planning system were discussed with staff from the Physical Planning Unit of the Department of Local Administration and the Director General of Internal Affairs.

2 The existing situation

2.1 Urban Risk Assessment for Port Vila and Luganville

Stage 2 of the Risk Mapping and Planning for Urban Preparedness Project assembled the hazards for the Port Vila and Luganville study areas. Maps for the severity of each of these hazards were prepared for various mean return periods ranging from 10 to 2500 years depending on the particular hazard. Following compilation of the hazard data, an urban risk assessment was undertaken and risk maps were produced for each hazard for the various return periods. A full discussion of the hazards and mapping is provided in the *Hazard and Risk Maps and Geo-data Report*, dated 8 December 2015.

What is a return period?

A return period describes the frequency or probability of an event occurring. Large events occur rarely, but smaller events occur much more frequently. It is often the large events that we are concerned about as they can cause proportionally much higher levels of damage. A 1 in 100 year event means that an event of this size or larger occurs on average once every 100 years. This means that there is a 1 in 100 (or 1%) chance in any given year that an event of this size will occur. In land use planning we will generally only plan around larger less frequent events – 1 in 100 or greater.

Analysis of the risk information was undertaken by overlaying the 2009 census and the Pacific Catastrophic Risk Assessment and Financing Initiative (PCRAFI)¹ building databases over the risk maps using Geographic Information Systems (GIS) to determine the exposure within the two study areas.

What is exposure?

Exposure is where people, property or other elements experience a hazard.

The analysis suggests that both urban areas are at risk from earthquake and wind and that a large proportion of the buildings and population are exposed. River flood and coastal inundation are risks that have more limited geographic extents being confined to the river valley and coastal areas. Many of the people and buildings that are exposed to moderate to high levels of risk from the 100 year mean return period flood are also exposed to similar levels of risk from the 10 year mean return period flood.

A multi-risk map has been developed that depicts combined maximum potential risk for seismic, flood, and coastal inundation risk for the 100 year mean return period. Figure 2-1 is an example of a combined maximum potential risk map and shows the 100 year mean return period for earthquake (seismic), wind, river flood and coastal inundation for Port Vila. Tsunami risk is mapped separately due to the difference in return period for this data set.

The multi-risk map indicates the relative risk associated with urban development and settlement in a particular area. The individual 100 year mean return period risk maps need to be referred to in order to understand the source of the risk seen in the multi-risk map. Once the source of the risk is identified, the individual hazard maps can be used to look at the likely severity of hazard expected in an area. If the expected level of hazard

¹ *World Bank, 2011.* PCRAFI developed disaster risk assessment tools to help Pacific countries better understand, model, and assess their exposure to natural disasters. The project included the identification and mapping of buildings to enable risk assessments.

is such that it would prevent the proposed development, thought could be given to the mitigation options that might be available to reduce the impact of the hazard. Mitigation option could include changing the location of the activity within a site, changes to structures (eg. floor levels), or altering how an activity is undertaken on a site. If mitigation is not an option, the hazard maps are useful in determining what other land uses may be more compatible with the expected levels of hazard. The risk and hazard maps for both longer and shorter return periods need to be considered as these provide information on the severity of the hazard event expected for other mean return periods.

Appendix A contains a guidance note explaining how to use the hazard and risk maps. This guidance note has accompanied the maps provided to the key project stakeholders.

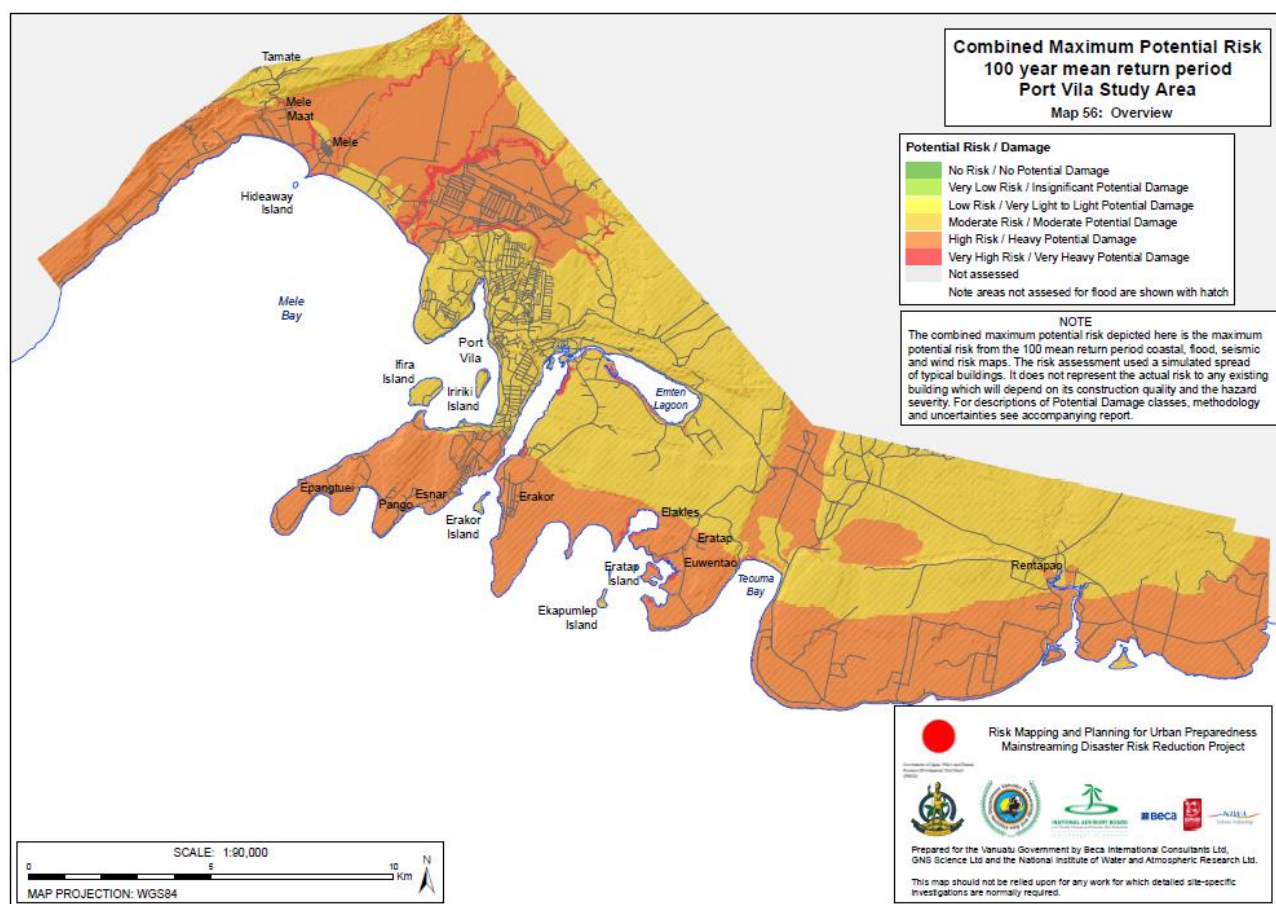
A summary of the risk assessments for Port Vila and Luganville are set out below. The risk assessment comprises two elements, an assessment for buildings (i.e. where buildings are affected) and also a population assessment (i.e. where people are affected). The building assessment is based on the building data collected as part of the PCRAFI study. The population data is based on the 2009 population census. Further discussion of the methodology adopted and the detail of the risk assessments is contained in the *Hazard and Risk Maps and Geo-data Report*, dated 8 December 2015.

The risk assessment for Port Vila and Luganville provides the framework for the URMS that follows.

2.1.1 Greater Port Vila risk assessment

The risk maps for each of the hazards and the combined risk map for Port Vila are contained in **Appendix B**. Figure 2-1 is the combined maximum potential risk map and shows the 100 year mean return period for seismic, wind, river flood and coastal inundation risk for Port Vila.

Figure 2-1: Combined maximum potential risk for Port Vila for the 100 year mean return period



Building assessment

- Of the buildings captured by PCRAFI, 11,650 buildings were used as the basis of the risk analysis for Port Vila. For both **earthquake and wind** more than 80% of buildings in the Port Vila study area are in the Moderate Potential Damage area and about 15% fall into the High Potential Damage area.
- For **river flood** 81% of buildings fall into the Insignificant or Very Light to Light Potential Damage areas, 15% in the Moderate Potential Damage area, and 2% into each of the Heavy and Very Heavy Potential Damage areas.
- For **coastal inundation** 94% of buildings fall into the None, Insignificant or Very Light to Light Potential Damage areas, 5% in the Moderate Potential Damage area, and less than 1% into each of the Heavy and Very Heavy Potential Damage areas.

The buildings assessed for flood hazard in Port Vila were only those in the flood study area and so the number of buildings was fewer (3737). Table 1 uses these buildings and the risk data for the 100 year mean return period and shows that:

- For both **earthquake and wind** more than 80% of buildings in the Port Vila study area are in the Moderate Potential Damage area and about 15% fall into the High Potential Damage area.
- For **river flood** 81% of buildings fall into the Insignificant or Very Light to Light Potential Damage areas, 15% in the Moderate Potential Damage area, and 2% into each of the Heavy and Very Heavy Potential Damage areas.
- For **coastal inundation** 94% of buildings fall into the None, Insignificant or Very Light to Light Potential Damage areas, 5% in the Moderate Potential Damage area, and less than 1% into each of the Heavy and Very Heavy Potential Damage areas.

Table 1: Assessment of potential damage to the existing buildings in the Port Vila study area

	Unknown	None	Insignificant	Very Light - Light	Moderate	Heavy	Very Heavy
Seismic	0	0	0	0	9943 (85%)	1708 (15%)	0
River Flood	7918	0	2445 (65%)	596 (16%)	546 (15%)	80 (2%)	70 (2%)
Wind	0	0	0	0	9536 (82%)	2115 (18%)	0
Coastal Inundation	0	10,863 (93%)	57 (< 1%)	101 (1%)	567 (5%)	98 (< 1%)	21 (< 1%)

Within the table above, the figures relate to the number of buildings and the percentage in the brackets is the percentage that that figure represents of total building in the assessment. For example, for wind, 2115 buildings are in the Heavy potential damage zone and this represents 18% of the buildings assessed.

The potential damage zones are based on the simulated spread of buildings not the actual buildings existing in those areas and therefore the assessment is not a pure risk assessment. It does however indicate the buildings in Port Vila are exposed to potentially Moderate to Heavy levels of damage from earthquake and wind for the 100 year mean return period. Some 800 buildings (approximately 20% of all stock) are in areas prone to river flooding and are exposed to Moderate to Very Heavy levels of potential damage. Approximately 685 buildings (less than 10% of all stock) are in areas prone to coastal inundation and are exposed to Moderate to Very Heavy levels of potential damage.

Table 2 shows the number of buildings in each of the Potential Damage zones for earthquake and wind at the 500 year mean return period and for river flooding for the 10 year mean return period. At the longer return period of 500 years, the Potential Damage from earthquake is significantly higher with more buildings falling

into the Heavy Potential Damage (19%) and Very Heavy Potential Damage (15%) zones. For wind the spread is also different but may reflect the poor quality of the wind model and no further analysis was undertaken. For flood, it can be seen that for the 10 year mean return period the number of buildings exposed to Moderate to Very Heavy levels of potential damage is similar to that for the 100 year mean return period.

The majority of buildings fall outside of the Mele River floodplain which was the focus of the flood modelling. The risk in the areas outside of Mele floodplain is likely to be lower than within the modelled floodplain with the exception of the Teouma floodplain. Within the table, the percentages for flood are calculated using only the buildings within the area of flood modelling (ie. within the Mele catchment).

Table 2: Assessment of potential damage to the existing buildings in the Port Vila study area

	Unknown	None	Insignificant	Very Light - Light	Moderate	Heavy	Very Heavy
Seismic (500 year)	0	0	0	0	7731 (66%)	2214 (19%)	1708 (15%)
Wind (500 year)	0	0	0	0	89 (1%)	11,401 (98%)	16 (1%)
River Flood (10 year)	7918	0	2647 (71%)	567 (15%)	450 (12%)	36 (1%)	35 (1%)

Population assessment

An analysis was undertaken using the 2009 census data using the GPS locations and count of occupants. Using this spread of population and the risk data assembled for the 100 year mean return period (See Table 3) it can be seen that:

- For both **earthquake and wind** approximately 85% of population of the Port Vila study area live in the Moderate Potential Risk area and about 15% live in the High Potential Risk area.
- For **river flood** hazard at the 100 year mean return period, 82% of population within the area assessed for flood risk (ie. not the whole Port Vila study area) live in the Very Low or Low Potential Risk areas, 14% in the Moderate Potential Risk area, and 2% into each of the High and Very High Potential Risk areas.
- For **coastal inundation** hazard at the 100 year mean return period, 97% of population live in the None, Very Low or Low Potential Risk areas, 3% in the Moderate Potential Risk area, and less than 1% in each of the High and Very High Potential Risk areas.

This suggests that the population of the Port Vila study area are exposed to potentially Moderate to High levels of risk from earthquake and wind for the 100 year mean return period. Some 4265 people are in areas prone to river flooding and are exposed to Moderate to Very High levels of potential risk. Approximately 2330 people are in areas prone to coastal inundation and are exposed to Moderate to Very High levels of potential risk.

Table 3: Assessment of potential risk to people in the Port Vila study area

	Unknown	None	Very Low	Low	Moderate	High	Very High
Seismic	0	0	0	0	56,644 (87%)	8620 (13%)	0
River Flood	41,245	0	16,816 (70%)	2998 (12%)	3444 (14%)	368 (2%)	453 (2%)
Wind	0	0	0	0	55,410 (85%)	9583 (15%)	0
Coastal Inundation	0	61,999 (95%)	231 (< 1%)	712 (1%)	2074 (3%)	241 (< 1%)	15 (< 1%)

Table 4 shows the number of people in each of the potential risk and damage zones for earthquake and wind at the 500 year mean return period and for river flooding for the 10 year mean return period. At the longer return period of 500 years, the Potential Risk from earthquake is significantly higher with more people living in High Potential Risk (20%) and Very High Potential Risk (13%) areas. For wind, the spread is also different but may reflect the poor quality of the wind model and no further analysis was under taken. For flood, it can be seen that for the 10 year mean return period the number of people living in areas with Moderate to Very High levels of potential risk is about 75% that for the 100 year mean return period.

Table 4: Assessment of potential risk to people in the Port Vila study area

	Unknown	None	Very Low	Low	Moderate	High	Very High
Seismic (500 year)	0	0	0	0	43,278 (66%)	13,366 (20%)	8620 (13%)
Wind (500 year)	0	0	0	0	856 (1%)	64,040 (98%)	428 (1%)
River Flood (10 year)	2353	0	17,643 (73%)	3323 (14%)	2676 (11%)	208 (1%)	229 (1%)

2.1.2 Areas of Localised Risk in Port Vila

Within the greater Port Vila urban area, there are some locations that are subject to greater risk for particular hazards. These are:

- Mele floodplain – seismic;
- Teouma river floodplain – seismic (and likely also flood but not specifically modelled for river flood);
- River margins in the Mele catchment – river flood. While not modelled, the margins of the Teouma River are also likely to have greater risk;
- Coastal margins and extending inland at rivers mouths and embayments – coastal inundation; and
- All low lying areas and floodplains – tsunami. This includes the Mele flats, Ifira Island, Pango Peninsula, Erakor, Eratap, Teouma Bay and river flats.

In these areas, a specific locational response is required to respond to the High and Very High level of potential risk to buildings and people. Such responses may include informing residents of the potential risks, relocating residents in the worst affected areas, preventing further development in those areas and developing early warning and evacuation response plans. These responses are discussed in further detail in Section 5 and the Stakeholder Participation and Communications Implementation Plan.

2.1.3 Specific Conclusions for Port Vila

For the Port Vila study area at the 100 year mean return period approximately 85% of the buildings and population are exposed to Moderate levels and 15% to High levels of potential risk from earthquake and wind. This compares with approximately 6% of the buildings and population exposed to Moderate to Very High levels of potential risk from coastal inundation.

Comparison of flood with the other hazards is difficult due to the limited extent of the flood modelling. Analysis was only done with the buildings and population within the areas where flood modelling was undertaken. For Port Vila, approximately 19% of the buildings and population in the flood study areas are exposed to Moderate to Very High potential risk at the 100 year mean return period.

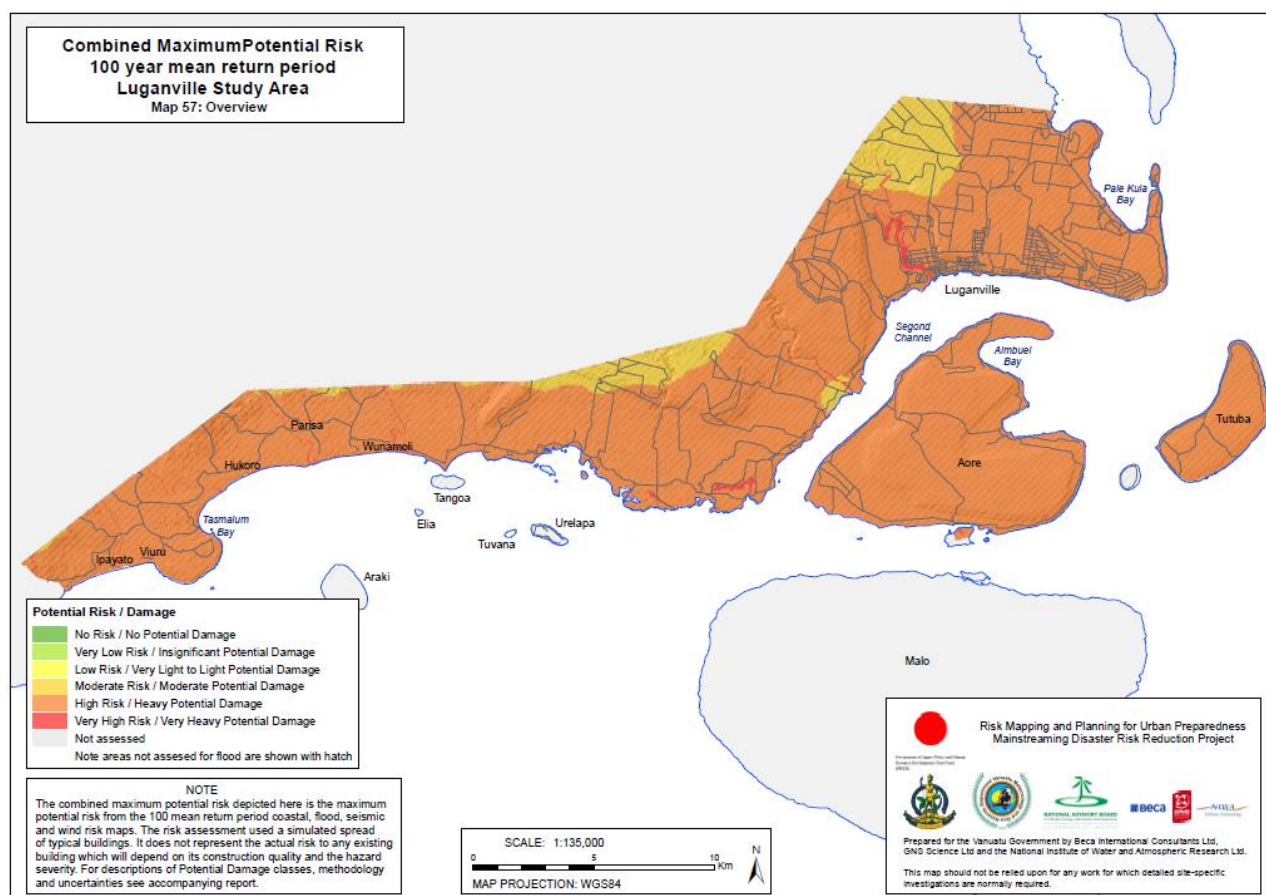
The analysis suggests that most of Port Vila is at risk from earthquake and wind, and that a large proportion of the buildings and population are exposed. Flood and coastal inundation are risks that have more limited geographic extents as the risk is confined to the Mele floodplain and coastal areas.

Multi-risk maps for the 100 year mean return period have been developed that depict the overall level of maximum risk from at least one hazard at that return period. The multi-risk maps indicate the maximum relative risk associated with developing in a particular area. The 100 year mean return period multi-risk map shows the maximum risk from earthquake, wind, flood and coastal inundation. It should be noted that flood risk is available only for the Mele catchment.

2.1.4 Luganville Risk Assessment

The risk maps for each of the hazards and the combined risk map for Luganville are contained in **Appendix C**. Figure 2-2 is the combined maximum potential risk map and shows the 100 year mean return period for coastal, river flood, seismic and wind risk for Luganville.

Figure 2-2: Combined maximum potential risk for Luganville for the 100 year mean return period



Building assessment

The PCRAFI data available for the Luganville study area is very limited. It covers the eastern quarter of the study area ending half way between the Sarakata River and Saint Michel. It does however cover the Luganville Municipal area. The 2009 census data is more complete, covering the entire study area.

Of the buildings captured by PCRAFI, 5145 buildings were used as the basis of the risk analysis for Luganville. The buildings assessed for flood hazard in Luganville were only those in the flood study area and so the number of buildings was less (2792). Table 5 uses these buildings and the risk data for the 100 year mean return period and shows that:

- For **earthquake** 98% of buildings are in the Moderate Potential Damage area and about 2% fall into the High Potential Damage area.
- For **wind** all buildings fall into the Heavy Potential Damage area.
- For **river flood** 74% of buildings fall into the Insignificant or Very Light to Light Potential Damage area, 22% in the Moderate Potential Damage area, 2% into the Heavy and 3% into the Very Heavy Potential Damage area.
- For **coastal inundation** 96% of buildings fall into the None, Insignificant or Very Light to Light Potential Damage area, 3% in the Moderate Potential Damage area, and 1% into each of the Heavy and Very Heavy Potential Damage area.

It must be understood that the Potential Damage zones are based on the simulated spread of buildings not the actual buildings existing in those areas and therefore the assessment is not a pure risk assessment. It does however indicate that most of the buildings in Luganville are exposed to potentially Moderate levels of damage from earthquake and Heavy levels of damage from wind for the 100 year mean return period. Some 730 buildings are in areas prone to river flooding and are exposed to Moderate to Very Heavy levels of potential damage. Approximately 200 buildings are in areas prone to coastal inundation and are exposed to Moderate to Very Heavy levels of potential damage.

The majority of buildings fall outside of the Sarakata River floodplain which was the focus of the flood modelling. The risk in the areas outside of Sarakata floodplain is likely to be lower than within the modelled floodplain with the exception of the extreme west of the study area where there are many rivers floodplains (Wayalo, Mulea, Adson, Maniao etc). In Table 5 the percentages for flood are calculated using only the buildings within the area of flood modelling.

Table 5: Assessment of potential damage to the existing buildings in the Luganville study area

	Unknown	None	Insignificant	Very Light - Light	Moderate	Heavy	Very Heavy
Seismic	0	0	0	0	5066 (98%)	79 (2%)	0
River Flood	2353	0	1588 (57%)	476 (17%)	608 (22%)	44 (2%)	76 (3%)
Wind	0	0	0	0	0	5145 (100%)	0
Coastal Inundation	0	4825 (94%)	53 (1%)	163 (1%)	144 (3%)	50(1%)	10 (< 1%)

Table 6 shows the number of buildings in each of the Potential Damage zones for earthquake and wind at the 500 year mean return period and for river flooding for the 10 year mean return period. At the longer return period of 500 years, the Potential Damage for earthquake is significantly higher with more buildings falling into the Heavy Potential Damage (98%) and Very Heavy Potential Damage (2%) zones. For wind the spread is also different but may reflect the poor quality of the wind model and no further analysis was undertaken. For

flood, it can be seen that for the 10 year mean return period the number of buildings exposed to Moderate to Very Heavy levels of potential damage is roughly half the number for the 100 year mean return period.

Table 6: Assessment of potential damage to the existing buildings in the Luganville study area

	Unknown	None	Insignificant	Very Light - Light	Moderate	Heavy	Very Heavy
Seismic (500 year)	0	0	0	0	0	5066 (98%)	79 (2%)
Wind (500 year)	0	0	0	0	0	2803 (54%)	2342 (46%)
River Flood (10 year)	2353	0	1949 (70%)	447 (16%)	327 (12%)	30 (1%)	42 (2%)

Population assessment

An analysis was undertaken using the 2009 census data using the GPS locations and count of occupants. The census data covers the whole of the Luganville study area and provides a more complete picture than does the building data.

Using this spread of population and the risk data assembled for the 100 year mean return period (Table 7) it can be seen that:

- For **earthquake** almost all of the population (99%) of the Luganville study area live in the Moderate Potential Risk area and 1% live in the High Potential Risk area.
- For **wind**, it is the opposite with 99% of the population living in in the High Potential Risk area and 1% living in the Moderate Potential Risk area.
- For **river flood** 75% of population within the area assessed for flood risk (ie. not the whole Port Vila study area live in the Very Low or Low Potential Risk areas, 21% in the Moderate Potential Risk area, and 2% into each of the High and Very High Potential Risk areas.
- For **coastal inundation** 97% of population live in the None, Very Low or Low Potential Risk areas, 3% in the Moderate Potential Risk area, and less than 1% in the High Potential Risk area.

This suggests that the population of the Luganville study area are exposed to potentially Moderate levels of risk from earthquake and High levels of risk from wind for the 100 year mean return period. Some 1810 people are in areas prone to river flooding and are exposed to Moderate to Very High levels of potential risk. Approximately 590 people are in areas prone to coastal inundation and are exposed to Moderate to High levels of potential risk.

Table 7: Assessment of potential risk to people in the Luganville study area

	Unknown	None	Very Low	Low	Moderate	High	Very High
Seismic	0	0	0	0	19,755 (99%)	258 (1%)	0
River Flood	13,124	0	3960 (54%)	1580 (21%)	1575 (21%)	120 (2%)	116 (2%)
Wind	0	0	0	0	166 (1%)	20,309 (99%)	0

	Unknown	None	Very Low	Low	Moderate	High	Very High
Coastal Inundation	0	19,261 (96%)	83 (< 1%)	77 (< 1%)	529 (3%)	63 (<1%)	0

Table 8 shows the number of people in each of the Potential Risk zones for earthquake and wind at the 500 year mean return period and for river flooding for the 10 year mean return period. At the longer return period of 500 years, the Potential Risk from earthquake is significantly higher with almost all the population living in High Potential Risk areas. For wind the spread is also different but may reflect the poor quality of the wind model and no further analysis was undertaken. For flood, it can be seen that for the 10 year mean return period the number of people living in areas with Moderate to Very High levels of potential risk is about a third of that for the 100 year mean return period.

Table 8: Assessment of potential risk to people in the Luganville study area

	Unknown	None	Very Low	Low	Moderate	High	Very High
Seismic (500 year)	0	0	0	0	0	19,841 (99%)	133 (1%)
Wind (500 year)	0	0	0	0	0	11,919 (58%)	8556 (42%)
River Flood (10 year)	13,124	0	5064 (69%)	1369 (19%)	802 (11%)	87 (1%)	29 (< 1%)

2.1.5 Areas of Localised Risk in Luganville

Within Luganville, there are some locations that are subject to greater risk for particular hazards. These are:

- Sarakata floodplain and associated overland flow paths affecting areas of Pepsi, Sarakata and Solway and the western end of the central business district adjacent to the river – River flooding
- Floodplains and areas of softer soils – seismic risks from liquefaction
- Coastal margins and extending inland at rivers mouths and embayments – coastal inundation
- All low lying areas and floodplains. This includes the broader Sarakata floodplain and Pale Kula – Tsunami .

In these areas, a specific locational response is required to respond to the High and Very High level of potential risk to buildings and people. Such responses may include informing residents of the potential risks, relocating residents, preventing further development in those areas and developing early warning and evacuation response plans. These responses are discussed in further detail in Section 3.3 of this Strategy.

2.1.6 Specific Conclusions for Luganville

For the Luganville study area, at the 100 year mean return period approximately 98% of the buildings and population are exposed to Moderate levels and 2% to High levels of potential risk from earthquake. For wind, all buildings and almost the entire population are exposed to a High level of potential risk. This compares with approximately 4% of the buildings and population exposed to Moderate to High levels of potential risk from coastal inundation.

Comparison of flood with the other hazards is difficult due to the limited extent of the flood modelling. Analysis was only done with the buildings and population within the areas where flood modelling was undertaken. For

Luganville, approximately 26% of the buildings and population in the flood study area are exposed to Moderate to Very High potential risk.

The analysis suggests that most of Luganville is at risk from wind, and that a large proportion of the buildings and population are exposed. Earthquake, river flood and coastal inundation are risks that have more limited geographic extents as the risk is confined to the softer soils, the Sarakata river valley and low lying coastal areas. A similar number of the people and buildings alongside the Sarakata River are exposed to Moderate to High levels of risk from both the 100 and 10 year mean return period floods.

Multi-risk maps for the 100 year mean return period have been developed that depict the overall level of maximum risk from at least one hazard at that return period. The multi-risk maps indicate the maximum relative risk associated with developing in a particular area. The 100 year mean return period multi-risk map shows the maximum risk from earthquake, wind, flood and coastal inundation. It should be noted that flood risk is available only for the Mele catchment and part of the Sarakata catchment.

2.2 Urban growth and areas of risk

Stage 2 of the Project included an analysis of urban growth trends for the Greater Port Vila urban area and Luganville. That analysis examined the historical growth trends, existing urban development, the legislative framework and the key drivers that are directing growth in the urban areas. This section summarises the findings of the assessment that will influence the Urban Risk Management Strategy. Further details and discussion can be found in the *Urban Growth Trends Report*, dated 22 December 2015.

The *Urban Risk Assessment and Geo-data Management Report* defines risk as occurring only when a hazard is present at a location where people or property are exposed and vulnerable. Therefore understanding where people and property are currently located and are likely to locate in the future is important in developing a response to risk.

Total risk can be represented quantitatively by this equation:

Total Risk = Hazard x Exposure x Vulnerability, where:

Hazard =	A dangerous phenomenon, substance or human activity that could cause loss of life, injury, property damage, loss of livelihood, or social or economic disruption
Exposure =	People, property or other elements exposed to the hazard
Vulnerability =	the susceptibility of a person, property, or other element to the damaging effects of a hazard

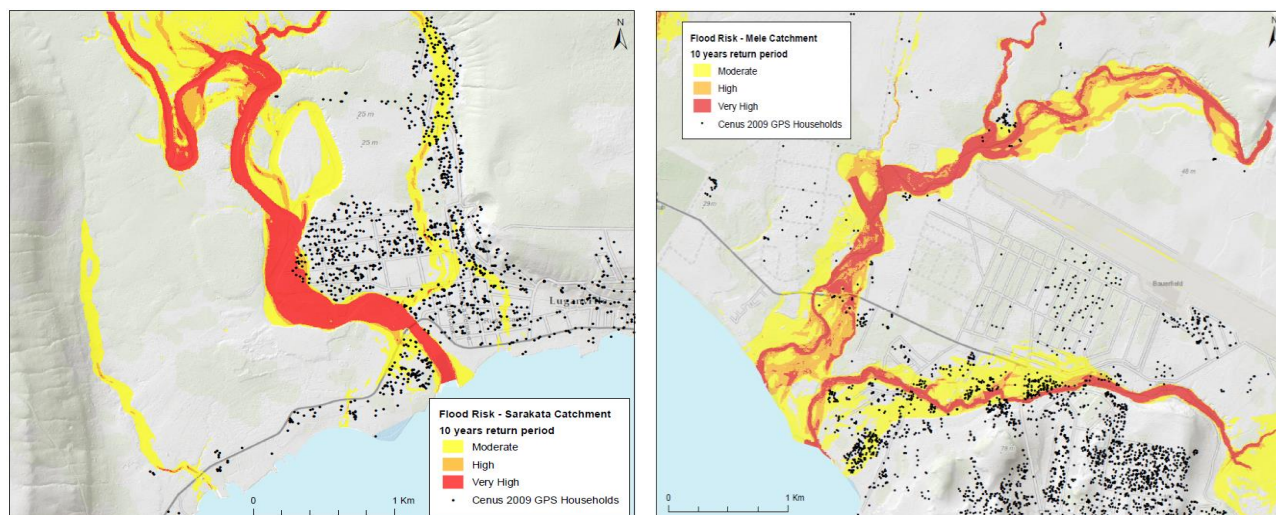
This approach to defining risk is best explained by the following example from the *Urban Risk Assessment and Geo-data Management Report*. If we consider two suburbs with the same severity and frequency of hazard, but one has more people or assets, then the risk in that suburb is greater. If both suburbs have the same population and number of assets but one has a greater vulnerability because of poor building standards, then the risk is greater in that suburb.

The risk maps in Appendix B and C provide a visual representation of the type, location and severity of potential risk to inform the Urban Risk Management Strategy and guide the delivery of institutional, community and locational specific responses. Population growth rate and population density are used to inform the strategy and assist in identifying and prioritising urban areas requiring risk responses in order to treat potential risk.

For example, the risk maps indicate that the Mele area, located west of the Port Vila municipal boundary, is exposed to several natural hazards. This is reflected in the combined risk map, where a moderate to very high potential risk covers most of this area. In addition, the urban growth trends assessment indicates that

population growth rate in this area is generally between 10-30% meaning that people are continuing to move into the area. This is depicted in Figure 2-3 below. Accordingly, this area is one that should be prioritised and addressed by appropriate institutional, community and especially locational specific risk responses recommended as part of this Strategy. The areas alongside the Sarakata River in Luganville are also subject to flooding risk and have existing communities living close to the river and within moderate, high and very high risk areas.

Figure 2-3: Flood risk and population for Sarakata (Luganville) and Mele (Port Vila) catchments



A summary: the fastest growing areas in Port Vila

In Port Vila, growth is occurring predominantly outside the Port Vila municipal boundaries. Population growth is greatest on the northern and eastern periphery of the city and is associated with mainly lower income residential development including some areas of informal settlement. Land development is currently occurring throughout the greater Port Vila area and future growth for Port Vila is expected to continue in an agglomerative and largely ad-hoc manner on land outside the municipal boundary. The areas within the municipal boundary are generally experiencing natural growth whereas the population growth outside the municipal boundaries appears to be largely derived from people moving into the area.

The historic growth trends for Port Vila indicate that the city is growing at a rate of approximately 4% per year meaning the equivalent of 375 new households are required each year to accommodate the growing population. Many of these new dwellings are located on the periphery of the city in areas of high or very high risk such as parts of the Mele Flats and Bauerfield in the north-west and Teouma Road to the south east of the city.

A summary: the fastest growing areas in Luganville

The fastest growing areas of Luganville are located in the more informal areas located alongside the Sarakata River including Sarakata and Solway and the area around the airport including Ban Ban and Pekoa. In Luganville, like Port Vila, development is also occurring outside the municipal boundaries but it does not involve the same numbers. At 2% per year, the average annual growth rate for Luganville is similar to the rural areas of Vanuatu and is therefore likely to result primarily as a result of natural growth rather than internal migration. Even at this lower rate, the equivalent of 54 new households are required each year to accommodate the additional population. The areas of Sarakata and Solway alongside the Sarakata River are among the fastest growing areas in Luganville and parts of these with both formal and informal settlements that are already subject to increased risk of flooding.

Case Study: National Risk Atlas, Mexico

The National System of Civil Protection (Sistema Nacional de Protección Civil, SINAPROC) was established following the devastating Mexico City earthquakes of 1985 to improve Mexico's civil protection capacities. SINAPROC has developed several tools to systematically gather and analyse data and information, such as the National Risk Atlas, an innovative tool that integrates information on hazards, exposure and vulnerability across all three levels of government (federal, state, local). The National Risk Atlas provides a comprehensive national view of all disaster risks, and its Geographic Information System (GIS) architecture provides an excellent visualisation of the spatial relation between hazards, the population and assets at risk (see figure below).



Figure 2-4: The National Risk Atlas

The National Risk Atlas is available for agencies, civil protection authorities and the public to inform disaster risk reduction measures such as land use management, urban development planning and risk mitigation infrastructure. Highly valuable links to the scientific community have been established, which help feed the NRA with data about natural hazards, particularly for earthquakes, floods and tropical cyclones. Government institutions provide detailed input to the National Risk Atlas about population exposure, social vulnerability and exposure of public assets.

Projects like this demonstrate the usefulness of GIS data to generate public awareness of natural hazards and inform disaster risk reduction through land use management, urban development and community responses.

Adapted from Review of the Mexican Civil Protection System (OECD, 2013)

3 The response to urban risk

3.1 A Risk Management Approach

This Strategy provides a risk based approach to respond to the identified risks in greater Port Vila and Luganville.

What is Risk Reduction?

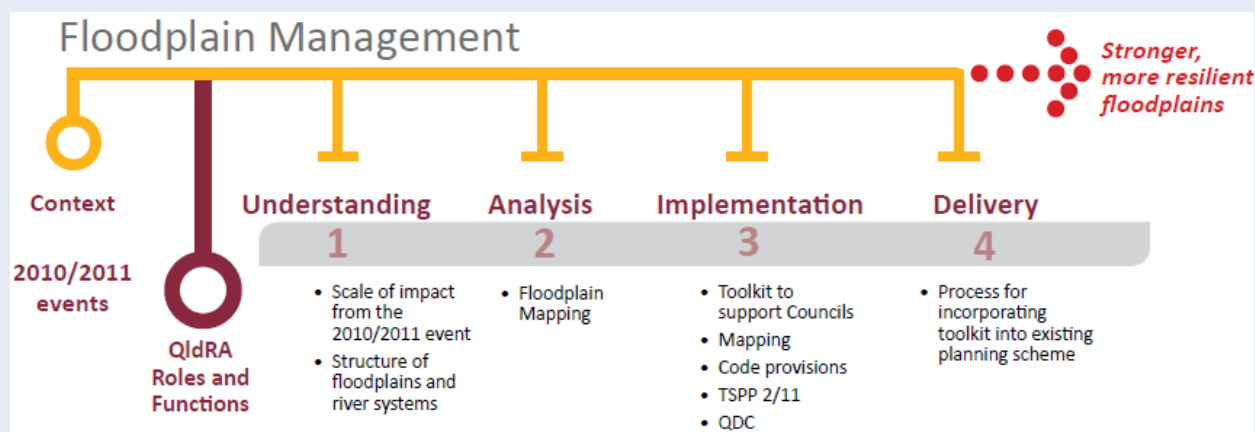
Risk reduction aims to minimise the impact of natural hazards like earthquakes, landslides and hurricanes on disaster-prone communities by doing everything possible before disaster occurs to protect lives, limit damage and strengthen their capacity to bounce back quickly from adversity. A natural hazard only becomes a disaster when it disrupts society's normal functioning. Risk reduction is a framework of elements ranging from early warning of hazards to community self-assessment and action to reduce local vulnerability.

Case Study: Queensland Flood Management Toolkit, Australia

Approximately 26% of the state of Queensland lies within a floodplain. To reduce risks from flooding, state authorities have developed a toolkit to assist planning for stronger communities located within floodplains. The toolkit encourages local government to implement planning mechanisms to address development in floodplain areas through a fit-for-purpose approach on a case-by-case basis.

The toolkit is focused on several themes, including:

- Land use planning
- Building controls
- Coastal management
- Landscape and environment
- Education and information



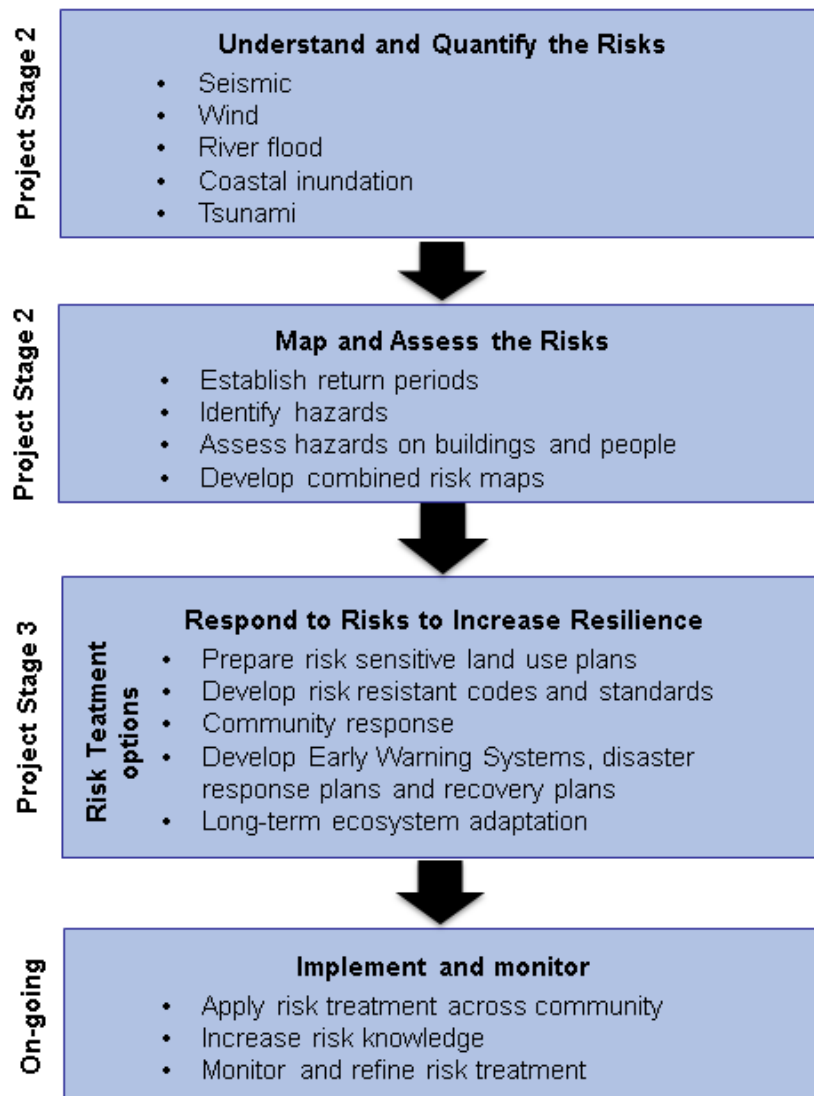
Extract from the toolkit

The implementation of practical, fit-for-purpose solutions has demonstrated the benefit of well-considered strategic planning in achieving better floodplain management and more resilient communities.

(Saunders et al, 2014)

The figure below sets out a risk based management approach to assess and respond to urban risks. This approach is adapted from Dickson et al (2012) and the United Nations Office for Disaster Risk Reduction (UNISDR) Urban Risk Assessment Framework.

Figure 3-1: Addressing Risk for Vanuatu's Urban Areas



In relation to the above figure, Stage 2 of the Project focussed on understanding and quantifying the risks in Port Vila and Luganville and then mapping and assessing those risks (ie. the first two boxes in the above figure). This Strategy forms the response to risks (ie the third box).

Ecosystem adaptation is a long-term response to risk which restores or establishes ecosystems as a risk prevention measure. It involves establishment of healthy well-managed coastal and terrestrial ecosystems such as wetlands, forests, coral reefs and sea grasses which can act as natural infrastructure to buffer against hazards. There are already a number of projects in Vanuatu looking at long term ecosystem adaptation. This tool is not addressed further in this strategy due to the long term nature of the actions and outcomes.

3.2 Risk treatment options and tools

In identifying the risk treatment to best respond to an identified risk, the selection of which of the particular five treatment options set out in box 3 (Respond to risks to increase resilience) in Figure 3-1 is appropriate will depend on the extent to which the particular risk can be managed. There are several options available to treat identified risks as listed in Figure 3-2. In practice, responses often cover more than one option.

Figure 3-2: Risk response treatment

Response	Response explanation and example
Eliminate or avoid the risk	Involves removing the risk such that the probability of the risk occurring or the effect of the risk if it does occur. For example relocation.
Transfer or share the risk	Involves transferring the impact of the risk to a third party. For example insurance.
Mitigate the risk	Involves treating the risk to minimise the impact or probability of the risk occurring. The risk is not eliminated and therefore, some residual risk remains. For example structural interventions to strengthen buildings to resist earthquake shaking.
Accept and manage the risk	Involves tolerating the risk. For example warning systems such as a tsunami warning or tropical cyclone early warning/monitoring systems.

The treatment response for each hazard will depend on the probability of the risk occurring and the impact of the risk. For example, where there is a high probability of a risk occurring and the consequences to life or property are severe, then eliminating or avoiding the risk may be the most appropriate response.

When selecting the most appropriate suite of options for Port Vila and Luganville, the principles set out below have been used to guide option selection and development²:

- Principle 1:** Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.
- Principle 2:** Identify, assess and monitor disaster risks and enhance early warning.
- Principle 3:** Use knowledge, innovation and education to build a culture of safety and resilience at all levels.

² Hyogo Framework for Action (HFA) 2005-2015 adopted in January 2005 by the World Conference on Disaster Reduction held in Kobe, Japan.

Principle 4: Reduce the underlying risk factors.

Principle 5: Strengthen disaster preparedness for effective response at all levels by:

- Integrating Disaster Risk Reduction into policies, planning and longer-term programming
- Targeted risk management and mitigation
- Focussing on building community safety and resilience

Adherence to these principles will result in a package of tools that achieve the greatest impact in regard to risk reduction for Port Vila and Luganville.

The primary options available to address risks in the urban areas can be broadly grouped as follows:

Prepare risk sensitive land use plans - Changes to the existing Land Use Planning system:

These will address future developments only unless more significant intervention, such as relocation of existing development, is anticipated. Retrospective action is often difficult to justify unless there is high and immediate risks to life – for example, moving people from within a major river flood plain or moving a temporary market from beneath a slope which is known to be vulnerable to seismic activity.

Future developments can be undertaken in hazard prone areas provided they are able to be cognizant of the hazard or are not in and of themselves risk sensitive. For example, for an area of land which is liable to moderate flooding, agriculture could still be an acceptable use as could an open space use such as a park or a sports field. Similarly, some forms of development could be undertaken in a flood responsive manner – a warehouse or an industrial use may be acceptable provided the floor level is above the predicted flood level.

Develop risk resistant codes and standards - Changes to existing development controls:

Many of the hazards in Vanuatu can best be addressed by making sure buildings are designed and constructed to meet risk resistant standards. In addition to having these matters covered in a Building Code, consideration needs to be given to the administrative and financial capacity to enforce the standards. In some cases, for example traditional buildings in rural areas or on the fringes of the urban areas, small changes to existing traditional building practices may be able to greatly increase resilience. Effective community based tools could include simple guides explaining what individuals can do to strengthen their homes against common hazards.

Community response:

Much of resilience springs from the actions of individuals and communities in the face of hazards. By providing the community with relevant information on the hazard (nature, location and frequency) and options for action, community response can be enhanced. A good example is a tsunami evacuation and response plan – with the relevant data on expected water levels and likely paths in inundation, the community can select its escape paths and safe havens. Guided selection by the community generally results in more robust engagement by the community and “ownership” of the response plan.

Warning systems for certain hazards:

This is the foundation of the “Readiness” element of Disaster Risk Reduction and is the basis of good response planning. It also allows for a measure of “avoidance” if people can move away from the affected areas or into designated and specifically designed community refuges. An early warning system for cyclones is already in place in Vanuatu. An early warning system for tsunami is currently under development and community response plans form part of this Strategy.

The primary tools for addressing the risks identified in Stage 2 of the Project for Port Vila and Luganville are set out in Table 9. Within the table the primary tool to address the risk is identified as well as supporting tools that can complement the primary tool.

Table 9: Options for addressing identified risks in Port Vila and Luganville

Risk	Land Use Plans	Controls and standards	Community response	Warning systems
Seismic	√	√√	√	
Wind		√√	√	√√
River flood	√√	√	√	√√
Coastal inundation	√√		√	√√
Tsunami	√		√	√√

√√ Primary tool √ Supporting tool available

The selection of options to address seismic risk recognises that land use planning is of limited application except for two limited areas – where ground is susceptible to liquefaction and areas at risk of debris outflow from slope collapses. The individual risk maps identify the locations in Port Vila and Luganville that are subject to these risks. The areas susceptible to liquefaction are fairly extensive whereas areas that could experience slope collapse are confined to steeper terrain.

The primary responses for seismic and wind are the national building standards. There are large areas of hazard across Port Vila (in fact the whole of Efate) and Luganville study areas (refer to the Risk Maps in Appendix A and B).

River Flood, Coastal Inundation and Tsunami risks all have a strongly concentrated geographic expression and are limited in their coverage. This makes them more amenable to a Land Use Planning response which is limited to the affected locations.

Wind, River Flood, Coastal Inundation and Tsunami are also amenable to responses managed via warning systems. For cyclones this is well developed in Vanuatu and the recent experience of Cyclone Pam proved the value of this investment in early warning protocols and preparedness planning operations. River flooding is likewise predictable but relies upon a network of rainfall monitoring stations which Vanuatu currently does not have. Tsunami are monitored internationally and Vanuatu is a recipient of and contributor to this information network. Further work is currently underway in VMGD to enhance the warning systems for tsunami.

What is the risk mapping tell us?

Some hazards are localised (flood, coastal inundation):

For these, the most effective tools are to use risk sensitive Land Use Planning to reduce risk and to encourage development in low risk areas

Some hazards are widespread (wind, earthquake):

For these, the most effective tool is to use building design and construction standards to reduce risk.

Some hazards have warning time (wind, flood, coastal inundation and tsunami):

For these, early warning systems are effective as they allow time to prepare and evacuate.

There is a role for Community Response and Adaptation across all risks however the potential contribution varies. For seismic and wind this would primarily focus on making the public aware of the value of proper construction techniques and standards. The aim should be to explain how this will greatly contribute to resilience at the family and community level. For example if a roof is lost from a structure in a cyclone but the structure remains substantially intact, then a tarpaulin can restore immediate shelter whereas if the structure collapses as part of the roof loss then a new structure is required.

Community response and adaptation can be seen to have a supporting role – for risks where warning systems are in place, community adaptation can be in the form of response plans at both the household and community level. Tsunami evacuation plans are a case example – the science can provide the maps – where is inundated, where the nearest high ground is available but it is best if the community develops their response within the framework provided by a plan template as a standard procedure.

The table below provides a summary of the tools available under each of the response options. This includes both statutory and non-statutory tools which are explored further in the subsequent sections of this Strategy.

Table 10: Toolbox of options

	Response	Possible tools
Institutional responses	Changes to existing land use planning system	Rezone risk prone land
		Regulate development in risk prone areas
	Changes to existing development controls	Building codes and standards
Community responses	Community adaptation	Community risk response plans
		Public awareness campaigns
		Training elected and traditional leaders
		Training for local building contractors
		Guides for retrofitting buildings
		Identifying community safe areas
	Early warning systems for certain hazards	Wind warning
		Flood warning
		Coastal inundation warning
		Tsunami warning

During the November 2015 visit to Port Vila and Luganville, the Project Team conducted several workshops with Project stakeholders. The workshops explored approaches for the Urban Risk Management Strategy based on the existing legislative framework and current risk management practices. These discussions have enabled the development of an Urban Risk Management Strategy that will strengthen the existing functioning frameworks within key institutional and community settings to deliver increased resilience in urban areas.

Based on discussion with stakeholders to date, the following key points have been identified to guide the development of risk responses for the five natural hazards (seismic, river flood, wind, coastal inundation and tsunami):

- **Institutional responses** should integrate with and strengthen the existing legislative framework and policy. This will include addressing:

- Land use management controls, in particular the development of a zoning plans that considers the risk of natural disasters in identified areas;
 - Appropriate implementation of existing development controls and instruments to reduce impact of natural disasters; and
 - Locational specific responses informed by potential risk maps.
- **Community responses** should strengthen existing decision making processes currently followed by provincial councils
 - **Communication** with the community should incorporate simple, graphic explanations with limited words
 - **Existing programmes and projects** should be considered and where appropriate included as part of a coordinated risk response
 - **GIS data**, which will inform the development of risk responses in this strategy, should also be made readily available to relevant government institutions as well as other private and public sectors via appropriate platforms.

Case Study: Community Flood Alert System, Jakarta



In Jakarta there are several large-scale infrastructure projects that aim to protect coastal neighbourhoods from tidal surges and subsequent flooding. Additional risk responses, such as flood alert systems, are developed at the community level and are largely self-organised.

Warnings from upstream floodgates are sent via SMS text message to neighbourhood leaders so they can inform their communities to evacuate low lying areas. These systems, which have evolved out of local necessity, continue to be developed to deliver effective risk reduction.

This case study shows how flood preparedness in the high-risk communities can be achieved through a combination of communities understanding their risks, preparing for disasters, and by improving the early warning of incoming inundation. Community response plans are structures around expected flood levels.

The photo alongside shows a simple colour-coded flood warning pole.

(Dickson et al, 2012)

3.3 Locational specific responses

Some risk responses recommended as part of this Strategy are appropriate for implementation in specific locations. Areas where there is potential for heavy or very heavy damage for particular risks will require specific attention and should be addressed on a case-by-case basis.

A combination of institutional and community responses may be required depending on the location and nature of the potential risk (eg. Mele for tsunami). General responses recommended to increase resilience of urban areas have been outlined in Sections 4 and 5 of this report.

Locational specific responses that may be appropriate include:

- Relocation of existing buildings subject to repeated risk of heavy to very heavy damage;
- Retro-fitting of buildings unable to suitably withstand force of natural disasters;
- Education of community whose existing dwellings lie in high to very high risk zones; and
- Prevention of further inappropriate development, to be guided by updated Zoning Plans.

The *Stakeholder Participation and Communications Implementation Action Plan* sets out a process for the development of community response plans. The process has been focussed on responding to tsunami risk in communities but is just as applicable to areas subject to high risks from other hazards. It is recommended that areas in Port Vila and Luganville subject to such risks are identified and prioritised for community response plans.

STRATEGY PART B: THE INSTITUTIONAL RESPONSE

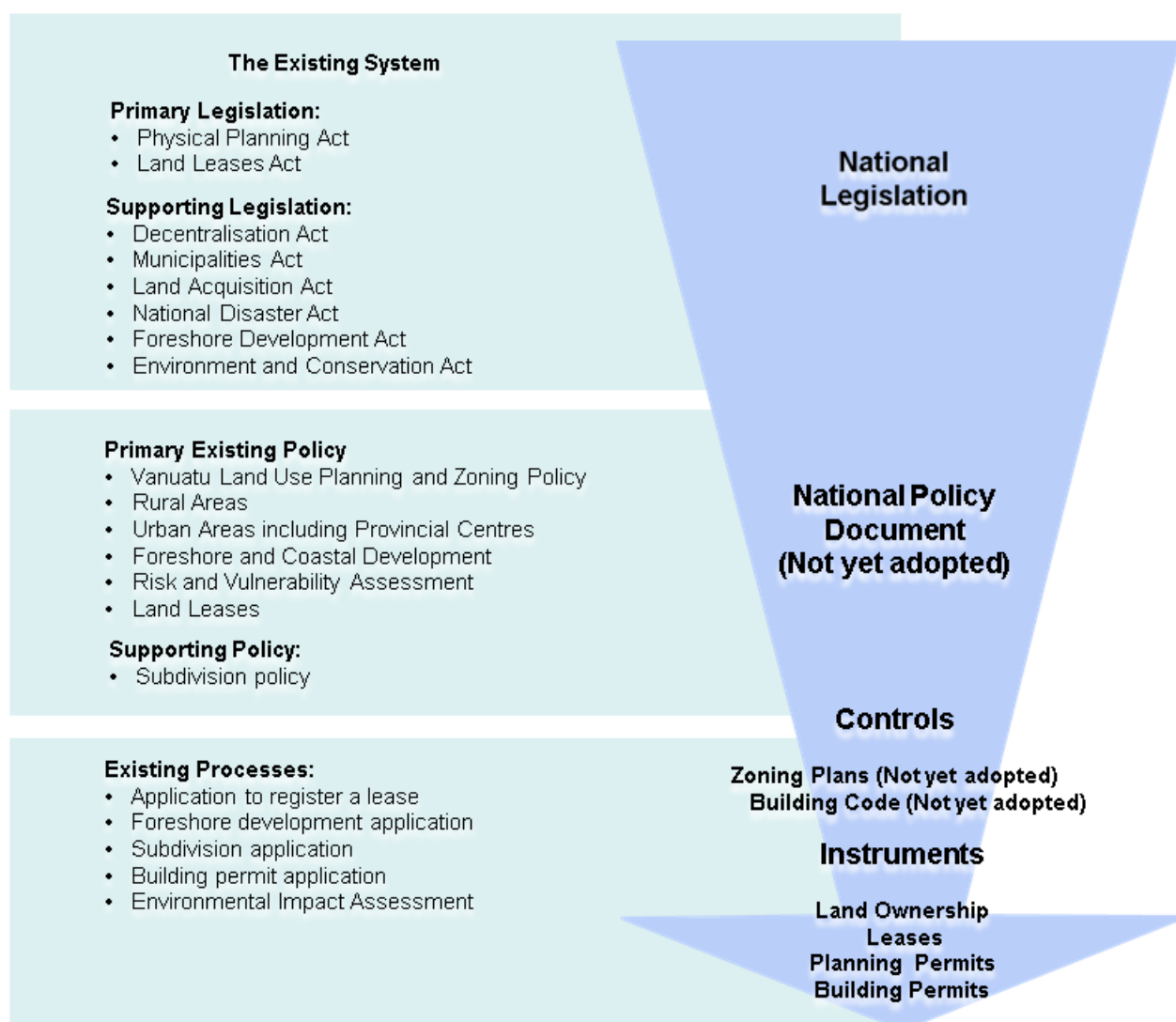
4 The Institutional response

This section sets out the institutional response to risk. This includes recommendations for changes to the existing Land Use Planning system and development controls. The institutional response is primarily reliant on statutory mechanisms to address risk however there are also non-statutory mechanisms that complement this more formal approach including staff training, information dissemination and integrating existing programmes/practices to address risk. The institutional response set out in this section is supported by community response mechanisms set out in Part C: The Community Response of this Strategy.

4.1 The existing land use planning framework

Vanuatu has an existing land use planning framework consisting of legislation, national policy, development controls and other instruments. Discussions with key stakeholders have assisted an understanding of the land use planning framework and its current function within the urban context in Vanuatu. Figure 4-1 depicts the existing formal land use planning system.

Figure 4-1: The existing land use planning framework



The Project team has reviewed the documents set out in Figure 4-1 to determine whether the existing framework provides sufficient of a foundation to integrate land use planning responses that promote resilience in Vanuatu's urban areas. Table 11 provides a summary assessment of the various land use planning mechanisms.

