

Resiliency 2025:

Improving Our Readiness for the
Cascadia Earthquake and Tsunami

Kate Brown, Governor

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STATE OF OREGON
Office of the Governor
KATE BROWN

Vision

Protect all Oregonians by ensuring we are prepared to survive and recover from the expected 9.0 magnitude Cascadia earthquake and ensuing tsunami.

Executive Summary

When the next Cascadia subduction zone earthquake strikes the Pacific Northwest, Oregon will face the greatest challenge of our lifetimes. Oregon's buildings, transportation network, utilities, and population are underprepared for such an event, and we must accelerate our preparations.

In 2013, the Oregon Seismic Safety Policy Advisory Commission issued the Oregon Resilience Plan, which reported that the Cascadia earthquake would result in the death of thousands of Oregonians and economic losses would total at least \$32



billion. According to the report, Oregon's buildings and lifelines (transportation, energy, telecommunications, and water/wastewater systems) would be damaged so severely that it would take three months to a year to restore full service in the western valleys, more than a year in the hardest-hit coastal areas, and many years in the coastal communities inundated by the tsunami. A [2018 report](#) from the Oregon Department of Geology and Mineral Industries on the Portland metro region also describes significant casualties and economic losses.

Experience from past disasters in other areas has shown that businesses will move or fail if services cannot be restored in one month. With the current projected recovery timelines, Oregon faces a very real threat of permanent population loss and long-term economic decline after the earthquake.

To protect Oregon's communities and economy, Governor Brown will build upon the success of the 2013 Oregon Resilience Plan with *Resilience 2025: Improving Our Readiness for the Cascadia Earthquake and Tsunami*.



This policy agenda focuses on six key strategies:

- 1. Continue state investments in seismic upgrades of schools and emergency services buildings throughout Oregon.*
- 2. Develop a plan for the Critical Energy Infrastructure Hub to prevent and mitigate catastrophic failure and ensure fuel supplies and alternate energy sources are available to responders and the public.*
- 3. Implement a statewide earthquake early warning system by 2023.*
- 4. Work with local governments, community groups and the American Red Cross to ensure that 250,000 vulnerable homes have 2-week ready supplies in the next three years.*
- 5. Strengthen local emergency management organizations and develop more robust logistical staging bases, local supply chains, and more earthquake and mass displacement insurance options.*
- 6. Update the Oregon Resilience Plan in 2021 to reflect current best practices, community input, and academic research, including a specific plan for the Oregon Coast.*



Background

Cascadia Subduction Zone

In the last 25 years, scientists discovered how the Cascadia subduction zone -- a place 50 to 75 miles off Oregon where two of the Earth's plates meet, one sliding under the other -- could produce devastating earthquakes in the Pacific Northwest. After further research, geologists have discovered that a 8.0 earthquake at the Juan de Fuca plate off the West Coast has occurred on average every 250 years over the past 10 millennium; a 9.0 earthquake occurs on average every 540 years. The last 9.0 earthquake of this size occurred in the year 1700, or 318 years ago.¹ Due to this research, scientists now estimate there's a 7 to 12 percent chance that a powerful earthquake and tsunami will impact the entire Pacific Northwest within the next 50 years, and a 37 percent chance that a very large earthquake will impact Southern Oregon and northern California in that timeframe.

Tsunami

An earthquake on the Cascadia subduction zone, a 600 mile long fault zone that sits off the Pacific Northwest coast, can create a Cascadia tsunami that will reach the Oregon coast within 15 to 20 minutes. Massive earthquakes of magnitude 9.0 or greater have been generated on the fault zone that probably produced strong shaking that endured for several minutes. A destructive tsunami can follow moments later.

Communities along the Pacific coast and along estuaries are at greatest risk. A nearby earthquake could drop the low-lying regions of the coast several feet below sea level. The highest tsunami waves could reach 80 feet and severely flood coastal communities near beaches, bay mouths, and low-elevation coastal plains. Oregon's at-risk population is approximately 40,000 on the outer coast, excluding tourists and visitors that seasonally swell the population manyfold.

