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TSUNAMI WARNING, PREPAREDNESS, INTERAGENCY COOPERATION: LESSONS LEARNED

HEARING

BEFORE THE

SUBCOMMITTEE ON NATIONAL SECURITY, HOMELAND DEFENSE AND FOREIGN OPERATIONS

OF THE

COMMITTEE ON OVERSIGHT AND GOVERNMENT REFORM

HOUSE OF REPRESENTATIVES

ONE HUNDRED TWELFTH CONGRESS

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TSUNAMI WARNING, PREPAREDNESS, INTER-AGENCY COOPERATION: LESSONS LEARNED

WEDNESDAY, APRIL 14, 2011

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON NATIONAL SECURITY, HOMELAND DEFENSE AND FOREIGN OPERATIONS,
COMMITTEE ON OVERSIGHT AND GOVERNMENT REFORM,
Washington, DC.

The subcommittee met, pursuant to notice, at 3:12 p.m., in room 2154, Rayburn House Office Building, Hon. Jason Chaffetz (chairman of the subcommittee) presiding.

Present: Representatives Chaffetz, Gosar, Labrador, and Tierney.

Also present: Representative Hanabusa.

Staff present: Thomas A. Alexander, senior counsel; Molly Boyl, parliamentarian; Kate Dunbar, staff assistant; Adam P. Fromm, director of Member liaison and floor operations; Mitchell S. Kominsky, counsel; Justin Kim and Scott Lindsay, minority counsels; and Zieta Merchant, LCDR, fellow.

Mr. CHAFFETZ. The committee will come to order.

Good afternoon and welcome to today's hearing, Tsunami Warning, Preparedness and Interagency Cooperation: Lessons Learned. I would also like to welcome Ranking Member Tierney, members of the subcommittee and those of you watching live on the Web cast at oversight.house.gov. Thank you all for joining us.

I appreciate your patience. We have a lot of votes and things happening on Capitol Hill today. I appreciate the distance that many of you have traveled, some short, some rather long. We appreciate it. This is an important topic and we appreciate your participation.

Apologies in advance; we get called out for votes. Also, we have a markup going on in the committee I am participating in next door, and I may need to go to that as well. Nevertheless, we are glad you are here. This is an important topic that literally would affect millions of people's lives. Hopefully it will never come to that. Hopefully it is just a lesson in preparedness. But when that disaster, if, and hopefully it doesn't ever happen, the work that you are doing now and the preparation is vital to our country and the lives and safety of so many Americans and people around the world.

Fifty thousand people were dead or went missing and millions more were suddenly homeless in 11 countries. Our Pacific states and territories are also in reach of the damaging effects of tsunamis. According to the National Oceanic and Atmospheric administration, the contiguous United States has suffered from

tsunamis originating in Chile, Japan, Russia and Alaska. In 2009, American Samoa was struck by a tsunami that killed 22 people. That is why we are here today.

This subcommittee will examine the extent to which the Federal Government is capable of determining the threat from tsunamis, can issue timely and effective warnings about a tsunami and has the plans in place to respond to a tsunami. Also, the subcommittee will look at how successful the Federal Government is in helping local and State authorities develop tsunami-resilient communities, and how these entities conduct public outreach. We will also examine lessons learned from Japan and the extent to which they can be applied.

Taxpayers have invested substantial resources to ensure U.S. preparedness. The Federal entities principally responsible for this mission are the U.S. Geological Survey, NOAA and the Federal Emergency Management Agency. Career officials from these agencies are here today. We have also invited their State counterparts to testify about collaboration with the Federal Government.

A representative from the State of Alaska is here with us today. The States of Oregon, Washington and Hawaii have submitted their statements for the record. We are only disappointed that California chose not to participate.

I ask unanimous consent that those statements be placed in the hearing record. Without objection, so ordered.

[The information referred to follows:]

Subcommittee on National Security, Homeland Defense and Foreign Operations

Committee on Oversight and Government Reform

2157 RAYBURN HOUSE OFFICE BUILDING, WASHINGTON, DC 20515

Statement of Record

April 14, 2011

Brigadier General Mike Caldwell, Interim Director

Emergency Management Agency

State of Oregon

'Tsunami Warning, Preparedness, and Interagency Cooperation: Lessons Learned'

Thank you for the opportunity to submit a written statement for the record on today's important hearing before the Subcommittee on National Security, Homeland Defense and Foreign Operations. The topic of tsunami preparedness is especially relevant in light of the recent 9.0 M earthquake and resulting tsunami on March 10, 2011. The impact of this event was felt all around the Pacific basin, with the tsunami reaching, and causing $7 million in damage in Oregon. There was no loss of life in Oregon from the tsunami due to previous education and outreach funded by such sources at NOAA through the National Tsunami Hazard Mitigation Program, state, and local sources.

Tsunami hazard in Oregon

The 9.0 magnitude Japan earthquake on March 10, 2011 created a subsequent tsunami on the U.S. West Coast. In most instances, the tsunami impacts were negligible, although there were areas of localized damage. One person was killed when swept off a rock near Crescent City, California as he was taking photographs of the event. In Oregon, our impact was small except in the Port of Brookings on our southern coast.

At 1035 hours, approximately 3 hours after the tsunami warning center predicted the first wave would arrive on the Oregon coast, an 8 to 10 foot wall of water struck the Port of Brookings Harbor and caused an estimated $6.7 mil in damage. This is a small port but a very important port for our south coast and supports 60 commercial fishing vessels, 342 sport/recreation pleasure craft and it's recognized as the easiest bar crossing on our entire coast. The fishing industry is the number one economic activity in this remote part of Oregon and generates $67 million in economic activity annually for this town of 14,000 residents. It should be noted that our Governors request for Presidential Declaration of this disaster was approved and singed by the President in four days. FEMA responded with personnel and expertise within 24 hours of the incident. In short, the federal response to this disaster was magnificent!

As we reviewed the activities of this event we concluded that we were fortunate that the tsunami inundation was far smaller than estimated, due in large part to the tide was receding to an extremely low level just as the waves were arriving. This acted as a shock absorber which contributed significantly we believe to the relatively low impact. However, the lessons learned by all jurisdictions are invaluable for our future tsunami response planning.

Many valuable lessons were learned during this tsunami event.

1. The federal tsunami warning system, run by the National Weather Service, worked remarkably well, in spite of early technological and IT issues. The alert products were received accurately and in a timely fashion. However, in our after action review, it was noted that when the West Coast and Alaska Tsunami Warning Center (WCATWC) sends alert products, it also sends premium reports which the counties found cumbersome, and in more than one instance, important information was missed due to the volume of data being forwarded. This could be rectified in future events by streamlining the verbiage in the message products.

2. The National Weather Service provided excellent data and warnings to the state and local governments. A key lesson learned is that the NOAA tone alert radios are an absolute must for public buildings, hospitals, schools and all public lodging facilities. Oregon has emphasized the use of alert radios in our educational efforts in order to create redundancy in distant tsunami warning systems.

3. Most tsunami warning sirens worked. However several of these sirens are old and repair parts are no longer manufactured and some failed. But those sirens were operated manually. Widespread reliance on tsunami warning sirens is misguided and can create a false sense of security in the public. It is vitally important that the public understand that they are active participants in the tsunami warning system. Oregon's educational efforts have focused on this personal responsibility in creating a culture of awareness. These tsunami warning systems will be unreliable in the event of a locally-generated Cascadia Subduction Zone earthquake and tsunami.

4. Local law enforcement, along with volunteer fire fighters and Community Emergency Response Teams (CERT) in most cases, effectively conducted evacuations within the forecasted inundation zone. Shelters were established and generally worked well.

5. In some instances, churches and other well-meaning people stood up shelters. Unfortunately, these self-activated centers did not report to local emergency management officers and loved ones were stressed in attempts to locate mostly elderly family members. More training is needed so that sheltering can happen in a more orderly manner.

6. One trend that was observed was that some decision makers did not fully understand the hazard posed by a distant tsunami. In one instance, a small school district superintendent did not take the risk seriously and refused to cancel school. Reports indicate that grade school children were waiting on a dock for the school bus pick-up in a known and documented inundation zone about 30 minutes past the predicted tsunami's arrival. As we now know, the significant wave that struck Brookings did not occur until 3 hours past the prediction of initial wave arrival time. This decision could have been catastrophic.

7. Situational awareness between counties and the state office of OEM needs improvement. County Sheriffs were hampered in communication with adjoining jurisdictions particularly across state lines in Crescent City, California. Oregon is working a pilot project with DHS, Washington, Idaho, Alaska & Montana to create a North West version of virtual USA. Presently we have developed a web based system in Multnomah County that has great potential for local Emergency Managers. Unfortunately, we are funding this from already scarce resources, thus its progress is slow. Had this web based system been employed in our coastal counties, the situational awareness would have been much better.

8. Additionally, the state Emergency Coordination Center will develop a more resilient information system and push information received from one county to all others.

9. Critical information was broadcast on local radio stations in an effective and timely manner. The locally owned stations provided an invaluable service to the public at large and have an excellent

working relationship with local Emergency Managers. One problem discovered in Tillamook County was the lack of information being put out to public in Spanish language. This was noted and will be fixed.

10. FCC digital EAS policies need to be reconsidered. The existing policies mandate the public broadcast messages must be received (digitally) by the radio or TV station. However, states struggle to find the funding to purchase the equipment and develop the procedures to send the message.

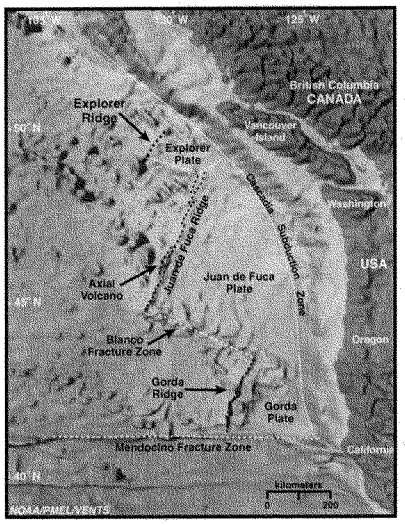
11. Another noted phenomenon was that the Hispanic community self-evacuated almost to a person. How they received the information is unclear, but no Hispanic children were in school the day after the event, and employers reported very few Hispanic workers come to work the day of the event. What network they have informally established is unclear, but we are looking into it as something we may emulate. Translation of public education materials into foreign languages is extremely important in making sure that all of our citizenry are safe during tsunami events.

12. Reverse 911 was used, but reports indicate that it was not 100% successful. Lack of telephone switching capacity appears to be the issue and needs to be resolved. This again refers to a lack of financial resources in communities most likely to be impacted by damaging tsunami events. Reverse 911 plays a vital role in providing redundancy is tsunami warning systems, and where it worked well, it greatly aided in a positive action by the public.

This event was an excellent no-notice full-scale exercise. Our systems were tested, and in some instances, failed. Federal state and local, first responders and emergency managers gained tremendous experience with the benefit of a minimal impact to our citizens. Even though one coastal community suffered a serious economic blow, by and large we on the West Coast dodged a bullet!!! The real question now is, are we smart enough to take the lessons learned and improve our systems so we can save lives and recover from a catastrophic event that will happen.

Local tsunami hazard from the Cascadia Subduction Zone

The Cascadia Subduction Zone runs just off our coast and is capable of producing mega-thrust earthquakes similar in size and scope of the 2004 Indonesian and 2011 Japanese earthquake and tsunami.



In some areas, the western edge of the fault is less than 75 miles off of the Oregon coast and slants at a 45 degree angle eastward bringing it under the main continental shelf. The ground shaking from estimated mega-thrust earthquake will be felt from northern California to British Columbia, from the coast to well past the Cascade Range of mountains.

The reaction time from the time of the predicted 8 to 9 magnitude earthquake and ensuing tsunami could be as few as 6 to 7 min, up to 15 to 20 min before a potential 60 foot (or higher) tsunami strikes our coastal communities. We also predict that most, if not all tsunami warning sirens will most likely not be operational due to the significant earthquake. Bridges and roadways will be impassable to vehicles. Communication systems will probably be damaged and probably not functional. Structures will be demolished and injuries and death are a given.

So what have we learned from the Japan earthquake and tsunami and how do we prepare our citizens to survive the coming catastrophic Cascadia Subduction Zone earthquake and tsunami?

Education is a valuable and ongoing need. The public and decision makers need the tools and knowledge to plan for and respond to a catastrophic earthquake and tsunami. Financial resources are needed to create the culture of awareness that will enable the public to be a full partner in preparedness through emergency kits and plans for safety.

Infrastructure and the built environment need to be robust to weather the extreme ground shaking and liquefaction caused by a catastrophic earthquake. A 2007 study[1] by the Oregon Department of Geology and Mineral Industries (DOGAMI) shows a high percentage of hospitals, schools and emergency responder facilities are at a high or very high susceptibility to collapse in a Cascadia Subduction Zone earthquake. Over 300,000 Oregon school children go to school every day in these risky buildings. Oregon has authorized $30 million per biennium in bonds to retrofit hospitals, schools, and emergency responder facilities. However, only $22.5 mil has been obligated to date due to the difficult state economic situation. This has allowed Oregon to retrofit 17 schools out of an estimated 906, and 18 emergency service facilities out of an estimated 223 needed.

The Portland Metro Area, and the Willamette Valley presents a host of complex problems and challenges. This area of Oregon concentrates over 85% of the state's population. The state's key infrastructure in terms of electric distribution, natural gas and petroleum all terminate and re-distribute from the three county Portland Metro Area. The curtailment of these essential commodities will hamper response and delay recovery which will have significant social economic impacts on the entire state. Increased resources are needed to prepare the public, not just in the coastal regions, but also the highly populated Portland Metro Area which most likely will also be greatly impacted.

The federal agencies, NOAA, USGS, and FEMA, need to continue to fund scientific efforts through state/federal partnerships in order to fully understand the seismic hazard posed by the Cascadia Subduction Zone and to better define the threat. However the vast majority of federal funding has been tied to physical science and at some point it needs to be shifted to preparedness (education, planning, equipment (alarms, etc..).

WHERE DO WE GO FROM HERE?

1. Education of all coastal and inland residents is essential. With the known fact that these citizens may only have 6 or 7 minutes between the Cascadia Subduction Zone earthquake event and a major tsunami, there is no warning system that can be relied on to warn citizens. Educating them to understand that if the ground moves, they must move to high ground immediately. They must not wait for some authority to tell them to evacuate.

2. All residents need to have a 72 hour sustainment kit at a minimum. These kits need to be in multiple locations, such as in cars as well as houses, as buildings may be destroyed.

3. Alternative communication means must be employed by local authorities like HAM radios with back-up power, satellite phones. Most likely land line and cell systems will not be available.

4. Funding needs to be enhanced to support state and local efforts to educate and inform citizens. Over the past two years, the Oregon Office of Emergency Management has received FEMA National Earthquake Hazard Mitigation Program (NEHRP) grant dollars, averaging $81K a year, for earthquake and tsunami preparedness. The office has one person assigned to cover over 363 miles of coast line and the seventeen counties within the Cascadia Subduction hazard zone. This funding is totally inadequate.

5. Funding needs to be increased to provide essential facilities seismic upgrades so local responders can survive in order to render aide post event.

6. Additional funding is required to further develop the tsunami inundation zone data. This is critical to insure that these areas are identified and known for response by outside agencies.

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[1] DOGAMI (2007) *Statewide Seismic Needs Assessment Using Rapid Visual Screening (RVS).* DOGAMI Open-File Report O-07-02.

7. Purchase battery back-up tone alert radios for all coastal residents in or near known inundation zones. This is a small amount of money that could save thousands of lives.

Reauthorization of the TSUNAMI WARNING AND EDUCATION ACT (TWEA)

The State of Oregon strongly recommends the reauthorization of the TSUNAMI WARNING AND EDUCATION ACT (TWEA). This key legislation has created a strong tsunami mitigation program predicated on robust federal/state partnerships.

The State of Oregon recommends strong support for the reauthorization of TWEA and limiting the 27% of the funds authorized under Section 8 to non-federal partners, as was originally intended. Through the National Tsunami Hazard Mitigation Program (NTHMP), strong state/federal partnerships have greatly improved tsunami preparedness and mitigation activities. In Oregon, NTHMP has funded a multi-year educational effort that paid dividends during the recent Japan tsunami when the public knew what to do when the warning was issued, but even more importantly, took proper action. While there is room for improvement, Oregon's coastal residents did remarkably well during the tsunami evacuation because great effort was expended in an NTHMP-funded effort.

Creation of additional Tsunami Warning Centers (TWC)

A 2011 National Academy of Science report[2] found that the tsunami warning center "mission is critically dependent on technical infrastructure and human capital, both of which the committee assessed to be insufficiently supported." Current funding resources do not allow for the needed robustness in the existing two TWC. The March 11, 2011 Japan earthquake and tsunami event revealed weaknesses in both the IT infrastructure and redundancy capability of the existing tsunami warning centers.

The creation of additional warning centers may in fact jeopardize the ability of the existing TWCs to provide their required functions since they continue to have issues with IT infrastructure and other systems. Moreover, as identified by the recent NAS report, coordination between the two centers is hardly sufficient and adding additional centers will only seek to increase confusion, both in the public and emergency management. If messaging issued by the centers is not simple and consistent, we risk the public's loss of faith.

The argument of a local Caribbean hazard necessitating an additional warning center situated on Puerto Rico is not viable as a justification. The tsunami warning system is not designed to warn of a locally-sourced tsunami and would not be able to respond quickly enough to provide a timely warning to coastal Caribbean communities. The creation of this third center would draw limited funds away from improving the two existing centers, thereby risking the lives and property of American citizens.

Oregon strongly supports increased funding to the two existing tsunami warning centers to improve infrastructure and redundancy capabilities.

Closing Statement

The Cascadia Subduction Zone is over 100 years beyond its cycle of causing a major 8-9 magnitude earthquake. It's a known major disaster waiting to happen. As a nation we traditionally spend very few dollars to prepare for catastrophic events, but spend tremendous amounts of money to respond &

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[2] National Academy of Science, 2011. *Tsunami Warning and Preparedness: An Assessment of the U.S. Tsunami Program and the Nation's Preparedness Efforts*. WA, DC: National Academies Press. Pg. 164.

recover. As we have seen in Japan, one of the most prepared nations in the world with respect to earthquake and tsunami preparation, thousands of lives have been lost. Billions of dollars in infrastructure have been destroyed. Yet, there are numerous examples where buildings that did have seismic fixes are standing and can be used in short order after the quake. These are the choices we have before us. Prepare, or cross our fingers and hope this event happens on someone else's watch.

