NTHMP Maritime Tsunami Hazard Preparedness, Response, Mitigation, and Recovery Guidance

March 2011: MES Co-Chair, Kevin Miller, pointing at sunk boats and recovery efforts in Crescent City Harbor (thinking about creating maritime preparedness, response, mitigation and recovery guidance)

Rick Wilson, California Geological Survey

Coordinated with the state partners in California and with other states through the National Tsunami Hazard Mitigation Program

Tsunami Hazards/Issues for Harbors and Ports

There are a number of **TSUNAMI HAZARDS** that could directly affect harbors and boaters:

- **Strong and unpredictable currents**, especially where there are narrow entrances, narrow openings, and other narrow or shallow parts of harbor
- **Eddies/whirlpools** causing boats to lose control
- Sudden **water-level fluctuations** where docks and boats:
  - Hit bottom (grounded) as water level drops
  - Could overtop piles as water level rises
- Dangerous conditions offshore – what is **safe-offshore depth** for vessels?
- **Tsunami bores and amplified waves** resulting in swamping of boats and damage to docks
- **Drag** on deep draught boats causing damaging forces to the docks they are moored to
- **Collision** with other boats, docks, and debris in the water
- **Scour and sedimentation** can affect harbor protection measures and shipping channels, respectively
- **Dangerous tsunami conditions can last tens of hours** after first wave arrival, causing problems for inexperienced and unprepared boaters who take their boats offshore
- Recovery delays because of **environmental hazards**

Guidelines and Best Practices for Tsunami Hazard Analysis, Planning, and Preparedness for Maritime Communities

Contents

Blue was completed by MMS

Green started by MMS and will need completion by MES

Keys to Guidance:

1) **Consistency in hazard analysis methods used;**
2) **Consistency in content and "look" of products between states and within NOAA;**
3) **Consistency with messaging in preparedness products and outreach; and,**
4) **Consistency in response activities and recommendations**

Guidance for Safe Minimum Offshore Depth for Vessel Movement

Work between NOAA, NTHMP States/Territories/Commonwealths, and U.S. Coast Guard

State/Territory	Minimum offshore safe depth		Notes
	Distant Source (ships in harbor)	Local Source (ships at sea)	
California	30 fathoms	100 fathoms	Evaluated, except for San Francisco Bay*
Oregon	30 fathoms	100 fathoms	Evaluated
Washington	30 fathoms	100 fathoms	Evaluated, special conditions inside Puget Sound*
Alaska	30 fathoms & vessels should be at least ½ mile from shore	100 fathoms	Evaluated
Hawaii	50 fathoms	50 fathoms	Evaluated; implemented in Coast Guard plan in some locations
Puerto Rico	50 fathoms	100 fathoms	Evaluated
US Virgin Islands	50 fathoms	50 fathoms	Evaluating*
Gulf Coast		100 fathoms	Evaluating*
East Coast		100 fathoms	Evaluating*
American Samoa	50 fathoms	50 fathoms	Evaluating*
Guam	50 fathoms & vessels should be at least ½ mile from shore	100 fathoms	Coordinated with USCG Guam Sector
Commonwealth of Northern Mariana Islands	50 fathoms & vessels should be at least ½ mile from shore	100 fathoms	Coordinated with USCG Guam Sector

*Please contact the MMS state representative for further information

Determining Appropriate Maritime Planning and Response Guidance

	2-Level Response Guidance (Alert-Level Response)	Multiple-Level Response Guidance (Playbook Response)
Type of maritime community	Small open-coast harbors or harbors within rivers or bays which have not experienced significant tsunami damage in the past	Harbors and ports which have had damage in past events, especially during both Advisory and Warning level events
Basis for response planning	Response for either Advisory level events or Warning level events	Response specific to multiple scenarios between the Advisory and Warning level range
Scenario modeling required	Minimal modeling required, velocity and flow depth for one or two maximum considered distant source scenario	More comprehensive modeling is required for a variety of distant tsunami sources with the near-shore forecast peak wave amplitude range of 0.3m to 1.5m
Relative cost*	Minor cost for modeling single maximum scenario	Moderate cost for modeling multiple scenarios
Relative accuracy	Moderate accuracy for capturing tsunami conditions	Higher accuracy by selecting response plan with more specific information about severity and location of damaging currents
Decision making and response	Simplified approach with only two choices predetermined by the tsunami alert level	Advanced approach with a number of response choices based on forecast peak wave amplitude from the Warning Center
Real-time decision making assistance from state/NWS	Assistance to select the response level is not required	Assistance to select the response level is recommended; MINIMUM scenario plan may be recommended by state or NWS IDSS

*Cost of modeling will vary. States/Territories should calculate these costs before meeting with harbor/port officials.