1. https://www.oregonlive.com/news/index.ssf/2009/04/big_earthquake_coming_sooner_t.html



“A nearby earthquake could drop the low-lying regions of the coast several feet below sea level. The highest tsunami waves could reach 80 ft”

Almost 230,000 people from 11 nations were lost during the 2004 Indian Ocean tsunami, making it one of the deadliest natural disasters in human history. The startling global impact of this event instigated a reexamination of tsunami hazards along the Oregon coast. The Oregon Department of Geology and Mineral Industries (DOGAMI) is currently working closely with Oregon Emergency Management and other government agencies, universities, and research partners to develop the next generation of tsunami inundation maps for the entire Oregon coast. New evacuation maps are derived from computer simulations of tsunamis developed from our improved understanding of how undersea earthquakes produce tsunamis and from lessons learned from the devastating 2004 Indian Ocean tsunami.

New models of how shallow earthquakes deform the seafloor, informed by a better understanding of the structure of the Earth’s crust and the geologic record of how often such earthquakes and tsunamis occur in Oregon, suggest that prior tsunami inundation maps may underestimate the true hazard. New tsunami simulations indicate that the largest waves may run up to elevations twice as high as earlier



models predicted and flooding may inundate hundreds of yards farther up coastal valleys. As a result, evacuation zones for some coastal communities may need to be revised and likely will result in larger evacuation areas.

Historical actions

After the Loma Prieta earthquake struck the Bay Area of California in 1989, Oregon residents wanted state government to address earthquake hazards and preparedness. As a result, the Interagency Seismic Task Force recommended that a new state commission be formed in response to this need. The Oregon Seismic Safety Policy Advisory Commission (OSSPAC) was formed as a result of Senate Bill 96 in 1991. Since then, OSSPAC has continued to increase Oregon's awareness of earthquake hazards by supporting earthquake education, research, and legislation.

Oregon took its first step in assessing potential economic and infrastructure damage in the event of a large earthquake in 1999 when DOGAMI published a preliminary statewide damage and loss study identifying the dire consequences of a Cascadia earthquake and tsunami for Oregon's infrastructure and for public safety.² The report was the first wakeup call about the catastrophic impacts of a 9.0 earthquake and how woefully underprepared Oregonians and communities are in their ability to recover from such an event. The report estimated a direct economic loss of \$12 billion and more than 7,800 deaths and injuries. Further, the report indicated that more than 17,300 households would be displaced and there would be a need to provide emergency shelter to more than 12,400 individuals.

In the 2011 session, the Oregon Legislature commissioned a statewide assessment of schools and emergency response facilities, and also funded significant investments in improving seismic upgrades to unsafe schools and other critical facilities. That legislative session also saw

2. Oregon Department of Geology and Mineral Industries, Earthquake damage in Oregon: Preliminary estimates of future earthquake losses, 1999



the passage of House Resolution 3 calling on OSSPAC to plan for the impacts of a Cascadia earthquake and tsunami.

On February 28, 2013, OSSPAC delivered a copy of the Oregon Resilience Plan³ to the Legislative Assembly. The plan set out to help Oregonians know what to expect from the state's infrastructure in the event of a large magnitude earthquake and to propose the level of infrastructure reliability that a resilient state should provide. The plan's recommendations highlighted ways to close the gap that separates expected and desired performance.

