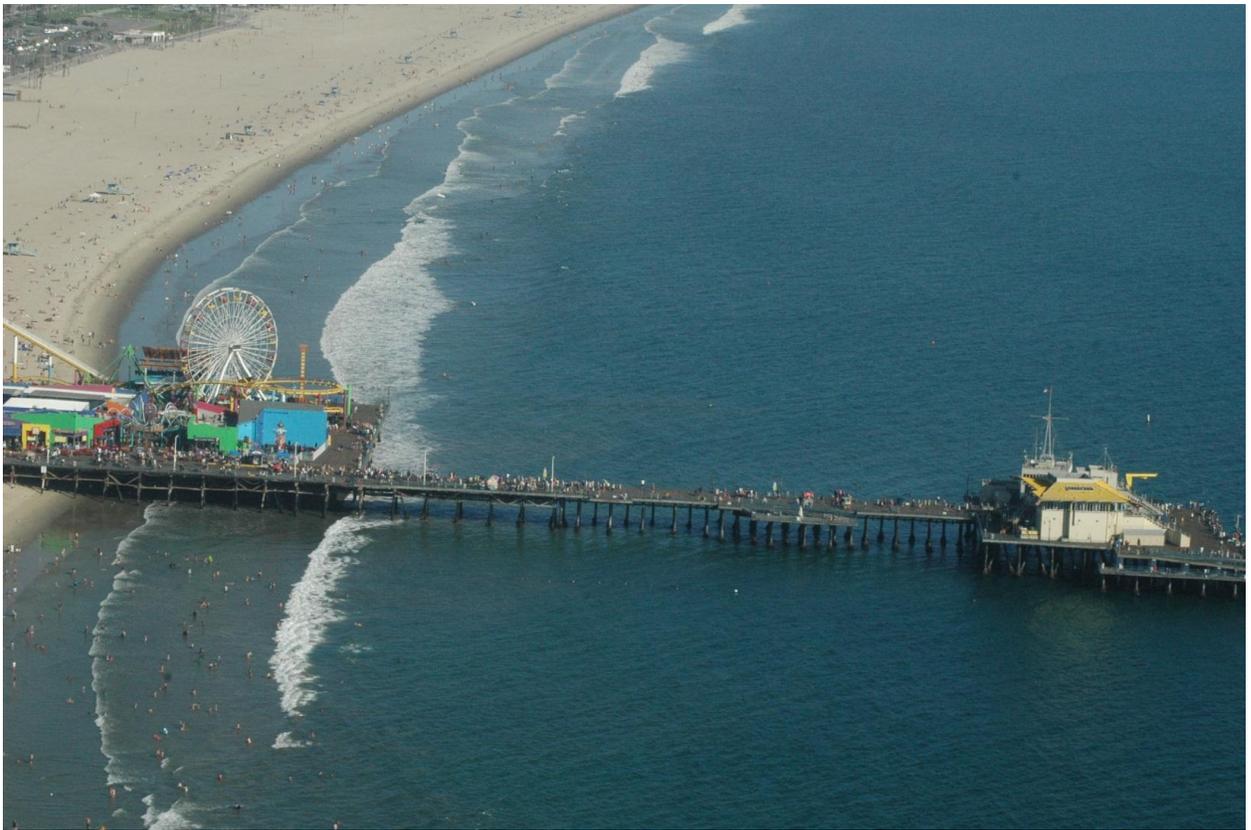


City of Santa Monica Tsunami Response Plan



Office of Emergency Management



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City of Santa Monica

Tsunami Emergency Response Plan

What is a Tsunami?

A tsunami is a system of gravity waves formed in the sea as a result of a large-scale disturbance of sea level over a short duration of time. A tsunami can be generated by submarine volcanic eruptions, by displacement of submarine sediments, by coastal landslides into a bay or harbor, by meteor impact, or by vertical displacement of the earth's crust along a subduction zone/fault. The latter is by far the most frequent cause of tsunami and for all practical purposes the primary cause of tsunami capable of propagation across an ocean basin. The rupture of the earth's crust will also generate a major earthquake that will be detected and measured by seismic instrumentation throughout the world. However, not all major coastal or near-coastal earthquakes produce tsunami. At present, there is no operational method to determine if a tsunami has been generated except to note the occurrence and epicenter of the earthquake and then detect the arrival of the characteristic waves at a network of tide stations.

Types of Tsunamis:

Near Source Tsunami

A near source, or a locally generated tsunami, such as the occurrences in Japan in 2011 and Sumatra in 2005 are possible at many points along the California Coast. These occur if a large earthquake displaces the sea floor near the coast; the first waves may reach the coast within minutes after the ground shaking stops. There is no time for authorities to issue a warning. People on the beach or in low coastal areas need to be aware of the tsunami risk and be prepared to move to higher ground as soon as they are able after a strong earthquake and stay there until told by an official source that the danger is passed.

Distance Source Tsunami

Distant source, or regional/pacific wide, tsunami may be generated by very large earthquakes in other areas of the Pacific Ocean and may reach our coastline many hours after the earthquake occurred. Tsunami Warning Centers are responsible for gathering information on earthquakes which may generate tsunami and alerting state and local officials who may order evacuation. The Japan earthquake in 2011 created a "Distant Source Tsunami" warning for areas outside of the earthquake impact area, including the West Coast of the United States.