Thank you for this opportunity to submit written testimony.

MR. JIM MULLEN

Director, Washington Military Department
Emergency Management Division

STATEMENT FOR THE RECORD

Submitted to the House Oversight and Government Reform Committee

Subcommittee on National Security, Homeland Defense, and Foreign Operations

Tsunami Warning, Preparedness, and Interagency Coordination: Lessons Learned

April 14, 2011

Washington State Emergency Management Division
Building 20; MS: TA-20
Camp Murray, Washington 98430
(Ph): 253-512-7001

Statement for the Record of Mr. Jim Mullen
Washington State Emergency Management Division
April 14, 2011

Introduction

Thank you Chairman Chaffetz, Ranking Member Tierney, and distinguished members of the Subcommittee for convening this hearing and allowing me the opportunity to submit this statement for the record related to tsunami warning, preparedness, and the interagency cooperation following the Japanese earthquake and subsequent tsunami on March 10-11, 2011.

The tragic events that occurred on March 10th in Japan illustrate the need to remain focused on the local earthquake and tsunami threats facing our nation. The events that we witnessed across the Pacific are almost identical to the events we expect to see off our coast during a magnitude 9.0 Cascadia Subduction Zone earthquake & tsunami. On March 11th, we were reminded that multiple Pacific Rim countries' fates are inextricably linked when an earthquake in Japan can trigger tsunami waves that reach the west coast of the United States killing two people and causing tens of millions of dollars worth of property damage and millions more in economic impacts.

Other witnesses may also highlight the continued need for the reauthorization of the Tsunami Warning and Education Act (TWEA), but I would like to provide you with my perspective on how this important Act has markedly improved tsunami warnings for our nation, explain why state and local tsunami public education is needed, and briefly discuss some early lessons learned from this incident.

Tsunami Warning

On March 10, 2011, Washington State Emergency Management Division's Duty Officers received notification around 11:22 p.m. from the West Coast and Alaska Tsunami Warning Center that Washington State would be placed under a Tsunami Watch, which indicated some action may be necessary as data collection and analysis continued. EMD's Duty Officers immediately began notifying coastal counties and tribes of the impending tsunami providing responders as much time as possible for preparation and action. The State Emergency Operations Center (EOC) was activated to Phase II at 11:30 p.m. to support local jurisdictions, tribes, and to coordinate state agency resources in support life safety priorities.

Around 12:47 a.m. on March 11, 2011 the Tsunami Watch was upgraded to a Tsunami Advisory, and being at a Phase II enabled us to immediately ramp up to effectively coordinate and support local jurisdictions and tribes as well as respond to media inquiries. This increased level of alert meant local jurisdictions would be closing beaches, evacuating ports and harbors, and the State EOC was coordinating with State Agencies to provide any necessary assistance to protect the public. Washington could have been included in the Tsunami Warning that was issued for Oregon and California. We were fortunate in this incident that unlike Hawaii and our neighbors to the south, we did not experience any damage as the waves hit our shore.

Throughout the entire event, we were in constant contact with the West Coast and Alaska Tsunami Warning Center. We applaud the accuracy of the Center's forecast of the tsunami waves' arrival times and projected wave heights. Receiving timely and accurate information was critical to providing a good response, at federal, state and local levels.

We conducted hourly conference calls with local emergency management offices in order to relay information from the Tsunami Warning Center and coordinate response activities between all levels of government. Decisions on whether to use sirens, closing roads, and designating evacuation locations are all examples of response actions that might have been undertaken needlessly had the information from the Center not been available.

During the event, some areas of Grays Harbor County met the Tsunami Warning level criteria. Impressive communication and coordination between the Tsunami Warning Center, the State EOC, and Grays Harbor Emergency Management enabled us to continue monitoring yet decide that the risks to the public did not warrant a coastal evacuation. A full-scale evacuation could have resulted in wasted public resources and put lives at peril as evacuations in the middle of the night can be dangerous.

There were lessons to be learned, however. The West Coast and Alaska Tsunami Warning Center experienced significant problems with their website which served as the primary source for updated tidal information. Also the warning center staff inadvertently issued an erroneous message indicating a downgraded threat level at the height of the event. While the initial feedback has been extremely positive from our local and tribal partners, a formal After Action Review of our response to this incident will be conducted to ensure we are doing everything possible to protect our coastal residents.

Tsunami Preparedness

I suspect many of you are wondering "How prepared is Washington State to deal with this type of disaster?" While we have made substantial progress and are much better prepared today then we were in 2004 during the Indonesian Tsunami, there is still much more work to be done. Japan represents a country which dedicates substantial resources to tsunami preparedness yet current figures confirm 13,000 of their citizens perished in this incident. This demonstrates a need to refocus the interest that occurred during the last major earthquakes and tsunamis in Chile during February 2010, American Samoa in 2009, and Indonesia in 2004.

Fortunately, because of the resources provided by the National Tsunami Hazard Mitigation Program (NTHMP), which is authorized by TWEA, Washington State Emergency Management Division has been able to put programs in place dedicated to assist our state, our local communities, and our tribes become better prepared to deal with these no-notice events. After all, data from warning centers exists to move the public out of harm's way. Without professional education of dedicated state, tribal, and local emergency management practitioners and general public education on what to do when the ground begins to shake, we cannot ensure public safety.

EMD's Earthquake/Tsunami Program is a state-level natural hazards risk reduction program, bringing together federal, state and local and tribal partners to promote response planning, preparedness activities, public education and outreach, as well as mitigation related activities within Washington's communities.

In Washington we are committed to seeking creative and innovative solutions that make the most of scarce resources. Our efforts have recently been recognized by the Western States Seismic Policy Council with an Award in Excellence. Through our Tsunami Public Education Instructor: Train-the-Trainer program, we have created local community based champions for earthquake and tsunami preparedness. This also provides additional support for local emergency managers to conduct public education – a critical component of community & personal preparedness. Of utmost importance for states with local tsunami hazards, like Washington, is getting people to recognize a need to self-evacuate immediately when ground shaking occurs. No technical warning system can provide the time needed for folks to move to high ground when local events are near shore. We must rely on an educated public to respond quickly and appropriately to preserve life.

Tourists and visitors to our coast are largely unfamiliar with earthquakes and tsunamis. Our Disaster Preparedness Training for the Hospitality Industry program educates hotel staff on these hazards. That 18-year old working behind the front desk on their summer job is our first responder in these times of crisis. That hotel or motel staff member needs to know what to do during an earthquake and tsunami so that visitors can be directed to safety.

Map Your Neighborhood (MYN) is a program that was developed by WA EMD and brings neighbors together to plan and prepare for disasters using an organized process. It teaches people how to become self-reliant post disaster for a period of time until help can arrive. Currently there are 29 Washington counties, 80 cities, 30 states, and one international country that have implemented MYN. Right now, families are struggling financially, but this should not prevent them from getting life saving information during events like we experienced this past month. We have been fortunate to receive funding through the NTHMP to provide individuals and families that meet income requirements with a free NOAA weather radio. After completion of some basic tsunami preparedness training, participants are given a NOAA weather radio giving them the opportunity to receive for the first time tsunami alerts and warnings.

WA EMD, through support from Governor Gregoire, Senator Cantwell, and the NTHMP has developed and deployed the All-Hazards Alert Broadcast (AHAB) Siren System to warn individuals within siren range of an approaching tsunami. To date, we have 50 sirens located along our Washington outer coast, Strait of Juan de Fuca, and Puget Sound. We test this system on a daily basis to determine operational status in order to troubleshoot and make needed repairs. We also audibly test the sirens on the first Monday of each month in order to make sure everything is fully operational. Washington State and its contractor, Federal Signal developed this state-of-the-art technology and it has become the de facto standard for tsunami warning sirens.

Our outer coastal communities are at risk from tsunami inundation and in many cases have no access to natural high ground. The only solution in these areas, like the Long Beach Peninsula,

Ocean Shores, Westport, is vertical evacuation. This new evacuation strategy means providing artificial high ground through the use of towers, berms or buildings specifically engineered to withstand the tremendous forces from a Magnitude 9.0 earthquake and 30-foot tsunami waves. We commend the joint efforts of FEMA and NOAA for authoring engineering guidance on this new approach. Project Safe Haven is a program specifically designed to incorporate local feedback on developing community accepted solutions for tsunami evacuation where natural high ground is minimal or non-existent. Washington State is leading the way nationally and internationally on this new evacuation strategy. Funding sources must be identified in order for these innovative designs for saving lives can be implemented.

Interagency Coordination

The coordination required for tsunami warnings, preparedness efforts, and mitigation strategies cut across all levels of government and when implemented properly, like they were on March 10-11, 2011, allow us to ensure public safety in our local communities. We have made tremendous progress over the past seven years as a state and as a nation when it comes to preparing for the inevitable subduction zone events that threaten both our national and economic security.

However, at this moment coastal states are caught in the middle of a federal dispute over which agency has responsibility for tsunami hazard mitigation, FEMA or NOAA. Both agencies point towards the other when it comes to implementation of tsunami mitigation efforts, like vertical evacuation, and other initiatives. The events in Japan help us realize that we cannot afford to waste additional time arguing jurisdictional issues when innovative solutions exist that could save lives. FEMA and NOAA need to join forces and provide the leadership that ensures our citizens have life saving options when tsunamis come ashore.

There has been much discussion within the tsunami community over the past few years of creating a third warning center for the Caribbean area since a local subduction zone hazard has been identified. Washington State does not support this notion, recognizing that the existing warning centers currently provide this service and warning centers provide no increased warning time for locally generated tsunamis. If this rationale were applied across the United States, Washington, Oregon, and California would all need individual warning centers.

In 2011, the National Research Council of The National Academies issued a report entitled "*Tsunami Warning and Preparedness: An Assessment of the U.S. Tsunami Program and the Nation's Preparedness Efforts.*" This report clearly highlights the technological and coordination challenges facing the existing NOAA Tsunami Warning Centers. We strongly recommend that neither Congress nor NOAA approve creation of additional warning centers, but instead direct current resources towards improving warning capability through information technology system upgrades in existing centers.

The Tsunami Warning and Education Act, which authorizes the Tsunami Warning Centers, the off-shore buoys, and the National Tsunami Hazard Mitigation Program (NTHMP) is set to expire in September 2012. We respectfully call on Congress to reauthorize this vitally important Public Law; with minor modifications as to date it has served us well.

The NTHMP epitomizes a program which relies upon federal and state partners working together for the common cause of protecting our coastal communities at risk from damaging tsunamis. Funding for the NTHMP is 27% of the overall NOAA Tsunami Program, but the intent of this funding was to provide resources directly to states for "community based" efforts. Over the years this funding has been stretched to support not only states' efforts, but the overall NOAA Tsunami Program. The reauthorization of TWEA should direct resources to non-federal members of the NTHMP federal-state partnership only.

Conclusion

As you can see, we take these threats to our state, our citizens, our economy and our environment seriously. With the continued support of Congress, it will be possible to provide federal, state, and local communities with the tools necessary to manage these no-notice threats in order to protect lives and property. As you continue to explore these issues, please feel free to utilize Washington State's expertise gained through years of exercises and real events.

Thank you for the opportunity to submit this written testimony.

Edward T. Teixeira
Vice Director of Civil Defense
Hawaii State Department of Defense

TESTIMONY
BEFORE THE
SUBCOMMITTEE ON NATIONAL SECURITY, HOMELAND DEFENSE AND FOREIGN OPERATIONS
COMMITTEE ON OVERSIGHT AND GOVERNMENT REFORM
THE UNITED STATES HOUSE OF REPRESENTATIVES
ON
TSUNAMI WARNING, PREPAREDNESS, AND INTERAGENCY COOPERATION: LESSONS LEARNED

APRIL 14, 2011

Chairman Chaffetz, Ranking Member Tierney, and distinguished members of the Subcommittee:

Thank you for providing the opportunity to present written testimony regarding our experience during the Honshu (Tohoku) Earthquake and Tsunami of March 10-11, 2011, in terms of our Tsunami Warning System, Interagency Cooperation, and lessons we have learned thus far. The potential threat of a tsunami to the State of Hawaii from a strong earthquake along the Pacific Rim or from an area in Hawaii is a real concern for State and county civil defense agencies. We, therefore, need to be vigilant and ready to evacuate our coastal areas 24/7, 365 days a year.

Tsunami Warning System

The Tsunami Warning System in Hawaii worked during the evening of March 10 through first wave arrival on March 11. The Tsunami Warning System is based on the Emergency Alert System and supported by the State's outdoor siren warning system that includes a variety of mass notification programs at the county level including social media resources. From a federal perspective, the Emergency Alert System (EAS) worked flawlessly. The State's outdoor siren warning system comprised of 367 siren systems, however, performed at about an 88 percent operational rate. (The majority of sirens not sounding are older models to be replaced with solar-powered systems with State funds).

In addition to the EAS, outdoor siren systems, mass notification systems, the Civil Air Patrol, Hawaii Wing, was mobilized by the State Emergency Operating Center (EOC) to fly pre-planned routes

providing tsunami warning instructions by air in remote areas and along coastlines. County emergency response agencies implemented their plans to alert and evacuate coastal communities and neighborhoods. Local police in all counties provided traffic control points at pre-designated intersections to prevent residents and visitors from entering tsunami evacuation zones. And finally, the news media including three radio stations that broadcasted in Japanese, Korean, and in other languages carried public information messages until the Tsunami Advisory was cancelled.

The support the Hawaii State EOC and county EOCs received from the Pacific Tsunami Warning Center located in Ewa Beach, Hawaii, was nothing short of excellent. We were notified by the Pacific Tsunami Warning Center (PTWC) within minutes of the Honshu (Tohoku) Earthquake and placed in a Tsunami Watch by 7:56 p.m. (HST), March 10. The State of Hawaii was subsequently placed in a Tsunami Warning at about 9:31 p.m. (HST), March 10. Earliest wave arrival to the State of Hawaii was estimated at 2:59 a.m. (HST), March 11.

Through the leadership and efforts of Dr. Charles McCreery, Director, PTWC, and his staff, emergency managers, government officials including Governor Neil Abercrombie and our county mayors, were kept apprised hourly of deep ocean buoy and tide gauge station readings via a telephone and video teleconference system provided through the State EOC. Dr. McCreery and his staff were available to address questions from emergency managers and key government officials through first wave arrival. More importantly, Dr. McCreery did not downgrade the Tsunami Warning until he and his staff received appropriate measurements from tide gauges within State waters that wave oscillation in and around our harbors was below a half meter. When that occurred, the PTWC issued a Tsunami Advisory for the State of Hawaii at about 7:31a.m., March 11, enabling our county government response agencies to survey coastal areas and subsequently provide All Clear instructions where appropriate. That single decision by Dr. McCreery, after enduring nine and half hours in a Tsunami Warning condition, saved lives and prevented damage to marine vessels that were waiting out at sea.

Interagency Cooperation

Interagency cooperation at all levels of government including the support from the private sector was excellent. Hourly conference calls as mentioned above provided an opportunity to address and to resolve issues requiring agency coordination and clearance. Federal agency representatives present in the State EOC to provide assistance and coordination included: U.S. Coast Guard Sector Commander, Captain Jo Anna Nunan and staff; Federal Emergency Management Agency, Pacific Area Office Deputy Director, Marilyn Shigetani and staff; U.S. Department of Homeland Security Protective Services Advisor, Richard Mitchem; liaison teams from U.S. Army Pacific, Joint Task Force Homeland Defense (Executive Agent for U.S. Pacific Command for Defense Support to Civilian Authorities); and senior commanders from the Hawaii Army and Air National Guard. The National Weather Service, Honolulu

Forecast Office, provided support throughout the period through EAS messaging and weather products. There were also representatives from non-government organizations, i.e., University of Hawaii, American Red Cross, Hawaiian Electric Company, etc. At two hours before first wave arrival, Governor Abercrombie received a briefing from State and federal agency representatives on the state of preparedness by 15 Emergency Support Functions. The briefing clearly showed that agencies at all levels of government including the private sector were taking appropriate measures to evacuate our coastal areas, to protect lives and property, and to safeguard our visitors.

Lessons Learned

As a State, we continue to identify areas for improvement and have yet to convene an interagency After Action Review. As you are aware, President Obama recently approved Governor Abercrombie's request for federal disaster assistance. That said, the State Civil Defense Division and other State and county agencies are implementing disaster management responsibilities to address the needs of residents and businesses affected by the tsunami. At Governor Abercrombie's request, the Small Business Administration approved an Administrative Disaster Declaration for Hawaii County on March 29, 2011. As well, Governor Abercrombie requested an SBA Administrative Disaster Declaration for Maui County on April 8, 2011. That request was approved by SBA on April 12, 2011.

Thus far, we have learned that the best technology available to the Pacific Tsunami Warning Center can neither predict nor measure the power of a tsunami on exposed shorelines. Safety and security managers have indicated that most of the damage to hotel properties in West Hawaii, and to businesses in Kailua-Kona, and residential properties in the South Kona District, Hawaii County, occurred between 5:30 a.m. (HST), and 7:30 a.m. (HST), or 2-4 hours after first wave arrival time to the county. We estimate that the tsunami wave height at Kealakekua Bay, South Kona, may have been between 11-15 feet causing major damage to about ten residential units and a church.

The estimated height of the tsunami wave was brought to our attention by a researcher and Tsunami Advisor to the City and County of Honolulu, Dr. Dan Walker, who built and installed a water pressure recorder on a utility pole at Kealakekua Bay. The water pressure recorder at Kealakekua Bay sounded an alarm at 7:00 a.m., March 11.

Over the years, Dr. Walker installed several water pressure recorders which use a cell phone to transmit if the recorder is inundated by the ocean. This simple invention was created to record the effects of a local earthquake along selected points of the shoreline in that seismically active region at a very low cost. The March 11 Tsunami has proved that we need additional water pressure recorders installed in that region and elsewhere in the State. Dr. Walker has patiently waited for more funding from the State or from a federal grant to install more recorders.