The 2013 Legislature passed Senate Bill 33, which created the Governor's Task Force on Resilience Plan Implementation. The Task Force made recommendations on priority actions for seismic resilience based on 140 recommendations from the Oregon Resilience Plan. The Task Force studied these and other recommendations, including those specified in Senate Bill 33, and brought forward the most critical to be implemented in the 2015-17 biennium.⁴

Seismic rehabilitation Grant and School Capital Improvement Matching Programs

The Seismic Rehabilitation Grant Program (SRGP) is a state of Oregon competitive grant program that provides funding for the seismic rehabilitation of critical public buildings, particularly public schools and emergency services facilities. SRGP requires that school facilities be retrofitted to Life Safety and emergency service facilities to Immediate Occupancy standards as defined by the American Society of Civil Engineers. Life Safety means that a building may be damaged beyond repair during an earthquake but people will be able to safely exit the building. Immediate Occupancy means that not only will the building remain standing after an earthquake, but emergency services will be able to continue to operate and provide services. This program has been funded at \$340 million since 2011.

3. Oregon Resilience Plan, Feb 2013, https://www.oregon.gov/oem/Documents/Oregon_Resilience_Plan_Final.pdf

4. https://www.oregon.gov/oem/Documents/2014_ORTF_report.pdf



“An earthquake and tsunami could cause a direct economic loss of \$12 billion, more than 7,800 deaths and injuries, and displace more than 17,300 households”

In 2015, Governor Brown signed into law Senate Bill 447 to establish the Oregon School Capital Improvement Matching Program. Funds can only be awarded after a district passes a local general obligation bond. The program operates as an incentive and funds are committed to districts ahead of the election. Districts can use this information to let their community know about the possibility of receiving some matching funds from the state should their local bond pass. Once awarded, the district may use the funds to support capital construction projects, and in some cases, do seismic upgrades at the same time. This program has been funded at \$225 million since 2015.



Critical Energy Infrastructure Hub in Portland

Oregon's Critical Energy Infrastructure (CEI) Hub is located in an area with significant seismic hazard. Significant liquid fuel, natural gas, and electrical infrastructure and facilities are situated in this relatively small area in Portland. The CEI Hub covers a six mile stretch on the lower Willamette River located between the south tip of Sauvie Island and the Fremont Bridge on US Highway 30.

The energy sector facilities in the CEI Hub include:

- All of Oregon's major liquid fuel port terminals
- Liquid fuel transmission pipelines and transfer stations
- Natural gas transmission pipelines
- Liquefied natural gas storage facility
- High voltage electric substations and transmission lines
- Electrical substations for local distribution

More than 90 percent of Oregon's refined petroleum products come from the Puget Sound area of Washington State. Oregon imports the products by pipeline and marine vessels to the CEI Hub before it is distributed throughout Oregon to the end user. One large consumer is the Portland International Airport. In addition, much of NW Natural's natural gas passes through the CEI Hub. A high voltage electrical transmission corridor crosses the area as well as supplies distribution for this area.

Based on visual observations, engineering judgment, limited analyses, and limited information from the facility operators, city records, and available literature, significant seismic risk exists in the CEI Hub. Some critically important structures appear to be susceptible to significant damage in a major earthquake, with catastrophic consequences. Multiple liquid fuel transmission pipe breaks and natural gas transmission pipe breaks are possible. Damage to liquid fuel, natural gas, and electrical facilities in the CEI Hub is likely. The waterway would likely be closed and require clean up.



Recent Accomplishments

Under Governor Brown's leadership and following the recommendations of the Oregon Resilience Plan, Oregon has taken the following steps to prepare for the Cascadia earthquake:

- Appointed Oregon's first State Resilience Officer (SRO), Mike Harryman, to coordinate resilience activities for the state
- Directed the SRO to complete a 5-Year Progress Report on the Oregon Resilience Plan
- Seismic Upgrades: Preparedness for Schools – passed \$234 million in funding to make schools safe for students and staff
- Seismic Upgrades: Emergency Services Buildings – passed \$63 million in funding to support emergency services buildings throughout the state
- Oregon School Capital Improvement Matching Program – passed \$225 million in funding to match school district investments in new, seismically-sound facilities
- Directed the Executive branch agencies to complete Continuity of Operation Plans for all major state agencies to ensure operations in the event of a major disaster
- Developed and tested the Governor's Disaster Cabinet and Continuity of Government Plan
- Passed \$670,000 to purchase and keep in Oregon 30 National Science Foundation-owned sensors at 15 sites as part of the Pacific Northwest Seismic Network. The University of Oregon used federal funds to upgrade the sensors to contribute to the ShakeAlert early warning system.

