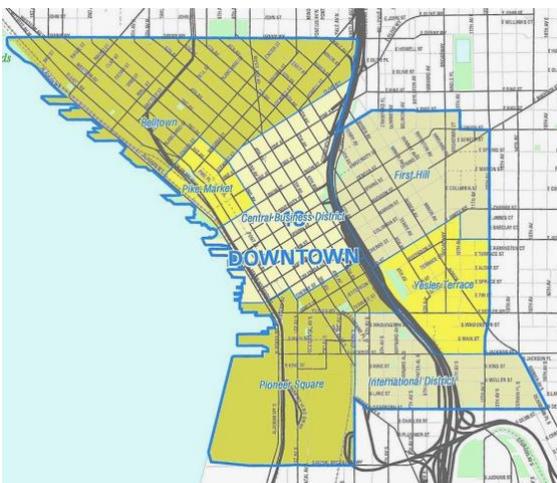


Figure 3. Seattle Seawall and Viaduct Collapse in a Simulation



Source: <https://vimeo.com/projectviz/seattle-central-waterfront/video/59241518>

Figure 4. Downtown Seattle Map



Source: https://en.wikipedia.org/wiki/Street_layout_of_Seattle#/media/File:Seattle_downtown_neighborhoods.jpg

Much of Seattle's critical infrastructure was seismically vulnerable, including most of the city's more than 150 bridges and a water system that would lose all pressure within 16 to 24 hours of a major earthquake.⁹ (Figures 3 and 4) Retrofits would run in the billions of dollars; precise costs were unknown in the early 2000s because city departments hadn't even calculated them.

The challenge was as much political as budgetary. Seattle voters regularly approved levies for capital projects, such as new libraries, community centers, or public transportation. Proposing a levy, however, required a political champion—either the mayor or members of the

city council—and it was rare to find someone eager to press taxpayers to spend a lot of their money now on what many considered a distant problem. “It’s not as if anyone was against seismic-hazard preparedness. It just wasn’t a big priority,” said Richard Conlin, a city council member from 1998 to 2013.

Despite growing awareness of Seattle's severe seismic risk, preparedness was an extremely low priority for most of the city's departments as well. Disaster response required a citywide effort in which different departments would be responsible for different support functions. A department's ability to execute its function depended on widespread awareness, effective planning, and close coordination, yet many departments had no dedicated staff position responsible for emergency management.

The Office of Emergency Management, whose job was to prepare the city for disasters and coordinate the responses, was buried within the Seattle Police Department and had little influence across the city government. In 2005, the office had only nine staff; it was in an old facility; and, because of what the director described as a contentious relationship between himself and the mayor, it lacked executive-level support. Departments bristled at the OEM's requests to develop response plans and commit staff time to exercises. Paraphrasing a line from Sheri Fink's book about Hurricane Katrina *Five Days at Memorial*, OEM information technology system coordinator T.J. McDonald said, “Emergency management people were seen mostly as earnest basement dwellers who made the hospitals do emergency drills at inconvenient times.”

City officials also faced challenges when it came to making the public aware of seismic hazards. As the high-tech hub home of Microsoft, Amazon, and offices of Google and Facebook, Seattle grew rapidly in the 1990s and 2000s. Many of the newcomers were unaware of the city's earthquake risk, and some were transient workers, who had less interest in solutions for long-term problems that required immediate investments. Plus, although it was relatively prosperous, Seattle

had large low-income and non-English-speaking immigrant populations. According to census data, 24% of the city's population spoke languages other than English at home.¹⁰ Among those vulnerable populations struggling to make ends meet or navigate a new culture, the reservoir of concern for vague possibilities was especially shallow.

FRAMING A RESPONSE

Disaster preparedness had three components: *mitigation* to lessen the impact, *response* to save lives in the immediate aftermath, and *recovery* to restore the city to pre-disaster health. Prior to 2005, Seattle city officials had laid some groundwork—most of it in response, some in mitigation, and little in recovery.

Mitigation meant hardening the city's structures to withstand a major earthquake. A study by the National Institute of Building Sciences found that on average, every dollar spent on mitigation saved six dollars in emergency response.¹¹ And despite the high up-front expense and general lack of political will, Seattle had made some investments in mitigation in the years after the heightened seismic risk was revealed.

