STATEMENT OF
DR. WILLIAM LEITH
SENIOR SCIENCE ADVISOR FOR EARTHQUAKE AND GEOLOGIC HAZARDS
U.S. GEOLOGICAL SURVEY
U.S. DEPARTMENT OF THE INTERIOR
BEFORE THE
HOUSE COMMITTEE ON NATURAL RESOURCES
SUBCOMMITTEE ON ENERGY AND MINERAL RESOURCES
REGARDING
EARTHQUAKE EARLY WARNING

JUNE 10, 2014

Chairman Lamborn, Congressman Holt, Members of the Subcommittee, thank you for this opportunity to discuss the development and implementation of earthquake early warning in the United States. The U.S. Geological Survey (USGS) has worked closely with our State, university, and other private-sector partners to develop the current pilot system, which holds great promise for protecting lives, livelihoods, and prosperity in the future.

The earthquake risk in the United States is well known: more than 75 million Americans in 39 States are at direct physical risk from the shaking caused by earthquakes. A single large event could cause thousands of deaths and tens of thousands of injuries from the shaking alone, and many more from possible resulting fires, hazards and other hardships that come in the wake of large quakes. FEMA has estimated that direct earthquake losses average more than $5 billion each year, and indirect economic impacts are even greater. Three-quarters of this risk is concentrated on the West Coast, where California has a 99.7 percent chance of a magnitude 6.7 or larger earthquake in the next 30 years, and Oregon and Washington have a 10 percent chance of a devastating magnitude 8-to-9 earthquake in the Cascadia subduction zone.

The impact of an earthquake on the West Coast will not be felt merely by those who experience the shaking itself, but rather by the entire country and the rest of the world. A number of military installations, as well as five of the ten busiest ports in the United States, are along the West Coast; the two busiest ports are in Southern California, in the heart of the earthquake threat. If those ports suffer significant damage, imports and exports from Asia, and the businesses that depend on them, would be seriously threatened.

We at the USGS are proud of our long history of reducing the impacts of earthquakes on the nation by translating our science into practical applications that can be used by disaster response officials, public utility managers, insurance companies, hospital managers, elected officials and others to help save lives and protect property. Our science is used <u>before</u> earthquakes to set insurance rates, develop building codes, and build resilience into critical infrastructure and is used <u>after</u> earthquakes to estimate losses and inform emergency response and recovery decisions. Now, the USGS, together with university partners and with support from the Gordon and Betty

Moore Foundation, are developing a pilot project to demonstrate an important new technology — earthquake early warning — that can detect earthquakes and send alerts so quickly that people and systems can take protective actions before damaging shaking arrives. We call this capability *ShakeAlert*.

A new product of the Advanced National Seismic System

ShakeAlert is being built upon the existing earthquake monitoring capabilities of the USGS Advanced National Seismic System (ANSS) — a modern national infrastructure for reporting on earthquakes and collecting data critically needed to reduce earthquake losses. Since 2000, according to a plan requested by Congress, the USGS and its partners have been developing the ANSS, with one of the end-goals of the completed system being to provide earthquake early warnings. As a result of the recent investment of $20 million through the American Recovery and Reinvestment Act, the system has tripled in size to more than 2500 stations and is now about one-third completed. The goal of the pilot project will be to issue ShakeAlerts wherever the ANSS infrastructure is sufficiently developed. However, the USGS recognizes that earthquake early warning must compete for finite budget resources, and funding for this new effort must compete with existing USGS programs for budget priorities.

For example, in its current demonstration-and-test phase in California, ShakeAlert has been sending live alerts to dozens of users for more than 2 years. In that time, the performance of the system has been impressive; for example, it sent alerts just 4 seconds after the start of two damaging quakes in southern California this past April. One deliverable from this pilot project will be to assess the results of this development-and-test phase and present those findings in a manner that decision-makers can use.

But the system is not complete. Recently the USGS published a technical implementation plan outlining our strategy for moving ShakeAlert from a demonstration to full operation to provide alerts to the public and businesses on the West Coast of the United States. The plan calls for adding more sensors, hardening data and alert communications, and rigorously testing the system to ensure its reliability. The plan also lays out how the system would be managed, outlines opportunities for private partnership, and estimates the cost of building and operating the system.

How will alerts be delivered?

Alerts will be sent over both public and private routes, including the internet, social media, and wireless networks to TV, radio and cellular networks, and to automated control systems that can stop trains, place equipment in a safe mode, and isolate systems — while the public takes cover. Public mass notification systems will be accessed through FEMA's Integrated Public Alert and Warning System (IPAWS) to provide authenticated alert messages to cellular phones as Wireless

Emergency Alerts (WEA), radio and TV via the Emergency Alert System (EAS), NOAA All Hazards Weather Radios, and websites and social media applications. Alerts may also be sent via public state, county, and local alert and notification systems as well as through private redistribution channels like cell phone apps, push notification channels, social media providers like Twitter, Google and other alert technologies as they develop. Commercial mass notification companies may also redistribute alerts to their customers.

How much warning is possible?