In addition, in 2017, the Governor signed Senate Bill 311 which authorizes cities and counties to adopt an ordinance or resolution providing property tax exemption to commercial, industrial, and multi-family buildings built before January 1, 1993, that will be seismically



retrofitted, for a period not to exceed 15 years. Senate Bill 85 (2015) allows cities and counties to create loans or loan guarantee programs for seismic upgrades of private buildings. The Governor believes that these types of public/private partnerships will give responsible business owners the tools they need to best prepare for the Cascadia earthquake.

Finally, in 2017 the Governor signed Senate Bill 850, which required OSSPAC to establish a committee to assist the commission in establishing policy recommendations regarding life and property protection following a major earthquake or tsunami event. The committee conducted reviews of policy options, prepared a summary of existing state agency reports and studies, and provided recommendations for policy measures regarding life and property protection.⁵ This includes, but is not limited to, the investigation of insurance-related issues for earthquakes and tsunami events. Senate Bill 850 also directed OSSPAC to form a committee to look into mass care/ mass displacement activities after an event.⁶

5. <https://www.oregon.gov/oem/Documents/OSSPAC-18-01%20Insurance%20Final%20Report.pdf>

6. <https://www.oregon.gov/oem/Documents/OSSPAC-18-02%20Mass%20Care%20Final%20report.pdf>



The Governor's Strategy:

Following the launch of the 2013 Oregon Resilience Plan, Resiliency 2025 will continue to improve Oregon's lifelines, safeguard our critical infrastructure, and protect the public.

- ONE:** Continue state investments in seismic upgrades of schools and emergency services buildings throughout Oregon.
- TWO:** Develop a plan for the Critical Energy Infrastructure Hub to prevent and mitigate catastrophic failure.
- THREE:** Implement a statewide earthquake early warning system by 2023.
- FOUR:** Work with local governments, community groups, and the American Red Cross to ensure that 250,000 homes have 2-week ready supplies in the next three years.
- FIVE:** Strengthen local emergency management organizations and develop more robust logistical staging bases, local supply chains, and more earthquake and mass displacement insurance options.
- SIX:** Update the Oregon Resilience Plan in 2021 to reflect current best practices, community input, and academic research, including a specific plan for the Oregon Coast.



ONE: Continue state investments in seismic upgrades of schools and emergency services buildings throughout Oregon

The state must continue investing in seismic upgrades of schools and emergency services buildings throughout Oregon by continuing to fund several key programs. The following programs must be adequately funded:

- School Seismic Program
- Emergency Services Buildings Program
- Oregon School Capital Improvement Matching Program

By 2021, the state must also complete a formal assessment on the seismic rehabilitation program to determine long-term bonding request and complete an economic forecast for additional mitigation and risk reduction funding for schools⁷ and emergency service facilities (hospitals⁸, 911-centers, police and fire stations).

TWO: Develop a plan for the Critical Energy Infrastructure Hub to prevent and mitigate catastrophic failure

Due to a combination of the existing seismic hazards, vulnerability of the exposed infrastructure, and potential consequences, Cascadia earthquakes pose substantial risk to the CEI Hub and to Oregon. Not only are the energy sector facilities in the CEI Hub dependent on other sectors and systems in Oregon, including transportation and communication, but they are interdependent upon each other. A major Cascadia earthquake and tsunami would likely produce an unprecedented catastrophe much larger than any disaster the state has faced.