Initial funding for Dr. Walker's project was provided from our annual allocation of National Tsunami Hazard Mitigation Program (NTHMP) Grant funds. A change of program policy prevented the use of these funds for "research" work. As grantee for the NTHMP grant funds, we were not able to continue with Dr. Walker's project. (NTHMP grant fund information is provided at the enclosed Truth-in-Testimony Form). We recommend that Congress look into NTHMP grant guidance to ensure State and local governments are provided the opportunity and discretion to maximize these funds to best accommodate their tsunami preparedness and mitigation needs.

The other important lesson we have learned is that the nominal investment we have made over the past seven years in tsunami inundation map modeling has paid off in the development of new tsunami evacuation maps for the City and County of Honolulu. New tsunami evacuation maps for Hawaii County are in development. (Tsunami inundation map modeling is in progress for Maui County. Tsunami inundation map modeling for Kauai County is projected for early 2012). Accelerated by State funding in 2006-2007, the tsunami inundation map modeling project conducted by Dr. Kwok Fai Cheung, University of Hawaii, is probably the best example of science and technology at work in providing the tools Hawaii's civil defense agencies and emergency responders need in evacuating our coastlines. As well, the tsunami inundation map modeling has produced new tsunami evacuation maps for the City and County of Honolulu that are available in local phone directories and on-line sources through the National Oceanic and Atmospheric Administration (NOAA) web server. The tsunami evacuation mapping on-line tool is available at our website www.scd.hawaii.gov.

The tsunami inundation map modeling project is also funded by our allocation of annual NTHMP grant funds. We recommend that Congress continue to fund NOAA and specifically the NTHMP Grant so that this State and other states can continue to develop tsunami inundation maps as data and technological improvements become available.

Finally, I recommend that your Subcommittee consider another fact-finding by the Government Accountability Office (GAO). Previous GAO fact-finding sessions on tsunami preparedness provided sound recommendations.

Thank you, again, for giving me the opportunity to provide written testimony on this important matter.

Aloha!

Mr. CHAFFETZ. We look forward to hearing from our panel of witnesses. I would like to recognize the distinguished ranking member, the gentleman from Massachusetts, Mr. Tierney, for his opening statement.

Mr. TIERNEY. Thank you, Mr. Chair, and thank the witnesses for being with us here today.

I am going to ask that my statement in its entirety be placed in the record, if there is no objection.

Mr. CHAFFETZ. Without objection, so ordered.

Mr. TIERNEY. I would just make a couple of quick points, in the interest of time here. One is obviously that we stand by the Japanese people during this very difficult time and we will continue to do that, I am sure.

But also, by all accounts, it would seem to us that the response in this country worked admirably during the Japanese tsunami situation. So I want to thank all of you and congratulate you on that. According to the interim director of the Emergency Management Association from Oregon, "The Federal response to this disaster was magnificent."

So it doesn't belie the fact that we all need to continue to be prepared. We can never be too prepared on that. And Congress has to make sure that there is adequate support for each and every one of these agencies in all of their responsibilities, but in particular on this topic with respect to the tsunamis.

I am a bit concerned when I look at some of the budget proposals being put forward. They do reduce the budget for a number of the agencies, and I want to hear from the witnesses at some point during the time whether or not that is likely to impact our ability going forward to be as prepared and ready both to detect and to respond to these incidents.

So with that, I yield back, Mr. Chairman. Thank you again.

[The prepared statement of Hon. John F. Tierney follows:]

Statement of John F. Tierney
Ranking Member
Subcommittee on National Security, Homeland Defense, and Foreign Operations
Committee on Oversight and Government Reform
U.S. House of Representatives

Hearing on "Tsunami Warning, Preparedness, and Interagency Cooperation: Lessons Learned"

As Prepared for Delivery

April 14, 2011

Thank you, Chairman Chaffetz. I welcome all of our witnesses this afternoon, and thank you for helping us understand what role each of your agencies and states play in preparing our communities for the threat of a tsunami.

It has been more than one month since the eastern coast of Japan was hit by a large earthquake-generated tsunami. That terrible event devastated the lives and livelihoods of millions. We stand by the Japanese people during their time of suffering.

In the last ten years, NOAA has observed dozens of earthquake-generated tsunami waves. Several of these have caused significant loss of life and property damage. Though incomparable to what Japan experienced, the March tsunami caused extensive property damage in the United States along the coasts of California, Hawaii, and Oregon.

The Japan tsunami is the latest in a string of powerful tsunamis to strike the Pacific rim and Indian Ocean. In 2004, more than 200,000 people died after an earthquake and tsunami off the coast of Thailand. In 2006, more than six hundred people were killed by a tsunami off the coast of Indonesia. And in 2009, a serious tsunami struck off American Samoa, causing significant loss of life and property damage.

When an earthquake triggers a tsunami, we rely on preparation, warnings, and response. By all accounts are warning and response system worked admirably during the Japan tsunami. Within minutes of the initial earthquake, USGS and NOAA analyzed the data and disseminated warnings to all of the key national, state, and local decision-makers.

Several hours later, after the tsunami struck the West Coast, taking two lives and causing tens of millions of dollars in property damage, FEMA responded within 24 hours with their personnel, resources, and expertise. According to the Interim Director of the Emergency Management Agency of the State of Oregon, "the federal response to this disaster was magnificent!"

In short, by all accounts it would appear that this real-life test of our tsunami response systems is a success story.

But the Japan tsunami also taught us that we can never be too prepared. The Japanese were as well prepared for a serious tsunami as any state in the world, yet they still lost over 20,000 lives. It may take years for that country to fully recover.

That tragic event should serve as a real wake-up call to the Congress that it must continue to fully support NOAA, USGS, and FEMA. Unfortunately, some have proposed budget cuts for those agencies that would significantly undermine their ability to perform their tsunami preparation, warning, and response missions effectively. I hope that this hearing serves as an important reminder of the vital role that these federal agencies play in our homeland security.

Thank you, Mr. Chairman.

Mr. CHAFFETZ. Thank you.

Members will have 7 days to submit opening statements for the record.

We will now recognize our panel. Dr. William Leith is the Acting Associate Director for Natural Hazards at the U.S. Geological Survey. Ms. Mary Glackin is the Deputy Under Secretary for Operations at the National Oceanic and Atmospheric Administration. Ms. Nancy Ward is the Regional Administrator for Region IX of the Federal Emergency Management Agency. Kenneth Murphy is the Regional Administrator for Region X of the Federal Emergency Management Agency. And Mr. John Madden is the director of the Division of Homeland Security and Emergency Management for the State of Alaska.

Pursuant to committee rules, all witnesses will be sworn in before they testify. If you would please rise and raise your right hands.

[Witnesses sworn.]

Mr. CHAFFETZ. Let the record reflect that the witnesses answered in the affirmative. Thank you.

We will now hear your testimony. If you would be so kind as to limit your comments to 5 minutes. Your full statement will be submitted for the record, for others to be able to peruse. But if you could keep your verbal comments to 5 minutes, in order to get through this, plus the questioning, we would certainly appreciate it. You should see a nice red light when you get to that 5 minutes.

We will start with you, Dr. Leith. You are recognized for 5 minutes.

STATEMENTS OF WILLIAM LEITH, ACTING ASSOCIATE DIRECTOR FOR NATURAL HAZARDS, U.S. GEOLOGICAL SURVEY, U.S. DEPARTMENT OF INTERIOR; MARY GLACKIN, DEPUTY UNDER SECRETARY FOR OPERATIONS, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, U.S. DEPARTMENT OF COMMERCE; NANCY WARD, REGION IX ADMINISTRATOR, FEDERAL EMERGENCY MANAGEMENT AGENCY, ACCOMPANIED BY KENNETH MURPHY, REGION X ADMINISTRATOR, FEDERAL EMERGENCY MANAGEMENT AGENCY; AND JOHN W. MADDEN, DIRECTOR, ALASKA DIVISION OF HOMELAND SECURITY AND EMERGENCY MANAGEMENT

STATEMENT OF WILLIAM LEITH

Mr. LEITH. Mr. Chairman, members of the subcommittee, thank you for inviting the U.S. Geological Survey to testify at this hearing.

The USGS is tasked under the Stafford Act to issue forecasts and warnings for earthquakes, volcanic eruptions and landslides. For tsunami, we provide critical science and monitoring support to NOAA, FEMA and other agencies. We provide hazard alerts to a broad suite of users, including the general public.

The scope of each notification depends on the severity and extent and possible impact of the event. Our key users include not only FEMA and NOAA, but the Nuclear Regulatory Commission, State transportation and water Management agencies, including Utah,

for example, local emergency managers and national and international disaster response organizations.

To monitor earthquakes in the United States and abroad, the USGS operates the Advanced National Seismic System, and in partnership with the National Science Foundation, the Global Seismographic Network. ANSS and GSN seismic data are relayed directly to the NOAA tsunami warnings centers, enabling them to respond within minutes of a major event.

We also participate in the National Tsunami Hazard Mitigation Program [NTHMP]. The USGS invested $2.3 million in fiscal year 2010 in research and assessment activities supporting the goals of the NTHMP. USGS contributes guidance in the preparation of tsunami inundation maps, as well as capabilities to survey coastal and near-shore bathymetry and topography, which of course strongly influence tsunami wave heights and inundations.

The U.S. west coast, Hawaii and the Pacific territories are all at risk for damage from tsunami generated by earthquakes. Our shores host two subduction zones that are capable of magnitude 9 earthquakes: one offshore of Alaska, which last ruptured in 1964, and the other in the Pacific Northwest, known as Cascadia, which last ruptured in 1700. This latter one deserves special mention. Recent investigations of offshore deposits indicate that the zone may have produced magnitude 9 size earthquakes perhaps 20 times in the last 10,000 years. Further research is therefore needed to fully document and assess the earthquake potential in this area.

With respect to our southern and eastern shores, the USGS has done extensive research for the Nuclear Regulatory Commission on tsunami history and potential in the Atlantic coast and the Caribbean. These regions have less frequent damaging tsunami than in the Pacific, and historic tsunami of the size that hit Japan on March 11th are not known. But the historic and geologic record suggests that the tsunami risk here cannot be dismissed.

What did we learn from the recent Japanese earthquake and tsunami? On the day of the earthquake, technical coordination between NOAA, the tsunami warning centers and the USGS National Earthquake Information Center was seamless. Since then, close coordination of post-disaster information and response activities has occurred under the protocols of the National Earthquake Hazard Reduction Program.

Also, while tsunami damage and loss of life were heavy in Japan, it appears that the investments made there in monitoring and warning systems, earthquake-resistant construction, public information and preparedness activities actually significantly limited the damage and loss of life before the earthquake. Still, the disaster has taught us that scientists need to thoroughly document the prehistoric record of large earthquakes in order to fully assess their likelihood and consequences.

Looking forward, the United States can reduce tsunami risks, improve public warning and response in three basic areas. First, continued public education through ongoing efforts in the United States, Pacific States and territories, particularly in Hawaii and the Pacific Northwest. Second, the completion of this advanced national seismic system including the enhancement of networks in the eastern United States and the development of earthquake early

warning capabilities which were in place in Japan and apparently effective. And third, enhanced research into the frequency and effects of prehistoric tsunamis. Our recorded history is simply too short to provide adequate probabilities for such rare events.

Mr. Chairman, this concludes my remarks, and I would be happy to take any questions you or the committee may have.

[The prepared statement of Mr. Leith follows:]

STATEMENT OF
DR. WILLIAM LEITH
ACTING ASSOCIATE DIRECTOR FOR NATURAL HAZARDS
U.S. GEOLOGICAL SURVEY
U.S. DEPARTMENT OF THE INTERIOR
BEFORE THE
COMMITTEE ON OVERSIGHT AND GOVERNMENT REFORM
SUBCOMMITTEE ON NATIONAL SECURITY, HOMELAND DEFENSE, AND FOREIGN OPERATIONS
UNITED STATES HOUSE OF REPRESENTATIVES
APRIL 14, 2011

Chairman Chaffetz, Members of the Subcommittee, thank you for inviting the U.S. Geological Survey (USGS) to testify at this hearing on "Tsunami Warning, Preparedness and Interagency Cooperation: Lessons Learned."

The USGS role in natural hazard assessment and alerting

The U.S. Geological Survey (USGS) is tasked by the President under the Stafford Act to issue forecasts and warnings for earthquakes, volcanic eruptions, and landslides. For tsunami, wildfire, flood and hurricane hazards, the USGS provides critical support to the National Oceanic and Atmospheric Administration (NOAA) and other agencies tasked with warning responsibility. In order to carry out these mandates, the USGS requires a monitoring infrastructure that includes local, national and global networks; reliable and redundant telecommunications; modern computing centers for data analysis and dissemination; and a skilled staff of analysts, technicians, scientists, and network support personnel. To ensure that publicly funded monitoring networks and education programs are targeted to regions at highest risk, the USGS performs assessments at a national scale of the distribution and extent of each natural hazard for which we have primary responsibility—and, in high-hazard urban areas, at a local scale. To improve the accuracy and timeliness of warnings and to minimize false alarms, we perform (and fund university and State partners to perform) targeted research to understand the underlying processes and their predictability. To maximize the extent to which hazard information is received and acted upon by appropriate individuals when disasters strike, we pursue and foster links with local governments, emergency management agencies and the media. We target our work to the areas with the highest hazard and the greatest risk.

The USGS provides hazard alerts to a broad suite of Federal, State, and local government agencies, private-sector entities, including the media, and foreign entities. We use a broad range of technologies to distribute earthquake alerts and notifications, including the Internet, text messaging, pager, phone, NOAA Weather Wire, and briefings to media. Currently, more than 250,000 persons and entities subscribe to the USGS Earthquake Notification Service. Last year, the USGS served almost 50 million unique visitors for earthquake information.

The scope of our notification process depends on the severity, extent, location, and possible impact of the hazard at hand. Targeted distribution also proceeds to key users that can include the Department of Health and Human Services, U.S. Environmental Protection Agency, the

Nuclear Regulatory Commission, State departments of transportation and water management agencies, local emergency managers, national and international disaster response organizations, and over 200 foreign agencies. The USGS also shares earthquake data and analysis products with tsunami warning centers in Japan, Chile, and Russia.

USGS support for NOAA tsunami warnings and hazard assessments

To monitor earthquakes in the United States and abroad, the USGS operates the *Advanced National Seismic System* (ANSS) and, in partnership with the National Science Foundation (NSF), the *Global Seismographic Network* (GSN). The ANSS includes a 100-station national "backbone" plus 14 regional seismic networks in high-hazard areas and is operated through partnerships with universities and state governments. The GSN is a constellation of 150 globally distributed, modern seismic and other sensors, operated by USGS and the *Incorporated Research Institutions for Seismology* (IRIS). Seismic data from the GSN flow in real time to the USGS *National Earthquake Information Center* (NEIC) in Golden, Colorado, where they are analyzed. ANSS and GSN seismic data are also relayed in near-real time to the NOAA tsunami warning centers, enabling those centers to respond within minutes after a major earthquake. The USGS and NOAA exchange earthquake locations and magnitude estimates, with USGS providing the final authoritative magnitudes of events.

Using $9.6 million allocated by Congress under the American Recovery and Reinvestment Act (ARRA), the USGS and NSF are modernizing the Global Seismographic Network. Although the GSN is nearly complete, the ARRA-funded upgrades are being used to maximize the performance and efficiency of the existing network. The USGS is also using ARRA funds to modernize the ANSS. When the ARRA investments are completed at the end of this year, the ANSS will be approximately 25% completed.

The USGS also participates in the *National Tsunami Hazard Mitigation Program* (NTHMP), a partnership among NOAA, the USGS, FEMA, NSF, and the 28 coastal U.S. States and Territories. The NTHMP reduces the impact of tsunamis through hazard assessment, warning guidance, and mitigation. The USGS invested $2.3 million in FY 2010 in research and assessment activities supporting the goals of the NTHMP. The NTHMP is coordinating the preparation of tsunami inundation maps for high-risk coastal communities in Alaska, California, Hawaii, Oregon, and Washington. The USGS provides guidance in the preparation of these maps by analyzing and interpreting deposits from historic and prehistoric tsunamis to estimate inundation limits, flow velocities, and recurrence intervals. The USGS works with the NTHMP partners to develop education and outreach programs that turn our scientific understanding of tsunamis into easily-understood explanations of tsunami hazards facing American coasts. The USGS, along with NOAA, NASA, FEMA, and the Army Corps of Engineers, also contributes capabilities to survey coastal and near-shore bathymetry and topography. Finally, to determine the effects of tsunami inundation on land, USGS maps the run-up elevation and distance, flow-speed and direction indicators, and patterns of sedimentary deposition.

Tsunami threats in the Pacific

The West Coast of the United States, Hawaii, and the Pacific Territories are all at risk for damage from tsunamis generated by distant earthquakes. U.S. shores also host two subduction zones that are capable of magnitude-9 earthquakes: one off shore from Alaska, which last ruptured in 1964, and the other in the Pacific Northwest, known as Cascadia, which last ruptured in 1700.

Earthquakes in the Alaska and Aleutian subduction zones generated tsunamis in 1938, 1946, 1948, 1957 and 1964. Overall, approximately 16 tsunamis of all sources with inundations over three feet have occurred in Alaska since 1853. Alaska's famous fjords are also the source for another type of "tsunami": one in which landslides perched on the steep walls of fjords catastrophically fail and splash into the water, generating extreme wave heights. An example is the 1958 Lituya Bay tsunami, which was caused by an earthquake-triggered landslide. Local inundation reached 1,720 feet above sea level. These are localized phenomena and they do not produce distant tsunamis.

While the Cascadia subduction zone has not produced a great earthquake in the past 300 years, recent investigations of offshore deposits indicate that the zone may have produced magnitude 9-size earthquakes perhaps 20 times in the past 10,000 years, and more frequently magnitude 8-size earthquakes, at least in its southern extent. More research is therefore needed to fully document and assess the earthquake and tsunami potential of the Cascadia zone.

Hawaii also has a long recorded history of tsunamis, not only from distant sources but from earthquakes and landslides near Hawaii, termed local tsunamis. In the 20th century, an estimated 221 people were killed by tsunamis on the islands of Hawaii. One of the largest and most devastating tsunamis Hawaii has ever experienced was in 1946 from an earthquake along the Aleutian subduction zone. Run-up heights reached 33 to 55 feet and 159 people were killed. That tsunami caused more than $26 million in damage (not adjusted for inflation).