Based on this assessment, the Project Team considers that there is already a substantial framework for an Urban Planning response to hazards, however the implementation of the existing legislation through national policy and development controls is extremely weak. Enacting further legislation will therefore not, in and of itself, lead to a strengthened response. Rather, attention and resources should focus on strengthening the existing mechanisms to give greater consideration to natural hazards based on sound scientific information and analysis. In addition, measures to enhance performance/implementation of existing controls should be a parallel focus. Specific provision has been made for such measures in the Action Plan accompanying the URMS.

Key observation – the legal framework

The problem is not the existing legislation, but its implementation. The solution is to focus on strengthening and implementing what is already in place.

The following sections serve as a more detailed review of the specific existing land use planning documents and recommend changes to strength the existing framework.

Table 11: Summary assessment of primary land use planning mechanisms

Instrument	Status	Mechanisms for implementation	Issues and gaps	Implementation and monitoring
Legislation				
Physical Planning Act	Enacted	Declared Physical Planning Areas. Establishes process for development approvals.	No requirement for zoning plans. No reference to national policy. No specific reference to hazards in identification of Physical Planning Areas or consideration of development applications.	Declared Physical Planning process used but documentation weak Implemented through zoning plans and development applications. Implementation generally weak. Knowledge of Act outside specific areas of Government is weak.
Land Leases Act	Enacted	Implemented through land lease applications.	No specific reference to hazards as part of lease consideration. Establishes the process for lease approvals.	Implemented through the land lease process.
National Policy				
Vanuatu Land Use Planning and Zoning Policy	Draft since May 2012	Currently not formally implemented.	No specific connections back into legislation or implementation mechanisms. No policy direction for urban areas.	Not implemented.
Controls				
Building Code	Draft since 1990	Implemented through the building permit process.	Not formally endorsed. Information in code is extensive and therefore difficult to digest.	Limited monitoring of development approved under the Code. Limited enforcement.
Port Vila zoning plan	Draft, date unknown	Implemented through development applications.	Not formally endorsed. No reference to hazards. Only covers municipal areas. No supporting development controls.	No monitoring or enforcement.
Luganville zoning plan	Draft, date unknown	Implemented through development applications.	Not formally endorsed. Some reference to hazards in identification of zones. No supporting development controls.	No monitoring or enforcement.

4.2 Legislation

The primary legislation for land use planning in Vanuatu is the Physical Planning Act (1987) and the Land Leases Act (1984). This legislation is supported by the Decentralisation Act, Municipalities Act, Land Acquisition Act, National Disaster Act and Foreshore Development Act.

4.2.1 The Physical Planning Act (1987)

The Physical Planning Act (1987) (Consolidated Edition 2006) exists *to provide for controlling the development of land*. Development, as defined in the Act, means *the carrying out of building or other operations in, on, over or under the land or the making of any material change in the use of buildings or land, or the subdivision of any land*.

The purpose of the Act should be broadened to incorporate the concept of resilience.

Development classes

Section 1 of the Act describes different types of development as classes, as set out in Table 12.

Table 12: The twenty-three development classes as described in the Physical Planning Act (Section 1)

Class	Development
1	Retailing any commodity other than those defined in Classes 2, 3, and 4.
2	Retailing hot food.
3	Retailing liquor.
4	Retailing fuel and oil.
5	A wholesale warehouse or repository for any purpose.
6	An office for any purpose.
7	Light industry for any purpose which would not affect the amenities of a residential area.
8	General industry for any purpose which would not seriously affect the amenities of a residential area.
9	Special industry for any purpose which by virtue of the materials used or stored, or the hours of operation would seriously affect the amenities of a residential area.
10	Single household residence.
11	Multiple occupation (more than one household), or as an apartment building.
12	Boarding or guest house, or a hotel providing sleeping accommodation.
13	Residential boarding school or a residential college.
14	School or college.
15	Public worship or religious instruction.
16	Institution providing for the boarding, care and maintenance of children, old people or persons under disability, a convalescent home, a nursing home, a sanatorium or a hospital.
17	Use (other than residentially) as a health centre, a school treatment centre, a clinic, a day nursery or a dispensary, a consulting room, or surgery.
18	Art gallery (other than for business purposes) a museum, a public library or reading room, a public hall or an exhibition hall.
19	Theatre, a cinema, a music hall or a concert hall.
20	Dance hall, a swimming bath, vapour or foam bath or a gymnasium or sports hall.
21	Sports field with ancillary facilities, open space, garden, landscaped area or park.
22	Marina with ancillary facilities excluding accommodation.
23	Any other class that the Minister may by Order prescribe.

The level of detail on development classes in a piece of land use planning legislation is conceptually dated. Such an approach was more common in the 1970s and 80's and is less relevant today.

These development classes do not currently follow through into the draft zoning plans that have been prepared for Port Vila and Luganville. Keeping the development classes and land use zones fairly consistent is advisable. In order to do this the classes could be grouped to result in broad land use zones. This approach is discussed further in relation to the zoning plans in Section 4.4.

Physical Planning Areas

Section 2 of the Act defines Physical Planning Areas as any area declared as such by a provincial or municipal council within its jurisdiction.

Section 3 of the Act requires Council to prepare a plan of an area declared as a Physical Planning Area. Clause 3.3 requires that *the plan shall specify those areas in which the Council is prepared to consider applications for specified kinds of development, and may contain such other information as the Council may see fit.*

Within Port Vila and Luganville the existing Municipal Council jurisdictions is limited to the areas confined by the respective municipal boundaries. Both municipal areas are Declared Physical Planning Areas.

Areas within the Shefa and Sanma provinces have been Declared Physical Planning Areas. The extent of these areas does not appear to be mapped and readily available and therefore the geographical extent of these areas is generally uncertain amongst the stakeholders spoken to by the consultant team.

It is recommended that Section 3 of the Act is amended to provide clear timeframes for the preparation of the plan and require that the plan is displayed at Council offices and Department of Local Administration.

Section 4 of the Act stipulates that *no person shall carry on development in a Physical Planning Area, except as specified in the declaration of that Physical Planning Area, without having first received permission in writing from the Council.*

Action:

Clearly document the existing Declared Physical Planning Areas and extend to include High and Very High Risk areas.

- All existing physical planning areas to be mapped and displayed at Council offices and Department of Local Administration
- All Urban areas of High to Extreme risk to be identified.
- All areas of existing and potential population growth within these areas identified.
- Additional areas identified and progressed to declare them as physical planning areas.
- Determine types of development that needs to be restricted in these areas to respond to risk and feed these into the zoning plan formulation process.

Currently there is no mandate to develop zoning plans and associated development controls for Physical Planning Areas. Neither Port Vila nor Luganville have an adopted plan and zoning plans have not been prepared for the Physical Planning Areas outside the municipal boundaries. Preparation and endorsement of plans to guide the future development of these areas needs to be undertaken as a matter of priority.

A zoning plan and accompanying schedules should be required for all Declared Physical Planning Areas under the Physical Planning Act. It would also assist if the Act specified the following:

- The timeframe for preparing a draft plan;
- A plan having immediate effect once displayed;
- The consultation process for finalising the plan;
- The process for endorsing the Plan;
- A process for amending the Plan; and
- Where the Plan must be displayed (as a minimum at Council offices and the DLA).

In addition, those areas that have been identified as Declared Physical Planning Areas do not appear to be cognisant of population growth or respond to identified areas of High to Extreme risk where development should be controlled. The examination of urban growth trends undertaken as part of Stage 2 of the Project indicates that the areas urban growth for Port Vila and Luganville are located on the periphery of the municipal area. The hazard and risk mapping shows that several of these areas are subject to High to Extreme risk. This means that further development of these areas will place people at greater risk.

The areas of High to Extreme risk for Port Vila and Luganville have been mapped and growth areas identified. These areas should to be incorporated into Declared Physical Planning areas (where they are not already) and a zoning plan prepared for those areas as a matter of priority to control further development in these areas where it cannot adequately respond to natural hazard risk. That mapping indicates that some areas that area experiencing continued growth (for example the Mele Coastal development area) are subject to multiple risks.

Figure 4-2 and Figure 4-3 show the areas of High to Extreme risk and urban growth for Port Vila and Luganville.

Figure 4-2: Areas of Port Vila Exposed to High to Very High potential risk

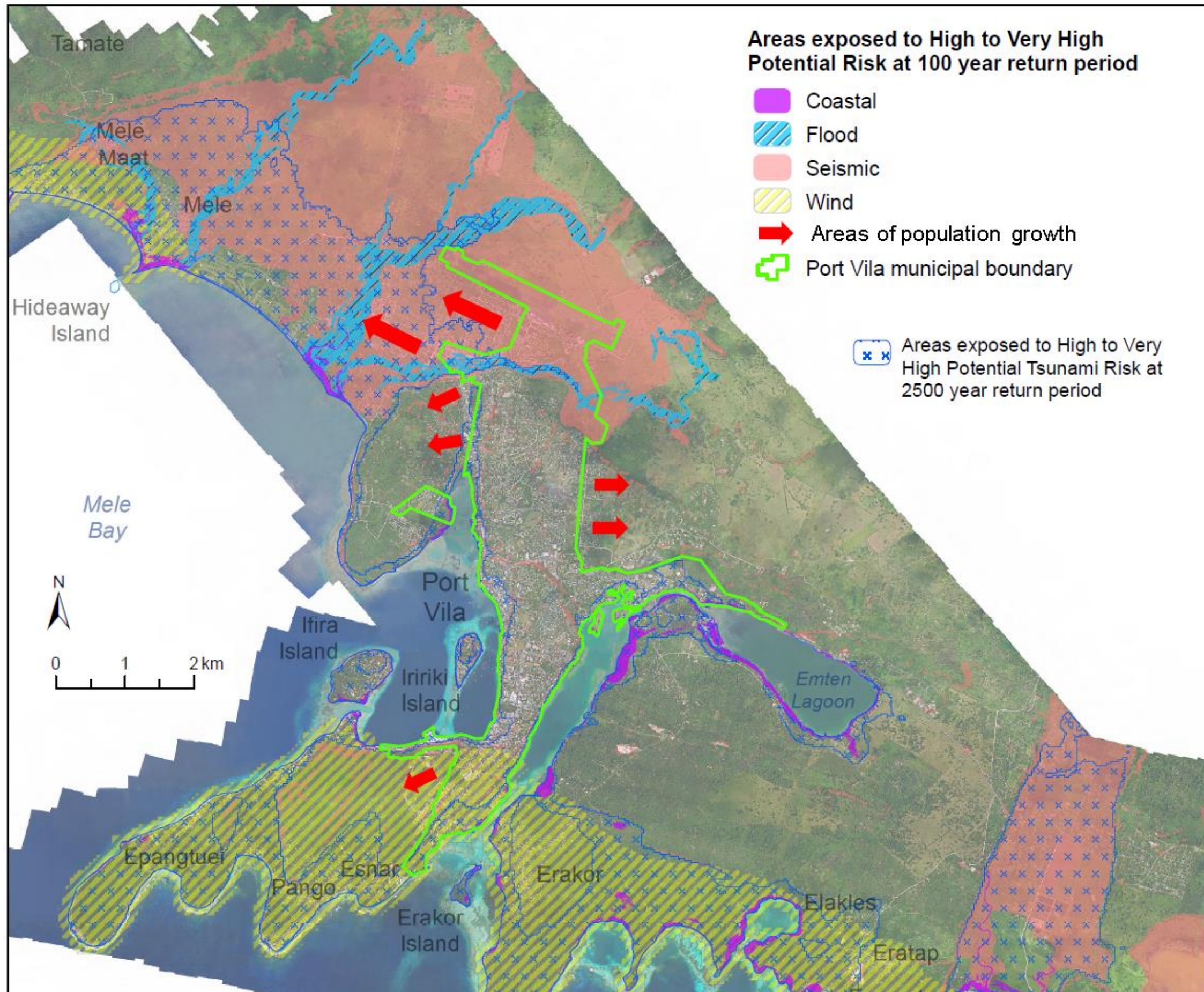
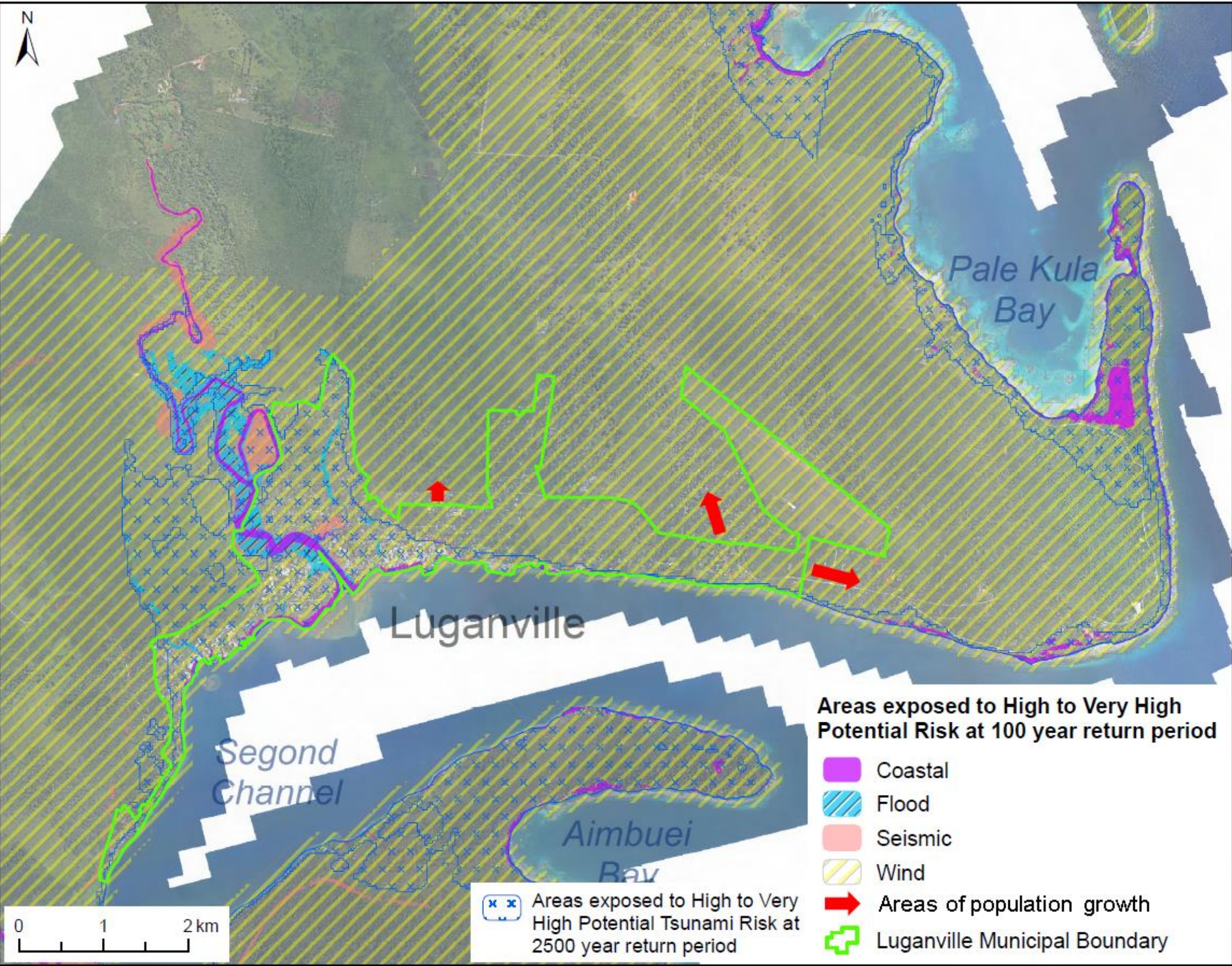


Figure 4-3: Areas of Luganville Exposed to High to Very High potential risk



Section 5 of the Physical Planning Act specifies that an application for development shall be made to the Council in such form and containing such information as the Council may specify. It would assist if the Act contained a schedule setting out the standard information that an application must include. This amendment would serve to standardise applications and ensure comprehensive thought is given to new development and information provided by the applicant is comprehensive and appropriately structured for the consideration of Council staff. Additional information specific to the proposed use would be outlined in a relevant schedule to the Zoning Plan prepared by the Councils.

In light of these recommendations, Schedule 3 to the Act should be consistently applied to ensure that the proper assessment of development applications is enforced within Declared Physical Planning Areas. Further discussion and recommended actions for the development and building permit process is provided in Section 4.6.2.

In addition, the Act needs to establish a clear requirement for the preparation of national policy/policies and assign responsibility for its preparation.

Overall the Physical Planning Act presents an opportunity to strengthen resilience in urban areas as a response to the potential risk of natural hazards. In particular, the first five sections of the Act can be strengthened to support more considered land-use planning responses that prevent inappropriate development in high risk areas. Recommendations for Section 1 to 5 that will elevate resilience to a primary objective of the Act are set out in Table 13.

Action:

Amend the Physical Planning Act

Amend sections 1-5 of the Physical Planning Act to support more considered land-use planning responses that control inappropriate development in high and very high risk areas. In particular:

- Purpose - Broaden to incorporate the concept of resilience.
- Section 1 - Divide and assign the development classes to 7-8 land use zones for use in zoning plans.
- Amend Section 3 - Require that all urban and peri-urban areas characterised as receiving heavy to very heavy potential damage on the 100 year combined risk maps should be declared as Physical Planning Areas.
- Amend Section 3 – Set out a clear process for development of zoning plans include: timeframes, effect upon notification, amendments to plans, consultation process and displaying Plans.
- Amend Section 4 - Development in a physical planning area to require zoning plans and accompanying schedules for all Declared Physical Planning Areas and referencing the risks of land on which development is occurring.
- Amend Section 5 - Include reference to a new Schedule 3 – Standard information required for an application for planning permission.

Table 13: Recommendations to strengthen the Physical Planning Act to achieve resilient urban areas

Reference	Relevant Existing Policy	Recommended amendments
Purpose	To provide for controlling the development of land	Broaden to incorporate the concept of resilience
Section 1- Interpretation	Development Class (also referred to as 'types of development') - see Table 12 in this report	Replace development classes with zones. Assign the 22 classes to approximately 9 land use zones. This could be: 3 residential zones, 2 commercial zones, 2 Industrial zones (light and heavy), 1 community use/facilities zone and 1 open space zone. Amend Section 1 of the Act to require Zoning Plans for all declared Physical Planning Areas.
Section 2 - Physical planning areas	(1) A Council may declare any area within its jurisdiction to be a Physical Planning Area. (2) In making such a declaration a Council (a) shall have due and proper regard for the rules of custom; (b) shall consider the welfare both of the people in the area affected and of the people of Vanuatu generally; (c) shall ensure that persons affected by the proposed declaration have been given adequate notice of it, and that those people are given an opportunity to make representations to the Council. (3) In declaring an area to be a Physical Planning Area, the Council may in its absolute discretion decide that one or more of the types of development specified in Schedule 1 shall not require permission for development, and it shall specify those types of development in the declaration. (4) All declarations shall be published in the Gazette.	All urban areas characterised as receiving heavy to very heavy potential damage on the 100 year combined risk maps should be declared as Physical Planning Areas. This includes those urban areas outside municipal boundaries. This will assist efforts to develop resilient urban areas in Port Vila and Luganville and implement many recommendations of this Strategy. In declaring a Physical Planning Area within Port Vila and Luganville municipal boundaries, Council would be dutifully considering the <i>welfare of the people in the area affected and of the people of Vanuatu generally</i>, as set out in Clause (2)(b). Amend the Act to specifically require that Councils have a responsibility to develop and implement plans so as to avoid exposure to risks from natural hazards.
Section 3 - Plans	(1) Whenever a Council declares an area to be a Physical Planning Area it shall prepare a plan of that area. (2) In preparing the plan, the Council shall follow the proceedings specified in section 2(2). (3) The plan shall specify those areas in which the Council is prepared to consider applications for specified kinds of development, and may contain such other information as the Council may see fit. (4) When it is completed notice of the plan shall be published in the Gazette, together with information on where and when that plan may be viewed by the public.	Amend the section to address: - The timeframe for preparing a draft plan (set a minimum timeframe). We suggest 2 years for a declaration. - A plan having immediate effect once displayed (so that it is immediately enforceable) - The consultation process for finalising the plan (including who needs to be consulted). We suggest a 3 month public consultation period following the public notice. - The process for endorsing the Plan (the formal process/steps required). We suggest that the public hearings be held and the plan endorsed following consideration of the hearings and a decision on relevant issues. - A process for amending the Plan (how, when and who can approve changes). We suggest that the plan cannot be amended for a period of 2 years following its approval. - Where the Plan must be displayed (as a minimum at Council offices and the DLA) Amend and finalise Zoning Plans for the areas within the Port Vila and Luganville municipal boundaries declared as Physical Planning Areas informed by risk maps. Zoning Plans should also include risk prone land in provincial urban areas outside municipal boundaries. Similar population density, growth and exposure to risk in these areas warrant an identical approach to land use planning as in municipal boundaries.
Section 4 - Development in a physical planning area	No person shall carry on development in a Physical Planning Area, except as specified in the declaration of that Physical Planning Area, without having first received permission in writing from the Council.	Amend Section 4 to require that development in a Physical Planning Area must respect inherent risks of the land on which it is proposed, and in doing so demonstrate consideration of development practice that will ensure appropriate risk and hazard response for use of the land.
Section 5 - Application for planning permission	An application for development shall be made to the Council in such form and containing such information as the Council may specify, and shall be accompanied by such number of copies as the Council may specify.	Amend the Act to include Schedule 3 – Standard information required for an application for planning permission. This would standardise applications and ensure comprehensive thought is given to new development and that information provided by the applicant is comprehensive and appropriately structured for the consideration of Council. Additional information specific to the proposed use would be outlined in a relevant schedule to the Zoning Plan.

4.2.2 The Land Lease Act (1984)

The Land Leases Act (1984) (Consolidated Edition 2006) exists *to provide for the creation and disposition of leases of land, for their registration and for matters connected therewith.*

In terms of an institutional response to urban risk management, the greatest opportunity to increase resilience in urban areas lies with amendments to Part 7 (Leases) of the Act.

Recommended amendments to the Act have been outlined in Table 14, and should be introduced in conjunction with those recommendations put forward for the Physical Planning Act (see Table 13).

Table 14: Recommended amendments to the Land Leases Act (1984) (*shown in bold and italics*)

Reference	Relevant Existing Legislation	Recommended Amendment
31 - Leases	Subject to the provisions of this Act and of any other law, the owner of land may lease the land or part of it to any person for a definite term.	Reword section to read: "Subject to the provisions of this Act and of any other law, the owner of land may lease the land or part of it to any person for a definite term for an allowable use under an applicable Zoning Plan. "
32A - Application of sections 32B (Extension of leases) and 32C (Right of Renewal of a lease)	(1) Sections 32B and 32C apply only to leases of public land. (2) In subsection (1), public land means land: (a) declared to be public land under the Land Reform Act [Cap. 123] or any other Act; or (b) acquired for a public purpose under the Land Acquisition Act [Cap. 215].	Add an additional clause to read: (3) 32B and 32C may only be applied if the use of the leased land is consistent with a use specified under an applicable Zoning Plan.
38 - Purpose and development conditions to be specified	Every lease shall specify (a) the purpose and use for which the land is leased; and (b) the development conditions, if any.	Add an additional clause to read: (c) the potential risk to the leased land from natural hazards, if available.
41- Agreements implied in leases on the part of the lessor	Save as otherwise expressly provided in the lease and subject to any written law there shall be implied in every lease the following agreements by the lessor with the lessee binding the lessor (a) – (k) (various)	Add the following agreement to the Act: (l) to use the leased land in a way that is consistent with a use specified under an applicable Zoning Plan.

Under Section 47 of the Act, *the agreements and conditions contained or implied in any registered lease may be varied, negated or added to, by an instrument in the prescribed form executed by the lessor and lessee.* For leased land exposed to high to very high potential risk, it may be necessary to assess current land use and act accordingly in light of recommendations made within this Strategy.

Action:**Amend the Land Leases Act**

Amend the following sections of the Land Lease Act to address risks:

- Section 31 – Leases
- Section 32A - Application of sections 32B (Extension of leases) and 32C (Right of Renewal of a lease)
- Section 38 - Purpose and development conditions to be specified
- Section 41- Agreements implied in leases on the part of the lessor.

4.3 The Vanuatu Land Use Planning and Zoning Policy

The national policy document guiding land use planning is the *Vanuatu Land Use Planning and Zoning Policy* (Final Draft, May 2012). This policy document is still in its draft form and it is understood that it is yet to be formally adopted.

The Policy sets priorities and outlines legislative and institutional settings to enable land use planning that encourages the best current use of land resources. National policy such as this is critical to set an overarching framework for the development of local plans, guidelines and processes to enable land use planning that is consistent across the country. Without such policy, municipal and local Council staff are left to provide their own response leading to often costly, ineffective and inconsistent documents.

We recommend that the Policy is recast to provide a strong land use planning approach to establish a resilient Vanuatu through resilient communities and development.

This Policy seeks to address several important land use planning issues in Vanuatu, including:

- Minimising the impacts of economic development pressures on customary land.
- Acknowledging the importance and significance of multi-stakeholder processes in the governance of land.
- Highlighting the underutilisation of Vanuatu's cultivable land for productive use.
- Looming effects of urbanisation and informal settlements in the major urban centres of Vanuatu.
- Emphasizing the role of the land sector as an important part of the framework for environmental and natural resource management.
- Mandating proper planning and development of the land asset; including the management of government and public lands, the management of common property resources, individual and community based land use planning and urban planning and development.

Missing from this list is the important role that urban areas fulfil in the country. We recommend that an urban policy is included which addresses the economic and social functions of Vanuatu's main urban areas including Port Vila and Luganville.

In addressing the key land use planning issues, the Policy has identified three principles to inform land use planning in Vanuatu. These are:

- Kastom - land use planning must recognise and validate traditional authority and customary uses of land.

- Equity - well considered and transparent dealings in land related activities, including land use planning and decision making.
- Sustainable development - the use of land that maximises both current and future development outcomes.

The Policy uses these principles to address land use policy areas via several policy directives. The existing land use policy areas (policy sections) in the Policy can be strengthened to address natural hazard risk management and address the importance of urban areas. The sections that can address this issue are *urban areas*, *foreshore and coastal development*, *risk and vulnerability management* and *land leases*.

A summary of the recommendations to strengthen the Policy and promote resilience are outlined in Table 15. In addition to these, it is also recommended that the policy be renamed the *Vanuatu Land Use Planning and Development Policy*. This name better reflects the direction outlined in this policy, especially if it is updated to include the recommendations of this Strategy aimed to promote resilient development of urban areas.

In order for the policy document to serve as the primary document providing guidance for land use and development under the Physical Planning Act, a mandate for the policy and responsibility for its preparation needs to be clearly established in the Act. This is discussed further in Section 4.2.1 of this report.

Action:

Review the draft Vanuatu Land Use Planning and Zoning Policy to become the Vanuatu Land Use Planning and Development Policy.

Develop the Policy as the primary document providing guidance for land use and development under the Physical Planning Act.

Amend the policy directives in the draft policy to provide a strong land use planning approach to a resilient Vanuatu by acknowledging the importance of resilient urban areas.

Rename as the *Vanuatu Land Use Planning and Development Policy*.

Consult stakeholders on the policy directives to gain commitment to the requirements under the policy.

As a matter of priority develop the Urban policy referenced in the Urban Areas policy directive to assist Councils in the development of zoning plans for their areas.

That the Physical Planning Unit of DLA immediately submit the Policy to the Council of Ministers for endorsement.

Table 15: Recommendations to strengthen the Vanuatu Land Use Planning and Zoning Policy³

Land Use Area	Relevant Policy Directives	Key Recommendations
Urban Areas	Develop a National Urban Policy which outlines land use planning priorities in urban and peri-urban areas including municipalities and provincial centres. In regards to land use planning, this policy should include but not be limited to: - Acknowledgement of multiple land use, ownership and lease arrangements within urban areas (in contrast to exclusive control by the municipal authorities) - Specification of the development outcomes expected from each planning area or zone, based on environment and stakeholder aspirations - Mechanisms to reduce or mitigate negative impacts from proximate but differing land uses, and protect amenity of existing land use - A determination of different urban land use options and an informed recommendation of optimum locations for various types of development Develop specific protocols on stakeholder consultation in relation to land use planning decisions in urban and peri-urban contexts. These protocols should specifically consider kastom governance representatives, minorities, women, youth, economically disadvantaged groups, churches and the private sector. Require (through legislation or regulation) that urban land use decision-making be based on comprehensive land use planning processes, and provide appropriate monitoring and enforcement mechanisms including but not limited to: - Development applications - Zoning and development controls documents Formally incorporate growth and demographic projections in urban land use planning and transport, housing, amenities, and the identification of expansion processes including growth considerations on green space, recreational areas, infrastructure, public services physical planning areas and zones. Formally incorporate climate change projections and urban vulnerability assessments in urban land use planning processes.	Prepare a national Urban Policy that promotes urban settlements that are responsive to natural hazards. Utilise risk maps to inform land use planning in areas where risk ratings are classified as high or very high. In these areas, only specified land uses should be permitted. Where existing inappropriate land uses are located, other mechanisms, such as community response and early warning systems, may be suitable to protect amenity of existing land use. Incorporate risk assessments in urban land use planning processes. This will involve the development of Zoning Plans that provide guidance for appropriate land use based on strategic development objectives, local environmental conditions and potential risk from natural hazards.
Foreshore and Coastal Development	Develop a national policy on use of the foreshore including but not limited to: - Access to the marine area below the high watermark - Compensation mechanisms and processes for loss of access or use - Access to and use of foreshore areas of cultural or kastom significance (e.g. tabu sites, coral reefs, traditional hunting grounds, lagoons, and estuaries) Develop and implement land use provisions within national, provincial, municipal or community plans that: - Control or prevent some foreshore land use developments (e.g. coastal privatization) - Control the scale and cumulative effects of foreshore and coastal land use - Guide how risk is managed in vulnerable foreshore areas (e.g. climate change, tsunamis, storm surge)	Provide guidance on how to manage risks with potential for significant damage to foreshore areas. Due to the high vulnerability of foreshore areas in relation to natural hazards, a case by case risk assessment should be mandatory for all proposed foreshore development. This needs to take account of the potential from coastal inundations, storm surge and particular geotechnical characteristics that need to be considered during design. The Foreshore Development Act should be amended to include any institutional responses arising from this Strategy relating to foreshore development.
Risk and Vulnerability Management	Develop and formally integrate the use risk and vulnerability assessment tools, methodologies and associated information into land use planning processes at all levels. For example when: - Declaring zones within physical planning areas - Determining development controls and conditions - Assessment of land use and development applications Formally require a consideration of local knowledge and kastom as sources of risk and vulnerability mitigation in land use planning processes at all levels. Refuse consent (through legislation or regulation) for land uses and development (public or private) that pose an unacceptable level of risk and vulnerability to Vanuatu's people, livelihoods, infrastructure or ecosystems.	Institutional risk responses should incorporate controls and instruments, zoning plan, development controls and modified land use and development applications. These responses should be strictly integrated into land use planning processes at all levels and refusal should be given when requirements are not met. Community responses are also necessary and should consider local knowledge and kastom to develop and communicate effective risk responses.
Land Leases	Elaborate lease conditions based on and making specific reference to comprehensive land use planning processes to ensure compatibility with the aspirations of kastom landowners, leaseholders and local governments (e.g. province) and existing strategic or development plans. Require that land leases unambiguously set out and are guided by land use conditions. Land use conditions may either be contained within individual leases or built into national guidelines for leased land. Revise the lease creation process to trigger public communication and community-based land use consultation activities. Require consideration of land capability and risk within lease creation processes such that the application for consent to lease triggers planning considerations and an assessment of the need for formal impact assessments. Develop and enforce regulations for land use and development on leased land including but not limited to: - Defined use categories of land leases and subdivisions - Mandatory assessment of use impacts (social, environmental, economic) under the different lease categories utilizing analytical tools such as cost benefit analysis - Adherence to mandates and advice from land use planning authorities Review and amend the lease category designation process to include the power of approval and veto on certain land uses by landowners, consultation with affected parties as well as alignment with relevant planning regulations and provincial development plans.	Community based land use consultation should utilise publicly available GIS risk data to aid communication of potential risks in areas where land leases are sought. An Application for Consent to Lease should trigger an assessment of potential natural risks on the land where a lease is sought. A Risk Assessment Sheet and other similar tools would be suitable for this assessment. Establish communication channels between the Physical Planning Unit, municipal and provincial councils and the Ministry of Lands and Natural Resources, who administer land leases, to develop, coordinate and enforce regulations for land use and development.

³ Within the table, directives that provide opportunities to integrate risk responses within existing/proposed frameworks are highlighted in grey.

4.3.1 Risk Mitigation Regulations

The Terms of Reference for the Project require consideration of whether specific Natural Disaster Risk Mitigation Regulations should be prepared to support the Physical Planning Act. The primary purpose of any new regulation would be to set out a legislative directive for key responsibilities and actions in regards to risk mitigation for Vanuatu.

The Project team has not recommended separate regulations but rather recommends strengthening existing legislation and practice as set out in Section 4 of this URMS. With limited human and capital resources available, the Project team are of the view that a stronger outcome can be achieved by strengthening existing measures.

The following matters have been taken into account in determining this as an alternative mechanism.

- Further regulations are unlikely to improve the integration of natural hazards into decision making based on the limited implementation of existing regulations;
- National Disaster legislation is already in place and overlaps several matters that would be contained in new regulations;
- Cluster groups for each hazard have been formed outside of the regulatory frameworks and are working effectively

The development of additional regulations could follow in the future but is currently a lower priority compared to changing existing legislation and practice.

4.3.2 Supporting National Legislation

Supporting legislation to the Physical Planning Act and Land Leases Act are:

- Decentralisation Act
- Municipalities Act
- Land Acquisition Act
- National Disaster Act
- Foreshore Development Act
- Environment and Conservation Act

A consistent consideration of resilience and the on-going management of risk is required at both national and local level. Although changes to the above legislation have not been recommended as part of this strategy, future assessment of the listed legislation should take place to identify opportunities to strengthen institutional responses to disaster risk reduction.

It should also be ensured that relevant policy areas of the final *Vanuatu Land Use Planning and Development Policy* and national legislation are fully integrated to strengthen disaster risk reduction and resilience.

Action: Review secondary legislation to identify opportunities to strengthen disaster risk reduction and resilience	Following amendments to the Physical Planning Act and the Land Leases Act and preparation and endorsement of the revised Vanuatu Land Use Planning and Development Policy, the following legislation should be reviewed to identify where changes can integrate and strengthen the approach for disaster risk reduction and resilience: • Decentralisation Act • Municipalities Act • Land Acquisition Act • National Disaster Act • Foreshore Development Act • Environment and Conservation Act
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4.4 Development Controls and Zoning Plans

Both Port Vila and Luganville municipal areas currently have a form of zoning plan. Figure 4-4 shows the Port Vila zoning plan and Figure 4-5 shows the Luganville plan. The sections that follow provide specific observations and recommendations for the plans to strengthen disaster risk reduction and resilience.

As part of Stage 2 of the Project, potential risk maps have been prepared. This work is presented in the *Hazard and Risk Maps and Geo-data Report*, dated 8 December 2015, and its outcomes have been summarised in Section 2.1 of this strategy. It is recommended that the risk maps are used to inform the zoning plans for both Port Vila and Luganville Physical Planning Areas. Individual potential risk maps will highlight areas that require special attention

In addition, the zoning plans should consider the entire urban area, and not just the area within the municipal boundary. This reflects that natural hazards do not respect the boundaries between the municipal and provincial areas and a collective consistent approach is required to address risk. To achieve this, a collaborative approach involving the Physical Planning Unit, municipal town planning and the provincial councils is essential.

The existing Zoning Plans for Port Vila and Luganville provide a foundation for the Physical Planning Unit, the municipal and the provincial councils to develop updated Zoning Plans that support disaster risk reduction. As a minimum, areas of high to very high potential risk for river flood and coastal inundation that have been identified on the 100 year combined risk map should be declared as Physical Planning Areas and should have Zoning Plans developed. Areas of tsunami risk at the 2500 year return period should be included.

The zoning plans should include appropriate land use responses for areas identified as having very heavy potential damage, heavy potential damage, and moderate to no potential damage. The following points provide a general guide for using the risk maps to establish Zoning Plans that support resilient development.

- In areas of very high potential risk, all new development should be avoided. Alternative land uses, such as farming and public open space, should be considered.
- In areas of high potential risk, residential development should be avoided, and retail, commercial, industrial and public use development should be subject to recommended development controls, by way of a Zoning Plan, building controls and locational specific responses.

- In areas of moderate to limited potential risk, existing development and desired land use interfaces should be considered when developing Zoning Plans in any urban areas also declared as Physical Planning Areas.

The sections below identifies the key changes for the Port Vila Zoning Plan and the Luganville Zoning Plan to respond to the risk mapping and urban growth findings for the two areas. The Costed Action Plan in Part D of this report includes resources to implement these changes.

4.4.1 Port Vila Zoning Plan

The Port Vila zoning plan is extremely detailed with regard to land uses, with over 50 land uses represented. However the plan is lacking in broad strategic direction and is not oriented towards future development. The zoning plan is regarded more as a representation of existing land uses at the time the plan was prepared, rather than a strategic document that can be used to guide development.

The plan only covers the areas within the Port Vila municipal boundary and therefore it does not address areas of significant growth within the Shefa Province. In effect the plan is therefore just the Port Vila Municipal Council area plan.

The plan has not been formally adopted and the zoning plan is not given particular regard when assessing proposed developments.

The consultant team recommend that a new zoning plan is prepared. The particular matters that need to be addressed in the plan:

- Reflect and give effect to key policy directives of the Vanuatu Land Use Planning Development Policy
- Respond to the key findings of the Urban Growth Trends for Port Vila and incorporate changes to accommodate population growth.
- Reframing the plan as the Greater Port Vila Urban Area Zoning Plan
- Redefining the plan boundaries to take in Physical Planning Areas in Shefa Province including areas of growth and high and very high risk areas
- Incorporating the key roading networks and life line infrastructure including access to the port, airport and directing heavy traffic away from the central business district
- Simplifying the land use zones to the 9 zones which will be set out in the Physical Planning Act
- Incorporating hazard risk mapping including 100 year flood and storm surge areas to identify high risk zones where additional development restrictions will apply
- Prepare a schedule of development controls and limitations for each land use zone. This would set out what developments are permitted and which require specific permission.

Figure 4-4 provides the existing zoning plan annotated with recommended changes to address hazards and risks.

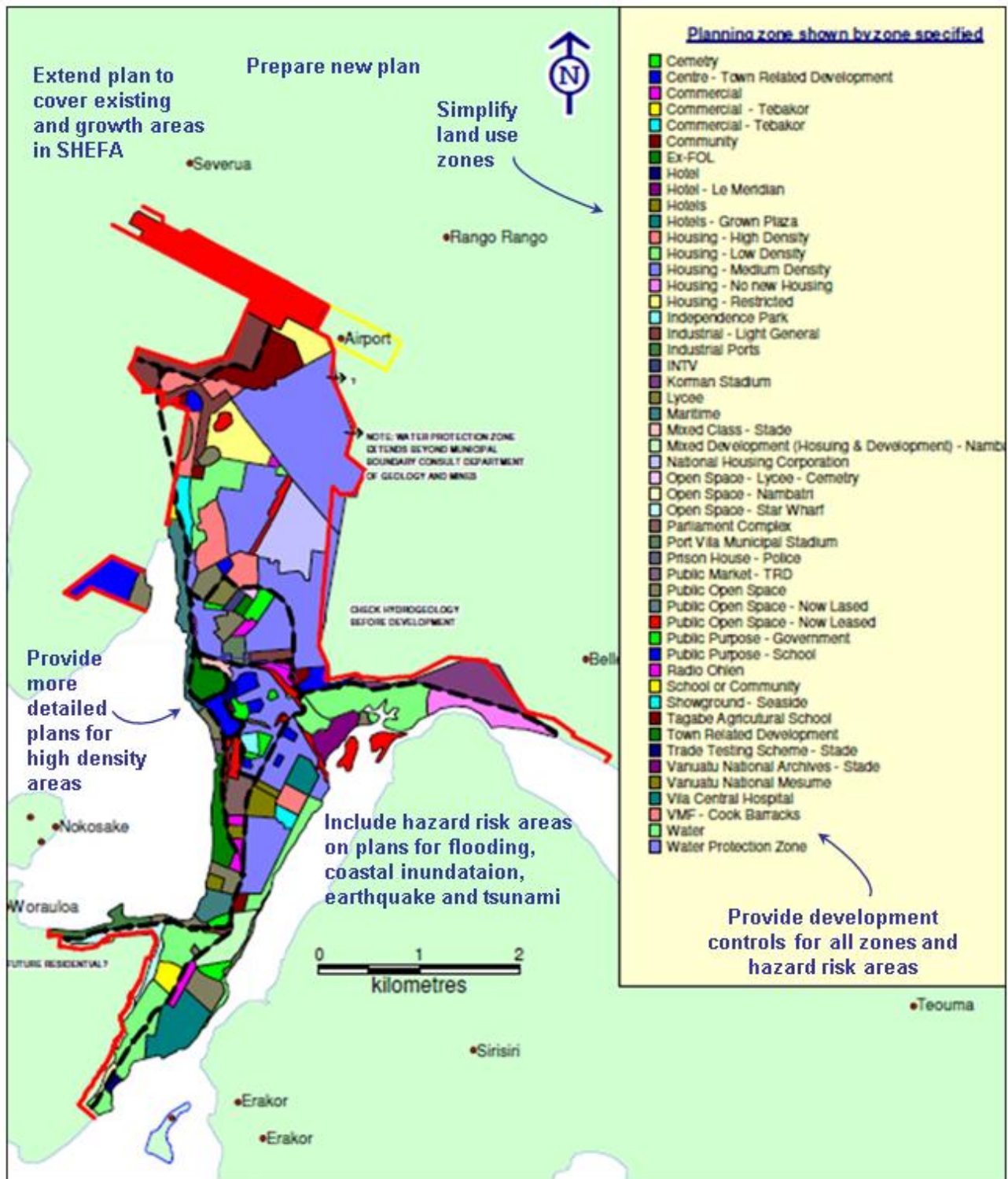
Action:

Prepare a new zoning plan for the Greater Port Vila Urban Area

Prepare a new zoning plan for Port Vila to address the key matters set out in Section 4.4.1 of the Urban Risk Management Strategy.

Formally adopt the Greater Port Vila Urban Area Zoning Plan.

Figure 4-4: Existing Port Vila zoning plan



4.4.2 Luganville Zoning Plan

The Luganville zoning plan is substantially more advanced and up to date than the Port Vila plan (see Figure 4-5).

The plan covers the Luganville Municipal Council area and an area of the Sanma Province extending generally three kilometres from the municipal boundary.

The land use zones are represented as one of fifteen different land uses. The denser urban areas are cluttered with a number of different zones.

The plan has not been formally adopted and the zoning plan is not given particular regard when assessing proposed developments.

The consultant team recommend that the zoning plan is reviewed and revised to strengthen disaster risk reduction and resilience. The particular matters that need to be addressed in the plan:

- Reflect and give effect to the key policy directives of the Vanuatu Land Use Planning and Development Policy.
- Respond to the key findings of the Urban Growth Trends for Luganville and incorporate changes to accommodate population growth.
- Revise the land use zones for the Sanma Province areas to reflect existing and future residential areas.
- Retain and review the riparian reserve area along the Sarakata River to reflect the 100 year flood modelling for the river. Include relevant controls for the zone to address the risk.
- Retain and review the foreshore area to reflect the storm surge risk. Include relevant controls for the zone to address the risk.
- Include a coastal inundation hazard area and relevant controls for the zone to address the risk.
- Include hazard areas outside the boundaries of the plan (eg. Pela Kula Bay) where they are subject to high and very high risk.
- Prepare a schedule of development controls and limitations for each land use zone. This would set out what developments are permitted and which require specific permissions.

Figure 4-5 provides the existing Luganville zoning plan annotated with recommended changes to address hazards and risks.

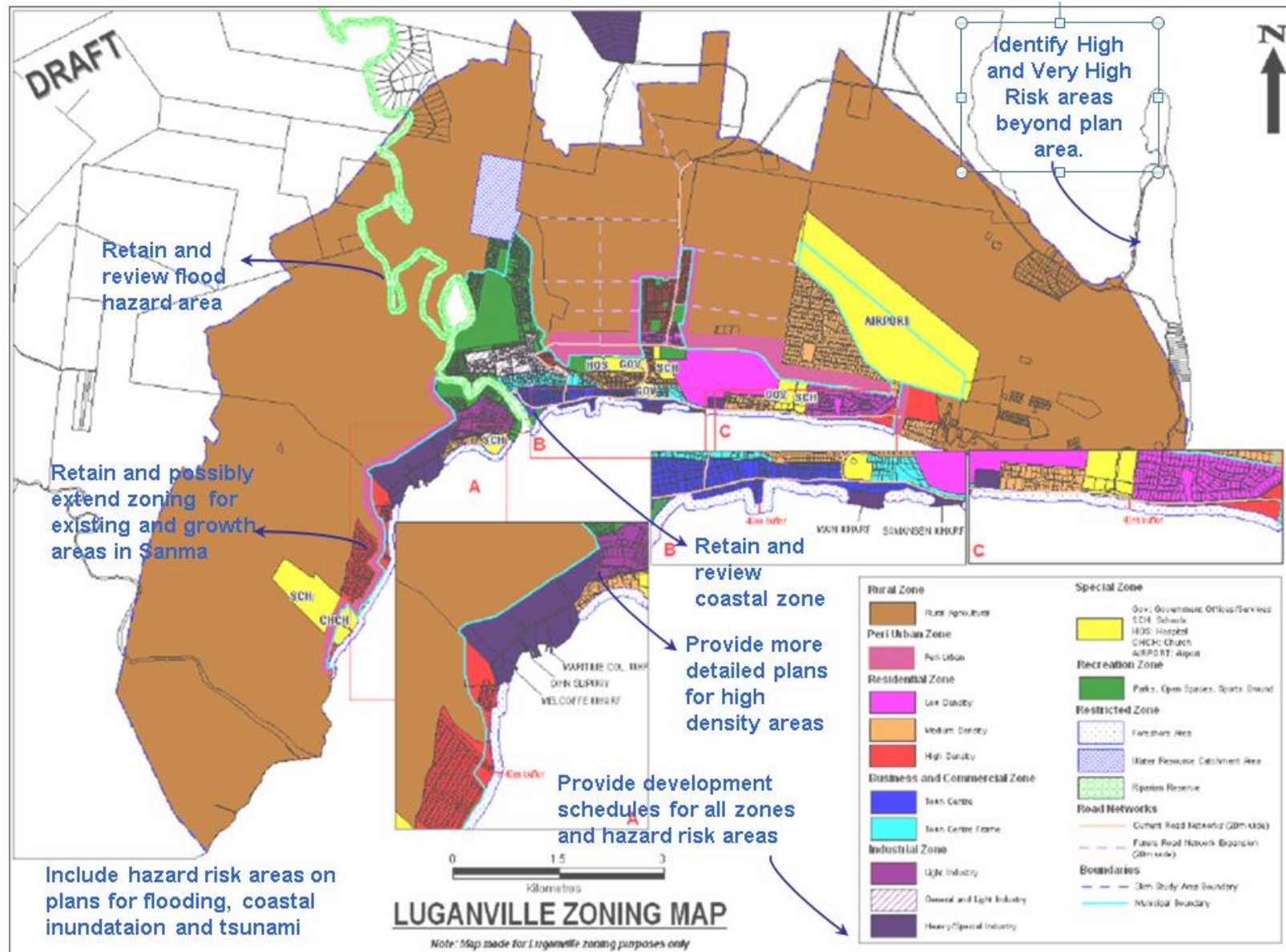
Action:

Review and revise the Luganville Zoning Plan to strengthen disaster risk reduction and resilience

Review and revise the zoning plan for Luganville to address the key matters set out in Section 4.4.1 of the Urban Risk Management Strategy.

Formally adopt the Luganville Zoning Plan.

Figure 4-5: Existing Luganville zoning map with matters to be addressed



4.5 The Building Code

Vanuatu has a National Building Code which is in three volumes – The National Building Code; A Partial Commentary on the National Building Code and the Home Building Manual.

These documents were produced in 1990 under an AusAid funded Pacific Building Standards project. We understand that although these documents are referred to by designers and used by regulators in the Public Works Department (PWD), they have never been officially ratified or endorsed as such. We have reviewed the documents and they are very comprehensive reflecting the state of knowledge about building design and performance as it existed in the late 1980's principally in Australia and New Zealand. They refer to relevant parts of the Australian or New Zealand Standards which have subsequently been substantially amended and updated. The Code was specifically developed to accommodate the seismicity and cyclonic wind loadings expected in Vanuatu. Notwithstanding the fact that the codes and standards the Code was based upon have changed, we would still recommend its immediate adoption.

The Home Building Manual is focussed upon the standard construction of single storey timber framed and masonry block construction. It is a comprehensive and well-illustrated document but at approximately 270 pages it is not readily accessible for many people such as small village based building teams or self-builders. At the other end of the scale we are aware of the Red Cross 2013 (reprinted 2015) – *Besik Konstraksen Hanbuk* (Basic Construction Handbook) which is a 25 page heavily graphical manual on basic construction methods for self-built housing suitable for village construction.

There is a need for both levels of documentation and probably for some intermediate “How To” guides to more widely disseminate some simple construction techniques and retro fitting options to increase the resilience of local building stock to the two major natural hazards (Wind and Earthquake) identified in this project. These documents should be developed in English and Bislama and should promote the use of materials and technology which is readily available throughout Vanuatu. We recommend that these documents also include the concept of “resilience” as the basic purpose or rationale for their adoption/implementation.

An additional manner in which the performance of the construction sector (both formal and informal) could be improved is to maximise the use of existing technical and vocational training institutions within Vanuatu. We are aware of three such bodies:

- Vanuatu Institute of Technology – currently offers a two year course in Building and Construction which appears to cover all the basic skills required to be able to construct buildings in conformity with the National Building Code. We assume most of the graduates from its course seek employment within the formal construction sector who generally construct the bulk of the commercial and larger buildings in the country.
- The Vanuatu Technical and Vocational Education Training Programme (TVET) also appears to be a potential avenue perhaps more focussed upon basic village level construction and self-build.
- The Australia-Pacific Technical College (APTC) does not currently offer the Australian Level III Certificate in Carpentry in Port Vila but it does in other locations around the Pacific.

There may well be other channels whereby this basic construction methodology information is and can be disseminated to the community. We are aware of at least two other NGO lead projects active in this space and there are likely to be others. We have made some recommendations in respect of the NGO sector and the Shelter Cluster in Stakeholder Participation and Communications Implementation Action Plan.

Action: Adopt and enforce the Building Code	Adopt and enforce the currently proposed Building Code as a matter of urgency. Promulgate the availability of the Code as an electronic document.
Action: Develop simple guide(s) to promote the application of the Building Code across a wider range of building projects	Research simple guide formats around key topics such as Foundations, Walls and Roofs, Bracing and Tie Downs. Investigate potential for Technical Institutions in-country to assist in formulation. Produce and make guides available through Municipal and Provincial offices.
Action: Develop simple guide to assessment and enforcement under the Building Code	Develop intermediate “How To” guides for simple construction techniques and retro fitting options to address wind and earthquake (and other hazards). These documents should be developed in English and Bislama and should promote the use of materials and technology which is readily available throughout Vanuatu.

4.6 Development Instruments

4.6.1 Land Ownership and Leases

Procedures for assessing applications for Land Ownership and Land Leases should be amended to consider potential risk to individual land parcels as a result of natural hazards. Recommended amendments to the Land Leases Act (1984) have been outlined in Section 4.1.2. These amendments, if implemented, aim to increase resilience through an initial awareness of natural hazards affecting land parcels. Land ownership should also be similarly regulated. Although the ownership of land is independent of the proposed use, the consideration of applicable land use zone is recommended to purchasers of land in urban areas.

Action: Amend the procedures for assessing applications for land ownership and land leases	Develop a checklist and other guidance to assist officers assessing applications for land ownership and land leases in the consideration of hazards and risks.
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4.6.2 Planning and Building Permits

The assessment of hazards and risk should be a key component at the front end of the planning and building permit process. The example Risk Assessment Sheet provided in **Appendix D** is a simple way to review hazards in the planning permit application process. This assessment sheet should be completed by the applicant, with assistance if necessary, and reviewed by the responsible authority. This assessment sheet can be further developed/tailored for specific assessments.

The decision flow chart in Appendix D serves as a guideline for the responsible authority to assess proposed development against potential risk. The guideline recommends that when assessing risk for an area, Council staff should first consult the 100 year combined risk map to gain an understanding of the hazardscape for the

area but the individual maps should then be consulted to determine which hazard(s) are contributing the overall risk. This will then inform the appropriate response for that hazard.

As recommended in Section 4.2.4, requirements for planning permit applications should be specific to the proposed use and defined in a schedule to each zone. Proposed buildings on any land should also be assessed and checked against Building Code specifications.

Action:

Develop risk and hazard and information for applicants and Council staff.

Develop a package of simple risk and hazards assessment information for applicants.

Develop an assessment process for Council staff assessing applications.

4.7 Recommendations for Institutional Response to Risk

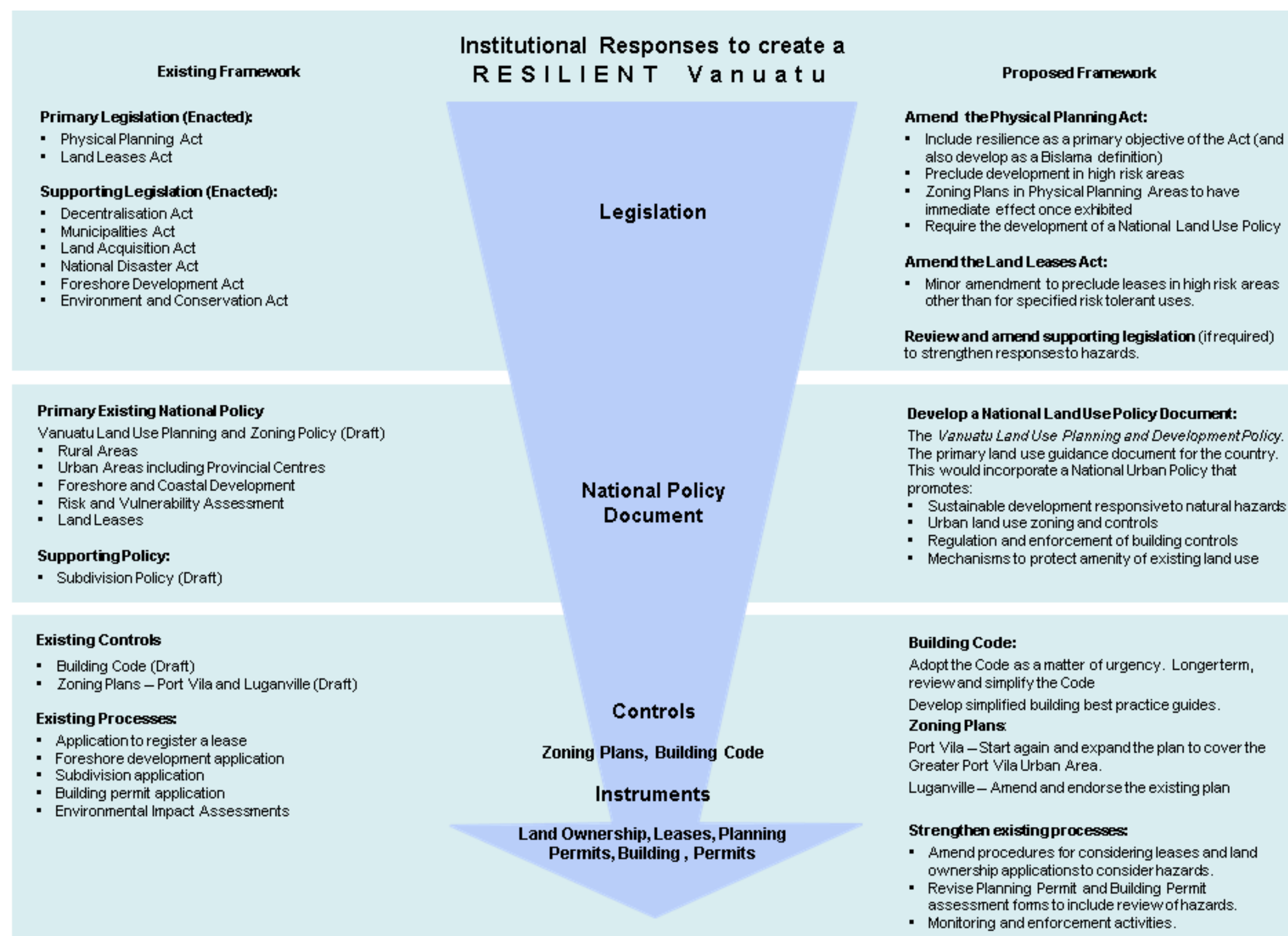
This part of the Urban Risk Management Strategy has set out the institutional response to natural hazards as part of risk management approach. The strategy identifies a number of changes to existing legislation, policy and practices that collectively strengthen the response. Figure 4-6 sets out the existing and proposed institutional response as recommended in this Strategy. Broadly the strategy is to build on the existing planning instruments by strengthening and implementing what exists before looking to additional legislation as a tool.

The following matters have affected the implementation of legislation and policy in the past:

- The fragmented nature of decision making at local and national level;
- Regular change of personnel at local level;
- Lack of formal training for those administering land use planning legislation and policy;
- Ministerial intervention in land use planning decisions;
- A general lack of enforcement of existing regulations/codes;
- Different development regimes for municipal and urban areas; and
- Zoning plans and other policy not being formally adopted and therefore carrying little weight in land use planning decisions.

These form constraints to the implementation of the institutional responses to risk identified in this part of the Strategy. The recommendations in this section seek to address some of these issues by providing a structured response to risk supported by sound technical information. This will allow decision makers to act with greater certainty. However, it is acknowledged that some of the constraints identified above cannot be easily eliminated as they have number complex contributing factors including political, financial and social matters. The recommendations carried through into the Action Plan in Part D – The Costed Action Plan prioritise the actions that can have the greatest impact on land use planning decisions.

