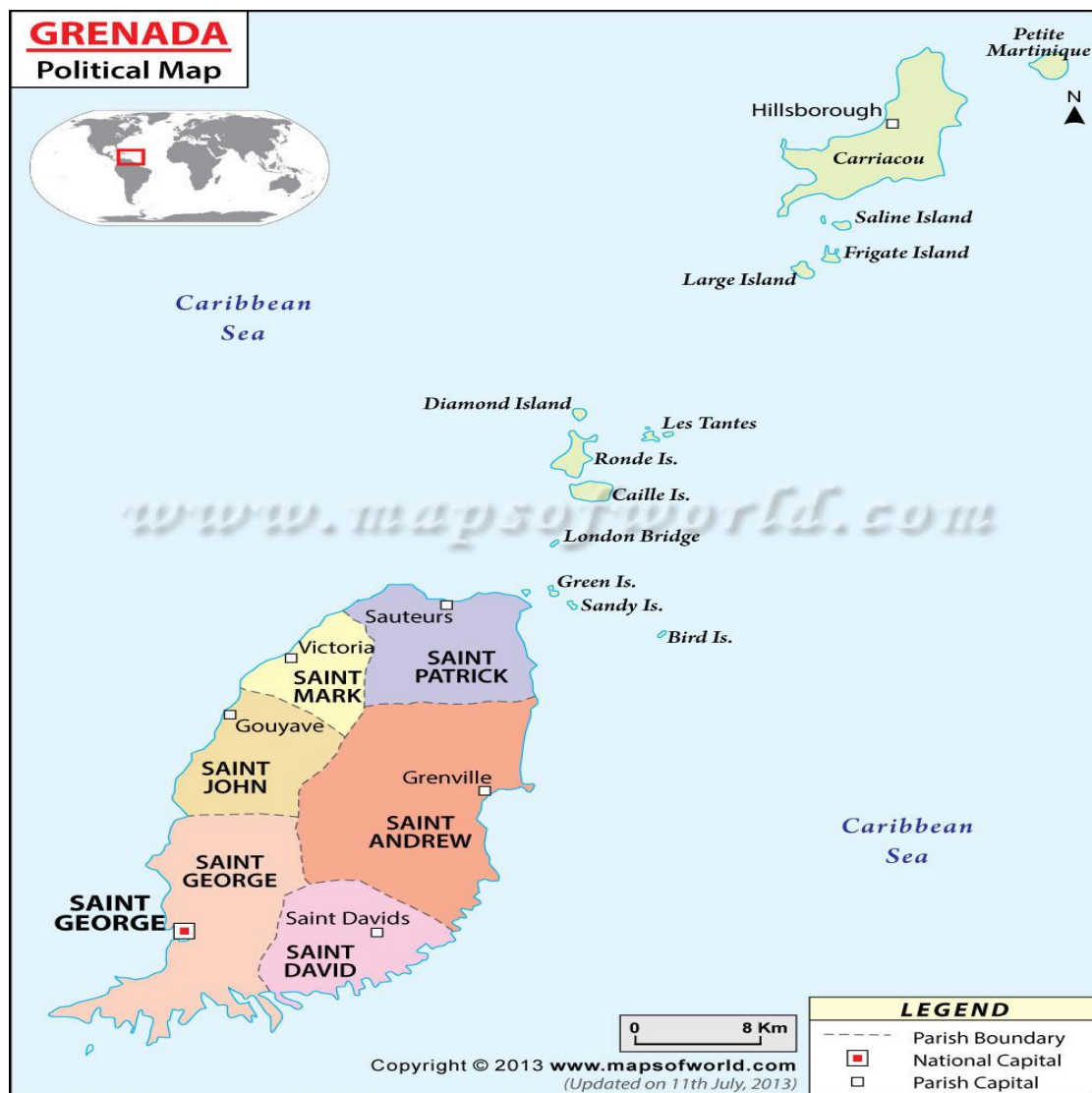


Version 5.0

Grenada Tsunami Warning Protocol

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Preface

The CDEMA Participating States' Model Standard Operating Procedures (SOP) is adapted herein for use for Grenada. The adapted SOP outlines the essential responsibilities of the Grenada National Tsunami Warning Focal Point and National Tsunami Warning Center (NTWFP/ NTWC) to receive the Tsunami product, to analyse the Bulletin, and to initiate actions based on the analysis to alert and notify the National organizations and the public.

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1. BACKGROUND

This documents Grenada's Standard Operating Procedures (SOPs) for responding to the receipt of Tsunami products emanating from the Tsunami Service provider for the Caribbean and Adjacent Regions, the Pacific Tsunami Warning Center (PTWC). The Grenada Tsunami Warning SOPs are the implementation procedures to be followed when a Tsunami Bulletin is received by the National Tsunami Warning Focal Point and National Tsunami Warning Center (Grenada Meteorological Office).

2. PURPOSE

This document is the Standard Operating Procedures (SOPs) for the Grenada National Tsunami Warning Focal Point (GNTWFP) and warning center (NTWC) staff in responding to the Pacific Tsunami Warning Center (PTWC) issued Tsunami products.

SOPs provide procedural guidance on actions to be taken to coordinate (who, what, when, where and how) tsunami early warning and response.

3. STATEMENT OF GRENADA'S VULNERABILITY TO A POSSIBLE TSUNAMI

Grenada is part of a volcanically and tectonically active ridge formed along the Lesser Antilean island arc system. The island has only one potentially active volcano on land, Mt. St. Catherine, with most of the geothermal activity being associated with it. Grenada is also threatened by the presence of a submarine volcano, 'Kick 'em Jenny' located 9 km North of Grenada. Volcanoes, earthquakes, and therefore tsunamis are potential threat issues facing Grenada, given the fact that most of the population lives on or near the coast.¹