In 1998, FEMA selected Seattle as a pilot city for Project Impact, a federal program that gave \$1-million grants to cities for natural disaster preparedness. The city's OEM used the grant to fund USGS seismic-hazard maps, to launch a do-it-yourself home retrofit program, and to finance nonstructural retrofits to furnishings, electrical fixtures, shelves, and the like for 46 schools. Project Impact spurred a flurry of public meetings and community events.

In 2001, three weeks after the completion of one such retrofit at an elementary school, in which a massive rooftop water tank was drained and the water system reworked, the Nisqually earthquake struck. Had the retrofit not been performed and the tank been full, hundreds of gallons of hot water would have inundated a third-grade classroom. "Project Impact saved lives," said Jim Mullen, director of the OEM

from 1994 to 2005. But shortly thereafter, the federal government discontinued funding for Project Impact. "I learned a powerful lesson from that: Don't rely on outside help," Mullen recalled.

Seattle voters approved some funding for mitigation. Citing his experience from a visit to Kobe, Japan, after a 1995 earthquake there and capitalizing on a bump in public awareness because of the 2001 Nisqually earthquake, Mayor Greg Nickels championed what the press called the Fire Levy. The levy passed in 2003, when 69% of Seattle voters approved \$169 million to upgrade, replace, and modernize more than 30 of Seattle's 33 fire stations so they could withstand seismic shaking and to build a new, state-of-the-art facility for the city's Emergency Operations Center—the hub that activates after a disaster to coordinate the response.¹²

Disaster response depended on planning. The OEM had created the Seattle Disaster Readiness and Response Plan based on the National Incident Management System, a comprehensive framework for joint operation and personnel organization released in 2004 by the US Department of Homeland Security (text box 1). Under the plan, city departments fulfilled 15 emergency support functions (ESFs). Transportation (ESF-1) was handled by the Department of Transportation; communications (ESF-2) was the domain of the IT Department; and so on.

As prescribed by the federal template, in the event of an earthquake the OEM would activate the city's Emergency Operations Center and coordinate communications and operations between city departments as well as with the government of King County, the government of the state of Washington, and the federal government, including requests for military assistance. The Fire Department—responsible for firefighting (ESF-4), search and rescue (ESF-9), and hazardous materials (ESF-10)—would lead the immediate response to an earthquake.¹³

The Seismic Hazard Annex to the plan delivered an unambiguous message to Seattle residents with regard to the event of a major

Box 1: The National Incident Management System Template

In its own planning, the Seattle Office of Emergency Management drew on the framework, vocabulary, systems, and processes for emergency response established nationwide in 2004. The template, initially designed to help fight California forest fires, had gradually evolved over decades. It was premised on the idea that in any sort of emergency speed was crucial, as was the ability to integrate diverse capabilities, including different levels of government.

The incident response system pre-defined roles and responsibilities with respect to resource management, command and coordination, and communications and information management. It could be tailored to the demands of a specific type of disaster or emergency (flexibility). It identified essential functions and job definitions (standardization). And it outlined a command structure that permitted agencies or levels of government to retain authority while also collaborating with others to achieve a common goal (unity of effort).

For more on this system, see FEMA, *National Incident Management System*, third edition, October 2017 accessible at https://www.fema.gov/media-library-data/1508151197225-ced8c60378c3936adb92c1a3ee6f6564/FINAL_NIMS_2017.pdf

earthquake: You're pretty much on your own. Emergency response resources would be insufficient to "address all or even a majority" of life safety needs; the emergency 911 network—in the low likelihood it was still operational—would become overloaded; it would take several days to establish shelters; with no stockpiles of food or water for the general public, it could take days before emergency supplies were available; and, most ominously, the number of expected deaths would likely exceed the capacity of city morgues, so the public would be responsible for the dead or, in the words of the plan, "fatality management."¹⁴

Taken together, those limitations meant that community preparedness had to be a crucial element of disaster-response planning. In 1996, LuAn Johnson, public education adviser at the OEM, developed a neighborhood program that organized and trained citizens to serve on response teams that could be self-reliant for three days. After the 2001 Nisqually earthquake, an OEM survey found that 92% of the 459 participating neighborhoods had responded effectively.¹⁵

Mullen also established the Auxiliary Communication System—a network of trained volunteer amateur, or ham, radio operators spread throughout the city that would mobilize in the event of a disaster to provide emergency communications.