Figure 4-6: Existing and proposed land use planning framework to promote resilience



STRATEGY PART C: THE COMMUNITY RESPONSE

5 Stakeholder Participation and Communications Implementation

5.1 Introduction

As identified in Section 3 of this Strategy, much of resilience springs from non-statutory responses from the actions of individuals and communities in the face of hazards. By providing the community with relevant information on the hazard (nature, location and frequency) and options for action, community response can be enhanced and community resilience increased.

What is a Resilient Community?

Resilient communities are those that can adapt, respond and be quick to recover so that they are environmental, socially and economically sustainable. To achieve this, disaster resilient development focuses on reductions in vulnerability over the short, medium and longer term.

This Section contains the *Stakeholder Participation and Communications Implementation Plan*. It sets out:

- The review of existing Education, Information and Communications materials (EIC);
- A review of key messages (explanation and call to action); and
- A participation and communication plan, including community based tsunami evacuation maps and plans. This is supported by Standard Operating Procedures for:
 - Community-Based Tsunami Evacuation Maps and Signs (SOP 11) (**Appendix G**); and
 - Creating Tsunami Evacuation Maps in QGIS (SOP 12) (**Appendix H**).

Flowing out of these are a number of actions recommended to provide a strengthened community response to hazards. Those actions are included (along with the Institutional Response Actions) in the *Costed Action Plan* in **Part D** of this Strategy.

Based on the tools provided in the *Stakeholder Participation and Communications Implementation Action Plan*, the VMGD and the NDMO are progressing tsunami evacuation planning and the development of community based response plans.

Complementing the tsunami modelling, evacuation plans and community response plan development which falls under the scope of this Project, the VMGD and the NDMO are currently also progressing Tsunami Early Warning Systems including sirens, warning messaging on TV, Radio, Short Message Service (SMS) and social media.

5.2 Review of existing EIC materials

The VMGD houses the newly formed National Advisory Board on Climate Change (the NAB) and the Disaster Risk Reduction Project Management Unit (the PMU). The NAB and PMU both report to the VMGD and the National Disaster Management Office (NDMO), but sit within the VMGD offices. Education, Information and Communication are a joint responsibility of the NAB. The NAB have a process in place to endorse EIC materials. The existing EIC materials were reviewed by the Project Team.

EIC materials for the project hazards were reviewed by building a combined spreadsheet (NAB MASTER EIC DATABASE v1.xlsx; stored in Y:\VMGD_NDMO Interagency Plans on the network drive VMGD_NDMO_Shared on \nasara) as follows:

- A folder of validated NDMO EIC materials from the PMU network.
- VMGD glossaries for climate, forecast and geohazards (.doc and .publisher formats, supplied).
- VMGD Service and products spreadsheet
- VMGD Community outreach education strategy plan (note the above spreadsheet supercedes the Appendix 4 list in this document)
- Vanuatu IEC material metadata spreadsheet IClim
- NAB portal resources database at <http://nab.vu/document-search>, searched using the keywords: tsunami, tsunamis, flood, floods, flooding, landslide, landslides, cyclone, cyclones, earthquake, earthquakes, coastal inundation,

A summary of the content of these resources is given in **Appendix E**.

Additional EIC materials (not endorsed by NDMO or VMGD) have undoubtedly been produced over the last decades by other agencies, especially Non-Government Organisations (NGOs), but these are beyond the scope of this report if they are not listed in the above NDMO/VMGS/NAB metadata and archive sources.

5.2.1 Metadata analysis

5.2.1.1 About the material

The most comprehensive list is in the IClim Vanuatu EIC materials spreadsheet. This contains the following information (see **Appendix J** for specific values):

Title
 NAB Endorsed?
 Type of Educational or Awareness Resource
 Author
 Published by; Financed/Supported by
 Published in; Publishing Year
 Target Group Subject/Strand
 Climate Change Disaster Risk Management
 Specific TVET Training Area/Focus
 Content/Topics
 Regional Focus
 Utilised in Language
 Weblink
 Download
 File name
 Comments
 Notes

5.2.1.2 Target audiences

The VMGD Communications, Engagement and Partnership Strategy (2012) documents current engagement strategies, and EIC material, with a very wide inclusive definition of communication and a recognition of engagement as a key part of EIC. It summarises current engagement structures under the following headings:

- Government of Vanuatu Structures
- Coordinating committees and Taskforces such as the NACCC, the NTF, the VHT and the upcoming NAB.
- NGOs
- Directly from VMGD to communities

A detailed list of stakeholders for communication and engagement is given in **Appendix F**.

The VMGD service and products spreadsheet also adds useful re-distribution classification information as follows:

- Primary audience;
- Second party distributor of weather information products and services; and
- Methods of second party dissemination of weather information.

5.2.1.3 Message content grouped by DRR phase

The content of the existing EIC materials reviewed is summarised in **Appendix G**.

There should be resources that cover a range of elements of hazard, risk and risk mitigation. No metadata was readily available on the message categories covered within the overarching Disaster Risk Reduction phases of Reduction, Preparedness, Response and Recovery (UNISDR, 2015). Key message categories were listed as follows against those phases.

UNISDR DRR Phase 1: Reduction

1. Hazard event explanation - a description of the hazard itself and what to expect in the event;
2. Risk information - that includes the consequences of a particular scale hazard event (or range);
3. Urban planning information
4. Options for structural or natural mitigation - information that includes structural building options or natural modifications that provide mitigation

UNISDR DRR Phase 2: Preparedness

5. Pre-event preparedness information

UNISDR DRR Phase 3: Response

6. Warning source and trigger information - warning sources and the triggers within those warnings that should lead to protective action (e.g. levels, codes, zones);

7. Map(s) of hazard or evacuation area – the area covered by the hazard or the area that should be evacuated;
8. During event instructions - Instructions for what to do during a hazard event;
9. Event information / Forecasts

UNISDR DRR Phase 4: Recovery

10. After event instructions - recovery instructions

Additional

11. Further information links - further information links such as an organisation or website that contains further useful details
12. Glossary/definitions

5.2.1.4 Who produces the EIC, when and how?

The most detailed breakdown is in the VMGD services and products spreadsheet which sets out the following information:

Division, Hazard, Product and Services, Frequency

- Division of VMGD/NDMO
- Produced by which role
- Issued on what basis/trigger?
- Frequency

WFSD method of dissemination

- | | |
|-----------------|--------------------|
| • Email | • Newspaper |
| • Email List | • Radio |
| • VMGD Intranet | • SMS |
| • VMGD Website | • Facebook |
| • Other Website | • Telephone In/Out |
| • TV | • Fax |

5.2.2 Summary of existing EIC materials

Appendix L provides an assessment of the existing EIC materials.

5.2.3 Discussion and recommendations

As an overarching plan, the VMGD Communications, Engagement and Partnership Strategy (2012) is a well written comprehensive summary of good practice with a clear workplan. We endorse that strategy and note simply that each of the 11 EIC content types listed in Section 5.2.2 should be covered by some EIC resource. However, not all types of content need to be covered in a single EIC resource. They should all be up to date

and consistent with the latest warning and mapping framework. All content types should be covered in Bislama and most are probably also needed in English and French for non-native audiences (primarily expatriates, people visiting business and tourists).

All EIC materials should be consistent with or directly use the NDMO and VMGD key messages.

Action:

Education, Information and Communication resources

Search through non-endorsed materials over a period of time, especially from the NGOs the NAB regularly engages with, to find resources that are of high quality and address gaps in terms of content for specific hazards that we have identified in this report. We also recommend using the gap analysis to assist in formulating future projects and programme outputs that target gaps.

The accessibility and quality of the resources is important. The quality is addressed by the NAB validation process (existing). Accessibility should be considered in future work. This is picked up in the Action Plan.

5.2.3.1 Gaps in products

Through the review of existing material (above) the gaps in coverage in terms of components of Disaster Risk Reduction (DRR) and also target audiences were identified. These are highlighted as yellow columns in Appendix L. The gaps are summarised as follows (and listed in the actions table):

- All hazards – hazard and risk map interpretation for the public, urban planning interpretation and factsheets/packs/resources for all audiences. All EIC information is on the website;
- Coastal Inundation – Everything other than hazard and risk needs to be written. Even the hazard and risk material isn't for the public. One could argue that a lot of cyclone advice holds for non-cyclone surge;
- Earthquake – Urban planning information for all audiences; Structural guidance (stronger buildings); Further information on the website;
- Flooding – Urban planning information, Structural guidance (stronger buildings, flood engineering); Flood forecasting. Further information on the website; glossary;
- Landslide – Risk maps; Forecasts; glossary; and
- Tsunami –options for structural and natural mitigation (vertical evacuation buildings, sea walls (generally unaffordable and not advised), dune restoration and planting (generally only effective for smaller tsunami).

Action:

Gaps in Education, Information and Communication material

Identified information gaps should form the priorities for EIC material. This is picked up in the accompanying Action Plan.

Specific recommendations within each key message types are given in **red text** below.

5.3 Review of key messages

This section sets out the combined NDMO and VMGD messages for each hazard. As a minimum, it is recommended that key messages should focus on a brief hazard explanation and a call to action.

The following two existing lists were used as starting point to examine what the current message are:

- NDMO key messages;
- Save the Children Yumi Redi project 2016 key messages (NAB validated); and
- Tsunami includes the 5 key messages from the maps developed here. It also includes what the sources/hazards are the warning types, and the exercise and education plan – with a focus around schools. This now needs NAB validation, but is consistent with the NAB validated tsunami messages.

Note that draft volcano key messages are being developed for a separate project in parallel at present.

5.3.1 Summary of existing situation

Key messages only include hazard (for some), warning sources and during event information. No coastal inundation key messages have been developed at all.

Action:

Key messages

Key messages should be developed for each hazard to cover all 10 elements of DRR phased EIC materials (Section 5.2.1.3 above) – see the completed set of 10 elements for Tsunami (5.3.2 below).

5.3.2 Tsunami

This set of key messages has been fully developed as part of this project to cover all 10 elements of DRR phased EIC materials (Section 5.2.1.3 above). This is because the messages are needed for the community engagement around tsunami evacuation maps that has started as part of this project.

Hazard event explanation

- Tsunami is a series of wave and the first one might not be the largest.
- It may take many hours for the largest wave to arrive
- Natural signs that might bring a tsunami
 - Strong earthquake
 - Long earthquake (lasting longer than 60 seconds)
 - Loud noise coming from the ocean
 - Draw back of the ocean

Risk

- Risk is a combination of severity of hazard and the level of vulnerability at a given place. A highly developed location, or a place with a lot of people, close to the coastline is a relatively high tsunami risk situation for Vanuatu.
- Know the risk zones in the risk maps. Consider the implications of high tsunami risk areas for Vanuatu.
- To mitigate risk know and comply with the zoning plan.

Urban management

- Know and comply with the zoning plan, hazard and risk zones for all hazards.
- Apply the institutional responses to risk (See Part B of this Strategy)
- Consider building further from the coast or higher above sea level, in a mapped lower risk zone for more important building types, or developments that will have a lot of people present. Complying with the zoning plan achieves this.

Structural and natural mitigation (Recommendations in red text)

Add this message once tsunami vertical evacuation structures are in place: Evacuate to the top of tsunami evacuation structures if these are the closest safe area. Stay there until the official all clear.

- Consider restoring sand dunes and planting along the coast, this will help for more frequent smaller tsunami but is less effective for large tsunami.

Maps

- Know your tsunami evacuation zones, routes, and safe locations
- Learn and remember the warning sources, triggers, what to do during and event and after the event
- Exercise your evacuation routes annually and improve the maps

Further information

Develop a NAB Portal and/or a VMGD website address to host all EIC materials and key messages. Put the link for all EIC materials on this portal.

Glossary

See the International Tsunami Information Centre glossary in the resources section of the NAB portal: <http://nab.vu>

Call to action – before, warnings, during, after

Before warning/event

- Know your tsunami evacuation zones, routes, and safe locations.
- Learn and remember the warning sources, triggers, what to do during and event and after the event.
- Apply Tsunami tendenko as recommended by the Japanese after 2011 – “everyone for themselves”. People died in Japan coming into or not leaving the zone to try and find others. Make sure you trust your children’s school’s plans before a tsunami, so you don’t risk leaving them without a parent. Similarly for any other vulnerable person (elderly, infirm, disabled).
- Exercise your evacuation routes annually and improve the maps.

Warning sources and triggers, during event, after event

- In a long or strong earthquake if you are in evacuation zone immediately go to a safe location, don’t wait for anything. An earthquake longer than a minute OR hard to stand up, it doesn’t have to be both
- For areas without CDC plans and evacuation maps, existing message holds: “*Following an earthquake (either big or long) immediately move to higher ground on foot and wait until the all clear is given by NDMO before coming down. Remember to take emergency kit as the all clear can take more than 2hrs.*”

- Official warnings come from NDMO and VMGD via TV, radio, SMS-text message, the smartphone app, facebook, twitter, email or websites.
- Multi-hazard warning sirens are part of the NDMO-VMGD official warning system. If sirens sound seek further information from the official warning sources.

During event

- If you are in an evacuation zone, walk or ride bicycles quickly following routes to a safe location. Don't use cars.
- In an official warning, evacuate from the zones stated in the warning

After event

- Stay in safe places until all clear from NDMO

5.3.3 Cyclone

Explanation (Recommendations in red text)

NDMO does not give a message – consider using the message from the Red Cross poster.

Call to action

- National Alerts
 - Blue within potential 24hrs – cyclone preparation, tie down roof, trim garden crops, ensure your emergency kit is ready, pick up loose items from yard
 - Yellow within 12hrs – School and government close, food preservation, water preservation, move to strong / safe place, fit cyclone shutters if you have them
 - Red Cyclone is imminent – Stay indoors and wait out the cyclone
- Continue to listen to the radio for cyclone updates and mark the path of the cyclone on the cyclone tracking map
- Have emergency kit ready – including; torch, batteries, battery radio, water, matches, firewood, food, blankets, charged mobile phone, medical supplies and prescriptions, firewood, kitchen utensils, water container, warm clothing, plastic bag to store important document and cyclone tracking map.

5.3.4 Earthquake

Explanation (Recommendations in red text)

NDMO does not give a message – consider using the message from the Red Cross poster.

Call to action (Recommendations in red text)

Before event

This key message text needs to be developed.

During event

- STOP, DROP, HOLD & COVER
- Not all earthquakes cause tsunamis but if you feel a strong earthquake or a long one you should move to higher ground

The NAB should consider for earthquakes adopting the message to get to tsunami safe locations for areas with maps (In an earthquake that is longer than a minute or hard to stand up, doesn't have to be both)

5.3.5 Coastal inundation

This key message text needs to be developed.

Explanation (Recommendations in red text)

NDMO does not give a message – consider using the message from the Red Cross poster.

Call to action (Recommendations in red text)

Before and during event

NDMO does not give a message – consider using the message from the Red Cross poster.

5.3.6 Landslide

Explanation (Recommendations in red text)

NDMO does not give a message – consider using the message from the Red Cross poster.

Call to action (Recommendations in red text)

Before event

Ways to protect your house and family from landslide:

- Know the history of the area before building house and gardens
- Don't cut down too many trees in sloping areas or hill
- Plant some trees in landslide prone areas to hold the ground together
- Don't build houses or regularly occupy areas at the bottom of the hill or cliff.
- If you live in a landslide prone area identify safe place
- Don't cut slopes without engineering report on strength of materials
- Make sure water pipes don't leak

Warning sources and triggers, during event, after event; and during event

This key message text needs to be developed.

5.3.7 Floods

Explanation (Recommendations in red text)

NDMO does not give a message – consider using the message from the Red Cross poster.

Call to action

Before event

Ways to protect your house, garden and family from flooding:

- Know the history of the area before building house and gardens.
- Build stilt or floor house in low lying areas
 - There may be a translation problem with this message – NDMO should check this meaning.
- During the design of the house and garden look to include drainage system

-
- Look to include water catchment systems
-

Warning sources and triggers, during event, after event

This key message text needs to be developed.

During event

- If your house is prone to flooding think about rebuilding to higher ground
 - When river is high do not cross (eg. when the water is above your knees and fast flowing).
 - Don't let children play in flood waters
-

5.4 How and when to use key messages

The Action Plan in Part D of the Strategy recommends that all aspects of key messages need to be developed for all hazards as per the elements in Section 5.2.1.3. The correct key messages for each element of DRR phases (reduction, preparedness, response and recovery) should then be the primary message in all EIC material endorsed by the NAB for that phase. The NAB should also ensure that audience-appropriate EIC materials exist, of endorsed quality, for all DRR phases for all hazard.

5.5 Participation and community engagement

5.5.1 Community engagement for all-hazard risk reduction

Section 5.5.2 lays out a process for community based tsunami evacuation mapping, planning, exercises and warning response. This process should be conducted within the existing Community Disaster Committee (CDC) framework, and existing committees where they have been formed.

The project team recommends that CDCs in areas exposed to other high risk and very high potential risk and potential damage (see section 6 and associated risk maps of the *Hazard and Risk Maps and Geo-data Report*, dated 8 December 2015) could also adopt a similar approach to these hazards, for example:

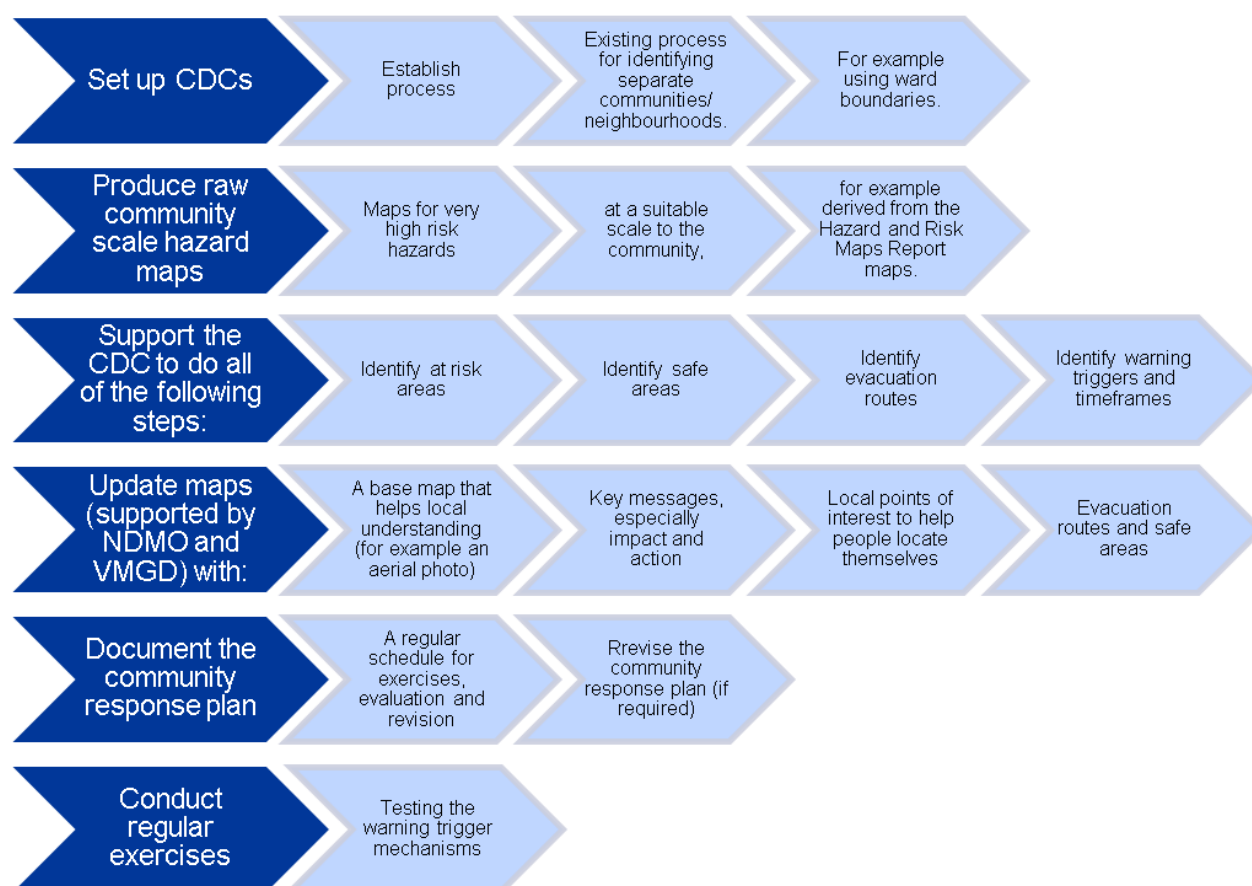
- Mele area rivers, Port Vila (100 year return, Map 44);
- Sarakata River flood plain, Luganville (100 year return, Map 47);
- Wind (500 year return, Map 51) – It should be noted however that the wind risk assessment is based on limited modelled data; and
- Coastal inundation (100 year return, Maps 52 and 53).

Earthquake risk at 500-2500 year return is also very high in many areas (maps 37-38, and 40-41). The primary mitigation is through urban planning and building standards (Section 4) because warning ahead of shaking is not currently feasible. The measures proposed to strength urban planning and building standards to address these risks are set out in the *Urban Risk Management Strategy*.

5.5.1.1 CDC community response planning

For warnable hazards, the CDC method for community response planning should be used. The process for community response planning is outlined below and was developed and ratified in five workshops in January and February 2016 in Port Vila and Luganville for tsunami.

Figure 5-1: The process for community response planning



The CDC community response planning should focus on all of the high and very high risk hazards that the community faces, with commonality where appropriate (e.g. evacuation routes and safe areas that work for more than one hazard, e.g. river flooding, coastal inundation and/or tsunami). Conversely, providing distinction where needed, for example separate maps for wind, flooding and tsunami hazards when there is the potential for different conflicting hazardous and safe locations (and evacuation routes) appropriate to each hazard.

5.5.2 Community based tsunami evacuation maps and plans

This section documents the process for CDC development of tsunami evacuation maps and plans in detail, following the general principles laid out in Section 5.5.1.1.

5.5.2.1 Calculation of evacuation zones

Please refer to Lukovic et al. (2016) for an explanation of the calculation of evacuation zone areas in GIS.

5.5.2.2 Community participation process for individual maps and plans

SOP 11 (**Appendix G**) details the engagement procedures and map modification process. It involves the use of training and facilitation powerpoints (**Appendix J**).

5.5.2.3 Preparation of evacuation maps in GIS framework

SOP 12 (**Appendix I**) details the process for preparation and completion of evacuation maps in QGIS.

5.5.2.4 Consultation of evacuation map and planning framework

Workshops were conducted to discuss and ratify the evacuation mapping and planning framework. The workshops were held between 25 January and 1 February 2016 in Port Vila and Luganville with Provincial and local authorities and with NDMO.

5.5.2.5 Roll-out plan

The plans were rolled out to communities with 30 meetings to date. Further community consultations is planned.

5.5.2.6 Sustainability

It is expected that communities will continue to run annual exercises of their tsunami evacuation plans and maps. This will focus on two clear messages: Clear the road and Test the routes.

5.5.3 Discussion of specific participation and EIC mechanisms

Four key aspects of participation and EIC were highlighted to be explored within this Project. Recommendations for these aspects are discussed here in the context of the wider MDRR activities and the action plan.

5.5.3.1 Public awareness campaigns and exercises

Public exercises can be the best education. All public awareness campaigns and exercise schedules should be planned and budgeted in terms of staff time to be sustained permanently from year to year. They should focus on hazard and call to action key messages, how the public can get more information and should be checked regularly. Checking includes that the locations of EIC materials (hard copy and digital) are suitable to discovery by the intended audience.

5.5.3.2 Training of elected and sub-national leaders

During the timeframe of this Project, facilitators have been were trained to help with the community consultation process. This training involved a three day course covering:

- An introduction to risk and hazard concepts and risk based response planning.
- The level of hazard and risk, based around hazard and risk maps.
- Urban planning and emergency management options for risk reduction – highlighting that these are two complementary tools.
- Presentation of key messages, warning arrangements, exercise plans, CDC plans (including tsunami evacuation) and tsunami signage.
- The Action Plan contained in Part D of the Strategy, especially who does what, the timeline, and expected outcomes.
- The URMS with implementation tools and pathway, potential barriers, what is needed from leaders (especially municipal boundary, zoning area, zoning plan changes, risk maps, enforcement).

The training material will be retained for use again in the future.

5.5.3.3 Safe Haven assembly points

These are included as part of the community based tsunami evacuation mapping process (above).

5.5.3.4 Low cost retrofitting of houses and community buildings, training of local contractors

The Vanuatu Building Code is very good, however, it needs to be endorsed and used. There is also value in community/individual action (the bottom up approach) supported by simple guides/messages on how to take action. Low cost retrofitting of houses and community buildings, training of local contractors are potential risk mitigation measures that target informal settlement (or don't rely on the formal land use planning system).

The booklet "*Besik Konstraksen Hanbuk blong bildim wan sef Selta - 2013*" published in Bislama after Cyclone Pam (2015) provides excellent guidance for the construction of new village style buildings. To complement this document, the action plan notes it would be worthwhile to research and write a similarly simple and accessible retrofitting (earthquake and cyclone) guideline for shelters and larger buildings.

5.6 Conclusions for Community Response

Existing EIC materials have been reviewed and the metadata has been consolidated into one spreadsheet for future NAB use. The elements of messaging for the four UNISDR DRR phases has been scored and gaps in content have been identified. Key messages have been reviewed for all project hazards and recommendations made for further work to fill gaps. Comprehensive key messages have been developed for tsunami here because of the need to include them in tsunami evacuation maps being rolled out as part of this project.

The community-based process for rolling out response plans has been summarised, with details developed for tsunami evacuation mapping, including SOPs for the process and for the preparation of maps.

The evacuation routes and other local information developed as part of the community consultation process are owned by the community. They are the most likely to be correct and used as a result, but they also cannot by this nature be verified by our project team. The framework developed here focuses on how to best support communities to draw these routes and locations themselves. The EIC materials reviewed are not assessed in terms of accuracy of their content – there is a separate process for this, namely the NAB endorsement. We do denote whether a resource has been NAB endorsed so far. Key messages have been reviewed here, which are NAB endorsed. The only messages reviewed further in terms of content are those related to tsunami. These new message components will need further NAB endorsement but they are verified as appropriate by the project team.

The recommendations in these sections are carried through into the Action Plan in **Part D – The Costed Action Plan**.

STRATEGY PART D: COSTED ACTION PLAN

Ref	Report section	Proposed activity	Responsibility <i>Owner & Actor (Individual or Agency)</i>	Timing <i>(Short 1yr, medium 2-3yr and long term <5yr)</i>	Indicative cost/resources	Expected outcome	Implementation
Urban Risk Management Strategy - Tsunami evacuation map consultation and sign installation							
SPCI 1	Part C, Section 5	Complete consultations for Port Vila and Luganville as per SOP 11 (Appendix G).	Project manager	Short	[per consultation cost] * 60?	Consultation to support tsunami response plans completed.	
SPCI 2	Part C, Section 5	Print A3 Tsunami evacuation maps for each community.	Project manager	Short	Cost for unit volume of A3 maps. And number of maps	Tsunami evacuation maps made available to each community	
SPCI 3	Part C, Section 5	Complete sign layout plans for each community.	Project manager	Short	[per sign cost] [list vendor] Evacuation zone signs Evacuation routes signs Safe Location signs Information boards	Final plans available for each community.	
SPCI 4	Part C, Section 5	Incorporate signs into Port Vila Tourism Infrastructure Redevelopment project (waterfront)	Project manager & PVTIR team	Short	Nil	Tsunami warning signs in place on the Port Vila Waterfront	Align sign location and installation considerations at least
SPCI 5	Part C, Section 5	Procure and install signs	Project manager	Short	[per sign installation cost] concrete, poles, fittings, labour. Per unit. All inclusive contract.	Signs installed.	Count signs from sign layout plan. Be aware of any issues with digging a hole and concreting a post.
SPCI 6	Part C, Section 5	Port Vila, Luganville and national exercises	Project manager	Short	Cost exercises * 3	To undertake regular tsunami evacuation exercises.	
SPCI 7	Part C, Section 5	Annual earthquake tsunami exercise every year from now on.	NDMO & VMGD	ONGOING	Cost exercises	To undertake annual earthquake tsunami exercise	At a minimum have all coastal schools participate.
SPCI 8	Part C, Section 5	Support of two pilot community consultations	NDMO & VMGD support from GNS Science	Short	Flights and costs for a few days to surround two back to back consultations and provide mentoring	Community consultation supported by GNS consultant.	

Ref	Report section	Proposed activity	Responsibility <i>Owner & Actor (Individual or Agency)</i>	Timing <i>(Short 1yr, medium 2-3yr and long term <5yr)</i>	Indicative cost/resources	Expected outcome	Implementation
SPCI 9	Part C, Section 5	Investigate feasibility of vertical evacuation for Ifira, Yacht club area, ports/mama's market, Mele. Luganville coast west of river, etc.	NDMO & VMGD support from GNS Science & Beca	Short	Contract cost	Feasibility of evacuation for specific areas confirmed and available to inform decision making.	- Desktop needs analysis - consider number of people and time to safety - Consult communities - Inform private locations (e.g. Hideaway) - Specify structure design options. - New 2016 FEMA guidance - Raised armoured land/berms - Structural steel platforms - Multi-use reinforced concrete buildings with ramps - Narrow ramp building over Mama's market that integrates with cliff stabilisation and access to cliff top. - Approach donors - Consider communications and welfare needs for several days on the structure
					Subtotal costs: - Costs for consultations and exercises - Contract costs - NDMO and VMGD staff time - costs for resources		
Urban Risk Management Strategy - Other community based CDC consultations							
SPCI 10	Part C, Section 5	Target high and very high hazard communities (E.g. very high risk cases with warning response actions – flooding, coastal inundation, wind)	NDMO & VMGD	Medium	[per consultation cost]	Community response plans prepared for high and very high flooding, wind, coastal inundation, landslide hazard CDC areas.	Implemented for high and very high hazard CDC areas for flooding, wind, coastal inundation, landslide
Urban Risk Management Strategy - Additional EIC materials and key messages for all hazards							
SPCI 11	Part C, Section 5	All hazards – hazard and risk map interpretation for the public, urban planning interpretation support documents (short, plain language, with images and examples)	NDMO & VMGD with NGOs	Medium	development cost per resource	Information that fills current gaps available for the public.	- Simple resources repackaging hazard and risk maps - Urban planning fact sheets/ information packs/ resources for planning officers, developers, informal settlements via NGOs/community groups
SPCI 12	Part C, Section 5	Coastal Inundation – Everything other than hazard and risk needs to be written. Even the hazard and risk material isn't for the public. One could argue that a lot of cyclone advice holds for non-cyclone surge.	NDMO & VMGD with NGOs?	Medium	development cost per resource	Information that fills current gaps available for the public.	Print and web-based materials
SPCI 13	Part C, Section 5	Earthquake – Urban planning information for all audiences; Structural guidance (stronger buildings); Further information on the website;	NDMO & VMGD with NGOs?	Medium	development cost per resource	Information that fills current gaps available for the public.	Print and web-based materials

Ref	Report section	Proposed activity	Responsibility <i>Owner & Actor (Individual or Agency)</i>	Timing <i>(Short 1yr, medium 2-3yr and long term <5yr)</i>	Indicative cost/resources	Expected outcome	Implementation
SPCI 14	Part C, Section 5	Flooding – Urban planning information, Structural guidance (stronger buildings, flood engineering); Forecasting. Further information on the website; glossary	NDMO & VMGD with NGOs?	Medium	development cost per resource	Information that fills current gaps available for the public.	Print and web-based materials
SPCI 15	Part C, Section 5	Landslide – Risk maps; Forecasts; glossary	NDMO & VMGD with NGOs?	Medium	development cost per resource	Information that fills current gaps available for the public.	Print and web-based materials
SPCI 16	Part C, Section 5	Tsunami - Options for structural and natural mitigation.	NDMO & VMGD with NGOs?	Medium	Development cost per resource	Information that fills current gaps available for the public.	- vertical evacuation buildings, - sea walls (generally unaffordable and not advised), - dune restoration and planting (generally only effective for smaller tsunami)
SPCI 19	Part C, Section 5	Building code implementation support documents (short, plain language, with images and examples)	MIPU with Beca	Medium	Contract costs	Easy to read guide guides suitable for developers and Council officers.	- Guide for developers - Guide for Council officers - Guide for inspection officer
SPCI 20	Part C, Section 5	Write retrofitting (earthquake and cyclone) guideline for shelters and larger buildings.	MIPU with Beca	Medium	Contract costs	Easy to read guide for	Note the validated simple shelter construction handbook from Red Cross
SPCI 21	Part C, Section 5	Publish all existing and new resources, in print and across all repositories	NDMO & VMGD with NGOs?	Short (existing) Medium (new)	Printing costs, staff time to upload and validate	All resources available in print and soft copy.	- Upload to NAB portal - Submit for NAB endorsement - Print - Add to website
SPCI 22	Part C, Section 5	Regularly check that the locations of EIC materials (hard copy and digital) are suitable to discovery by the intended audience	NDMO & VMGD	ONGOING	Staff time	Resource available to intended audience.	
SPCI 23	Part C, Section 5	Regular education campaigns	NDMO & VMGD	ONGOING	Staff time and resources	Increased awareness of hazards	- Hazard and call to action key messages - How to get more information
SPCI 24	Part C, Section 5	Write additional key messages	NDMO & VMGD	Short	Staff time	Key messages available for use in education campaigns.	- Messages for tsunami, coastal inundation, landslide, earthquake, flood - Covering: hazard description (for most hazards – some exist), risk, urban planning, options for structural/natural mitigation, pre-event preparedness (for most hazards – some exist), how to use maps, after event instructions, recovery/build-back-stronger. - Add to website (below)
					Subtotal costs: - Development costs for resources - Contract costs - NDMO and VMGD staff time		

Ref	Report section	Proposed activity	Responsibility <i>Owner & Actor (Individual or Agency)</i>	Timing <i>(Short 1yr, medium 2-3yr and long term <5yr)</i>	Indicative cost/resources	Expected outcome	Implementation
Urban Risk Management Strategy - Multihazard warning system							
SPCI 25	Part C, Section 5	Procure and install sirens	Project manager & vendor	Short	Per siren cost * number of sirens	Tsunami evacuation sirens installed	
SPCI 26	Part C, Section 5	Procure and implement system for triggering sirens	Project manager & vendor	Short		System for triggering sirens operational	
SPCI 27	Part C, Section 5	Procure and implement CAP warning origination system and RSS feeds	Project manager & programmer/ provider	Short	Potentially free if one of 3 free tools is used; need resource of staff member and likely some coding cost	CAP warning origination system and RSS feeds operational	- Username and password protected - Delivers validated CAP to VMGD RSS feed - Register alerting authorities with WMO OID Register - Get WMO, FIA and Google Alert Hubs to propagate RSS feed(s)
SPCI 28	Part C, Section 5	Engage and implement smartphone application system	Project manager & provider	Short	Potentially free; need resource of staff member	Smartphone application system operational	
SPCI 29	Part C, Section 5	Procure and implement platform to deliver to other alerting end points – SMS Email, web apps inc. FB Twitter	Project manager & vendor	Short	Coding cost and staff member resource	Alerts available via other end points	
SPCI 30	Part C, Section 5	Implement connection to deliver to TV & audio	Project manager & Gencom Technology	Short	Costed and contracted	TV and radio alert system operational	- Scrolling full screen - Graphics Character Generator (crawl)
SPCI 31	Part C, Section 5	Website development	Project manager & vendor with NAB or VMGD website(s)	Short	Coding cost and staff member resource	Updated website	- Alerting end point - Add all EIC and key messages for all hazards on website
SPCI 32	Part C, Section 5	Write templates for each hazard for each warning level	Project manager with NDMO & VMGD	Short	Staff time	Templates available for each hazard for each warning level	Draw upon key messages
					Subtotal costs: - Some items potentially free - Siren costs - Contract costs for TV and radio alert system - NDMO and VMGD staff time		
Urban Risk Management Strategy - Supporting implementation of the URMS							
URMS 33	Part B	Urban Risk Management Strategy implementation mentoring for DLA and Council consultations	DLA to manage Beca to deliver	Short	Flights and costs for 4 visits by Urban Planner 160 hours in total Time = \$40,000 Disbursements = \$10,500	To provide mentoring and revised actions as the strategy is implemented	- Staff mentoring - Assistance with Council consultations - Assistance with scoping and work programming - Technical reviews

Ref	Report section	Proposed activity	Responsibility <i>Owner & Actor (Individual or Agency)</i>	Timing <i>(Short 1yr, medium 2-3yr and long term <5yr)</i>	Indicative cost/resources	Expected outcome	Implementation
URMS 34	Part A, Section 1.2	Make mapping data and maps available across local and national government agencies	VMGD and DLA	Short	VMGD staff time DLA staff time	To make hazard and risk information readily available to local and national government staff to assist with decision making.	• Hard copy and PDF copies of maps provided • Practical guidance document for how to use maps • Maintain GIS data on the VMGD server • Provide training on how to use maps and data. • GIS training – link to Tim’s work • Ideas on how to use information - Discuss with Dave
URMS 25	Part A, Section 1.2	Make urban growth, hazard and risk information available to stakeholders (agencies, NGOs, public) through the NAB portal.	VMGD NAB portal administrator	Medium to long-term	VMGD staff time Web expertise	To disseminate hazard and risk information to the public so that they can use the information to make informed decisions regarding individual risk.	• Upload existing reports and maps to NAB portal • Upload new materials as they are developed. • Communicate to stakeholders that materials are available
URMS 36	Growth Trends Report	Urban growth information – work with National Statistics Office to refine Census enumeration districts – in particular large units on urban area periphery.	DLA PPU National Statistics Office	Medium	DLA staff time National Statistics Office staff time	To refine the census enumeration districts to improve the reporting of urban growth in the future. To continue data collection relating to urban structures that can improve the accuracy of future risk assessments.	•
					Subtotal costs: • Consultant costs- \$50,500 • DLA, National Statistics Office and VMGD staff time • Web expertise		
Urban Risk Management Strategy - Changes to Legislation							
URMS 37	Part B, Section 4.2	Amend the Physical Planning Act: • Purpose of the Act • Section 1 – Interpretation (use classes) • Section 2 – Physical Planning Areas • Section 3 - Plans • Section 4 – Development in a physical planning area • Section 5 – Application for planning permission	DLA	Short	DLA staff time Legal advisor	To incorporate the concept of resilience within the Act and strengthen decision making responding to risk under the Act. Clarification to requirement to produce plans to make clear they are zoning plans which also show road hierarchy and non-development high hazard areas	• Confirm proposed changes • Workshops with Councils to confirm requirements. • Draft changes and bill – seek formal input and feedback • Formal process/sign-off • Enact changes • Train implementers on changes

Ref	Report section	Proposed activity	Responsibility <i>Owner & Actor (Individual or Agency)</i>	Timing <i>(Short 1yr, medium 2-3yr and long term <5yr)</i>	Indicative cost/resources	Expected outcome	Implementation
URMS 38	Part B, Section 4.2	Amend the Land Lease Act: 31 – Leases 32A – Application of sections 32B and 32C 38 – Purpose and development conditions.	Dept of Lands	Short	Department of Lands staff time Legal advisor	To strengthen decision making under the Act to respond to risk. Clarification that leases for certain forms of development will generally not be entertained in high hazard areas.	- Confirm proposed changes - Draft changes and bill - Enact changes
					Subtotal costs: DLA and Department of Lands staff time Costs for legal advisor		
Urban Risk Management Strategy - National Policy							
URMS 39	Part B, Section 4.3	Develop a Vanuatu National Urban Policy building on and superseding the existing Vanuatu Land Use Planning and Zoning Policy.	DLA to lead	Short	DLA staff time Urban Planning advisor Flights and costs for 2 visits by Urban Planning advisor 80 hours in total Time = \$20,000 Disbursements = \$5,000	To provide national direction to decision making on the development and management of the Country's urban areas.	- Amend the policy document to address gaps and strengthen risk responses. - Workshop the policy with key stakeholders. - Formally endorse the policy
					Subtotal costs: DLA staff time Urban planning advisor - \$25,000		
Urban Risk Management Strategy - Physical Planning Areas							
URMS 40	Part B, Section 4.2	Identify current Declared Physical Planning Areas and declare additional areas where these are subject to high or very high risk and population growth.	Councils with support from DLA	medium	DLA staff time Mapping resources (GIS)	To more clearly document existing Physical Planning Areas. To use the Physical Planning Areas to manage risk in areas subject to high or very high risk and areas of growth.	- All existing physical planning areas to be mapped and displayed - All Urban areas of High to extreme risk to be identified. - All areas of existing and potential population growth within these areas identified. - Additional areas identified and process to declare them as physical planning areas. - Determine types of development that needs to be restricted in these areas to respond to risk.
					Subtotal costs: DLA staff time GIS mapping costs		

Ref	Report section	Proposed activity	Responsibility <i>Owner & Actor (Individual or Agency)</i>	Timing <i>(Short 1yr, medium 2-3yr and long term <5yr)</i>	Indicative cost/resources	Expected outcome	Implementation
Urban Risk Management Strategy - Zoning Plans							
URMS 42	Part B, Section 4.4	Prepare a new zoning plan for the Greater Port Vila areas to respond to risk mapping and urban growth findings.	PVMC and SHEFA Provincial Council with support from DLA.	Short - Medium	DLA staff time PVMC staff time SHEFA Provincial Council staff time Urban Planning advisor Mix of in-country support during other visits plus remote review/monitoring Allow 80 hours remote time Time = \$20,000	To have a risk based zoning plan in place for Port Vila that can guide decision making.	- SHEFA and Port Vila Councils to agree approach including the boundaries of the combined zoning plan. - Identify transport corridors, business nodes, critical infrastructure, future growth areas, hazards etc. - Confirm land use zones. - Confirm restrictions applying to zones and prepare schedules for zones. - Adopt the zoning plan.
URMS 41	Part B, Section 4.4	Amend the existing draft Luganville zoning plan to respond to risk mapping and urban growth findings including: - Redefining the boundaries of the zoning plan to include high and very high risk area (eg. Pale Kula Bay) - Identifying high flood, seismic, costal inundation and tsunami risk areas and the development restrictions that apply to these areas. - Zoning existing development areas and areas of likely future growth.	LMC and Sanma Provincial Council with support from DLA.	Short	DLA staff time LMC staff time Sanma Provincial Council staff time Urban Planning advisor Mix of in-country support during other visits plus remote review/monitoring Allow 80 hours remote time Time = \$20,000	To have a risk based zoning plan in place for Luganville that can guide decision making.	- Sanma and Luganville Municipal Councils to agree approach. - Identify areas of high risk. - Revise zoning plan to incorporate additional areas of potential future growth and areas subject to high risk. - Agree development restrictions that apply to each zone. - Develop rules for each zone. - Adopt the zoning plan
					Subtotal costs: - DLA , PVMC and SHEFA & Sanma Provincial Council staff time - Urban Planning advisor - \$40,000		
Codes and Permits							
URMS 43	Part B, Section 4.5	Adopt the proposed Building Code.		Short	MIPU staff time Legal advisor	To have a building code in place that can be consistently administered, monitored and enforced.	- Adopt the draft building code - Train those administering the code - Produce a simple to use guide for developers - Monitor the implementation of the code
URMS 44	Part B, Section 4.5	Prepare materials to support the assessment of permit applications including a risk and hazard assessment which is to be completed by the applicant and reviewed by the responsible authority.		Short	DLA staff time	To provide a consistent and robust permit assessment process that responds appropriately to risk.	Prepare check sheets for development and building permit process.
					Subtotal costs: - MIPU and DLA staff time - Costs for legal advisor		

Ref	Report section	Proposed activity	Responsibility <i>Owner & Actor (Individual or Agency)</i>	Timing <i>(Short 1yr, medium 2-3yr and long term <5yr)</i>	Indicative cost/resources	Expected outcome	Implementation
Other actions – extending hazard and risk modelling and assessment							
Other 1		Expand flood mapping to cover Teouma catchment Update hazard and risk maps with new data	VMGD to manage NIWA and GNS Science		25 hours remote time \$4,300	To assess flood risk for the Teouma catchment Updated hazard and risk maps for Port Vila	Develop metadata, include hazard in existing flood maps, develop risk and update risk maps.
Other 2		Develop model for tsunami wave height at coast for rest of Vanuatu including creating a Solomon Trench source.	GNS Science	Short	125 hours remote time \$21,500	Wave heights at the coast for all of Vanuatu that will be used by future evacuation zone modelling.	- Develop and run Solomon Trench source model - Develop database of wave amplitude estimates for all areas of Vanuatu - Note the alternative is to use a pessimistic maximum wave height estimate of 35 m but this could cause over-evacuation in an event.
Other 3		Develop tsunami evacuation zones for areas where LiDAR is already available (East Santo, East Malekula, North Efate). Investigate feasibility of using lower resolution elevation data for West Tanna (an area identified by VMGD as being of interest).	GNS Science	Short	125 hours remote time \$20,000	To provide tsunami evacuation zones covering all existing areas of LiDAR that can be used by VMGD to develop tsunami evacuation maps and guide community response planning.	- Requires input from 2 above or would use 35 m pessimistic wave height assumption - Develop evacuation zones as for Port Vila and Luganville - Develop and test methodology for areas where LiDAR is not available - Deliver zones with metadata and short explanatory note
Other 4		Develop tsunami evacuation zones for other populated areas using lower resolution elevation data and methodology developed for West Tanna.	GNS Science	Short/Medium	Dependent on success of above Tanna feasibility project 225 hours remote time \$38,000	Evacuation zones covering all existing areas of LiDAR than can be used by VMGD to develop tsunami evacuation maps.	- Assumes cost-effective methodology can be developed - Develop evacuation zones as for Port Vila and Luganville - Deliver zones with metadata and short explanatory note
Other 5		Develop tsunami evacuation maps and undertake community consultations for new areas.	VMGD	Short/Medium	VMGD to cost	Evacuation maps and community consultations using the methodology already developed in Port Vila and Luganville will raise community awareness to the issues and safe zones.	- Create tsunami evacuation maps using templates - Undertake community consultations
Other 6a		Extend hazard and risk mapping to cover North Efate LiDAR extent: - seismic including amplification, liquefaction and landslide -training counterparts in methodology of above	GNS Science	Short/Medium	\$12,000 (65 hours remote) \$12,000 (time) plus \$4200 (disbursements)	Hazard and risk maps as developed for Port Vila and Luganville	Counterpart training in developing site class, liquefaction and landslide hazard maps spread over 3 days in Port Vila

Ref	Report section	Proposed activity	Responsibility Owner & Actor (Individual or Agency)	Timing (Short 1yr, medium 2-3yr and long term <5yr)	Indicative cost/resources	Expected outcome	Implementation
Other 6b		Extend hazard and risk mapping to cover North Efate LiDAR extent: - tsunami inundation modelling, hazard and risk maps and data delivery	GNS Science	Short/Medium	\$27,000 (159 hours remote), reduced by \$3,600 if ‘Other 2’ task is funded as this requires Solomons source model to be developed.	Hazard and risk maps as developed for Port Vila and Luganville	Tsunami inundation would require the development of the Solomon’s Trench source and availability of good bathymetric data.
Other 6c		Extend hazard and risk mapping to cover North Efate LiDAR extent: - coastal inundation modelling - coastal hazard and risk maps and datasets	NIWA GNS Science	Short/Medium	\$6,000 (remote time) \$4,300 (25 hours remote)	Hazard and risk maps as developed for Port Vila and Luganville	- NIWA models coastal inundation. - GNS develops hazard and risk maps and delivers data in suitable form.
Other 6d		Extend hazard and risk mapping to cover North Efate LiDAR extent: - flood modelling - flood hazard and risk maps and datasets	NIWA GNS Science	Short/Medium	\$27,000 (time) plus \$3000 (disbursements) \$4,300 (25 hours remote)	Hazard and risk maps as developed for Port Vila and Luganville	- NIWA undertakes site visit - NIWA models flood. - GNS develops hazard and risk maps and delivers data in suitable form.
Other 6e		Extend hazard and risk mapping to cover North Efate LiDAR extent: - wind	GNS Science	Short/Medium	\$4,300 (25 hours remote)	Hazard and risk maps as developed for Port Vila and Luganville	Develop risk maps and datasets using existing wind hazard information
					Subtotal costs: Consultant costs - \$184,900 VMGD costs for tsunami evacuation maps and consultations		
Mapping (GIS) support							
Other 7		- Integrate the National Tsunami safety zone datasets (to be supplied under the MDRR) and support the production of Tsunami safety maps for designated priority areas around the country (in addition to the pilot urban areas) - Support DLA and NDMO to implement and roll out its national village profiling program to help enable the addressing of critical spatial data gaps as outlined below (bullets 4 & 5) - Continue to develop the National village profiling database and data entry system and integrate this into VanMap and update the spatial datasets outlined below (bullets 4 & 5) - Develop a system for integrating the national profile data and updating the building footprint dataset including current use and building construction data - Continue to work towards a national, accurate dataset for settlements villages using the national village profile datasets and methodology developed in the pilot areas (Tanna) - Train, integrate and support use of Inasafe and Pacific Riskscape (new project) within stakeholder agencies and	VMGD to manage	Long	Travel \$19,000 Salary \$220,000 Per Diem \$85,000		This is an on-going local support role involving 15 months activity and 10 visits spread over 3 years

Ref	Report section	Proposed activity	Responsibility <i>Owner & Actor (Individual or Agency)</i>	Timing <i>(Short 1yr, medium 2-3yr and long term <5yr)</i>	Indicative cost/resources	Expected outcome	Implementation
		customise these to suit Vanuatu requirements where necessary • Promote closer ties with crowd (open) source mapping systems (OSM/HOT etc.) to enable spatial data gaps to be filled more efficiently • Continue to develop the national web-based mapping system (VanMap) and integrate NDMO/VMGD/DLA data into this system • Continue to promote and develop the NSDI • Continue to support the GIS users group • Continue to develop SOPs and provide ongoing training for all of the above					
					Subtotal costs: • Consultant costs- \$324,000		

6 References

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Appendix A - Guidance note for using the hazard and risk maps

Hazard and Risk Maps: Risk Mapping and Planning for Urban Preparedness

Contents

About these maps	1
Maps and report	2
Using the risk and hazard maps	4
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About these maps

This USB contains the Hazard and Risk Maps that were created for the Port Vila and Luganville study areas under the Risk Mapping and Planning for Urban Preparedness Project as part of the Mainstreaming Disaster Risk Reduction Project (MDRR) implemented by the Vanuatu Meteorology and Geohazards Department (VMGD). The work was undertaken by Beca International Consultants Ltd (Beca), GNS Science and the National Institute of Water and Atmospheric Research (NIWA).

The hazards covered are seismic, river flood, wind, coastal inundation and tsunami. Maps showing the severity of each of these hazards have been prepared for various mean return periods from 10 to 2500 years depending on the hazard and the data available. Following compilation of the hazard maps, an urban risk assessment was undertaken and risk maps were produced for each hazard for the various return periods.

In this study we have defined risk as a function of the likelihood of a hazard event occurring and the consequence resulting from that event. The risk maps implemented a semi-quantitative methodology using the available fragility functions to estimate the level of damage resulting from the different hazards in a quantitative way but describing the results using qualitative terms such as 'Insignificant', 'Very Light to Light', 'Moderate', 'Heavy', and 'Very Heavy' potential damage. Associated with these damage descriptors are more detailed consequence descriptions. Related qualitative terms such as 'Very Low', 'Low', 'Moderate', 'High' or 'Very High' are used to describe the potential risk. Each of these potential damage and risk terms has been assigned a colour and all risk maps use the same descriptors and colours.

Multi-risk maps for the 100 year mean return period were developed that depict the overall level of maximum risk from at least one hazard at that return period. The multi-risk maps indicate the maximum relative risk associated with developing in a particular area. The multi-risk map shows the maximum risk from earthquake, wind, flood and coastal inundation. It should be noted that flood risk is available only for the Mele catchment and part of the Sarakata catchment.

While the multi-risk maps show the maximum level of risk, the individual risk maps are required to understand the source of the maximum risk. Once the source of the maximum risk is identified, the appropriate hazard maps can be used to look at the severity of the hazard expected in an area. If the expected level of the hazard would adversely affect the proposed development, thought could be given to the mitigation options that might be available to reduce the impact of the hazard. If mitigation is not an option, the hazard maps will be useful in determining what other land uses are more compatible with the expected levels of hazard. It is recommended that the risk and hazard maps for both longer and shorter return periods also be considered as these will provide information on the severity of the hazard event expected at other return periods.

Maps and report

Use this link to open the [report](#).

The table on the following pages lists all the available maps and the Map number provides a link to open the appropriate map.

Map	Theme	Map Title
1	Seismic hazard	PGA 100 year mean return period on rock - Vanuatu
2	Seismic hazard	PGA 500 year mean return period on rock - Vanuatu
3	Seismic hazard	PGA 2500 year mean return period on rock - Vanuatu
4	Seismic hazard	Inferred site class - Port Vila study area
5	Seismic hazard	Inferred site class – Luganville study area
6	Seismic hazard	Expected MMI (modified for Inferred Site Class) for 100 year mean return period Port Vila study area
7	Seismic hazard	Expected MMI (modified for Inferred Site Class) for 500 year mean return period Port Vila study area
8	Seismic hazard	Expected MMI (modified for Inferred Site Class) for 2500 year mean return period Port Vila study area
9	Seismic hazard	Expected MMI (modified for Inferred Site Class) for 100 year mean return period Luganville study area
10	Seismic hazard	Expected MMI (modified for Inferred Site Class) for 500 year mean return period Luganville study area
11	Seismic hazard	Expected MMI (modified for Inferred Site Class) for 2500 year mean return period Luganville study area
12	Seismic hazard	Inferred liquefaction susceptibility – Port Vila study area
13	Seismic hazard	Inferred liquefaction susceptibility – Luganville study area
14	Seismic hazard	Inferred landslide susceptibility – Port Vila study area
15	Seismic hazard	Inferred landslide susceptibility – Luganville study area
16	River flood hazard	Maximum flood depth for 10 year mean return period flood – Port Vila study area
17	River flood hazard	Maximum flood depth for 50 year mean return period flood – Port Vila study area
18	River flood hazard	Maximum flood depth for 100 year mean return period flood – Port Vila study area
19	River flood hazard	Maximum flood depth for 10 year mean return period flood – Luganville study area
20	River flood hazard	Maximum flood depth for 50 year mean return period flood – Luganville study area
21	River flood hazard	Maximum flood depth for 100 year mean return period flood – Luganville study area
22	River flood hazard	Maximum flood velocity for 10 year mean return period flood – Port Vila study area
23	River flood hazard	Maximum flood velocity for 50 year mean return period flood – Port Vila study area
24	River flood hazard	Maximum flood velocity for 100 year mean return period flood – Port Vila study area
25	River flood hazard	Maximum flood velocity for 10 year mean return period flood – Luganville study area
26	River flood hazard	Maximum flood velocity for 50 year mean return period flood – Luganville study area
27	River flood hazard	Maximum flood velocity for 100 year mean return period flood – Luganville study area
28	Wind hazard	1-minute sustained wind speed for 50 year mean return period - Vanuatu
29	Wind hazard	1-minute sustained wind speed for 100 year mean return period – Vanuatu
30	Wind hazard	1-minute sustained wind speed for 250 year mean return period - Vanuatu
31	Wind hazard	1-minute sustained wind speed for 500 year mean return period - Vanuatu
32	Coastal Inundation hazard	Coastal inundation exposure zones – Port Vila study area

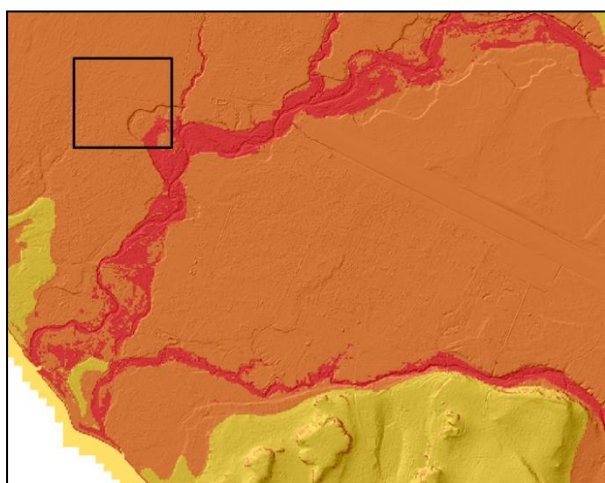
Map	Theme	Map Title
33	Coastal Inundation hazard	Coastal inundation exposure zones – Luganville study area
34	Tsunami hazard	Tsunami inundation depth (maximum of all scenarios) – Port Vila study area
35	Tsunami hazard	Tsunami inundation depth (maximum of all scenarios) – Luganville study area
36	Seismic risk	Seismic risk for 100 year mean return period – Port Vila study area
37	Seismic risk	Seismic risk for 500 year mean return period – Port Vila study area
38	Seismic risk	Seismic risk for 2500 year mean return period – Port Vila study area
39	Seismic risk	Seismic risk for 100 year mean return period – Luganville study area
40	Seismic risk	Seismic risk for 500 year mean return period – Luganville study area
41	Seismic risk	Seismic risk for 2500 year mean return period – Luganville study area
42	River flood risk	Flood risk for 10 year mean return period – Port Vila study area
43	River flood risk	Flood risk for 50 year mean return period – Port Vila study area
44	River flood risk	Flood risk for 100 year mean return period – Port Vila study area
45	River flood risk	Flood risk for 10 year mean return period – Luganville study area
46	River flood risk	Flood risk for 50 year mean return period – Luganville study area
47	River flood risk	Flood risk for 100 year mean return period – Luganville study area
48	Wind risk	Wind risk for 50 year mean return period
49	Wind risk	Wind risk for 100 year mean return period
50	Wind risk	Wind risk for 250 year mean return period
51	Wind risk	Wind risk for 500 year mean return period
52	Coastal Inundation risk	Coastal inundation risk for 100 year mean return period – Port Vila study area
53	Coastal Inundation risk	Coastal inundation risk for 100 year mean return period – Luganville study area
54	Tsunami Inundation Risk	Tsunami risk (maximum of all scenarios) – Port Vila study area
55	Tsunami Inundation Risk	Tsunami risk (maximum of all scenarios) – Luganville study area
56	Maximum Combined Risk	Combined maximum risk for 100 year mean return period – Port Vila study area
57	Maximum Combined Risk	Combined maximum risk for 100 year mean return period – Luganville study area

Using the risk and hazard maps

Step 1: Determine the level of potential risk

Consult the combined risk maps (Map 56 for Port Vila, Map 57 for Luganville). These maps show the maximum risk from all hazards for the 100 year mean return period.

