OREGON SCHOOLS FACE “THE REALLY BIG ONE”: ADVANCING SCHOOL-CENTERED COMMUNITY RESILIENCE

Y. Wang,¹ E. Wolf,² and D. Dougherty³

ABSTRACT

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- Safer, Stronger, and Smarter
- Prepared to Shelter
- Equipped to Function
- Ready to Serve

These levels are intended to guide the investments and initiatives needed to better prepare Oregon schools and communities for “the Really Big One,” a Cascadia Subduction Zone earthquake and tsunami.

Introduction

In the 25 years since moderate to strong earthquakes in the northern Willamette Valley and Klamath Falls damaged buildings including schools, Oregon has systematically established programs to invest in seismic retrofits of public buildings. K-12 schools supply a focus for this safety investment that has proven popular with both legislators and the general public.

Oregon’s Department of Geology and Mineral Industries (DOGAMI) helped to guide the first rounds of the state’s investment in earthquake retrofits by publishing a statewide assessment of seismic needs in 2007 [1]. The screening of nearly 2,200 school buildings helped officials to discern the magnitude of the potential exposure of schools to earthquake damage and tsunami inundation, alerted school administrators to previously unrecognized risks to their students and staff, and provided lawmakers with data needed to underpin a program of state investment.

Growing awareness of Oregon’s vulnerability to powerful earthquakes on the Cascadia Subduction Zone fault, heightened by the magnitude (M) 9.0 Tohoku earthquake and tsunami that struck Northeast Japan in 2011 and focused by publication of author Kathryn Schulz’s Pulitzer Prize-winning New Yorker article “The Really Big One” in 2015 [2], prompted a rapid expansion of state investments to strengthen buildings. Since 2009, cumulative state commitments to this priority have surpassed $310 million.

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In 2013, the *Oregon Resilience Plan* (ORP) prepared by the Oregon Seismic Safety Policy Advisory Commission (OSSPAC) offered comprehensive guidance for state efforts to prepare for a Cascadia earthquake and tsunami. Emphasizing investments and actions needed to minimize loss of life and keep the state economy functioning in the aftermath of a major earthquake, the ORP acknowledged that seismic resilience would require more than hardening the state’s built environment. As the authors of the ORP put it, “human resilience supported by Oregon’s civic infrastructure (community-based, non-governmental, and faith-based organizations) is needed to achieve full community resilience” [3].

Schools can help lead Oregon’s consideration of this “community resilience” goal. Citizens expect schools to play a prominent role during and after natural disasters. Making expectations explicit by designing initiatives to enable schools to serve the whole community afterwards must frame new objectives.

**The First Retrofit Decade**

More than fifteen years ago, the State of Oregon made earthquake safety in public school buildings a matter of public policy. Although state building codes require seismic life safety for all new school buildings, the vast majority of existing schools were built to earlier code standards that do not meet life safety performance levels. In 2001, Oregon adopted legislation mandating that public school buildings “found . . . to pose an undue risk to life safety during a seismic event” must be rehabilitated before January 1, 2032, “subject to availability of funding” [4].

The state legislature and OSSPAC elected to ask Oregon voters to decide whether the State should be allowed to borrow to help school districts upgrade their schools to satisfy the 2001 law. In 2002, a statewide ballot measure requesting this approval passed with the support of more than 55 percent of votes cast. The vote added an amendment (Article XI-M) to the Oregon Constitution allowing the State to issue taxpayer-backed general obligation bonds for seismic rehabilitation of public education buildings [5].

Few school districts took voluntary steps to identify their high-risk buildings or to mitigate them, and the state had nowhere to direct its new bonding authority. In 2005, the Legislature passed laws requiring public school buildings to be screened using a Federal Emergency Management Agency (FEMA) “rapid visual screening” methodology to identify seismic vulnerability.

DOGAMI completed this statewide assessment of seismic needs in 2007. Teams of professionals evaluated 2,185 buildings at 1,101 schools in 170 school districts, representing 97 percent of the total statewide enrollment for the 2005–2006 academic year. The assessment identified 1,018 individual school buildings posing a “high” or “very high” risk of collapse that required further evaluation by engineers [6].