Because residents involved in disaster preparedness tended to be more affluent, preparedness planners had to engage more closely with low-income, minority, and immigrant communities. Those residents, who typically struggled to make ends meet while trying to navigate a new culture and city, would be disproportionately affected by an earthquake.

The city of Seattle still lacked the third element of preparedness, a disaster recovery framework. Recovery would require a more-intensive planning process, given the scope and variety of stakeholders involved. "Long-term recovery is about investment bankers and schools and the health department, not the police and fire departments," Mullen stressed.

GETTING DOWN TO WORK

From 2005 onward, Seattle implemented some mitigation projects, but those efforts fell far short of what was needed to meaningfully reduce the impact of the anticipated threat. Much of Seattle's progress came from the city's improvements in seismic-hazard awareness, planning, and response capability, all of which fell within existing department mandates. A new emergency manager took responsibility for extending seismic-hazard awareness in departments, for developing plans, and for coordinating across sectors. To help prepare the city for a disaster, she and other city officials and

community organizers developed and augmented various networks within individual city departments, between city departments; between the city and certain private organizations, between the city and the public, and within individual communities.

Building municipal support for preparedness

In 2005, Mayor Nickels hired Barb Graff to head the OEM. Unlike her two immediate predecessors, both of whom had come to the job from other lines of work, Graff was an experienced emergency manager. She had been director of the corresponding OEM in the nearby city of Bellevue for 15 years. Her background gave her credibility with the mayor. And she positioned herself as an apolitical professional. “She plays the bureaucratic game very astutely,” said Mullen, who was OEM director for 12 years before Graff. “She’s one of the smartest people politically in emergency management.”

One of Graff’s top priorities was to elevate the issue of seismic preparedness in the municipal government. Taking advantage of support by the mayor, she set out to build citywide coalitions and institutional structures that would not only improve coordination and awareness for preparedness but also compel city departments to take greater responsibility for the issue and implement their own plans.

Doing so was no easy task. City department employees were busy, and like the residents of Seattle, they had more-pressing priorities than preparing for an earthquake that was certain to happen but had a low probability of occurring in any given year. Graff’s job was to get them to care. Rather than bully or browbeat, she relied on co-optation, subtle nudging, and innovations in bureaucratic structure and process.

Graff’s playbook was in the form of Emergency Management Accreditation Program (EMAP) standards, a set of 64 emergency management best practices and protocols developed by an independent, nonprofit organization of emergency management professionals. The standards covered mitigation,

response, and recovery and provided a blueprint of ways Seattle could improve its preparedness.¹⁶ Graff’s ultimate goal was to obtain EMAP accreditation for the city’s own emergency management program, which would mark formal endorsement of the city’s efforts by outside professionals. Graff recognized that achieving the standards would require first, getting city departments more involved and second, building partnerships both within and outside the city.

The OEM had assigned the 15 emergency support functions to different city departments, but before 2005, neither the OEM nor the mayor’s office had held the departments accountable for completing the often substantial amount of work and planning each function entailed. Graff began pushing the departments to deliver, but many of the departments lacked the resources to do that. So, during the 2006 budget season, several requested funding for a full-time staffer to fulfill the emergency support function work. The mayor called in Graff and suggested to her that the city locate these new employees in the OEM, so that she could help oversee and coordinate their work. Instead, Graff persuaded him to put them into their respective departments but require their participation in weekly meetings at the OEM to ensure accountability and share ideas. She reasoned that by embedding emergency management staff departments, the OEM would be able to exercise more influence over those departments. Those 15 or 16 employees—depending on that year’s budget—came to form what was called the Strategic Working Group.

Graff had inherited a separate forum—the Disaster Management Committee—which in 2005 was an exclusive group of nine senior-level members from within the city who met a few times a year. Graff expanded the committee, adding the Strategic Working Group members and inviting stakeholders from the community, nonprofits, the private sector, and other governments in the region to participate. She increased the frequency of the committee’s meetings to at least once a month and diversified their content. Besides discussing policy issues and

city plans and procedures, some meetings featured guest speakers, such as the mayor of Christchurch, New Zealand, who conveyed preparedness lessons to the Seattle committee in 2011—months after an earthquake had devastated his city. “There was immense value in bringing in speakers who had been through what we hadn’t been through,” Graff said. The committee created institutional momentum for preparedness issues because members would return to their respective departments with new information, ideas, and connections.