7. Wang, Wolf, Dougherty, Oregon Schools Face "The Really Big One": Advancing School-Centered Community Resilience, 2017

8. Wang, Richer, Lamb, DePew, Cascadia Earthquakes: Preparing Coastal Hospitals, 2017



“The Governor has directed the State Resilience Officer to implement a statewide earthquake early warning system by 2023”

Western Oregon will likely face an electrical blackout, extended natural gas service outages, liquid fuel shortages, as well as damage and losses in the tens of billions of dollars in a future major Cascadia earthquake. To prepare for a catastrophic disaster and become more resilient, we must improve personal safety and security, and safeguard communities and businesses.⁹

To begin to address the dangers at CEI, and following the recommendations of the City Club of Portland report, the Governor is directing the following:

- The Oregon Office of Emergency Management, in coordination with Oregon Department of Energy and Oregon Department of Environmental Quality, should commission a risk abatement study to evaluate real-time options to mitigate product flow from the CEI Hub into the Columbia and Willamette Rivers immediately following a major earthquake. The study should include multiple scenarios based on expected earthquake size and liquefaction conditions at individual facilities. Following the study, the agencies should propose specific mitigation options, including rapid containment and recovery.

9. <https://www.oregon.gov/energy/safety-resiliency/Documents/2013%20Earthquake%20Risk%20Study%20in%20Oregon%E2%80%99s%20Critical%20Energy%20Infrastructure%20Hub.pdf>



- By December 2019, OSSPAC should issue a report covering the following:
 - o An analysis of state and federal guidance on the regulatory authority for seismic upgrades to both structures (tanks, terminals) and pipelines to include land mitigation.
 - o A determination of private sector incentives focused on hardening current infrastructure, conducted in conjunction with Oregon Solutions.
 - o The use of the Earthquake Early Warning (ShakeAlert) system among private sector owners at the CEI Hub.
 - o The question of statutory authority of a current state agency to develop long-term mitigation efforts and if necessary, recommend which state agency would be best suited for this new authority.
- Following this report, the designated state agency must:
 - o Work with owners of CEI Hub facilities to ensure the provision of an engineering assessment of each facilities' vulnerability to a Cascadia Subduction Zone (CSZ) earthquake and other information relevant to mitigating the current risks.
 - o Develop and implement, in collaboration with industry stakeholders, standards for construction and retrofit of storage tanks at the CEI Hub. The standards should be designed to prevent releases and to preserve substantial functionality in the event of a CSZ earthquake.



THREE: Implement a statewide earthquake early warning system by 2023

The U.S. Geological Survey (USGS), State of Oregon, and a variety of public and private partners have worked together to improve seismic monitoring and implement an onshore public earthquake early warning system on the west coast, known as ShakeAlert.

Because the Pacific Northwest lies in the Cascadia Subduction Zone, it has the potential for some of the most violent earthquakes. Yet, it lacks a fully instrumented earthquake early warning system—a common place safety precaution that other places with as much seismic activity have, such as Japan, Mexico, and Chile.

In order to improve public safety and reduce the loss of life and critical infrastructure, public and private partners have worked to plan and build out the west coast onshore early warning system known as ShakeAlert. This system will monitor both the San Andreas Fault in California, the Cascadia Subduction Zone in the Pacific Northwest, and numerous other crustal faults. The system will build on the current network of sensors (operated by the University of Washington, University of Oregon, University of California, Berkeley, and the California Institute of Technology). These efforts were funded at \$12.9 million in the Fiscal Year 2018 federal budget, and when fully implemented, advocates will request \$28.6 million per year for operations and maintenance. To leverage and fully utilize this federal funding, the states of Washington and California annually contribute approximately \$600,000 and \$1.2 million respectively to seismic monitoring activities in their states.



Earthquake early warning will prove critical in a Cascadia event and during other seismic events:

- Earthquake alerts allow users and automatic systems to initiate actions to protect themselves, equipment, and delicate operations from injury or damage during shaking.
- For large Cascadia Subduction Zone events, an alert could be received between seconds and several minutes prior to strong shaking, valuable time to get to safety.
- The USGS will generate the alerts and delivery will come by other public and private means (internet, radio, television, cellular), including FEMA's Integrated Public Alert and Warning System (IPAWS).
- Often using automation, industry and others will be able to power down critical operations that will protect both human lives and equipment.
- The Oregon Department of Transportation and other transportation agencies may eventually be able to close down bridges, and in doing so, save lives.