EMERGENCY STATUS:

Sequence of Operational Activities

Tsunami Warning: A Tsunami Warning is issued when a potential tsunami with significant widespread inundation is imminent or expected. Warnings alert the public that widespread, dangerous coastal flooding accompanied by powerful currents is possible and may continue for several hours after arrival of the initial wave. Warnings also alert emergency management officials to take action for the entire tsunami hazard zone. Appropriate actions to be taken by local officials may include the evacuation of low-lying coastal areas when there is time to safely do so. A local tsunami requires immediate self-evacuation possibly through areas damaged by earthquake and at risk of after-shocks. Distant events may allow several hours to implement emergency procedures and evacuation. Evacuation routes must take into account potential earthquake damage. In the event of a Tsunami Warning, Los Angeles County will use the Emergency Alert System (EAS) to warn the public about an anticipated tsunami.

The City of Santa Monica will utilize all means of communications to inform the community of an impending tsunami event.

Primary means of notification will include:

- Utilization of the City of Santa Monica's Alert and Notification system, SM Alerts. SM Alerts has pre-loaded the contact information for those located in the designated tsunami inundation zone, and those who have opted-in to receive emergency notifications, and is capable of disseminating thousands of notifications in a short period of time.
- Deployment of all available City vehicles with public address systems, bullhorns, and sirens to notify those located within the designated tsunami inundation zone. Door to door notifications by public safety personnel may also be conducted.
- Coordinated public information notification Citywide, utilizing local and regional media, City TV Channel 16, AM Radio KRS 1680, and Social Media.

Tsunami Advisory: A Tsunami Advisory is issued due to the threat of a potential tsunami, which may produce strong currents or waves dangerous to those in or near the water. Coastal regions historically prone to damage due to strong currents induced by tsunamis are at the greatest risk. The threat may continue for several hours after the arrival of the initial wave, but significant widespread inundation is not expected for areas under an advisory. Appropriate actions to be taken by local officials may include evacuations and closing of beaches.

Tsunami Watch: A Tsunami Watch is issued to alert City officials and the public of an event that may later impact the Watch area. The Watch area may be upgraded to a Warning or Advisory - or canceled - based on updated information and analysis. Therefore, emergency management officials and the public should prepare to take action. Watches are normally issued based on seismic information without confirmation that a destructive tsunami is underway.

Tsunami Messages: Alert Types



Damage Assessment Phase: The Public Works Department will serve as the lead for damage assessment and will be the representative for all utilities concerns. Additionally, the Building and Safety Division of the Planning and Community Development Department will work closely with the Police, Fire, and Public Works Departments to quickly and accurately evaluate impacted areas. Activities include reconnaissance of public infrastructure, alternate route identification, building access, utility access rerouting, and temporary repairs.

Recovery:

Re-Entry

- A tsunami may cause damage to buildings and roads. During the transition into the recovery phase, structure, roads, utilities, and other infrastructure must be inspected to ensure that they are safe for public reentry. This function may require using both City personnel and private sector resources.

Demobilization

- When the response phase of the incident transitions into the recovery phase, the demobilization stage can begin. Internal and external response partners can begin to be released and agencies can return to their normal working roles as soon as practical.

Restoration

- Restoration to impacted areas can be a long process following the potentially damaging effects of a tsunami. Local resources may be exhausted and additional assistance from other public and private partners may be needed.

It is important to consider the following issues during the cleanup and recovery phase.

- Cleanup of debris on public property, the beach, and repair of City infrastructure such as streets and utilities.
- Hazardous materials specialists may be needed to assist in cleanup efforts.
- Health services may be needed to assist with water purification, inoculations, and sanitation.
- Safe refuge and shelter sites may be required to house people affected by the tsunami.

Public Disaster Assistance

The City of Santa Monica will coordinate with county, state, and federal officials in locating and operating a Disaster Assistance Center if needed. The Disaster Assistance Centers will provide:

- Emergency family and individuals housing and financial relief information and services;
- Disaster loans to individuals and businesses when appropriate;
- Temporary housing assistance;
- Crisis counseling.

After Action Reporting and Documentation: All involved City Departments will be required to provide a report and log of actions taken during the tsunami response and recovery efforts. The After Action Report will be collected and finalized by the Office of Emergency Management.

The After Action Report will contain the names of agency personnel involved in particular assignments, describe responsibilities, duties performed, detailed accounts of staff hours, material utilized, any contracts with private vendors to support the emergency operations, and other pertinent information.

This After Action Report will become part of the official record of the City's involvement in the response and recovery operations.

Emergency Public Information (all phases): The Office of Emergency Management is responsible for developing all public information related to a potential or imminent tsunami event. The City of Santa Monica has a pre-established Public Information Team comprised of staff from all City departments. This group will assist in the dissemination of all event related public information. The team will utilize SM Alerts, City T.V., local media, department specific email contacts, the City's website, and other forms of media.

People who live or work in the projected tsunami inundation zone can register for SM Alerts to receive information updates and notifications of potential tsunami alerts, watches, or warnings by landline telephone, cellular phone, email, and text message. Those who do not register with the City of Santa Monica's notification system will be notified by landline telephone only.

As part of the Office of Emergency Management's ongoing disaster preparedness public education efforts, tsunami preparedness is a primary focus of hazard mitigation community awareness. Tsunami preparedness information for Santa Monica is available from the Office of Emergency Management and can be found on the OEM website (www.smgov.net/oem).