Graff also recognized the importance of high-level buy-in. Copying an idea from the city of Los Angeles, Graff created the Mayor’s Emergency Executive Board, which comprised the directors of 22 city departments. The board met quarterly to review policy issues related to emergency management and make recommendations to the mayor.

The city budget was another mechanism that compelled departments to invest more time and effort in seismic-hazard preparedness. Graff found an ally in Conlin, a city council member who was a rare champion for the issue. In 2007, Graff and Conlin saw an opening. When the government passed its annual budget, Conlin attached “statements of legislative intent” to executive department appropriations that said those departments would produce assessments of how a catastrophic earthquake would affect their operations. The council or mayor’s office could then follow up with those departments to keep the issue in the public eye. “The goal was to get the departments to start thinking about seismic hazards and why they needed to plan for them,” said Conlin.

As another tactic to get departments involved, in 2013 Graff led the creation of a multiyear citywide strategic plan that set department emergency-preparedness goals and implementation targets. “We had been conducting strategic planning just within OEM. But we realized that in a city with a workforce of 12,000, our staff of 14 wasn’t enough to make sure targets were realized. We needed the active

participation of other departments,” Graff recalled.

In June 2013, the OEM’s Strategic Working Group gathered for a daylong retreat to brainstorm and set citywide preparedness priorities for the next three years. The group finished developing the plan in five subsequent sessions and presented it to the Mayor’s Emergency Executive Board and the Disaster Management Committee, which voted to approve it. The Strategic Working Group updated the plan annually and reviewed progress on plan goals.

The OEM regularly updated other plans, performed exercises to test the plans’ efficacy, and hired a dedicated staffer to socialize them across the city. “For a plan to be effective, you need to have partnerships with the people and organizations that are involved in that plan,” said Graff. The OEM also developed new plans on all-hazards-mitigation (2009), continuity-of-operations (2012), and comprehensive training (2013), as well as a disaster recovery framework. The Seattle Disaster Readiness and Response Plan was renamed the Comprehensive Emergency Management Plan. Updated every three years, it covered emergency operations and included several disaster-specific annexes.¹⁷

Public–private coordination: Health care

Improving planning and preparedness within the municipal government was not enough, however. The private sector was essential to an effective earthquake response. “Emergency disaster response is very much a government function. And yet the government depends heavily on the private sector to realize a lot of the capabilities that must be in place to protect our communities,” said Onora Lien, executive director of the Northwest Healthcare Response Network, a health-care coalition in western Washington. “Disaster response has to be a public–private partnership.” That was especially true for health and medical services in the United States, where the private sector was responsible for almost all health-care delivery. In the event of a mass-casualty earthquake, an area’s hospitals,

They were trained and equipped primarily to extinguish fires and provide emergency medical services. A catastrophic earthquake would ignite blazes and injure victims, but the shaking would also cause hundreds—possibly thousands—of structures to partially or totally collapse. Research had shown that structural collapses were responsible for 75% of earthquake-related deaths.²⁰ (Text box 2)

Victims trapped in collapsed buildings would begin to die from injuries and exposure within hours. Although firefighters were trained to extricate motorists from crushed automobiles,

rescuing earthquake victims trapped beneath tons of rubble was another thing entirely, and expert urban search-and-rescue teams were mainly federal and regional operations that would take days to arrive.²¹ Seattle's fire department saw that it had to develop its own capacity.

Under Chief Gregory Dean, who led the department from 2005 to 2015, Seattle firefighters began receiving structural-collapse rescue training consistent with FEMA standards. Using mostly FEMA grant funds, the department procured heavy search and rescue equipment—including tools such as steel-cutting torches and concrete-

Box 2: Enlisting Engineers to Support an Effective Response

In an earthquake, the robustness of city systems—the likelihood they will operate correctly after a disaster despite damage—affects the ability of a community to quickly respond and recover.