The Governor has directed the State Resilience Office to implement a statewide emergency warning system by 2023 that ties multi-hazard events: earthquakes, wildland fires, landslides, and flooding events into one alerting and monitoring system.¹⁰ At the current pace and funding projections by USGS, Oregon's ShakeAlert system will only be built out at 50 percent by the end of Fiscal Year 2020.¹¹ In order to finish the current statewide system it will take an additional (one time) \$12 million in funding. The Governor will make recommendations in her 2019-21 budget to achieve the statewide system by 2023.

10. Earthquake Early Warning System: ShakeAlert, <https://www.shakealert.org/>

11. USGS: Technical Implementation Plan for ShakeAlert Product System-An Earthquake Early Warning System for the West Coast of the United States, 2014



“The Governor will charge the Oregon Office of Emergency Management with developing a plan to ensure that 250,000 homes in the CSZ region have 2-week ready supplies by 2021”

FOUR: Work with local governments, community groups, and the American Red Cross to ensure that 250,000 homes have 2-week ready supplies in the next three years

For many years, Oregonians have been talking about the importance of being prepared for the first 72 hours after the potential Cascadia earthquake. This summer, the Governor witnessed first-hand how unprepared many Salem residents were in response to the cyanotoxin water crisis. The Governor has strongly encouraged all Oregonians to prepare an emergency readiness kit for each family member.

But a large earthquake and tsunami will leave much of the area's transportation routes destroyed. Oregonians will have to count on each other in the community, in the workplace, and at home in order to be safe until responders can reach them. Oregon's Office of Emergency Management (OEM) now encourages people to be prepared to be on their own for a minimum of two weeks. This lessens the strain on emergency responders who need to focus limited resources on injured and other vulnerable populations immediately following a disaster.

The Governor will charge OEM with developing a plan, in coordination with county emergency management, non-profits, and the American Red Cross, to ensure that 250,000 homes in the Cascadia Subduction Zone region have 2-week ready supplies by 2021.



FIVE: Develop more robust logistical staging bases and more earthquake and mass displacement insurance options

After a devastating Cascadia earthquake, airports will become central to Oregon's recovery efforts. Air ambulances, coast guard operations, firefighting efforts, and the quick importing of essential survival supplies will all rely on Oregon's airports. Oregon's airports must be resilient in order to serve as logistical staging bases in the aftermath of the earthquake.

Governor Brown has directed the Oregon Office of Emergency Management to develop a grant program by 2021 that provides funding to public/private pre-selected Logistical Staging Bases (LSB). These bases will be used for life safety, humanitarian, and short-term recovery operations immediately following a Cascadia event.

Resources will be both in personnel and supply and services, to train state and local personnel into Incident Management Type-III teams for each site within the first 120-hours (five days) following a Cascadia event to provide command and control. The primary function of these LSBs will be to increase the capacity of local and regional emergency management organizations, with augmentation when possible by the Oregon Department of Forestry and the Oregon State Fire Marshall Office's Incident Management Teams.

Governor Brown will also establish by 2021 a grant program to provide seismic upgrades to publically-owned airports, using the 2017 Airport Resiliency Workshop data and adopting the Federal Emergency Management Agency tier system ratings to prioritize coastal and valley owned state airports to either build or enhance their infrastructure so that they can serve as life safety logistical bases following a Cascadia Subduction Zone earthquake and tsunami.