In 2009, at the direction of the Legislature, Oregon launched the nation’s first state-funded Seismic Rehabilitation Grant Program (SRGP), currently managed by Business Oregon, the state’s economic development agency. Under the leadership of Senate President Peter
Courtney, the 75th Oregon Legislative Assembly (2009–11) authorized the first sale of $15 million of so-called XI-M bonds for seismic mitigation of high-risk public school buildings. Between 2009 and 2013, twenty-four K-12 school and community college buildings received the first seismic retrofits funded by the state (See Table 1).

Table 1. Oregon’s Seismic Rehabilitation Grant Program, 2009-2019

<table>
<thead>
<tr>
<th>Biennium</th>
<th>XI-M Bonds Authorized</th>
<th>School/CC* Projects</th>
<th>School/CC Districts</th>
<th>Average Project Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009-11**</td>
<td>$ 11,250,000</td>
<td>16</td>
<td>11</td>
<td>$ 703,125</td>
</tr>
<tr>
<td>2011-13</td>
<td>$ 7,614,000</td>
<td>8</td>
<td>8</td>
<td>$ 951,750</td>
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<tr>
<td>2013-15</td>
<td>$ 15,000,000</td>
<td>13</td>
<td>13</td>
<td>$ 1,153,846</td>
</tr>
<tr>
<td>2015-17</td>
<td>$ 176,870,000</td>
<td>141</td>
<td>56</td>
<td>$ 1,254,397</td>
</tr>
<tr>
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<td>$ 101,180,000</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>totals</td>
<td>$ 311,914,000</td>
<td>178</td>
<td>***</td>
<td>$ 1,187,849</td>
</tr>
</tbody>
</table>

*“CC” indicates “community college.”
**An initial $15 million XI-M bond authorization in 2009 was administratively reduced by $3,750,000 in 2010 during the Great Recession.
***Column does not total because some school districts have been awarded grants in multiple rounds.

Sources: Oregon Legislative Assembly, Business Oregon.

In 2011, following the Tohoku earthquake and tsunami, Oregon House Resolution 3 directed OSSPAC to lead and coordinate preparation of an Oregon Resilience Plan to “make recommendations for policy direction to protect lives and keep commerce flowing during and after a Cascadia earthquake and tsunami” [7].

OSSPAC presented its plan to the Legislature in 2013. The Commission recommended that lawmakers “fully fund Oregon’s Seismic Rehabilitation Grants Program for K-12 schools, community colleges, and emergency response facilities” [8], a call that legislators took to heart. In 2015, the Legislature authorized $176,870,000 for seismic retrofits of public schools. This enabled the SRGP to provide retrofit funding to more than 140 additional schools. As of 2017, 169 elementary, middle, and high schools (many in non-metro and rural districts), 8 community colleges, and one university campus have been retrofitted with state support.

The 2015 Legislature also established an Office of School Facilities in the Oregon Department of Education. Duties of the office encompass facilities-related technical assistance programs for school districts, including $25,000 grants to school districts to underwrite seismic engineering evaluations. The office is developing a statewide database of school facilities that will track the modernization of Oregon schools, including seismic improvements.

There are other signs of rising interest in earthquake preparedness. Many Oregon school districts have passed local capital bond measures that fund earthquake safety improvements, and a record 328,000 Oregon schoolchildren participated in the 2017 Great Oregon ShakeOut drills that train students and staff to Drop, Cover, and Hold On in the event of an earthquake [9].
Citizens and schools stakeholders have begun to demand more. Some are now asking schools to consider providing post-earthquake emergency shelter for community members, a role that schools have never previously assumed. Legislators initiated a state review of policies to support mass care with passage of Senate Bill 850 in early 2017 [10]. The topic encompasses temporary shelters, food and water, emergency health services, and recovery assistance. OSSPAC will deliver its mass care report to the State Resilience Officer by September 30, 2018.

A shift in expectations has begun. Beginning in 2018 the SRGP grant criteria will require school districts seeking retrofit grants for gymnasiums, cafeterias, and other large common spaces to design those spaces to meet an Immediate Occupancy performance level, suitable to serve as shelters. OSSPAC has also proposed to change the State Building Code to require common spaces in new school buildings to meet Immediate Occupancy performance [11].

Schools as Centers of Community Resilience

Few facilities receive more oversight than public schools. Building inspectors, fire marshals, and liability experts regularly monitor schools. But the facilities are only as strong as their engineering and construction. Oregon’s aging schools were not designed to withstand seismic events. However, as engineering and construction practices advance, school districts have opportunities to design for resilience and prepare to assume new responsibilities.