Tsunamis are not solely produced by earthquakes. Approximately 5 percent of tsunamis that occurred in the past 250 years were produced by volcanoes. Some of these are among the most destructive tsunami events known. Volcano-induced tsunamis are generated in various ways but the largest, most destructive tsunamis have been caused by explosive eruptions and flank collapse events on island and coastal volcanoes. There is a demonstrated volcanic tsunami hazard in Alaska and Hawaii and a likely one in the Commonwealth of the Northern Mariana Islands. Improved volcano monitoring systems and response planning at volcanoes that have a potential tsunami hazard would help provide better mitigation.

Tsunami threats in the Atlantic

With respect to the U.S. Atlantic coast, nearby subduction zones are present only in the Caribbean Sea region (see below). But the Atlantic Ocean is not immune to tsunamis. A tsunami following the great 1755 Lisbon earthquake devastated coasts of Portugal and Morocco, reached the British Isles, and crested as high as 20 feet in the Caribbean. However, this tsunami did not affect the east coast of North America because of the perpendicular orientation of the plate boundary to the coast.

The large 1929 Grand Banks earthquake triggered a submarine landslide and tsunami that struck Newfoundland's sparsely settled coast, where it killed 27 people. An event like this, involving a submarine landslide, may be the most likely scenario for the Atlantic coast. Scars of past large submarine landslides abound on the continental slope off the Atlantic coast. As in the 1929 Grand Banks event, some of the slides probably resulted from large earthquakes. If earthquakes are the primary initiator of the observed landslide features, the hazard to the Atlantic coast is limited, as large earthquakes rarely occur in the vicinity of the Atlantic coast of North America—perhaps once a century, on average (Boston area, 1755; Charleston, 1886; Newfoundland, 1929). Additionally, this type of tsunami would affect a much smaller geographical area than one generated by a large subduction-zone earthquake, and its flooding effect and inundation distance would be limited by its shorter wavelength. However, more work is needed to more fully understand the triggering of submarine landslides and the extent of that threat in the Atlantic.

Tsunami threats in the Caribbean

The Caribbean is subject to a broader range of processes that have the potential to generate tsunamis. The sediments of the Netherlands Antilles yield evidence for large, prehistoric tsunamis from about 400 to about 3500 years ago. Three severe tsunamis have occurred at or near U.S. territories in the past 150 years: St. Thomas, 1867, several deaths; Puerto Rico, 1918, 42 deaths; and the Dominican Republic, 1946, 1,790 deaths by some reports.

The Caribbean Plate boundary is prone to tsunamis because it has all the tsunami-generating sources within a small geographical area:

1. Subduction-zone earthquakes of the type that generated the Japanese tsunami found along the Lesser Antilles and the Puerto Rico trench and the Hispaniola trench (1946 tsunami);
2. Other moderately large earthquakes due to more local tectonic activity that take place probably once a century, such as in Mona Passage (1918 tsunami) and in the Virgin Islands basin (1867 tsunami);
3. Moderate earthquakes that can trigger an undersea landslide;
4. An active underwater volcano ("Kick'em Jenny" near Grenada) where sea floor maps show previous episodes of flank collapse;
5. Above-water volcanic activity, wherein the Lesser Antilles periodically generates landslides that enter the sea to cause tsunamis; and
6. Distant tsunami from the African-Eurasian plate boundary, such as the great Lisbon earthquake of 1755, which produced 20 to 25 foot-high waves in the Lesser Antilles.

In 1867, a 9 foot high tsunami wave entered St. Thomas' Charlotte Amalie at the same time that a 21 to 30 foot wave entered St. Croix's Christiansted Harbor. Were that to occur again today significant infrastructure and population would be at immediate risk. According to UNESCO, if several cruise ships are in Charlotte Amalie when the 1867 event re-occurs, direct economic damage of between $500 million and $1 billion is possible.

International coordination

Significant progress has been made in international coordination of tsunami warnings since the Indian Ocean tsunami disaster of 2004. With NOAA leading tsunami warnings for the United

States, the USGS participates in regional tsunami coordination efforts, organized by the United Nations Educational, Scientific and Cultural Organization (UNESCO), in the Pacific, Indian Ocean, Caribbean, and Atlantic/Mediterranean regions. These efforts have led to the development of regional warning systems, data sharing, and the standardization of tsunami information products and coordination mechanisms.

Lessons learned from the March 11 earthquake and tsunami in Japan

Through our National Earthquake Information Center, the USGS provided rapid, accurate, authoritative and actionable earthquake information for the Japanese earthquake and its aftershocks, and their potential for damage. Technical coordination between the NOAA Tsunami Warning Centers and the USGS National Earthquake Information Center was exemplary. Following the earthquake, the USGS led inter-agency coordination activities under the National Earthquake Hazards Reduction Program (NEHRP). Still, there are several key lessons to be learned from the Tohoku earthquake:

- Scientists must thoroughly document the prehistoric record of large earthquakes, in order to fully assess the probabilities and consequences of the largest earthquakes.
- While tsunami damage and loss of life were heavy, preliminary information indicates that the investments made by Japan in monitoring and warning systems, earthquake resistant construction, and public information and preparedness activities dramatically limited damage and loss of life.
- Tsunamis can be generated very near the coastline. For tsunami warnings to be most effective, they must be generated and transmitted to the affected coastline as quickly as possible after detection.

Conclusion: Becoming more resilient to large earthquakes and tsunami

The United States could reduce tsunami risks and improve public hazard notification and warning of tsunami and their causative earthquakes in three basic areas:

- Continued public education, through ongoing efforts for the U.S. Pacific States and Territories, particularly in Hawaii and the Pacific Northwest.

- Completion of the Advanced National Seismic System, including the enhancement of the seismic network in the eastern United States, and the development of earthquake "early warning" capabilities (which were in place in Japan) along the West Coast of the United States. For earthquakes located near the coast, the requirement for rapid and accurate analysis is most pronounced.

- Enhanced research into the frequency and effects of prehistoric tsunamis. The recorded history in the Western Hemisphere is too short to provide adequate probabilities for such events to happen. Seismic characterization of tsunamigenic faults and study of past landslides on the sea floor and paleo-tsunami deposits on land are needed.

Mr.Chairman, this concludes my remarks. I will be pleased to answer any questions you or the Committee may have.

Mr. CHAFFETZ. Thank you. I appreciate your comments.

Ms. Glackin, you are recognized for 5 minutes.

STATEMENT OF MARY GLACKIN

Ms. GLACKIN. Thank you. Good afternoon, Mr. Chairman, Ranking Member Tierney and others members of the committee. We appreciate the opportunity to testify on this important topic this afternoon.

NOAA plays a critical role in ensuring our Nation is warned of many natural and man-made hazards and prepared to respond to these. The March 11th Japanese earthquake and tsunami served as reminders of our vulnerability to these hazards. And as my colleague has just described, there are major threats in our coastal regions. A rupture along any of these faults could set off a tsunami relatively close to the shore and impact coastal communities in mere minutes. NOAA is working to ensure our Nation is prepared for such potential catastrophes.

A comprehensive and effective tsunami warning process requires three parts. First, observations for detection and models to forecast the path and the impact. Second, timely and accurate alerts. And perhaps most importantly, community education and awareness to ensure the proper public response to alerts and warnings.

Today I want to discuss very briefly how NOAA integrates all three of these components and works with our customers and partners to ensure our Nation is prepared. We provide a host of products and services that minimize the impact of tsunamis, from advance preparedness of coastal communities to detection and warning service to post-event response and recovery efforts. NOAA operates a suite of instruments and tools, including an array of ocean buoys and monitoring stations more to the sea floor, sea level gauges at the coastline, our polar orbiting satellites are involved and that of our advanced computer modeling.

NOAA's services include around the clock forecast and warning centers and extensive public outreach and education efforts. Within minutes of the Japanese earthquake, NOAA received seismic data from USGS and other partners, and issued tsunami warnings and information statements for both domestic and international communities through our two centers in Hawaii and Alaska.

Wave data from our deep ocean data buoys and coastal data from our tide gauges were relayed via satellites and integrated into tsunami models. Our talented professionals translated this into warnings and forecasts. These alerts and warnings provided lead times of 7 hours for Hawaii, 4 hours for Alaska, and 9 hours for the west coast. Local and national weather service forecast offices that serve the U.S. coastline issued localized tsunami impact statements.

Together, this information helped emergency managers and local officials evaluate the ongoing threat until all the warnings and advisories were finally dropped over 36 hours after the initial earthquake.

The best warning information, however, is worth little unless those at risk are prepared and ready to respond. To achieve this level of preparedness, NOAA is engaged in an extensive array of outreach and education efforts. We work with our Federal partners, with local and State governments through the National Tsunami

Hazards Mitigation program. This program, formed in 1995 and reauthorized by Congress in 2006, works to reduce the impact of tsunamis on the U.S. coastal communities and includes all 28 U.S. coastal States, territories and commonwealths.

This program stresses the importance of NOAA's tsunami-ready program, a voluntary partnership among NOAA, State and local emergency management agencies. It strives to increase the public awareness of the threat that tsunamis pose, improve hazard planning and strengthen warning communication, linking the emergency management community with the public. Currently, there are 83 tsunami-ready communities. NOAA's goal is to recognize 105 by 2013.

We believe that tsunami-ready and the National Tsunami Hazards Mitigation Program is a model program for how the government at all levels can work together to improve hazard resilience in the United States.

In summary, the investments made by Congress and the administration in NOAA's tsunami warning system and the National Tsunami Hazard Mitigation program directly saved lives in the United States during last month's Pacific-wide tsunami disaster. Nothing can eliminate the physical threat that tsunamis pose. However, NOAA remains committed to leading U.S. efforts to save lives and property through tsunami preparedness, detection and forecasting efforts.

We will work in partnership to continuously improve our natural hazard services to the Nation. Thank you.

[The prepared statement of Ms. Glackin follows:]

WRITTEN STATEMENT BY
MARY GLACKIN
DEPUTY UNDER SECRETARY FOR OPERATIONS
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

COMMITTEE ON OVERSIGHT AND GOVERNMENT REFORM,
SUBCOMMITTEE ON NATIONAL SECURITY, HOMELAND DEFENSE AND FOREIGN OPERATIONS
U.S. HOUSE OF REPRESENTATIVES

April 14, 2011

Good morning Chairman Chaffetz, Ranking Member Tierney, and Members of the Subcommittee. My name is Mary Glackin and I am the Deputy Under Secretary for Operations for the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA). Thank you for the opportunity to testify at this hearing about natural hazards, including tsunamis, and our Nation's warning, preparedness, and response programs.

NOAA plays a critical role to ensure our Nation is warned of natural and man-made hazards, and is prepared to respond when these events occur. While probably best known for our role in hurricane, flood, and tornado forecasts and warnings, today I will focus my testimony on NOAA's forecasting, preparedness, and response role for tsunamis.

The March 11, 2011 Japan earthquake and tsunami serve as a stark reminder of human vulnerability to natural hazards. Japan is arguably one of the best prepared nations in the world for these two types of hazards, yet they have had severe challenges coping with the aftermath of the event. While the physical devastation wrought by the double punch of natural hazards is tremendous and the estimated loss of over 20,000 lives tragic, if not for Japan's extensive preparedness, the toll in human lives lost would have been far more catastrophic.

Of all Earth's natural hazards, devastating tsunamis may be among the most infrequent - but they pose a major threat to populous coastal regions, particularly in the seismically active Pacific Ocean Basin. One reminder of our Nation's own vulnerability is the Cascadia subduction zone – a geologic fault that runs just 50 miles off the coast of the Pacific Northwest from northern California to southern British Columbia in Canada. Other areas of concern for the U.S. are similar subduction zone faults within 70 miles of coasts of Alaska and Puerto Rico. A rupture along any of these faults could set off powerful ocean waves relatively close to shore, with the first waves impacting coastal communities in mere minutes. NOAA is working to ensure our Nation is prepared for such catastrophes, and for other environmental hazards both natural and man-made.

A comprehensive and effective tsunami warning process requires three parts:

- Observations to detect a tsunami and models to forecast path and impact,
- Timely and accurate alerts, and
- Proper response to the notifications as a result of ongoing community education and awareness activities.

Today, I will discuss how NOAA integrates all three components to form an effective tsunami warning, preparedness and response program.

NOAA'S ROLE

NOAA provides a host of products and services that minimize the impacts from tsunamis, from advanced preparedness of coastal communities, to detection and warning services, to post-event response and recovery efforts. NOAA operates a suite of instruments and tools including an array of ocean buoys and monitoring stations moored to the sea floor, sea level gauges along the coast, orbiting satellites, and advanced computer modeling. NOAA's services include around-the-clock forecast and warning centers and extensive public outreach and education efforts, providing the essential detection and warnings necessary to alert emergency officials and the public about the threat of tsunamis as well as information to help communities prepare for those threats.

With more than 40 years of experience building effective observation and warning systems, NOAA has operational responsibility for the U.S. Tsunami Warning System. NOAA's National Weather Service (NWS) issues tsunami warnings, advisories, and watches for the entire coastline of the U.S., its territories and commonwealths, and many nations in the Pacific and Caribbean, to alert emergency managers and the public to take life-saving actions. Tsunami alerts and warnings are issued by two warning centers: NOAA's Pacific Tsunami Warning Center (PTWC) in Ewa Beach, Hawaii, and NOAA's West Coast and Alaska Tsunami Warning Center (WC/ATWC) in Palmer, Alaska.

Within minutes of the Japanese earthquake, NOAA's PTWC issued tsunami warnings for Japan, Russia, Marcus Island, and the Northern Marianas Islands based on analysis of accessible global seismic data. Using readily-available seismic data, NOAA's WC/ATWC issued tsunami information statements assessing the potential preliminary threat for Alaska, British Columbia, Washington, Oregon, and California. After assessing the potential threat, both centers issued tsunami warnings and alerts for Hawaii, Alaska, Washington, Oregon, and California. These alerts and warnings provided lead times of seven hours for Hawaii, four hours for Alaska, and nine hours for the West Coast. Local NWS Forecast Offices that serve the U.S. coastline issued localized tsunami impact statements for areas such as Crescent City, California, which was heavily impacted by waves, rising waters, and tsunami generated currents for more than 24 hours following the initial tsunami wave that reached that area.

NOAA's initial tsunami warnings were expanded to include Hawaii and portions of Alaska and the West Coast, based on warnings that were updated with more specific observational data as the tsunami wave moved across the Pacific Ocean. For example, about 25 minutes after the earthquake, the tsunami was detected by one of NOAA's

Deep-ocean Assessment and Reporting of Tsunami (DART) stations located off the east coast of Japan. The information from the DART station along with coastal sea-level data was fed via satellite into NOAA's tsunami models that simulate the generation, propagation, and inundation of the tsunami. Coupled with data defining the shape of the ocean floor, the tsunami models provided predictions of arrival times, wave heights, and inundation areas for specific U.S. coastal locations to augment the original tsunami warnings and forecasts.

NOAA monitored the tsunami as it traversed the globe, largely through a global network of water-level gauges, in which NOAA's National Ocean Service's (NOS) gauge capacity plays a key role. NOS' tsunami-capable tide stations provide complete coverage for the U.S. coastline (see http://tidesandcurrents.noaa.gov/tsunami/ for locations). These data were rapidly relayed from these remote gauges via NOAA's Geostationary Operational Environmental Satellites (GOES) to tsunami warning centers. The U.S. Integrated Ocean Observing System, a NOAA-led interagency-regional collaboration to deliver ocean and coastal information, also provided real-time water level measurements for various Pacific locations through its partners in the Pacific islands. Together, these leveraged and complementary observation networks helped emergency managers and local officials evaluate the ongoing threat from follow-on waves until all warnings and advisories were finally dropped over 36 hours following the initial earthquake.

In the aftermath of the earthquake and tsunami, NOAA continues to perform critical roles in areas most impacted by the tsunami. NOS deployed navigation managers to interface directly with and help assess the needs of the commercial maritime community. Navigation Response Teams conducted hydrographic surveys to assist with submerged debris detection in critical marine transportation arteries, such as the port areas of Santa Cruz and Crescent City, California. The results of these surveys gave decision makers the information needed to safely reopen the ports to fishing and commercial shipping interests. NOS also provided the U.S. Coast Guard and California authorities with scientific support services for responding to existing and potential chemical and oil spill situations as a result of damaged vessels and infrastructure. For all tsunamis, NOS and NOAA's Office of Marine and Aviation Operations have the ability to provide geo-referenced, high-resolution aerial imagery of tsunami-affected areas of the U.S. in coordination with the Federal Emergency Management Agency (FEMA) to support detailed damage assessment, recovery and rebuilding efforts.

NOAA also supports response activities related to Japan's compromised nuclear facilities. Atmospheric dispersion models developed at NOAA's Office of Oceanic and Atmospheric Research (OAR) helped predict the airborne transport of radioactivity. These results are used by the International Atomic Energy Agency (IAEA), Environmental Protection Agency, U.S. Army Public Health Command, among others, to help understand the potential impacts from increased radioactivity. Twice a day, NWS is providing wind and precipitation forecasts for Fukushima and Tokyo, forecast discussions and a seven-day weather outlook for Fukushima. NOAA was recently named co-lead with the White House Office of Science and Technology Policy of a working group that will develop an ocean plume model for currents and worst case radiological

effects on the ocean. NOAA's National Marine Fisheries Service supports the Food and Drug Administration and the U.S. Department of Agriculture in ensuring a continuous safe supply of seafood to the American public, including monitoring of imports that may have been impacted by radioactivity.

THE GROWTH OF THE U.S. TSUNAMI WARNING SYSTEM

In December 2004, the catastrophic effects of the Indian Ocean tsunami focused the world's attention on the very real threat of tsunamis world-wide, and underscored the value of a comprehensive warning system and an educated public. Congress acted swiftly after that natural disaster and provided needed funding to improve the Nation's tsunami program – from preparedness to detection and prediction. NOAA thanks Congress for the important investment that was made in improving the Nation's tsunami capabilities.