Planning Assumptions:

Based on current scientific and disaster planning information, the majority of Santa Monica is well protected from the devastating effects witnessed in other parts of the world. The height of the bluffs north of the Santa Monica Pier and the distance between the ocean and development south of the Santa Monica Pier provides Santa Monica with a natural, geologic buffer from significant impacts of a tsunami. The identified inundation zone for Santa Monica has been developed in an abundance of caution with the most current scientific and geologic data available. The expected “worst case” scenario of a tsunami in Santa Monica would likely result in damage to the homes and businesses north of the Santa Monica Pier, below the bluffs. All areas above the bluffs in Santa Monica are not expected to be impacted by the effects of a tsunami due to the height of the bluffs. South of the Santa Monica Pier, experts with the National Weather Services, National Oceanic and Atmospheric Administration (NOAA), California Geological Survey, California Emergency Management Agency (Cal EMA) and University of Southern California (USC), state that there could be “ankle deep water on Main Street south of Pico Blvd”. The City of Santa Monica evacuation plans would extend up to 4th street to ensure protection of life and property.

If a near or far source tsunami were to impact Santa Monica, the following assumptions can be made:

- The activation of the city Emergency Operations Center (EOC).
- There may be loss of life
- There may be significant property damage.
- Large-scale evacuations may be necessary causing otherwise non-impacted jurisdictions to become a host for displaced populations.
- Transportation and evacuation routes may be damaged /disrupted.
- Power outages may occur and communication systems may be damaged.
- Economic losses to impacted businesses may occur during the response and recovery phases of a tsunami event.
- Losses to the tourist industry.
- Significant damage to the Santa Monica Pier.
- Releases of toxic pollutants due to the damage of the Santa Monica's Urban Runoff Recycling Facility.
- Impact to the City of Santa Monica Annenberg Public Beach House located at 415 Pacific Coast Highway

City of Santa Monica Responsibilities:

Tsunami Warning: Reports from responsible authority indicate that TSUNAMI INUNDATION IS IMMINENT OR HAS OCCURRED. The primary concern of the City of Santa Monica is the rescue of victims, saving lives, and protecting property.

- Verify the situation with Sheriff's department or County EOC.
- Make emergency notifications to the public.
- Alert City emergency response staff.
- Alert City Council.
- Declare a State of Emergency.
- Implement evacuation plan.
- Move available City resources to pre-designated higher ground.
- Establish on-going communications with County via OARRS.
- Activate the City EOC at the direction of the City Manager, Police Chief, Fire Chief, or Director of Public Works to help manage the emergency.
- Ensure safety & logistical support for City staff.
- Send a representative to Unified Command Post as a Liaison.
- Anticipate and provide for Mutual Aid requirements.
- Begin planning for the Recovery phase.
- Continue public notifications.

Tsunami Advisory: Reports from responsible authority indicate a TSUNAMI ADVISORY HAS BEEN ISSUED.

- Verify the situation, and anticipated arrival.
- Alert City emergency response staff.
- Alert City Council.
- Make preliminary "Advisory" notifications to the public.
- Monitor media for confirmation of arrival.
- Move available City resources to pre-designated higher ground.
- The City EOC may be activated at the direction of the City Manager, Police Chief, Fire Chief, or Director of Public Works to help manage the emergency.

Tsunami Watch/ Warning/ Alert Cancellation:

- Notify staff members and Council.
- Make necessary public notifications.
- Ensure documentation of all actions taken, for future reference.
- Return all resources that were relocated to their original locations.

Tsunami Response Plan Execution:

In addition to their normal responsibilities, City Departments and agencies are responsible for the following specific actions as part of the Tsunami Response Plan:

- Plan development and maintenance - Office of Emergency Management.
- Managing emergency operations - Office of Emergency Management.
- Coordination with the Operational Area - Office of Emergency Management.
- Evacuation planning - Santa Monica Police Department.
- Initial recovery planning - Office of Emergency Management.
- Reports to the City Council - Office of Emergency Management.
- Alert and notify the public - Santa Monica Police Department / Office of Emergency Management / Public Information Team.
- Assessing damage to City facilities - Public Works Department.
- Evacuation transportation - Big Blue Bus.
- Coordination with utilities - Public Works Department.
- Coordination with County Public Health on health impacts - Santa Monica Fire Department.
- Coordination with the Red Cross on sheltering needs - Office of Emergency Management / Community and Cultural Services.

Initial EOC Action Plan:

Implementation of this Plan will be directed by the City Manager, Fire Chief, Police Chief, or Director of Public Works.

RESPONSIBILITIES: In addition to their normal responsibilities, City Departments are responsible for the following specific actions:

EOC Director (City Manager or Designee):

- Reports to the City Council.
- Implementing overall response and recovery procedures for the City of Santa Monica.

Office of Emergency Management:

- Plan development and maintenance.
- Emergency Operations Center (EOC) coordination and activation.
- Activating the Emergency Alert and Notification System.
- Public information prior to and during a tsunami event.
- Policy / decision making.

Operations Section in the EOC:

- Managing emergency operations.
- Coordination with the Operational Area.
- Implementing emergency notifications and evacuations.
- Assessing damage to City facilities.
- Coordinating evacuation transportation needs.
- Coordination with utility companies.
- Coordination with County Public Health on health impacts.
- Coordination with the Red Cross on sheltering needs.

Planning and Intelligence Section in the EOC:

- Evacuation planning.
- Initial recovery planning.
- Documentation of all policies, decisions, resource requests, and other information.
- Developing the Incident Action Plan.
- Developing the Demobilization Plan.
- Developing the After Action Plan.

Logistics Section in the EOC:

- Manage requests for tsunami-related goods and services.
- Procurement assistance and mutual aid assistance can be provided by the County Operational Area, for issues that cannot be resolved through normal means.