In this example the area being considered for development outlined in black.



Sample of maximum risk map showing the highest risk from all hazards. The black square represents an area being considered for development.

POTENTIAL RISK	VERY LOW	LOW	MODERATE	HIGH	VERY HIGH
POTENTIAL DAMAGE	IN SIGNIFICANT	VERY LIGHT - LIGHT	MODERATE	HEAVY	VERY HEAVY

Legend for maximum risk map plus and all other risk maps.

The area being considered falls into both the VERY HIGH and HIGH potential risk zones at the 100 year mean return period. Any development of the site must be compatible with these levels of potential risk.

Step 2: Is the proposed land use incompatible with the risk?

Some types of land use are compatible with very high levels of risk and some are not compatible with even moderate levels of risk. Often it depends on the nature of the risk rather than its severity. It must be remembered the risk maps show the risk based on a simulated spread of typical buildings and inferred construction styles. The maps do not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity.

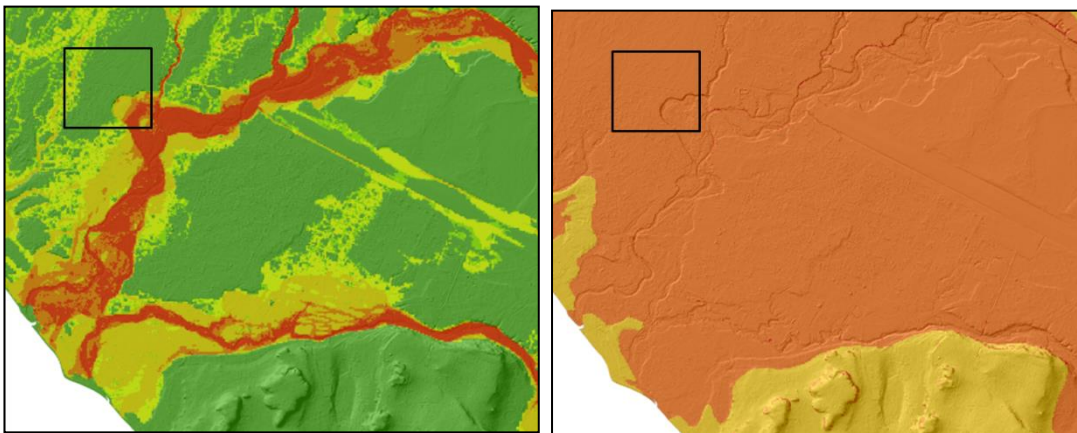
The maps cannot show the risk to all possible land uses and are not useful for assessing the risk for land uses such as cattle farming or cropping.

Look at the individual risk maps to determine which hazards are creating these potentially high levels of risk. Even if the maximum potential risk is low it is recommended that the individual risk maps are consulted to be sure the land use is compatible with the risk.

Step 3: Are any of the individual risks is incompatible?

If any of the individual risk maps shows a level of risk that is incompatible with the proposed development it will be necessary to look at the individual hazard maps associated with that risk map to determine what is causing the risk.

After looking at all of the individual risk maps associated with our example it is easy to see that the river flood risk map is the reason the lower right corner of the proposed development is in a VERY HIGH risk area and it is the seismic risk map that is responsible for the remainder of the development being in the HIGH risk area. Looking closely at flood risk we can see that on the left side of the proposed development an area of MODERATE AND LOW risk that did not show up on the combined maximum risk map because the risk from flood was less than the seismic risk. This information should not be ignored as even low levels of risk from some hazards may be incompatible with some proposed developments.

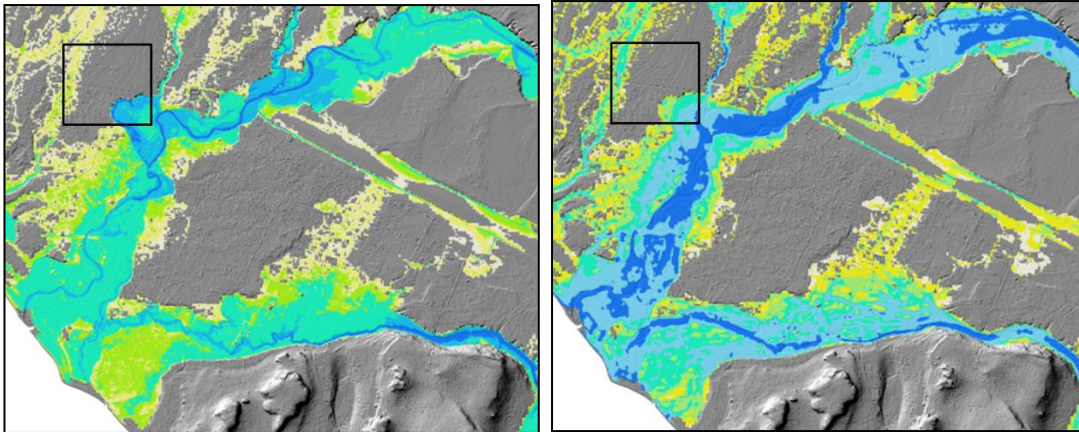


Flood risk map (left) and seismic risk map (right) for the area of the proposed development. Note that there is a flood risk present on the left side of the proposed development which does not show up in the maximum risk map.

Step 4: Look at the appropriate hazard maps to determine if the risk is compatible with the development, can be proven to be less than shown on the maps, or can be mitigated?

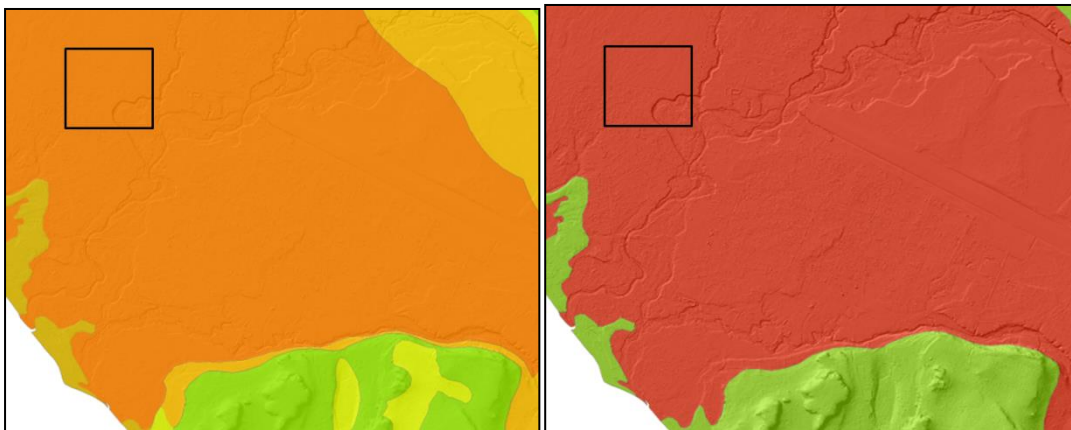
To understand whether the proposed development is compatible with the expected flood levels and the severity of ground shaking it is necessary to look at the underlying hazard maps to determine the expected severity of hazard. If the severity of the hazard is compatible with the development then it can proceed. If not it may be possible to undertake work to show the level of hazard (and therefore the associated risk) is lower. Another option is to consider if it is possible to mitigate the hazard by allowing for it in the way the development is designed.

The flood depth and the flood velocity maps will help to determine if the flood hazard is compatible with the proposed land use. It is unlikely that any new flood modelling work will show the hazard to be less than on these maps but it may be possible to design the development to mitigate the flood hazard. Stop banks are one method of protecting land from flood but raising floor levels is an option if flood depths and velocities are not too high



Flood hazard maps showing depth of flooding (left) and flood velocity (right).

The high level of potential seismic risk is the result of the proposed development being in an area of potentially thick soils as well as being in an area where liquefaction is considered possible. As discussed in the full report, these maps are based on inferred material properties and it is possible that geotechnical testing could prove the sediments to be sufficiently shallow so as to not amplify shaking and to be coarse-grained enough to not easily liquefy.



Site class map (left) showing the proposed development is in the Orange zone where the soils are considered to be Deep or Soft and are likely to amplify earthquake shaking. The proposed development is also in the Red zone of the Liquefaction Susceptibility map (right) which is considered to have a High susceptibility to liquefaction.

Summary:

In summary, using the 100 year mean return period combined risk map it is possible to see the overall level of risk for a particular area. It is then necessary to consult the individual 100 mean return period risk maps to understand the source of the risk. These individual risk maps will also be useful in illustrating lower levels of risk that might be important to consider for some proposed developments. Once the source of the risk is identified, the 100 year mean return period hazard maps can be used to look at the likely severity of hazard expected at the site. If the expected level of hazard is such that it would prevent the proposed development thought could be given to the mitigation options that might be available to reduce the impact of the hazard. Building controls could be used to ensure buildings are able to withstand the severity of the hazard. If mitigation is not an option, the hazard maps will be useful in determining what other land uses are more compatible with the expected levels of hazard.

It is recommended that the risk and hazard maps for both longer and shorter return periods be considered as these will provide information on the severity of hazard events expected with a reasonable likelihood of occurring during the life time of a building or person.

Limitations and warnings

This information has been prepared on the specific instructions of our Client. It is solely for our Client's use for the purpose for which it is intended in accordance with the agreed scope of work. Any use or reliance by any person contrary to the above, to which we have not given its prior written consent, is at that person's own risk.

The hazard information depicted on the maps is based on models and assumptions that have been fully documented in the accompanying report. Validation of the results has been difficult because of a lack of historic data.

The potential risk / potential damage information depicted on the maps is based on models and assumptions that have been fully documented in the accompanying report. Validation of the results has been difficult because of a lack of historic data. The risk modelling was based on a simulated spread of typical buildings and inferred construction styles. The maps do not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity.

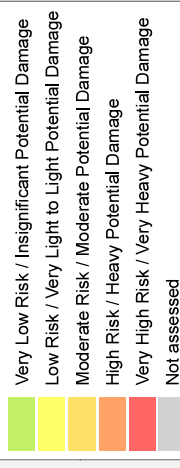
Users of maps and data are advised to treat the results with caution. They should not be used or relied upon for any work for which detailed site-specific investigations are normally required. The spatial accuracy of the datasets varies from +/- 5 m to more than 100m and these details are provided in the accompanying report. The maps are intended to assist planners and other stakeholders in making strategic-level planning decisions. Large developments or those which include buildings of local, regional or national importance or buildings that may contain large numbers of people or buildings with special post disaster functions require major site specific assessments of both hazard and risk.

Appendix B - Hazard risk maps and combined risk map for Port Vila

Potential Risk from River Flood 100 year mean return period Port Vila Study Area

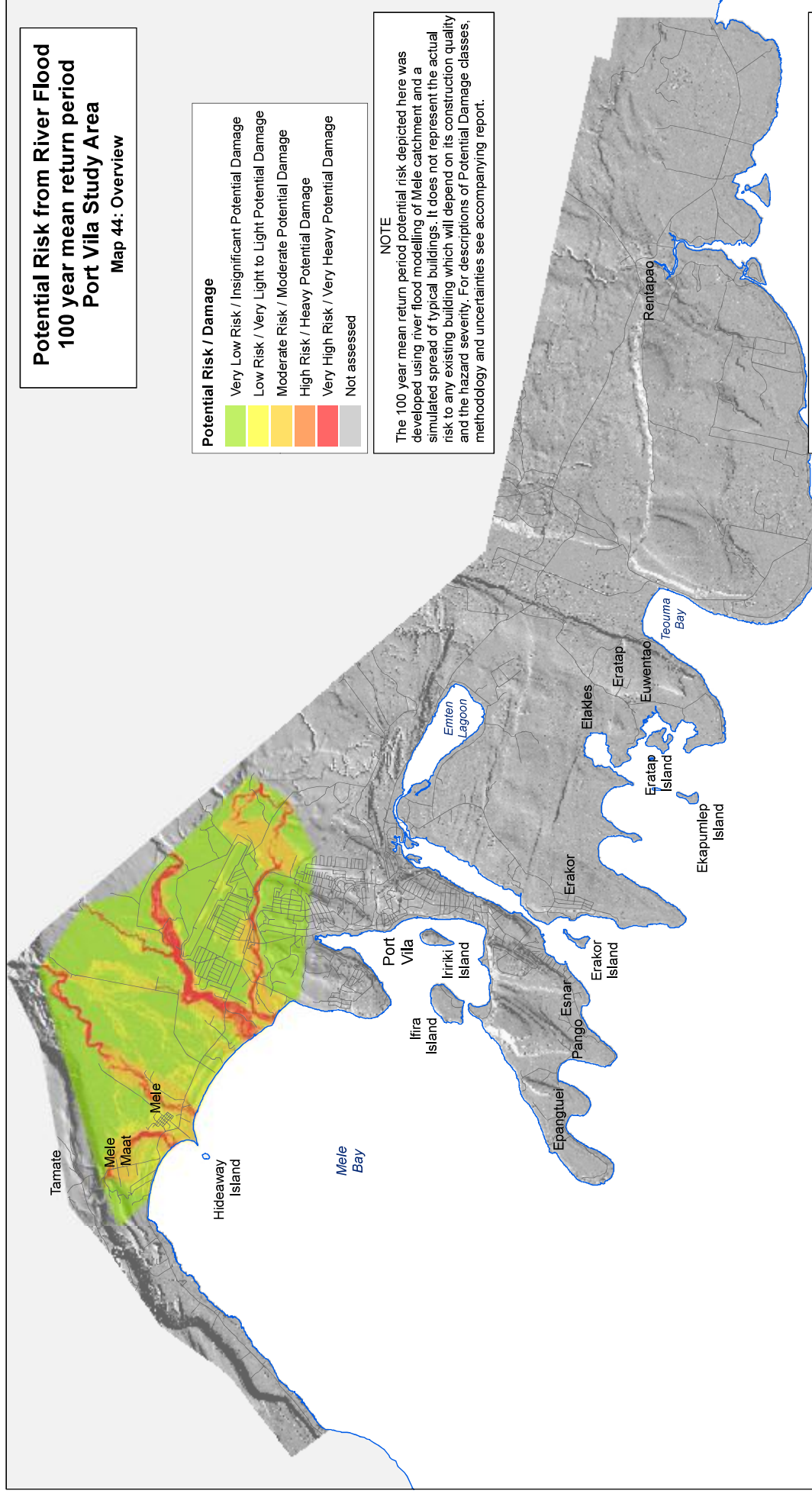
Map 44: Overview

Potential Risk / Damage



NOTE

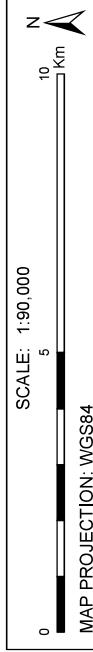
The 100 year mean return period potential risk depicted here was developed using river flood modelling of Mele catchment and a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.



Risk Mapping and Planning for Urban Preparedness
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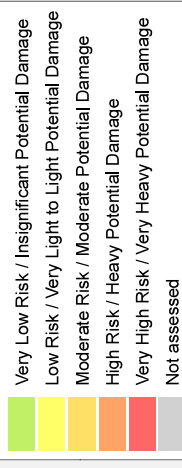
Prepared for the Vanuatu Government by Beica International Consultants Ltd,
GNS Science Ltd and the National Institute of Water and Atmospheric Research Ltd.
This map should not be relied upon for any work for which detailed site-specific
investigations are normally required.



Potential Risk from River Flood 50 year mean return period Port Vila Study Area

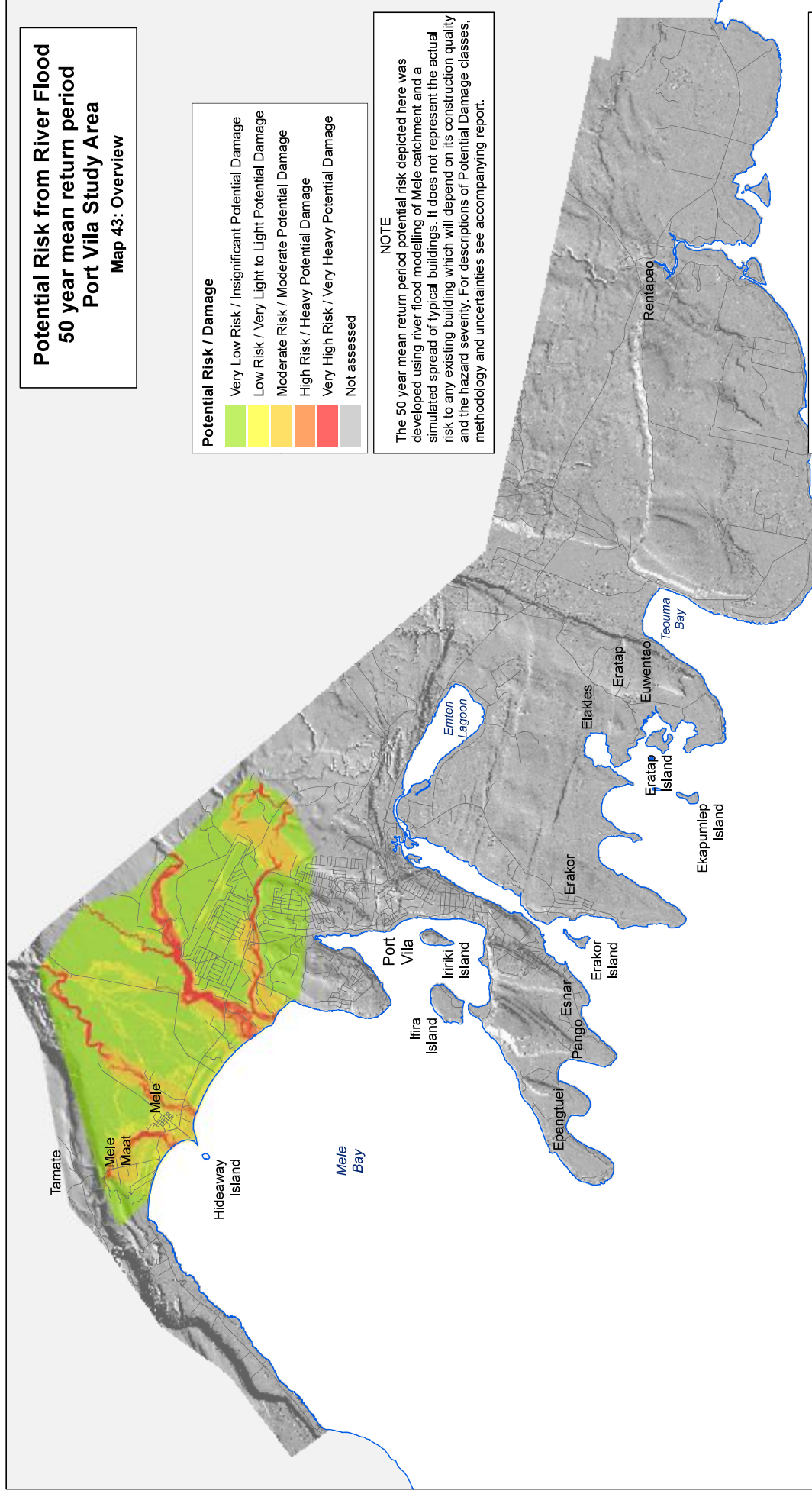
Map 43: Overview

Potential Risk / Damage



NOTE

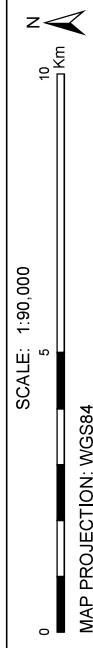
The 50 year mean return period potential risk depicted here was developed using river flood modelling of Mele catchment and a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.



Risk Mapping and Planning for Urban Preparedness
Mainstreaming Disaster Risk Reduction Project



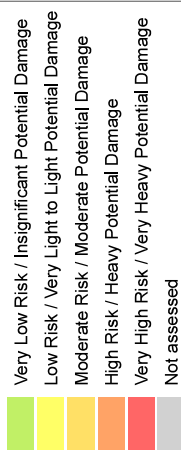
Prepared for the Vanuatu Government by Beica International Consultants Ltd,
GNS Science Ltd and the National Institute of Water and Atmospheric Research Ltd.
This map should not be relied upon for any work for which detailed site-specific
investigations are normally required.



Potential Risk from River Flood 10 year mean return period Port Vila Study Area

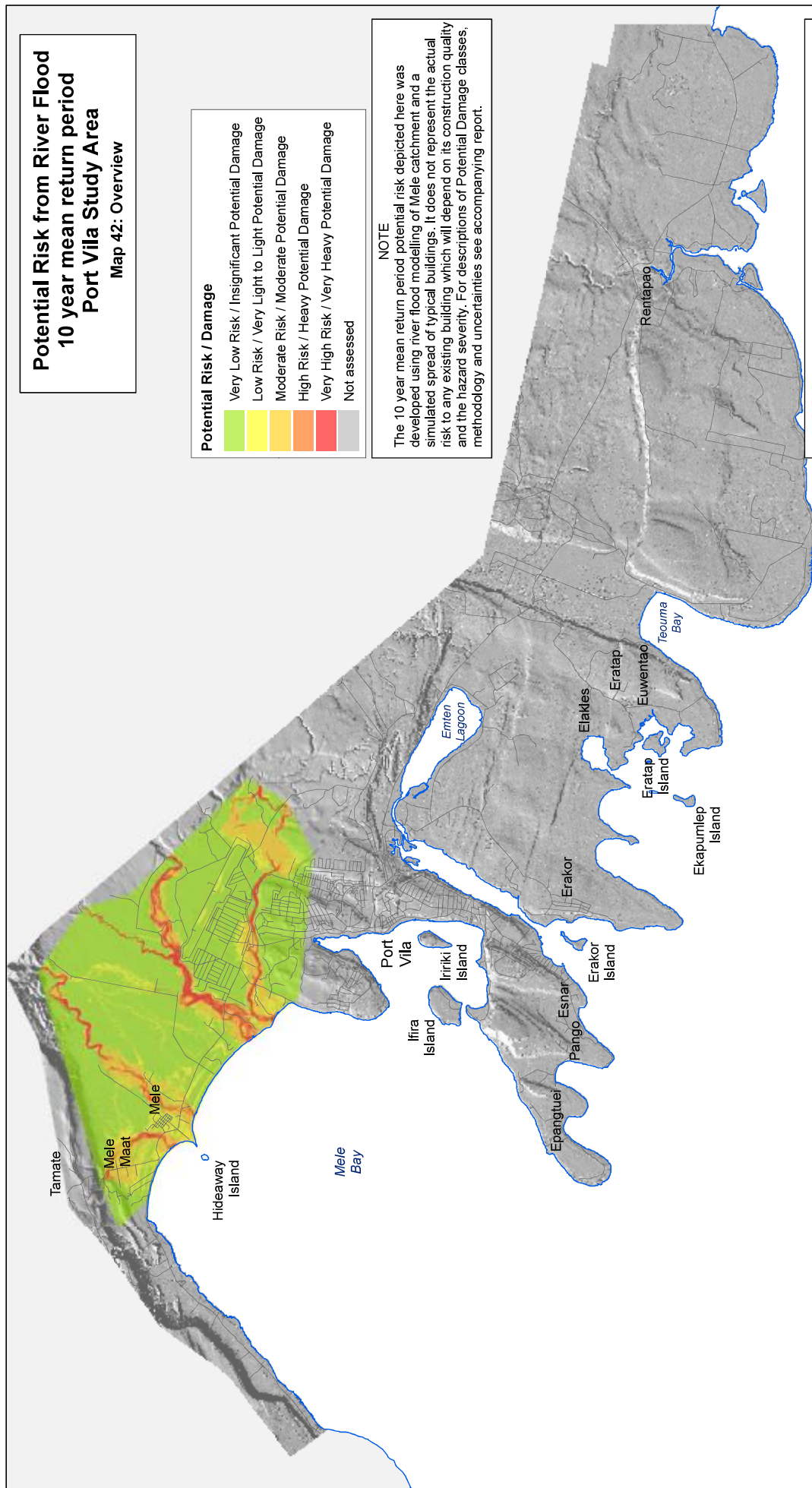
Map 42: Overview

Potential Risk / Damage



NOTE

The 10 year mean return period potential risk depicted here was developed using river flood modelling of Mele catchment and a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.



Risk Mapping and Planning for Urban Preparedness
Mainstreaming Disaster Risk Reduction Project



Prepared for the Vanuatu Government by Beica International Consultants Ltd,
GNS Science Ltd and the National Institute of Water and Atmospheric Research Ltd.

This map should not be relied upon for any work for which detailed site-specific investigations are normally required.

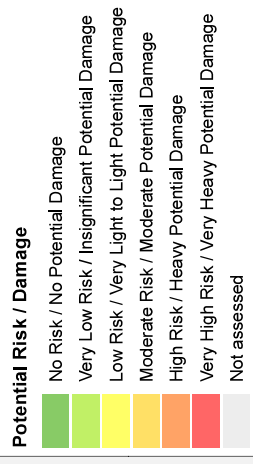
SCALE: 1:90,000



MAP PROJECTION: WGS84

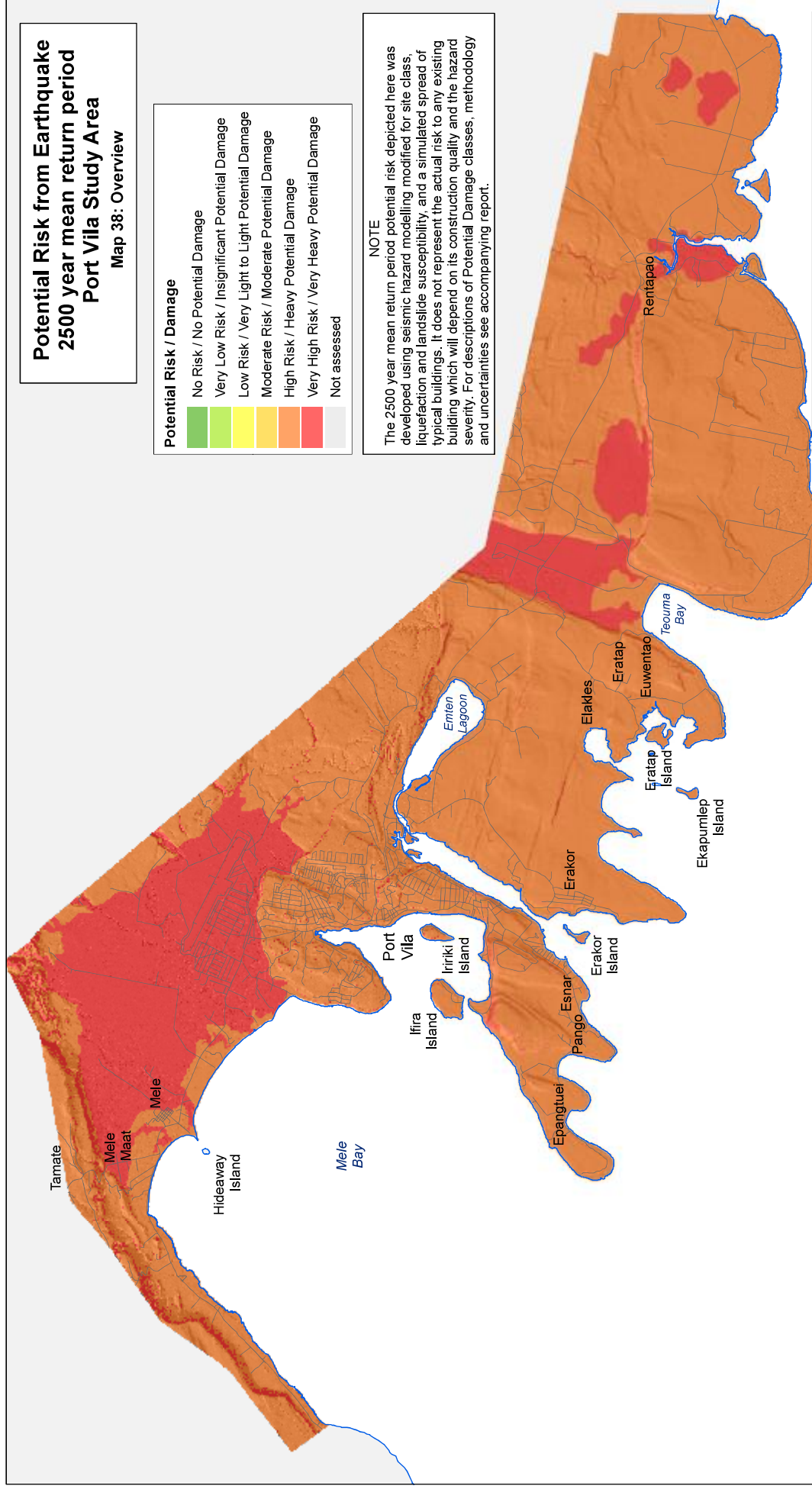
Potential Risk from Earthquake 2500 year mean return period Port Vila Study Area

Map 38: Overview



NOTE

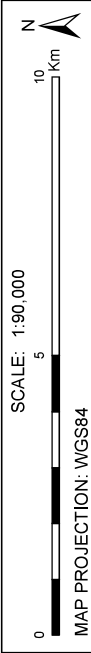
The 2500 year mean return period potential risk depicted here was developed using seismic hazard modelling modified for site class, liquefaction and landslide susceptibility, and a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.



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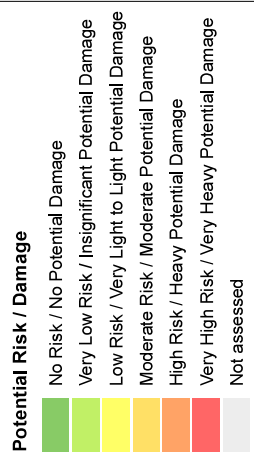


Prepared for the Vanuatu Government by Beca International Consultants Ltd,
GNS Science Ltd and the National Institute of Water and Atmospheric Research Ltd.
This map should not be relied upon for any work for which detailed site-specific
investigations are normally required.



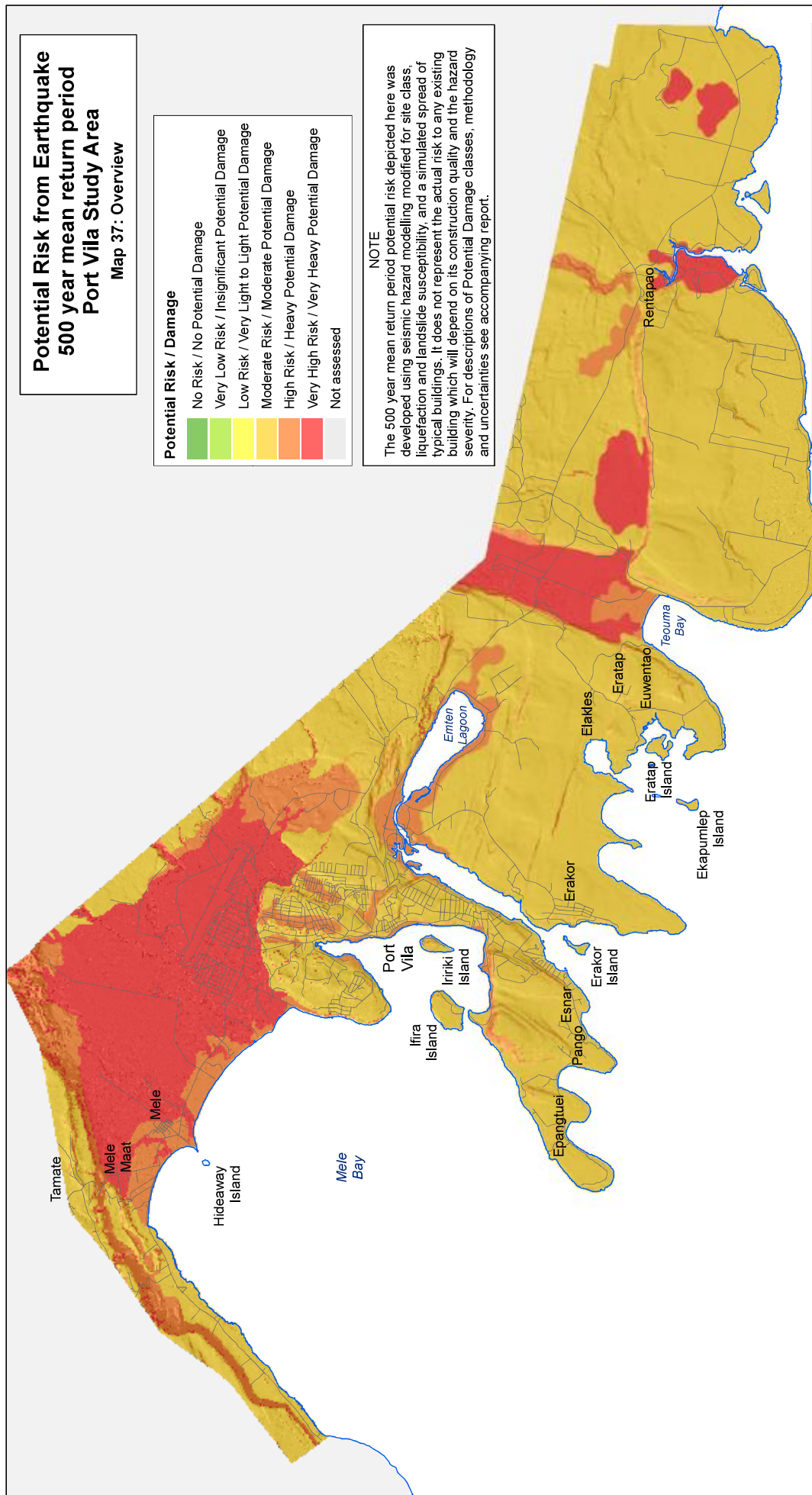
Potential Risk from Earthquake 500 year mean return period Port Vila Study Area

Map 37: Overview



NOTE

The 500 year mean return period potential risk depicted here was developed using seismic hazard modelling modified for site class, liquefaction and landslide susceptibility, and a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.



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investigations are normally required.

SCALE: 1:90,000

0

5

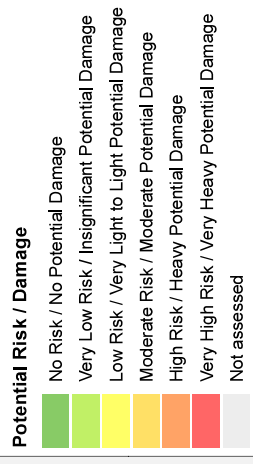
10

Km

MAP PROJECTION: WGS84

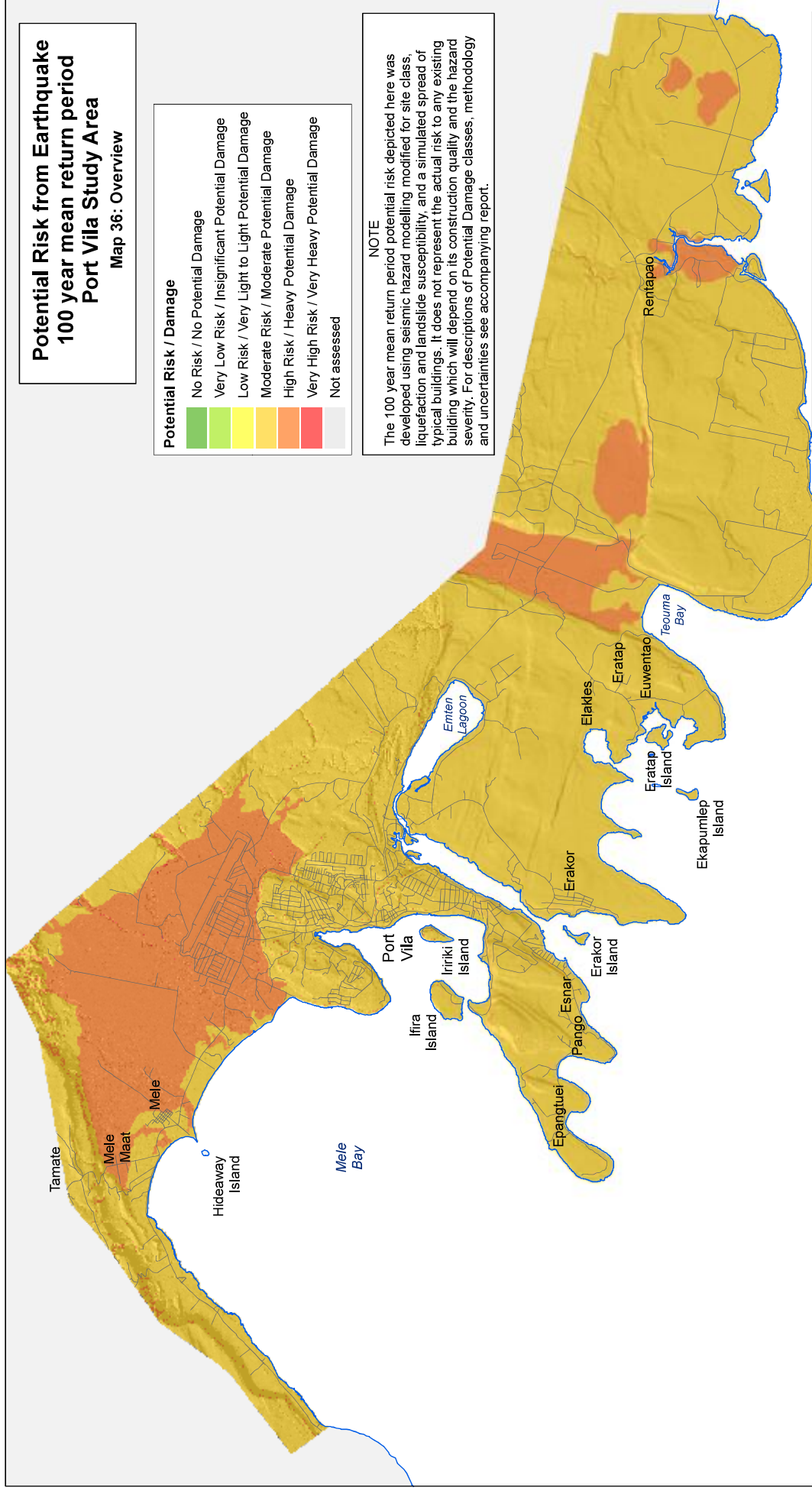
Potential Risk from Earthquake 100 year mean return period Port Vila Study Area

Map 36: Overview



NOTE

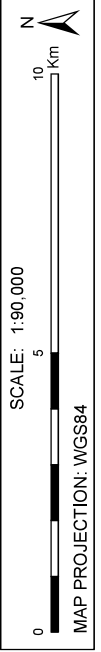
The 100 year mean return period potential risk depicted here was developed using seismic hazard modelling modified for site class, liquefaction and landslide susceptibility, and a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.



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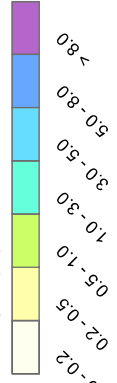
Prepared for the Vanuatu Government by Beca International Consultants Ltd,
GNS Science Ltd and the National Institute of Water and Atmospheric Research Ltd.
This map should not be relied upon for any work for which detailed site-specific
investigations are normally required.



Tsunami Inundation Water Depth Maximum Depth from all Scenarios Port Vila Study Area

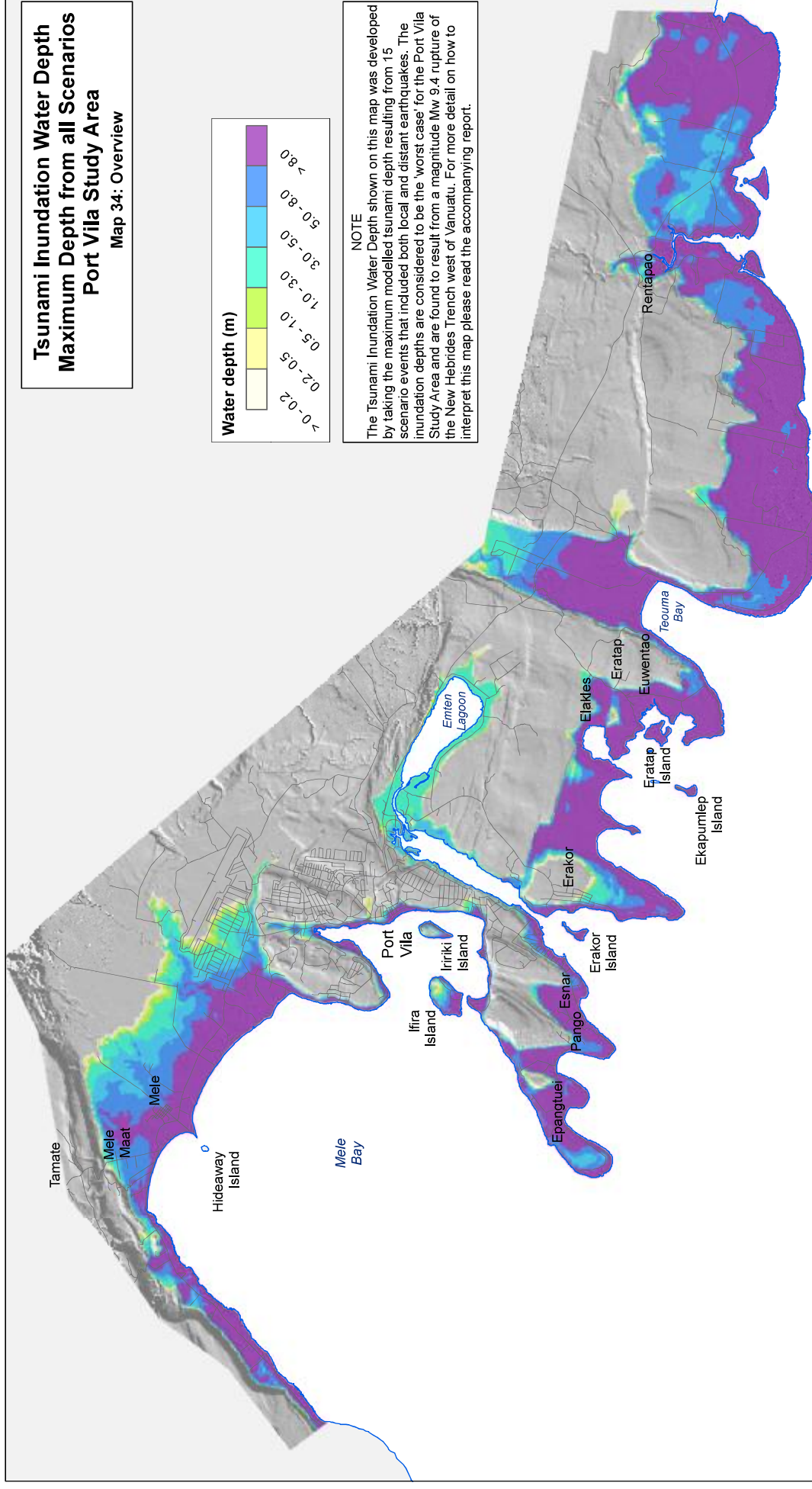
Map 34: Overview

Water depth (m)



NOTE

The Tsunami Inundation Water Depth shown on this map was developed by taking the maximum modelled tsunami depth resulting from 15 scenario events that included both local and distant earthquakes. The inundation depths are considered to be the 'worst case' for the Port Vila Study Area and are found to result from a magnitude Mw 9.4 rupture of the New Hebrides Trench west of Vanuatu. For more detail on how to interpret this map please read the accompanying report.



SCALE: 1:90,000



MAP PROJECTION: WGS84



Risk Mapping and Planning for Urban Preparedness
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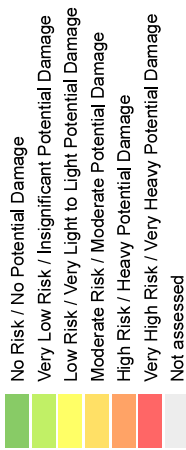


Prepared for the Vanuatu Government by Beca International Consultants Ltd.
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This map should not be relied upon for any work for which detailed site-specific investigations are normally required.

Combined Maximum Potential Risk c. 2500 year mean return period Port Vila Study Area

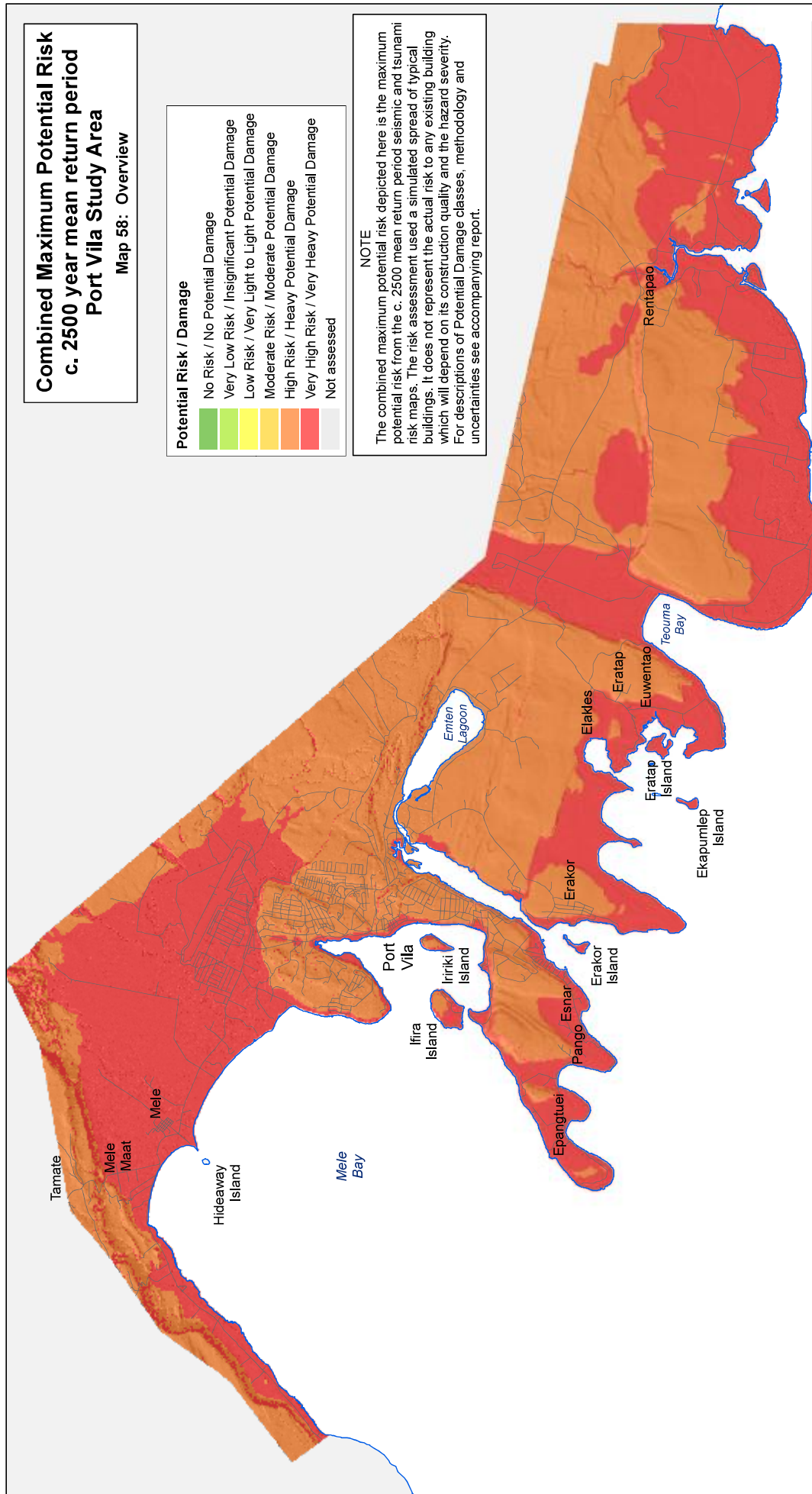
Map 58: Overview

Potential Risk / Damage



NOTE

The combined maximum potential risk depicted here is the maximum potential risk from the c. 2500 year mean return period seismic and tsunami risk maps. The risk assessment used a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.

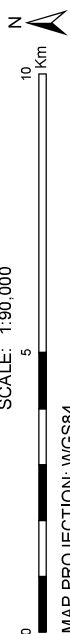


Risk Mapping and Planning for Urban Preparedness Mainstreaming Disaster Risk Reduction Project



Prepared for the Vanuatu Government by Beca International Consultants Ltd,
GNS Science Ltd and the National Institute of Water and Atmospheric Research Ltd.
This map should not be relied upon for any work for which detailed site-specific
investigations are normally required.

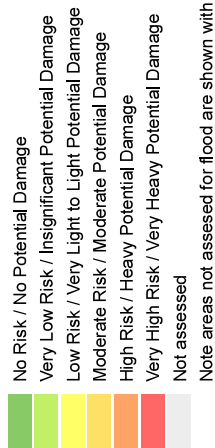
SCALE: 1:90,000



MAP PROJECTION: WGS84

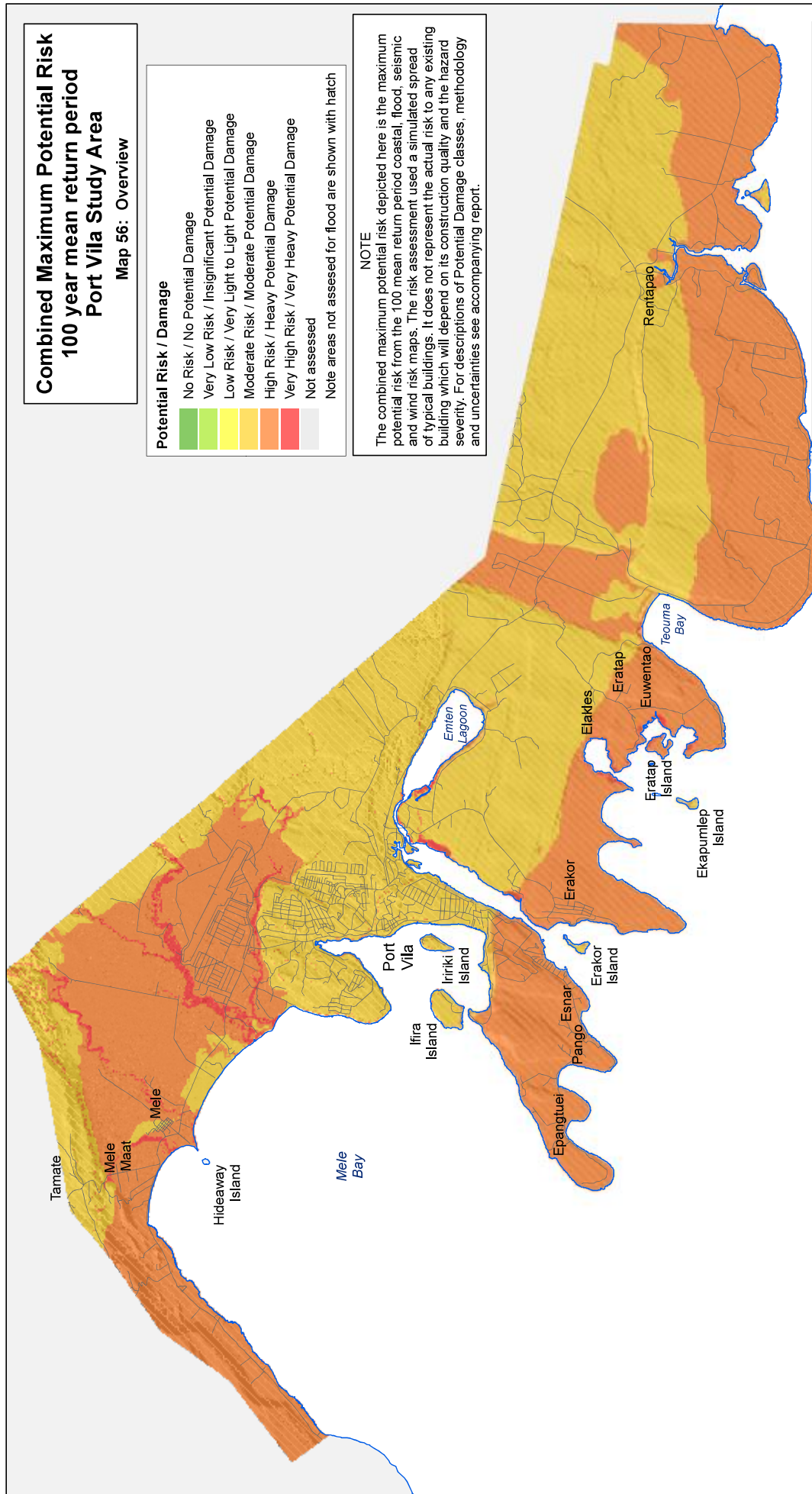
Combined Maximum Potential Risk 100 year mean return period Port Vila Study Area Map 56: Overview

Potential Risk / Damage



NOTE

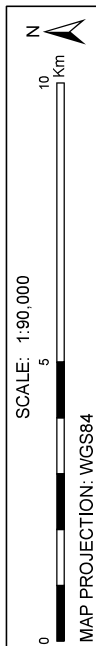
The combined maximum potential risk depicted here is the maximum potential risk from the 100 year mean return period coastal, flood, seismic and wind risk maps. The risk assessment used a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.



Risk Mapping and Planning for Urban Preparedness Mainstreaming Disaster Risk Reduction Project



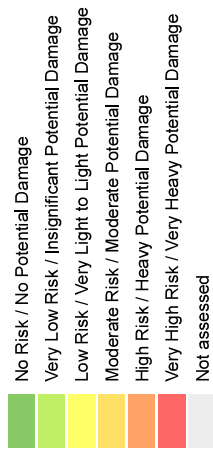
Prepared for the Vanuatu Government by Beca International Consultants Ltd,
GNS Science Ltd and the National Institute of Water and Atmospheric Research Ltd.
This map should not be relied upon for any work for which detailed site-specific
investigations are normally required.



Potential Tsunami Inundation Risk Maximum Risk from all Scenarios Port Vila Study Area

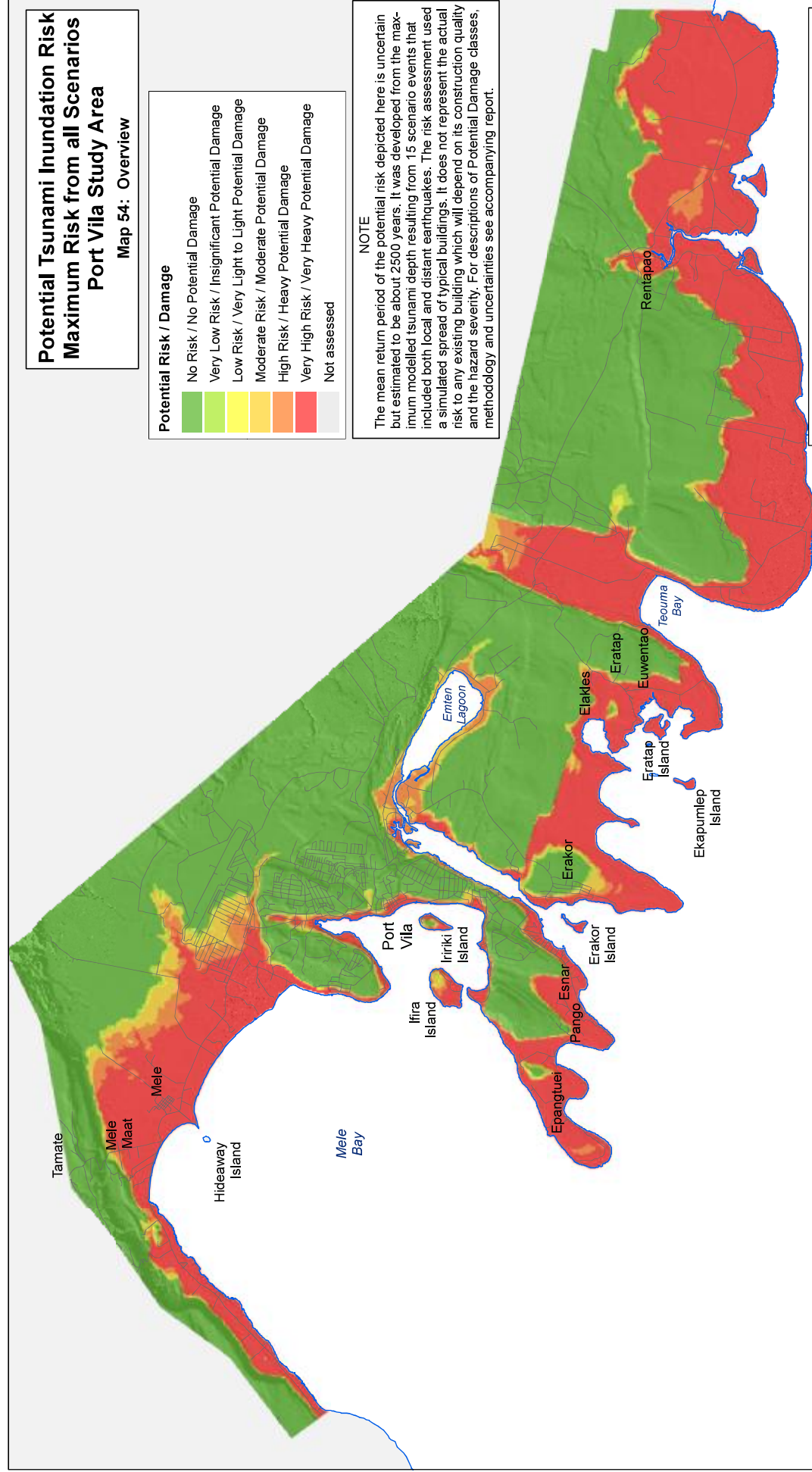
Map 54: Overview

Potential Risk / Damage



NOTE

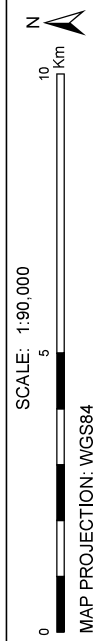
The mean return period of the potential risk depicted here is uncertain but estimated to be about 2500 years. It was developed from the maximum modelled tsunami depth resulting from 15 scenario events that included both local and distant earthquakes. The risk assessment used a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.