Prior to the Indian Ocean tsunami, NOAA had been steadily developing and improving the Nation's tsunami observing and prediction capabilities for decades, during a time when the threat of tsunamis was not recognized as publicly. In 1995, OAR developed the DART stations to provide crucial information on tsunami strength in the open ocean. OAR also developed advanced tsunami models that employ DART data to provide accurate tsunami inundation predictions for entire ocean basins.

NOAA uses the U.S. Geological Survey's (USGS) national earthquake monitoring network and the Global Seismic Network to analyze the earthquakes which can trigger tsunamis. NOAA also uses its NWS local operational seismic networks in Alaska and Hawaii to supplement USGS global data. NWS installed these networks after devastating earthquakes and local tsunamis before the global USGS network was established. The USGS received supplemental funds since the Indian Ocean tsunami to improve its seismic network and the smaller NWS networks. Together, NOAA and USGS leverage the resources and assets of each agency to increase the density of the seismic network to move closer to the density of Japan's state-of-the-art network. A denser network allows for quicker earthquake detection, warning and intensity determination, allowing NOAA to issue its tsunami warnings more quickly.

NOAA monitors and maintains an extensive water level observation network in coastal states and territories and has access to the global network of stations to detect and observe coastal water levels critical to understanding and predicting tsunamis. The data from these stations are used in NOAA's tsunami forecast models provide estimates of tsunami arrival times and the maximum tsunami wave height for areas at-risk to tsunami and surge events, assisting federal, state and local emergency managers in decisions about the need for evacuations and other safety measures.

Since receiving $17 million of emergency supplemental funding in fiscal year 2005 associated with the Indian Ocean tsunami, NOAA has made dramatic improvements to the Nation's tsunami warning program. These improvements included upgrading its detection capability by installing a global network of 39 DART stations (see Figure 1) that are operated and maintained by the NWS, and moving to 24x7 operations of its

tsunami warning centers. Efficiency of critical tsunami-related information delivery via satellite communications was also improved with these funds.

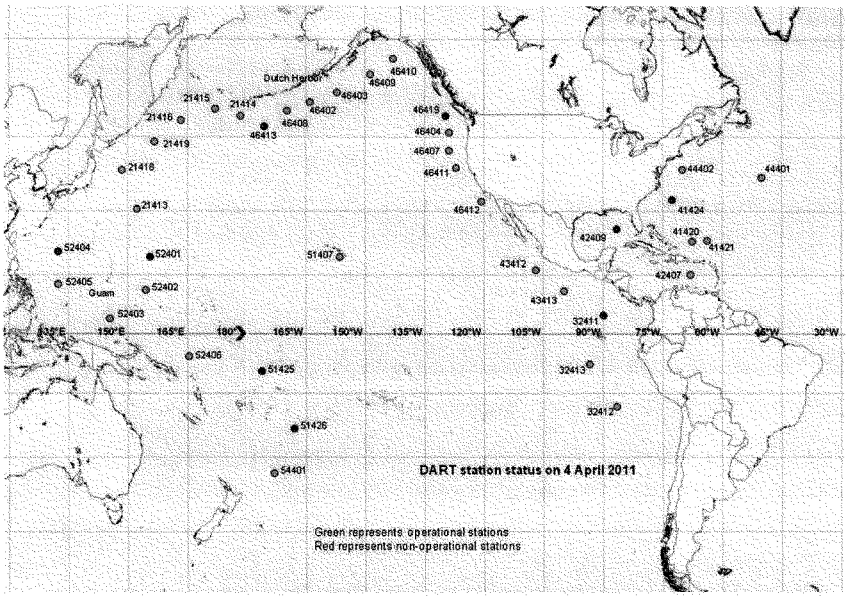

Fig. 1 Locations and operational status of the DART buoys

The funding Congress invested in NOAA has proven to be money very well spent. The warnings issued by NOAA's Tsunami Warning Centers were timely and very accurate (see Figure 2). Coupled with an effective education and outreach campaign, NOAA's response to the Japan tsunami saved countless lives and prevented property damage. NOAA has been operationally forecasting tsunami height for only the past few years, with much of the improved modeling capability driven by supplemental funding and funding provided by the 2005 Deficit Reduction Act. Only ten years ago, predicting the timing and height of tsunamis was a limited and speculative capability. NOAA has come a long way since then, but still has room to improve forecast accuracy.

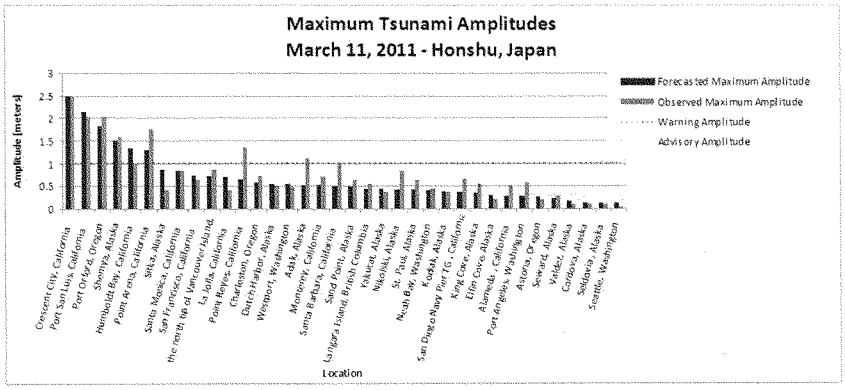

Fig. 2 Forecast and observed tsunami amplitudes

OUTREACH AND EDUCATION

In addition to providing accurate observations and alerts for natural hazards, an educated and responsive public is critical to achieving community preparedness for any natural hazard and in particular a rare and unpredictable event such as a tsunami. Simply knowing the precursors to a tsunami – strong coastal earthquakes or rapidly receding water – and having a pre-defined action plan for moving rapidly to a higher location, have the potential to save countless lives even in areas where warnings are not received. To achieve this level of public awareness, NOAA has engaged in an extensive array of outreach and education efforts.

Globally, NOAA supports outreach and education through the International Tsunami Information Center in Hawaii, operated by NOAA's National Weather Service for the United Nations Educational, Scientific and Cultural Organization's Intergovernmental Oceanographic Commission. On the national level, NOAA and our Federal partners work with local and state governments through the National Tsunami Hazards Mitigation Program (NTHMP), which is designed to reduce the impact of tsunamis on U.S. coastal communities. The NTHMP consortium includes all 28 U.S. coastal States, Territories and Commonwealths, USGS, FEMA, and NOAA. It is a model program for how government at all levels can work together to improve hazard resilience in the United States.

Led by the NWS, with additional support from OAR, the NTHMP is the Nation's community-focused program to improve tsunami mitigation and preparedness of at-risk areas within the United States and its territories. While the United States is not subject to frequent tsunamis, the impact of just one destructive tsunami can be truly catastrophic. To reduce the social and economic effects of a tsunami, the NTHMP takes actions to improve preparedness and response of U.S. coastal communities.

With the passage of the Tsunami Warning and Education Act in December 2006, the mission of the NTHMP has been further focused on:

- Improving the quality and extent of coastal inundation mapping,
- Promoting and improving community outreach and education networks and programs to ensure community readiness,
- Integrating tsunami preparedness and mitigation programs, and
- Promoting the adoption of tsunami warning and mitigation measures by Federal, state, tribal, and local governments and non-governmental entities.

One component of the NTHMP and NOAA's mitigation and education preparedness activities is NOAA's TsunamiReady™ program. TsunamiReady™ is a voluntary partnership between NOAA, state, and local emergency management agencies. The TsunamiReady™ program strives to increase public awareness of the threat that tsunamis pose, improve hazard planning, and strengthen warning communication linking the emergency management community and NWS with the public. The current goal of TsunamiReady™ is to create tsunami resilience in communities by better integrating tsunami hazard preparedness into coastal community culture, and providing coastal jurisdictions with a level of "minimal readiness" for the tsunami hazard.

To support proper response to tsunamis, local NWS forecast offices and other NOAA resources work with coastal counties, cities, and "communities," which may include schools, businesses and public venues, to become TsunamiReady™. For communities to achieve this recognition they must have the ability to receive NOAA's tsunami alerts, further warn the public, identify evacuation zones and conduct tsunami education activities. Currently, there are 83 TsunamiReady™ communities, including all four counties in Hawaii, seven communities in Alaska and 42 along the west coast. NOAA's goal is to recognize 105 TsunamiReady™ communities by 2013. The NWS TsunamiReady™ program and other outreach efforts such as the first National Tsunami Awareness Week (March 20-26, 2011) educate local communities on how to properly respond to tsunamis.

NOAA'S FUTURE IMPROVEMENTS

With our integrated, agency-wide program, NOAA has demonstrated the capability to help formulate accurate and timely warnings and has made tremendous progress in educating vulnerable communities in preparing for and responding to tsunami warnings. However, as the Japan tsunami has shown, tsunamis near coastal earthquake epicenters can cause catastrophic local damage to even the most well prepared nations. NOAA recognizes the important role our Federal and State partner agencies play in improving our understanding of, preparation for, and response to all types of tsunamis. We are working together with these partners to provide vital information tools and services to help prevent and mitigate the security, economic, and public health risks our country faces from catastrophic near-source tsunamis.

NOAA is currently working on several actions to further improve the U.S. capabilities and preparedness for future tsunamis including:

- Developing tsunami inundation forecast models for harbors in Hawaii, the Pacific Islands, and the U.S. west coast that do not already have them,
- Working with our agency and state partners in the NTHMP to accelerate local tsunami preparedness capabilities, and
- Working with the international community on tsunami research and leveraging of assets.

SUMMARY

The dual goals of preparing for and mitigating natural hazards requires the continuous commitment and partnership of many individuals and sectors - from Federal, state, tribal, and local to public, private, and academic. The investments made by Congress and the Administration in NOAA's Tsunami Warning System and the National Tsunami Hazard Mitigation Program *directly* saved lives in the U.S. during last month's Pacific-wide tsunami disaster and during the American Samoa tsunami of September 2009. NOAA remains committed to leading U.S. efforts to save lives and property through tsunami preparedness, detection, and forecasting efforts. Although nothing can eliminate the physical threat that tsunamis and natural hazards pose, NOAA has demonstrated success in better predicting their onset, reducing their impact, and helping vulnerable communities become more resilient to the devastating effects tsunamis pose – and will work to continuously improve its natural hazards products and services to the Nation.

Ms. Ward, you are recognized for 5 minutes.

STATEMENT OF NANCY WARD

Ms. WARD. Good afternoon, Mr. Chairman, Ranking Member Tierney and distinguished members of the subcommittee.

I am the Regional Administrator for FEMA Region IX. My region encompasses California, Hawaii, Arizona, Nevada, American Samoa, Guam, the Commonwealth of the Northern Mariana Islands, the Republic of the Marshall Islands and the Federated States of Micronesia.

I am pleased to be here alongside Ken Murphy, Regional Administrator for FEMA Region X, which encompasses Alaska, Idaho, Oregon and Washington. We are honored to be here today.

I would first like to say that our thoughts and prayers go out to the people of Japan as they continue to recover from the devastation of the past several weeks. The events in Japan also serve, however, as a reminder of the importance of tsunami preparedness in our own country. While tsunamis occur infrequently, they have the potential to cause major destruction to the coastal communities in several FEMA regions.

Because tsunamis present great potential for damage to both people and property, all levels of government must be prepared for the threats associated with them. We in government also have a responsibility to coordinate our preparedness efforts with non-governmental entities, including private sector organizations, non-profit and faith-based groups, and perhaps most important, the individuals and families who live in these potentially affected communities.

My written testimony discusses FEMA's catastrophic planning efforts, which both includes all hazards approaches, a certain hazard-specific plans in areas at heightened risk for tsunami. This afternoon, however, I would like to discuss the recent tsunami threat to Region IX as an example of how FEMA works to support our State and local partners in the event of tsunami threat.

Just after 10 p.m. March 9th, FEMA region was alerted to a magnitude 9 earthquake, soon followed by a Pacific-wide tsunami warning. The Region IX watch center immediately alerted Region IX senior staff and made contact with our national watch center. Within the hour, the FEMA regional support team and our regional support coordination center was activated to a Level 1, FEMA's highest activation level. Our regional on-call incident management assistance team was noticed and placed on alert for immediate deployment to a potential tsunami-impacted area. Key Federal agency partners were also mobilized and directed to report to the RRCC to emergency support function coordination and assets.

Immediately following activation of our regional response coordination center, Region IX established lines of communication with our States and territorial partners, including FEMA Region X as a communication hub for jurisdictions throughout the Pacific. Simultaneously, in Hawaii, the FEMA Region IX Pacific Area office, located out in Fort Shafter in Hawaii, went operational. The Pacific Area office deputy director was dispatched to the State of Hawaii's civil defense emergency operations center and co-located with our State partners throughout the entire incident period.

In the aftermath of the tsunami, Region IX worked closely with Hawaii and California to conduct preliminary damage assessments. These PDAs resulted in disaster declarations requests for both Hawaii and California, a disaster declared last week for the State of Hawaii and California's request is still under review. Similarly, in Region X, FEMA's activation and coordination with their States resulted in a disaster declaration for the State of Oregon.

As is both policy and doctrine at FEMA, we worked very closely with all of our Federal Government partners, including invaluable contributions by both NOAA and the USGS. We also plan, train and exercise year around with State, local, tribal and territorial governments to help with tsunami and other planning education and awareness. As an example, FEMA supports the National Weather Service to promote the tsunami-ready campaign. We also encourage States and localities to use their grant funding to increase their disaster preparedness.

While no coastal community is tsunami-proof, we work with the community leaders and emergency managers to reduce the potential for disastrous tsunami-related consequences. The events in Japan have also raised important questions as to how a catastrophic earthquake and tsunami might affect our nuclear facilities and surrounding areas. At the direction of Administrator Fugate, we have increased our participation and exercises associated with our nuclear plants.

We are focused on conducting exercises that provide a true test of our emergency protocols and capabilities. This week, for instance, in San Onofre, California, State emergency experts are leading a mandated biennial exercise of the Southern California Edison Beachfront Nuclear Power Plant stationed in Orange County, California, a site, I might add, that supports the National Weather Service's tsunami-ready designation. As would be the case in any actual event, the NRC and the State have the primary authority. FEMA Region IX is participating in the exercise, both as a player and as an evaluator of how the exercise unfolds.

Most important, however, we work to instill a commitment to personal preparedness. April is also earthquake preparedness month, which will provide more of a platform for us to disseminate information. Thank you.

[The prepared statement of Ms. Ward follows:]

Written Statement of

Nancy Ward - Region IX Administrator

And

Ken Murphy – Region X Administrator

Federal Emergency Management Agency

"Tsunami Warning, Preparedness, and Interagency Cooperation: Lessons Learned"

Before the
Committee on Oversight and Government Reform

Subcommittee on National Security, Homeland Defense and Foreign Operations

U.S. House of Representatives
Washington, DC

April 14, 2011

I. Introduction

Good afternoon Chairman Chaffetz, Ranking Member Tierney and distinguished Members of the Subcommittee. It is an honor to appear before you today on behalf of FEMA to discuss tsunami preparedness.

Tsunamis, also known as seismic sea waves, are a series of enormous waves created by an underwater disturbance such as an earthquake, landslide, volcanic eruption or meteorite. A tsunami can move hundreds of miles per hour in the open ocean and smash into land with waves as high as 100 feet or more. Tsunamis are most common along the Pacific coast, but can strike anywhere along the U.S. coastline. The topography of the coastline and the ocean floor will influence the size of the wave.

Recent history has shown the destructiveness and devastation that tsunamis can create. On December 26, 2004, a magnitude 9.0 earthquake off Sumatra generated a tsunami in ten countries, killing more than 280,000 people.

The United States and its territories have recent experience with a tsunami's destructive force as well. On September 29, 2009, a magnitude 8.1 earthquake struck off the coast of American Samoa in the Western Pacific Ocean and the tsunami that followed struck the island nations of Samoa, Tonga and American Samoa. The tsunami damage resulted in nearly 200 deaths, hundreds injured across all three islands, and millions of dollars in damages. After the tsunami, President Obama declared a major disaster for American Samoa, allowing FEMA and our federal partners to immediately move supplies and staff across the Pacific from the Region IX logistics facility in Hawaii. FEMA's National Response Coordination Center coordinated teams of experts from FEMA, the U.S. Department of Health and Human Services, the U.S. Coast Guard, the Department of Defense, the Department of the Interior's National Park Service, the U.S. Army Corps of Engineers, the Small Business Administration, and other partners to help move the island towards recovery.

Of course, the images of utter devastation still remain fresh in our minds from the events in Japan just last month. On the evening of March 10th, a magnitude 9.0 earthquake off the northeastern coast of Japan generated a tsunami wave up to 98 feet high that traveled up to six miles inland in some areas. The true toll of the earthquake, tsunami, and nuclear situation is not completely known at this time. The Japanese government has confirmed more than 12,000 deaths, and projected damage estimates in the hundreds of billions of dollars.

These recent events remind us why catastrophic preparedness in general, and tsunami preparedness in particular, is so important. Our testimony discusses FEMA's catastrophic planning efforts, the National Warning System, tsunami mitigation, and most importantly, personal tsunami preparedness.

II. Catastrophic Planning

An incident of catastrophic proportions has the potential to imperil millions of people, devastate multiple communities, and have far-reaching economic and social effects. Time is of supreme importance, and the imperative to take immediate action begins in the communities where people live and work, where businesses and industries operate, and where local governments and institutions reside.

At the heart of our planning and preparedness efforts is our strong belief that our ability to succeed is tied to whether or not we are able to work together as a team. We must view all of the work FEMA does in concert with the rest of the emergency management team as part of a broad plan for addressing the demands and challenges of a catastrophic disaster.

In that regard, FEMA's "Whole Community" initiative recognizes and seeks to leverage the capabilities that both governmental and non-governmental entities play in preparing for and responding to a catastrophic disaster. It will take every member of the team working together for us to be successful in a catastrophic event.

We cannot effectively respond to a catastrophic disaster alone. Our planning and preparedness scenarios require all parties to pitch in, including FEMA and its partners at the federal level; state, local and tribal governments; non-governmental organizations in the non-profit, faith-based and private sector communities; and most importantly, individuals, families, and communities, who continue to be our most important assets and allies in our ability to respond to and recover from a major disaster.