Finance Section in the EOC:

- The Finance Department will establish guidelines for identifying emergency-related expenditures for city departments
- The Finance Department will process tsunami-related purchases of goods and services by city departments. Procurement assistance can be provided by the County EOC for life safety issues that cannot be resolved through normal means.
- Reports - Upon execution of this plan, the EOC will provide updated situation status reports to the Los Angeles County Operational Area, Office of Emergency Management.

Existing Mitigation Activities:

The City of Santa Monica has implemented a number of tsunami mitigation activities.

These include:

- Tsunami Response and Evacuation Plan.
- SM Alerts, the City's Alert and Notification System for internal and external partners.
- Tsunami inundation zone and evacuation route signage postings.
- Ongoing public education and outreach regarding tsunami preparedness.
- Use media sources, television, radio, web and social media, to promote public awareness and education.

Evacuation Routes:

In the development of the Tsunami Response Plan, the following primary and alternate evacuation routes have been identified:

Primary Evacuation Routes include:

- Santa Monica Freeway
- Colorado Boulevard
- Pico Boulevard
- Ocean Park Boulevard
- Marine Street

Alternate Evacuation Routes include:

- Ashland Avenue
- Bay Street
- Bicknell Street
- Hill Street
- Pacific Street
- Strand Street

Safe Refuge Sites:

- Santa Monica High School 615 Pico Boulevard
- Olympic High School 721 Ocean Park Boulevard
- Roosevelt Elementary School 801 Montana Avenue
- Washington Preschool 2802 Fourth Street

City Facilities in the Inundation Zone:

City facilities located in the inundation zone are the Santa Monica Pier, Beach Maintenance, Santa Monica Urban Runoff Recycling Facility and the Annenberg Community Beach House. An attempt to contact City staff and visitors at these facilities will be made by public safety officials. In the event of a tsunami, City staff should not wait for in-person notification to receive evacuation procedures.