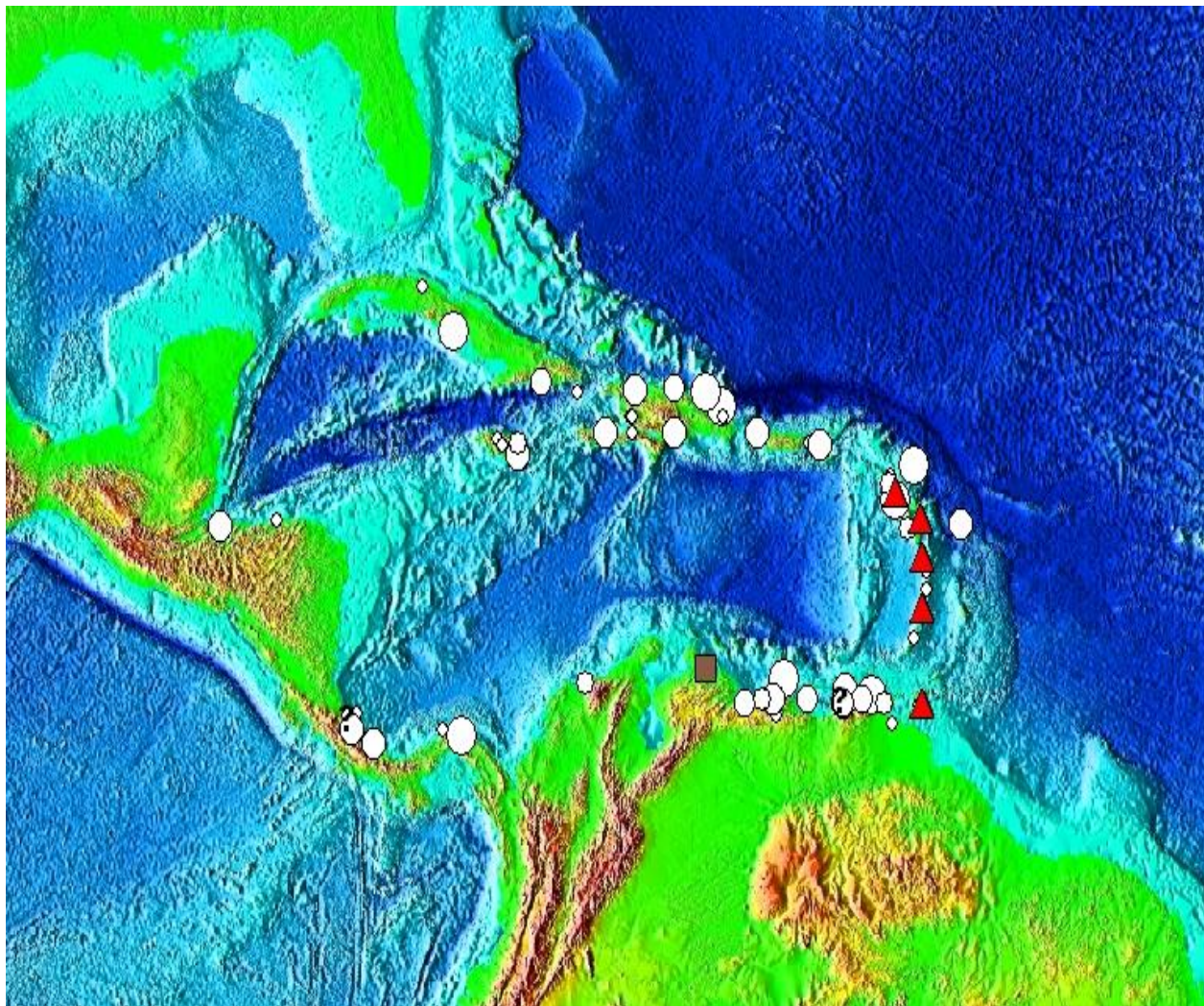
The Caribbean Sea and the Atlantic Ocean are potential sources for tsunami generation including earthquakes, sub-aerial, submarine landslides and underwater volcanic explosions. This SOP focuses on tsunamis generated by earthquakes. Arrival of damaging tsunami waves from the time of the seismic event within the Caribbean can occur almost immediately (within 5 minutes to 60 minutes if the event is locally generated and within 60 minutes to 3 hours if generated regionally, it can also occur after 3 hours if it's a teletsunami). The travel time is dependent on the distance of the shoreline from the earthquake epicenter and the bathymetry.

Tsunamis are generally generated when large bodies of water are displaced underneath the sea. Undersea displacement of water occurs when a seismic activity occurs 100 km or less under the ocean bottom or up to 100 km inland or a huge landslide takes place near a coast and displaces a large body of sea water. Huge landslides can be caused by a volcanic eruption or lava flow into the ocean. Undersea volcanoes can also displace large bodies of sea water.

The immediate provision of tsunami warning for coastal regions is essential in reducing and mitigating the catastrophic losses that such waves can bring. Earthquakes are not predictable as of yet; hence, once one occurs its potential is immediately assessed to forecast the possibility for an ensuing tsunami. Active Volcanoes in the Caribbean are monitored by the Seismic Research Center of the UWI (Siant Augustine, Trinidad and Tobago) and other volcano observatories and scientists monitoring their activity could provide warning about a potential eruption often within 3 to 14 days in advance of the eruption and thus the heightened potential for a tsunami.

Tsunamis have a great potential for causing serious damages. However, if we can assess its likelihood immediately, once a large earthquake occurs and evacuate before the arrival of a tsunami, lives can be saved.

The following shows historical tsunami source locations in the Caribbean Sea. The symbols indicate causes of the tsunami: Brown Square is a landslide, Red Triangle is a volcanic eruption, Question Mark is an unknown cause, and White Circle is an earthquake and the size of the circle is graduated to indicate the earthquake magnitude. Source: National Geophysical Data Center / World Data Service: NCEI/WDS Global Historical Tsunami Database. NOAA National Centers for Environmental Information. doi:10.7289/V5PN93H7 [2012]



5. TYPES OF TSUNAMI PRODUCTS ISSUED

5.1 PACIFIC TSUNAMI WARNING CENTER (PTWC)

The Richard H. Hagemeyer Pacific Tsunami Warning Centre (PTWC) in Hawaii is operated by the National Weather Service of the US National Oceanic Atmospheric Agency (NOAA). In support of the UNESCO/IOC Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (UNESCO/IOC CARIBE EWS), the PTWC serves as a Tsunami Service Provider and issues information and threat bulletins for the national authorities in each country, including Grenada. Usually within 5 to 15 minutes of a significant earthquake (usually greater than M 6.0), the PTWC issues a product indicating whether or not there is the potential tsunami threat from the earthquake and if there is a tsunami threat, the messages will indicate the areas (countries) under threat. These messages are sent to the officially designated Tsunami Warning Focal Point and National Tsunami Warning Center. In the case of Grenada this is the Meteorological Office. The Meteorological Office, acting as the National Tsunami Warning Center, will determine the appropriate level of alert for the country.

The criteria the PTWC uses for issuing a Tsunami Information Statement or Tsunami Threat message are summarized in Table 1. If the PTWC issues a Tsunami Threat message, once it understands the threat has passed it will issue a Final Threat bulletin. A full description of the products and procedures are included in the User's Guide for the Pacific Tsunami Warning Center Enhanced Products for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE-EWS), IOC Technical Series No 135. UNESCO/IOC 2017 (<https://www.weather.gov/ctwp/>).

The products issued by the PTWC are:

5.2 TSUNAMI INFORMATION STATEMENT

A Tsunami Information Statement is issued by PTWC to inform about the occurrence of a large earthquake with little or no tsunami generating potential, either because the earthquake has insufficient size, is located too far inland to disturb the sea, is too deep within the earth to significantly displace the seafloor, or some combination of the above. In rare cases, an earthquake in this category can be accompanied by a locally destructive tsunami due to a collateral tsunami generic phenomenon such as a landslide into the sea or an undersea slump.

This product is issued solely as advice to local governments that have the responsibility and authority to alert and instruct the public regarding appropriate response actions. Supplemental tsunami information may be issued if a tsunami signal is detected on nearby gauges or if there is a significant change to the preliminary earthquake parameters.