Because earthquake waves travel more slowly than information can be sent through communication systems, it is possible for electronic devices — such as smartphones or automated systems — to receive an alert that allows action before destructive shaking arrives. ShakeAlert can provide seconds to minutes of warning; the amount of warning time depends on the speed of the warning system and your distance from the event. A fast earthquake early warning system relies on a dense network to ensure enough sensors are near all possible earthquake sources. A dense network especially helps reduce the "blind zone," within which warning is not possible because the earthquake source is too close for an alert to outpace the seismic waves. To maximize warning time, the system must minimize delays in data processing, communication, and delivery of alerts.

What role will the private sector play?

This new capability will not only protect American businesses and speed recovery after devastating earthquakes but will stimulate a new business sector – the earthquake alert industry. Industry partnerships will be critical to the success of the system. Consultants will advise users on how to use alerts to take protective actions. Mass notification companies will customize alerts for their clients. Automated control producers will make and install equipment to take actions and sound alarms at user facilities. Entrepreneurs will undoubtedly develop creative new applications specific to various industry sectors.

A few seconds may not seem like a lot, but ShakeAlerts will trigger actions — both human reactions and automated responses through electronic systems — that will prevent immediate damage, injury, and death and will speed recovery. Workers in factories, construction sites, and hospitals can evacuate dangerous areas. Fire station doors can be opened to prevent jamming. Heavy equipment like trains, elevators, and port facilities can automatically stop in safe positions. Pipeline valves can be shut automatically, preventing spills. School children can drop, cover, and hold on, and crowds in theaters and sports venues can be forewarned and given instructions to prevent panic. During the aftershock period of a major earthquake, rescue workers will have alerts for their own safety.

Providing earthquake warnings is a USGS responsibility

The Earthquake Hazards Reduction Act (P.L. 95–124) gives the USGS the Federal responsibility for providing notifications of earthquakes. The most recent reauthorization of that Act (P.L. 108-360) notes the loss-reduction value of early-warning systems, specifically calls for disseminating warnings of earthquakes, and authorizes the USGS to establish and operate the Advanced National Seismic System (ANSS), "in order to enhance earthquake research and warning capabilities." In addition, in September 2013, California enacted legislation that calls for the California Emergency Management Agency, in collaboration with the California Institute of Technology, California Geological Survey, University of California Berkeley, the USGS, and others, to develop and deploy a comprehensive statewide earthquake early warning system.

Will the United States have earthquake early warning before or after the next big quake?

Several other countries have built systems in response to devastating earthquakes. Today, Japan's public system allows every person to receive advanced alerts of earthquake ground shaking from the Japan Meteorological Agency. No trains derailed in the 2011 magnitude 9.0 Tohoku earthquake in part because of earthquake early warning — and, according to a poll in Japan, 90% of the citizens think earthquake early warning is worth the investment (Fujinawa and Noda, 2013). Other regions that built systems after devastating earthquakes include:

- China (after the 2008 Wenchuan earthquake killed 87,587)
- Taiwan (after the 1999 Chi Chi earthquake killed 2,415)
- Istanbul, Turkey (after the 1999 Izmit earthquake killed 17,127)
- Mexico (after the 1985 Mexico City earthquake killed 10,153)
- Bucharest, Romania (after the 1977 Vrancea earthquake killed 1,500)

Mongolia is also investing in earthquake early warning; the National Emergency Management Agency tested its new system in the capital, Ulaanbaatar, in April 2014. Also in April, Mexico's system provided 71 seconds of warning for Mexico City following the magnitude 7.2 Guerrero earthquake near Acapulco.

In Japan, earthquake early warning has paid off for businesses as well as individuals. For example, a Japanese computer chip manufacturer suffered $15 million in losses from fire, equipment damage, and 30 days' lost productivity from two earthquakes in 2003. The firm then spent $600,000 on early warning, new shear walls in their basement, and repositioning of sensitive equipment. Two earthquakes have struck the area since the upgrades and have caused just $200,000 in losses and only 8 days' lost productivity.

Full implementation of the ShakeAlert earthquake early warning system will save lives and reduce injuries and property damage. It will make American businesses more resilient, will enhance national security by reducing panic and chaos, and will speed the economic recovery of areas hit by earthquakes. Earthquake early warning is a key step in building the Nation's resilience to natural disasters.

Thank you, Mister Chairman, for the opportunity to provide the Subcommittee with the Department's views on this subject. I look forward to answering your questions.

For More Information

Earthquake Early Warning website: http://earthquake.usgs.gov/research/earlywarning/

Yukio Fujinawa and Yoichi Noda, 2013, Japan's Earthquake Early Warning System on 11 March 2011: Performance, Shortcomings, and Changes. Earthquake Spectra: March 2013, Vol. 29, No. S1, pp. S341-S368. http://earthquakespectra.org/doi/abs/10.1193/1.4000127

Given, D.D., et al., 2014, Technical Implementation Plan for the ShakeAlert Production System—An Earthquake Early Warning System for the West Coast of the United States: U.S. Geological Survey Open-File Report 2014–1097, 25 p., http://pubs.usgs.gov/of/2014/1097/