Tsunami Signage & Maps



Tsunami Hazard Zone Notification

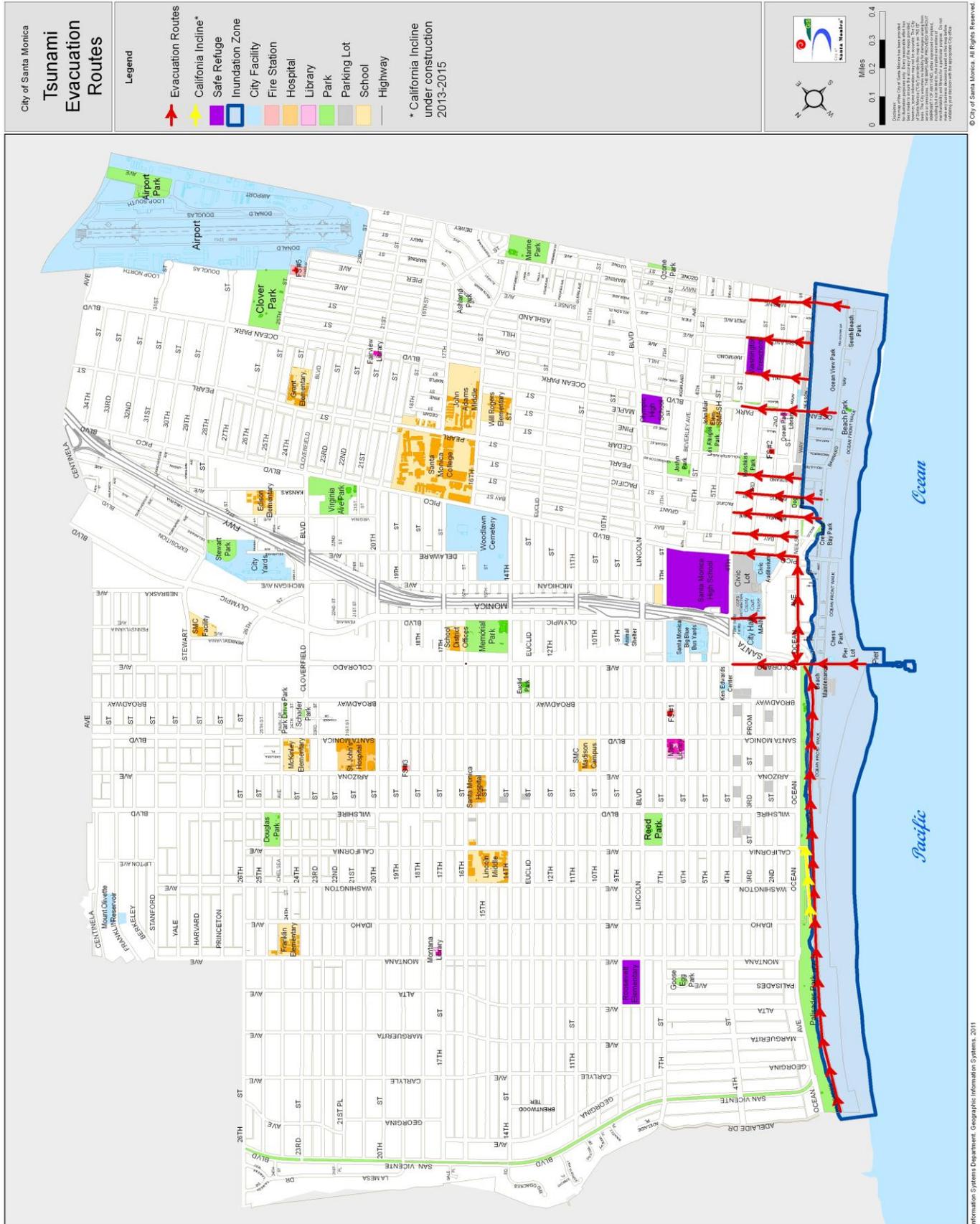


Tsunami Evacuation Route

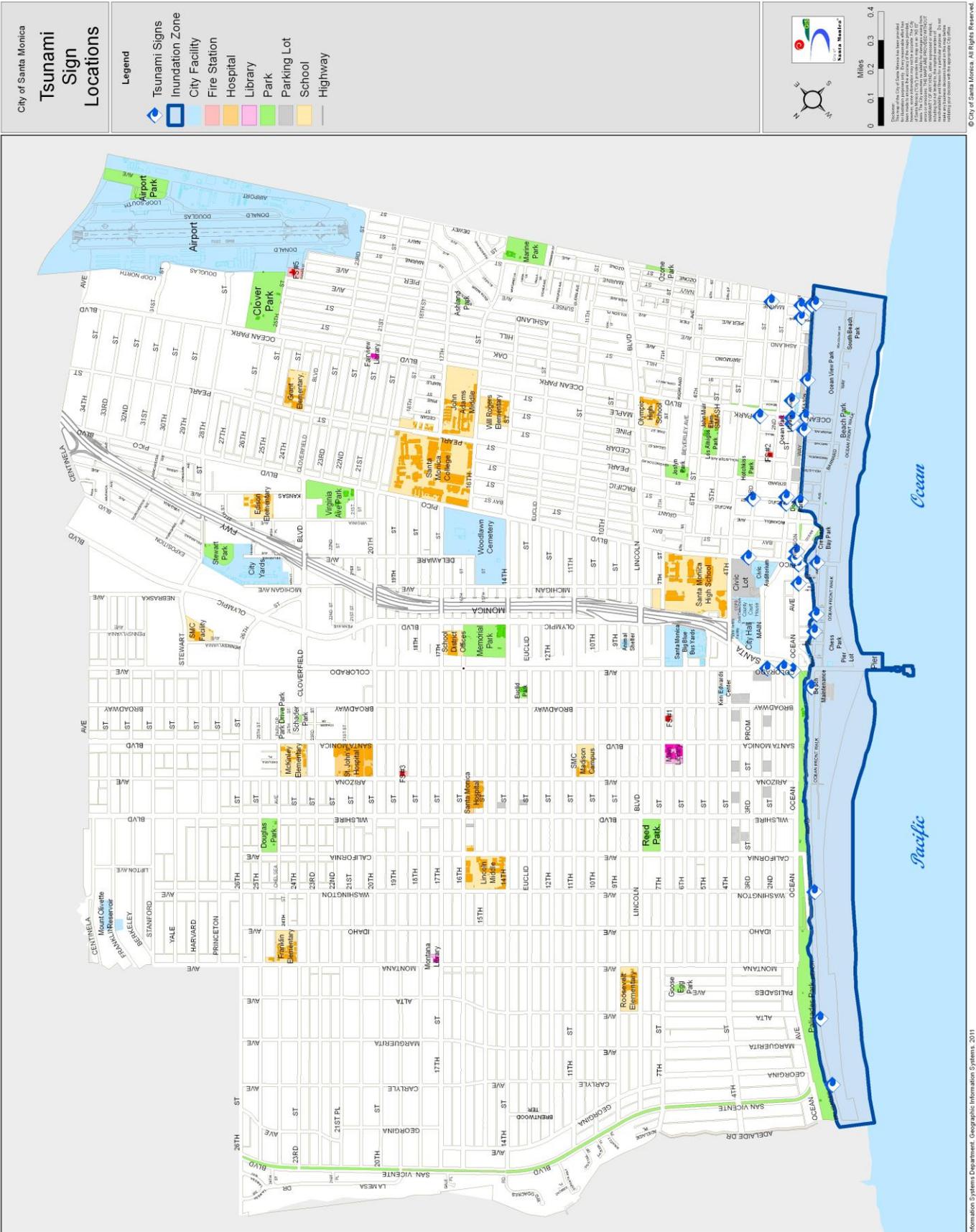


Indicates Tsunami Evacuation Route Direction

City of Santa Monica Tsunami Response Plan



City of Santa Monica Tsunami Response Plan



Public Education & Outreach

As part of the Tsunami Response Plan, the Office of Emergency Management will implement a comprehensive public education and outreach program. The program will incorporate printed material, internet information on the City and OEM homepages, public service announcements and messages on City TV, information provided to local print and online media outlets, and a series of community based education and information meetings with those who live and work in Santa Monica. The community meetings will include the dissemination of the following printed materials:

1. "How to survive a Tsunami" brochure (includes inundation zone and evacuation map)
2. SM Alerts informational flyer
3. Other emergency preparedness materials created by the Office of Emergency Management

Additionally, a significant part of the public education and outreach efforts are the posting of the tsunami hazard and tsunami evacuations signs in the inundation zone. The signage is a constant reminder for those who live, work and visit the inundation zone of the threat of a tsunami, prompting them to seek additional information.

IF YOU FEEL A STRONG EARTHQUAKE WHILE NEAR THE COAST:

1. PROTECT yourself during the earthquake



- If indoors, DROP under a sturdy table or object, COVER your head and neck and HOLD ON.
- If outdoors, move to a clear area if you can safely do so - away from trees, beach cliffs, signs and other hazards - and drop* to the ground.
- * If you have mobility impairments that prevent you from getting up on your own, do not drop to the ground but do cover your head and neck and hold on.