5.3 TSUNAMI THREAT MESSAGE

A Tsunami Threat Message is issued by PTWC following a large earthquake to inform that there is the potential for a destructive tsunami to impact the region declared under a threat, or to inform regarding a confirmed tsunami with the potential to cause damage to the region declared under a threat. It is the highest level of alert issued by PTWC for the Caribbean region. The criteria for the initial text products are based on earthquake parameters, while ensuing products are based on tsunami modeling and observations. It is issued by PTWC solely as advice to local governments that have the responsibility and authority to issue tsunami alerts (warnings, advisories, watches) for the areas under their jurisdiction or otherwise alert and instruct the public regarding appropriate response

actions. Such actions may include the evacuation of low-lying areas and the repositioning of ships and boats to deep water.

- Tsunami threat messages will be updated by the PTWC approximately every hour with information including any measurements of tsunami waves and any appropriate expansion or reduction of the region under a threat until the end of threat message is issued.

Table 1. Criteria for PTWC Initial Text Products for the CARIBE-EWS.

Region	Earthquake			Product	
	Location	Depth	Magnitude (Mw)	Type	Tsunami Threat
Caribbean	under the sea or very near the coast	any	< 6.0	none	none
			6.0 – 7.0	Information Statement	None - earthquake is too small
	well inland		≥ 6.0	Information Statement	None – earthquake is too far inland
Atlantic	under the sea or very near the coast	any	< 6.5	none	none
			6.5 – 7.0	Information Statement	None - earthquake is too small
	well inland		≥ 6.5	Information Statement	None – earthquake is too far inland
Caribbean or Atlantic	under the sea or very near the coast	≥ 100 km	≥ 7.1	Information Statement	None - earthquake is too deep
		< 100 km	7.1 - 7.5	Threat Message	Potential threat to coasts within 300 km
			7.6 – 7.8	Threat Message	Potential threat to coasts within 1000 km
			≥ 7.9	Threat Message	Potential threat to coasts with ETA ≤ 3 hours
Atlantic	under the sea or very near the coast	< 100 km	≥ 7.9	Information Statement	Potential threat but no coasts with ETA ≤ 3 hours. Evaluation continues.

5.4 SEISMIC RESEARCH CENTRE (SRC)

The Seismic Research Centre (formerly the *Seismic Research Unit*) of the University of the West Indies grew out of a Colonial Development and Welfare (CDW) project established in 1952 with the objective of monitoring volcanic activity in the Lesser Antilles and for providing a trained group of scientists in the West Indies who could react quickly to volcanic emergencies. During the first period of operation (1952 to 1957) the work of the Centre was extended to include the monitoring of tectonic

(non-volcanic) earthquakes and the non-volcanic islands of Trinidad, Tobago, Barbados and Antigua were included in the system. Today, with a network of over 50 stations, the SRC remains the authoritative source for information on the status of earthquake and volcanic activity in the English-speaking Eastern Caribbean. For local and eastern Caribbean earthquakes of Magnitude less than 6.0, the SRC would inform on the earthquake parameters. The SRC also monitors the volcanoes of the region and advises the countries when there is a change in activity, including potential eruption.

5.5 UNITED STATES GEOLOGICAL SURVEY (USGS)

The USGS operates the National Earthquake Information Center (NEIC). It is located in Golden, Colorado, 10 miles west of Denver. In addition to its domestic responsibilities and the maintenance of an extensive seismic database, the NEIC determines, as rapidly and as accurately as possible, the location and size of all significant earthquakes that occur worldwide. The NEIC disseminates this information immediately to concerned national and international agencies, scientists, critical facilities, and the general public.

The NEIC operates a 24-hour-a-day service to determine the location and magnitude of significant earthquakes in the United States and around the world as rapidly and accurately as possible. This information is communicated to federal and state government agencies who are responsible for emergency response, to government public information channels, to national and international news media, to scientific groups (including groups planning aftershock studies), and to private citizens who request information. When a damaging earthquake occurs in a foreign country, the earthquake information is passed to the staffs of the American embassies and consulates in the affected countries and to the United Nations Department of Humanitarian Affairs (DHA). The NEIC issues rapid reports for those earthquakes with magnitudes at least 3.0 in the eastern United States, 3.0 in the western United States, or 5.0 (or are known to have caused damage) anywhere else in the world. At the present time, the NEIC staff locates and publishes approximately 30,000 earthquakes on a yearly basis. These are the most important of the many million earthquakes which are estimated to occur each year.

The USGS has has real-time notification, feeds and web services (<https://earthquake.usgs.gov/earthquakes/feed/>), posts information on their website (<https://earthquake.usgs.gov/earthquakes/map/>) and also thru the Real Time Earthquake Display web service.

6. TSUNAMI ALERT LEVELS FOR GRENADA

Alert levels for tsunamis were developed for use by Grenada and are based on the tsunami products from the PTWC. Bulletins and forecast products will be used to establish the alert level and product to be issued by the NTWC. In addition to three alert levels, the NTWC will also issue Tsunami Bulletins and End of Threat Message. The tsunami alert levels and products for Grenada are:

Warning – A warning is issued when there is imminent danger of coastal flooding from tsunamis within the following three hours. People will be instructed to evacuate, run for higher ground. The Tsunami warning alert will be indicated by the color **RED**.

Advisory – A tsunami advisory is issued when there is imminent possibility of dangerous currents from tsunamis (no flooding). People will be instructed to move out of the water, off the beaches and out of harbors and marinas. The Tsunami advisory alert will be indicated by the color **ORANGE**.

Watch – A tsunami watch is issued when there is a distant earthquake and if a tsunami were to be generated and impact Grenada, it would take at least 3 hours and the local threat is under evaluation. People will be instructed to stay tuned for further official information. The Tsunami watch alert will be indicated by the color **YELLOW**.

Tsunami Bulletin. A tsunami bulletin will be issued in the case of a small or distant event with no local threat. It is issued for information only. In very rare cases, would an alert (Warning, Advisory or Watch) be issued after an information statement. A Tsunami Bulletin will be indicated in color **GREEN**.

End of Threat Message. If a Tsunami Warning, Advisory or Watch is issued, once the threat has passed or the evaluation yields there is no threat to Grenada, a End of Threat Message will be issued. This only indicates that there is no longer a tsunami threat, but if there has been a tsunami impact people will have to wait for an All Clear to be issued by NaDMA indicating it is safe to return.

Examples of these products are included in Appendix A.

The initial criteria to issue the alerts are in Table 2, while Table 3 is based on the quantitative PTWC forecast product issued 20 – 30 minutes after the earthquake. Figure 2 (GRENADA NTWFP STANDARD OPERATING PROCEDURES) is the flowchart that all personell in duty at NTWFP must follow to analyze the PTWC messages received and issue according the corresponding national product.

Table 2. Criteria Table for NTWC tsunami alerts and emergency response actions typically issued within 5-10 minutes of any large Caribbean or Atlantic earthquake, prior to the computation of a quantitative tsunami forecast.