Schools are natural candidates to provide gathering places for people to shelter and seek aid in emergencies. Acknowledging this aspiration in remarks about Oregon’s commitment to seismic retrofits, Governor Kate Brown said, “Ensuring every community in the state, particularly in rural regions, has safe community gathering places and emergency response infrastructure will be key to Oregon’s recovery from a significant seismic event” [12].

This expectation about post-disaster function is widely held. Unfortunately, few schools can assure that the expectation will be fulfilled. As FEMA has noted, “Existing school buildings are often designated as emergency shelters without proper assessment of whether the buildings were designed to resist natural hazard events and if they will be in adequate condition to shelter people during or after an emergency” [13].

Preparing a school to serve the community needs that comprise mass care after an earthquake or other natural disaster takes planning and preparation that falls well outside the scope of the typical responsibilities of educators. School administrators and staff will need to plan options to provide drinking water, food, electricity, communications, prescription medications, and other medical needs. Schools will need to coordinate with emergency managers, medical providers, and even hospitals and other care facilities to accommodate community needs after a seismic event. At present, there are few instances of such coordination.

But schools are pre-designed to accommodate many post-disaster functions. New schools are constructed to higher building code standards than many comparable large buildings, and can be designed to deliver even higher performance. Schools have gymnasiums and cafeterias that can accommodate substantial numbers of people, and classrooms and offices suitable for smaller group needs. School settings are also familiar to students and their families, supplying
psychological comfort when people face significant stress.

Old schools can be retrofitted for the safety of their occupants, and new schools can be designed to provide functional shelter. But to protect students and staff, to be prepared to resume their educational function and to serve their community after natural disasters, Oregon schools must consider additional steps to achieve “community resilience.” These steps, though less costly than structural upgrades or new construction, will require coordination with government and community partners that does not happen automatically.

School districts that progress toward serving this broader role in community safety are likely to attain different levels, supported as resources and community engagement allow. We propose four levels of community resilience that school-based initiatives can aspire to achieve, summarized in Table 2.

Table 2. Levels of School-Centered Community Resilience

| Level One: Every school | Safer, Stronger, and Smarter |
| Level Two: Every school | Prepared to Shelter |
| Level Three: Some schools | Equipped to Function |
| Level Four: Some schools | Ready to Serve |

Every school can become Safer, Stronger, and Smarter. Safer schools practice earthquake safety drills on a regular basis, involve family members in earthquake safety and family reunification activities, and implement nonstructural mitigation where possible. Stronger schools have received structural retrofits if needed, and may have cafeterias, auditoriums, or gymnasiums upgraded to an Immediate Occupancy standard if resources allow. Smarter schools consider the steps needed to resume classroom education after a seismic event, and discuss and plan for school and staff responsibilities in the post-earthquake response and recovery phase [14]. Most Oregon school districts could achieve Level One performance in at least some schools today.

Every school can be prepared to shelter students and staff until family reunification. While it may not be possible for people to re-enter a school building that has sustained damage in an earthquake, temporary measures to provide shelter on site can be planned and provisioned. Schools at Level Two have made such plans and assembled supplies to provide children safe and dry supervision until family reunification can take place. Level Two remains mostly an aspiration in Oregon schools as of 2017.

Some new schools can be equipped to function by anticipating post-earthquake needs for food, water, and power. These are likely to be schools expressly designed to exceed the building code standard of Life Safety. Schools in which at least portions of the facility are designed for Immediate Occupancy must also consider investments in stored supplies and infrastructure for critical utilities, to serve students and community members in the aftermath of an earthquake. Level Three schools are being planned and constructed in a few Oregon districts.

Whether retrofitted for safety or designed for resilience, some schools can be made ready
to serve the broader community. Level Four requires coordination with partner authorities to anticipate services (including communications, medical care, mental health, and possibly transitional housing) that the wider community may need after an earthquake, and discussion of arrangements to provide these needs from school sites. Schools designated as so-called Community Points of Distribution (CPODs) by county emergency management authorities may be candidates to model this coordination for other districts.

Engineers have a role to play in each level, but beyond Level One their contributions will likely be made as much in their capacities as engaged citizens, parents, and community members as professionals. Taking any school to the next level of community resilience will pose social and community challenges as well as budgetary and technical challenges.