Maritime Guidance for Distant Source Tsunami Events

Ports of Newport and Toledo
Lincoln County, Oregon

Oregon Maritime Tsunami Response Guidance (MTRG) No. 2015-OR-01

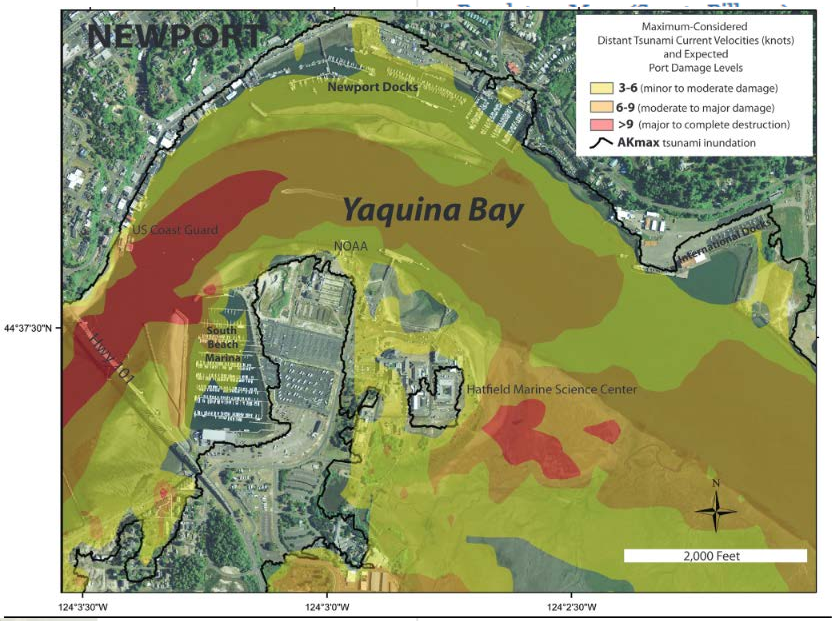
Maritime response guidance in this document is based on anticipated effects of a **maximum-considered distant tsunami event**, scenario **AKmax** of the Oregon Department of Geology and Mineral Industries (see www.oregontsunami.org for more information on this scenario). Smaller distant source tsunamis will occur more commonly and are likely to cause significantly less damage than this maximum considered scenario. Check with local authorities for more specific guidance that may be appropriate for smaller distant tsunami events.

NOTABLE HISTORICAL TSUNAMIS IN NEWPORT AREA

The table provides basic information about historical tsunami events; very minor tsunamis are not shown. The largest, most damaging distant-source tsunamis in Newport area have come from large earthquakes in the Alaska-Aleutian Islands region. The peak amplitude and damage information may help provide port authorities background for comparing future Advisory and Warning level tsunamis in the area. For example, the 2011 Japan tsunami may provide a threshold for no damage occurring below a forecast amplitude (wave height) of 0.43 m (1.4 ft).

Location	Event	Peak Amplitude Observed (m)	Peak Amplitude Observed (ft)	NTWC Tsunami Alert Level Assigned	Tides During First 5 Hours	Damage Summary
Newport area	1964 M9.2 Alaska	3.5	11.5	Warning	High*	light damage to ships and docks**
South Beach	2009 M8.0 Samoa	0.08	0.3	Advisory***	High	no damage reported
South Beach	2010 M8.8 Chile	0.16	0.5	Advisory***	Low	no damage reported
South Beach	2006 M8.3 Kuril	0.17	0.6	—	Low	no damage reported
South Beach	2011 M9.0 Japan	0.43	1.4	Warning***	Low	no damage reported

*Alaska 1964 arrival on PNW coast was at mean high water flood tide.
**1964 observation by ship captain Terry Thompson communicated February 19, 2015 to George Priest.
***Alert assigned by forecast OUTSIDE of bay.