Product Type	Earthquake Parameters	Potential Tsunami Type	Are Possible Hazardous Tsunami Waves Indicated for Grenada	Threatened Coast	Time Left to Initial Wave Arrival (ETA)	NTWC Alert Level for Threatened Coast	Emergency Response Answer
SRC, USGS or other Seismological Institution EQ Report	Felt earthquake in Grenada Magnitude of 4.0-6.0	None	No	None	Not Applicable	Bulletin	No immediate action required
PTWC Tsunami Information Statement	Magnitude of 6.0-7.0, or on land, or ≥ 100km (62mi) depth	None or Very Minor	No	None	Not applicable	Bulletin	No immediate action required
Tsunami Threat Message	Magnitude of 7.1-7.5, undersea or very near the sea, and < 100km (62mi) depth	Local Tsunami	Yes	< 300 km (186mi) from earthquake	< 1 hr typical	Warning	Evacuate threatened coast
			No	≥ 300 km (186mi) from earthquake	Not given	Bulletin	No immediate action required
	Magnitude of 7.6-7.8, undersea or very near the sea, and < 100km (62mi) depth	Regional Tsunami	Yes	< 1000 km (620 mi) from earthquake	< 3 hrs typical	Warning	Evacuate threatened coast
			No	≥ 1000 km (620 mi) from earthquake	Not given	Bulletin	No immediate action required
	Magnitude of 7.9 and greater, undersea or very near the sea, and < 100km (62mi) depth	Basin-wide Tsunami	Yes	Potential for a basin-wide tsunami	< 3 hours	Warning	Evacuate coast within 3 hours of ETA
			No		3 to 6 hours	Watch	Stay Tuned For Further Official Information
			No		> 6 hours	Bulletin	No immediate action required

Key criteria for each situation are indicated in bold red letters. In a local tsunami situation, in order to provide the fastest alert, earthquake magnitude and travel time criteria should be used. Issuance of a Warning, Watch, or Bulletin is dependent and the size of the earthquake and its closeness to coastlines. Smaller magnitude earthquakes that are closer to the coast may warrant issuance of a Warning. The M7.1 threshold is used by PTWC for its Pacific Tsunami Service and was used by the PTWC for its Indian Ocean Tsunami Watch Service. The 3-hour time criteria is based on the amount of time required for a country to safely complete a coastal evacuation. The 3-hr threshold used by PTWC is considered a conservative, but reasonable time criteria. Historically, the value is from a requirement from Hawaii State Emergency Management Agency as the time required to safely evacuate all coasts of the State of Hawaii. PTWC issues products for earthquakes as of Magnitude 6.0 in the Caribbean and Adjacent Region and M 6.5 for events further away in the Atlantic. Earthquakes of Magnitude less than 6.0 can be felt in Grenada and if local, maybe even strong enough for people to believe that there is a potential tsunami threat. For these cases a Tsunami Bulletin should be issued to avoid unnecessary self evacuations.

Table 3. Criteria Table for NTWC tsunami alerts and emergency response actions based upon PTWC threat messages that include a quantitative tsunami forecast typically issued **20 to 30** minutes after a large **Caribbean or Atlantic** earthquake with a tsunamigenic potential.1

PTWC Product Type	Earthquake Parameters	Maximum Tsunami Wave Amplitude Indicated for Grenada	Time Left to Initial Wave Arrival	NTWC Alert Level for Threatened Coast	Emergency Response Action
Tsunami Threat Message	Magnitude 7.1 or greater, undersea or very near the sea, and < 100km (62mi) depth	≥ 1 m (3.3 ft)	< 3 hrs	Warning	Evacuate threatened coast
			3 to 6 hrs	Watch	Stay Tuned For Further Official Information
			> 6 hrs	Watch	Stay Tuned For Further Official Information
		0.3 to 1 m (1 to 3.3 ft)	< 3 hrs	Advisory	Evacuate beaches and harbors
			3 to 6 hrs	Watch	Stay Tuned For Further Official Information
			> 6 hrs	Watch	Stay Tuned For Further Official Information
		< 0.3 m (1 ft)	Not given	Bulletin	No immediate action required

Key criteria for each situation are indicated in bold red letters. Threatened coast information from public text message, coastal forecast amplitude maps or the KMZ file. Because of the geographical extent of Grenada, all of Grenada will be included in the same alert level. The 3-hour time criteria is based on the amount of time required for a country to safely complete a coastal evacuation. The 3-hr threshold used by PTWC is considered a conservative, but reasonable time criteria. Historically, the value is from a requirement from Hawaii State Emergency Management Agency as the time required to safely evacuate all coasts of the State of Hawaii.

6.1 SCENARIO A WARNING

• PURPOSE

To provide procedural guidance and action steps to be followed in responding to a PTWC issued Tsunami Threat Message that indicates ***Grenada as threatened and arrival times are within three hours.***

GENERAL

Pacific Tsunami Warning Center will issue a TSUNAMI THREAT MESSAGE depending on the initial earthquake parameters and the estimated travel times. If a TSUNAMI THREAT MESSAGE is issued, updates will be provided until a FINAL THEAT MESSAGE is issued. The updated threat messages will provide the tsunami heights for the areas under threat as well as expected time of arrival and observations. It is possible that a FINAL THEAT MESSAGE is issued shortly after the initial threat message with no updates or enhanced graphical products having been issued.

In the case of a tsunami threat, once the quantitative forecast is provided by PTWC the NTWC will issue an update which includes the forecasted tsunami height for Grenada. Based on this information the NTWC will update Warning, downgrade to an Advisory or issue a Cancellation.

If Grenada is included within the countries where there might be hazardous tsunami waves, a warning will be issued only if the estimated time of arrival (ETA) is 3 hours or under. The Tsunami warning alert will be indicated by the color **RED**.

- **ACTIONS CHECKLIST**

A TSUNAMI WARNING HAS BEEN ISSUED.

THIS IS AN URGENT TSUNAMI WARNING FOR all areas listed in the Vulnerable Location form. (see appendix B)

A local tsunami has been generated. Immediately Evacuate all beaches and all low lying coastal areas.

Move inland to higher ground; do not approach harbors until the tsunami all clear has been announced.

If your vessel is near the harbors move away from land to a location further out. Stay tuned for further information.

- i. NTWFP/ NTWC Duty Officer must review the message from the PTWC and learn if the tsunami is forecast to arrive at Grenada.
- ii. The NTWFP/ NTWC Duty Officer must identify the potential risk locations coordinates on the map provided for this purpose and available in their offices.
- iii. If the seismic event does not threaten the Grenada coastline then the NTWFP/ NTWC should continue to monitor information about the event, advise NaDMA and the Radio room of the Royal Grenada Police Force (NaDMA and the Royal Grenadian Police Force for the Initial Tsunami Alert Notification Group) about the message and the assessment that it will not impact Grenada but take no further action.

NTWFP/ NTWC Duty Officer must IMMEDIATELY:

A. Notify Royal Grenada Police Dispatch that a tsunami warning is being issued.

B. The following public alerting tools will be used in the vulnerable areas by the corresponding entities:

- Airport Siren
- Fire Station Sirens
- Police Sirens/Vehicle Loud Speakers
- Church Bells

C. NTWFP Duty Officer must contact the primary broadcast stations and provide the Tsunami Alert message.

D. NTWFP/TWCP Duty Officer reports to the NaDMA Director at the EOC to provide continuing assistance throughout the remainder of the alert.