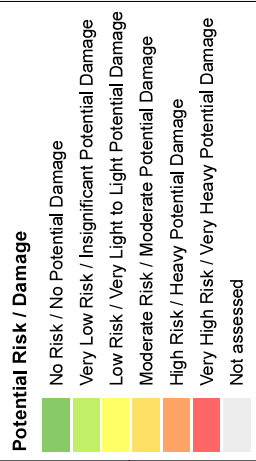
Risk Mapping and Planning for Urban Preparedness Mainstreaming Disaster Risk Reduction Project



Prepared for the Vanuatu Government by Beca International Consultants Ltd,
GNS Science Ltd and the National Institute of Water and Atmospheric Research Ltd.
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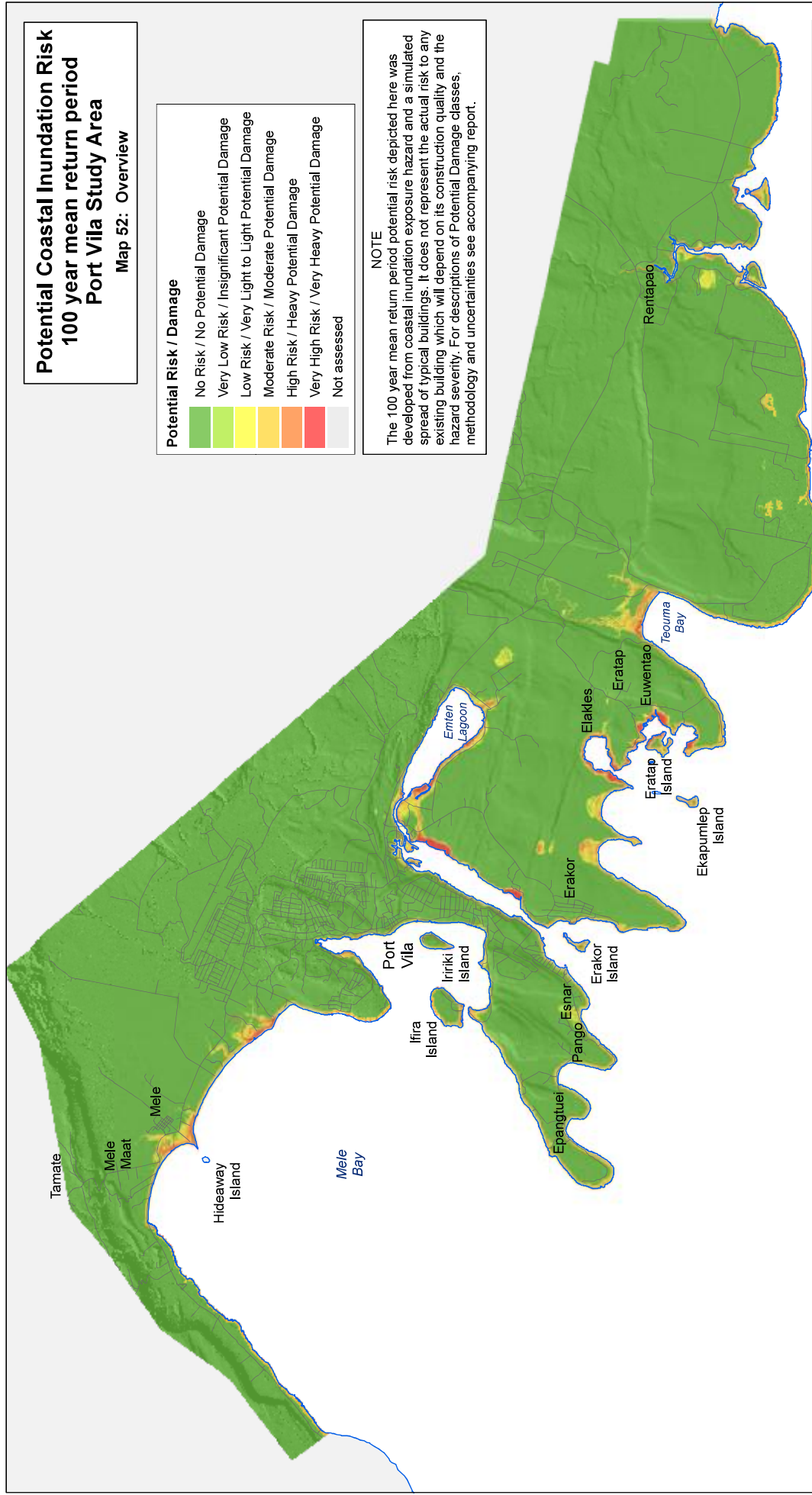


Potential Coastal Inundation Risk 100 year mean return period Port Vila Study Area Map 52: Overview



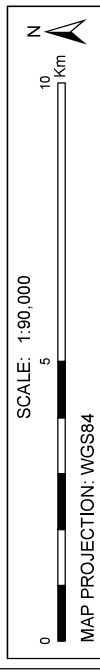
NOTE

The 100 year mean return period potential risk depicted here was developed from coastal inundation exposure hazard and a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.



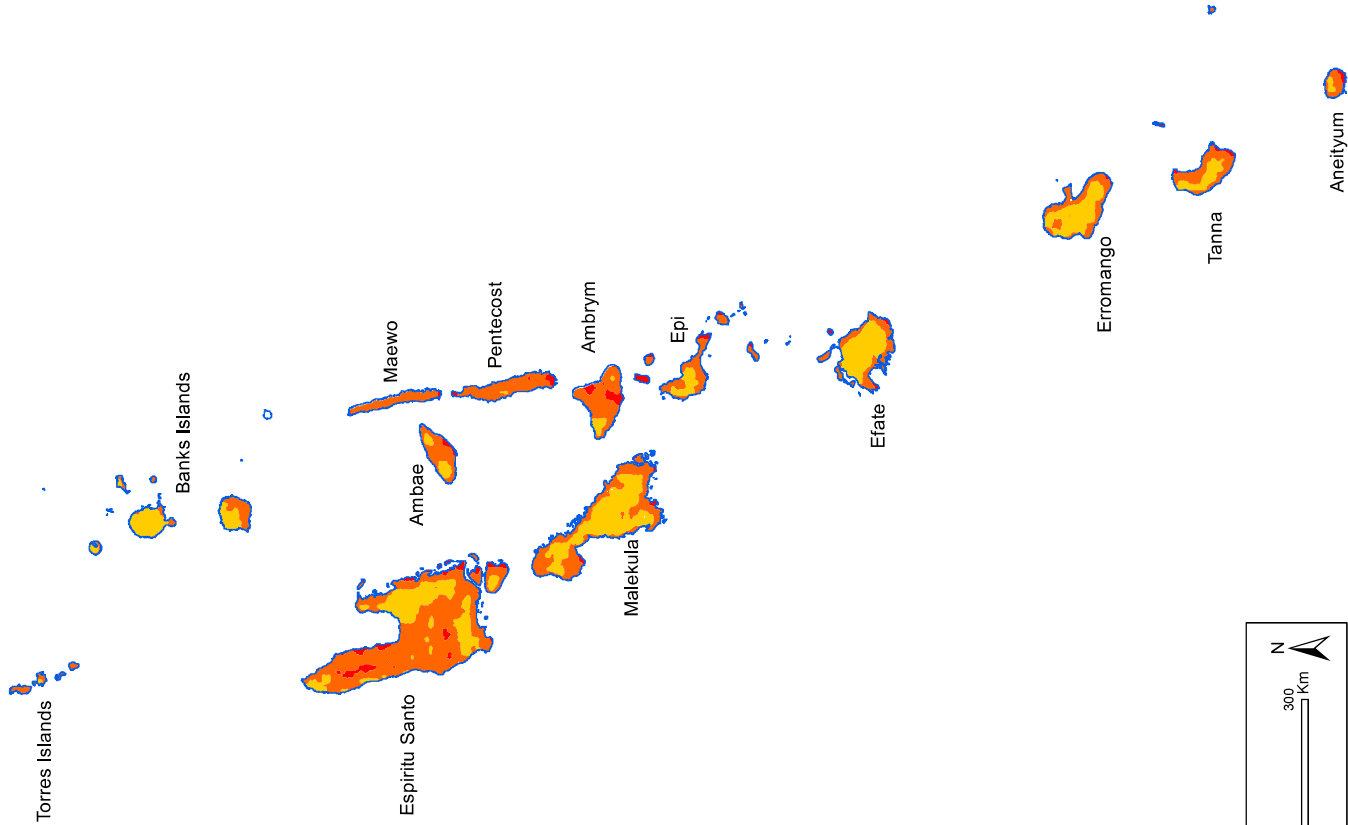
**Risk Mapping and Planning for Urban Preparedness
Mainstreaming Disaster Risk Reduction Project**

Prepared for the Vanuatu Government by Beca International Consultants Ltd,
GNS Science Ltd and the National Institute of Water and Atmospheric Research Ltd.
This map should not be relied upon for any work for which detailed site-specific investigations are normally required.

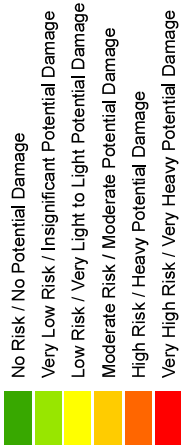


Appendix C - Hazard risk maps and combined risk map for Luganville

Potential Risk from Wind associated with Tropical Cyclone 250 year mean return period Vanuatu Map 50: Overview



Potential Risk / Damage



NOTE

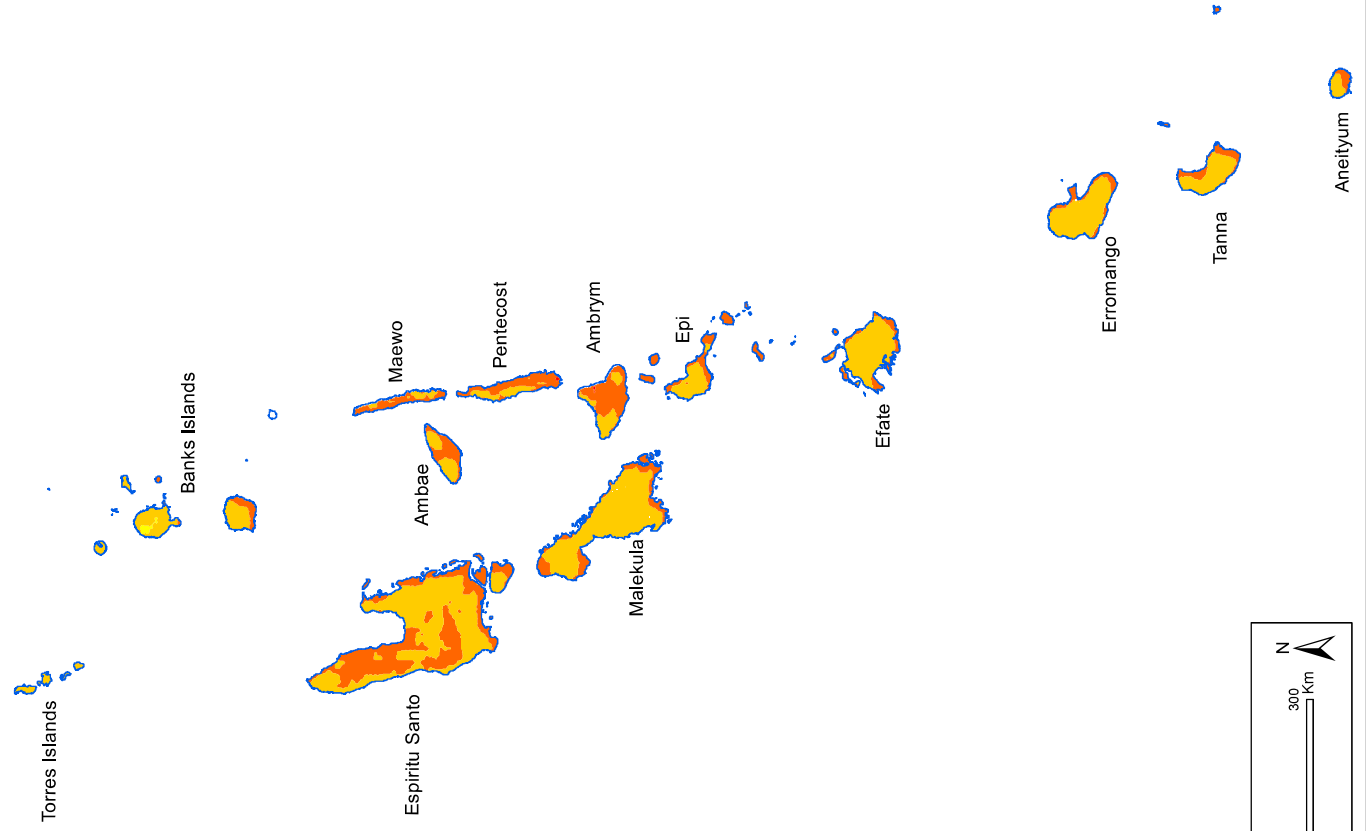
The 250 year mean return period potential risk depicted here was developed using wind hazard modelling by AIR Worldwide, fragility functions by Shorten et al. (2003), and a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.

Risk Mapping and Planning for Urban Preparedness
Mainstreaming Disaster Risk Reduction Project



Prepared for the Vanuatu Government by Beca International Consultants Ltd,
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Potential Risk from Wind associated with Tropical Cyclone 100 year mean return period Vanuatu Map 49: Overview



Potential Risk / Damage

No Risk / No Potential Damage

Very Low Risk / Insignificant Potential Damage

Low Risk / Very Light to Light Potential Damage

Moderate Risk / Moderate Potential Damage

High Risk / Heavy Potential Damage

Very High Risk / Very Heavy Potential Damage

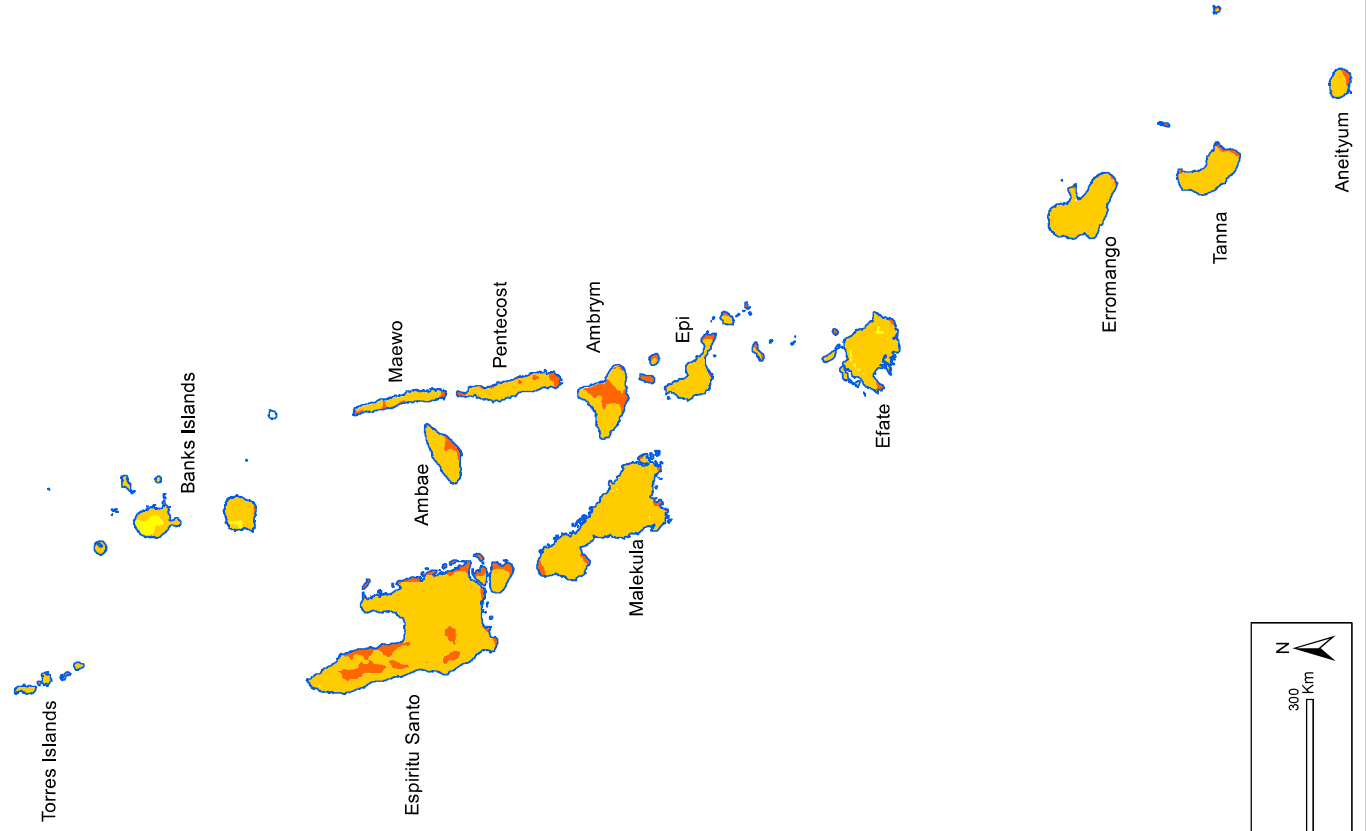
NOTE

The 100 year mean return period potential risk depicted here was developed using wind hazard modelling by AIR Worldwide, fragility functions by Shorten et al. (2003), and a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.

Risk Mapping and Planning for Urban Preparedness
Mainstreaming Disaster Risk Reduction Project

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investigations are normally required.

Potential Risk from Wind associated with Tropical Cyclone 50 year mean return period Vanuatu Map 48: Overview



Potential Risk / Damage

No Risk / No Potential Damage

Very Low Risk / Insignificant Potential Damage

Low Risk / Very Light to Light Potential Damage

Moderate Risk / Moderate Potential Damage

High Risk / Heavy Potential Damage

Very High Risk / Very Heavy Potential Damage

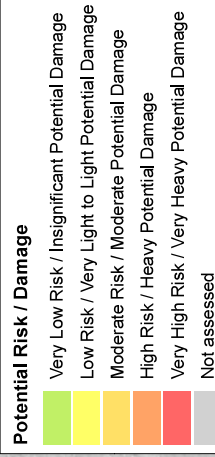
NOTE

The 50 year mean return period potential risk depicted here was developed using wind hazard modelling by AIR Worldwide, fragility functions by Shorten et al. (2003), and a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.

Risk Mapping and Planning for Urban Preparedness
Mainstreaming Disaster Risk Reduction Project

Prepared for the Vanuatu Government by Beca International Consultants Ltd,
GNS Science Ltd and the National Institute of Water and Atmospheric Research Ltd.
This map should not be relied upon for any work for which detailed site-specific
investigations are normally required.

Potential Risk from River Flood 100 year mean return period Luganville Study Area Map 47: Overview



NOTE

The 100 year mean return period potential risk depicted here was developed using river flood modelling of Sarakata catchment and a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.

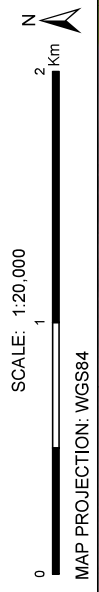
Luganville

Solway

Sarakata

Mango

Second Channel



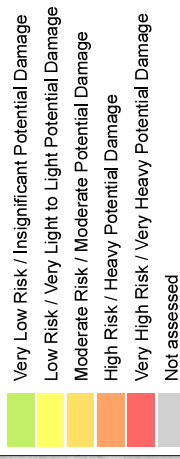
Risk Mapping and Planning for Urban Preparedness
Mainstreaming Disaster Risk Reduction Project



Prepared for the Vanuatu Government by Beica International Consultants Ltd,
GNS Science Ltd and the National Institute of Water and Atmospheric Research Ltd.
This map should not be relied upon for any work for which detailed site-specific investigations are normally required.

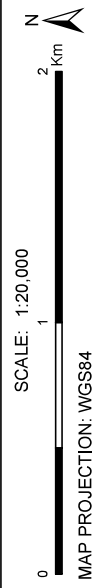
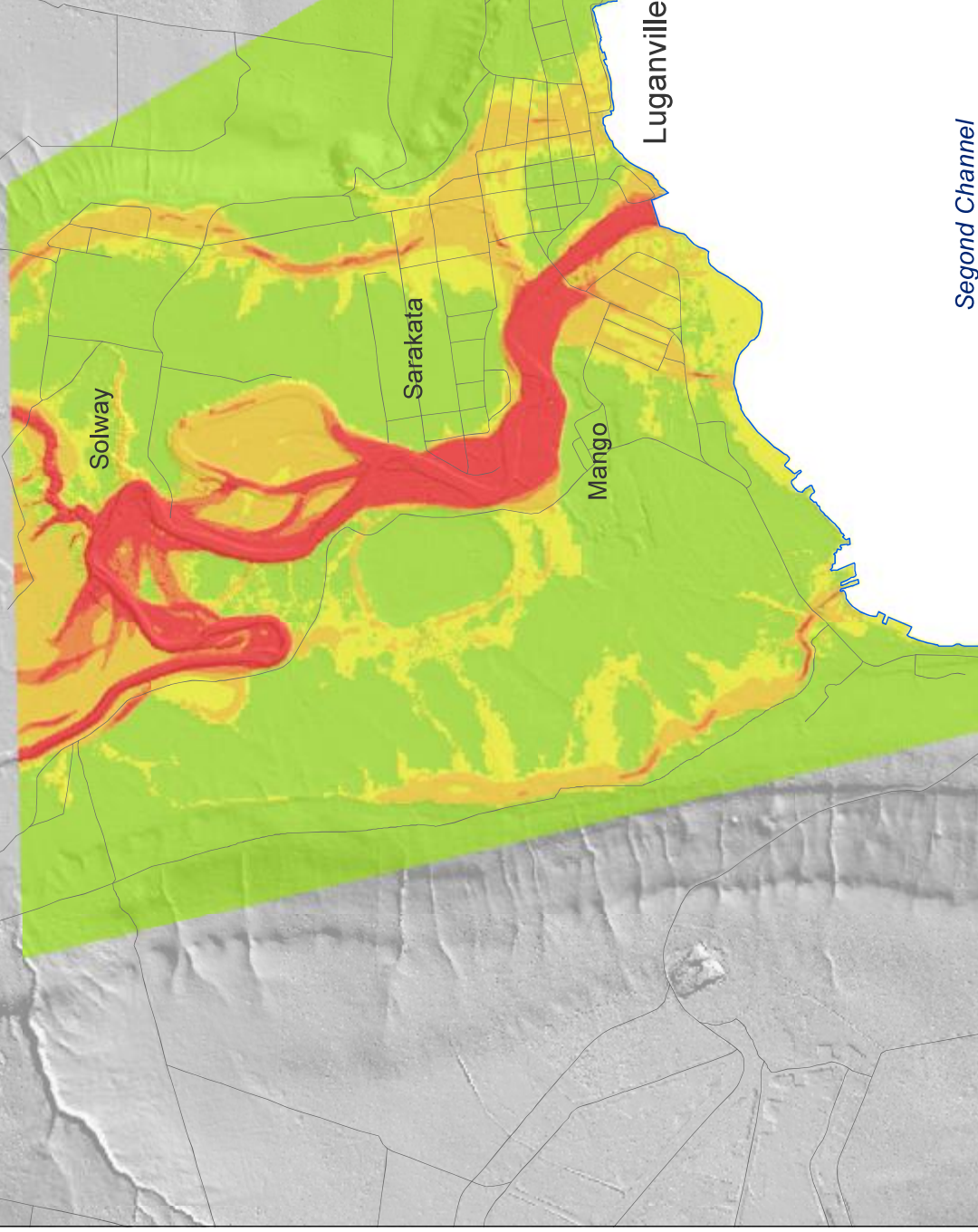
Potential Risk from River Flood 50 year mean return period Luganville Study Area Map 46: Overview

Potential Risk / Damage



NOTE

The 50 year mean return period potential risk depicted here was developed using river flood modelling of Sarakata catchment and a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.



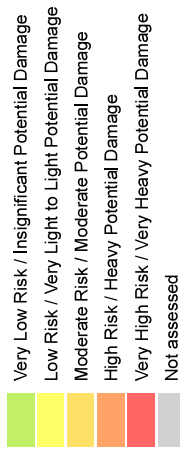
Risk Mapping and Planning for Urban Preparedness
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Prepared for the Vanuatu Government by Beca International Consultants Ltd,
GNS Science Ltd and the National Institute of Water and Atmospheric Research Ltd.
This map should not be relied upon for any work for which detailed site-specific
investigations are normally required.

Potential Risk from River Flood 10 year mean return period Luganville Study Area Map 45: Overview

Potential Risk / Damage



NOTE

The 10 year mean return period potential risk depicted here was developed using river flood modelling of Sarakata catchment and a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.

Luganville

Sarakata

Mango

Solway

Second Channel

SCALE: 1:20,000



MAP PROJECTION: WGS84

Risk Mapping and Planning for Urban Preparedness
Mainstreaming Disaster Risk Reduction Project

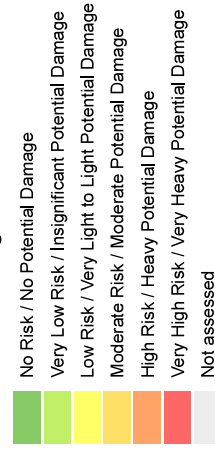


Prepared for the Vanuatu Government by Beca International Consultants Ltd,
GNS Science Ltd and the National Institute of Water and Atmospheric Research Ltd.
This map should not be relied upon for any work for which detailed site-specific
investigations are normally required.

Potential Risk from Earthquake 2500 year mean return period Luganville Study Area

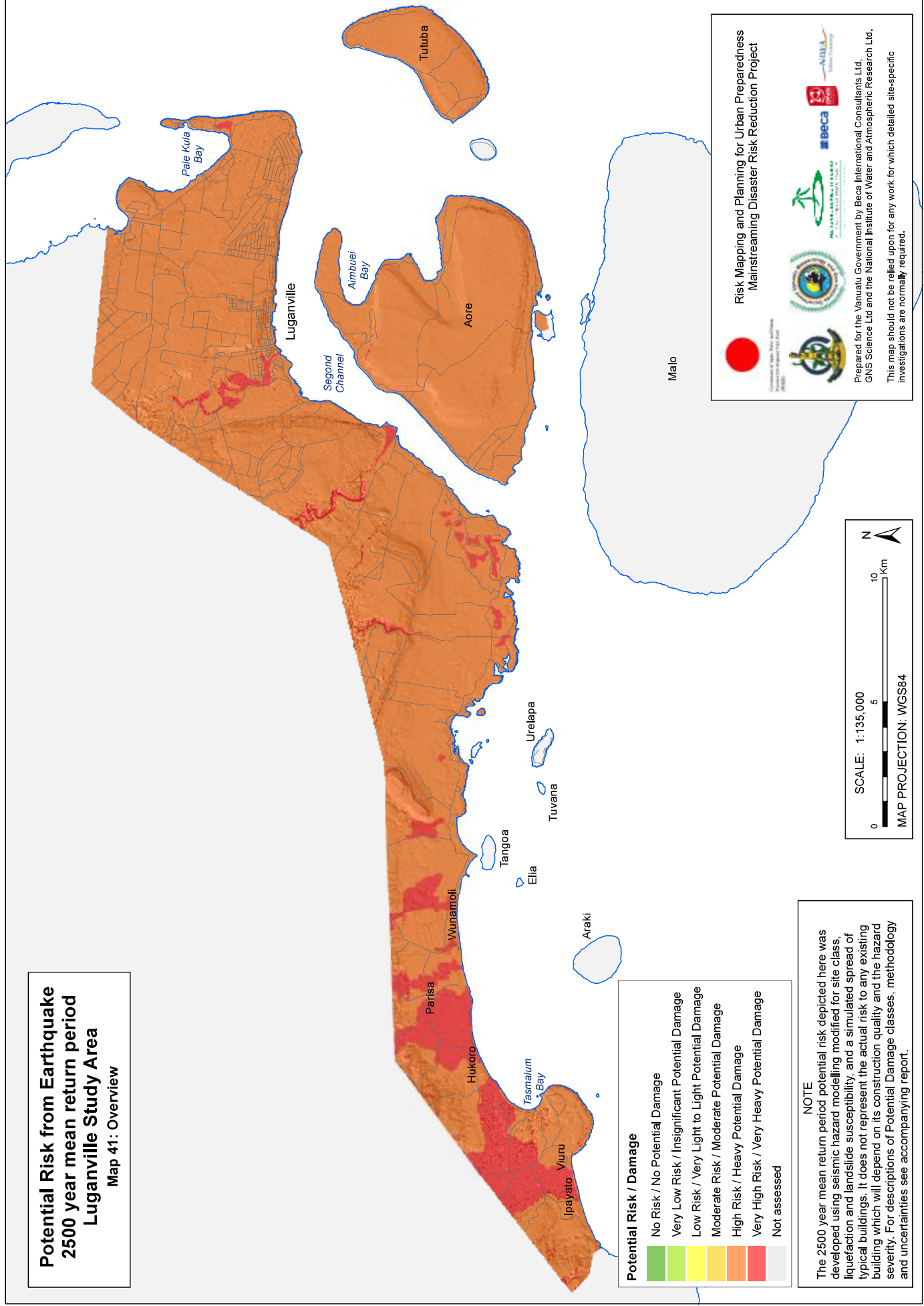
Map 41: Overview

Potential Risk / Damage



NOTE

The 2500 year mean return period potential risk depicted here was developed using seismic hazard modelling modified for site class, liquefaction and landslide susceptibility, and a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.



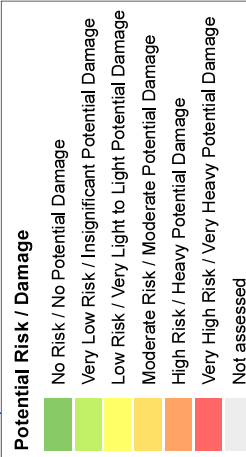
Risk Mapping and Planning for Urban Preparedness Mainstreaming Disaster Risk Reduction Project



Prepared for the Vanuatu Government by Beca International Consultants Ltd,
GNS Science Ltd and the National Institute of Water and Atmospheric Research Ltd.
This map should not be relied upon for any work for which detailed site-specific
investigations are normally required.

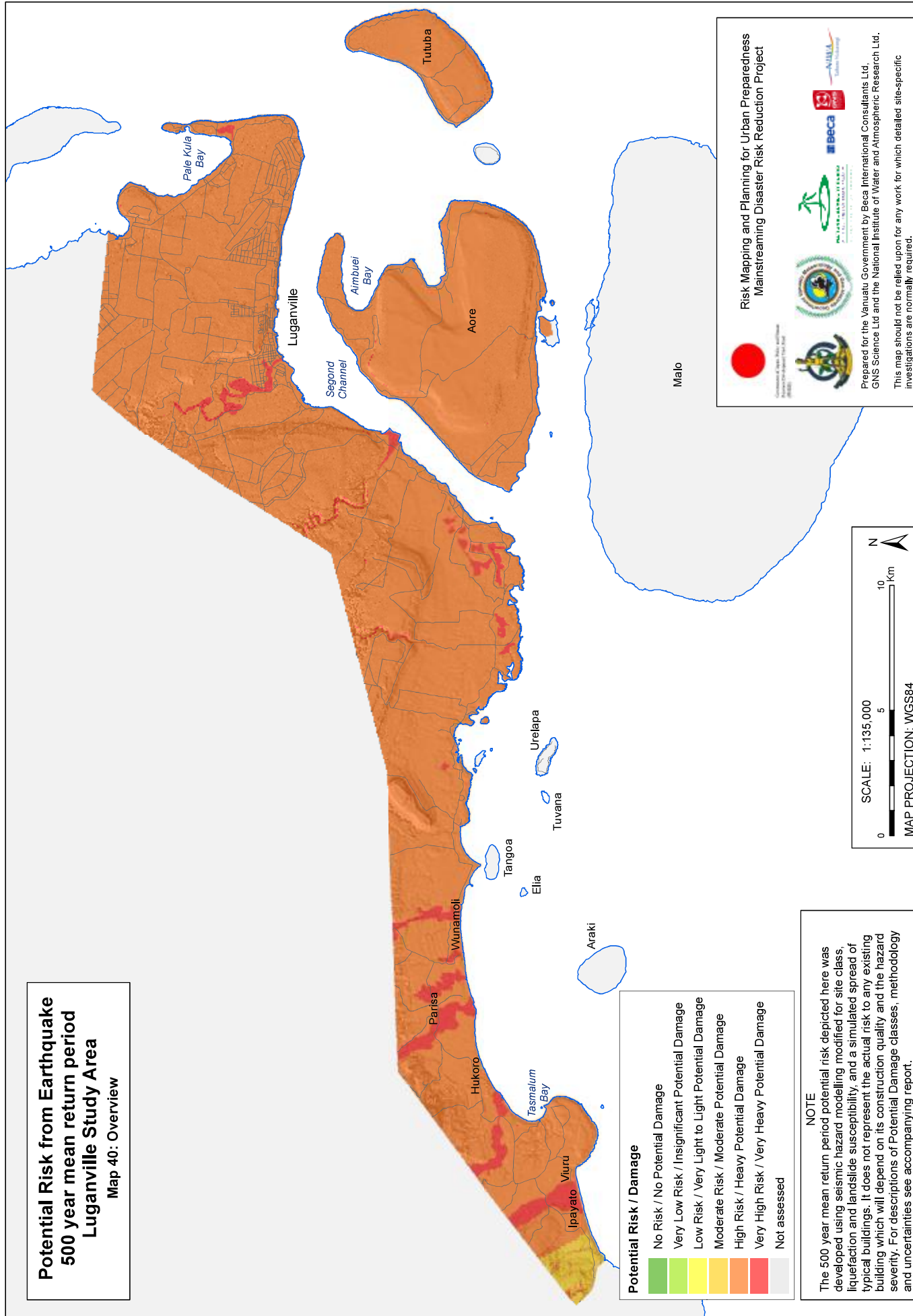
Potential Risk from Earthquake 500 year mean return period Luganville Study Area

Map 40: Overview



NOTE

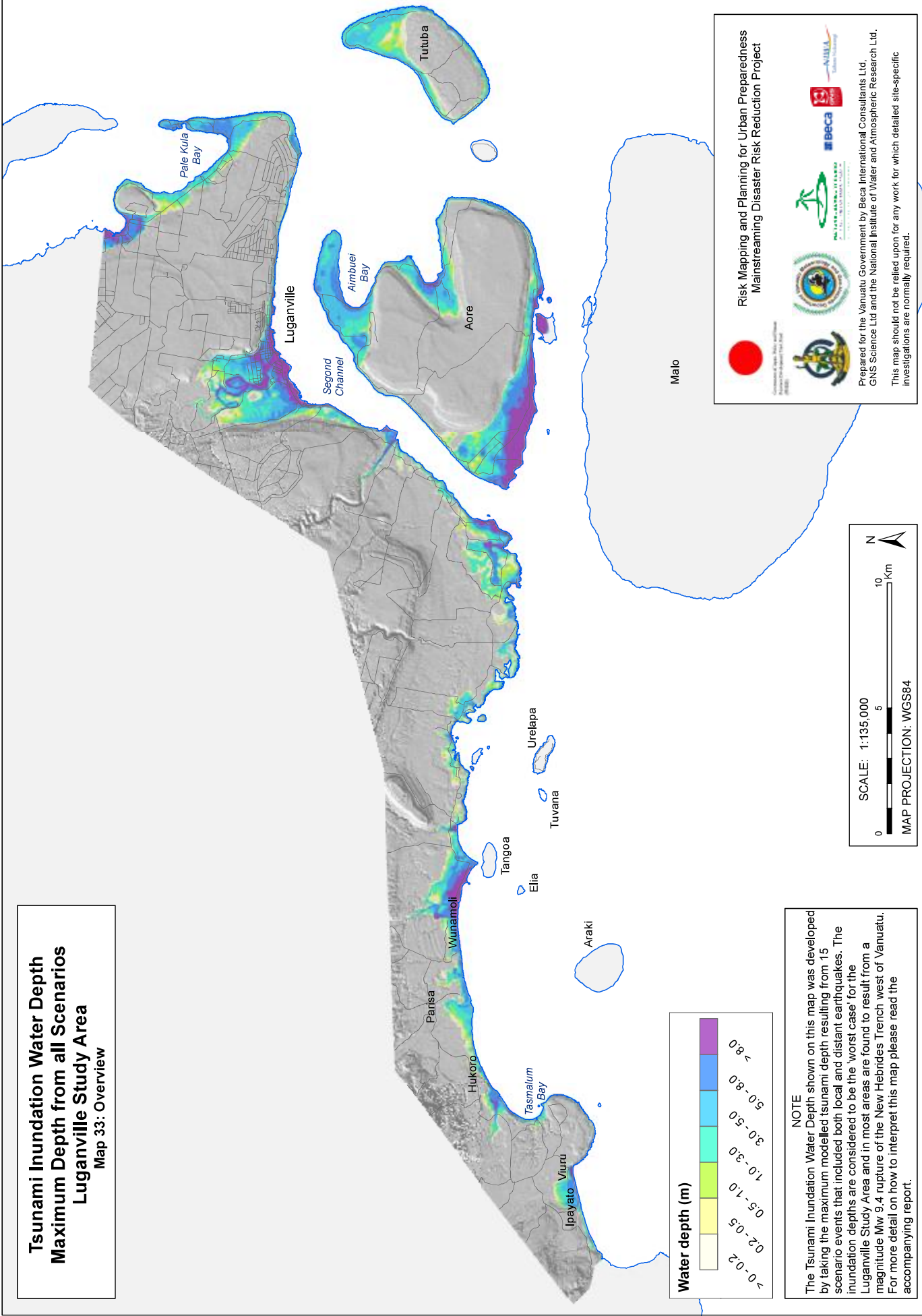
The 500 year mean return period potential risk depicted here was developed using seismic hazard modelling modified for site class, liquefaction and landslide susceptibility, and a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.



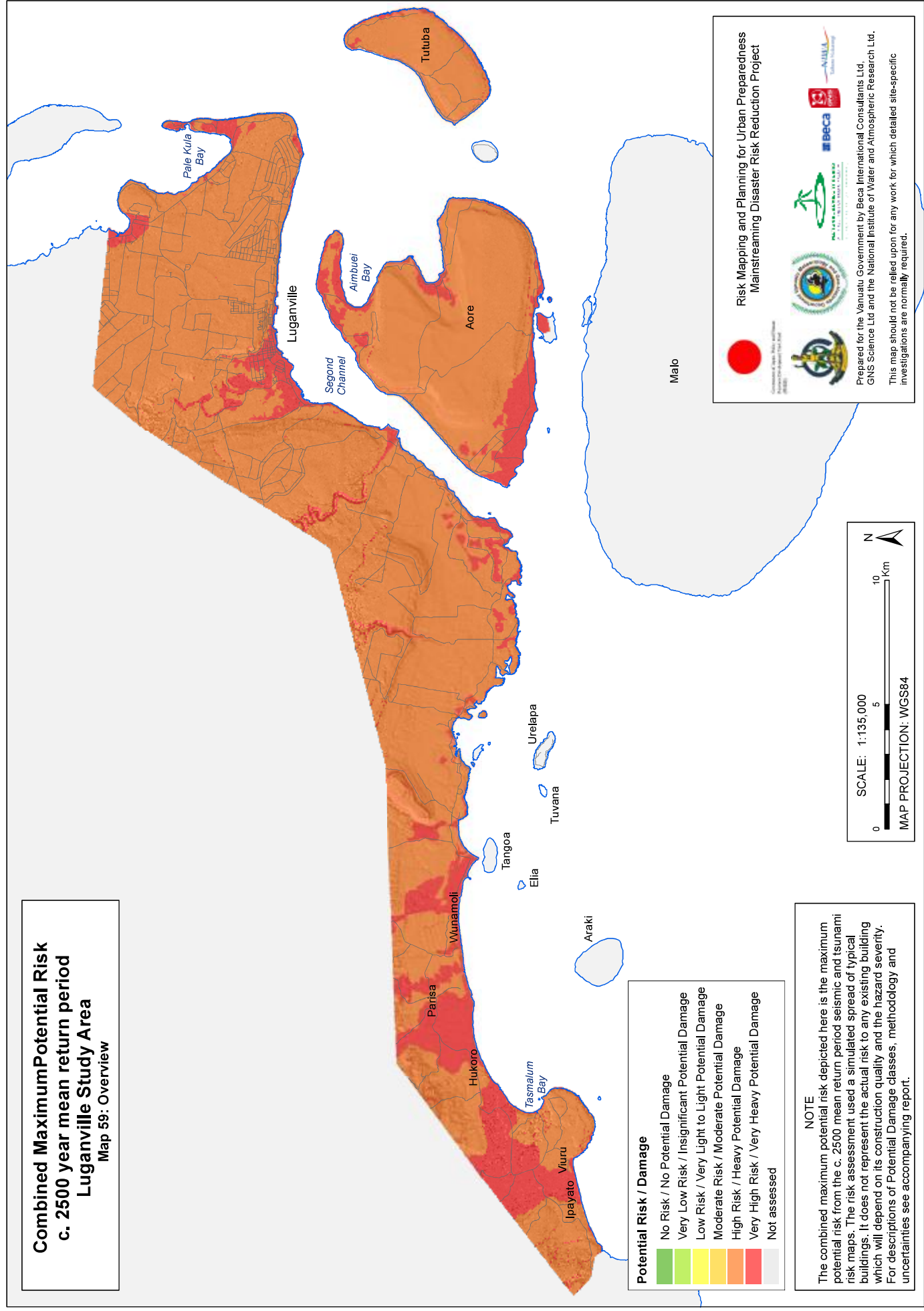
**Risk Mapping and Planning for Urban Preparedness
Mainstreaming Disaster Risk Reduction Project**

Prepared for the Vanuatu Government by Beca International Consultants Ltd,
GNS Science Ltd and the National Institute of Water and Atmospheric Research Ltd.
This map should not be relied upon for any work for which detailed site-specific investigations are normally required.

Tsunami Inundation Water Depth Maximum Depth from all Scenarios Luganville Study Area Map 33: Overview

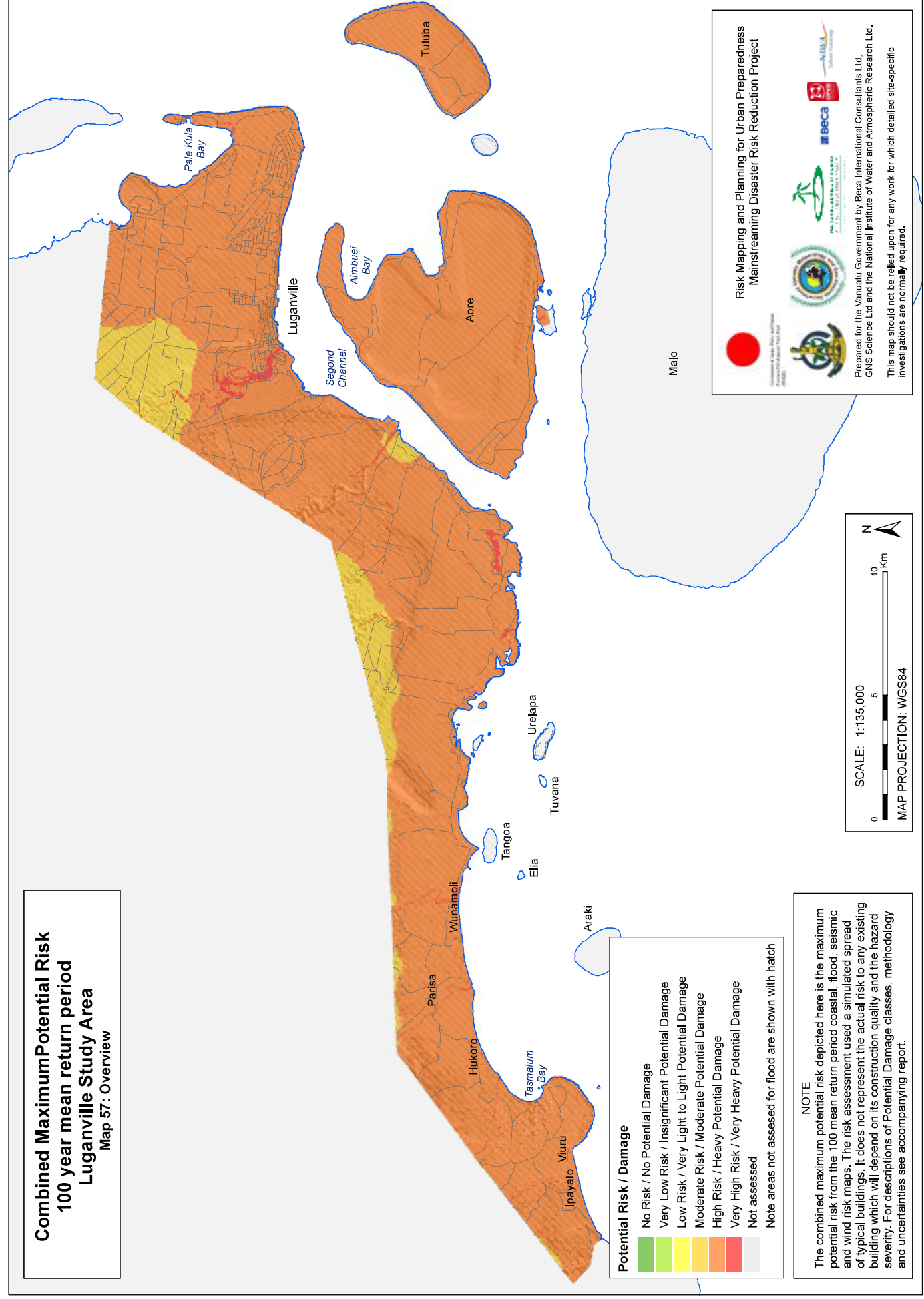


**Combined Maximum Potential Risk
c. 2500 year mean return period
Luganville Study Area**
Map 59: Overview



Combined Maximum Potential Risk 100 year mean return period Luganville Study Area

Map 57: Overview



Potential Risk / Damage

- No Risk / No Potential Damage
- Very Low Risk / Insignificant Potential Damage
- Low Risk / Very Light to Light Potential Damage
- Moderate Risk / Moderate Potential Damage
- High Risk / Heavy Potential Damage
- Very High Risk / Very Heavy Potential Damage
- Not assessed

Note areas not assessed for flood are shown with hatch

NOTE

The combined maximum potential risk depicted here is the maximum potential risk from the 100 year mean return period coastal, flood, seismic and wind risk maps. The risk assessment used a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.

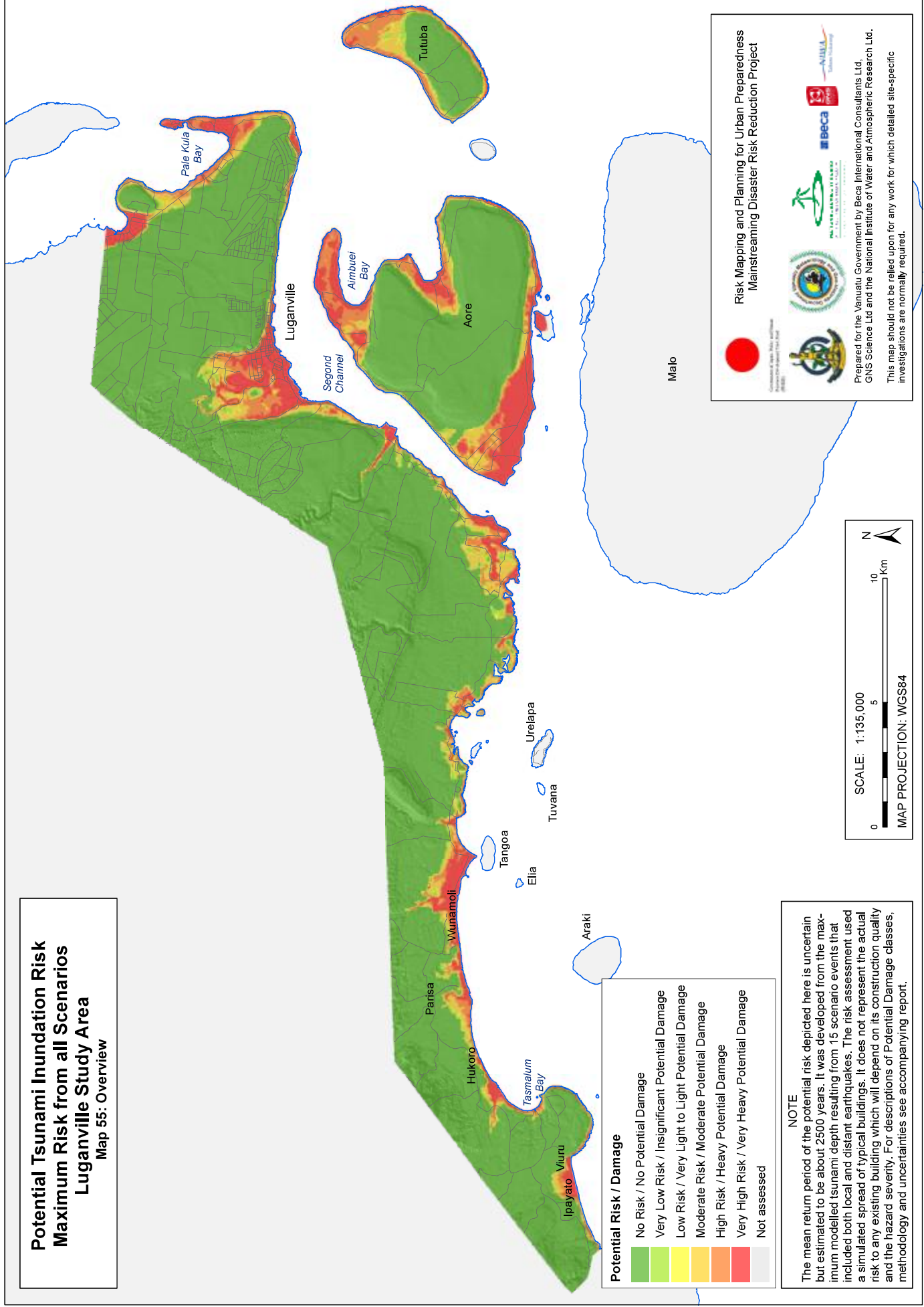
Risk Mapping and Planning for Urban Preparedness
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Prepared for the Vanuatu Government by Beca International Consultants Ltd,
GNS Science Ltd and the National Institute of Water and Atmospheric Research Ltd.
This map should not be relied upon for any work for which detailed site-specific
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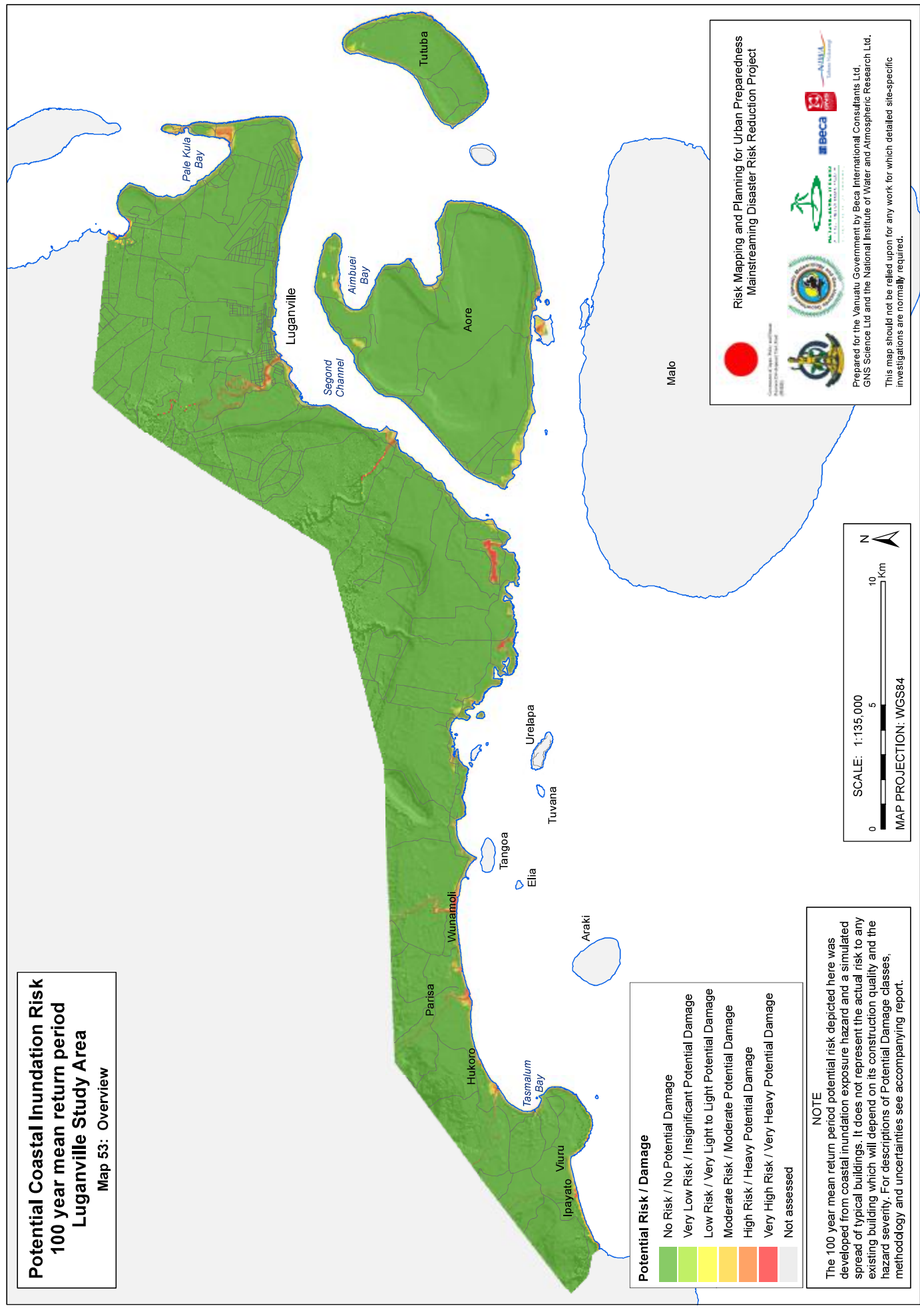
Potential Tsunami Inundation Risk Maximum Risk from all Scenarios Luganville Study Area

Map 55: Overview



Potential Coastal Inundation Risk 100 year mean return period Luganville Study Area

Map 53: Overview



Potential Risk / Damage

- No Risk / No Potential Damage
- Very Low Risk / Insignificant Potential Damage
- Low Risk / Very Light to Light Potential Damage
- Moderate Risk / Moderate Potential Damage
- High Risk / Heavy Potential Damage
- Very High Risk / Very Heavy Potential Damage
- Not assessed

NOTE

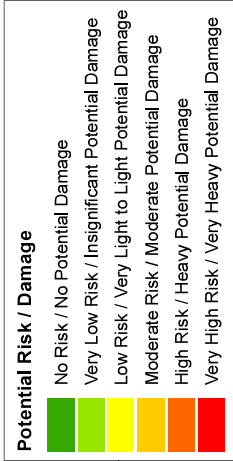
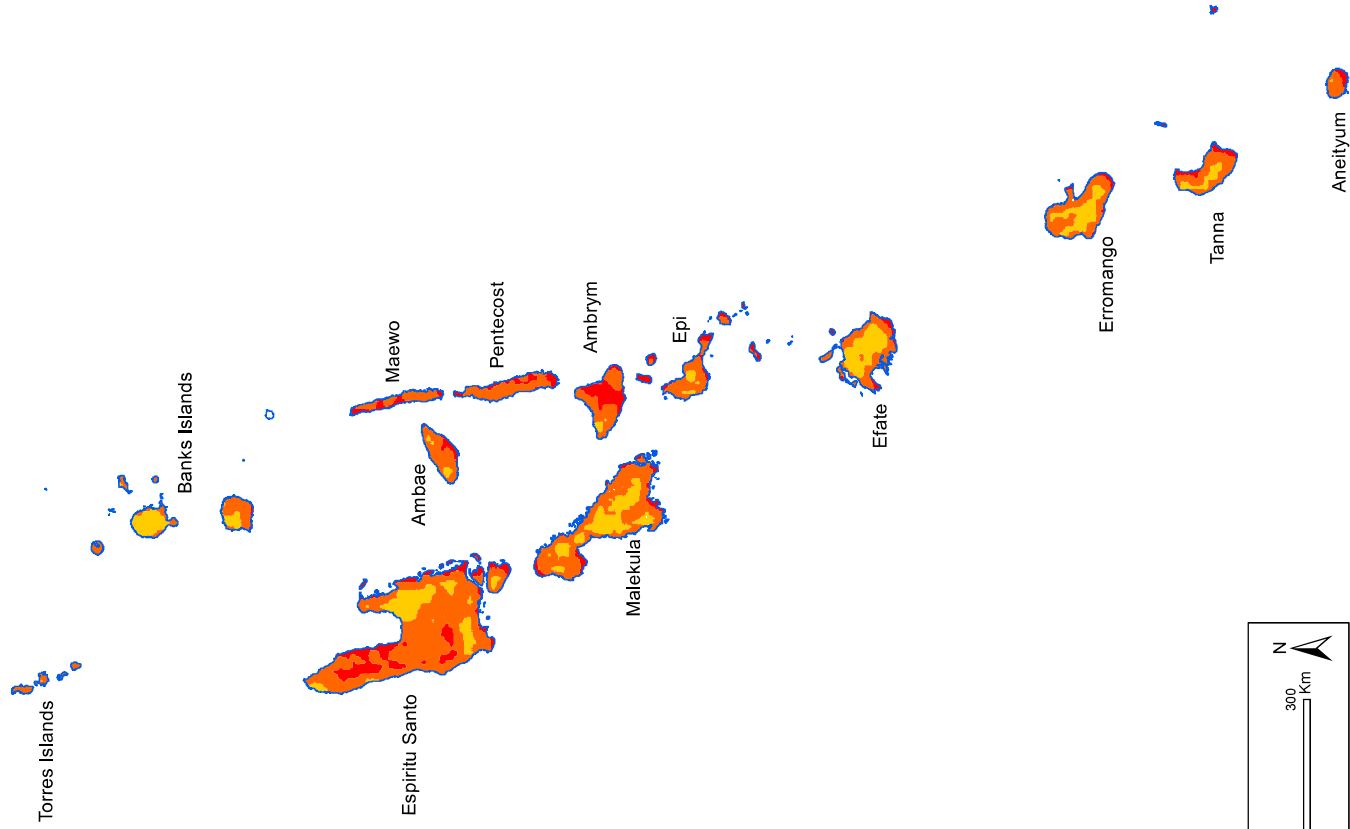
The 100 year mean return period potential risk depicted here was developed from coastal inundation exposure hazard and a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.