As the name of the initiative indicates, it is truly the *whole* community that must be prepared to respond in ways that extend beyond the normal paradigms in which we have traditionally operated. As a result, FEMA is addressing its own preparedness and response capabilities through the whole community framework. And it is through that lens that we will work to improve our preparedness for the next catastrophic disaster.

All Hazards Catastrophic Planning

Because disasters often occur with little to no notice, our catastrophic event response plans must be comprehensive and wide-ranging. Regardless of the type of emergency or disaster, FEMA will plan and be prepared to support our citizens and first responders by implementing and coordinating an accelerated, proactive national response to a catastrophic incident.

FEMA is coordinating and facilitating the development of detailed state and regional catastrophic response plans for earthquakes, hurricanes, tsunamis, improvised nuclear device attacks and other threats. Our planning assumptions for catastrophic disasters are based on worst-case scenarios and are designed to challenge preparedness at all levels, forcing innovative, non-traditional solutions as part of the response strategy to such events. To more effectively carry out operational planning, our Response Directorate has aligned existing federal response planning initiatives into a more holistic and coordinated planning approach that will incorporate

activities such as catastrophic planning, evacuation and transportation planning and emergency communications planning.

We have identified the highest priority tasks necessary to save and sustain lives and stabilize a catastrophic incident during the crucial first 72 hours, and have begun to work across all segments of society to identify how we can collectively achieve these outcomes. While the initial 72 hours after an incident are the most critical in saving and sustaining life, our approach spans not only response operations following a disaster, but also prevention, recovery, protection, and mitigation activities that occur before, during and after a catastrophic event. Changing outcomes will require public engagement and public action, which means fully embracing dialogue between our public safety and emergency services institutions and the communities they serve. This planning process results in the development and identification of existing capabilities that can be employed using pre-established logistics protocols and deployment solutions.

Hazard-Specific Response Plans

Recognizing that certain disasters present greater likelihoods of occurrence depending on the location, FEMA also conducts regional catastrophic planning efforts to address area-specific disaster scenarios. The plans focus on the immediate application of resources to life-saving and life-sustaining missions, with a goal of stabilizing the event within the first 72 hours. Some of our tsunami-focused planning efforts include:

- Cascadia Subduction Zone Planning Project: Located just off the Pacific Northwest Coast, the Cascadia Subduction Zone is an 800-mile long fault zone. The disaster response plan is based on a magnitude 9.0 earthquake and tsunami with a complete rupture along the entire fault. The plan is being developed as part of a partnership between FEMA Regions IX and X, the Department of Homeland Security's National Protection and Programs Directorate and Homeland Infrastructure Threat and Risk Analysis Center, state emergency management agencies in California, Washington, Oregon, Idaho and Alaska, and Canadian public safety officials in British Columbia. The planning efforts are currently in step 1 (forming the Collaborative Planning Team) of a six-step planning process. This planning project is scheduled to be completed in late 2012/early 2013. In the event of a Cascadia Subduction Zone earthquake or tsunami event before the completion of this plan, Regions IX and X will use existing national level plans, including the National Response Framework, the National Incident Management System, and other scenario specific plans, and tailor them as necessary to support response efforts.

- Earthquake/Tsunami Plan for Puerto Rico and U.S. Virgin Islands: FEMA Region II is currently working with Puerto Rico and the U.S. Virgin Islands to address the impact of a tsunami in those areas. The planning efforts are currently in step 1 (forming the Collaborative Planning Team) of a six-step planning process. Implementation and Plan Signature is scheduled for 2012.

III. National Warning System

Section 202 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act requires the President to ensure that "all appropriate Federal agencies are prepared to issue warnings of disasters to State and local officials."[1] The President has delegated this authority to FEMA, which funds and operates the National Warning System (NAWAS).

NAWAS is used to disseminate warning information concerning major disasters to more than 1,800 warning points throughout the continental United States, as well as Alaska, Hawaii, Puerto Rico and the Virgin Islands. This information includes, but is not limited to, terrorist actions, aircraft incidents, earthquakes, floods, hurricanes, nuclear incidents/accidents, severe thunderstorms, tornadoes, winter storms and tsunamis.

NAWAS is a 24-hour private line telephone system used to convey warnings to federal, state and local governments, and emergency responders. NAWAS allows the issuance of warnings to warning points nationwide or to selected stations. FEMA funds, operates and controls NAWAS and carries out these warning functions through the FEMA Operations Center (FOC) and the FEMA Alternate Operations Center (FAOC). The FOC and FAOC are equipped and staffed to transmit warnings and emergency information to all or selected warning points on the NAWAS. States distribute warnings internally via NAWAS to local warning points and use state-controlled warning/communications systems to alert those political jurisdictions not directly served by NAWAS.

Warning of a possible threat to the public's health, safety and property originate from many sources to include the National Oceanic and Atmospheric Administration (NOAA) and offices within NOAA that provide a variety of weather, water, and other relevant environmental information. The National Weather Service provides short and long-range weather forecasts and severe weather warnings and watches; the National Hurricane Center provides hurricane and tropical storm predictions; and the Tsunami Warning Centers in Hawaii and Alaska provide seismic and tsunami information for the Pacific, Atlantic, Gulf of Mexico and Caribbean regions.

NAWAS was utilized during the recent tsunami threat to the west coast of the U.S. last month. The NOAA Tsunami Warning Centers were busy with both verbal warnings over NAWAS as well as issuing bulletins. Because they exercise day-to-day control of the western portion of NAWAS, the FAOC in Thomasville, Georgia has primary responsibility for putting up the announcements, but the FOC can initiate them as well.

American Samoa, which is not connected to NAWAS, receives a direct call to its Department of Public Safety from the FOC and selected operations centers in Canada are added to the conferences by telephone when appropriate. The information shared is extremely valuable as it is delivered in real time and allows state and local officials to react immediately. Following the initial tsunami warnings after the Japan Earthquake, the Tsunami Warning Centers provided more than 35 updates via NAWAS to California, Oregon, Washington, and British Columbia until all warnings and watches were lifted.

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[1] Disaster Relief Act Amendments of 1974, Pub. L. No. 93-288, 88 STAT. 143, 145 (May 22, 1974).

IV. Tsunami Preparedness and Mitigation

FEMA is a member of the National Tsunami Hazard Mitigation Program (NTHMP) Coordination Committee, which is chaired by NOAA and includes representatives from federal, state, local and tribal governments. Authorized by the Tsunami Warning and Education Act, the Coordination Committee recommends how funds appropriated for carrying out the NTHMP should be allocated, and ensures that all components of the program are integrated with ongoing hazard warning and risk management activities, emergency response plans, and mitigation programs in affected areas, including integrating information to assist in tsunami evacuation route planning.[2]

The primary goals of NTHMP are to: 1) raise tsunami awareness among potentially affected populations; 2) develop integrated tsunami maps and models that can be used to develop improved warning guidance and evacuation maps; 3) improve tsunami warning systems; and 4) incorporate tsunami planning into state and federal multi-hazard programs. Due to strong interagency collaboration through the NTHMP, integrated tsunami elevation models and inundation maps have been completed for many of the highest hazard U.S. coastal communities in the Pacific and Caribbean. Because tsunami mitigation is integral to the nation's overall effort to reduce coastal losses and improve resilience, the NTHMP takes a multi-hazards approach that responds to socio-economic and disaster management priorities. This includes sharing the coastal digital elevation models developed by NOAA and the NTHMP for other uses such as storm surge, coastal flooding, and habitat assessment.

FEMA also coordinates tsunami efforts with NOAA and the U.S. Geological Survey through the National Earthquake Hazards Reduction Program. Many communities along our nation's west coast are vulnerable to a tsunami triggered by an earthquake along the Cascadia Subduction Zone, which could potentially generate a tsunami of 20 feet in elevation or more within mere minutes. Given their location, it would be very difficult to evacuate these communities in time, which could result in a significant loss of life. For that reason, in 2008, FEMA and NOAA co-published a document for engineers, architects, state and local government officials, building officials, community planners, and building owners, to provide guidance on how to build a structure that would be capable of resisting the extreme forces of both a tsunami and an earthquake. Known as "vertical evacuation," this potential solution involves evacuation into the upper levels of structures designed to resist the effects of a tsunami. In 2009, FEMA and NOAA completed a companion publication intended to present information on how vertical evacuation design guidance can be used and encouraged at the state and local levels.

TsunamiReady™

The TsunamiReady Program, developed by NOAA's National Weather Service in 2001, is another integral part of our nation's preparedness for a catastrophic disaster. This program is designed to help cities, towns, counties, universities and coastal areas more broadly reduce the

[2] Tsunami Warning and Education Act, Pub. L. No. 109-424, 120 STAT. 2902 (Dec. 20, 2006).

potential for disastrous tsunami-related consequences. TsunamiReady has helped community leaders and emergency managers strengthen their local operations with clear readiness guidelines, making communities better prepared to save lives through better planning, education and awareness. For example, one of the guidelines for a community to become TsunamiReady is to have multiple ways of receiving Tsunami Warnings, such as utilizing FEMA's National Warning System (NAWAS).

V. Personal Tsunami Preparedness

In the event of a disaster, individuals and communities are not liabilities; rather, they are our greatest assets and the key to our success. We are fortunate to have leadership at the Department of Homeland Security and at the White House who share our belief that individuals are integral aspects of our emergency management capability. As Secretary Napolitano said before the Council on Foreign Relations in July 2009, "for too long, we've treated the public as a liability to be protected rather than an asset in our nation's collective security...We need a culture of collective responsibility, a culture where every individual understands his or her role."[3]

Moreover, the ability to effectively communicate during and immediately after a disaster is essential to fulfilling our mission. When working on a tight timeframe with partners at the federal, regional, state, local and tribal levels, making sure that everyone is on the same page is extremely important. As a result, we have put systems in place to ensure that we can coordinate and communicate in ways accessible to diverse communities so that we can accomplish our objectives during disasters.

In the wake of the tragic events in Japan, we are reminded of the importance of personal preparedness.

FEMA's Ready Campaign

Ready (www.ready.gov) is FEMA's national public service campaign, which partners with the Advertising Council to educate and empower Americans to prepare for and respond to all emergencies, including natural disasters and potential terrorist attacks. The goal of the campaign is to get the public involved and to increase the level of basic preparedness across the nation.

Ready and its Spanish language version, *Listo*, ask individuals to take simple steps such as making a family emergency plan, getting an emergency supply kit, obtaining information about the different types of emergencies that could occur and the appropriate responses to each one, and getting involved in community efforts that promote neighbor-to-neighbor preparedness. The *Ready* tsunami webpage also provides a detailed list of tsunami terms, and recommends that citizens take certain protective measures both during and after a tsunami.

[3] Janet Napolitano, Secretary, U S. Department of Homeland Security, Common Threat, Collective Response: Protecting Against Terrorist Attacks in a Networked World, Address Before the Council on Foreign Relations (July 29, 2009) (available at http://www.cfr.org/immigration/common-threat-collective-response-protecting-against-terrorist-attacks-networked-world/p19929).

National Tsunami Awareness Week

Earlier this month, NOAA's National Tsunami Hazard Mitigation Program led National Tsunami Awareness Week, which works to educate people in the U.S. about tsunami preparedness. National Tsunami Awareness Week serves as a crucial reminder for all Americans to take the time to get prepared now, before disaster strikes. The week also provides an opportunity to learn about emergency management agencies' efforts to decrease the effects of a tsunami, and provides the public with information about warning signs of a tsunami as well as what individuals can do in the event of a tsunami.

VI. Conclusion

Tsunami preparedness is an important part of FEMA's catastrophic planning and preparedness efforts. However, we cannot do it alone. It is important to note that FEMA is not the nation's emergency management team – FEMA is just part of the team. We work closely with the whole community, which includes our governmental partners at the federal, state, local, tribal and territorial levels; we leverage the resources of non-governmental entities, including private sector, faith-based, and non-profit organizations. Finally and most importantly, we work to instill a commitment to preparedness among individuals, families, and communities, who serve as our nation's 'first' first responders and the key to our success.

The tragic events in Japan serve as a solemn reminder to us of the gravity of our preparedness message. As we keep both the victims and survivors in our thoughts and prayers, please be assured we will continue to do all we can to ensure that we are as prepared as possible.

Thank you again for the opportunity to appear before you today to discuss tsunami preparedness. I am happy to answer any questions you may have.

Mr. CHAFFETZ. Thank you.

Mr. Murphy, you are recognized for 5 minutes. Oh, joint statement. My apologies. Thank you. Well done, Mr. Murphy. [Laughter.]

Best one we have heard yet. No offense. [Laughter.]

Mr. Madden, we appreciate the distance that you have traveled here. You are now recognized for 5 minutes.

STATEMENT OF JOHN W. MADDEN

Mr. MADDEN. Thank you, Mr. Chairman and Ranking Member Tierney, and members of the subcommittee, for this opportunity.

I am the director of Homeland Security and Emergency Management for the State of Alaska. I am responsible for confronting the entire range of hazards that nature and humans can inflict on our citizens and economy.

We are no stranger to disasters. We have fires, floods, storms and cold every year. But the seismic hazards of earthquakes and tsunamis give little or no warning and require a different approach to preparedness.

In our history are many destructive earthquakes. The largest was the 9.2 earthquake which generated many tsunamis. It happened on Good Friday in 1964. That killed 131 people in Alaska, Oregon and California.

We believe that tsunami preparedness is an enterprise, a purposeful and industrious undertaking that requires extreme coordination. The State of Alaska works with many organizations on this enterprise, including several that are here at the table today.

We recently conducted the latest tsunami operations workshop in Dutch Harbor, Alaska, for communities throughout the 1,500 miles of the Aleutian Islands, the Alaskan peninsula and Kodiak Island. Many of these communities are within the areas that were threatened by the Japanese tsunami. Each community left that workshop with plans on evacuation, emergency operations and solid understanding of warnings, advisories and watches which were put to the test just a few weeks ago.

On March 10th, Alaska received almost instant notification of the earthquake and shortly thereafter received the first advisories from the West Coast and Alaska Tsunami Warning Center. This emergency combined four factors that greatly complicated our response. The warnings came in the middle of the night, in winter, in adverse weather and in isolated communities far remote from each other and from the nearest help. We established voice contact with every community in the warning and advisory area, and ensured that community leaders had the information necessary for their local decisions.

Alaska was very fortunate that only limited damage occurred in our coastal communities.

During last month's event, the tsunami preparedness enterprise worked as designed overall. The continuous monitoring yielded immediate detection. The computer models determined the potential for tsunami. The alert and warning centers transmitted the critical information. The deepwater buoys provided data to recalculate the estimated arrival times and amplitudes to very high accuracy. And all the State assets were primed and ready to respond as needed.

Most importantly, the communities received the information and invoked the plans that had been recently validated.

The State of Alaska strongly supports this tsunami enterprise, and particularly the continued authorization and funding of the National Tsunami Hazard Mitigation program within the Federal Government. Through funding to the States with tsunami risk, this program advances preparedness through tsunami-ready communities, sirens, training, exercises, signage and much more. We also recommend that resilient and redundant communications systems be made the highest priority to ensure continuity of the tsunami warning network.

The most critical element of the entire enterprise is public outreach and education. All the science, all the computers, all the warnings are useless if the affected community does not know how to respond to that threat. We must create and sustain a posture of preparedness in each person living or visiting our coastal communities. Only through exemplary interagency cooperation can we prepare for this most unpredictable and potentially devastating hazard.

With the continued support of Congress, you can provide the partners in this vital enterprise, Federal, State and local governments and the general public, with the means to continue effectively to protect lives and property.

[The prepared statement of Mr. Madden follows:]

Mr. John W. Madden

**Director, Alaska Division of Homeland Security
and Emergency Management**

TESTIMONY

**Before the House Oversight and Government Reform Committee
Subcommittee on National Security, Homeland Defense,
and Foreign Operations**

*Tsunami Warning, Preparedness and Interagency Cooperation:
Lessons Learned*

April 14, 2011

**Alaska Division of Homeland Security and Emergency Management
P.O. Box 5750
Ft. Richardson, Alaska 99505
(Ph) 907-428-7062**

Testimony of Mr. John W. Madden
Alaska Division of Homeland Security and Emergency Management
April 14, 2011

Introduction

Thank you Chairman Chaffetz, Ranking Member Tierney, and distinguished members of the Subcommittee for the opportunity to testify today regarding tsunami preparedness. I am John Madden, Director of the Alaska Division of Homeland Security and Emergency Management. My division is responsible for hazard mitigation, preparedness, outreach, planning, response, and recovery for the entire range of hazards that nature and humans can inflict on our citizens and economy.

Background

Alaska is no stranger to disasters. We have seasonal flooding when our rivers break up, storms from the Bering Sea and the Pacific and Arctic oceans, wildland fires across vast areas, extreme cold disrupting our supply chains and the provision of essential services. But the geological hazard of volcanoes and the seismic hazards of earthquakes and tsunamis give little or no warning and require a different approach to preparedness.

In our history are many destructive earthquakes. The largest was the 9.2 magnitude earthquake on Good Friday in 1964. That earthquake and tsunami killed 131 people in Alaska, Oregon, and California and damaged infrastructure in several nations. Dozens of Alaska communities – Anchorage, Seward, Valdez, Whittier, Cordova, and Kodiak among them – were heavily damaged from the ground shaking, subsidence, and tsunami.

Alaska faces three types of tsunami hazards. The first hazard comes from distant earthquakes such as what we experienced on March 10 and 11, 2011. That tsunami took four hours to travel the 2,000 miles to our westernmost community on Shemya and another five hours to traverse the 2,300 miles of our southern coast. The second hazard comes from near shore earthquakes creating a tsunami that will hit coastal communities within minutes.

The third tsunami hazard results from landslides above or below the water line that displace the water with a wave of extraordinary speed and power. In 1958, an earthquake of 7.7 magnitude in Lituya Bay, Alaska, broke loose 300 million cubic yards from a mountain into the bay. The resulting tsunami rose 1,720 feet almost instantaneously. Much of the damage in 1964 in Seward came from this lesser known hazard.

