STATE CAPITOL
ROOM 2032
SACRAMENTO, CA 95814
TEL (916) 651-4019
FAX (916) 651-4919

California Legislature

JOINT LEGISLATIVE COMMITTEE ON EMERGENCY MANAGEMENT

SENATOR HANNAH-BETH JACKSON
CHAIR

INFORMATIONAL HEARING
JOINT LEGISLATIVE COMMITTEE ON EMERGENCY MANAGEMENT

California's Next Mega-Quake: Assessing the State's Preparedness and Response Strategy

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1:30 p.m.
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Background Paper

Introduction

Living with the threat of earthquakes is simply a part of life in California. Every day, dozens of small earthquakes rattle beneath our feet – most of them too small to notice. Just yesterday, some residents of San Francisco woke to a shallow magnitude 3.2 earthquake about seven miles offshore almost directly west of the Golden Gate Bridge. In contrast, both geologic and recorded history tell us that infrequent, large-magnitude earthquakes, or "mega-quakes," are just as much a part of California's seismic reality as the smaller-intensity earthquakes to which many Californians have grown accustomed.

Unlike San Francisco's small temblor yesterday, large-magnitude quakes can shatter our cities and bring about widespread devastation, the effects of which may linger for years, if not decades. Two years after a magnitude 7.8 earthquake struck Nepal in 2015 and killed nearly 9,000 people, for example, some half-million Nepalese of the initial 3.5 million rendered homeless by the quake still live in temporary housing. Even in more

prosperous countries like Japan, recovery from a mega-quake can take a significant amount of time. More than five years after the magnitude 9.0 Tohoku earthquake and tsunami devastated the northeast coast of Japan in 2011, almost 200,000 people remain in temporary accommodations and a quarter of impacted farmland remains out of production.

Global experience from these and other major earthquakes helps inform not only how California should organize its post-event response efforts to aid the wounded and limit property damage, but also what policymakers and government leaders should anticipate and expect as we rebuild our cities and infrastructure. Today's hearing is the second of the Joint Legislative Committee on Emergency Management's two-part series on mega-quakes - those with a magnitude of 8.0 or greater - and will focus on the state's post-earthquake response and recovery efforts following a mega-quake in California.

California's Seismic Risk

California's west coast sits along the eastern edge of the "ring of fire" -- the name given to a tectonically active region encircling the Pacific Ocean where approximately 90 percent of the world's earthquakes occur. California's west coast can be divided into two predominant tectonic zones, each of which produces characteristically different earthquakes. The more familiar San Andreas Fault Zone extends for about 750 miles through the southern half of the state from the Salton Sea to Mendocino County, and marks the boundary between the Pacific Plate and the North American Plate. The San Andreas Fault Zone is characterized by strike-slip, or horizontal, movement between these tectonic plates and averages about 20-35 millimeters of movement per year.

North of the San Andreas Fault zone is the Cascadia Subduction Zone, a 620-mile long zone that runs from Mendocino County to Vancouver Island in British Columbia. The Cascadia Subduction Zone marks the boundary between the North American and Juan de Fuca tectonic plates. Unlike the San Andreas Fault Zone, the Cascadia Subduction Zone is characterized by a thrust fault where one tectonic plate (Juan de Fuca) is pushed underneath another (North American) at an average rate of 40 millimeters per year. Thrust faults such as this are capable of producing megathrust earthquakes - the most powerful in the world - which can exceed magnitudes of 9.0. Since megathrust earthquakes deform the ocean floor and often generate a significant series of tsunami waves. A megathrust tsunami was generated in 2011 by the Tohoku earthquake in

Japan, creating a wave 133 feet high that travelled up to six miles inland and led to the ultimate meltdown of the Fukushima Daiichi Nuclear Power Plant. The north coast of California is capable of generating similar megathrust earthquakes and tsunamis.

According to a 2014 U.S. Geological Survey (USGS) earthquake forecast for California, the state is nearly certain to experience an earthquake as strong as the 6.7 magnitude 1994 Northridge Earthquake in one of these two zones during the next 30 years. This USGS forecast also found that California's risk for a mega-quake (magnitude 8 or larger) during the same time period stands at about seven percent, and identifies the southern San Andreas Fault as having the greatest threat for earthquake activity of any region in California. An earlier 2008 report from USGS projected that a magnitude 7.8 earthquake along the southern San Andreas Fault would result in approximately 1,800 deaths and $213 billion in economic losses.