**Ground Truth from Three Oregon School Districts**

With respect to earthquakes, the age and location of school buildings are the primary challenges facing Oregon’s 197 school districts. Neither challenge is inexpensive to remedy. Three case studies illustrate how considerations of community resilience apply in school districts facing the messy realities of aging facilities, challenging school sites, and limited capital funding.

**Portland Public Schools: Fixing Aging Buildings**

Oregon’s largest school district, Portland Public Schools (PPS) (enrollment: 49,189), has an inventory of 79 K-12 schools that average over 70 years in age. Nearly all of the district’s buildings predate modern seismic building codes. Structural challenges, including unreinforced masonry (URM) load-bearing elements, are prevalent in the district. Funding for capital improvements was, until recently, scarce and sporadic.

Following the 1993 Scotts Mills earthquake (the so-called “Spring Break Quake”), PPS was among the first Oregon districts to direct capital funding to earthquake safety. A successful 1995 bond measure invested $47 million in seismic upgrades to 53 Portland schools. Projects included securing parapets and chimneys, reinforcing exits, and adding lateral strength.

Sixteen years passed before the district again asked voters to consider a school bond measure. When a 2011 measure fell short, the district prepared a long-range facilities plan and engaged its stakeholders in discussions about priorities. The outreach shaped a bond proposal intended to launch a 32-year renewal of the district’s schools. Seismic safety was a top priority of the 2012 bond, which funded the full modernization of three URM high schools, replacement of a dilapidated K-8, and incremental seismic retrofit projects at 13 schools plus seismic bracing with roof replacements at 21 schools. A success with voters, the 2012 bond financed the largest program of seismic safety improvements ever undertaken by an Oregon school district.

In 2017, Portland voters passed the second school bond measure in the multi-decade program. Among its major projects, this bond will include the full modernization of Benson High School, a century-old school containing URM bearing walls and shear walls. The bond will fully modernize or replace two additional high schools, construct a new middle school, and make health and safety improvements at schools throughout the district.
PPS has made an aggressive start on its exposure to seismic risk by bringing some of its highest-capacity buildings up to contemporary building code standards first. Planning community shelter in large-capacity spaces is a design priority for the new round of bond projects. Continuing to make incremental safety improvements at dozens of aging elementary and middle schools until they can be replaced by future bond measures will depend on the district’s ability to secure state retrofit (SRGP) grants and its ability to persuade Portland voters to continue to tax themselves to make public schools safer.

Seaside School District: Facing Tsunami Risk

Seaside School District (enrollment: 1,544 students), located on the Oregon Coast, is an anomaly among Oregon districts. Within its boundaries lie the highly desirable vacation destinations of Arch Cape, Cannon Beach, Gearhart, and Seaside. The district’s funding is primarily generated by the property taxes paid by owners of vacation homes located in these communities. Property tax collections exceed the State School Fund formula amount for the district’s enrollment, and for this reason, Seaside is one of a very few Oregon districts that do not qualify to receive education funding from the state’s General Fund. This circumstance limits the district’s eligibility for many state and federal grant opportunities. Despite the privileged real estate that surrounds it, Seaside has a sixty percent student poverty rate and serves a growing population of English-language learners.

Seaside also faces a hazard shared with just a few other coastal school districts: several of its schools are exposed to inundation by tsunamis. Earthquakes are the most common cause of such waves; distant tsunamis originate from seismic events across ocean basins, while local tsunamis can originate from earthquakes on an offshore fault close to shore. Seaside, adjacent to the Cascadia Subduction Zone fault, is highly vulnerable to a local tsunami. Four of Seaside’s five school buildings and the district’s administrative offices are located within the tsunami inundation zone, each fewer than fifteen feet above mean sea level. Fig. 1 illustrates the district’s extreme exposure to the tsunami hazard.

Seaside’s tsunami-exposed schools average more than 65 years in age. Each has been identified as having a high probability of collapse in an earthquake. But schools located within the tsunami inundation zone are ineligible for the state’s Seismic Rehabilitation Grant Program regardless of their structural condition. No other state funding is available to relocate the district’s educational programs to safer sites.