See appendix C for contact information

6.2 SCENARIO B ADVISORY

PURPOSE

To provide procedural guidance and action steps to be followed in responding to a Pacific Tsunami Warning Center issued TSUNAMI THREAT MESSAGE due to a seismic event *to determine whether the Tsunami threat message identifies Grenada as threatened by dangerous, strong currents (not flooding).*

GENERAL

In Grenada an ADVISORY is issued when PTWC indicates that waves of .3 to 1 m could impact any location in Grenada within the next 3 hours. People should be advised to move out of the water, off the beaches and out of harbors and marinas. The color for this alert level is **ORANGE**.

ACTIONS CHECKLIST

NTWFP Duty Officer must review the message from the PTWC and learn if the tsunami is forecasted to arrive in Grenada, its Expected Time of Arrival, forecasted tsunami wave heights and the specific areas that are vulnerable.

For example of Tsunami Advisory see appendix A

Grenada's NTWFP Duty Officer will initiate dialogue with the PTWC to verify assessment of tsunami wave arrival time, potential size of wave, and verification of potential wave arrival sites. It is presumed that this should take no longer than 15 to 20 minutes. Following this discussion, Grenada's National NTWFP/TWCP Duty Officer should issue the Tsunami Advisory and proceed to remainder of the SOP.

NTWFP/TWCP Duty Officer must IMMEDIATELY:

- A. Advise NaDMA, Grenada Police Force and all the corresponding stakeholders about the message and the assessment
- B. The following public alerting tools will be used in the vulnerable areas by the corresponding entities:

Airport Siren

Fire Station Sirens

Police Sirens/Vehicle Loud Speakers

Church Bells

6.3 SCENARIO C WATCH

PURPOSE

To provide procedural guidance and action steps to be followed in responding to a Pacific Tsunami Warning Center issued TSUNAMI BULLETIN due to a seismic event that is distant from Grenada (travel time is greater than 3 hours) and local threat is under evaluation.

GENERAL

Pacific Tsunami Warning Center (PTWC) will issue a Tsunami Threat Statement when there is a tsunami threat to one or more countries in the CARIBE EWS.

In Grenada a WATCH product is issued if the ETA is greater than 3 hours, indicating the threat to local area is under evaluation. When a distant event occurs and is under investigation /evaluation. The color for this alert level is **YELLOW**.

ACTIONS CHECKLIST

NTWFP Duty Officer must review the message from the PTWC and learn if the tsunami is forecasted to arrive in Grenada, its Expected Time of Arrival, forecasted tsunami wave heights and the specific areas that are are vulnerable.

If the seismic event does not threaten the Grenada coastline then the NTWFP/TWCP should continue to monitor information about the event, advise NaDMA and the The Royal Grenadian Police Force (NaDMA and the Royal Grenadian Police Force for the Initial Tsunami Alert Notification Group) about the message and the assessment that it will not impact Grenada and to take no further action.

If the event threatens Grenada's coastline, the NTWFP Duty Officer should issue a Tsunami Watch. Grenada's NTWFP Duty Officer will initiate dialogue with the PTWC to verify assessment of tsunami wave arrival time, potential size of wave, and verification of potential wave arrival sites. It is presumed that this should take no longer than 15 to 20 minutes. Following this discussion, Grenada's National NTWFP/TWCP Duty Officer should update message, as required based on discussion of wave arrival sites and proceed to remainder of the SOP.

NTWFP/TWCP Duty Officer must IMMEDIATELY:

A. Advise NaDMA and all the corresponding stakeholders about the message and the assessment

6.4 SCENARIO D (NO EXPECTED TSUNAMI IMPACT)

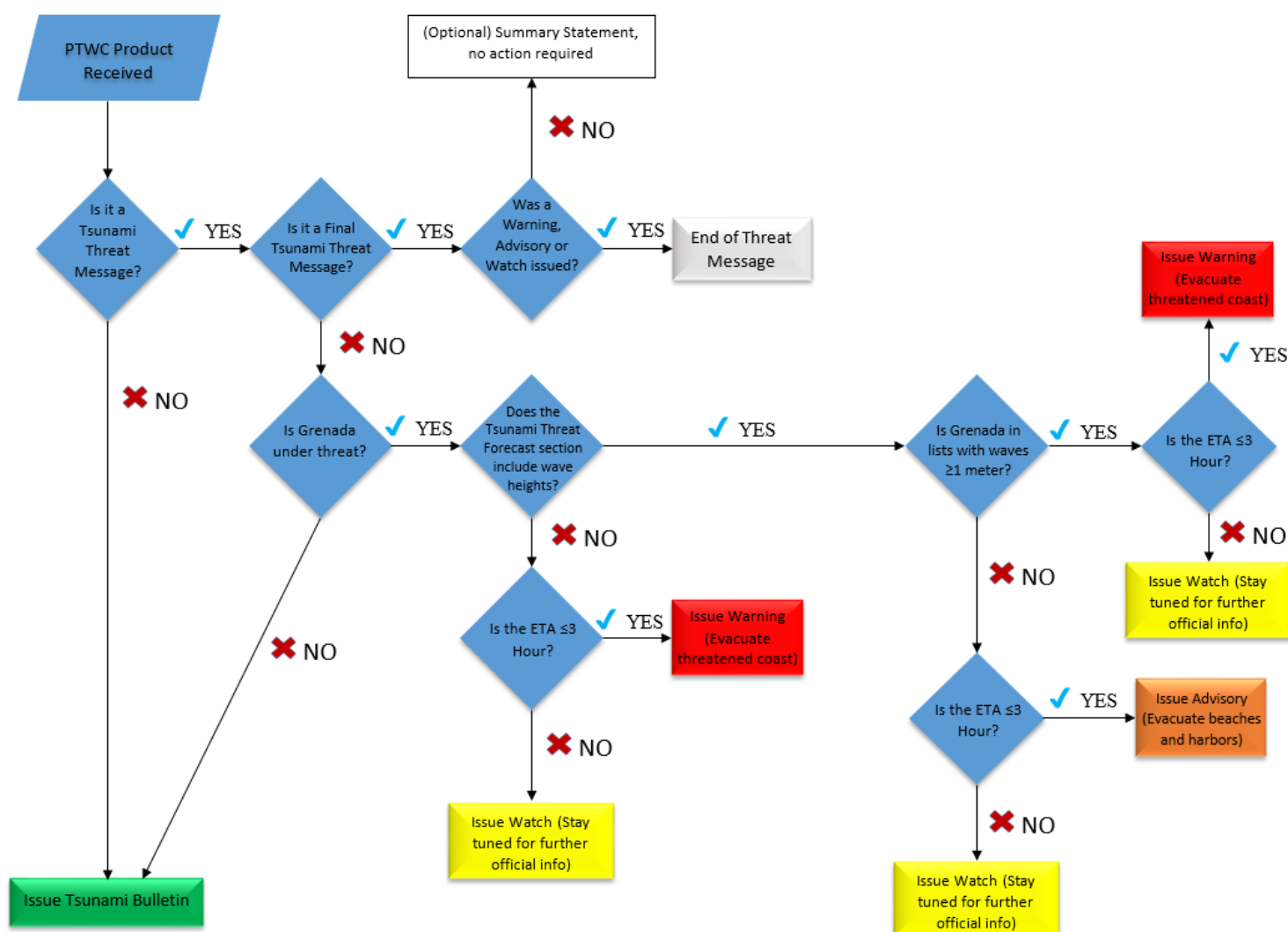
PURPOSE

To provide procedural guidance and action steps to be followed in responding to a Pacific Tsunami Warning Center (PTWC) issued TSUNAMI INFORMATION STATEMENT or TSUNAMI THREAT BULLETIN due to a local, regional or distant seismic event, but for which NO tsunami impact is expected for Grenada.