Preparedness Initiatives

Alaska believes that tsunami preparedness is not so much a system but an enterprise – a purposeful and industrious undertaking that requires effort or boldness. Every organization and profession dedicated to this enterprise is vital to the success of the whole. Each component – monitoring, detection, assessment, alert, warning, and public outreach, education, planning, and

training – must support all other components. The effectiveness of each component cannot be measured in isolation but only by the success of all the components.

Over the years since the 1964 Good Friday earthquake, the State of Alaska has been central in the creation of an evolving enterprise of many organizations:

- Alaska Division of Homeland Security and Emergency Management
- University of Alaska Fairbanks and the Geophysical Institute
- Alaska Division of Geology and Geophysical Surveys
- West Coast and Alaska Tsunami Warning Center
- Alaska Region of the National Weather Service
- Federal Emergency Management Agency

We built this enterprise to provide information to the public that they cannot get for themselves. But why do we do this? The purpose of the tsunami preparedness enterprise is to support informed decision making – by communities, by the private sector, and most importantly by individuals and households.

With leadership from the National Weather Service, Alaska now has seven coastal communities recognized as Tsunami Ready with three more on track to achieve this by summer's end. Since 2006, we have installed warning sirens in 26 communities with more identified for the future. We have placed NOAA Weather Radios in all communities where that signal is available. We also have placed these radios in critical facilities such as dispatch centers, schools, clinics, city offices, and emergency operations centers.

Our last state wide exercise, Alaska Shield 2010, focused on widespread disruption from earthquakes and tsunamis. The communities of Valdez and Cordova exercised their entire tsunami response with real evacuations of large portions of their citizens, search and rescue operations on land and sea, mass casualty drills, and real world sheltering and feeding of large numbers.

We created an outreach and education team that we call the "Tsunami Road Show." Supported by staff from all our partner organizations, the team meets with city leaders, schools, and the general public. We brief on earthquake and tsunami science, emergency preparations, evacuation procedures and sheltering. We distribute information for emergency professionals, children, and many sectors of the economy.

Our Quake Cabin is very popular at schools, fairs, and public events. It simulates the movement and feel of a strong earthquake inside the typical house. This demonstrates to children and adults alike the need for personal preparedness and safety.

In November 2010, the Alaska Division of Homeland Security and Emergency Management conduct its latest Tsunami Operations Workshop in Unalaska for communities through the 1,500 miles across the Aleutian Islands, Alaskan Peninsula, and Kodiak Island. Many of these communities are within the areas threatened by the Japanese tsunami. The workshop participants included emergency managers, educators, planners, first responders, and elected officials. Each

participating community left that workshop with plans on evacuation, emergency operations and a solid understanding of warnings, advisories, and watches.

We will continue with other Tsunami Operations Workshops in Southeast Alaska in September 2011 and the Central Gulf Coast in 2012.

Japanese Tsunami

On March 10, 2011, the Alaska State Emergency Coordination Center received initial notification of the earthquake in Japan within minutes. The preliminary estimate of 7.9 magnitude was just at the threshold of our concern for a distant tsunami. We began our notification and recall systems. As the magnitude was recalculated upward to 8.8, we received the first advisories from the West Coast and Alaska Tsunami Warning Center.

The Tsunami Warning Center is located about 40 miles from our State Emergency Coordination Center. As a precaution against possible system overload or interruption of the dissemination systems, we positioned one of our operations staff inside the Tsunami Warning Center with a cell phone and radio. There was an overwhelming demand on the Center's website and email distribution system that sometimes overloaded the system. These are the primary means of disseminated the Center's products and services. Our man with a radio proved to be extremely valuable to continued communications and will be part of our procedures in all future events.

This emergency combined four factors that greatly complicated our response. The warnings came in the middle of the night, in winter, in adverse weather, and in isolated communities remote from each other and from the nearest help.

The State of Alaska serves as a safeguard to the automated and electronic dissemination systems. My emergency operations staff established voice contact with every community in the warning and advisory area. They ensured the community leaders had the information necessary for their local decisions. They knew the local weather conditions and were in the best position to weigh the options.

We were fortunate that only limited damage occurred in Alaska and no disruptions to our communities or their supply chain.

Conclusion

During the Japanese tsunami event on March 10 and 11, 2011, the tsunami preparedness enterprise worked as designed.

The continuous monitoring system yielded immediate detection of the earthquake. The computer models swiftly determined the potential for tsunami. The alert and warning systems effectively transmitted the critical information. The deep water buoys provided real time information to recalculate the estimated arrival times and amplitudes to high accuracy. The State operations system provided the certainty that the communities received the needed information and that all

state assets were ready to respond as needed. The communities invoked emergency plans that were recently validated and tested....

The science and other systems supported the informed decision-making by communities and individuals.

The State of Alaska strongly supports the continued authorization of the National Tsunami Hazard Mitigation Program within NOAA. Through funding to states with tsunami risk, this program supports tsunami ready communities, sirens, preparedness training and exercises, evacuation planning and signage, modeling for inundation areas, and mapping for risk analysis and siting of safe havens. We also recommend resilient and redundant communications systems are the highest priority to ensure continuity of the tsunami warning network.

We continue to search for the horseshoe nail that would yield a less favorable outcome. I believe that the most critical element of the entire enterprise is the public outreach and education. All the science, all the computers, all the warning systems are useless if the affected community – the affected population – does not know how to respond to the threat. We cannot assume that Alaskans will have hours notice to prepare and take action. We must create and sustain a posture of preparedness in each person living or visiting our coastal communities. If the ground shakes for more than 20 seconds, do not wait for the warning. Move to higher ground immediately.

The nation's preparedness for tsunamis closely mirrors that of other hazards. It is complex and fraught with potential pitfalls. No one agency owns the system. Only through exemplary interagency cooperation can we prepare for this unpredictable and potentially devastating hazard. With the continued support of Congress, however, you can provide the partners in this vital enterprise – federal, state, and local governments, and the general public – with the means to continue effectively to protect lives and property.

Mr. CHAFFETZ. Thank you. I appreciate all your testimony. We will now move to a round of questioning. I am going to recognize myself to start for 5 minutes.

Ms. Glackin, let's talk about the modeling. Because the key to all of this is that chain reaction that all starts with the modeling that says, here it comes. How complete is that? As you look at the U.S. coastline, including our territories, obviously Alaska and Hawaii, are there parts of that aren't mapped? I don't know the technical way to ask that, but where are the vulnerabilities in the detection models?

Ms. GLACKIN. It is not all mapped. This is an area that we have been working on and in particular, using some of the resources that we have gotten from the Spectrum sale, which happened after the Indonesian tsunami. We have approached this in dealing with where we know there are risk areas. For example, as has been highlighted, off of Alaska and off of the Cascadia zone there.

We have a recent report, we have gone to the National Academies of Science to ask for a review of our tsunami warning program overall. One of the things that they have encouraged us to do is, in partnership with our Federal partners and States is to do an overall risk assessment across the United States to really have a handle on what the particular challenge areas are. We would like to take that on as one of the things that we will be looking at to find ways to resource this.

Mr. CHAFFETZ. So of our coastline, what percentage is not?

Ms. GLACKIN. We are able to issue a tsunami warning for any part of our coastline. It is not that there would not be a tsunami warning. We will be able to give you a better, where we have the more detailed modeling done, we will be able to give you more information about what the potential impacts will be, how much inundation and things like that. I will have to get back to you with exactly what percentage of all that.

Mr. CHAFFETZ. And that is the curiosity, as to where the vulnerabilities are. We have talked a lot about the Pacific, and my other part of the question is what about the Atlantic and obviously the Gulf and what-not? I don't know if you can speak to that.

Ms. GLACKIN. I think that when you think about vulnerabilities, tsunamis are caused primarily by the seismic activity there. They can also be caused by landslides under water. There is a more technical term for this, my colleague knows, to do that. And so a lot of what we have been doing in partnership is being driven by the seismic assessment of theirs. So we have done that risk assessment. That has informed how we put out our monitoring stations, what we call our DART buoys for doing this. So that level is done.

For us to make more progress, we have to do mapping of the inland areas there, so we have better handles on how the water will actually roll up.

Mr. CHAFFETZ. As a followup, I would be very curious again, as to where the vulnerabilities are.

Let me go to another part. In your written testimony you stated that "NOAA provides a host of products and services that minimize the impacts from tsunamis, from advanced preparedness of coastal communities to detection and warning services to post-event response and recovery efforts."

Ms. GLACKIN. I can use exactly the example for this recent event. One of the things that NOAA does as part of our National Ocean Service is we do navigational mapping. So we went into Crescent Harbor in California, where there had been so much destruction, and our ships did surveys there to identify debris that was on the sea bed floor and allowed the Coast Guard to be able to, we found out where it is, the Coast Guard comes in and removes it. So they were able to open the ports in a timely fashion.

Mr. CHAFFETZ. Let me go to Mr. Murphy. Your perceptions of concerns about what happens in your region, how good is this information that you are going to get? How is the coordination between the two different agencies?

Mr. MURPHY. I can tell you that it is very good, Mr. Chairman. We totally rely, actually not only on NOAA, but USGS products. And I can tell you from this recent Japanese earthquake and tsunami, everybody that I work with in our States usually are well wired into both the tsunami warning centers. You can also get your own personal alerts on your smart phone, BlackBerrys, computers. So I think a lot of that really pays dividends.

I agree with Ms. Glackin, I know that we have reached out to them, because we had damage in some of the ports in Oregon. We had great partners, working together to try and get those ports back open. Because there are so many issues where you need NOAA and USGS, Coast Guard, a few other agencies to get these communities in a recovery mode and back operating.

So I think as a group of agencies, we really do have to work together pre-event and post-event.

Mr. CHAFFETZ. Thank you. My time is expired.

I now recognize the gentleman from Massachusetts for 5 minutes.

Mr. TIERNEY. Thank you very much, Mr. Chairman.

Ms. Glackin, I just want to cover a little bit of territory with you. I note that there was some speculation when the H.R. 1, the so-called fiscal year 2011 proposal was originally presented, and was aiming to cut 16 percent of NOAA's budget, particularly that area devoted to operations, research and facilities, which would in fact fund some of the things yo have been talking about here today, including the DART buoys that are currently inoperative and the ability to maintain and repair them.

Do we still run that risk? How much of a budget cut could you sustain without running that type of risk, which seems to me to be quite serious?

Ms. GLACKIN. We were much relieved to see the numbers this week, compared to H.R. 1, in allowing us to be able to resource some of our critical operations. We are in the process of putting together a spend plan in terms of going forward in this. I think even importantly, getting some stability in the full-year funding is important, because we need to get out there with our ships and maintain some of our buoys, which we will be able to do once we all hope, I think, there is successful action this week on an appropriation.

Mr. TIERNEY. I take it that the fact that you suspended the maintenance and detection infrastructure and repair on that basis

would indicate that 16 percent was certainly going to require that you cut some?

Ms. GLACKIN. That is right.

Mr. TIERNEY. And now you are looking to see how much you have to cut? Or is there a chance that you won't have to cut anything?

Ms. GLACKIN. I think it is premature for me to say. We have challenges, certainly, at the funding level that is presented to us. And NOAA is working within the administration to develop a spend plan, which it will bring up for approval in Congress. So I think we will have tough choices to make in that, but it is premature to say what they would be.

Mr. TIERNEY. Now, the nine DART buoys that are currently inoperative, how long have they been inoperative?

Ms. GLACKIN. Sir, let me say a few words about that. Our DART buoy network is designed with some redundancy in it.

Mr. TIERNEY. I would assume.

Ms. GLACKIN. Yes, because you have them off the coast of Alaska. They will fail becomes sometimes the weather just pulls the moorings out and things like that.

What we like to do is get out there as soon as possible when we get good weather, get our ships out there and get those repaired. So we have been delayed in doing that this year, because of the lack of funding situation. So with the stability and funding going, we will be able to get those ships out there and get them repaired.

Mr. TIERNEY. Thank you, Mr. Chairman. I yield back.

Mr. CHAFFETZ. Thank you.

I now recognize the gentleman from Idaho, Mr. Labrador.

Mr. LABRADOR. Thank you. Thanks for taking the time and also thanks for waiting for a long time. We have had a hectic day and I know it has been difficult for you waiting. So I appreciate that.

Dr. Leith, in your testimony you state that the west coast of the United States, Hawaii and the Pacific Territories are all at risk for damage from tsunamis generated by distant earthquakes. How do you think, and Ms. Glackin, how do risks of such destructive tsunamis for the United States compare to what we have seen in Japan historically? And can you describe the potential damage that would result, and are we prepared as a Nation?

Mr. LEITH. The example that I would like to give in terms of the risk that we face is coming from Alaska, a known zone which can produce very large earthquakes and tsunami, is that we have had tsunamigenic earthquakes in the 1920's and 1930's, 1940's, 1950's and 1960's. But we have not had any since the 1960's. So we are in a situation, the earth is quite unpredictable in its generation, the timeliness of its generation of earthquakes. And what I would say as an earth scientist is that stress is building up. We can expect another tsunami coming from Alaska.

I can't comment, and it is outside the work of our agency, in terms of the preparedness on the coastline for that. But we are working with NOAA and FEMA and developing scenarios for a large earthquake generated in Alaska and its impact all the way down on the coast. USGS provides the scientific basis for that scenario, and then the other partners, Federal, State and local, take it from there to evaluate the impacts.

Mr. LABRADOR. Ms. Glackin.

Ms. GLACKIN. Thank you. I think all of us appreciate this committee taking the time to have this hearing. Because I think what we can't afford as a Nation is complacency. That is the danger with events that are infrequent, like tsunamis.

I think with respect to the vulnerability in this country that our ability to put out warnings, as long as we are able to sustain our infrastructure that is there, I feel good about. I think that there is a real challenge, though, in keeping the local communities ready to respond for this.

I really want to make the point to this committee that is in my written testimony but I didn't say here, when you have these local tsunamis, you really need to know, to move and not wait for the warning. People have to be trained and in tune and when that ground is shaking and the water is receding, you move. You are not waiting for your cell phone to tell you something.

And the fact that this is in the coastline, where we have so many visitors, populations swell there, people are unfamiliar with roads, it is incredibly important that they are able to move from that coastline and know what to do.

So that is going to take a continued, I think, investment and attention at all levels of government.

Mr. LABRADOR. Thank you.

To followup on that comment, Mr. Murphy, and I am going to ask the question of all the panelists, what can we do to improve warning and response times?

Mr. MURPHY. I think probably, and I would agree with Ms. Glackin, we can never be too prepared. As you might well imagine, we have so many visitors on the Pacific coast, both in Ms. Ward's region and mine, that you never can over-educate the people. I think it is something you have to consistently do. You clearly have to partner with everybody.

In FEMA, we have taken an initiative called the whole of community. You really have to share resources and make everybody a part of that team.

I can tell you that some of our States in Region X, Oregon and Washington, you have to partner with the hotel association and get them to make some investments about teaching their visitors who stay in their facilities what to do. Because somebody from a landlocked State or part of the country may not understand what you need to do in a tsunami. I know we promote really, don't drive, you go up a hill or things like that, and try to teach them some things. And of course, basic preparedness for any type of disaster. If that family takes the time to have a family plan, build a kit and stay informed of what is going on, they will have a much better chance.

Then I would finally say, both Ms. Ward and I in our regions continue to work on catastrophic planning of what can happen. Since this is a no-notice event, the Cascadia Subduction Zone lies very close to the west coast of the United States, it would take a very quick second to change how life would be out there. So we keep working on the catastrophic issue and how we might deal with it.

Mr. CHAFFETZ. The gentleman's time has expired.

Mr. TIERNEY. Mr. Chairman?

Mr. CHAFFETZ. Yes?

Mr. TIERNEY. Mr. Chairman, I ask for unanimous consent that the gentlewoman from Hawaii be allowed to participate on the panel. And given that all the Members have asked at least one round, be now allowed to ask 5 minutes of questions.

Mr. CHAFFETZ. Without objection, so ordered.

Mr. TIERNEY. Thank you.

Mr. CHAFFETZ. We will now recognize the gentlewoman from Hawaii.

Ms. HANABUSA. Thank you, Mr. Chairman, and thank you to the members of this committee.

To those who are testifying, thank you for being here. As mentioned, I represent Hawaii, and I represent the first congressional district, which as some of you may know, contains the Pacific Tsunami Warning Center. It is a place and an issue that is very dear to many of us, especially in light of the last tsunami that hit Japan. And we do know the impact of what the warning system meant for the people of Hawaii. We were very fortunate, we had no deaths. We did have property damage. But I credit that to really how well it operates. Because of that, I asked to be permitted to sit here.

My main concern, of course, first, and I guess we can start with Ms. Glackin, is to discover the NOAA budget, which is presently scheduled to be cut. What impact will that have on, for example, the Pacific Tsunami Warning Center? I know I am reading your statement, you felt the Continuing Resolution has had an impact in terms of the DARTs not being able to be repaired and so forth. I think you said nine are inoperative at this time.

So can you tell me exactly what impact it would have, at the present funding level?

Ms. GLACKIN. With the proposed funding level of the bill that is under consideration now, it does present challenges for NOAA. We will have some very tough choices in front of us given the breadth of activities that we have and the many critical services we provide. I didn't go into it here but mentioned elsewhere are things like hurricane services, severe weather, we have flooding going on in the country now, in the north central part of the country, and dams that are in danger of failing there.

So we will have very tough challenges in front of us. It is premature to say, and I am not able to today, because decisions haven't been made about how we will make all of those decisions. But we are anxious, getting the DART buoys repaired is, I can tell you, near the top of our list. So I expect to see action on that, shortly after getting this next pot of money in our checkbooks at NOAA.

Ms. HANABUSA. The issue of the DARTs, and I think our written testimony stated that there are nine that are inoperative. Can you tell me where those nine are located?

Ms. GLACKIN. They are along Alaska and along the Aleutian Islands. I have a little map here that will tell me that.

Ms. HANABUSA. Is that the map in your testimony?

Ms. GLACKIN. Yes, it is the map in the testimony. So there is one on the Aleutians, there is one off of the Puget Sound, out that way. They are in the territories, in the Midway between Hawaii and

Japan. And then there are several, one in the Caribbean, one off the Atlantic coast and two down toward Australia.

Ms. HANABUSA. So are those the ones in red in your map?

Ms. GLACKIN. Yes.

Ms. HANABUSA. Can you explain, I only have a minute plus here, but can you explain what the DART does and how significant they are to the warning system?