The 1964 Great Alaskan earthquake (magnitude 9.2) generated a distant tsunami that struck Seaside and nearby communities. Inundation by the tsunami ripped homes from foundations and carried one bridge deck a quarter mile upstream. Beginning in the 1990s, Seaside School District commissioned DOGAMI scientists to determine inundation levels associated with local tsunamis from prior Cascadia earthquakes. The findings indicated much higher inundation elevations than previously assumed. The researchers recommended that Seaside School District relocate its schools on buildable property not at risk of liquefaction and at least 80 to 100 feet above mean sea level.
The Weyerhaeuser Corporation, owner of the only land suitable for a safe school campus in the vicinity of Seaside, allowed geotechnical consultants to evaluate over 1,000 acres of its commercial timberland for a potential new campus. After extended negotiations, in 2015 Weyerhaeuser donated 80 acres to the school district for a new school site.

In November 2016, local citizens passed a $99.7 million bond measure to relocate all Seaside schools outside the tsunami inundation zone, earning a $4 million matching grant from the State of Oregon. The four existing school sites will be sold to supplement the bond measure. Seaside’s tsunami-safe K-12 campus is scheduled to open in the fall of 2020.

**Beaverton School District: Adopting Resilient Design**

When Beaverton School District (enrollment: 40,806 students) voters passed a $680 million construction bond in 2014, the district made an unprecedented commitment. Beaverton would design seven new facilities including a middle school and high school to exceed the seismic building code requirement of Life Safety. The district’s new schools would be designed and engineered as close to an Immediate Occupancy standard as was deemed to be feasible, capable of protecting students and staff during an earthquake and enabling the schools to be occupied and used promptly afterwards [15].
Beaverton became the first school district in Oregon to design new educational facilities for resilience. In consultation with community and local government partners, Beaverton took steps to prepare the new schools to function after a major Cascadia earthquake. The schools are designed to function off-grid for electricity for a period of time, have water and sewer lines hardened to withstand ground shaking, and include external connection ports for water in the event of utility service disruptions.

Planners anticipated a cost premium of less than $1 million each to make this commitment to resilience at the new middle school and high school. Nevertheless, cost pressures on school construction are intense. Beaverton’s Mountainside High School, a $186 million project, experienced cost escalation in a highly competitive market. Resilient performance that exceeds code requirements might seem a natural priority to “value engineer” out of project goals. But Beaverton facilities leaders expect the “resilience premium” to pay off during the 100-year lifetime of the new buildings.

An ancillary benefit is the deepening of relationships with local partners including public utilities and the local governments tasked with preparedness planning. The next step is to hold these parties accountable so that the schools will be fully prepared to serve as temporary shelters after an earthquake, fulfilling commitments to Level Three and Level Four performance.

**Conclusions**

Schools embody a social value disproportionate to the numbers of children and families that they serve. School leaders are entrusted with the safety of children, creating settings in which children of all backgrounds are given an opportunity to learn. FEMA notes that this is “one of the greatest responsibilities assigned to adults in our society” [16].

Advancing schools through the levels of community resilience presented in this paper implies that schools have an opportunity, and perhaps an obligation, to serve all of the citizens asked to pay for basic safety through their taxes, not just those citizens with children enrolled in school. If schools step up to embrace roles in shelter, mass care, and as community service points after an earthquake or other natural disaster, they directly strengthen the community as a whole.

“As public buildings located in nearly every neighborhood, schools will be linchpins of emergency response and recovery from a Cascadia earthquake,” says Oregon’s State Resilience Officer Mike Harryman. “If events like the Great Oregon ShakeOut that reach hundreds of thousands of Oregon schoolchildren each year can be augmented with tabletop discussions bringing school leaders and other stakeholders together to address challenges of shelter and care, progress toward community resilience will be rapid. And it will not be costly” [17].

Oregon has made significant advances managing the risks posed by schools not built to withstand earthquake shaking. By 2017, schools equivalent to 17 percent of the 1,018 most at-risk school buildings identified by DOGAMI ten years earlier had received retrofits paid with state funds. Local school bond measures have fixed and replaced many more hazardous buildings. Though years of work remain before Oregon’s public school buildings can be considered comprehensively “safe,” the policies and financial tools needed to reach Oregon’s statutory safety goal (Life Safety for every school by 2032) are at hand.
In 2013, the Oregon Resilience Plan proposed a 50-year timeframe to implement the policies needed to make the state resilient to a Cascadia earthquake. Oregon is now well into the first decade of that effort. School initiatives, beginning with retrofits and extending through the levels of school-centered community resilience proposed here, can help to sustain the momentum as the state prepares for the “Really Big One” that we know will come.

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