GENERAL

Pacific Tsunami Warning Center (PTWC) will issue a Tsunami Information Statement when an event occurs and it is understood there is NO tsunami threat anywhere in the CARIBE EWS region. When the PTWC issues a tsunami threat, some or all of the CARIBE EWS could be under threat. If PTWC issues an Information Statement or Grenada is not listed as a country under threat by the PTWC, the Grenada NTWC/TWFP will issue a Tsunami Bulletin indicated by the color **GREEN**

NTWFP Duty Officer must review the message from the PTWC, advise NaDMA and all the corresponding stakeholders about the message and the assessment that it will not impact Grenada but no other follow up is required.

FIGURE 2. GRENADA NTWFP STANDARD OPERATING PROCEDURES

7. TSUNAMI WARNING RESPONSIBILITY AGREEMENT DOCUMENT

The following is a form of document which outlines the responsibility of the NTWFP / NTWC to implement SOPs for Tsunami and Other Coastal Hazards Warnings. It can be used as a summary document to inform all government and non-government agencies and to obtain a formal sign off from the Prime Minister's Office for the activities.

Grenada NTWFP/ NTWC responsibility and function agreement

Grenada's NTWFP/ NTWC staff receives a TSUNAMI MESSAGE for the Caribbean and Adjacent Regions via, EMWIN, fax, telephones, or email advising about an event which has occurred somewhere in the Caribbean or Atlantic Oceans from the PTWC. The NTWFP/ NTWC Duty Officer will follow the Tsunami Warning SOP.

In the event of a strong local earthquake, a tsunami is forecasted for Grenada and/or a Tsunami Warning or Advisory for Grenada is issued:

1. All other NTWFP/ NTWC staff (non duty officers) will immediately and as safely as possible report to the Emergency Operating Center (EOC) in their area. If unable to SAFELY respond to the EOC, they will proceed to an alternate location (*Predetermined location*). NTWFP/ NTWC staff that are unable to respond to EOC should communicate their alternate location to the EOC.
2. NTWFP/ NTWC staff should be aware of evacuation routes, from residence to the EOC.

8. ADMINISTRATION AND SUPPORT

The NTWFP/ NTWC Duty Officer is responsible for maintaining a copy of the TSUNAMI PRODUCT/INFORMATION STATEMENT SOPs in the SOP Operations Manual. All NTWFP/ NTWC staff should be provided a copy.

The NTWFP/ NTWC will ensure that all staff are familiar with the SOP, that appropriate training about the SOP is conducted, and that all staff are drilled and prepared to respond quickly following receipt of a Tsunami product.

NaDMA in collaboration with NTWFP/ NTWC will ensure that all government agencies and non-government agencies are educated about the Tsunami Risk, Tsunami Response SOPs, and any and all related responsibilities required of these agencies.

The NTWFP/ NTWC consults with The Grenada National Disaster Management Agency (NaDMA) Director to discuss any changes in alert and notification equipment or procedures or status of equipment that might affect procedures for executing this SOP.

Recommendations for additions, deletions or modifications to the SOPs will be submitted to NTWFP/ NTWC for vetting. The final document should be submitted to cabinet for approval.

APPROVED: _____ DATE: _____

Appendix: A

Example of Messages to be Issued by NTWC

Sample Message Text Template: BULLETIN

Tsunami Message Number 1
Date and Time of Message Issuance
Grenada Meteorological Office

TSUNAMI BULLETIN

EVALUATION

An earthquake has occurred...but there is no tsunami threat to Grenada from this earthquake based on available data at this time.

PRELIMINARY EARTHQUAKE PARAMETERS

An earthquake has occurred with the following preliminary parameters reported by the Pacific Tsunami Warning Center.
< copy earthquake parameters from PTWC message. Convert UTC time to local time. >
Origin Time -
Coordinates -
Depth -
Location -
Magnitude -

RECOMMENDED ACTIONS

- No action is required.

NEXT UPDATE AND ADDITIONAL INFORMATION

- This will be the only message issued for this event unless new information indicates a change in threat status
- Authoritative information about this event can be found at XXX <web site>

Sample Message Text Template: WATCH

Tsunami Message Number <Insert Number of Message>
Date and Time of Message Issuance
Grenada Meteorological Services

A TSUNAMI WATCH IS IN EFFECT FOR ALL COASTAL AREAS OF GRENADA
Repeat
A TSUNAMI WATCH IS IN EFFECT FOR GRENADA

PRELIMINARY EARTHQUAKE PARAMETERS

An earthquake has occurred with the following preliminary parameters reported by the Pacific Tsunami Warning Center.
< copy earthquake parameters from PTWC message. Convert UTC time to local time. >
Origin Time -
Coordinates -
Depth -

Location -
Magnitude -

EVALUATION

A major earthquake has occurred which may have generated a destructive tsunami. The tsunami threat to Grenada is still under evaluation. If there is a tsunami threat then the earliest impacts would occur around <earliest ETA for country>. Appropriate action should be taken to prepare in case there is a threat. A decision regarding the threat will be made no later than <country decides this time based upon the minimum lead time needed for a beach or full evacuation>.

TSUNAMI THREAT FORECAST

< copy PTWC sections applicable to a country's coastal tsunami amplitude wave forecasts in meters above the tide level. View kmz file to determine if the threat is for all coasts or can be limited to certain sections of coast.>

ESTIMATED TIMES OF ARRIVAL

Estimated times of arrival (ETA) of the initial tsunami wave for points within threatened regions are given below. Actual arrival times may differ and the initial wave may not be the largest.

Location Region Coordinates ETA (local time)

< copy PTWC wave arrival time sections applicable to a country's coastline. Convert UTC time to local time. >

RECOMMENDED ACTIONS

- This message is issued as guidance to government agencies responsible for public safety alerts.
- Persons located in threatened coasts should stay alert for instructions from national and local authorities.

POTENTIAL IMPACTS

- A tsunami is a series of waves and the time between wave crests can vary between five minutes to one hour. The hazard may persist for many hours after initial wave arrival.
- The first wave may not be the largest.
- A coastal tsunami of only 1-meter amplitude above tide level can cause strong currents in a harbor, be dangerous to swimmers in the water and be hazardous to persons along inland waterways.
- Flooding impacts can vary significantly from one section of coast to the next due to local bathymetry and the shape and elevation of the shoreline.