Risk Mapping and Planning for Urban Preparedness Mainstreaming Disaster Risk Reduction Project



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This map should not be relied upon for any work for which detailed site-specific
investigations are normally required.

Potential Risk from Wind
associated with Tropical Cyclone
500 year mean return period
Vanuatu
Map 51: Overview



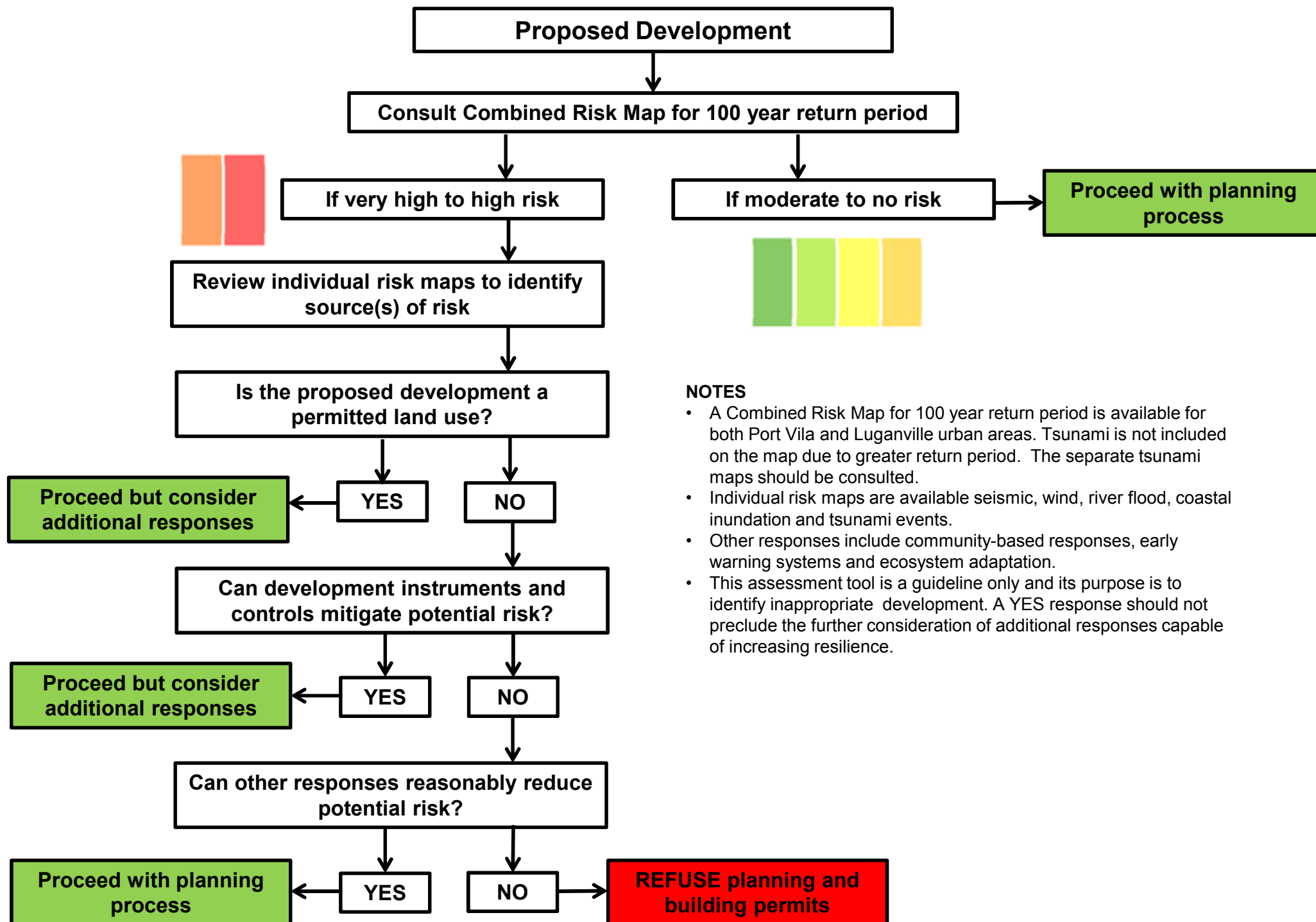
NOTE

The 500 year mean return period potential risk depicted here was developed using wind hazard modelling by AIR Worldwide, fragility functions by Shorten et al. (2003), and a simulated spread of typical buildings. It does not represent the actual risk to any existing building which will depend on its construction quality and the hazard severity. For descriptions of Potential Damage classes, methodology and uncertainties see accompanying report.

Risk Mapping and Planning for Urban Preparedness
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This map should not be relied upon for any work for which detailed site-specific
investigations are normally required.

Appendix D - Risk assessment sheets for Council staff



Appendix E – Review of EIC material

[illegible]

[illegible]

[illegible]

in folder 7.2a	NAB Folder	In folder		NAB Endorsement	Many	Public aswareness and education for disaster risk reduction: Key Messages for Vanuatu	Report	Bislama, English	-		X		NA		X	X	X	X	Save the Children
	Iclim	In folder	On portal	NAB Endorsed	Many	School Disaster Management: A child-	Lessonplan, Curriculum, Syllabus, Teacher guide	English											Save the Children
on portal	on portal		On portal		Many	Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI)	Datasets	English	X						X	X			SOPAC
in folder 7.2b	NAB Folder	In folder		NAB Endorsement ?	Many	The little handbook of disaster and climate change networked governance structure in Vanuatu	Booklet	English	-						X	X	X		Save the Children
	Iclim	?			Many?	Disaster Management Family disaseter plan	Other resource type	English							X				Save the Children
					Many	Community Disaster Plan	Sticker	Bislama			X			In for endorsement			X		Red Cross
					Many	Information Board		Bislama			X			In for endorsement			X		Climate Division
44 VMGD					Severe Weather	Television appearance after rainfall and climate outlook							X		X	X	X	X	Obswervation Division
48 VMGD					Severe Weather	METAR							X		X	X	X	X	Obswervation Division
51 VMGD					Severe Weather	Secorded Variables							X		X	X	X	X	Obswervation Division
49 VMGD					Severe Weather	SPECI							X		X	X	X	X	Obswervation Division
50 VMGD					Severe Weather	Synotic Observation							X		X	X	X	X	Obswervation Division
11 VMGD					Severe Weather	24 hour recorded Variables for synoptic stations							X		X	X	X	X	Weather Forecasting and Services Division
18 VMGD					Severe Weather	Area Forecast (ARFOR)							X		X	X	X	X	Weather Forecasting and Services Division
9 VMGD					Severe Weather	Cities Forecast							X		X	X	X	X	Weather Forecasting and Services Division
4 VMGD					Severe Weather	Clients Bulletins	Bulletin						X		X	X	X	X	Weather Forecasting and Services Division
12 VMGD					Severe Weather	Coastal Marine Forecast							X		X	X	X	X	Weather Forecasting and Services Division
13 VMGD					Severe Weather	Coastal Marine Wind Warning							X		X	X	X	X	Weather Forecasting and Services Division
5 VMGD					Severe Weather	Daily Post Weather bulletins	Bulletin						X		X	X	X	X	Weather Forecasting and Services Division
					Severe Weather	Gale Wind Warning							X		X	X	X	X	Weather Forecasting and Services Division
7 VMGD					Severe Weather	Graphic Daily Post	Graphic						X		X	X	X	X	Weather Forecasting and Services Division
3 VMGD					Severe Weather	Graphic Satellite Image	Image						X		X	X	X	X	Weather Forecasting and Services Division
8 VMGD					Severe Weather	Graphic TV Weather	Graphic						X		X	X	X	X	Weather Forecasting and Services Division
16 VMGD					Severe Weather	Habour Forecast							X		X	X	X	X	Weather Forecasting and Services Division
14 VMGD					Severe Weather	High Seas Forecast							X		X	X	X	X	Weather Forecasting and Services Division
15 VMGD					Severe Weather	High Seas Wind Warning							X		X	X	X	X	Weather Forecasting and Services Division
6 VMGD					Severe Weather	Independent Newspaper Weather Bulletin							X		X	X	X	X	Weather Forecasting and Services Division
2 VMGD					Severe Weather	Mean Sea Level Pressure Chart	Chart						X		X	X	X	X	Weather Forecasting and Services Division
1 VMGD					Severe Weather	Radio Weather Bulletins	Bulletin						X		X	X	X	X	Weather Forecasting and Services Division
20 VMGD					Severe Weather	Route Forecast (ROFOR)							X		X	X	X	X	Weather Forecasting and Services Division
21 VMGD					Severe Weather	Severe Weather Bulletin	Bulletin						X		X	X	X	X	Weather Forecasting and Services Division
22 VMGD					Severe Weather	Severe Weather Outlook							X		X	X	X	X	Weather Forecasting and Services Division
17 VMGD					Severe Weather	Terminal Aerodrome Forecast (TAF)							X		X	X	X	X	Weather Forecasting and Services Division
19 VMGD					Severe Weather	Terminal Trend Forecast (TTF)							X		X	X	X	X	Weather Forecasting and Services Division
10 VMGD					Severe Weather	Weather Forecast Policy	Policy						X		X	X	X	X	Weather Forecasting and Services Division
CEP 2012	CEP 2012				Tropical Cyclone	Yu rere long saeklon sisen ia? DL pamphlet					X		X				X		Weather Forecasting and Services Division
CEP 2012	CEP 2012				Tropical Cyclone	Tropic Cyclone - DL pamphlet			X		X						X		CARE International
on portal	on portal		On portal		Tropical Cyclone	Saeklon	Comic Book	English, Bislama			X		X				X		CARE International
on portal	on portal		On portal		Tropical Cyclone	Yumi Mas Rere	Comic Book	English, Bislama			X						X		CARE International

[illegible]

Appendix F - Key stakeholders

Key Stakeholders

Stakeholder	Role in land allocation or access	Details of who
Central and local government		
Ministry for Climate Change Adaptation, Meteorology, Geo-Hazards, Environment, Energy and Disaster Management	Monitoring of natural hazards, public awareness, Disaster response co-ordination, and coordinating initiatives addressing climate change and disaster risk reduction.	Disaster Committee Chairman, National Disaster Management Office, National Advisory Board, Vanuatu Meteorological and Geo-Hazards Department.
Ministry of Internal Affairs	Co-ordination of government responses to local government plan development, building permits and bylaws.	Department of Local Authorities – Physical Planning Unit.
Ministry of Infrastructure and Public Works Utilities	Oversight of public infrastructure, building code, controls and permits. Opening up new areas for development through the building of roads and provision of services.	Public Works Department Service providers (eg. UNELCO)
Port Vila and Luganville Municipal Councils	Regulatory planning control for areas within the municipal boundary including provision of services. Elected representatives for the Municipal Area.	Department of Local Authorities Staff and Councillors, Municipal Planners, Area Council Chairman, Area Council Secretaries, and Ward Councils.
SHEFA and Samna Provincial Councils	Physical Planning and zoning of SHEFA province. Regulatory planning control for declared province including provision of services within defined urban areas. Elected representatives for the SHEFA Province.	Department of Local Authorities. Provincial staff, Provincial Planners, Councillors, Area Council Chairman and Area Secretaries.
Ministry of Lands and Natural Resources	Administering leases, land registry and land survey. Screening of land lease applications. Decisions on lease periods and land use attached to leases.	Department of Lands, Land Management and Planning Committee
Department of Agriculture	Allocation of agricultural land.	Department of Agriculture
Landowners and leaseholders		
Government (as landowner)	Landowner within declared areas. Control of government leased land.	Department of Lands
Chiefs	Appointed chief over an area.	Malvatumauri – Council of Chiefs, Port Vila – Ifira, Tanvasoko, Mele, Pango and Erakor Paramount Chiefs. Santo chiefs. Chiefs and representative for community settlement areas.

Stakeholder	Role in land allocation or access	Details of who
Custom landowners	Owners of land and control of tenancy arrangement for custom owned land.	Landowners of Efate and Santo. Department of Justice (for land disputes)
Leaseholders	Community leases, corporate/company leases, and individual leases	Department of Lands, individual leaseholders.
Land occupiers (residents and businesses)		
Residents of informal settlements	Residents of areas that do not meeting building standards/regulations.	Community leaders, customs landowners/chiefs
Private residents	Residents of areas with titles that are legally registered.	Community leaders and individuals
Private owners of business and commercial land	Owners of businesses and commercial land and premises.	Business groups
Manufacturers and large employers	Siting of new and growing businesses that provide employment for low income people.	Large manufacturers and employers (eg. port, airport, resorts)
Land development and sales sector		
Land development companies/organisations	Land development including subdivision, infrastructure provision and land sale.	Land development companies/agencies (eg. Caillard Kaddour Ltd and Vanuatu National Provident Fund)
Real estate firms	Sales of residential, commercial and industrial land.	Real estate companies (eg. First National Real Estate)
Financial sector		
Financial institutions	Provision of loan equity.	Member Financial Services Limited, Commercial banks (eg. National Bank of Vanuatu, ANZ, Westpac and Bred Bank)
Insurance companies	Mortgage and asset insurance.	Insurance companies (eg. AFA Limited and QBE Insurance (Vanuatu) Limited)
Providers of low cost/affordable housing		
National housing providers	Provision of low cost, affordable housing and land.	National Housing Corporation, housing schemes.
Non-Government Organisations and community organisations	Supporting residents of informal settlement areas including through house building programmes.	Churches, NGOs (eg. Habitat for Humanity)
Women and youth		
Women	Gender balance equity.	Woman Groups, Vatu Mauri Consortium
Youth	Future community and political leaders.	Youth Forums, schools and education providers.

Appendix G - Key messages reviewed

Division, Materials, Hazard			Language			Current Status	Formats			Type of Material						
Division	Materials	Hazard	Bislama	English	French		Printed Copies Avail	PDF Avail	Original Files	Brochures	Flyers	Posters	Booklets	Banners	Newsletters	Video Documentary
Weather Forecasting and Services Division	Understanding Weather	Severe Weather		✓		Completed		✓	✓		✓					
Weather Forecasting and Services Division	Vanuatu Tropical Cyclone Bulletins and Warning Categories	Severe Weather		✓		Completed		✓	✓		✓	✓				
Weather Forecasting and Services Division	Aviation Weather Products	Severe Weather		✓		Completed										
Weather Forecasting and Services Division	Public Weather Products	Severe Weather		✓		Completed		✓	✓	✓						
Weather Forecasting and Services Division	Marine Weather Products	Severe Weather		✓		Completed		✓	✓	✓						
Weather Forecasting and Services Division	Vanuatu Tropical Cyclone Bulletins and Warning Categories	Severe Weather		✓		Completed		✓	✓		✓	✓				
Weather Forecasting and Services Division	Forecast Division Banner	Severe Weather		✓		Draft Version			✓					✓		
Weather Forecasting and Services Division	Tropical Cyclone	Severe Weather		✓		In Development							✓			
Weather Forecasting and Services Division	Cloud Charts	Severe Weather		✓		In Development						✓				
Weather Forecasting and Services Division	Weather Terms	Severe Weather		✓		In Development				✓						
Weather Forecasting and Services Division	Weather Calendar	Severe Weather		✓		In Development						✓				
Weather Forecasting and Services Division	Weather Newsletter	Severe Weather		✓		In Development									✓	
Weather Forecasting and Services Division	Tracking Map	Severe Weather		✓		In Development										
Weather Forecasting and Services Division	Overall Division Presentation	Severe Weather		✓		In Development			✓							✓

Appendix H - SOP 11 Tsunami evacuation maps and signs

Standard Operating Procedure: Community-Based Tsunami Evacuation Maps and Signs

National Disaster Management Office and
Vanuatu Meteorology and Geo-Hazards Department



 **Beca**



 **NIWA**
Taihoro Nukurangi

Version 1.1, 28 July 2016

As part of the Mainstreaming Disaster Risk Reduction Project (MDRR) being implemented by the Vanuatu Meteorology and Geohazards Department (VMGD).

1. Introduction

The Vanuatu Meteorology and Geo-hazard Department (VMGD) and National Disaster Management Office (NDMO) together produce tsunami evacuation maps and signs for cities and villages in Vanuatu, through a community engagement process adapted from that designed for Samoa (Wright (compiler), 2011)¹.

This SOP gives instructions for the process of base map production (details in SOP 12), community engagement to complete the map and determine the types and locations of signs, and the production and installation/distribution of those maps and signs.

This SOP should be read in conjunction with the **National Disaster Management Plan**, the National Tsunami Response Plan (NDMO), and the VMGD Technical Standard Document: Tsunami Warning Sirens System, Warning and Information Dissemination Technical Design Document (VMGD).

2. Digital map and sign files

Digital files held at VMGD need to be customised for each community, to produce two Tsunami Evacuation Plan products (an 'Evacuation Map' and an 'Information Board'), and up to 4 different sign types (one of which is the 'information board' product).

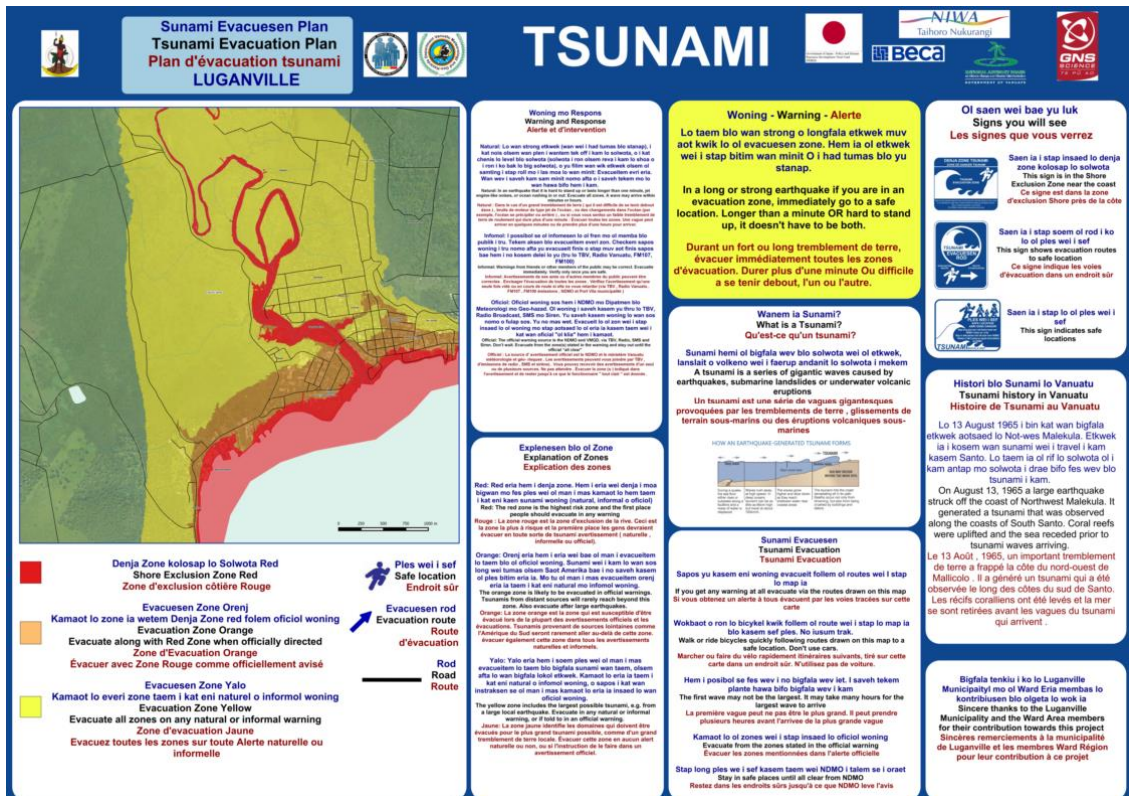
All files are stored on the VMGD data centre servers and accessible through the network in the folder [LiDAR NAS:\GIS_Data\Operations\Divisions\Geo_hazards] and a copy of initial versions is also held at GNS Science.

The GIS tsunami zone layer is a stand-alone shapefile held by VMGD in that folder, with a copy at GNS Science.

2.1. *Tsunami Evacuation Plan*

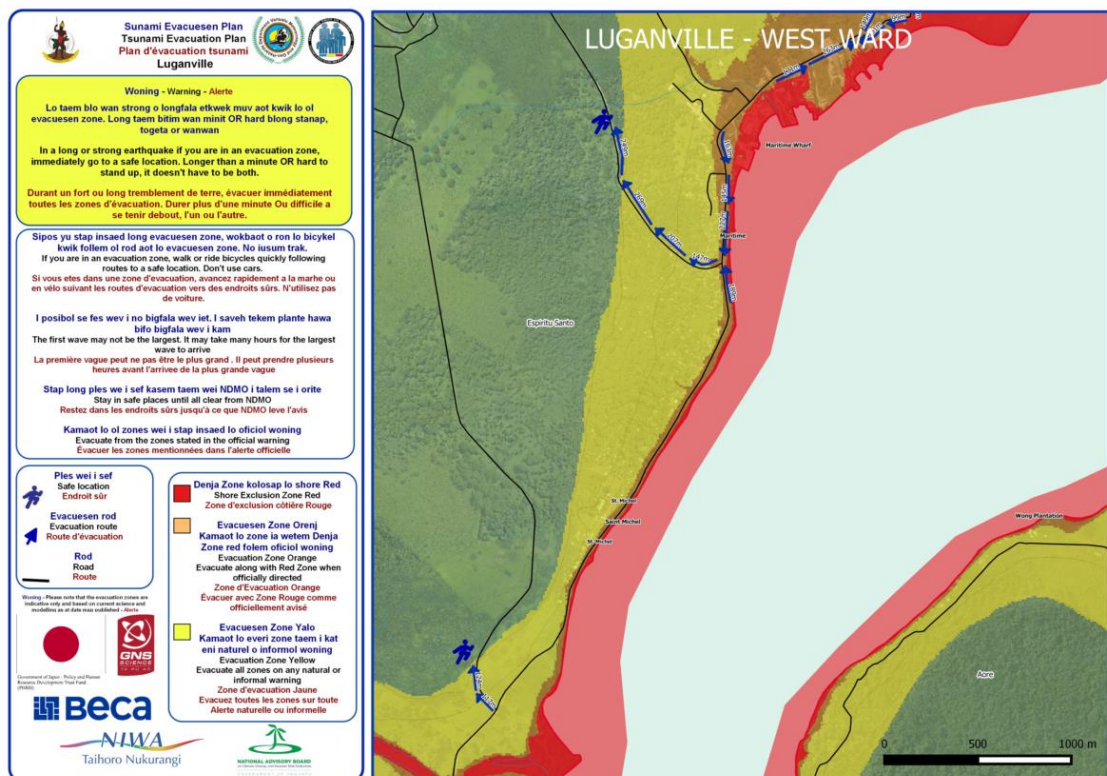
The two Tsunami Evacuation Plan products are drawn in two QGIS composers:

- (1) **TsunamInfo_V#[initials]_[place].QGS – info board print layout** (below)
e.g TsunamInfo_V4MH_Port Vila



(2) TsunamiMap_V#[initials]_A3L_[place].QGS – A3 print layout (below)

e.g. TsunamiMap_V4MH_A3L_Vila



These include links to the GIS tsunami zone layer, base air photo imagery, and information graphics as shown above. They are stored on the Tsunami GIS PC, on the network, and a copy is held at GNS Science.

Increase the version number (V#) by one for any significant template changes, and add the owners initials (eg. MH is Morris Harrison) so advice can be sought from the last user.

2.2. Signs

Six sign types (Figure 1) are available for installation. They are:

DZ – Danger zone

SR L – Left arrow safe route

SR R – Right arrow safe route

SL – Safe location

LR – Two-arrow double-sided safe route – (formed from using the above two files)

IB – Information board including evacuation zone and route map



Figure 1 Tsunami sign types

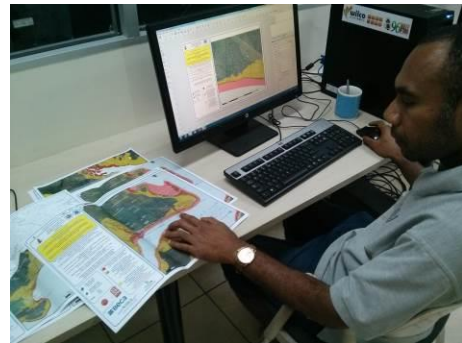
2.3. Presentations

Four different presentations were prepared:

A Powerpoint presentation named MDRR (Santo TOT workshop MDRR presentation 4.6.16FI) to explain the Mainstreaming Disaster Risk Reduction Project. This include where the project fund originates from, mentioning the financier (Government of Japan through World Bank), project sites, implementing departments, local authorities and external partners involved, key components of the project, duration of project, what has been achieved so far and explaining what mainstreaming means.

A Powerpoint presentation named xxxx to explain the structure and processes that are in place for communities to understand and follow when seeking assistance from the government. The roles of the National Disaster Management Officer in the Disaster Management Cycle and the importance of each community having its own Community Disaster and Climate Change Committee (CDCCC) and the role of the CDCCC as per Tsunami Evacuation Plan.

A Powerpoint presentation named Geohazards (Geohazards_EQ_Tsunami_mjh) to explain what Geohazards are in general terms giving examples in Vanuatu, what a tsunami is, how it is generated and where the word “Tsunami” originates from and become accepted by the scientific community. The presentation ends with explaining earthquake and subsequent tsunami risks in Vanuatu.



A Powerpoint presentation named Tsunami Evacuation (tsunami eva maps1_mjh) is included, to explain tsunami warning and tsunami response. The Tsunami Warning part explains what tsunami warnings are i.e. the different types of warnings including official warnings from the Vanuatu Meteorology and Geo-hazards Department and other dissemination means such as through SMS and Sirens. Whilst the Tsunami Response part acts as an introduction to the Tsunami Evacuation Plan Products i.e. the Tsunami evacuation maps and Information Boards, and the evacuation signs.

3. Base map printing process

The NDMO/VMGD decides on the next municipality ward or provincial area council and VMGD prepares a draft of the Tsunami Evacuation Maps and Information Boards for that place on their computer screen and discusses two things between the NDMO and VMGD:

1. The boundaries of the map – this should be:
 - Suitable to cover the ward/area council well.

Once the draft is agreed on screen with VMGD and NDMO a test print is needed to check the colours of the image and zones are OK. Then several copies of the Tsunami Evacuation Maps (Figure 2) are printed out at A3 scale for planning and discussion use outside in that ward/area council. Draft Tsunami Evacuation signs of A3 size were also printed out for each ward/area council.

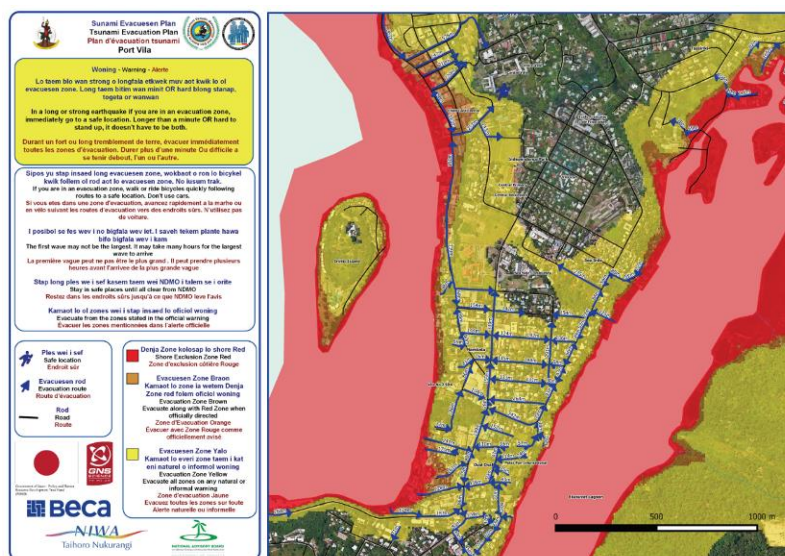


Figure 2 Example of base A3 Tsunami Evacuation Maps

4. Village consultation process

Use additional resources wherever available – consultation is resource intensive. For example existing or reactivated CDC. Additional facilitators supplied via these avenues need training. In the two municipalities, Port Vila and Luganville, councillors and ward chair persons were used to coordinate and facilitate consultation in different communities in their respective wards. In the Greater Port Vila and Greater Luganville, area council secretaries (employed under provincial governments) were used to coordinate and facilitate consultations in different communities in their Area Councils.



4.1. Facilitator Training

There are 2 facilitator trainings; one in Port Vila for representatives from Port Vila Municipality Wards (Southern Ward, Central Ward, Fresh Wota – Tassiriki, Anamburu and Northern Ward) and Greater Port Vila Area Councils (Eratap, Erakor, Pango, Ifira, Tanvasoko and Malimerum) and another one in Luganville for representatives from Luganville Municipality Wards (West Ward, Sarakata Ward, Central Ward and East Ward) and Greater Luganville Area Councils (Southeast Area and South Area 2). Representatives are area secretaries, municipal councillors, ward chair persons and other

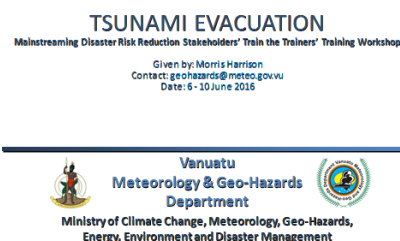
community members nominated by area secretaries, councillors and ward chair persons. All four presentations in section 2.3 were presented at the facilitators training. After all presentations, activities were conducted to help participant understand the Tsunami Evacuation Plan products (Tsunami Evacuation Maps and Information Board) and the signs. Breakout groups of different Wards and Area Councils were used during activity session. These trainings took place before community consultations for the respective municipality and area council takes place.

The following short clips were shown to participants:

- Megathrust Earthquakes
- Solomon Vanuatu EQ Tectonics

4.2 Presentation

All four presentations in section 2.3 were presented at each community consultation venue. Give the Powerpoint community presentation, explaining to the audience tsunami, the threat in Vanuatu, evacuation maps and signs, the warning signals that should trigger evacuation, and the process laid out below. Insert any wider DRR or CDC plan process consultation as needed into the consultation.



4.2. Break-out groups

Break into separate groups of Men, Youth, Women, and disabled people, and facilitate discussion in these groups of the location of the zones, discussing the key outcomes: (1) possible evacuation routes, (2) sign locations (assembly areas) on the routes, and (3) local place names needed on the maps. Draft evacuation maps, information boards and signs were used (Figure 3). Groups wrote directly on the drafts.

Drawing and labelling maps, adding routes, locating signs



Figure 3 Example (left) a break-out group discussing their ward evacuation map,(routes and locations added), and (right) a break-out group explaining a change in the word and language used on the Danger Zone sign during their presentation up front.

Hand draw three things on the Draft evacuation maps, information boards and signs (Figure 3):

(1) Drawn on proposed evacuation routes using arrows

- Draw on sign locations for the following four sign groups (code them using the seven letter codes from Figure 1)
- **Denja zone** – several, usually down at the coast and on the coastal road. Label these ‘**DZ**’
- **Safe route**– at the beginning of evacuation routes and along them where additional direction is needed. Label these ‘**L**’ for left arrow, ‘**R**’ for right arrow, or ‘**LR**’ for two arrows back to back double-sided
- **Safe location** – outside of the evacuation zones, at an agreed suitable safe place, e.g. building or at least a clearing. Label these ‘**SL**’.
If the safe place is a long way inside the safe zone a **Safe Direction ‘SD’** sign can be added just inside the safe zone, to explain evacuees are now safe but where to go to reach the safe location building/evacuation centre.
- **Information board** – Perhaps 1 or 2 in a place, where lots of people will see it, including tourists and locals

(2) **Location names** that help people read the map – churches, schools, police station, shop, etc. And also the main local names, **especially including the first describable place along each safe route inside the safe zone** – so people know when they are safe while evacuating.

(3) Write or correct English, French and Bislama version of evacuation maps, information boards and signs

After all groups done then each group presented their work in front while others listen and asks questions after each presentation. After which all used draft materials were collected.

4.2.1 Mapping Consultation Sites

Using a pocket GPS all consultation sites for each ward and area council were recorded. The coordinates were uploaded on google-earth and a map of each ward and area council community consultation sites produced (Figure 3)

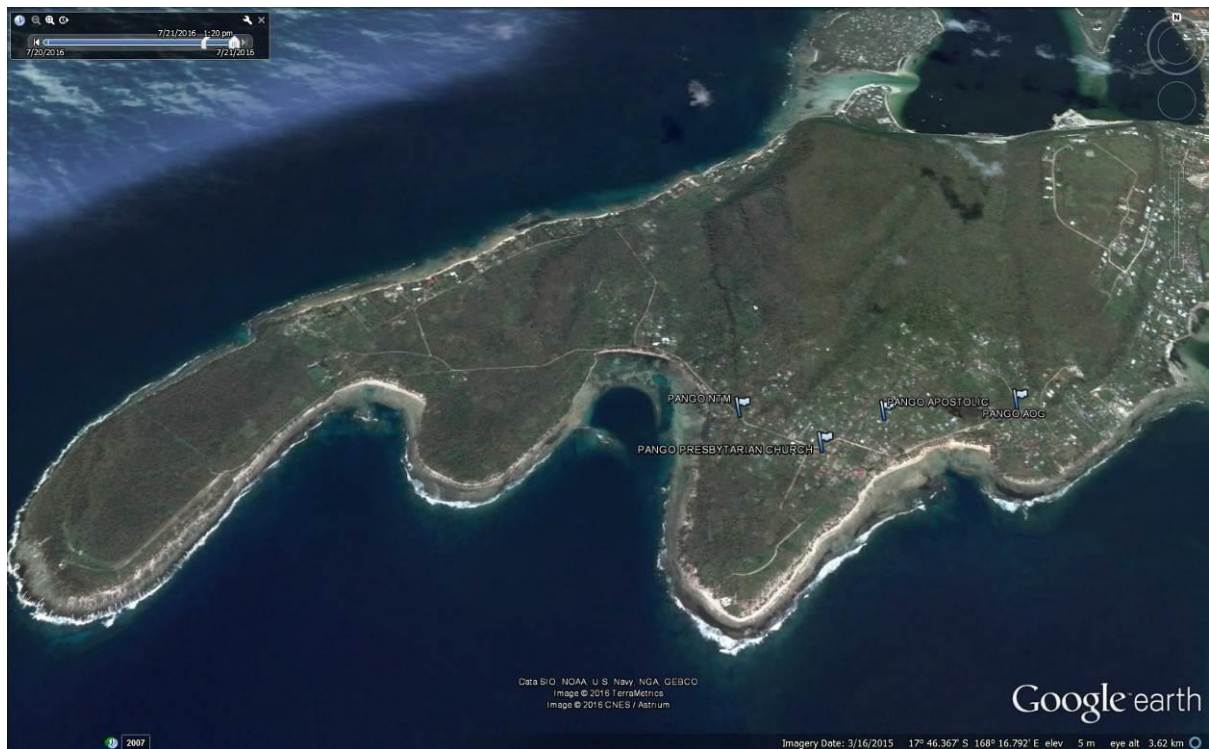


Figure 3. Consultation sites for Pango Area Council

4.3. Field checking

Then walk or drive through the evacuation routes (Figure 4) and check if they make sense, if the sign locations make sense, and if the local names are correct. Also, photograph each sign location, and write notes. Check authorisation to dig and concrete, or to co-locate the sign on an existing pole or wall etc.



Figure 4. Example of a site for DZ and IB; on the left is a landing and picnic site whilst on the right is a park used for public activities such as festivities, mass gathering just along the beach



Figure 5. Example of sites; on the left is a safe route so LR site whilst on the right is a school football field used site for DZ since next to beach

4.3.1 Mapping Signs and Information Board Sites

Using a pocket GPS all signs and information board sites for each ward and area council were recorded. The coordinates were uploaded on google-earth and a map of each ward and area council signs and information board sites was produced (Figure 6).

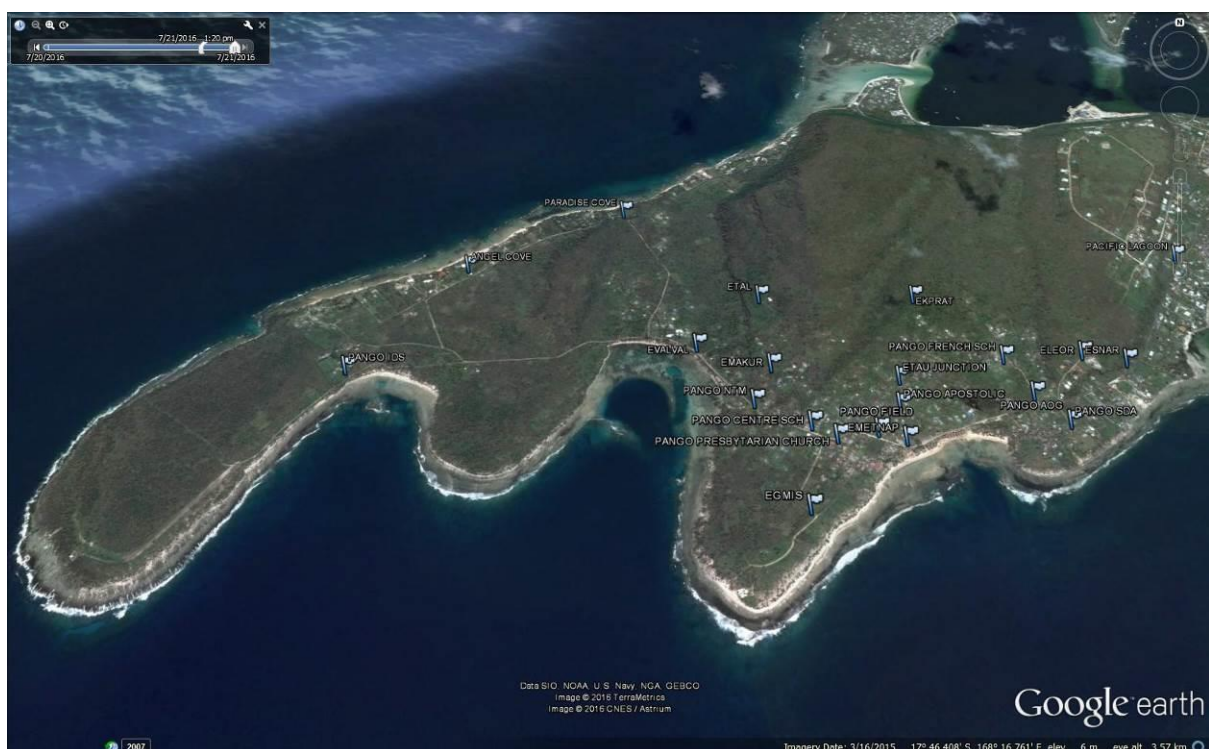


Figure 6. Signs and Information Board sites for Pango Area Council

4.4. Revisions

Revise (Figure 8) by hand what is drawn and written on the draft maps from what was learned on the walk/drive around.

Figure 7 walking through the route

Figure 8 Revising the maps from the walk around

5. Update digital maps

Update the QGIS files:

with three things on them from the results of the community consultation in Section 4:

- (1) Evacuation routes – white or blue lines with arrow-heads on the in-land end
- (2) Location names – white dots and written names
- (3) Safe locations – little icons of a person running

Also check that logos and legend items are all correct – e.g. make sure the logo for the project/organisation paying for the signs is right.

6. Print and distribute signs and maps

6.1. Publish the maps to PDF

Publish to PDF (Figure 6) at **810mm x 1140mm** [Ask sign maker about costs and available sizes, e.g. see Samoan efficiency of 3 signs per 1220-2440] and send it to the sign maker.

VMGD publish xxx to PDF (Figure 7) for printing on paper as needed.

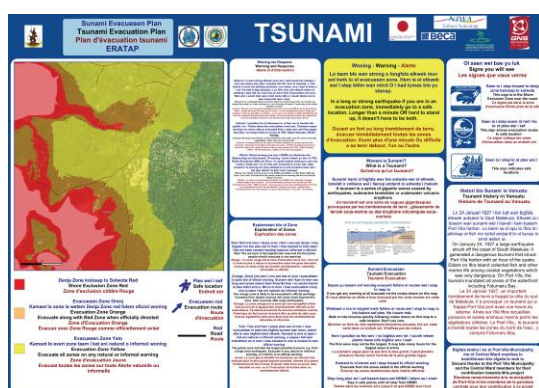


Figure 6 Completed Information Board

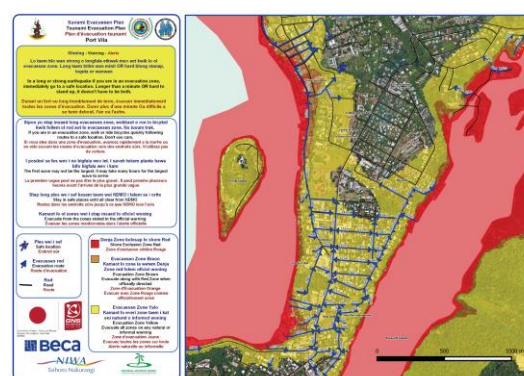


Figure 7 Completed A3 sheet

6.2. Counting and printing signs

Carefully count and record in a spreadsheet the numbers of each of the six sign types (Figure 1) from the revised community consultation maps that are needed.

Contract the sign maker to make that number of each sign type.

Information boards should each be printed at **810mm x 1145mm** – this is just slightly smaller than A0 and allows three signs to be cut from one standard 1220mm x 2440 board (this is the standard

product size available). Make sure the sign manufacturer does not change the aspect ratio – it is important the sign is not squashed. They should simply scale the PDF image to fully fit **810mm x 1145**, without chopping any of the graphics off on any edge.

6.3. Install and supply signs and maps

- **Fix** the signs including information boards to galvanised iron poles and **install** these in place in appropriate depth holes. Avoid making the hole too shallow.
- **Supply** the xxxxx.PDF file to people in the place/village as digital or printed paper copies (ideally laminated) as needed.
- **Upload** the two PDFs to the **website**,
- **Add** the maps to other community plans (e.g. CDC) and the SOP.

6.4. Technical specifications of signs

[to be added]

Appendix 1 Evacuation zone heights at coast and inland

VMGD and NDMO are often asked what height the zones are based upon. This Appendix provides a brief summary from Lukovic et al., (2016).

It is important to understand the difference between wave height at the coast used for a tsunami evacuation zone, and the possible run-up height on land that that zone needs to allow for. See Figure 8 – the run-up of a tsunami can be up to double the wave height on steep coastal land, and it then drops off inland. So a tsunami zone designed for maximum wave height **8m needs to include land up to 16m** above sea level at the coast, dropping off inland.

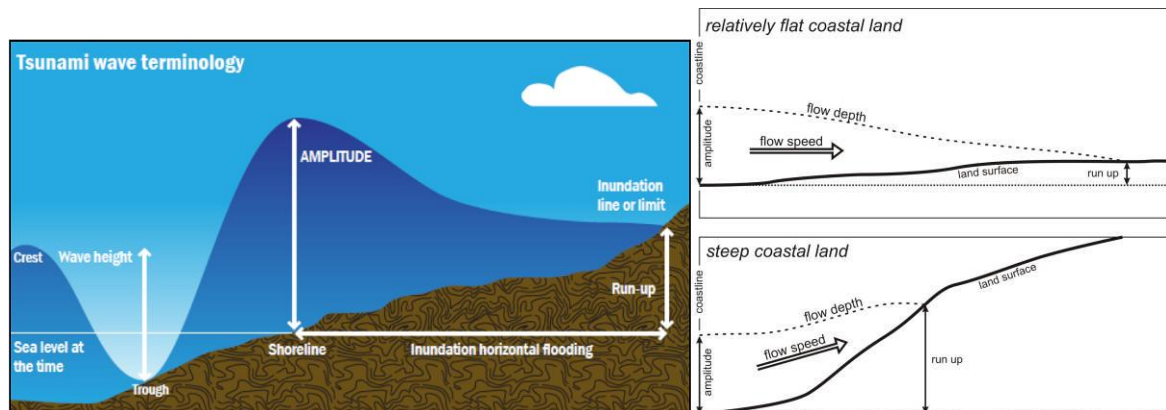


Figure 8 (left) Terminology – wave height vs. run-up, (right) run-up on flat vs. steep coastal land.

Table 1 and 2 give the wave heights, and run up heights at coast, that the largest evacuation zones are drawn for in Vanuatu. For example for Port Vila Table 1 gives 1-3 m for the orange zone – this means the maximum wave height is 3 metres, and the evacuation zone includes land up to 6m elevation at the coast, which needs to be on top of high tide. The elevation of the zone drops off 1m every 200m inland. So for example **for Port Vila:**

- The yellow evacuation zone for the largest tsunami is at 35m elevation at the coast
- It is at 30m elevation at 1km inland
- It is at 25m elevation at 2km inland
- and it reaches just over 7km horizontally inland on flat ground.

Table 1 Summary of input values used for development of raw evacuation zones for Port Vila

Evacuation zone	Intention for use	Potential run-up at coast	High Tide
Red	0.3-1 m tsunami threat warning	2 m	0.45 m
Orange	1-3 m tsunami threat warning	6 m + 20% = 7.2 m	0.45 m

Yellow	Maximum credible tsunami or 'greater than 3 m' tsunami threat warning	35 m	0.45 m
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Table 2 Summary of input values used for development of raw evacuation zones for Luganville

Evacuation zone	Intention for use	Potential run-up at coast	High Tide
Red	0.3-1 m tsunami threat warning	2 m	0.5 m
Orange	1-3 m tsunami threat warning	6 m + 20% = 7.2 m	0.5 m
Yellow	Maximum credible tsunami or 'greater than 3 m' tsunami threat warning	25 m for the east part of the coast	0.5 m
		35 m for the remainder of the coast	

Appendix 2 Sign location table template

A2.1. Locations

Based on the description of activities (Section 2) the sign locations are documented in 4 formats:

1. Table 1 below for a list of sign locations for each sign type (Figure 1), with a description and photo number for each site.
2. **Generate and use a paper map or QGIS version xx.jpg** - a map of sign locations, coded by location number followed by sign type code(s) from Figure 1 of the SOP. For example 23E2 is a pole at location 23 with an Evacuation Zone (E) sign along with a pair of left and right evacuation route signs back-to-back (2).
3. Folder **xx** contains a photo of each sign location named by location number.

A2.2. Next steps

Quantities and quotes

Get three quotes for the following totals:

10	Evacuation Zone signs
14	Left Evacuation Route signs
11	Right Evacuation Route signs
20	Double Evacuation Route (back-to-back) signs, each one includes a <u>Left and Right</u> sign
10	Safe Location signs
9	Safe Location Direction signs:
	1 to [place]
	1 to [place]
	2 to [place]
	1 to [place]
	1 to [place]
	3 to [place]
74	TOTAL small signs, and:
4	<u>Information boards</u>

Permission

Get permission for [and location #s needed] to place left and right evacuation route signs back to back on [for example the traffic light yellow pole at the northeast corner of the intersection, pointing south].

Permit all other locations on the road reserve

Adding logos

Add suitable **xx** Project logo from **yy**

Manufacture

Order the signs (manufactured on poles) using the .PDF files detailed in SOP, along with the unique safe location direction sign .PDF files directing people to **xx**, **xx**, **xx**, the Prayer House, **xx**, **xx** and **xx**.

Install

Install the signs so that the Evacuation Zone signs face away from the water, or in another logical orientation, so that arrows point with the evacuation route on the evacuation map, and with oversight from person(s) who participated in GPS and photo acquisition for locations.

Table 1 Location numbers and sign types for each [examples from Apia, Samoa]

Location	corner of road	evac zone	route	safe locn	info	safe drctn	coordinates	Description (in xls file)
1	W		L				S13 49.819 W171 46.318	
2	SE		2				S13 49.877 W171 46.195	
3	SW		2				S13 49.990 W171 46.248	
4	E		R				S13 50.094 W171 46.277	
5	SE		2				S13 50.317 W171 46.397	
6	E		L				S13 50.398 W171 46.441	
7	E					SD	S13 50.691 W171 46.616	
9	SE		2				S13 49.939 W171 46.068	
10	SW		2				S13 50.227 W171 46.086	
11	S		L				S13 50.340 W171 46.066	
13	SE		2				S13 50.326 W171 46.209	
14	E					SD	S13 50.384 W171 46.149	
15	E			S			S13 50.577 W171 46.140	
16	SE		2				S13 49.904 W171 46.126	
17	SE		R				S13 50.018 W171 46.177	
18	W		L				S13 50.172 W171 46.243	
19	S		L				S13 50.314 W171 46.281	
20	S		L				S13 50.352 W171 46.212	
21	N	E	2				S13 49.979 W171 45.809	
22	SW					SD	S13 50.368 W171 45.828	
23	E			S			S13 50.676 W171 45.813	
27	N		2				S13 50.226 W171 45.435	
28	N		2				S13 50.196 W171 45.370	
29	W		L				S13 50.309 W171 45.330	
30	E					SD	S13 50.515 W171 45.294	
31	E		R				S13 50.646 W171 44.677	
32	S			S			S13 50.885 W171 44.807	
33	N	E	2				S13 49.999 W171 45.733	
34	W		2				S13 49.851 W171 45.586	
35	SW		2				S13 49.970 W171 45.283	
36	S		L				S13 50.113 W171 44.756	
37	S	E	L				S13 49.963 W171 44.772	
38	E	E	R				S13 49.618 W171 45.520	
39	N	E	R				S13 49.711 W171 45.225	
40	SW	E	L				S13 48.944 W171 46.766	
41	NE		R				S13 49.098 W171 46.659	
42	COURT				INFO		S13 49.090 W171 46.682	
43	E	E	R				S13 49.475 W171 46.411	
44	SW		L				S13 49.710 W171 46.343	
45	NE		2				S13 49.783 W171 46.275	
47	NW		L				S13 50.076 W171 46.395	

49	SE		R			S13 50.175 W171 46.427
50	NE		R			S13 49.940 W171 46.599
52	SW		2			S13 50.330 W171 46.648
53	E		R			S13 50.531 W171 46.688
54	E				SD	S13 50.680 W171 46.826
55	NW			S		S13 51.209 W171 47.175
56	E			S		S13 51.162 W171 47.432
57	SE				SD	S13 50.601 W171 47.088
58	SE		2			S13 50.273 W171 46.930
59	SE		2			S13 50.172 W171 47.160
60	W				SD	S13 50.462 W171 47.291
61	SE			S		S13 50.671 W171 47.394
62	W	E	L			S13 49.976 W171 47.111
63	BUS				INFO	S13 49.737 W171 46.237
64	TRSM				INFO	S13 49.893 W171 45.978
65	W				INFO	S13 49.678 W171 45.528
66	E			S		S13 50.449 W171 45.553
67	NE		2			S13 50.219 W171 45.645
68	SW		2			S13 50.210 W171 45.823
69	SW	E	L			S13 49.846 W171 44.958
70	E	E	R			S13 50.160 W171 44.613
71	NE		2			S13.841 W171.743
72	S			S		S13 50.853 W171 44.546
73	S				SD	S13 50.611 W171 44.965
74	SE			S		S13 50.852 W171 45.027
75	E			S		S13 51.093 W171 45.071
76	E				SD	S13 50.451 W171 45.403

Left 14
Right 11
Back-to-back (2) 20

	zone	route	safe	info	Safe direction
TOTAL:	10	45	10	4	9

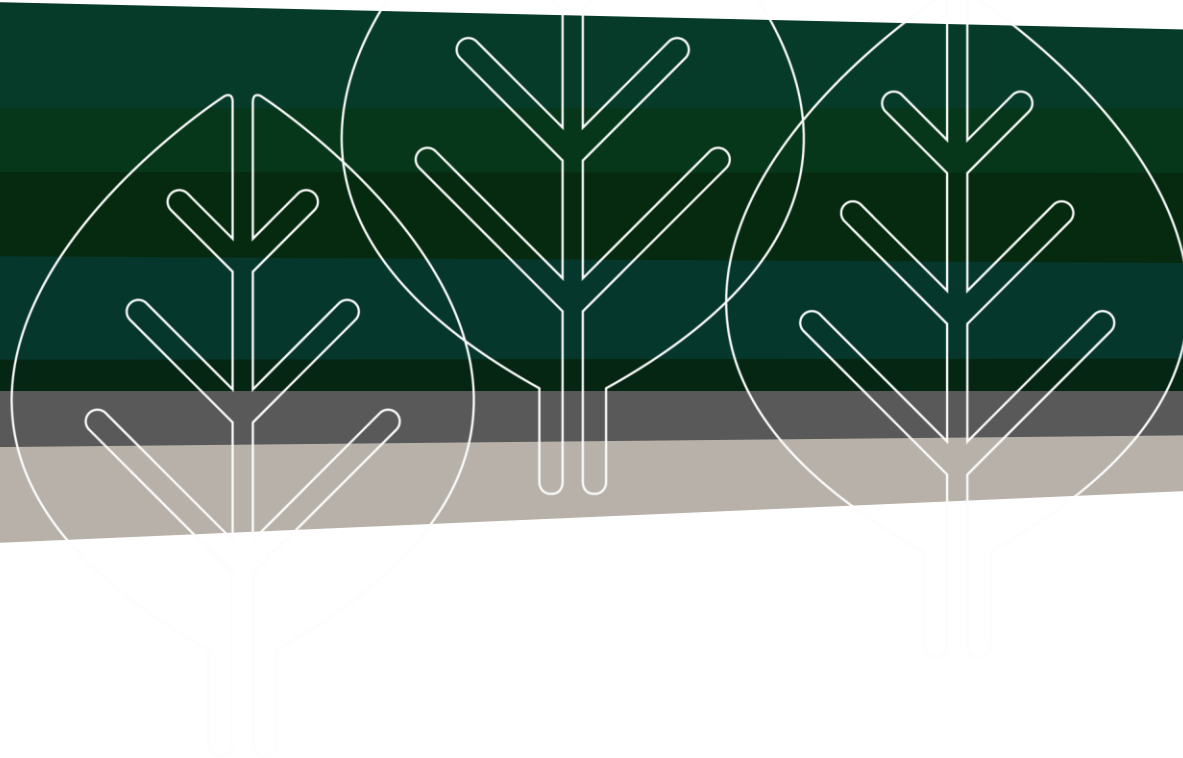
Appendix I - SOP 12 Creating tsunami evacuation maps in QGIS



STANDARD OPERATING PROCEDURE (SOP 12)

FOR

Creating Tsunami Evacuation Maps in QGIS



**Increasing Resilience to Climate
Change and Natural Hazards Project
and Mainstreaming DRR (MDRR)**
Vanuatu Meteorology and Geo-
Hazards Department
Project Management Unit



Prepared for: VMGD

Prepared by: T Gunson/G Leonard

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1 CREATING TSUNAMI EVACUATION MAPS IN QGIS

1.1 Context

This SOP must be read in conjunction with two other documents:

1. SOP11 – Vanuatu community tsunami evacuation maps and signs (2016)
2. This Stakeholder Participation and Communications Implementation Action Plan (2016) prepared for the Risk Mapping and Planning for Urban Preparedness Project, as part of the Mainstreaming Disaster Risk Reduction Project (MDRR) being implemented by the Vanuatu Meteorology and Geo-hazards Department (VMGD).

SOPxx lays out the wider process for community evacuation map development that this SOP13 is part of, and the Action Plan explains the multi-hazard risk mapping and risk reduction activities that tsunami evacuation maps contribute to.

1.2 Pre-requisites

The following prerequisites should be checked and applied to the base map;

1. Map specification (coverage, scale, page size and orientation, map type, etc.)
2. Text content (title, disclaimer, data sources, legend etc.)
3. Load project (from server) or apply Template
4. Check and locate/open base mapping layers
5. Add/edit/create applicable layers
6. Add Tsunami escape routes, place names and meeting areas

1.2.1 Map Specification

For tsunami maps the following specifications should be used;

Map coverage should show the community that is developing this particular evacuation map - define area of interest/coverage from the initial meeting with that community. Ward boundaries are a good starting point.

- The page size should be A3 and the orientation Landscape. Because the map element is square the page orientation does not need to change from one place to the next.
- The scale should be somewhere between 1:10 000 and 1:25 000 (determined largely by the coverage requirement above, but not so small that points of interest, evacuation zones and evacuation routes cannot be seen clearly)
- The map type is an orthophotomap (unless agreed otherwise with the community) with specific vector overlays (see 4 below for specific layers)

1.2.2 Text Content

For tsunami maps the following text should be used:

Title – “Tsunami Evacuation Plan” [with Bislama and French Translations] (new line) – name of the place i.e. “Port Vila” Text size 36, font – Arial, Bold

For example:

Sunami Evacuesen Plan
Tsunami Evacuation Plan
Plan d'évacuation tsunami

Luganville

The disclaimer should read “Please note that the evacuation zones are indicative only and based on current science and modelling as at date map published”

Data sources should be listed, for example: Image DIGO 2004, base topographic layers DoL, MoET, MoH etc.

Text for Box 1:

Woning - **Warning - Alerte**

Lo taem blo wan strong o longfala etkwek muv aot kwik lo ol evacuesen zone. Long taem bitim wan minit OR hard blong stanap, togeta or wanwan

In a long or strong earthquake if you are in an evacuation zone, immediately go to a safe location. Longer than a minute OR hard to stand up, it doesn't have to be both.

Durant un fort ou long tremblement de terre, évacuer immédiatement toutes les zones d'évacuation. Durer plus d'une minute Ou difficile a se tenir debout, l'un ou l'autre.

Text for Box 2:

Sipos yu stap insaed long evacuesen zone, wokbaot o ron lo bicykel kwik follem ol rod aot lo evacuesen zone. No iusum trak.

If you are in an evacuation zone, walk or ride bicycles quickly following routes to a safe location. Don't use cars.

Si vous etes dans une zone d'evacuation, avancez rapidement a la marhe ou en vélo suivant les routes d'evacuation vers des endroits sûrs. N'utilisez pas de voiture.