Maritime Tsunami Response Playbooks

Maps are FEMA RiskMAP Products

Real-time recommendation

Communities/Harbors	Recommended MINIMUM Tsunami Response Playbook Plan, based on tsunami forecast amplitude (wave height)
Port of Oakland	Response Plan B
Alameda Marinas	Response Plan A
East San Francisco	Response Plan B
North San Francisco	Response Plan B
Pillar Point Harbor	Response Plan B
Santa Cruz Harbor	Response Plan B
Moss Landing Marinas	Response Plan B
Monterey Harbor	Response Plan A
Morro Bay Marinas	Response Plan B
Santa Barbara Harbor	Response Plan A
Ventura Harbor	Response Plan A

DRAFT 03/20/2015

Maritime Tsunami Response Playbooks: Background Information and Guidance for Response and Hazard Mitigation Use

By Rick Wilson[1*], Patrick Lynett[2], Kevin Miller[3], Amanda Admire[4], Aykut Ayca[2], Edward Curtis[5], Lori Dengler[4], Michael Hornick[5], Troy Nicolini[6], and Drew Peterson[6]

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1) California Geological Survey, California Department of Conservation *Professional License and Certification PG 5676, CEG 1881

2) University of Southern California
3) California Governor's Office of Emergency Services
4) Humboldt State University
5) Federal Emergency Management Agency
6) NOAA, National Weather Service

THE NATIONAL TSUNAMI HAZARD MITIGATION PROGRAM (U.S.)

APPENDIX
eference Page for Determining Real-Time Maritime Tsunami Response Activities

in basic information about the earthquake and tsunami from National ng Center in Alaska, regional National Weather Service office, and/or ncy manager. NOTE: Tsunami Alert Level may change in first couple earthquake; WATCH may be upgraded to ADVISORY or WARNING.

ation _____
gnitude _____
evel (circle one) WATCH ADVISORY WARNING
ted tsunami amplitude/wave height _____
ami arrival time _____

mi evacuation and response will depend on the amount of time before ival. Four (4) hours is considered the threshold time needed for a quick reference, we offer the following guidance:

our hours before
ival, we recommend the

RY – evacuate beaches, rbor docks, and piers
NG – evacuate entire ximum on-land acuation zone, or follow idance provided by local ergency manager

an four hours before ival, and your harbor has ed its tsunami response ans, the harbor can utilize ST AMPLITUDE from Step le on the right to identify ate response plan to use.

Reference Pages for Details in Maritime Playbook	Scenario Playbook Plan Letter	Peak Amplitude/wave height (in meters above existing conditions at harbor entrance)
	(No action)	0.2
Page 8-9	A	0.5
Page 10-11	B	0.8
Page 12-13	C	1.3
Page 14-15	D	1.5
Page 16-17	E	6