TSUNAMI OBSERVATIONS

The following are tsunami wave observations from coastal and/or deep-ocean sea level gauges at the indicated locations. The maximum tsunami amplitude is measured with respect to normal tide level.

Gauge Location

Coordinates Time of Measure Max Tsunami Amplitude Wave Period

< copy PTWC tsunami observation section. >

NEXT UPDATE AND ADDITIONAL INFORMATION

- The next NTWC message will be issued hourly or sooner if the situation warrants.
- The Tsunami Watch will remain in effect until further notice.
- Authoritative information about this event can be found at XXX <web

site>

Sample Message Text Template: ADVISORY

Tsunami Message Number <Insert Number of Message>
Date and Time of Message Issuance
Grenada Meteorological Office

TSUNAMI THREAT MESSAGE
A TSUNAMI ADVISORY IS IN EFFECT FOR GRENADA

Repeat
A TSUNAMI ADVISORY IS IN EFFECT FOR GRENADA

PRELIMINARY EARTHQUAKE PARAMETERS
An earthquake has occurred with the following preliminary parameters reported by the Pacific Tsunami Warning Center.
< copy earthquake parameters from PTWC message. Convert UTC time to local time. >
Origin Time -
Coordinates -
Depth -
Location -
Magnitude -

EVALUATION
Based on all available data... There is a tsunami threat to Grenada of sea level fluctuations and strong ocean currents that could be a hazard along coasts... beaches... in harbors... and in coastal waters.

The earliest estimated time that hazardous sea level fluctuations and strong ocean currents may begin in Grenada is <insert time and date from PTWC bulletin>

Actions to protect human life... safety and property should be taken immediately.

Monitoring is underway to further evaluate the tsunami threat.

People may have experienced shaking from the earthquake.

TSUNAMI THREAT FORECAST
< copy PTWC sections applicable to a country's coastal tsunami amplitude wave forecasts in meters above the tide level. >

ESTIMATED TIMES OF ARRIVAL
Estimated times of arrival (ETA) of the initial tsunami wave for points within threatened regions are given below. Actual arrival times may differ and the initial wave may not be the largest.
Location Region Coordinates ETA (local time)
< copy PTWC wave arrival time sections applicable to a country's coastline. Convert UTC time to local time. >

RECOMMENDED ACTIONS
• This message is intended to trigger appropriate actions by <agencies responsible for carrying out evacuations, etc.> in accordance with their tsunami warning standard operating procedures.

- Persons located in or near threatened coasts should stay alert for instructions from national and local authorities.

POTENTIAL IMPACTS

- Impacts will vary at different locations within Grenada
- Sea level fluctuations that are generally less than 3 feet above and below the tide level.
- Waves and currents that can drown or injure people in the water.
- Waves and currents on beaches and in harbors, marinas, bays and inlets that may be especially dangerous.

TSUNAMI OBSERVATIONS

The following are tsunami wave observations from coastal and/or deep-ocean sea level gauges at the indicated locations. The maximum tsunami amplitude is measured with respect to normal tide level.

Gauge

Location Coordinates Time of Measure Max Tsunami Amplitude Wave Period

- < copy PTWC tsunami observation section. >

NEXT UPDATE AND ADDITIONAL INFORMATION

- The next NTWC message will be issued hourly or sooner if the situation warrants.
- The Tsunami Advisory will remain in effect until further notice.
- Authoritative information about this event can be found at XXX <web site>

Sample Message Text Template: WARNING

Tsunami Message Number <Insert Number of Message>

Date and Time of Message Issuance

Grenada Meteorological Office

TSUNAMI THREAT MESSAGE

A TSUNAMI WARNING IS IN EFFECT FOR GRENADA

Repeat

A TSUNAMI WARNING IS IN EFFECT FOR GRENADA

PRELIMINARY EARTHQUAKE PARAMETERS

An earthquake has occurred with the following preliminary parameters reported by the Pacific Tsunami Warning Center.

< copy earthquake parameters from PTWC message. Convert UTC time to local time. >

Origin Time -

Coordinates -

Depth -

Location -

Magnitude -

EVALUATION

A major earthquake has generated a tsunami that could be destructive to coasts in Grenada. The earliest estimated time that the first impacts may occur is <earliest ETA for your country from the PTWC bulletin, converted to local time>. Authorities and people should take appropriate action to save lives and reduce property damage for this threat.

TSUNAMI THREAT FORECAST

< copy PTWC sections applicable to a country's coastal tsunami amplitude wave forecasts in meters above the tide level. >

ESTIMATED TIMES OF ARRIVAL

Estimated times of arrival (ETA) of the initial tsunami wave for points within threatened regions are given below. Actual arrival times may differ and the initial wave may not be the largest.

Location Region Coordinates ETA (local time)

< copy PTWC wave arrival time sections applicable to a country's coastline. Convert UTC time to local time. >

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RECOMMENDED ACTIONS

- This message is intended to trigger appropriate actions by <agencies responsible for carrying out evacuations, etc.> in accordance with their tsunami warning standard operating procedures.
- Persons located in or near threatened coasts should stay alert for instructions from national and local authorities.

POTENTIAL IMPACTS

- A tsunami is a series of waves and the time between wave crests can vary between five minutes to one hour. The hazard may persist for many hours after initial wave arrival.
- The first wave may not be the largest.
- A coastal tsunami of only 1-meter amplitude above tide level can cause strong currents in a harbor, be dangerous to swimmers in the water and be hazardous to persons along inland waterways.
- Flooding impacts can vary significantly from one section of coast to the next due to local bathymetry and the shape and elevation of the shoreline.

TSUNAMI OBSERVATIONS

The following are tsunami wave observations from coastal and/or deep-ocean sea level gauges at the indicated locations. The maximum tsunami amplitude is measured with respect to normal tide level.

Gauge

Location Coordinates Time of Measure Max Tsunami Amplitude Wave Period

-
- *< copy PTWC tsunami observation section. >*

NEXT UPDATE AND ADDITIONAL INFORMATION

- The next NTWC message will be issued hourly or sooner if the situation warrants.
- The Tsunami Warning will remain in effect until further notice.
- Authoritative information about this event can be found at XXX <web site>

Sample Message Text Template: END OF THREAT MESSAGE

Tsunami Message Number <Insert Number of Message>
Date and Time of Message Issuance
Grenada Meteorological Office

END OF TSUNAMI THREAT MESSAGE
THE TSUNAMI WARNING, ADVISORY AND/OR WATCH IS CANCELLED FOR GRENADA
Repeat
THE TSUNAMI WARNING, ADVISORY AND/OR WATCH IS CANCELLED FOR GRENADA

EVALUATION

[after destructive tsunami waves]

Based on all available data, the destructive tsunami waves have now passed and there is no further threat. However, some coasts may still experience small sea level fluctuations lasting for several more hours.