The Legend should contain the following items:

Legend Box 1:

Ples wei i sef

Safe location

Endroit sûr

Evacuesen rod

Evacuation route

Route d'évacuation

Rod

Road

Route

Legend Box 2:

Denja Zone kolosap lo shore Red

Shore Exclusion Zone Red

Zone d'exclusion côtière Rouge

Evacuesen Zone Orenj

Kamaot lo zone ia wetem Denja Zone red folem oficial woning

Evacuation Zone Orange

Evacuate along with Red Zone when officially directed

Zone d'Evacuation Orange

Évacuer avec Zone Rouge comme officiellement avisé

Evacuesen Zone Yalo

Kamaot lo everi zone taem i kat eni naturel o informol woning

Evacuation Zone Yellow

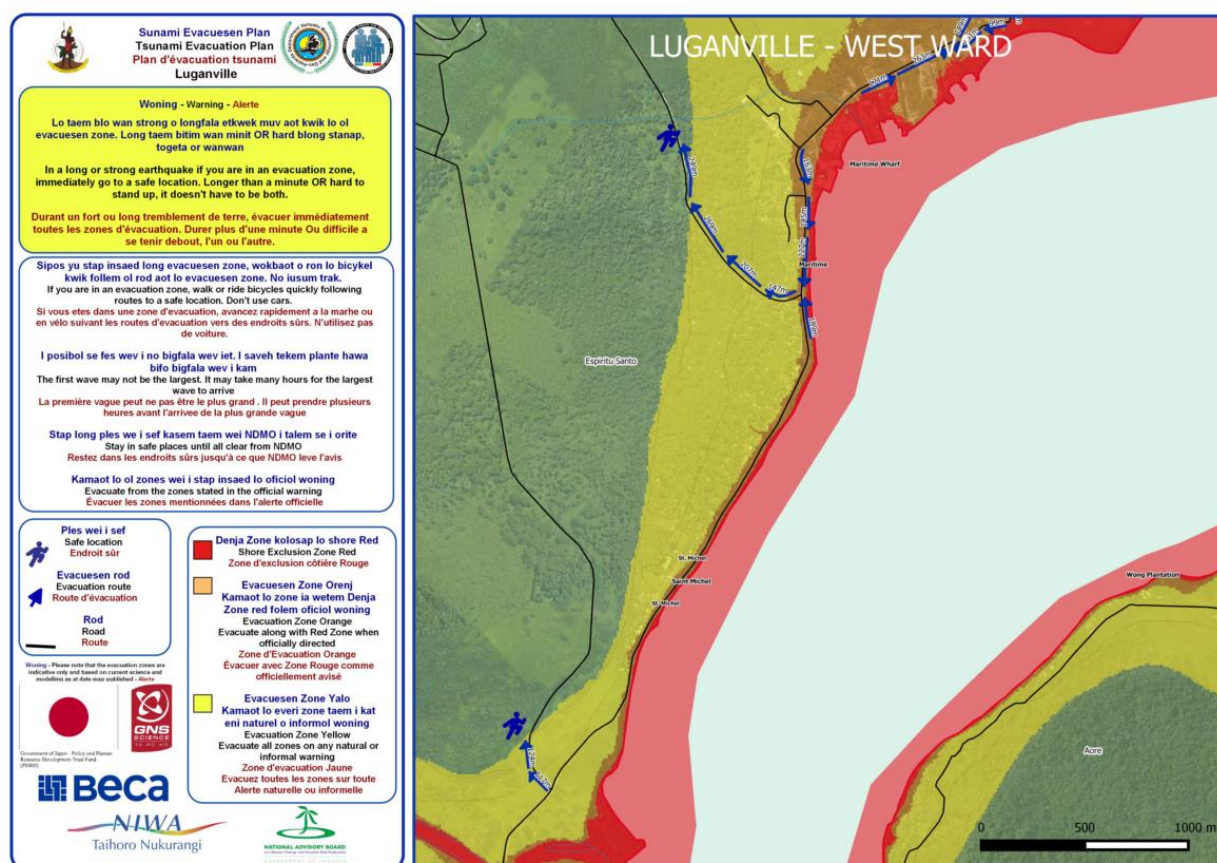
Evacuate all zones on any natural or informal warning

Zone d'evacuation Jaune

Evacuez toutes les zones sur toute Alerte naturelle ou informelle

Eight logos should be added:

- Government of Vanuatu
- VMGD
- NDMO
- Government of Japan – Policy and Human Resource Development Trust Fund (PHRD)
- GNS Science
- Beca
- NIWA
- National Advisory Board



Example of a completed evacuation map for the West Ward of Luganville Municipality, Santo

1.2.3 Load Project or Apply Template

The tsunami map QGIS project is in the:

D:\GIS drive of the Tsunami GIS PC.

Otherwise a backup can be downloaded from the server:

LiDAR NAS:\GIS_Data\Operations\Divisions\Geo_hazards
(See Section 1.3 for instructions)

There are 2 main project files as follows:

1. Tsunami Evacuation Maps (e.g. TsunamiMap_V4MH_A3L_Vila) and
2. Tsunami Information Boards (e.g. TsunamiInfo_V4MH_Port Vila).

If the tsunami map QGIS project already exists then load it from the D: drive location or the backup on the server.

Otherwise the appropriate layers should be opened (see below) and the Tsunami Map Template should be applied (refer to Section 1.3 for an explanation on how to do this).

1.2.4 Check and locate/open base mapping layers

The layers are located in the layers subfolder of the project folder (accessed from either the D: location or the backup on the server, see above)

The layers required for this map include:

- TsunamiEvacuationPoints
- TsunamiEvacuationRoutesPortVila
- Schools2014
- Road_centrelines_LLWGS84
- Rivers
- Gazetteer 2014
- Contours
- Coastline
- Level2 Raw TsunamiEvacuationZone_Luganville.shp
- Level2 Raw TsunamiEvacuationZone_PortVila.shp
- Sea Background
- Islands
- LuganvilleWGS84UTM58S20cmAdjustedS1mW1m
- Vanuatu_Efate_20cm_Mosaic_WGS84_59s
- EspirituSantoTopo2012-RGB-020_58

1.2.5 Add/edit/create applicable layers

Layers that need to be created and added to these base datasets include;

- evacuation routes - TsunamiEvacuationRoutesPortVila
- evacuation safe locations - **TsunamiEvacuationPointsPortVila**
- Local points of interest - **PointsOf Interests**

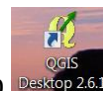
These layers may also need to be edited from time to time.

1.3 Opening an Existing Tsunami Map Project

Either access from the D: or from the network drive server. Ensure there is a mapped network drive on your computer linked to the LIDAR NAS (Refer to SOP 3 Maintaining the Spatial Datasets). The IP address is VMGD NAS (LIDARNAS [\\192.168.60.31](http://192.168.60.31)) and the mapped drive should be Y:\ i.e.  GIS_Data (\\LIDARNAS) (Y:) . If not please request your ITC administrator to add this to your computer (Note: your computer must be connected to the VMGD network).

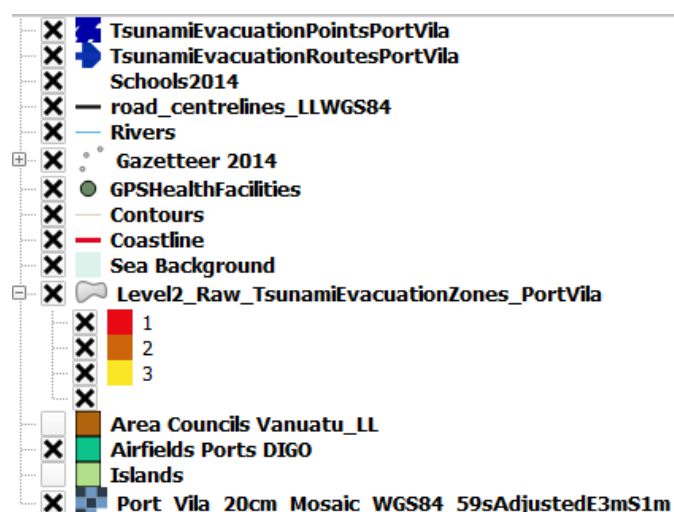
The login for this is: Username = gisuser Password = vumap15gis
Important Note: You must login to the NAS before opening QGIS

Open QGIS 2.8 (or above) by clicking on the icon on the desktop

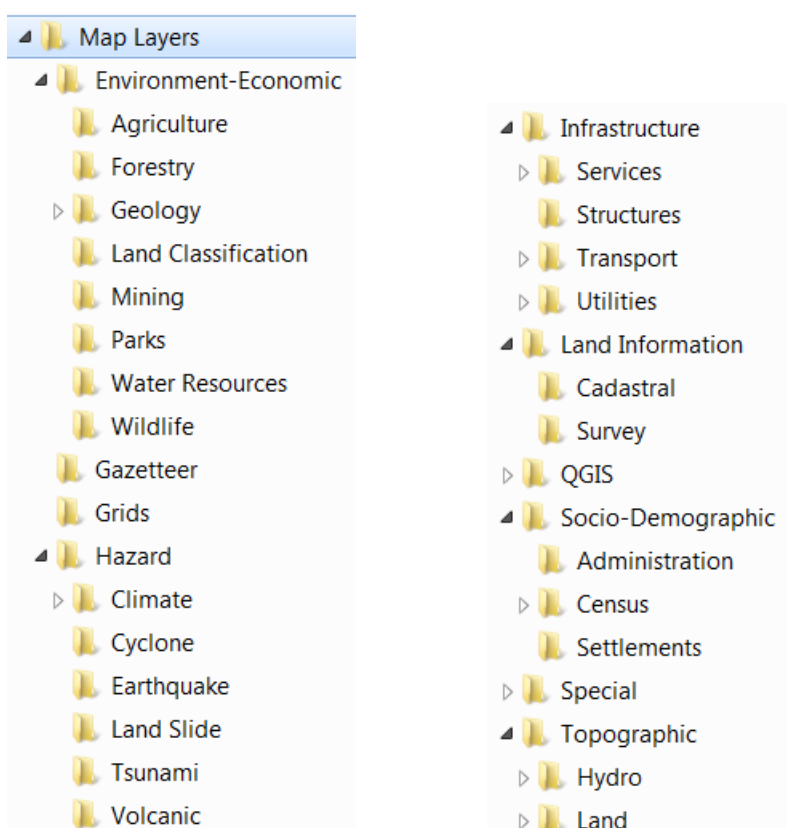


Select **Project/Open** from the main menu and navigate to **Y:\Operations\QGIS Projects\ UAV Imagery Index.qgs** and open this project. **Note:** There may be an icon on the desktop with a shortcut to this project, if so then double click on this to open.

The following layers will be opened and the Tsunami base map will be displayed. Most of these layers are self-explanatory, see below for an explanation of those that may not.



More layers can be added as required by selecting the **Add Vector Layer** tool  and by navigating to the Y:\Operations\Map Layers folder and selecting the appropriate folders/layer files which are stored using the following folder structure.



1.4 Creating New Layers

QGIS has tools to create and edit data. These tools can be used for generating new asset datasets or managing information. When creating new data you should store your data in shapefiles as these will be accessible by most other GIS packages.

- Firstly ensure that your map and layers have been configured correctly
- In QGIS select Layer | New | New Shapefile Layer or click on the **New**

Shapefile layer  tool.

- Set the type of shapefile you want to create as either point, line or polygon. A single shapefile can only be one of these types. Usually the type of data you are capturing will determine the geometry type – ie lines for evacuation routes, polygons for evacuation areas, points for locations
- Set the Coordinate System by pressing the Specify CRS button. For most layers use WGS84 /LatLong (EPSG: 4326). Use the Filter tool to help you find the right coordinate system

Next you need to configure your attributes. Attributes are columns or fields containing data related to the objects in the layer – you should add attributes for any information you want to capture. For example, if you want to capture school locations then you may add the following

attributes:

- **NAME** | Text Data, Width of 20 (Width is the number of characters)
- **NUMBER_STUDENTS** | Whole Number (No decimal places), width of 4
- **VILLAGE** | Text Data, Width of 40

Use the New Attribute section to add any attributes you require. Be sure to configure the type of attribute (ie number or text) correctly as this cannot be changed easily afterwards.

New Vector Layer

Type: ☒ Point ☐ Line ☐ Polygon

EPSG:32759 - WGS 84 / UTM zone 59S Specify CRS

New attribute

Name:

Type:

Width: Precision:

Add to attributes list

Attributes list

Name	Type	Width	Precision
NAME	String	20	
NUMBER_STUDE...	Integer	4	
VILLAGE	Integer	4	

Remove attribute

OK Cancel Help

Press **OK** to create your new shapefile. Set the output location for your shapefile (C:\GIS\Operations\Your_Name\The_Project)

Your new shapefile will then be added to your map and will be ready to add data to.

There are 2 new layers that need to be created /edited for the Tsunami mapping, they are;

1. The evacuation routes to a safe zone (line features)
2. The evacuation safe/meeting points (point features)

1.5 Creating New Vector Data

Digitising

Digitizing is the process of creating new features/shapes by using base layers already loaded onto a map such as Aerial Photography. Digitizing is a common process used in GIS to capture new data and assets.

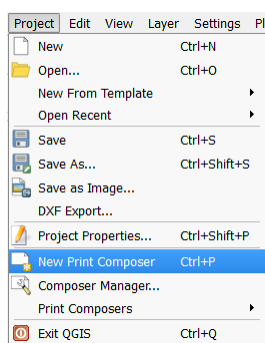
- Firstly ensure that your map has the layer added that you want to add new features/shapes to (i.e. the one you have just created in the previous Section)
- Select the layer you want to edit in your Layers panel by Left Clicking on it
- On the Digitizer toolbar press the Toggle Editing button  to make the selected layer editable
- Use the Add Feature tool  to add new features onto the map by left clicking on your map (points will be single click, lines and polygons require multiple clicks then a right click to finalise) **Note:** the icon for this tool will appear differently depending on the type of layer you are editing; i.e. points, lines or areas.
- When you add a new feature you will be prompted to specify the values for your attributes. **Note** that you can leave attributes blank if necessary
- When you are finished to save your edits press the **Toggle Editing** button

You will then be prompted to either **Save** or **Discard** your edits. Choose wisely as there is no undo after you select to either save or discard

1.6 Composing a Tsunami Map from a Template

A template has been created for the Tsunami mapping and this can be used to speed up the process of creating new maps for different areas. To create a map output for printing or making a pdf using QGIS which might include scale bars, legends, titles and other features you use the Print Composer

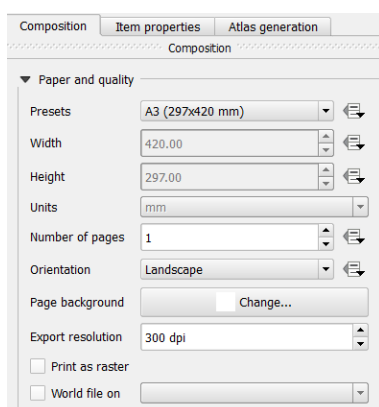
- Ensure that your map and layers have been configured correctly including layer names, positions and styles
- In QGIS select **Project | New Print Composer**



- You will then be prompted to enter a title for your map layout. This will enable you to find your specific map product in the future. It is a good idea to use a name that is meaningful and if possible has the size and orientation of the intended map e.g. **Port Vila Tsunami Map A3L** (the A3L is the paper size and orientation, L for landscape and P for portrait)

Once your map opens you will see a blank page presented, this is the print Composer Canvas. It is necessary to set the desired page size and orientation now so that the layout is correct later on.

On the right hand side in the **Items** area select the Composition Tab, the Paper and quality properties will be displayed. Set the values as required, the example below shows A3 landscape.

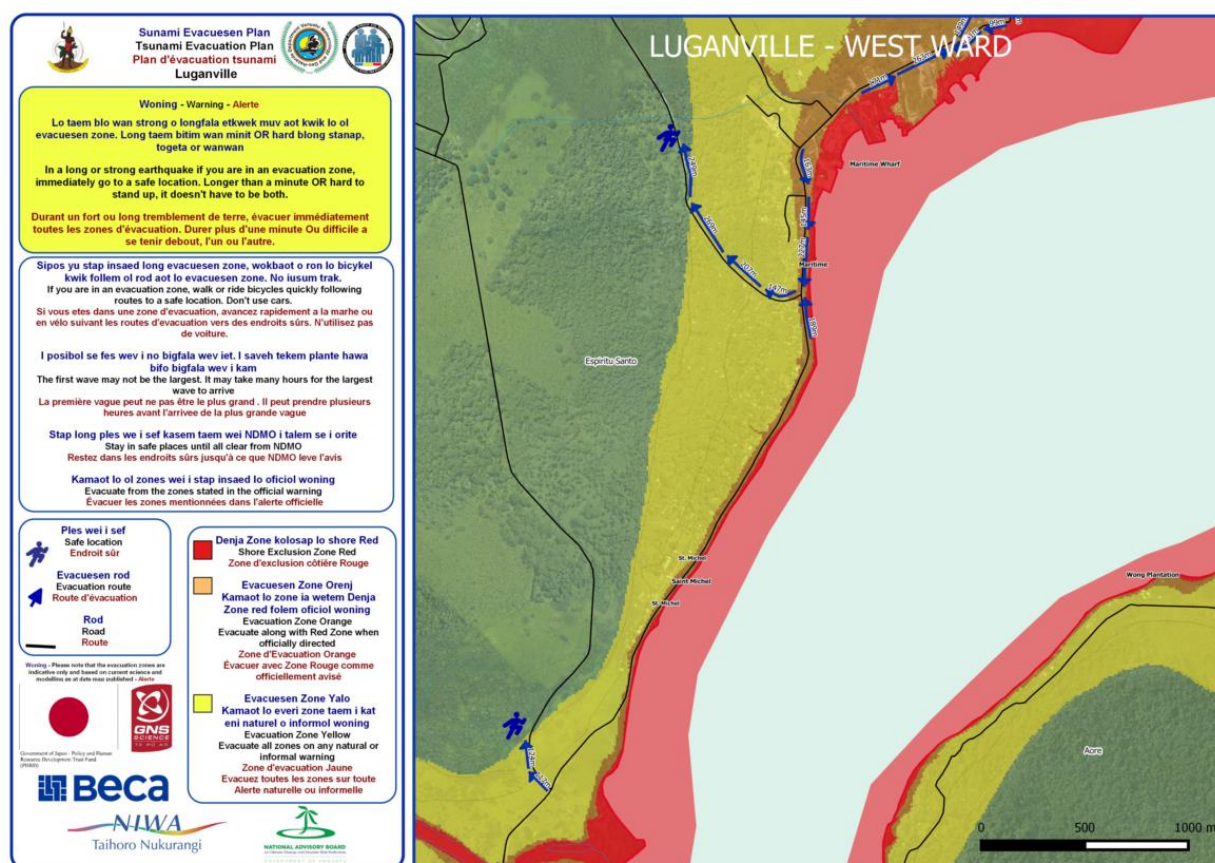


Click on the **Zoom Full** tool  to see all of the canvas.

Now we can apply a Template to the map canvas.

Click in the **Composer** menu and select **Add Items from Template...** Then navigate to the appropriate Tsunami map template on the server (/.....) and click **Open**.

This will open and apply all of the components and items required on the Tsunami Map as shown in the diagram below, the only thing that will need to be changed is the map coverage which is determined by the current Map canvas window.



Set the map canvas window to the desired coverage by zooming and panning keeping in mind the following:

If the current **Map Canvas** window is the same shape (i.e. rectangle is in proportion, not size) as your Composer map area then the map should look the same as the current map. If you draw it a different shape then the map will zoom differently. The easiest way to get your map to look the way you want is to set the Map canvas window to the shape you want your map to be and then zoom in (or out) to display exactly the extents that are required.

In the **Map Composer** select the map area by clicking inside the box. Then click on the **Item Properties** tab (left hand panel), then click on the **Set to map canvas extent** button.

The map should now look like your standard Tsunami Map, items can be added, removed, edited or moved to fine tune the map to get the desired result using the methods described below. The final map should be saved as PDF on the server ready for review.

General Properties

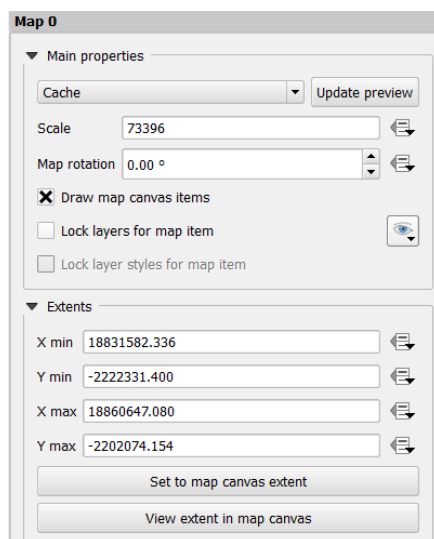
Under the **Item list** (right hand side) each item that you add to the canvas will have a name and be shown as a separate item on the list. This area also allows you to turn the item on or off or to lock the item from edits. You can also rearrange the item order by dragging each item up or down in the list or delete it.

Select the **Item properties** tab, this accesses the property values associated to whichever canvas item is currently selected. If a map is selected then the configurable properties include (these are discussed in detail below):

- Main properties – sets scale, map rotation, visibility pre-sets
- Extents – bounding rectangle extent, current map canvas or vice-versa
- Atlas setup
- Grids – enables grids to be set up
- Overviews – enables overview/inset maps to be set up
- Position and size – page/item layout
- Rotation – item/frame rotation (not map rotation see Main properties for that)
- Frame – set frame properties
- Background – set background colour
- Item ID – can set an ID for the item for coding and expression use
- Rendering – set blending and transparency

On the Main properties Dialog an easy way to fine tune the size of the map is to adjust the scale value to get the map sized correctly. The map will resize based on the centre of the map currently displayed in the Map canvas, to move the centre pan the map to the desired location

using the **Move item content** tool  on the sidebar, the zoom mouse wheel will also work with this tool selected but is more of a rough adjustment.



1.7 Composing an information board

The tsunami information board QGIS project is in the D:\GIS drive of the Tsunami GIS PC. Otherwise it can be downloaded from the server (LiDAR

NAS:\GIS_Data\Operations\Divisions\Geo_hazards\). The main project file is the Tsunami Information Boards (e.g. TsunamiInfo_V4MH_Port Vila). If the tsunami map QGIS project already exists then load it from the server (LiDAR NAS:\GIS_Data\Operations\Divisions\Geo_hazards\). Otherwise the appropriate layers should be opened (see below) and the Tsunami Map Template should be applied (refer to Section 1.4 for an explanation on how to do this).

1.8 Printing the Map

In the Map Composer make sure the map you want to print is visible and everything is correct. Zoom in and pan around if necessary to check that the map is finalised and ready to print, the checklist includes;

- Scale bar (is the scale correct)
- Legend (are all visible data layers defined)
- Border
- Coordinate grid (are coordinates visible)
- Is text readable (labels, title etc)
- Does title inform the user what the map is showing
- Does the map cover the area required



If all is OK then use the output toolbar to perform the required task. The two main ones used are the **Print** and **Save to PDF** (from which you can print). Depending on the printer selected ensure that the paper size and orientation is correct and the print preview looks correct. To do this select the printer and click on **Preferences**. Once setup select **OK** to print.

Appendix J - Powerpoint for CDC tsunami evacuation mapping and planning consultations

Mainstreaming disaster risk reduction (MDRR) Project in vanuatu

Project Background

Component 1: Risk Mapping to Support Urban Preparedness and Planning (~VT66Million).

Component 2: Establish a tsunami warning system for Port Vila and Luganville (~VT136.5Million)

Component 3: Strengthen the National Advisory Board on Climate Change and Disaster Risk Reduction (~VT21Million)



Project's objective

- ▶ **Project Objective:**

To strengthen urban planning and tsunami preparedness in the main urban areas of vanuatu through the following specific outcomes;

- ▶ Risk information and risk reduction considerations incorporated in urban planning process and policies;
- ▶ Tsunami warning services strengthened and community access to timely and accurate warnings improved; and
- ▶ A joint national platform for disaster risk management and climate change adaptation established.



Project's benefit

(How are we going to benefit from the project?)

Project Benefits

- ▶ The tsunami warning systems to be installed in Port Vila and Luganville will help the urban population prepare for tsunami.
- ▶ The data collated from the hazard and risk assessment will inform urban planning policies.



Tsunami aftermath in the Solomon Islands

Community consultation for
completing tsunami
evacuation maps, routes
and signs location.

PORT-VILA & LUGANVILLE



Partners [add logos]

- ▶ beca
 - ▶ GNS Science New Zealand
 - ▶ NIWA
 - ▶ VMGD
 - ▶ NDMO
-
- ▶ Govt. of Japan
 - ▶ World Bank



History of major Pacific tsunami

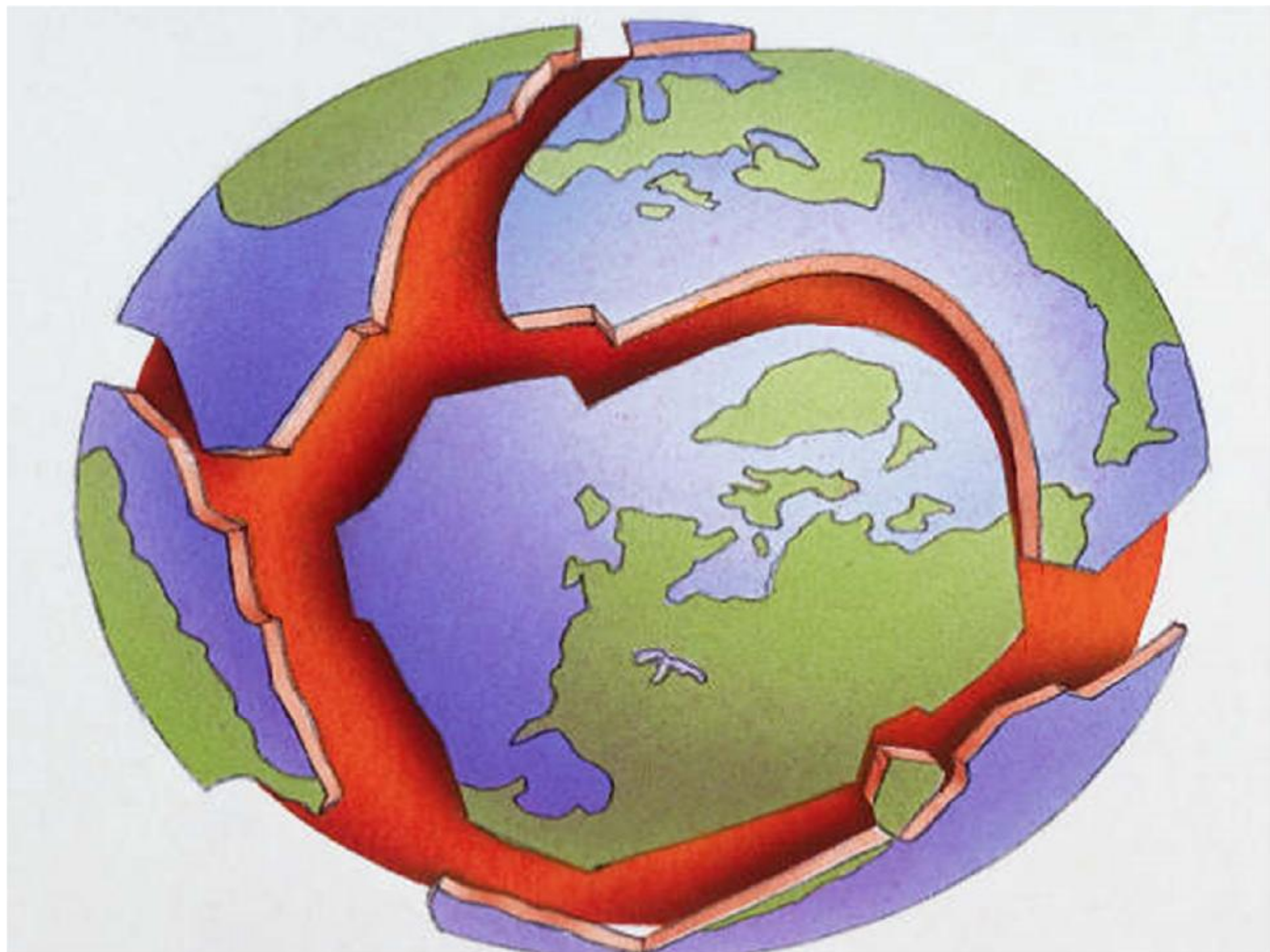
- ▶ 2004 Indian Ocean
- ▶ 2009 Tonga and Samoa area
- ▶ 2010 & 2015 Chile
- ▶ 2010 Tanna
- ▶ 2011 East Japan

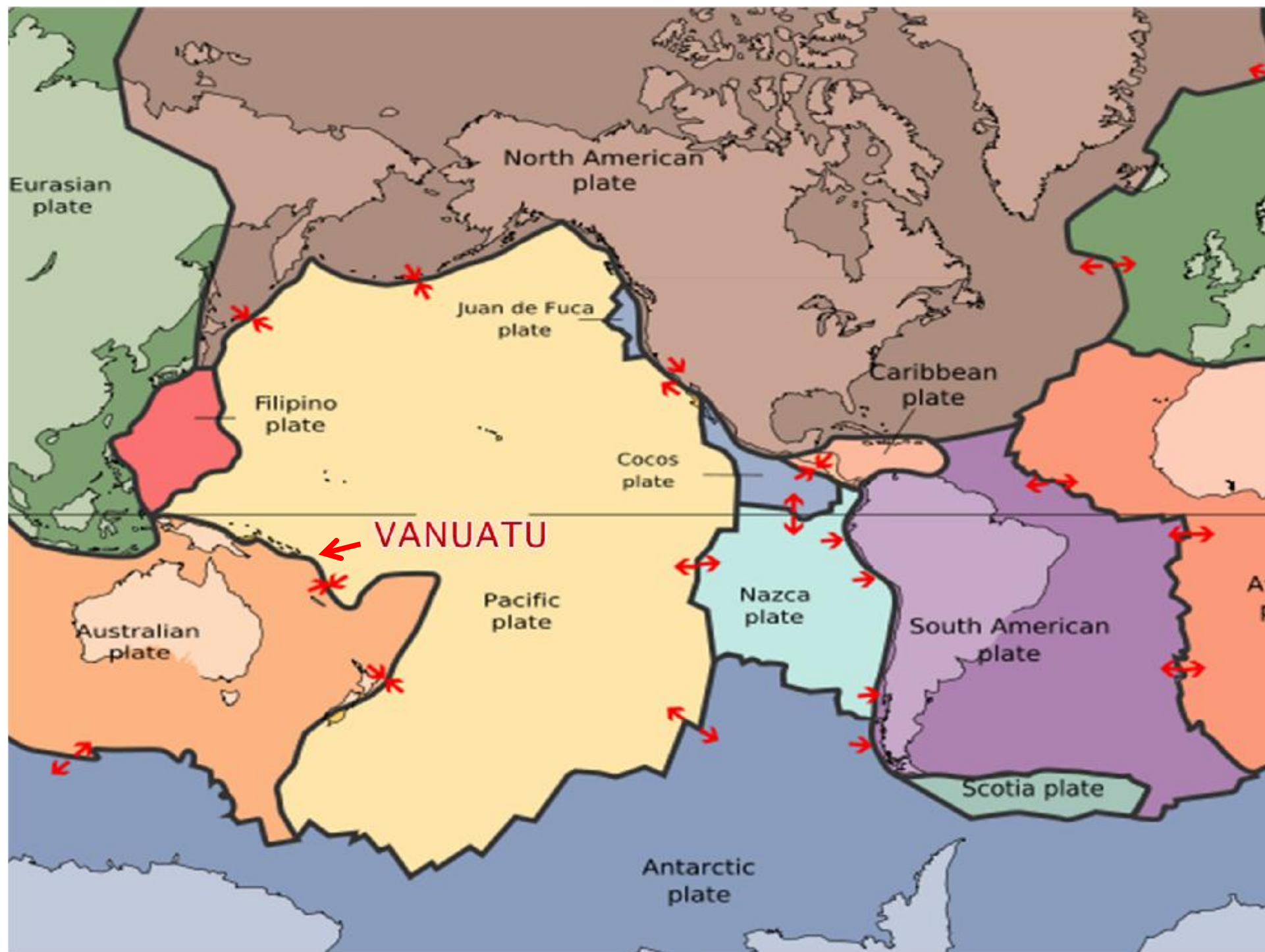


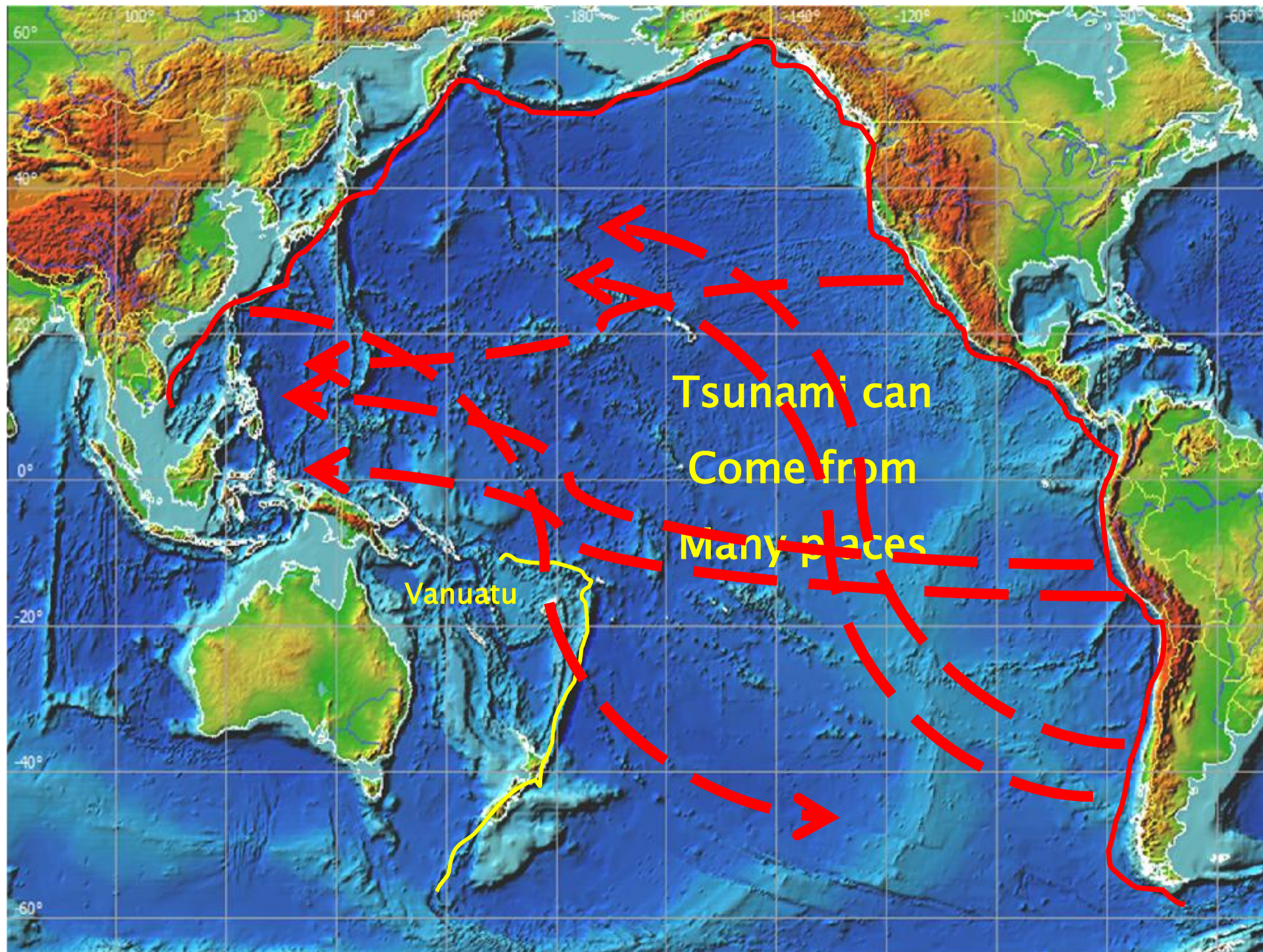
TSUNAMI AND WARNING

- ▶ In a long or strong earthquake...
- ▶ LAPATAIGA FAALENATURA
 - LULU MATAUTIA O SE MAFUIE E SILI ATU MA LE 1 MINUTE O LULU
 - LULU O SE MAFUIE UA O O LONA MALOSI I LE TULAGA UA LEMAFAI AI ONA E TU I LUGA
 - PE FAAFUASEI E LE MASANI AI O LE TAI
- ▶ Official warning sources
 - TELEFONI FEAVEAI
 - LEITIO
 - TV

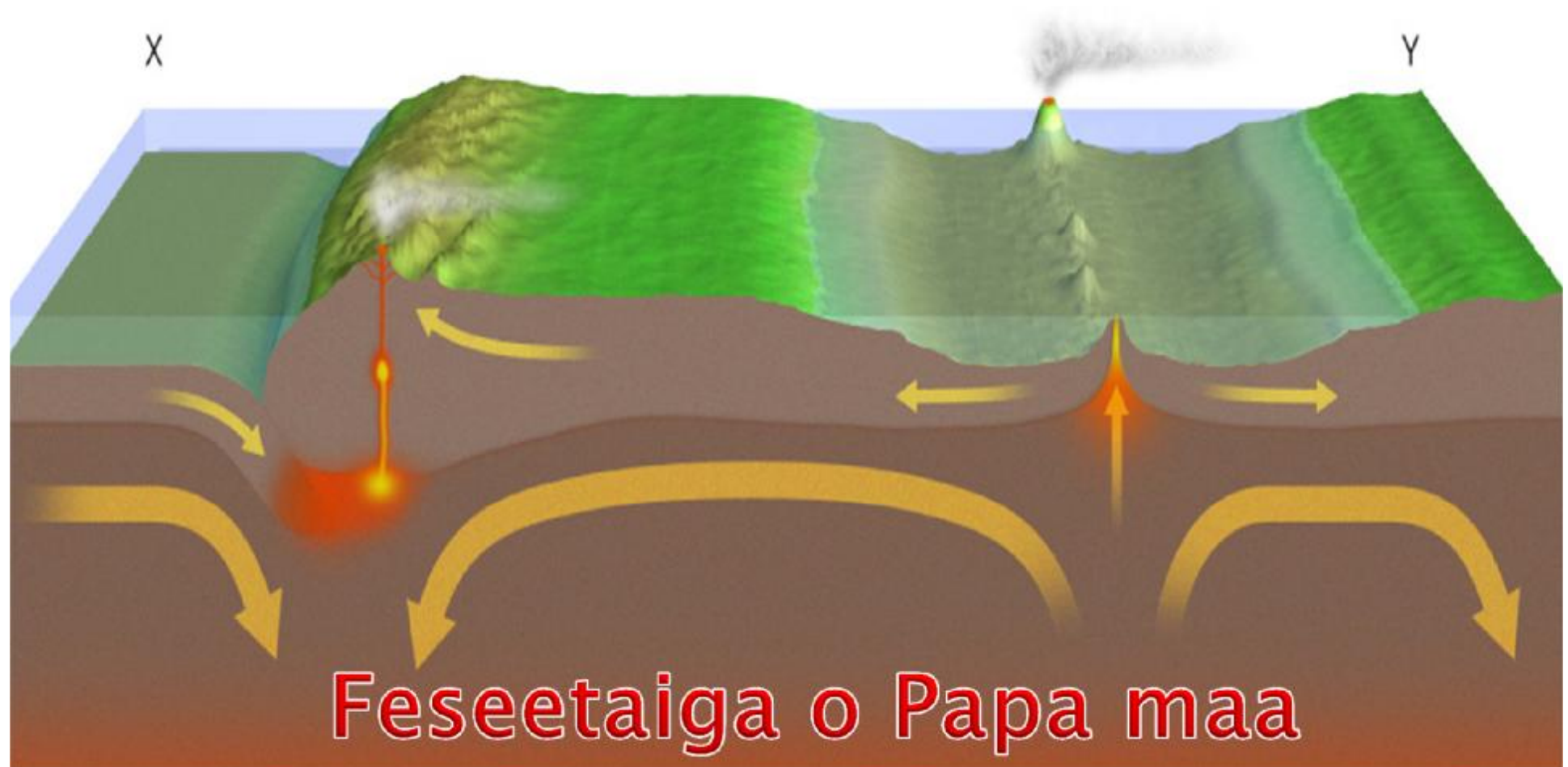


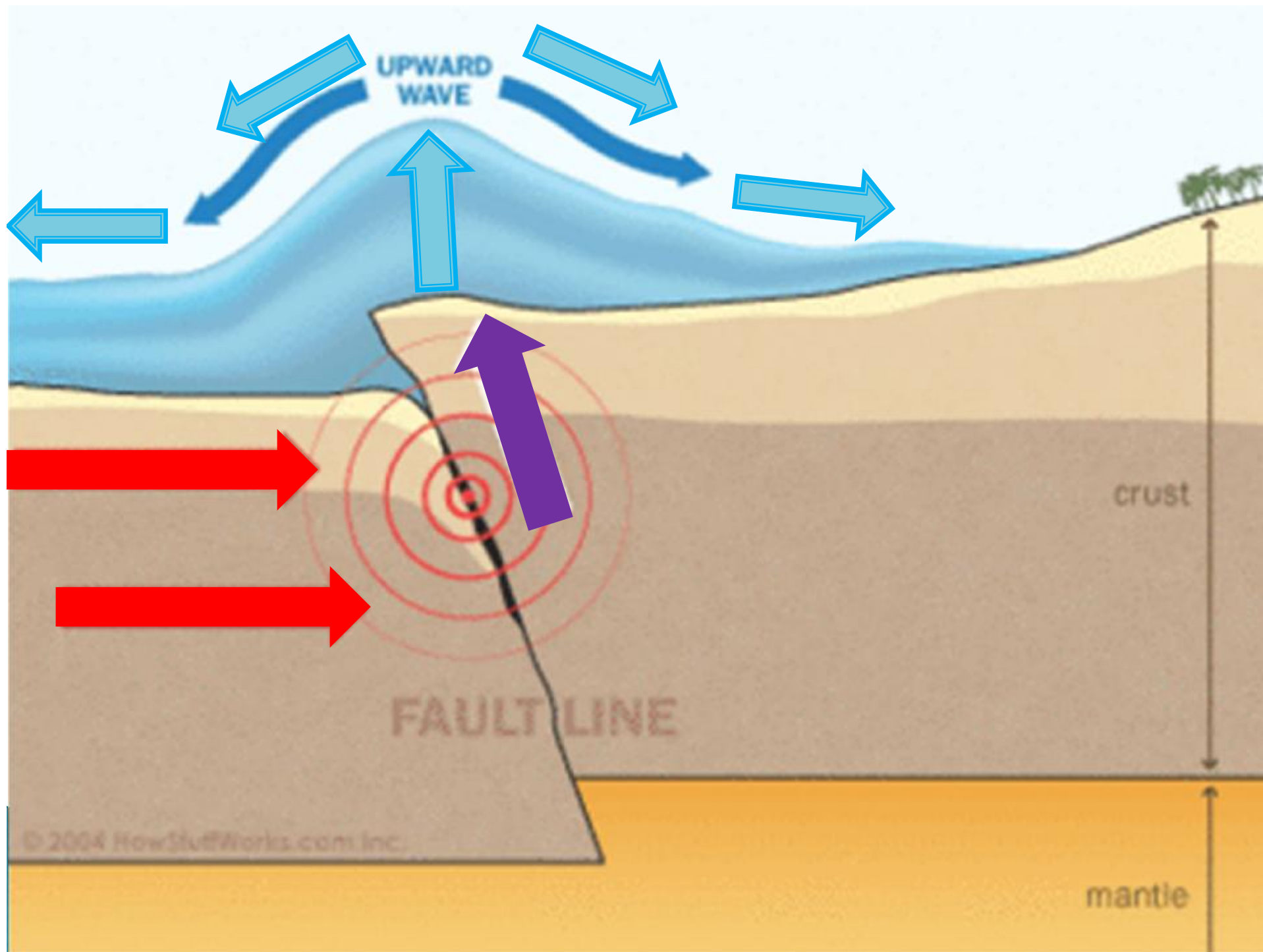




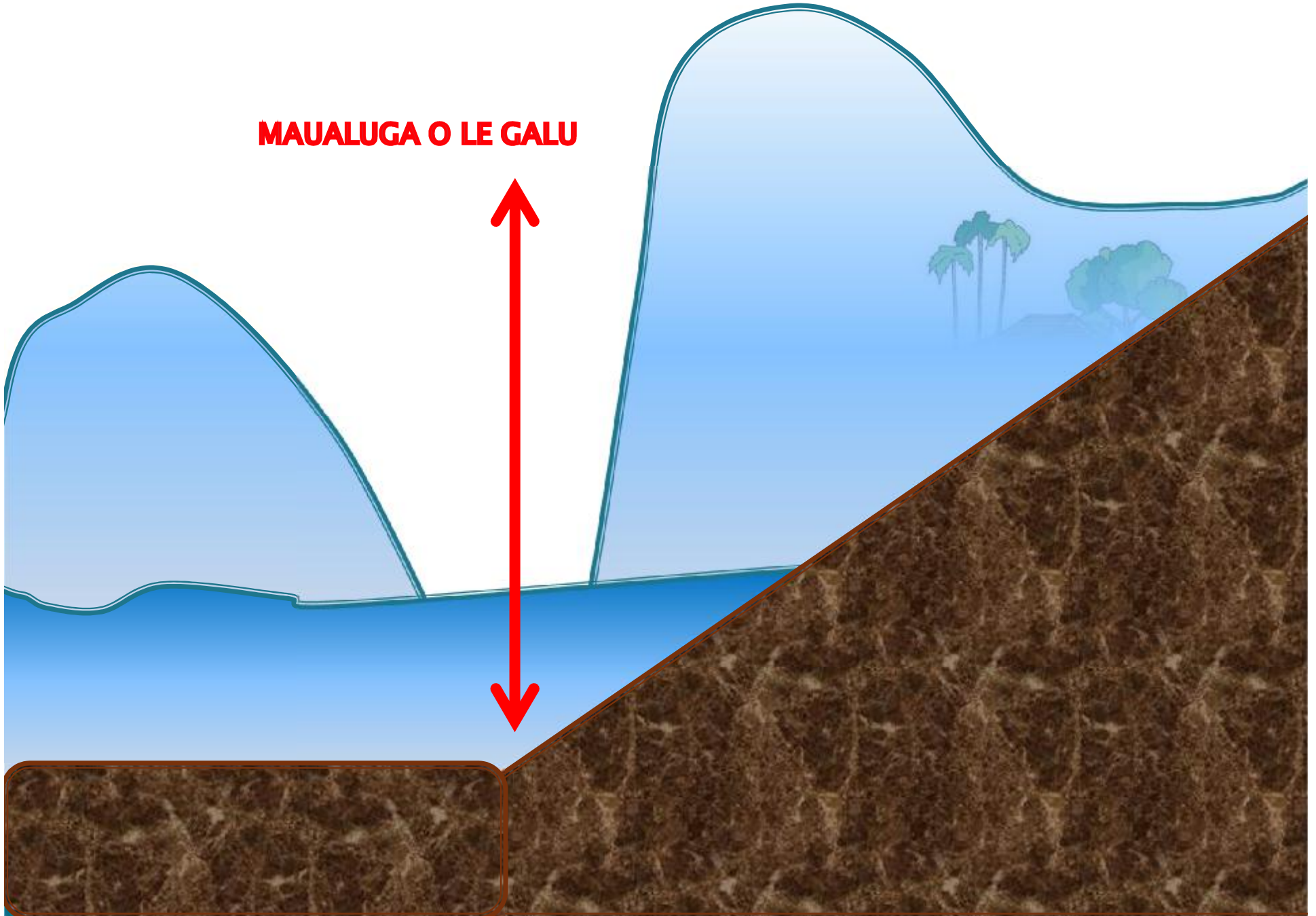


MAFUIE MA MAUGA MU





MAUALUGA O LE GALU



Evacuation key messages

- ▶ In a long or strong earthquake if you are in evacuation zone immediately go to a safe location. Longer than a minute OR hard to stand up, it doesn't have to be both
- ▶ If you are in an evacuation zone, walk or ride bicycles quickly following routes to a safe location. Don't use cars.
- ▶ The first wave may not be the largest. It may take many hours for the largest wave to arrive
- ▶ Stay in safe places until all clear from NDMO
- ▶ Evacuate from the zones stated in an official warning



Extra messages

- ▶ Don't wait, evacuate immediately after a big earthquake. Don't collect your things.
- ▶ Don't come into the zone, make sure you are happy your children will be safe, so you don't worry and put yourself at risk.



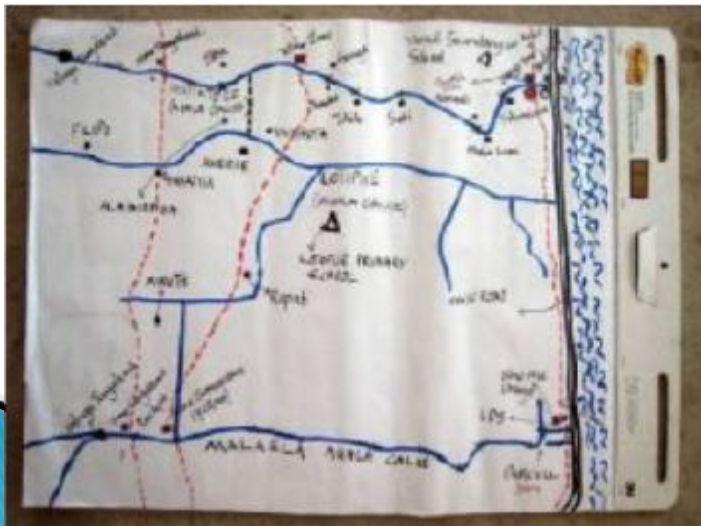
Choosing routes and signs

- ▶ What's the best routes and the best safe places?
- ▶ Where do you want to put the sirens and signs?
- ▶ What else do you need on the maps to help locate yourself (Point Of Interest)
- ▶ What is the best area for each map?



Community consultation agreed

- ▶ Presentation to the community
- ▶ Break-out groups (men, youth, women, disability)
 - Drawing and labelling maps, adding routes, safe locations, locating signs
 - Location names that help people read the map
- ▶ Field checking



Warning & Information Dissemination

- ▶ In a long or strong earthquake if you are in evacuation zone immediately go to a safe location.
- ▶ Don't wait for official warning in that particular case
- ▶ For source further away the official warning system will keep the people informed:
 - Sirens, TV, Radio, SMS, Website, Email, Phone, Mobile Applications (RC Global Federation/Washington DC Hazard App – All of New Zealand), ...
 - VMGD/NDMO will provide information on the area to evacuate



Framework planning workshops

▶ **Wednesday 27th January**

- 8:30am to 11:00am – Shefa Provincial Government Council
- 1:30pm to 3:00pm – Port Vila Municipal Council

▶ **Thursday 28th January**

- 9:00 to 11:00 Sanma Provincial Government
- 1:30 to 3:00 Luganville Municipal Council

▶ **Monday 1st February**

- Port Vila Municipal second meeting



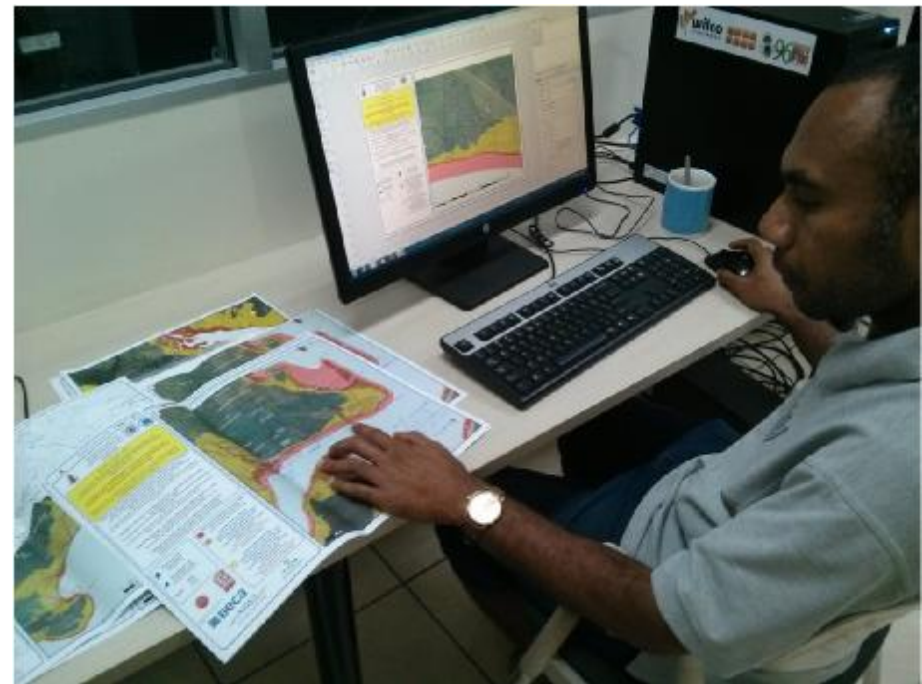
Evacuation map and consultation planning

- ▶ Identify the area of responsibility (spatial vs electoral vs social/neighbourhood groups)



Consultation areas recommended

- ▶ Luganville maps being prepared
- ▶ Monday meeting for Port-Vila municipal

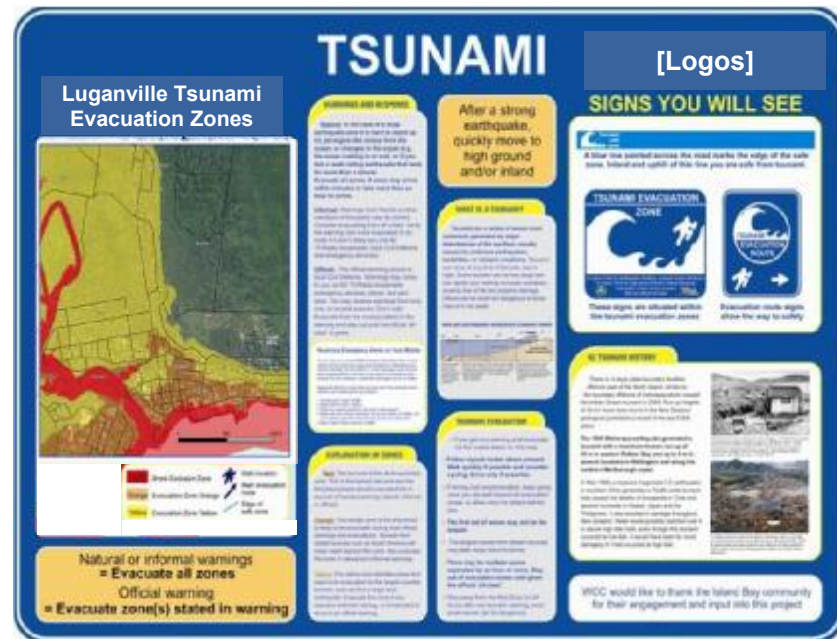


Exercises

- ▶ 2016
 - Luganville
 - Port Vila
 - National
- ▶ Every year
 - Schools? In New Zealand every school every year.



SIGNS



DANGER ZONE

1



2 INFORMATION BOARD

- EVACUATION MAP
- WARNINGS
- WHAT TO DO
- SIGNS

TSUNAMI

Luganville Tsunami Evacuation Zones

Legend:

- Shore Exclusion Zone
- Evacuation Zone Orange
- Evacuation Zone Yellow
- Main evacuation route
- Edge of safe zone

WARNINGS AND RESPONSE

Natural: In the case of a large earthquake (one it is hard to stand up in), jet engine-like noises from the ocean, or changes in the ocean (e.g. the ocean rushing in or out), or if you feel a weak rattling earthquake that lasts for more than a minute. Evacuate all zones. A wave may arrive within minutes or take more than an hour to arrive.

Informal: Warnings from friends or other members of the public may be correct. Consider evacuating from all zones. Heed the warning only once evacuated or on route if it won't delay you (via NZ TV/Radio broadcasts, local Civil Defence and emergency services).

Official: The official warning source is local Civil Defence. Warnings may come to you via NZ TV/Radio broadcasts, emergency services, phone, text and siren. This may include warnings from only one, or several locations. Don't wait. Evacuate from the zone(s) stated in the warning and stay out until the official "all-clear" is given.

Receiving Emergency Alerts on Your Mobile

Emergency alerts are sent to mobile phones that have been registered with the Civil Defence. To receive alerts, you must have your mobile phone set up to receive alerts. If you have a mobile phone, you should have received a text message from Civil Defence. If you have not received a text message, you should contact your mobile phone provider to ensure your phone is set up to receive alerts.

WHAT IS A TSUNAMI?

Tsunamis are a series of waves most commonly generated by major disturbances of the sea floor, usually caused by underwater earthquakes, landslides, or volcanic eruptions. Tsunamis can occur at any time of the year, day or night. Some tsunamis can be very large and can rapidly and violently inundate coastlines, causing loss of life and property damage. Others can be small but dangerous to those near or in the water.

TSUNAMI EVACUATION

If you get any warning at all evacuate via the routes shown on this map. Follow signed routes where present. Walk quickly if possible and consider running. Drive only if essential.

If driving and tsunami warned, keep going over you are well beyond all evacuation zones, to allow room for others behind you.

The first set of waves may not be the largest.

The largest waves from distant sources may take many hours to arrive.

There may be multiple waves separated by an hour or more. Stay out of evacuation zones until given the official "all-clear".

Stay away from the Red Zone for 24 hours after any tsunami warning, even small waves can be dangerous.

SIGNS YOU WILL SEE

A blue line painted across the road marks the edge of the safe zone. Inland and uphill of this line you are safe from tsunami.

These signs are situated within the tsunami evacuation zones.

Evacuation route signs show the way to safety.

NZ TSUNAMI HISTORY

There is a large plate boundary faultline offshore east of the North Island, similar to the boundary offshore of Indonesia which caused the Indian Ocean tsunami in 2004. Run-up heights of 30 m+ have been found in the New Zealand geological (probable) record of the last 6,000 years.

The 1855 Wairarapa earthquake generated a tsunami with a maximum known run-up of 16 m in eastern Poulter Bay and up to 5 m in several locations in Wellington and along the northern Marlborough coast.

In May 1960, a massive magnitude 9.5 earthquake in southern Chile generated a Pacific-wide tsunami that caused the deaths of thousands in Chile and several hundreds in Hawaii, Japan and the Philippines. It also resulted in damage throughout New Zealand. Water levels possibly reached over 4 m above high tide mark, even though this tsunami occurred at low tide. It would have been far more damaging if it had occurred at high tide.