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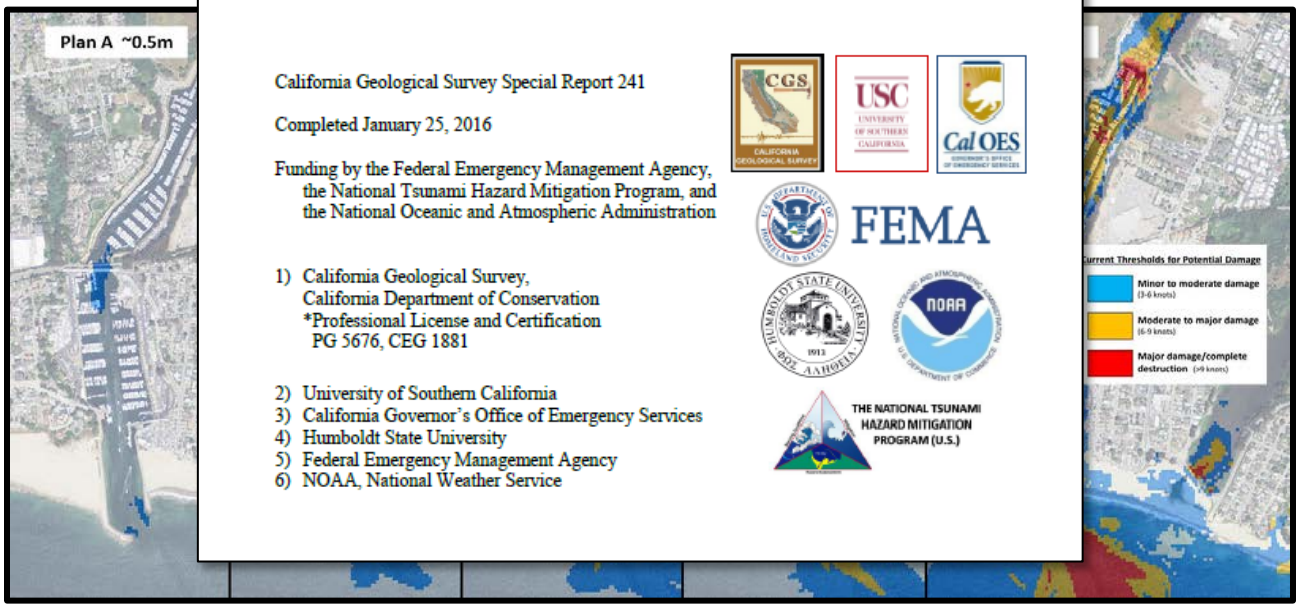
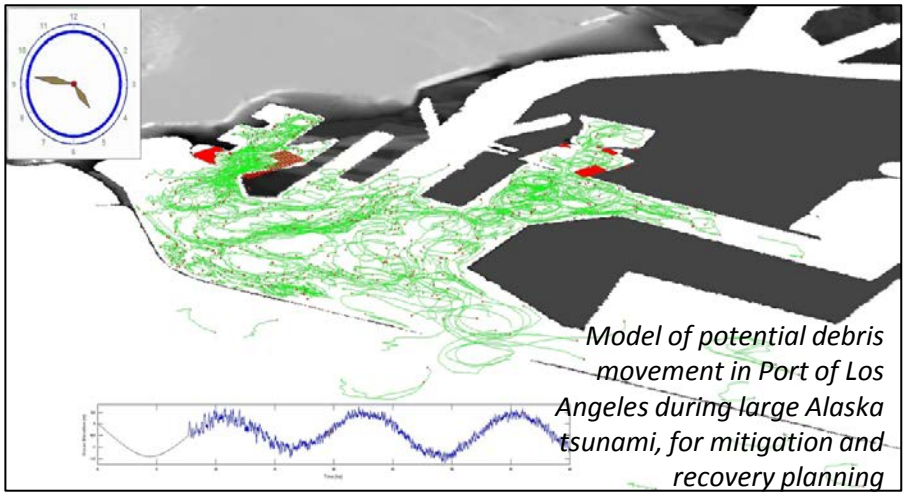


Tsunami Hazard Products for Mitigation and Recovery Planning - Potential Use in National Guidance



Model of potential debris movement in Port of Los Angeles during large Alaska tsunami, for mitigation and recovery planning

Maritime Mitigation

Harbor Improvement Reports and other products that integrate risk reduction methods for coastal hazards (tsunami, SLR, storm, etc.) into Local Hazard Mitigation Plans

Dock replacement in Santa Cruz Harbor in 2013, funded by FEMA and CalOES

Maritime Recovery

Guidance for harbors, communities, and state to produce recovery plans for large local- and distant-source events.

General Maritime Tsunami Mitigation Measures

Mitigation Measures for Reducing Impacts in Maritime Communities

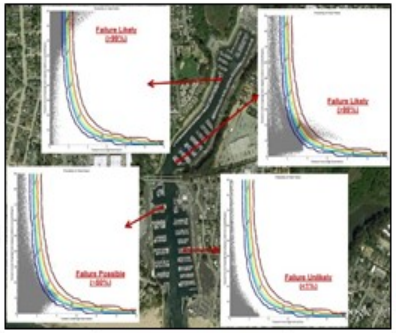
Real-time response ("soft") mitigation measures	Permanent ("hard") mitigation measures
Reposition ships within harbor	Increase size and stability of dock piles
Move boats and ships out of harbors	Fortify and armor breakwaters
Remove small boats/assets from water	Replace flotation portions of docks and dock cleats
Shut down infrastructure before tsunami arrives	Increase flexibility of interconnected docks
Evacuate public/vehicles from water-front areas	Improve movement along dock/pile connections
Restrict boats from moving during tsunami	Increase height of piles to prevent overtopping
Prevent boats from entering harbor during event	Deepen/Dredge channels near high hazard zones
Secure boat/ship moorings	Move docks/assets away from high hazard zones
Personal flotation devices/vests for harbor staff	Widen size of harbor entrance to prevent jetting
Remove hazardous materials away from water	Reduce exposure of petroleum/chemical facilities
Remove buoyant assets away from water	Strengthen boat/ship moorings
Stage emergency equipment outside affected area	Construct flood gates
Activate Mutual Aid System as necessary	Prevent uplift of wharfs by stabilizing platform
Activate of Incident Command at evacuation sites	Install debris deflection booms to protect docks
Alert key first responders at local level	Ensure harbor structures are tsunami resistant
Restrict traffic entering harbor; aid traffic evacuating	Construct breakwaters further away from harbor
Identify/Assign rescue, survey, and salvage personnel	Install Tsunami Warning Signs
Identify boat owners/live-aboards; establish phone tree, or other notification process	Identify equipment/assets (patrol/tug/fire boats, cranes, etc.) to assist response activities