Further north, researchers at Oregon State University have predicted based on historical averages that the southern end of the Cascadia Subduction Zone – from Northern California to Newport, Oregon – has a 37 percent chance of producing a mega-quake in the next 50 years. Officials at the Oregon Department of Geology and Mineral Industries have predicted a 10 to 14 percent chance of a magnitude 9.0 or greater earthquake along the Cascadia Subduction Zone over the next 50 years, which could generate a tsunami up to 100 feet in height. (*See* Lori Tobias, *Big Earthquake Coming Sooner Than We Thought, Oregon Geologist Says*, The Oregonian [Apr. 19, 2009]).

California's Earthquake Response Plan

Within California, the Governor's Office of Emergency Services (OES) serves as the lead agency for managing statewide earthquake readiness. As part of this mission, OES has developed three response plans for a mega-quake scenario: the Cascadia Subduction Zone Earthquake and Tsunami Response Plan; the Bay Area Earthquake Plan; and the Southern California Catastrophic Earthquake Response Plan. Each plan provides a framework outlining how local, tribal, state, and federal governments and private and nongovernmental organizations will respond and coordinate following a catastrophic earthquake in California, focusing on delivering a rapid and effective response to meet the needs of survivors in affected areas. While each plan differs, all three plans anticipate immediate and devastating impacts to the human environment, including:

- **Damage to infrastructure** – Damage to transportation, water, wastewater, industrial, power, public safety, medical, and housing infrastructure will result in the need for significant support in all impacted areas.

- **Loss of transportation capacity** – Damage to transportation networks could cause large population areas to become isolated and the supply chain serving residents to become degraded.

- **Loss of water and wastewater services** – A severe earthquake will damage water utility pipelines and facilities, resulting in interrupted sources of supply and ultimately loss of service.

- **Damage to petroleum infrastructure** – In a severe earthquake, petroleum refining and distribution infrastructure may not be fully operational. Partial or complete failure of storage tanks is possible in areas of peak ground acceleration or liquefaction. Oil pipelines might rupture through displacement at points where pipelines cross faults, and may be damaged by ground shaking in liquefaction areas. Interruption of public fuel supplies through commercial gas stations is also probable due to power failure and degraded infrastructure. Although retail gas stations may have fuel in underground tanks, they will be unable to pump fuel without electric power.

- **Loss of electrical power** – A severe earthquake could damage much of the affected area's electrical power infrastructure. Electrical transmission lines and towers will likely fail as a result of ground shaking; gas pipeline breaks and leaks will occur, creating hazardous conditions and fires; and power could be out to communities for weeks, due to lack of repair parts caused by high demand and manufacturing delays.

- **Loss of communications capabilities** – Extensive damage to existing communications infrastructure would result from a severe earthquake—damage that could take several weeks or months to repair. Neither landline nor cellular telephone systems will work for at least the first day post-event, probably longer, due to system overload and damage to cell phone towers. Loss of communications capabilities will impact the response and needed communication with the public.

Immediately following a catastrophic earthquake and the disruption of critical infrastructure throughout an affected area, the response capabilities of local and regional first responders are likely to be overwhelmed. In accordance with the State

Standardized Emergency Management System, affected jurisdictions will activate their emergency operations centers and begin collecting information about the scope and extent of the disaster. They will also begin collaborating with state, interstate, and federal partners to deploy immediate life-saving resources through pre-arranged emergency management assistance compacts and mutual aid agreements.

One of the first objectives in response to a mega-quake will be to re-establish effective communications in the disaster area. Responding agencies and private sector partners will deploy emergency communications equipment at key sites, including incident command facilities, victim reception centers, equipment staging areas, and material embarkation and debarkation sites, in order to coordinate lifesaving and life-sustaining response operations and public information efforts. Simultaneously, public sector responders and mass care service providers like the American Red Cross will begin providing life-sustaining resources to survivors, such as sheltering, hydration, and feeding, and will assist with family reunification, distribution of emergency supplies, and the sheltering, feeding, registration, and tracking of individuals within a disaster zone. Hospitals and medical facilities will execute surge plans and, as necessary, may establish alternate care sites or assist in the deployment and operation of mass casualty field treatment units. Logistics planners will also activate transportation, distribution, and materiel handling operations to create a temporary supply chain to deliver and distribute resources among survivors and responders.