2. MOVE to high ground

- As soon as it is safe to move, go to higher ground.
- Avoid downed power lines and weakened over passes.
- If you are outside of a tsunami hazard zone, stay where you are.



3. STAY there

- Remain on high ground. Waves from a tsunami may arrive for eight hours or longer.
- Return to the coast only when officials have announced that it is safe to do so.



THINGS YOU SHOULD KNOW ABOUT TSUNAMIS

- A tsunami is a series of waves or surges most commonly caused by an earthquake beneath the sea floor.
- An unusual lowering of ocean water, exposing the sea floor, is a warning of a tsunami or other large wave. This "draw back" means the water will surge back strongly.
- Tsunami waves are unlike normal coastal waves. Tsunamis are more like a river in flood or a sloping mountain of water and filled with debris.
- Tsunamis cannot be surfed. They have no face and are usually filled with debris.
- Large tsunamis may reach heights of twenty to fifty feet along the coast. The first tsunami surge is not the highest and the largest surge may occur hours after the first wave. It is not possible to predict how many surges or how much time will elapse between waves.

ADDITIONAL RESOURCES

FEMA's emergency preparedness information site:
www.Ready.gov
About tsunamis:
<http://wcatwc.arh.noaa.gov>
Identifying natural hazards in your neighborhood
www.calema.ca.gov
Preparing for earthquakes and tsunamis:
www.earthquakecountry.org
The California Geological Survey
www.consrv.ca.gov/cgs
LA County Office of Emergency Services
<http://lacoa.org>

How to Survive a Tsunami



City of Santa Monica Tsunami Response Plan

TWO WAYS TO FIND OUT IF A TSUNAMI MAY BE COMING

1. NATURAL WARNING

Strong ground shaking, a loud ocean roar, or the water receding unusually far exposing the sea floor are all nature's warnings that a tsunami may be coming. If you observe any of these warning signs, immediately go to higher ground or inland. A tsunami may arrive within minutes and may last for eight hours or longer. Stay away from coastal areas until officials announce that it is safe to return.



2. OFFICIAL WARNING

You may hear that a Tsunami Warning has been issued. Tsunami Warnings might come via radio, television, telephone, text message, door-to-door contact by emergency responders, or NOAA weather radios. Move away from the beach and seek more information on local radio or television stations. Register with the city's alert notification system, SM Alerts, to receive emergency updates via phone, email or text message.

WHEN SHOULD I EVACUATE?

Evacuation should not be automatic. Before evacuating you should determine if you are in a hazard zone and consider possible hazards that may exist along your evacuation route.

- Know if you live, work, or play in a tsunami hazard zone.
- COUNT how long the earthquake lasts. If you feel more than 20 seconds of very strong ground shaking and are in a tsunami hazard zone, evacuate as soon as it is safe to do so.
- GO ON FOOT. Roads and bridges may be damaged.
- Avoid downed power lines.
- If you hear that a tsunami warning has been issued but did not feel an earthquake, get more information. Listen to the radio, television or other information sources and follow the instructions of emergency personnel.

WHERE SHOULD I GO?

Coastal areas contain signage that will show you what areas are safe and what areas may be at risk. Use them to guide you to a safe area.



PREPARE NOW

How you prepare will affect how you recover. Being prepared for earthquakes and tsunamis prepares you for all kinds of disasters.

- Know if you live, work, or play in a tsunami hazard zone.
- Learn what the recommended tsunami evacuation routes are in your city. Identify safety zone(s) near you, and decide on your primary and secondary evacuation routes.
- If you live or work in a tsunami hazard zone get a NOAA weather radio with the public alert feature for your home and office. It will alert you even if turned off.
- Assemble a small evacuation kit with essential documents, medications, a flashlight, a portable NOAA weather radio and batteries, water, snacks and warm clothes. Keep your evacuation kit by the door so you can 'grab & go'.
- Walk your route – consider what you would do at night or in stormy weather.
- Make a reunification plan with your loved ones. Decide when and where you will meet if you are separated.
- Make plans for how to address any functional needs or disabilities you might have. If you need help evacuating, prearrange assistance from neighbors including transport of mobility devices and durable medical equipment. If you are mobility impaired, account for the extra time that you may need.
- Decide on the best strategy for protecting your pets.
- If you live in the tsunami hazard zone, sign up for SM Alerts now. In the case of a tsunami, you will receive up to date information and instructions.



California Incline under construction 2013 – 2015

Being prepared for emergencies is as easy as 1-2-3...

SIGN UP FOR SM ALERTS

HAVE A PLAN

GET A KIT!

Visit the Office of Emergency Management at www.smgov.net/OEM and be ready!

OEM
CITY OF SANTA MONICA
OFFICE OF EMERGENCY MANAGEMENT

Sign up | Stay Informed! A new service from the City of Santa Monica.



**SIGN UP FOR
SM ALERTS**

SMAlerts.net

Visit SMAlerts.net or scan the QR code to sign up!

In the event of an emergency, get important text, email or voice messages sent to your mobile phone, your work email, your home or anywhere you need to receive important safety messages. It's easy and free.

Your information will not be shared outside of the SM Alerts system.
For more information, visit SMAlerts.net
or call the Office of Emergency Management at 310.458.2263.



Register for Community Updates, too. Details when you sign up!

Background Information:

General Situation: The Threat

Recent tsunami events around the world serve as a reminder of the need for an effective tsunami response plan. Tsunamis, though infrequent in the State of California, are highly dangerous and can potentially cause the loss of life and property damage. California is at risk of tsunami damage from events that happen within a few minutes of warning or several hours of warning. In Santa Monica, the identified tsunami inundation zone (see Tsunami Inundation Zone Map, pg.16) could potentially be at risk.