Natural or informal warnings = Evacuate all zones

Official warning = Evacuate zone(s) stated in warning

WCC would like to thank the Island Bay community for their engagement and input into this project

3

TSUNAMI EVACUATION ROUTE



- ▶ Signs to indicate the evacuation route

4

SAFE LOCATION



- ▶ Stay until the all clear



Suggestion drawn by
Women at Luganville
Municipal meeting



PLES WEI I SEF

SAFE LOCATION

ABRI SANS DANGER

**Stap long ples wei i sef kasem taem wei
NDMO i talem se i orite**

**Stay in safe places until all clear from NDMO
Restez a l'abri jusqu'au signal d'annulation
du NDMO**

TSUNAMI **BIGFALA WEF**

DENJA ZONE TSUNAMI

ZONE DE DANGER TSUNAMI

**TSUNAMI
EVACUATION ZONE**

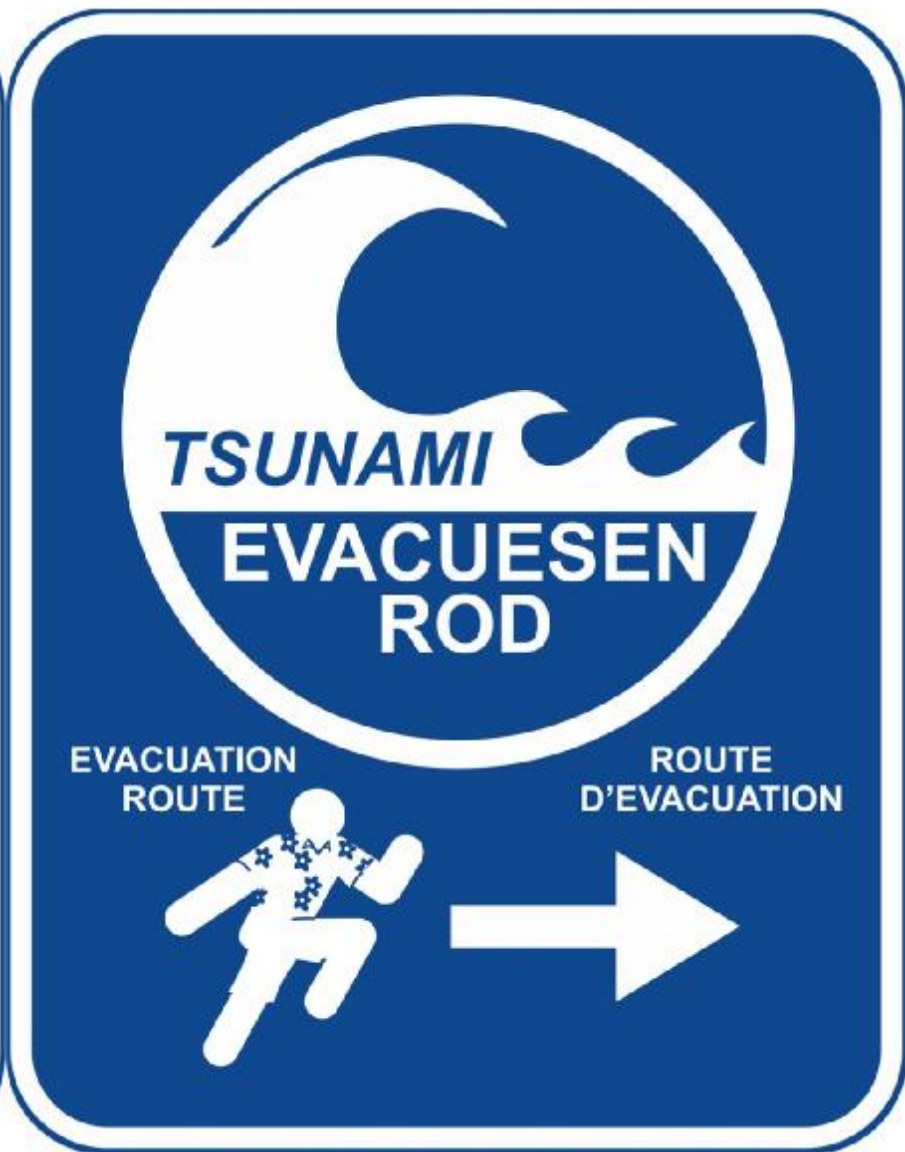
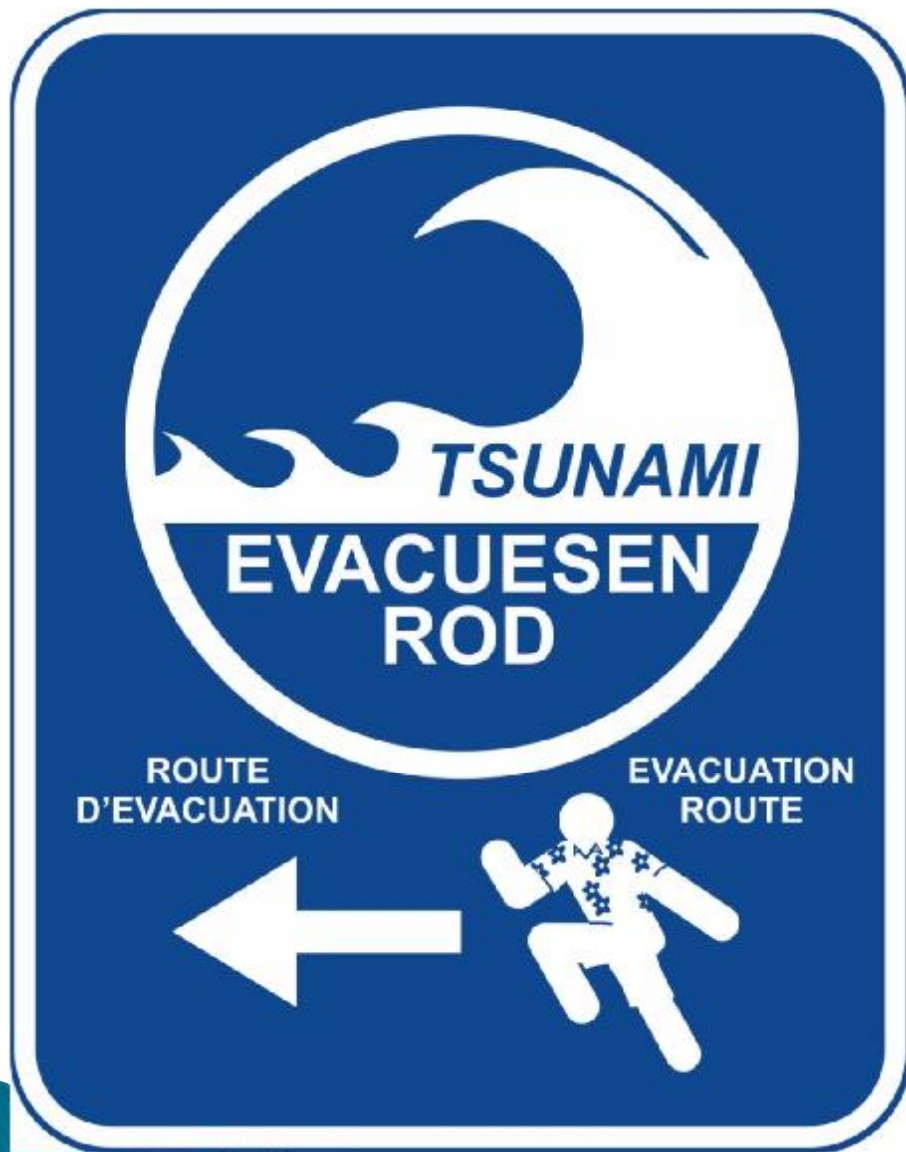


Taem lo wan edkwek longer tan wan minut O wan we i had blo stanap yu mas runwe.

In an earthquake longer than a minute OR hard to stand up evacuate all zones.

Pour un seisme superieur a une minute

OU difficile a rester debout evacuez toute la zone



TSUNAMI [Logos]

Luganville Tsunami Evacuation Zones



CRITICAL WARNING
In Luganville (annexed) situated in warning

Signs you will see:

- Blue sign with white text:** When a tsunami warning is issued, you must evacuate immediately. Do not wait for the tsunami to arrive. Stay in safe places until you are told to return.
- Blue sign with white text:** When a tsunami warning is issued, you must evacuate immediately. Do not wait for the tsunami to arrive. Stay in safe places until you are told to return.
- Blue sign with white text:** When a tsunami warning is issued, you must evacuate immediately. Do not wait for the tsunami to arrive. Stay in safe places until you are told to return.

DENJA ZONE TSUNAMI
ZONE DE DANGER TSUNAMI



TSUNAMI EVACUATION ZONE

When the water suddenly recedes or surges, you must evacuate immediately. Do not wait for the tsunami to arrive. Stay in safe places until you are told to return.

Pour un tsunami supérieur à une minute
Du danger à l'alerte, évacuez tout de suite.

TSUNAMI
EVACUESEN
ROD



EVACUATION ROUTE ROUTE D'EVACUATION

PLES WEI I SEF
SAFE LOCATION
ABRI SANS DANGER



Stop (long place) and / or high ground (safe place)
RORO / safe place / safe place
Stay in safe places until you are told to return from RORO
Restez à l'abri jusqu'à ce qu'on vous le dise

TSUNAMI BIGFALA WEF



5

A3 Print and PDF

► Evacuation map, What to do, Warnings

Sunami Evacuesen Plan
Tsunami Evacuation Plan
Plan d'évacuation tsunami
Port Vila

Warning - Waring - Alerie
La taem blo wan strong e longtala etikwek enu aet kwik le ol
evacuesen zone. Long taem blim wan minit OR hard blong stanap,
togeta or wanwan
In a long or strong earthquake if you are in an evacuation zone,
immediately go to a safe location. Longer than a minute OR hard to
stand up, it doesn't have to be both.
Durant un fort ou long tremblement de terre, évacuer immédiatement
toutes les zones d'évacuation. Durs plus d'une minute Ou difficile à
se tenir debout, l'un ou l'autre.

Slipes yu stap insaed long evacuesen zone, wolbaet o ron lo bicykel
kwik follem ol rod aot lo evacuesen zone. Ne lusum trak.
If you are in an evacuation zone, walk or ride bicycles quickly following
routes to a safe location. Don't use cars.
Si vous êtes dans une zone d'évacuation, avancez rapidement à la marche ou
en vélo suivant les routes d'évacuation vers des endroits sûrs. N'utilisez pas
de voitures.

I posibol se fes wev i no bigtala wev lef. I savesh tekem piante bawa
bito bigtala wev i kam
The first wave may not be the largest. It may take many hours for the largest
wave to arrive
La première vague peut ne pas être la plus grande. Il peut prendre plusieurs
heures avant l'arrivée de la plus grande vague

Stap long ples we i sef kasem taem wai NDMD i talen se i cite
Stay in safe places until all clear from NDMD
Restez dans les endroits sûrs jusqu'à ce que NDMD leve l'avis

Kamsaot lo ol zones wev i stap insaed lo ofisial waning
Evacuate from the zones stated in the official warning
Évacuez les zones mentionnées dans l'alerte officielle

Ples wev i sef
Safe location
Endroit sûr

Evacuesen red
Evacuation route
Route d'évacuation

Rod
Road
Route

Denja Zone kolesap lo shore Red
Shore Exclusion Zone Red
Zone d'exclusion côtière Rouge

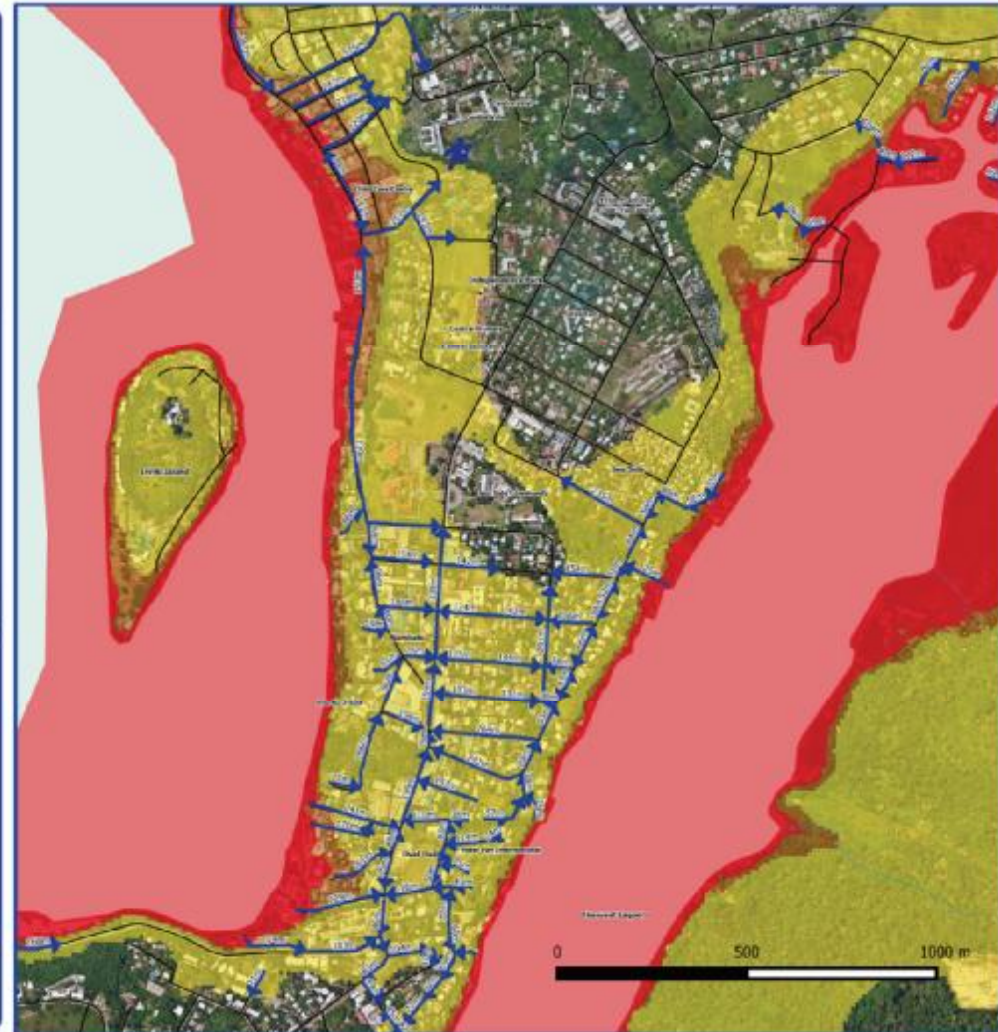
Evacuesen Zone Brown
Kamsaot lo zone la watem Denja
Zone red follem ofisial waning
Evacuation Zone Brown
Evacuate along with Red Zone when
officially directed
Zone d'Evacuation Orange
Évacuer avec Zone Rouge comme
officiellement averti

Evacuesen Zone Yalo
Kamsaot lo everi zone taem i kat
eni naturel o informal waning
Evacuation Zone Yellow
Evacuate all zones on any natural or
informal warning
Zone d'évacuation Jaune
Évacuez toutes les zones sur toute
Alerte naturelle ou informelle

Beca
NIWA
Tahiti Nukurangi

GNS
Geomatics Division
Ministry of Natural Resources
and Environment

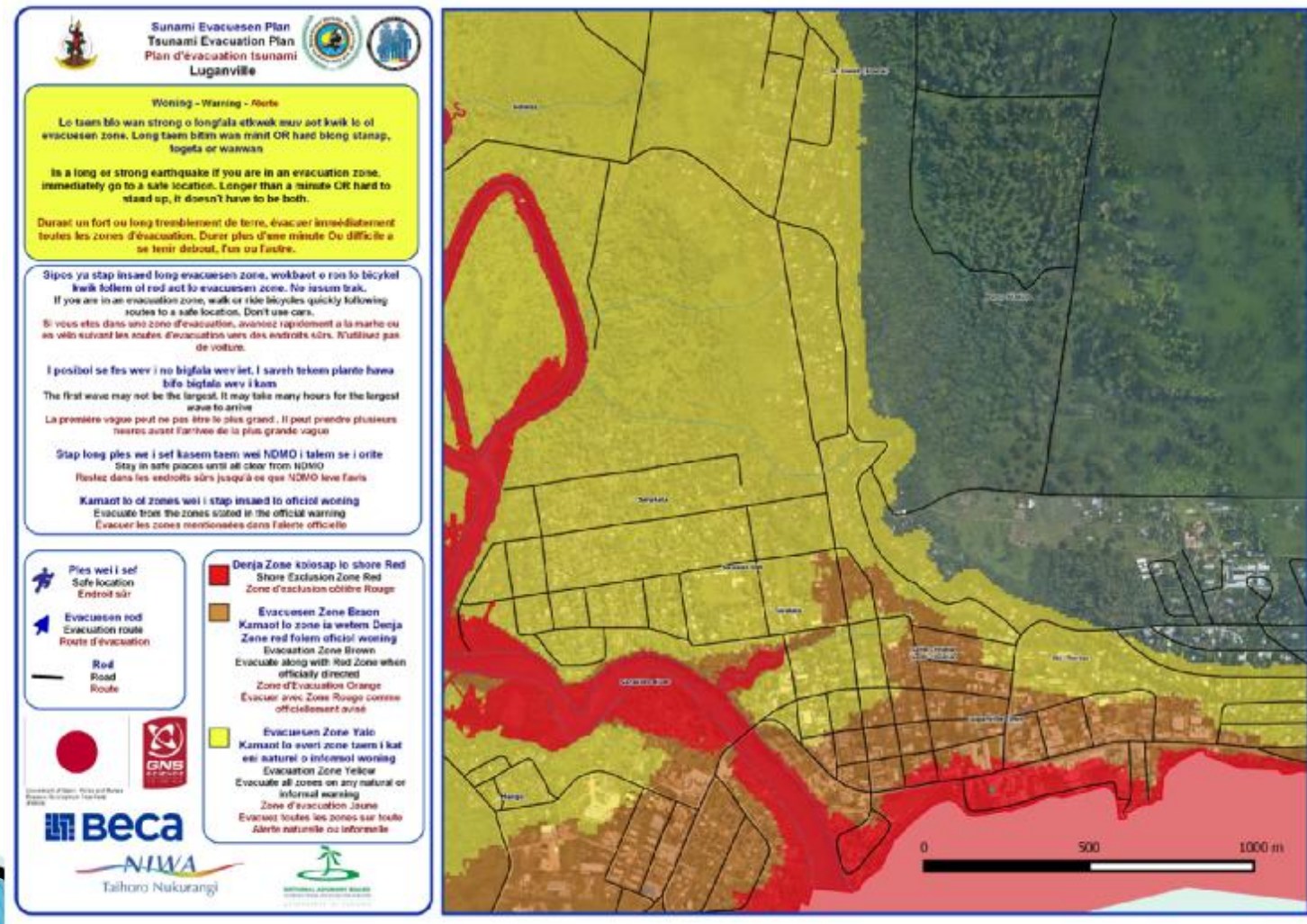
NATIONAL AUTHORITY ON DISASTERS



5

A3 Print and PDF

► Evacuation map, What to do, Warnings



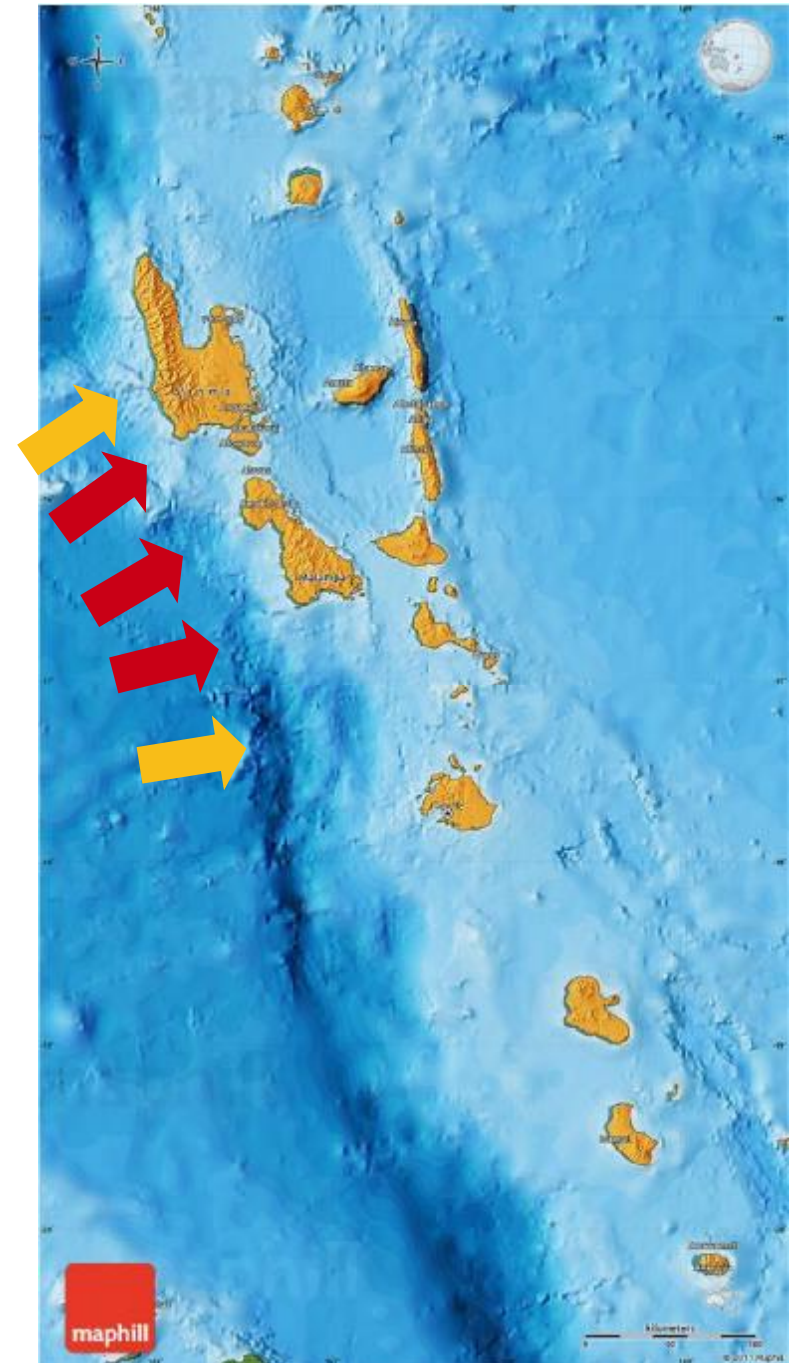
**•An earthquake
longer than 1 minute**

**OR one in which it is
hard to stand up**

Doesn't have to be both

**Tsunami could arrive in
10+ minutes**

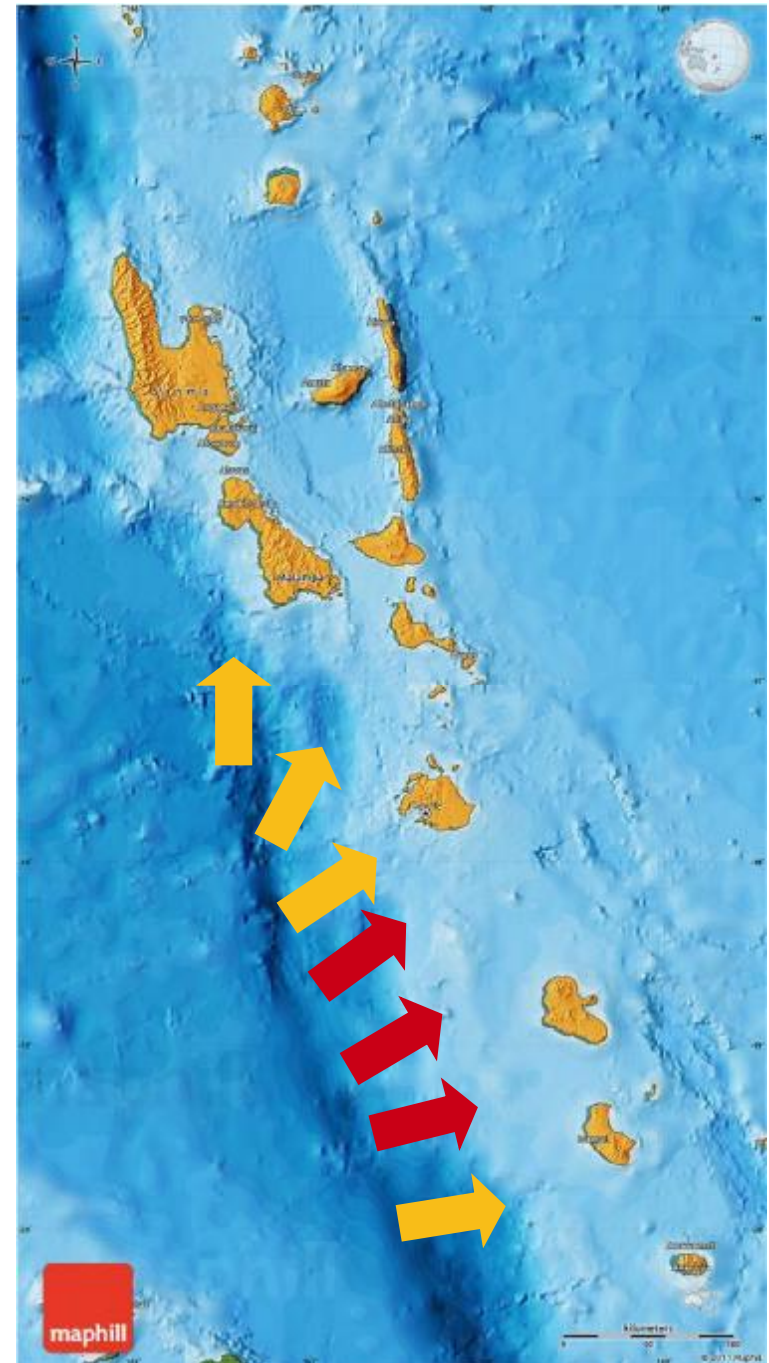
EVACUATE ALL ZONES!!!!



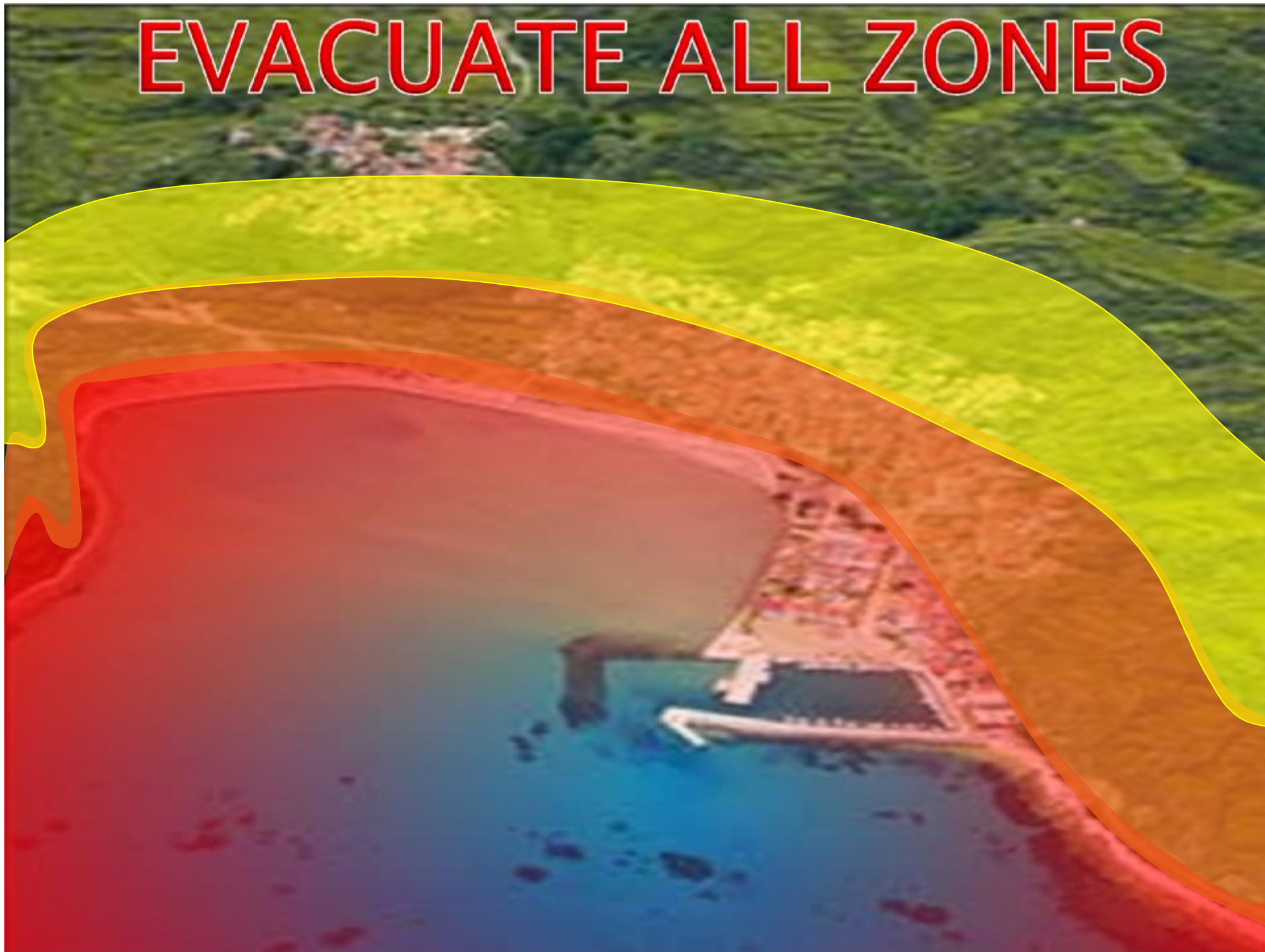
- An earthquake longer than 1 minute

Likely is from further away

EVACUATE ALL ZONES!!!!



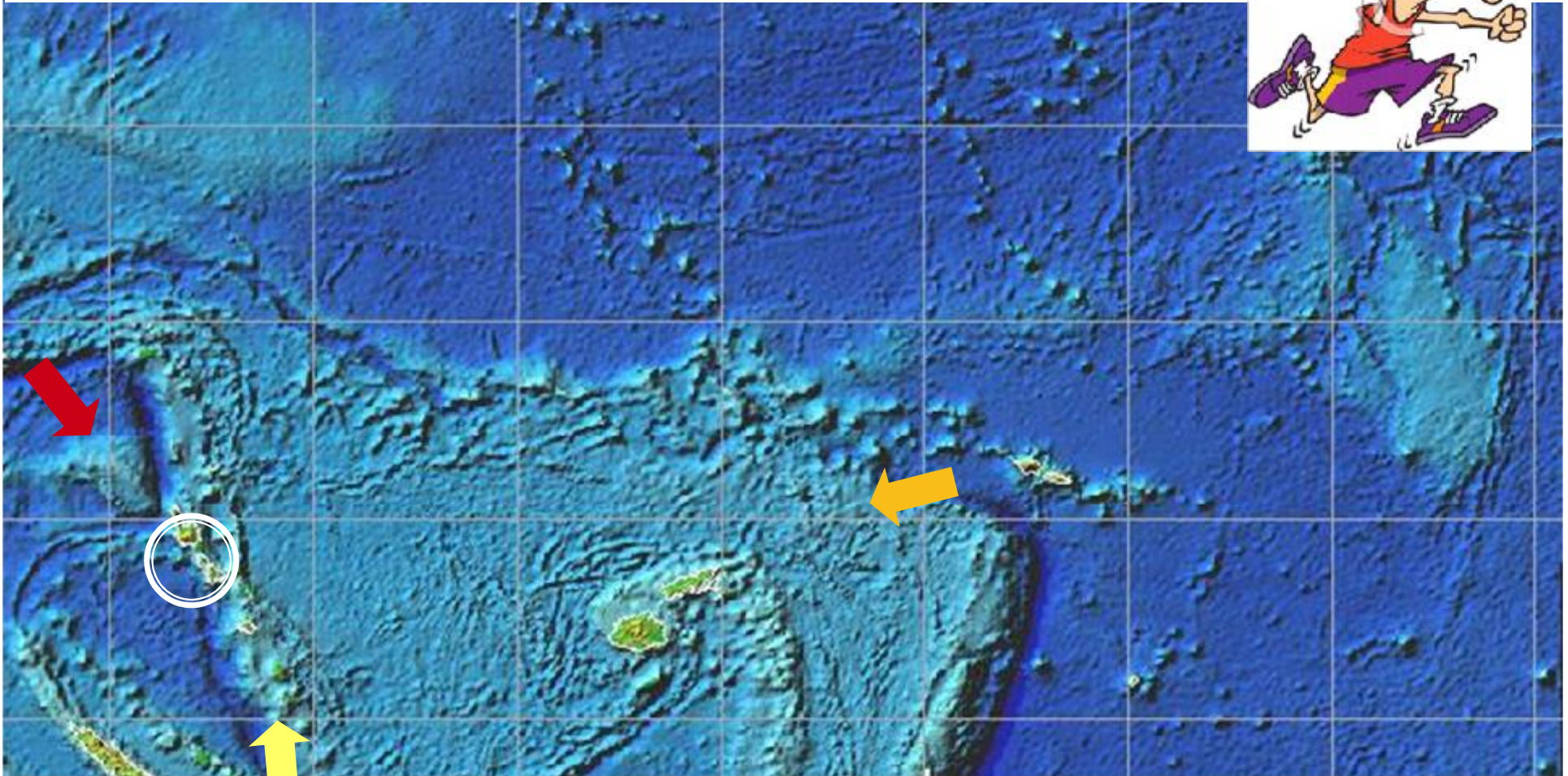
EVACUATE ALL ZONES



REGIONAL

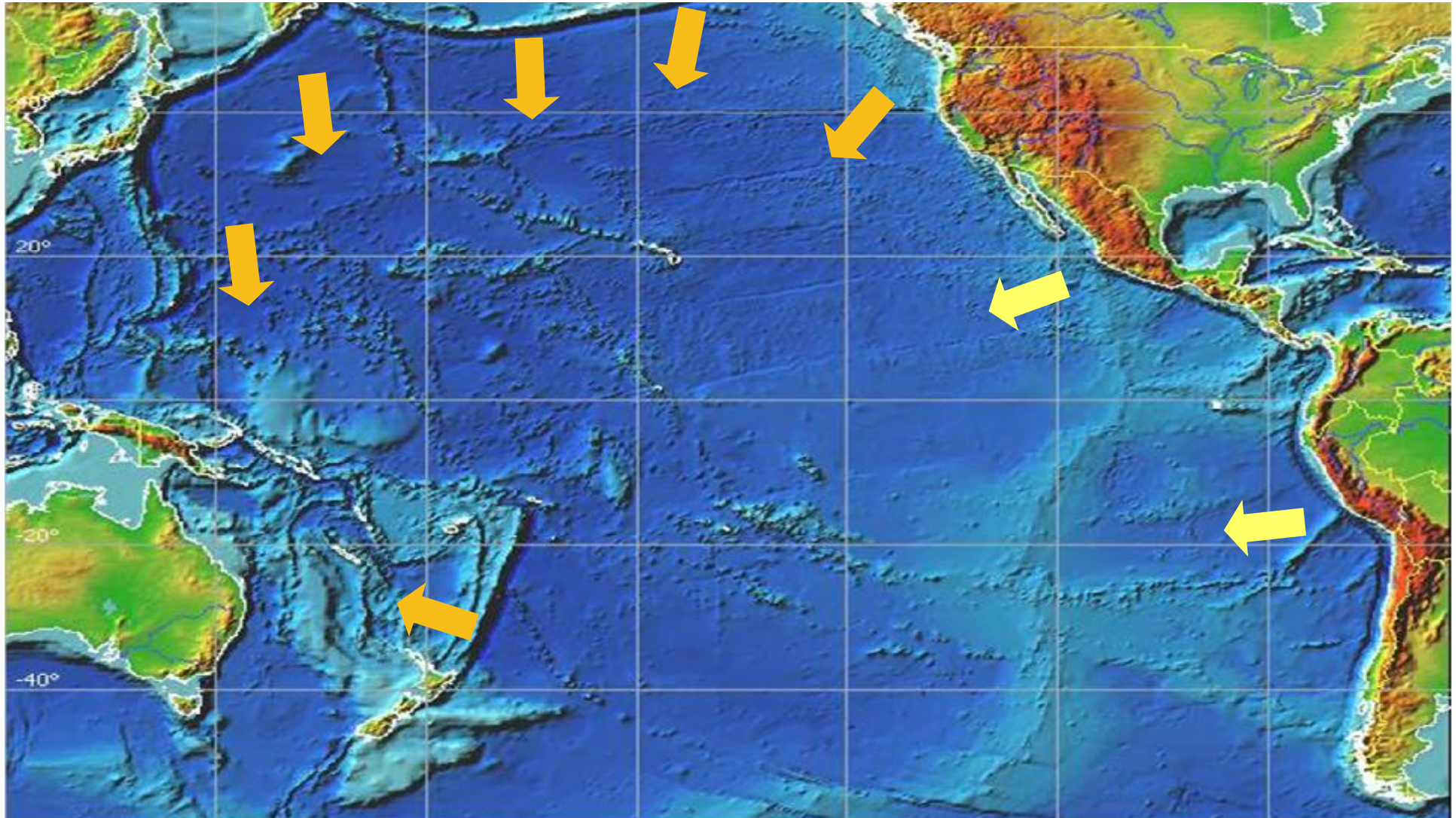
If there is time for an official warning

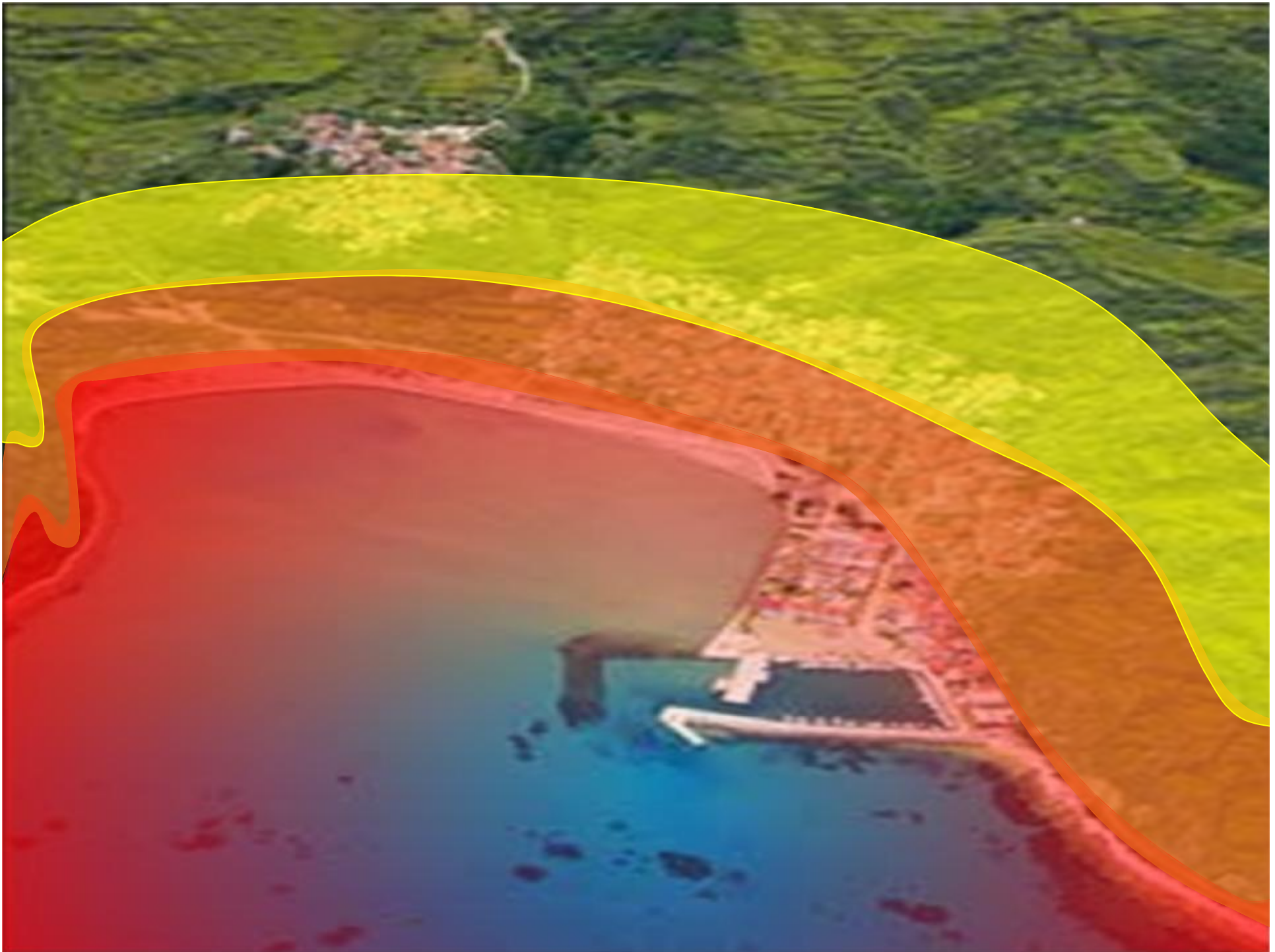
EVACUATE THE ZONES STATED



DISTANT

There will be an official warning
EVACUATE THE ZONES STATED





Thailand



America



Philippines

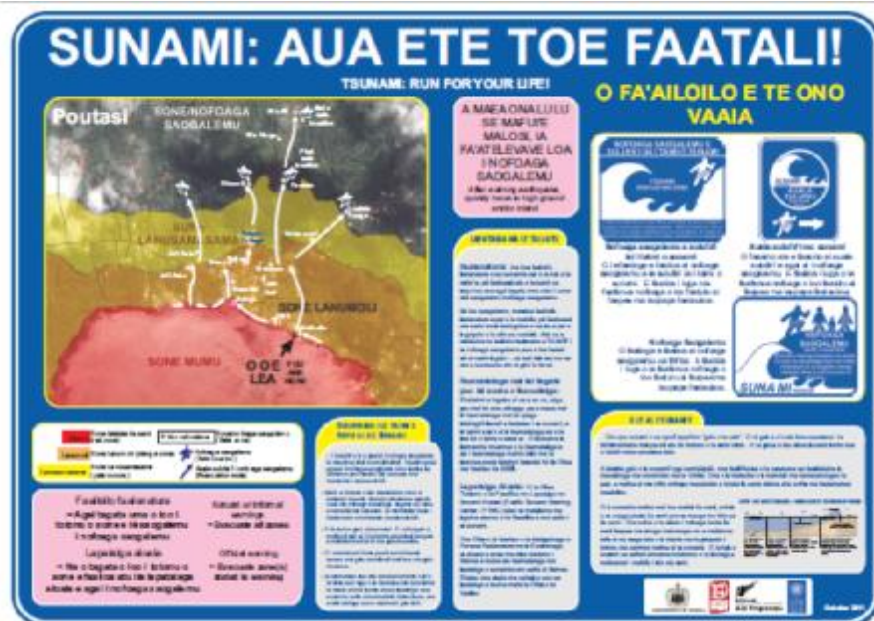


AO NANG TAXI CLUB		
KRABI TOWN		400 B
KRABI AIRPORT		300 B
PHUKET AIRPORT		2,000 B
PHUKET TOWN		2,000 B
PATONG-KATA-KARON		2,500 B
TRANG TOWN-AIRPORT-STATION		2,000 B
PAKMANG-BEACH		1,700 B
SURAT TOWN-TRIN-STATION-AIRPORT		2,500 B
DONDAK PEH		3,500 B
PHAN NGA BAY		1,700 B
SATONK TOWN		4,500 B
SATONK PAKBARA PEH		3,500 B
NATYAI		4,500 B
KOA LAK-KOA SOK		2,500 B
LANTA ISL		2,800 B
KRABI ONE DAY		2,500 B
TIGER CAVE		4,500 B

Samoa



SAMOA



Future workplan

- ▶ 55–60 consultations across Port Vila and Luganville.
- ▶ Develop signage layout for Port Vila and Luganville as per SOP
- ▶ Consider links to waterfront redevelopment? Sign considerations at least
- ▶ Print Signs, Info boards, A3 maps
- ▶ Install signs
 - Any issues with digging a hole and concreting a post? Co-location agreements for poles and walls?
- ▶ Three exercises in 2016
 - Plan for the three exercises – workplan. law enforcement, stores closed etc.
- ▶ Consider schools exercises/drills each year
- ▶ Tsunami roll out facilitator role within NDMO
- ▶ Application of multi-hazard mapping and Urban Management Strategy project components
- ▶ Fully cost this all within budget



► 2016 – First semester

- Public Consultation Preparation Phase: Early February (VMGD/NDMO). Planning and costing
- Starting of Communities Consultations: February–March. More than 60 expected consultations (VMGD/NDMO/Provinces/Municipalities) in Greater Port-Vila and Greater Luganville
- Finalization of evacuation routes, signs location and evacuation maps
- Signs Technical specifications and procurement
- Warning and Information Dissemination System final design, specifications and procurement



► 2016 – Second semester

- Signs installation in every communities
- Presentation to the communities and distribution of Tsunami tools (brochure, equipment to the CDC) (VMGD/NDMO/Provinces/Municipalities) in Greater Port-Vila and Greater Luganville
- Installation of the Warning information and Dissemination System, including “Sirens”
- Preparation and planning of 3 live exercises
- Luganville live Tsunami Exercise
- Port-Vila live Tsunami Exercise
- National live Tsunami Exercise



Tankyu tumas



Appendix K - Specific values for education, information and communication materials

IClim Vanuatu EIC materials – Specific Values

IClim Vanuatu EIC materials metadata specific values:

- Title
- NAB Endorsed? Y/N
- Type of Educational or Awareness Resource (Textbook, Lesson plan, Curriculum, Syllabus, Unit Materials, Teacher guide, Game, Awareness Brochure, Other resource type, Webpage)
- Author
- Published by
- Financed/Supported by
- Published in
- Publishing Year
- Target Group (Early Childhood, Primary, Secondary, Tertiary, TVET Training, Curriculum Developers & Teacher Trainers, Communities, Civil Service, General public, Experts, Scientists, Disabled, Women, Men, Youth, Children, Teacher Education)
- Subject/Strand (such as Geography, History, Physics, Maths, Economics, Accounting, Commercial studies, Agriculture, Science, Biology, Chemistry, Basic Sc, Home Economics, Language & Culture, Family Life Education & Life skills, Community & culture, Physical Education, Health Social science etc)
- Climate Change (Science/Causes & Effects of Climate Change, Changes, Impacts, Vulnerability, Adaptation, Mitigation)
- Disaster Risk Management (Preparedness, Prevention, Mitigation, Risk Analysis/Assessment, Management/Response, OHS, Early Warning, Hazards, Tectonic hazards, Climatic hazards, Man-made hazards, Emergencies, etc)
- Specific TVET Training Area/Focus (Agriculture, Animal husbandry, Horticulture, Forestry, Health, Medical care, Nursing, Maritime Studies, Fisheries, Aquaculture, Sea Faring, Infrastructure, Plumbing, Welding, Engineering, Industrial Arts, Electronics, Electrical Engineering, Car Mechanics, Automotive Engineering, Building, Construction, Carpentry, Joinery, Woodwork, Business, Financial Management, Information Technology, Accounting, Bookkeeping, Journalism, Fire Fighting, First Aid, Sports, Theological studies, Religion, Culture, Community Development, Hospitality, Catering, Tourism, Cooking, Baking, Food & Nutrition, Home Economics, etc)
- Content/Topics (Climate, Weather, Green House Gas Effect, Carbon Cycle, Water Cycle, Volcanoe, Tsunami, Earthquake, Landslide, Tidal Waves, Tides, Coral Reefs, Mangroves, Crops, Plant Growth, Fish, Mammals, Volcanoes, etc)
- Regional Focus (Global, Africa, Asia, Europe, America, Australasia, Small Island States, South Pacific, Micronesian/Polynesian/Melanesian, Specific Country, Culture)
- Utilized in (classroom, school, library, teacher education institute, TVET Institute OR "none")
- Language
- Weblink
- Download
- File name
- Comments
- Notes

**Appendix L - Existing Education, Information and Communication
Materials**

Existing Education, Information and Communication Materials

Within this table **X** denotes covered, **-** denotes partially covered or in a limited way, **?** denotes unclear whether covered, **NA** denotes not applicable.

Hazard	Title	Type	Lang	Hazard event explanation	Risk information	Urban planning information	Options for structural/natural mit.	Pre-event preparedness info.	Warning source and triggers	Map of hazard or evacuation area	During event instructions	Event information / forecasts	After the event instructions/ recovery	Further information links	Glossary/definitions	Government of Vanuatu Structures	Coordinating Committees & Taskforces	NGOs	Public	Publisher	In folder of validated NAB resources	On NAB portal
Coastal Inundation	Coastal Inundation hazard maps	maps	E	X												X	X	X	-	Geo-Hazards Division		
Coastal Inundation	Coastal Inundation risk maps	maps	E	X												X	X	X	-	Geo-Hazards Division		
Earthquake	Earthquake hazard maps	maps	E	X					X							X	X	X	-	Geo-Hazards Division		
Earthquake	Inferred liquefaction hazard maps	maps	E	X					X							X	X	X	-	Geo-Hazards Division		
Earthquake	Earthquake risk maps	maps	E	X												X	X	X	-	Geo-Hazards Division		
Earthquake	Earthquake Bulletin											X				X	X	X	X	Geo-Hazards Division		
Earthquake	Earthquake Alert											X				X	X	X	X	Geo-Hazards Division		
Earthquake	Seismic Monitoring Information											X				X	X	X	X	Geo-Hazards Division		
Earthquake	Wanem blong mekem taem kraon seksek	Brochure	B, E, F	X	-	-		X	NA	X	X	X						X		Geo-Hazards Division		
Earthquake	Yumi Mas Rere Long Etkwek	Poster	B					X	NA	X	X	X						X		Red Cross	F	P
Earthquake	Seismology glossary	Booklet	B, E											X		X	X	X	X	Geo-Hazards Division		
Earthquake, tsunami	Earthquake, Tsunami	Comic Book	E, B	X					X	X	X	X						X		CARE International		P
Flood	Riva I flat	Comic Book	E, B	X					X	X		X						X		CARE International		P
Flood	Flood hazard maps	maps	E	X						X						X	X	X	-	Geo-hazards		
Flood	Flood risk maps	maps	E	X						X						X	X	X	-	Geo-hazards		
Flood	Yumi Mas Rere Long Flad	Poster	B	X				X	X	X	X	X						X		Red Cross	F	P
Landslide	Landslaed/Landslides	Comic Book	E, B	X		X	X	X	X	X		X						X		CARE International		
Landslide	Inferred landslide hazard maps	maps	E	X						X						X	X	X	-	Geo-hazards		
Landslide	Yumi Mas rere long Lanslaet	Poster	B	X				X		X		X						X		Red Cross	F	P
Many	SSD 221 And Planet Earth And It's Resources	Curriculum	E, F	-												X				?		P
Many	Skul yumi redi	Booklet	E					X										X		CARE International		P
Many	Multi-hazard risk maps	maps	E	X												X	X	X	-	Geo-hazards		
Many	Disaster Risk Reduction and Disaster Management National Action Plan (2006 - 2016)	Plan	E	?	?	?	?	?	?	?	?	?	?	?	?	X	X	X		Government of Vanuatu		P
Many	SUPPLEMENTARY PRIORITIES AND ACTION AGENDA ON DISASTER RISK REDUCTION AND DISASTER MANAGEMENT FOR A SAFE, SECURE AND RESILIENT SUPPLEMENTARY PRIORITIES AND ACTION AGENDA ON DISASTER RISK REDUCTION AND DISASTER MANAGEMENT FOR A SAFE, SECURE AND RESILIENT VANUATU	List	E	?	?	?	?	?	?	?	?	?	?	?	?	X	X	X		Government of Vanuatu		
Many	Key Messages	Document	E, B, F													X	X	X	X	NDMO		
Many	Community Based Disaster Risk Reduction - Handbook for local facilitator	Booklet	E													X	X	X		Red Cross	F	
Many	Riskland learn disaster prevention while you play	Game	E, Baslima	-	-	-	-	-	-	-	-	-	-	-	-			X		Red Cross	F	

				Hazard event explanation									Government of Vanuatu Structures							
				Risk information									Coordinating Committees & Taskforces							
				Options for structural/natural mit.									NGOs							
				Pre-event preparedness info.									Public							
				Warning source and triggers																
				Map of hazard or evacuation area																
				During event instructions																
				Event information / forecasts																
				After the event instructions/ recovery																
				Further information links																
				Glossary/definitions																
				Government of Vanuatu									Structures							
				Coordinating Committees & Taskforces																
Hazard	Title	Type	Lang														Publisher	In folder of validated NAB resources	On NAB portal	
Many	Public awareness and education for disaster risk reduction: Key Messages for Vanuatu	Report	B, E	-		-	X		X	N	A			X	X	X	X	Save the Children	F	
Many	School Disaster Management: A child-centred approach to School Disaster Management activities in Vanuatu Schools	Lesson plan, Curriculum, Syllabus, Teacher guide	E											X				Save the Children	F	P
Many	Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI)	Datasets	E	X										X	X			SOPAC		P
Many	The little handbook of disaster and climate change networked governance structure in Vanuatu	Booklet	E		-									X	X	X			F	
Many?	Participatory School Disaster Management Handbook: Consultation Draft / Field Testing Version 2 October, 2013	Other resource type	E											X				Save the Children	?	
Many	Family disaster plan	Sticker	B				X										X			
Many	Community Disaster Plan	Information Board	B				X										X	Red Cross		
Severe Weather	Television appearance after rainfall and climate outlook are released									X				X	X	X	X	Climate Division		
Severe Weather	METAR									X				X	X	X	X	Observation Division		
Severe Weather	Recorded Variables									X				X	X	X	X	Observation Division		
Severe Weather	SPECI									X				X	X	X	X	Observation Division		
Severe Weather	Synotic Observation									X				X	X	X	X	Observation Division		
Severe Weather	24 hour recorded Variables for synoptic stations									X				X	X	X	X	Weather Forecasting and Services Division		
Severe Weather	Area Forecast (ARFOR)									X				X	X	X	X	Weather Forecasting and Services Division		
Severe Weather	Cities Forecast									X				X	X	X	X	Weather Forecasting and Services Division		
Severe Weather	Clients Bulletins	Bulletin								X				X	X	X	X	Weather Forecasting and Services Division		
Severe Weather	Coastal Marine Forecast									X				X	X	X	X	Weather Forecasting and Services Division		
Severe Weather	Coastal Marine Wind Warning									X				X	X	X	X	Weather Forecasting and Services Division		
Severe Weather	Daily Post Weather bulletins	Bulletin								X				X	X	X	X	Weather Forecasting and Services Division		
Severe Weather	Gale Wind Warning									X				X	X	X	X	Weather Forecasting and Services Division		
Severe Weather	Graphic Daily Post	Graphic								X				X	X	X	X	Weather Forecasting and Services Division		
Severe Weather	Graphic Satellite Image	Image								X				X	X	X	X	Weather Forecasting and Services Division		
Severe Weather	Graphic TV Weather	Graphic								X				X	X	X	X	Weather Forecasting and Services Division		
Severe Weather	Habour Forecast									X				X	X	X	X	Weather Forecasting and Services Division		

				Hazard event explanation Risk information Urban planning information Options for structural/natural mit. Pre-event preparedness info. Warning source and triggers Map of hazard or evacuation area During event instructions Event information / forecasts After the event instructions/ recovery Further information links										Glossary/definitions Government of Vanuatu Structures Coordinating Committees & Taskforces NGOs Public						
Hazard	Title	Type	Lang															Publisher	In folder of validated NAB resources On NAB portal	
Severe Weather	High Seas Forecast									X					X	X	X	X	Weather Forecasting and Services Division	
Severe Weather	High Seas Wind Warning									X					X	X	X	X	Weather Forecasting and Services Division	
Severe Weather	Independent Newspaper Weather Bulletin									X					X	X	X	X	Weather Forecasting and Services Division	
Severe Weather	Mean Sea Level Pressure Chart	Chart								X					X	X	X	X	Weather Forecasting and Services Division	
Severe Weather	Radio Weather Bulletins	Bulletin								X					X	X	X	X	Weather Forecasting and Services Division	
Severe Weather	Route Forecast (ROFOR)									X					X	X	X	X	Weather Forecasting and Services Division	
Severe Weather	Severe Weather Bulletin	Bulletin								X					X	X	X	X	Weather Forecasting and Services Division	
Severe Weather	Severe Weather Outlook									X					X	X	X	X	Weather Forecasting and Services Division	
Severe Weather	Terminal Aerodrome Forecast (TAF)									X					X	X	X	X	Weather Forecasting and Services Division	
Severe Weather	Terminal Trend Forecast (TTF)									X					X	X	X	X	Weather Forecasting and Services Division	
Severe Weather	Weather Forecast Policy	Policy								X					X	X	X	X	Weather Forecasting and Services Division	
Tropical Cyclone	Yu rere long saeklon sisen ia? DL pamphlet							X		X	X						X	Weather Forecasting and Services Division		
Tropical Cyclone	Tropic Cyclone - DL pamphlet			X				X									X	Weather Forecasting and Services Division		
Tropical Cyclone	Saeklon	Comic Book	E, B					X		X	X						X	CARE International	P	
Tropical Cyclone	Yumi Mas Rere	Comic Book	E, B					X									X	CARE International	P	
Tropical cyclone	Radio Talk back show									X					X	X	X	X	Climate Division	
Tropical Cyclone	Cyclone Season Media Release	Press Release								X					X	X	X	X	Climate Division	
Tropical Cyclone	Cyclone Season Outlook									X					X	X	X	X	Climate Division	
Tropical Cyclone	Wind hazard maps	maps	E	X						X					X	X	X	-	Geo-hazards	
Tropical Cyclone	Wind risk maps	maps	E	X						X					X	X	X	-	Geo-hazards	
Tropical Cyclone	Besik Konstraksen Hanbuk blong bildim wan sef Selta - 2013	Other resource type, Awareness Handbook	B			X											X	Red Cross	F	
Tropical Cyclone	Yumi Mas Rere Long Saeklon	Poster	B	X				X		X	X	X					X	Red Cross	F P	
Tropical Cyclone	Graphic Tropical Cyclone Track Map	Map								X					X	X	X	X	Weather Forecasting	

				Hazard event explanation								Government of Vanuatu Structures					
				Urban planning information								Coordinating Committees & Taskforces					
				Options for structural/natural mit.								NGOs					
				Pre-event preparedness info.								Public					
				Warning source and triggers													
				Map of hazard or evacuation area													
				During event instructions													
				Event information / forecasts													
				After the event instructions/ recovery													
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				Glossary/definitions													