[or, if cancelled before wave arrival]

Based on the analysis of additional data it has now been determined that there is no tsunami threat to Grenada and a warning is no longer warranted. However, some coasts may still experience small sea level changes beginning around <earliest ETA> and continuing for several hours.

[or, if cancelled because the waves arrived and were too small]

Based on measurements of the tsunami waves now impacting the coasts of <country> a tsunami warning is no longer warranted. However, some coasts may continue to experience small sea level changes for several more hours.

RECOMMENDED ACTIONS

- This message is issued as guidance to government agencies responsible for public safety alerts.
- Persons located in threatened coasts should stay alert for instructions from national and local authorities.

TSUNAMI OBSERVATIONS

The following are tsunami wave observations from coastal and/or deep-ocean sea level gauges at the indicated locations. The maximum tsunami amplitude is measured with respect to normal tide level.

Gauge Location

Coordinates Time of Measure Max Tsunami Amplitude Wave Period

< copy PTWC tsunami observation section. >

PRELIMINARY EARTHQUAKE PARAMETERS

An earthquake occurred with the following preliminary parameters reported by the Pacific Tsunami Warning Center.

< copy earthquake parameters from PTWC message. Convert UTC time to local time. >

Origin Time -

Coordinates -

Depth -

Location -

Magnitude -

NEXT UPDATE AND ADDITIONAL INFORMATION

- This will be the final NTWC message.
- Authoritative information about this event can be found at XXX <web site>

APPENDIX B

SMS TYPE MESSAGES (160 CHARACTERS) TO BE ISSUED BY NTWC FOR DIFFERENT ALERT LEVELS

WARNING

GRENADA MET OFFICE HAS ISSUED A TSUNAMI WARNING. DANGER OF COASTAL FLOODING. MOVE TO HIGHER GROUND NOW. KEEP AWAY FROM THE COAST UNTIL NADMA SAYS IT IS SAFE TO RETURN.

ADVISORY

GRENADA MET OFFICE HAS ISSUED A TSUNAMI ADVISORY. DANGER OF STRONG CURRENTS. GET OUT OF WATER, OFF BEACHES, OUT OF HARBORS/MARINAS UNTIL NADMA SAYS IT IS SAFE.

WATCH

GRENADA MET OFFICE HAS ISSUED A TSUNAMI WATCH. DISTANT EVENT HAS OCCURRED. LOCAL TSUNAMI THREAT UNDER EVALUATION. STAY TUNED FOR OFFICIAL UPDATES.

TSUNAMI BULLETIN

GRENADA MET OFFICE HAS ISSUED A TSUNAMI BULLETIN. AN EARTHQUAKE HAS OCCURRED. THERE IS CURRENTLY NO TSUNAMI THREAT. ALWAYS STAY TUNED FOR OFFICIAL MESSAGES.

Appendix: C

Directory of Emergency Numbers

Organization	Name	Numbers		Email Address
		Work	Mobile	
National Disaster Management Agency	Coordinator Sylvan McIntyre	440-8390	405-7451	Sylvamac.biz@gmail.com
Minister Responsible for Disaster Management	Dr. Winston Garraway	440-2255 440-3767	534-5105	chestusw@hotmail.com chestusw4@gmail.com
Mrs. Merina Jessamy	Permenant Secretary	440-2708		Merina.jessamy@Gov.gd
Meteorological Office	Manager Mr. Hubert Whyte	444-4141/2	534-5262	Hwhyte@mbiagrenada.com
Royal Grenada Police Force	ACP Jessmon Prince	440-3999 435-8557	407-3123	Jessmon2031@gmail.com
Fire Station	Glenroy Corion	440-3296 440-2112	405-3176	rgpffire@hotmail.com glencori@yahoo.com
General Hospital	Osbert Charles	440-2898 435-0974	418-1969	Oscharles47@gmail.com
Prince's Alice Hospital	Osbert Charles	442-7252	418-1969	
Prince's Royal Hospital	Osbert Charles	443-7169	418-1969	
Grenada Coast Guard	Watson Edwards	444-1931 444-1932	418-6061	Watsonedwards@yahoo.com rgpfcoastguard@soiceisle.com
National and Water and Sewage Authority	Joel Thomas	440-2155	409-9694	
Community Program Officer of the North	Simeon Granger	440-8390	440-6499	cponorth@nadma.gd
Community Program Officer of the South	Roxanne Bonaparte	440-8390	499-2336	cpo@nadma.gd
Grenada Red Cross	Director General Mr. Terry Charles	440-1483 440-1830	403-4824	grercs@spiceisle.com terrycharles grenada@yahoo.com
Commissioner Of Police	Edvin Martin	440-3296 440-2112	405-3176	rgpffire@spiceisle.com wjames@rgpf.gd
Ministry of Works Chief Technical Officer	Mr. John St. Louis	440-2271	417-3809	Johncst.louis@yahoo.com ministryofworks@gov.gd
Ministry of Social Development	Mrs. Chrissie Worme- Charles	440-2269 440-7952	418-0736	chrissieworme@yahoo.com
Government Information Services	Raul Titus	440-2061	434-5107	gisgrenada@yahoo.com
Chief Medical Officer	Dr. George Mitchell	440-4709	534-5331	mitgeorgw@gmail.com
Search and Recue	Insp. Watson Edwards	444-1931/2	418-6061 405-9064	Watson edwards@yahoo.com

Appendix: D

Glossary

Tsunami: Means harbour wave, also known as seismic sea wave (mistakenly called “tidal wave,”) is a series of potentially enormous waves created by an underwater disturbance such as an earthquake, landslide, and volcanic eruption, or meteorite. Earthquake-induced movement on the ocean floor most often generate tsunami. If a major earthquake or landslide occurs close to shore, the first wave in a series could reach the beach in a few minutes, even before a warning is issued. Areas are at greater risk if they less than 100feet above sea level and within a mile of the shoreline.

SOP: Standard Operating Procedure, is a set of step by step instructions compiled by an organization to help workers carry out routine operation.

MOU: Memorandum of understanding, is an agreement between two or more parties outlining the terms and details of an understanding.

PTWC: Pacific Tsunami Warning Center, is one of two tsunami warning centers that are operated by NOAA in the United States. It is located in Hawaii. It has been designated as Tsunami Service Provider for the CARIBE EWS.

CARIBE EWS: UNESCO IOC Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions

NTWC: National Tsunami Warning Center. A centre officially designated by the government to monitor and issue tsunami warnings and other related statements within their country according to established national Standard Operating Procedures. For Grenada the NTWC is Grenada Meteorological Office.

NTWFP: National Tsunami Warning Focal Point, it is a 24*7 point of contact officially designated by the national Tsunami warning center or the government to receive and disseminate tsunami information from an intergovernmental coordination group according to established National Standard Operating procedures. For Grenada the NTWFP is Grenada Meteorological Office

EOC: Emergency Operating Center: is a central command and control facility responsible for carrying out the principles of emergency preparedness and emergency management, or disaster management functions at a strategic level before, during and after an emergency.

NaDMA: National Disaster Management Agency, this is the agency responsible for comprehensive disaster management in Grenada.

Appendix E

Notes

Serial	Date	Amendments	Signature