Diagram of tsunami vulnerability analysis for harbors, integrated into Harbor Improvement Reports for mitigation planning

(California CTP with FEMA Region IX; examples from Santa Cruz Harbor)

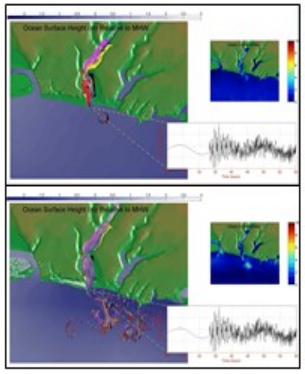
Numerical Current Velocity Modeling of design event (50-year equivalent) as input. Flood elevation and inundation modeling will also be used. Severe storms, extreme tides, and sea-level rise will also be evaluated in similarly.

Damage Potential Analysis – Current velocity and direction is compared to damage potential curves for various harbor structures and infrastructures.

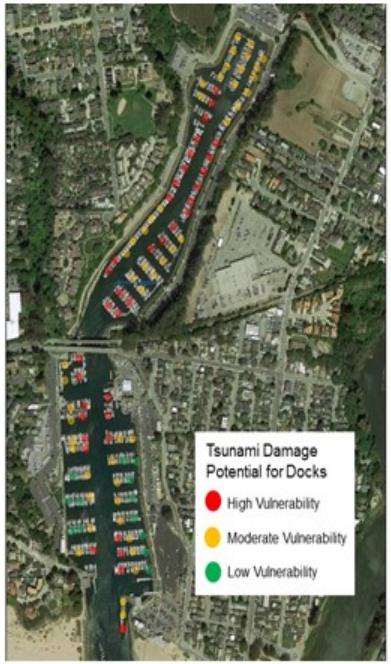


Sediment Movement Analysis – Current velocity data is used to determine where sediment erosion and accumulation will occur.

Debris Movement Analysis – Current velocity data is used to determine where debris (damaged docks, loose vessels, etc.) will move during and accumulate after event.



Vulnerability Analysis – Combines damage potential analysis with sediment and debris analyses to determine the vulnerability of harbor structures and infrastructure. Detailed analysis of sub-dock units will be included.



Mitigation Recommendations – The vulnerability of potential harbor pollutions sources will be evaluated and harbor mitigation/improvements recommended. These may included dock or infrastructure replacement or repositioning, increased dredging, and increased protection measures.

Tsunami Recovery Issues and Guidance - Maritime and Community
(California CTP with FEMA Region IX)

Damage to Port of Sendai, Japan, following March 11, 2011 tsunami

March 2014: Rebuild in "tsunami resistant" Crescent City Harbor

Direct Impacts (Damage):

- Vessels, docks, and harbor infrastructure damage
- Permanent land change in large local source EQ
- Debris in water and on land
- Sedimentation and scour
- Contaminants in water and sediment
- Environmentally protected areas/species

Indirect Impacts (Time):

- Residential reconstruction and/or relocation
- Commercial fishing and shipping disruption
- Business disruption
- Regulatory redundancy and delays
- Limited funding for recovery
- Limited resources for recovery
- Loss of business and workforce over time

- **Continue work with recovery/land-use planning specialist and colleagues in NTHMP and Japan**
- **Develop "Guidance for Tsunami Recovery" for harbors/communities and states**
- **Assist communities and harbors in developing local recovery plans**

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Contents

Recommend MES review beginning sections and verify

Recommend MES review offshore guidance document

Recommend MES streamline/ improve "General Maritime Guidance"

Recommend MES develop "Preparedness and Education…" section

Recommend MES work with FEMA to develop guidance for LHMP and funding

Recommend MES wait for mitigation/ recovery work in CA to be completed