“ Oregon’s airports must be resilient in order to serve as logistical staging bases in the aftermath of the earthquake”

To ensure Oregonians can stay in their communities, Governor Brown will create by 2021 an Oregon Safety Assessment Program (OrSAP)¹² to help local governments perform accurate assessment for safe occupancy of government, business, and residential buildings and facilities following an earthquake, flood, or other hazards. The creation of a robust post-earthquake building damage assessment program has been a goal of OSSPAC for over two decades. It was included as a prominent recommendation in Chapter 2, Business and Workforce Continuity, of the Oregon Resilience Plan in 2013.

To further help Oregonians stay in their communities, the Governor has directed the OSSPAC to develop recommendations in their September 2018 report for additional residential earthquake insurance and mass displacement care plans following a Cascadia event. The Governor plans to consider these recommendations when developing her 2019-21 budget.

12. California Safety Assessment Program, <http://www.caloes.ca.gov/cal-oes-divisions/recovery/disaster-mitigation-technical-support/technical-assistance/safety-assessment-program>



SIX: Update the Oregon Resilience Plan in 2021 to reflect current best practices, community input, and academic research, including a specific plan for the Oregon Coast

In 2019, the Oregon Resilience Plan will have been in place for six years. In 2018, the progress report was issued on the status of the recommendations in the original plan. The Governor has now directed the State Resilience Office to provide another update to the Oregon Resilience Plan by 2021.¹³ This update will continue to build a statewide long-term strategic framework that looks at all levels of government (state, local, and tribal) and the private sector.

The 2021 update will be conducted in partnership with Portland State University and the Initiative for Community and Disaster Resilience program. The three core areas that must be addressed in the plan are:

- Developing a scorecard that address four major themes: social capital, economic capacity, infrastructure and ecosystems, and governance. The scorecard will include the current situation and vulnerabilities in the state, address response and recovery capacity, and the state's adaptive capacity.
- Commissioning an authoritative economic study that measures how investments in seismic upgrades can mitigate the potential widespread economic devastation currently predicated by the Cascadia event.

As part of the update to the Oregon Resilience Plan, the Governor will request a formal assessment of Oregon's Seismic Rehabilitation Grant Program and the Oregon School Capital Improvement Matching Program. These assessments will determine long-term infrastructure planning and an economic forecast for additional mitigation and

13. Oregon Resilience Plan 5-Year Progress Update, Dec 2017, <https://www.oregon.gov/gov/policy/orr/Pages/index.aspx>



risk reduction funding for schools¹⁴ and emergency service facilities (hospitals¹⁵, 911-centers, police and fire stations). Governor Brown will continue to make recommendations for funding for these two programs in her 2019-21 recommended budget.

In order to ensure that coastal residents have the most opportunities to survive a Cascadia cause tsunami, Governor Brown will direct DOGAMI to complete a study by mid-2020 to relocate or to build vertical evacuation options for Coastal Schools and Hospitals that are within the Tsunami Inundation Zone.¹⁶ The study will also evaluate earthquake early warning sites, improving evacuation routes and plans, and building defensive wall structures.¹⁷

DOGAMI is aware of 12 public schools in the tsunami evacuation zone. This is based on an update of school data that DOGAMI management provided in 2016. The 12 schools include: 1 pre-K school, 5 elementary schools, 1 middle school, and 5 high schools. There are four hospitals in the tsunami evacuation zone. None are in the highest risk tsunami zone.¹⁸

14. Wang, Wolf, Dougherty, Oregon Schools Face "The Really Big One": Advancing School-Centered Community Resilience, 2017

15. Wang, Richer, Lamb, DePew, Cascadia Earthquakes: Preparing Coastal Hospitals, 2017

16. Western States Seismic Policy Council, Western States Seismic Policy Council 2017 Policy Recommendation Implementation Survey Results, <https://www.wsspc.org/>

17. <https://www.oregongeology.org/tsuclearinghouse/faq-tsunami.htm>

18. Info is based on this 2018 report: Oregon Coastal Hospitals Preparing for Cascadia http://www.oregongeology.org/pubs/ofr/O-18-03_report.pdf