Following immediate response efforts, public and private sector responders will begin to assess damage to healthcare and social service facilities, utilities, and transportation systems, and work to re-establish essential services. Many residents impacted by the disaster will shelter in place in their homes or neighborhoods, and will need life-sustaining supplies such as food and water, requiring responders to develop distribution systems for commodities and medical supplies. Non-residents will require transportation support out of disaster areas to return to their homes, and victims of the disaster may need to be taken out of the impacted area for further care, requiring responders to develop efficient embarkation and debarkation sites to facilitate movement. Government agencies and private sector operators of hazardous materials facilities will begin working to minimize environmental threats to people, property, and the environment through hazardous material containment, cleanup, and disposal operations, and mass fatality coordinators will begin the work of identifying and recovering human remains. Local, state, and federal agencies will also need to identify and obtain interim housing for displaced populations, since the demand for interim

housing post-earthquake will rapidly deplete existing interim housing stocks such as hotel rooms or rental units.

Recovery

As noted above, communities across the globe have taken years to recover from mega-quakes of the type capable of occurring in California. Many of these communities, including those in more prosperous nations, fail to fully recover within the first decade following a severe earthquake. In New Zealand, for example, a series of three severe quakes rocked the Christchurch area in 2010 and 2011, rendering tens of thousands of homes unsafe, and the first five years of recovery saw mostly demolition and cleanup work taking place. It was not until 2016 – five years later – that significant rebuilding even began, and today many area homes and the city's iconic cathedral have yet to be rebuilt.

Recovery and rebuilding in California following a mega-quake may follow this same pattern. Almost three years to the day following the 2014 South Napa magnitude 6.0 earthquake, rebuilding and recovery efforts continue in that region. The significantly more destructive force of a mega-quake would likely push recovery timetables well beyond that which California has experienced following other major earthquakes.

OES's response plans for mega-quake scenarios indicate that the damage likely to impact California's infrastructure and human environment will be severe. For the northern part of the state, the Cascadia Subduction Zone Earthquake and Tsunami Response Plan acknowledges the likelihood of 1,000 or more immediate fatalities, an additional 1,500 persons injured, and 28,000 structures damaged or destroyed as a result of a major earthquake and tsunami event. Modeling for a 7.8 magnitude earthquake in the Bay Area indicates that of the 7.7 million people who reside there, approximately 2,550 would be killed, 13,357 buildings would be destroyed, over half of all households in the affected area would lose power and water service, and economic losses could total up to $60.5 billion. In Los Angeles, the Southern California Catastrophic Earthquake Response Plan estimates that a magnitude 7.8 earthquake on the southern San Andreas Fault would kill 3,600 people, ignite 1,600 fires, cause between 10,000 and 100,000 landslides, and significantly damage 300,000 buildings – one out of every 16 in the region.

While the extent of destruction from a mega-quake will certainly be a factor in how long it takes California to recover and rebuild, another important aspect will be the

availability of adequate financial resources to finance recovery efforts. According to the private risk management firm AIR Worldwide, a mega-quake on the lower segment of the San Andreas Fault would result in residential and commercial losses totaling $234 billion, with less than 20 percent of the losses covered by insurance. Homeowners, businesses, and landlords would shoulder the remaining 80 percent of the losses, prompting many businesses to declare bankruptcy and homeowners to walk away from their mortgages. Economic impacts to the regional real estate market from such losses could depress construction and sale activity for decades.

Conclusion

The most recent earthquake forecast for California states with near certainty that an earthquake as strong as the 6.7 magnitude 1994 Northridge Earthquake will occur during the next 30 years, and that the state's chance for experiencing a mega-quake of magnitude 8.0 or greater over the same time period is about seven percent. Either of these earthquake scenarios would result in a significant loss of life, widespread damage to our state's infrastructure, and economic losses in the billions of dollars. This hearing will provide members of the Joint Legislative Committee on Emergency Management and the public with the latest information on California's plans for responding to and recovering from a major earthquake.