The tsunami inundation zone in Santa Monica has been identified as:

1. All beaches;
2. The area north of the Santa Monica Pier below the Bluffs (including Palisades Beach Road and the Annenberg Beach House) to the northern border of the City;
3. South of the Pier, all areas east up to 4th street, and south to the Venice border.

The majority of Santa Monica is well protected from the devastating effects witnessed in other parts of the world. The height of the bluffs north of the Santa Monica Pier and the distance between the ocean and development south of the Santa Monica Pier provides Santa Monica with a natural, geologic buffer from significant impacts of a tsunami. The identified inundation zone for Santa Monica has been developed in an abundance of caution with the most current scientific and geologic data available. The expected “worst case” scenario of a tsunami in Santa Monica would likely result in damage to the homes and businesses north of the Santa Monica Pier, below the bluffs. All areas above the bluffs in Santa Monica are not expected to be impacted by the effects of a tsunami due to the height of the bluffs. South of the Santa Monica Pier, experts state that there could be “ankle deep water on Main Street south of Pico Blvd”. The City of Santa Monica evacuation plans would extend up to 4th street to ensure protection of life and property.

Federal, State and County response:

In 1994, the United States Senate Appropriations Committee directed the National Oceanic and Atmospheric Administration (NOAA) to formulate a plan for reducing tsunami risks to the nation’s coastal residents. Subsequent studies have indicated the potential for a local or distant source tsunami affecting the pacific shoreline states. Subsequent studies and workshops sponsored or supported by NOAA, the Federal Emergency Management Agency, and the Governor’s Office of Emergency Services have raised the consciousness of public disaster services agencies, and led to the development of tsunami action plans in some of the most endangered localities.

City of Santa Monica
Tsunami Response Plan

The County Board of Supervisors has recognized the criticality of the tsunami threat and has directed the preparation of a County Operational Area Tsunami Emergency Response Plan.

Given the above conditions, and the recent activities of Federal, State and County agencies in defining the issues, a tsunami element would be a prudent addition to the city's overall disaster planning efforts. Integration of a tsunami element into existing emergency plans will provide for coordinated and supported activities, resource allocations, a strong foundation of expertise, and contain any additional elements necessary to create appropriate preparation and response.

Frequently Asked Questions

What is a tsunami?

- A tsunami is a series of waves with a long wavelength and period (time between crests) generated by a large, impulsive displacement of sea water.
- Time between crests of the wave can vary from a few minutes to over an hour, but generally are in the range of 15 to 30 minutes.
- Tsunamis are often incorrectly called tidal waves; they have no relation to the daily ocean tides.

How are tsunamis generated?

- Tsunamis are generated by any large, impulsive displacement of the sea level.
- The most common cause of a tsunami is sea floor uplift associated with an earthquake.
- Tsunamis are also triggered by landslides into or under the water surface, and can be generated by volcanic activity and meteorite impacts.

How often do tsunamis occur?

- On the average, two tsunamis occur per year throughout the world which inflicts damage near the source.
- Approximately every 15 years a destructive, ocean-wide tsunami occurs.

Can strike-slip (horizontal motion) earthquakes trigger tsunamis?

- Yes, approximately 10-15% of damaging tsunamis are triggered by strike-slip earthquakes.
- This type of earthquake is less likely to trigger a tsunami than one with vertical motion.
- The waves are likely generated by associated landslides or motion of a sloping bathymetric feature.
- Tsunamis generated by strike-slip earthquakes normally affect regions near the source only.

What does the word "tsunami" mean?

- Tsunami (soo-NAH-mee) is a Japanese word meaning harbor wave.

How fast do tsunamis travel?

- Tsunami velocity depends on the depth of water through which it travels
- Tsunamis travel approximately 475 mph in 15,000 feet of water. In 100 feet of water the velocity drops to about 40 mph.

How big is a tsunami?

- Tsunamis range in size from inches to over a hundred feet.
- In deep water (greater than 600 feet), tsunamis are rarely over 3 feet and are not normally noticed by ships due to their long period (time between crests).

- As tsunamis propagate into shallow water, the wave height can increase by over 10 times.
- Tsunami heights vary greatly along a coast. The waves can be amplified by shoreline and bathymetric (sea floor) features.
- A large tsunami can flood low-lying coastal land over a mile from the coast.

What does a tsunami look like when it reaches shore?

- Normally, a tsunami appears as a rapidly advancing or receding tide.
- In some cases a bore (wall of water) or series of breaking waves may form.

How is a tsunami different from a wind-generated wave?

- Wind-generated waves usually have periods (time between crests) between 5 and 15 seconds. Tsunami periods normally range from 5 to 60 minutes.
- Wind-generated waves break as they shoal and lose energy offshore. Tsunamis act more like a flooding wave. A twenty foot tsunami is a twenty foot rise in sea level.

What are the West Coast and Alaska Tsunami Warning Center's (WC/ATWC) responsibilities?

- The main mission of the WC/ATWC is to help protect life and property from tsunami hazard by providing tsunami information and warning messages to its area-of-responsibility (AOR).
- The WC/ATWC AOR is Puerto Rico, the Virgin Islands, Canada, and the ocean coasts of all U.S. states except Hawaii.
- Develop new processes and techniques to improve response times, forecast accuracy, and message content to residents in the AOR.
- Increase community preparedness and public tsunami education through the TsunamiReady program and outreach.
- For more information on the center, see <http://wcatwc.arh.noaa.gov/>.