Ms. GLACKIN. One of the things I think it is important to understand about warnings is, you don't want to cry wolf. If you warn too much, people won't take action. We have talked about here today how important it is for people to take action. NOAA will make its first judgment about issuing information based on the seismic activity. So when we hit a 7.1, we are going to go ahead and alert people of this potential.

What the DART does is allow us to actually detect whether a wave is moving. And if a wave isn't moving, we will immediately tell people to stand down. We haven't cried wolf, you will be more responsive next time.

So that is what the DART buoy does. It helps us pick up the wave moving across the ocean. Then we further confirm that with coastal tide gauge stations. So for example, off of Hawaii, we have a good network of tide gauge stations. They will also begin to detect water level changes.

Ms. HANABUSA. I would like to say that you were spot on on the height of the waves as they hit the Hawaiian Islands. I believe that is really due to the DART system that you have in place.

I also wanted to emphasize that my understanding is the biggest tsunami we had in Hawaii, that killed about 159 people, and the biggest one that hit Alaska, were off the Aleutian islands, weren't they?

Ms. GLACKIN. Yes, that is correct.

Ms. HANABUSA. Thank you. Thank you very much, Mr. Chair.

Mr. CHAFFETZ. Thank you.

I would now like to recognize myself for another 5 minutes.

Mr. Madden, you are right there on the front lines. You have testified that in terms of your interactions that things are as they are supposed to be. But this is a golden opportunity to suggest, crystal clear for the committee and for the Congress, what it is you think is missing from what the Federal Government is providing you in terms of information, etc.

Mr. MADDEN. Mr. Chairman, there are two items on that. One is that the emphasis so far has been on the seismic-generated tsunamis. The major killer in 1964 were the local tsunamis. The earthquake caused half of a mountain to slide down into the water. The water then proceeded in, not at a 33 feet height, but at a 200 feet height. And that gives almost no notice.

So it is the shaking of the ground, which is the only notice that the people have. That is why the preparedness is so important.

The second part is that, during this event, I am fortunate that the West Coast and Alaska Tsunami Warning Center is only 40 miles from my emergency operations center. I put a person in that center with a cell phone and a radio just in case something happened. And in this event, there was so much worldwide interest that the Web site could no longer put out their notices. They were

still putting it out by fax and other means. But they lacked the bandwidth to fully accommodate all of the interest and all of the system's demand.

We accommodated that within our State, that served us. Had it been longer than that, we were standing ready to contact our counterparts in Hawaii to act as that go-between. So it is communications system, bandwidth and enough capacity to handle a worldwide interest item, and that public education that for those coastal communities, if the earth shakes, don't wait, go to higher ground. That is the only way that the local tsunami threat will be reduced and save lives.

Mr. CHAFFETZ. Thank you.

Ms. Ward, we don't have California represented, and I believe that is part of your region. From your perspective, the Federal Government perspective, what are the States doing right or wrong? How well prepared are they?

Ms. WARD. Mr. Chairman, I think that along with my counterparts in Region X and the State of Alaska, they are doing the things that they need to do to get out the preparedness campaign, all hazards. And we have a couple of things, tsunami awareness week that ironically was just last week. And we do all hazards and catastrophic planning that we have focused on for the last several years significantly.

While some of those plans have focused on earthquake-specific, what we use and what we saw just recently for the State of Hawaii, as an example, is that planning, we use that specific plan that was for a Category 5 hurricane hitting Honolulu, we used the same elements of that plan, those checklists, to start our response activities for this event.

So we feel that they are doing what they need to be doing in partnership with all of us for preparing. But as you have heard from the panel, the complacency of preparedness, especially in an event or scenario that doesn't happen very often but that can have devastating effects to coastlines where we all share, at least at this end of the table, with tourists who come now and then to a place where they may not be as aware of these types of risks. It is a challenge and a balance to keep that preparedness.

Mr. CHAFFETZ. From your perspective, Ms. Ward and Mr. Murphy, are any of the States not doing what they are supposed to be doing? From your perspective, your professional perspective, are there any that are lagging behind or just ignoring the threat?

Ms. WARD. Mr. Chairman, I would say no. But I would also caution that in these economic times, for State governments and our territorial governments, that it is a challenge to prioritize these types of activities. But it is certainly a priority for all of my States and territories.

Mr. CHAFFETZ. Thank you. As we kind of wrap up here, maybe you could just, we will start with Mr. Madden, the No. 1 thing you would like to see happen moving forward.

Mr. MADDEN. The ability for communities to make informed decisions requires the network and on the training and exercise for them. So it is continuous emphasis on the individual's and the community's decisionmaking.

Mr. CHAFFETZ. Thank you.

Mr. Murphy.

Mr. MURPHY. I would concur with Mr. Madden, but I would also say that we need to continue to improve and escalate our efforts in catastrophic planning. If we really did have something that would hit the entire west coast, you really need a plan that will deal with that. So more and continued work.

Ms. WARD. And I would agree with both of them and add that the emphasis on personal preparedness for a plethora of risks is extremely important.

Ms. GLACKIN. I think what I would say is sustained improvement of the services we have now. And going to your first question, Mr. Chairman, I would say your point about really having the overall national assessment of tsunami risk done for the Nation, so that we are ensuring that we are covering everything that needs to be done.

Mr. LEITH. Thank you. I would come in from the technical and scientific side and say that I would very much like to see the completion of a seismic network and delivery system in the United States, a modern one that replaces the one that was built over the decades at the last part of the previous century.

Mr. CHAFFETZ. Very good.

Thank you all for attending. Please, if there are additional comments that you wish to submit, information that you can provide the committee, we would certainly appreciate that. Your full testimony, if you weren't able to get through it all, will be submitted again for the record. We appreciate the great length and time, we appreciate your understanding. We started a bit late, given the votes on the floor. Particularly Mr. Madden, who traveled such a great distance, we appreciate you all being here.

The great work that you do, it is a thankless job in many ways, but so vital when that disaster hits. We appreciate your dedication and your work for our country and thank you for being here.

At this time, the committee stands adjourned.

[Whereupon, at 4:05 p.m., the committee was adjourned.]

[Additional information submitted for the hearing record follows:]

MR. MIKE DAYTON

Acting Secretary, California Emergency Management Agency

STATEMENT FOR THE RECORD

Submitted to the House Oversight and Government Reform Committee

Subcommittee on National Security, Homeland Defense, and Foreign Operations

Tsunami Warning, Preparedness, and Interagency Coordination: Lessons Learned

April 11, 2011

California Emergency Management Agency
Executive Office
3650 Schriever Avenue
Mather, CA 95655
Phone: (916) 845-8539
Mike.Dayton@calema.ca.gov

Introduction

Thank you Chairman Chaffetz, Ranking Member Tierney, and distinguished members of the Subcommittee for convening this hearing regarding tsunami warning, preparedness, and interagency cooperation, and the lessons learned from the earthquake and subsequent tsunami that occurred in Japan on March 10, 2011.

The horrific scenes of destruction from Japan serve as a reminder of the power and devastation a massive earthquake and tsunami can have on coastal communities, a threat California also faces along portions of its 1,110 mile-long coast. When the tsunami reached the California coast 10 hours after the earthquake, and a large portion of our coastline was put into a Tsunami Warning, our state and local emergency response plans were activated and years of planning for an event such as this helped save lives and reduced property damage statewide.

To help better explain the actions we took during this event, we feel it is important to briefly describe our on-going program for tsunami hazard mitigation, awareness, and preparedness statewide.

Background on California Tsunami Preparedness

California has 20 coastal counties and over 90 coastal cities, including three major metropolitan areas, major port facilities and coastal military bases, 376,000 residents in the mapped tsunami inundation zones and millions of coastal visitors each year. The state has been a member of the National Tsunami Hazard Mitigation Program (NTHMP) since the program began in 1995.

The California Tsunami Hazard Mitigation and Preparedness Program is led by the California Emergency Management Agency (Cal EMA), and partners with the California Geological Survey (CGS) and other federal, state, and local organizations to reduce the impact of tsunamis along our coast. This program receives funding from the NTHMP through the Tsunami Warning and Education Act of 2006 (TWEA). California implements a comprehensive tsunami preparedness plan, with a significant number of accomplishments and on-going activities, including:

- Completion of statewide tsunami inundation maps for emergency evacuation and response planning, the first state to complete this for its entire populated coastline (available at www.tsunami.ca.gov);
- Direct assistance to local communities and coastal State Parks, who's jurisdictional responsibility includes one-third of the state's coastline, for emergency response planning, tsunami sign and siren placement, and achieving tsunami-ready status;

- Annual "live-code" testing of the Emergency Alert System in the northern part of the state, historically the area most prone to tsunami inundation and damage;
- Sustained emergency communication and response preparedness through annual review of response protocol and continuous table-top exercises with local agencies;
- Development of tsunami hazard preparedness products for not only the emergency response community, but also the maritime and land-use planning communities along California's coast;
- Tsunami education and outreach activities through dozens of workshops and conferences each year coordinated through our California Tsunami Steering Committee, comprised of representatives from coastal jurisdictions, state and federal agencies and other stakeholders; and,
- Observation of an annual Tsunami Awareness and Preparedness Week, during which public preparedness and media outreach activities are conducted, websites promoted, and education materials widely distributed.

We believe the potential impacts from the March 10 tsunami on the California coast were greatly reduced because of these statewide activities.

Tsunami Warning and the March 10 Tsunami

At 9:58pm (PST) on March 10, 2011, approximately twelve minutes after the Tohoku earthquake, Cal EMA received the first tsunami information statement from the West Coast and Alaska Tsunami Warning Center (WCATWC). Within the first hour, Cal EMA and the WCATWC discussed the severity of the event and the expected tsunami alert level and impacts in California. After some discussion, it was clear that portions of California's coast could be put into a tsunami "Warning," the highest level of alert.

Also within that first hour, contact was made with state scientists at the CGS, who provided estimates about the tsunami arrival time in California and indicated that initial wave cycles would be active during low-tide conditions along the coast. CGS also indicated that, based on numerical modeling performed for the statewide tsunami inundation mapping project, California could expect wave amplitudes between two to nine feet. This was consistent with estimates provided by the WCATWC in the next several hours and helped to validate the expected tsunami impacts in California.

Additional data were provided by the WCATWC regarding forecasted tsunami wave amplitudes and arrival times. The highest forecasted tsunami amplitudes for the state were about eight feet for Crescent City in Del Norte County, a location with a well-chronicled tsunami history. The emergency manager in Del Norte County was contacted and offered direct assistance.

Mandatory evacuations for coastal areas within both Del Norte County and Humboldt County, just to the south of Del Norte, were initiated well before first wave arrival at approximately 7:30am PST. For the remainder of the coast in the Warning area, where forecasted maximum wave amplitudes were projected to be less than six feet, significant inundation of dry land was not expected to occur because of the low-tide conditions. In these areas, many coastal jurisdictions initiated evacuations of beaches and harbors and voluntary evacuation for the pre-existing tsunami evacuation zones. For those areas where the Advisory was in effect, coastal jurisdictions recommended evacuation of beaches and harbor areas.

The first tsunami waves arrived along the coast between 7:30am and 9:30am (PST) on March 10. Though no significant dry-land inundation occurred, as was expected due to low tide conditions, there was significant damage in the harbors of Crescent City, Santa Cruz, and Fort Bragg within the first several hours of tsunami activity. There was also one fatality at the mouth of the Klamath River (Humboldt County) when the mandatory evacuation message was not heeded.

Throughout the event, Cal EMA and the WCATWC maintained communications with the affected jurisdictions. These discussions focused on the following topics:

- Actions being taken by local jurisdictions;
- Public information messaging;
- State assistance and resources needed;
- Evacuations actions;
- Shelters opening;
- Damages sustained; and,
- Recovery issues and coordination.

Based on preliminary post-tsunami evaluations, over 26 harbors and marinas received damage from the March 10 tsunami. Official damage estimates from FEMA and Cal EMA are at least $48 million. The State of California requested a Presidential federal disaster declaration for the State of California. On April 18, the President declared a federal disaster for the counties of Del Norte and Santa Cruz.

Preliminary post-tsunami evaluations indicate there are a number of improvements that can be made:

- Develop an improved maritime plan that includes hazard identification, clarification of alert notifications, emergency response guidance, and an education and outreach component for boaters. The state tsunami program had already initiated work on this project starting in San Diego Bay and Crescent City.
- Improve methods to discourage bystanders from congregating near the waterfront during Tsunami Warnings and Advisories.

- Improve communication with WCATWC.
- Address issues of fatigue among emergency managers during long Warning/Advisory periods.
- Consider background tidal conditions (low vs. high tide, storm conditions) in evacuation decision making.
- Provide temporary signage for coastal access points.
- Address language barriers, especially our large Spanish speaking population. The state tsunami program is producing Spanish-language versions of its statewide "How to Survive a Tsunami" brochure, the "Living on Shaky Ground" pamphlet, and the CGS Tsunami Note.
- Improve communication with media before and during event.
- Reduce information overload on county emergency managers.

A formal After Action Review of response to this incident will be conducted to ensure the state tsunami program and Cal EMA addresses these issues to protect our coastal residents and visitors from future tsunamis.

Interagency Coordination

The California tsunami program works closely with various federal, state, and local agencies to respond to tsunami events like the one on March 10, 2011. The State also coordinates long-term planning for tsunami hazard mitigation, awareness, and preparedness with the following entities:

- NOAA – As previously stated, the California tsunami program is one of the original members of the National Tsunami Hazard Mitigation Program (NTHMP). The state program continues to be involved in leadership roles on subcommittees within that NTHMP, allowing it to help guide and shape many of the long-term goals of the program. This coordination helps foster collaboration with various NOAA entities like the WC/ATWC and the National Weather Service's (NWS) National Geophysical Data Center, which is responsible for cataloging historic tsunami data and digital elevation models used for numerical tsunami modeling. The state tsunami program also coordinates community preparedness and TsunamiReady activities with the four NWS Weather Forecast Offices in coastal California.
- USGS – The state tsunami program is an active participant of the USGS Multi-Hazard Demonstration Project, established to determine the effects of a "worst case" distant tsunami on the coast of southern California. The California Geological Survey (CGS) and the USGS are also working together on several other projects to improve tsunami hazard analysis and mapping within the state. CGS is an active member of the USGS Tsunami Source Working Group which brings together world-class tsunami source specialists to share the latest information about potential tsunami sources that could

impact California. Because of these collaborations and the need to continue to learn from large events, the USGS has invited a member of CGS to take part in one of their post-tsunami surveys in Japan in the coming months.

- FEMA – Cal EMA is working closely with FEMA Regions IX and X on the Cascadia Catastrophic Earthquake and Tsunami Planning Project, which will develop plans and protocols for response to a very large earthquake and tsunami event along the Cascadia Subduction Zone. The state tsunami program has also entered into a Co-Operative Technical Partnership with FEMA to develop maps identifying tsunami hazards within harbors, and pre- and post-tsunami guidance for the over sixty maritime communities along California's coast.
- Tsunami programs from other states – The NTHMP provides a perfect platform for states to share information with each other about new and ongoing tsunami preparedness projects. State tsunami programs work closely together in the NTHMP to make sure that mitigation, awareness, and preparedness activities and messaging are done in a consistent manner across state lines. These states also coordinate through other organizations, like the Western States Seismic Policy Council, to help states speak with one voice on a national setting.
- State and local government partners in California – The most important relationship that the California tsunami program cultivates is with the various state and local agencies responsible for tsunami preparedness and response along the coast. This is primarily done through the California Tsunami Steering Committee, with representatives from each of the 20 coastal counties and one from the various state agencies responsible for coastal lands. All activities within the state tsunami program work plan relate to improving tsunami planning and preparedness at a coastal "community level." One of the more unique program goals is to assist the 122 California coastal State Parks to become TsunamiReady.

Future Concerns

As the California tsunami program continues to do innovative work with its federal, state, and local partners, there are a number of concerns the state program has for sustaining this work over the long term needed to protect its citizens:

- Reauthorization of the Tsunami Warning and Education Act - As mentioned previously, a majority of the funding for the California tsunami program comes from the Tsunami Warning and Education Act (TWEA). With the sunset of the TWEA set for September 2012, it is unknown how effective the state programs and the NTHMP overall can be without this valuable funding source. For this reason, we strongly encourage Congress to not only reauthorize the Act but also change the language so that it clearly affirms that the "State Partners" of the NTHMP receive the 27% of the funding provided under the

Act; this was the initial intent of the TWEA when it was passed in 2006. This is the only way to ensure that the TWEA can be implemented at a "community based" level.

- Carefully monitor the expansion of the DART buoy system – At approximately $11 million per year (2010 costs), the NOAA DART buoy system is very expensive to maintain and expansion of this system would only increase the cost. To put it in perspective, the annual cost for maintenance of these buoys is more than the funding for all the NTHMP state tsunami programs combined. Following the 2004 Indian Ocean Tsunami, the number of buoys was increased from 6 to 39. Even with a number of the buoys out of service during the last several events, there was enough redundancy in data available that the Warning Centers were able to provide accurate forecasts for their areas of operation. With difficult budgetary decisions to be made by NOAA in the coming years, expanding the system with additional buoys may occur at the expense of funding to states for "community based" preparedness. We request that Congress consider a proper funding balance between the DART buoy warning system and the states' needs when recommending funding priorities to NOAA.
- A third Tsunami Warning Center is unnecessary – Recently, there has been discussion that a third Warning Center be established in Puerto Rico. It has not been adequately demonstrated that a third Warning Center will greatly improve the overall warning system. The concern is that funding of this additional Warning Center could come at the expense of funding to the state tsunami programs, as well as siphoning scarce operating funds from the two existing centers. In addition, the recent National Academy of Science report on the national tsunami program discouraged setting up an additional Warning Center, and recommended perhaps combining the two that do exist into one Warning Center. Therefore, we recommend that Congress not authorize a third tsunami Warning Center.

Conclusion

The California tsunami program appreciates the opportunity to submit this testimony about the March 10, 2011, tsunami event and the future of state and national tsunami programs. With Congressional support for renewing the Tsunami Warning and Education Act, the state tsunami program in California can continue to improve tsunami preparedness and coastal resiliency for the people living along and visiting our coast. Please let us know if we can provide any additional information during your Congressional evaluations.

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