When are warnings or advisories issued?

- Warnings are issued when a potentially tsunami-producing earthquake over the threshold magnitude (7.0 in the Pacific AOR, 6.5 in the Atlantic AOR) occurs in the AOR.
- Warnings or advisories also may be issued when potentially tsunami-producing earthquakes over magnitude 7.5 occur outside the AOR and are likely to impact the AOR.
- The geographic extent of the warning or advisory is based on the size of the earthquake, tsunami travel times throughout the AOR, and expected impact zones.
- Warnings are normally issued approximately 5 minutes after earthquake occurrence.

Do all large earthquakes, greater than magnitude 7, generate tsunamis?

- No, only those which induce large sea floor displacements capable of disturbing the sea level over a wide area, or those that trigger landslides which displace significant amounts of sea water, trigger tsunamis.

How does the WC/ATWC respond to landslide-generated tsunamis?

- Many landslides which generate tsunamis are triggered by large earthquakes. In this case, local warnings will be issued based on the earthquake size.

- In some cases, sub-sea landslides will occur with little to no seismic energy release (e.g., Skagway, AK 1994).
- Historically, these events have been locally destructive with impacts occurring within minutes. The Tsunami Warning System is not set up to respond to this type of event.

What is a tsunami warning?

- A tsunami warning indicates that a tsunami may be imminent and that coastal locations in the warned area should prepare for flooding.
- The initial warning is typically based solely on seismic information.
- After the tsunami is recorded on sea level gages, the warning will be cancelled, restricted, expanded, or downgraded to an advisory.
- Warnings indicate that flooding up to the maximum expected limit is possible and residents should follow their local emergency management instructions.
- Warnings are issued when the earthquake information or tsunami forecasts indicate that a wave over 1 meter in amplitude is expected, possible, or ongoing.

What is a tsunami advisory?

- A tsunami advisory indicates a tsunami which may produce strong currents and is dangerous to those in or very near the water is expected.
- Large inundations are not expected in areas under advisory status.
- Advisories will be cancelled, extended, or upgraded to a warning depending on the event severity.
- Advisories are issued when the tsunami forecast is in the range of 0.3 to 1 meter, or an observed tsunami is in the range of 0.5 to 1.0 meters.

What is a tsunami watch?

- A tsunami watch is an early alert issued to areas which may later be impacted by a tsunami.
- Tsunami impact is normally at least three hours away for regions within a tsunami watch.
- The watch will either be upgraded to a warning or advisory in subsequent messages or cancelled depending on the severity of the tsunami.
- People within a watch area should stay alert for further information regarding tsunami threat.

What are nature's signs that a tsunami may be imminent?

- Hard ground shaking for 20+ seconds near the coast.
- Tsunamis may be accompanied by loud, booming noises or a dramatic recession of the water line.

Where should I go in the event of a tsunami warning or large, local earthquake?

- Know evacuation routes and potential hazard zones for your area. Most coastal communities have an evacuation plan and designated safe areas.
- If no tsunami hazard zone has been established or you don't know what it is, as a rule of thumb move to 100 feet above sea level or 1 mile inland.
- The WC/ATWC issues tsunami warnings, but the warnings and subsequent evacuations are implemented by state and local emergency management.

What do I do if I'm in a boat at sea or in a harbor during a tsunami event?

- Mariners in deep water (600 feet or greater) should stay at sea.
- Those in shallow water or harbors should move to deep water if there is enough time and weather conditions are suitable.

What information does the WC/ATWC evaluate in order to issue tsunami bulletins?

- WC/ATWC acquires seismic data from various seismic networks throughout its AOR. These data are processed to quickly determine the tsunami-potential of an earthquake.
- Messages are issued based initially on this first analysis of seismic data.
- If a tsunami may have been generated, sea level data, tsunami models, and historical tsunami information are analyzed to estimate impact level.
- Based on impact estimations, supplemental messages are issued.

How are tsunami messages issued?

- Warnings are broadcast through standard National Weather Service (NWS) dissemination methods such as the NOAA Weather Radio-All Hazards, the Emergency Alert System, and the Emergency Managers Weather Information Network.
- State Emergency Service Agencies receive the message through the FEMA National Warning System and the NOAA Weather Wire. The states immediately pass warnings to local jurisdictions.
- The US Coast Guard relays the message via radio.
- The warnings are posted on the WC/ATWC and NWS web sites.
- Many coastal communities supplement the basic notification systems. Contact the City of Santa Monica Office of Emergency management for local procedures.

Can the WC/ATWC predict earthquakes and tsunamis?

- No, earthquakes cannot be predicted.
- Once an earthquake has occurred, the arrival time of a tsunami, if generated, can be determined accurately.
- There is not normally enough time to accurately predict tsunami heights near the source. Away from the source, tsunami wave heights can be estimated based on mathematical tsunami models and observed wave heights.

What was the biggest earthquake ever recorded?

- The largest recorded earthquake occurred in Chile (9.5) in 1960.
- The second largest earthquake recorded was the 1964 Alaskan earthquake (9.2).

How is the maximum expected tsunami inundation determined for a specific location?

- In areas where the maximum potential source is known (e.g., areas with an active subduction zone offshore), tsunami generation, propagation, and run up can be mathematically modeled and maximum wave heights estimated. Or, if the area's largest expected earthquake has occurred in recorded times, the historical records can be used to constrain expectations.
- In areas where the maximum potential source is unknown and no historic events have occurred (e.g., parts of the U.S. Atlantic coast), maximum expected wave height is difficult to determine. Many potential sources must be considered to determine the maximum expectations.