Focused on the needs of the Seattle Fire Department, which would play a crucial role in any response, teams of engineers at the University of Washington and Princeton University had started to assess interdependencies among systems and the risk of cascading hazards that could impede its effectiveness after the Big One struck. The department especially worried about interactions between (1) building collapses, (2) fire ignitions, (3) the effect of debris fields on transportation access, and (4) the water network. Earthquake magnitude, the location of the epicenter, soil types, building structures and materials, population size, and topography were among the many things that would affect those four elements—and the interactions between them.

Working with city offices to map some of the elements, engineers created models that would help the fire department learn which areas were most vulnerable to building damage, determine whether the department's planned scouting routes were likely to be blocked with debris and which might provide access, and calculate the probability that the water supply would be adequate to extinguish a blaze in a given location. (For a more detailed discussion, see the accompanying video on the Innovations for Successful Societies website.)

The identification of such challenges began to help focus the fire department and the city on where they wanted to direct time, money, and effort. For example, the debris models underscored the utility of purchasing a drone the fire department could use to scout routes in the event of a disaster. Not only would a drone be able to see more and faster, but it would also mean the department would not have to divert scarce human resources and vehicles it needed for firefighting. (A drone could also help address a human problem: in a disaster, obtaining data to help set priorities was at a premium, but firefighters were trained not to pass by an emergency and relay information back to headquarters, but to stay and help, something that would actually impede the overall response.)

Other recommendations were to take special care to clean up underground and create firebreaks in the Pioneer Square neighborhood, which sat on risers; to purchase—or invent—mobile and floating water pumps that could tap water from cisterns on top of undamaged tall buildings or from Elliott Bay; to stock deployable water pipelines; and to use ductile (flexible) motion-resisting frames instead of rigid building frames. Helping people know the specific risks in their communities and what to do was most important of all.

boring drills—that it maintained in a tractor-trailer parked at a designated location in the city. An average of 50 firefighters per year took the two-day course, and by 2019, about 700 had been trained in how to rescue people from collapsed structures.

Responding to a catastrophic earthquake required special department procedures. The Seattle Fire Department was a centralized organization, with a top-down paramilitary chain of command; and most of the dispatch and resource-allocation decisions were made in the department’s downtown fire alarm center. But a major quake likely would render most if not all of the coastal city’s bridges impassable, fracturing Seattle into islands that would each have its own particular needs. The solution was to decentralize. The city’s 33 fire stations were divided into five battalions, each of which could operate independently. Each battalion chief would decide where to deploy the equipment and firefighters in that battalion’s region. Headquarters would staff a city Resource Management Center with an incident command team that would try to rebalance resources based on where lifesaving needs were greatest.

Under the department’s previous protocols, the firefighters in the field would call in incidents and resource requests over 800-MHz radio to the battalion chiefs, who would in turn call in to the resource center. Emergency preparedness officer Captain Cody Scriver said he recognized that this “push” model would be chaos after a catastrophic earthquake because the volume of reports and requests would likely jam the communication system. Resource allocation would depend more on who could get through than on the severity or urgency of an incident.

In 2018, Scriver developed a “pull” communications model, wherein battalion chiefs would call the engine companies. A general announcement would go out telling all units to prepare to report. Then, one by one, the battalion commander would ask each company for its top three incidents, the nature of each incident, the intersections involved, and the level of severity of

each. The resource center would then reach out to the battalion chiefs in the same fashion.

The department tested the pull communications system and implemented it citywide in early 2019.

Preparing residents

At the same time that Seattle’s OEM was building coalitions for preparedness across the city government, Graff focused on making a greater number of Seattle residents aware and ready for a catastrophic earthquake.

When Graff took over in 2005, she discontinued the OEM’s core outreach program of creating and maintaining neighborhood response teams. The program had required a major time commitment from participants, entailing completion of five courses over two years plus a full-day exercise. “That worked for residents who were more established and better off, but it was not reaching the vast majority of our community,” said Graff. (Figure 5)

Instead, the OEM adopted what staff jokingly called the Burger King outreach program, a reference to the fast-food chain’s well-known advertising slogan “Have it your way.” “If your organization or group wants a single presentation on earthquake preparedness, fine; we’ll provide that. If you want more-intensive training or more hand-holding, we’ll do that,” said Graff.

Figure 5. Community Training



Source: https://cdn.westseattleblog.com/blog/wp-content/uploads/2018/11/IMG_7323.jpg

The OEM hosted Community Emergency Response Team training, a 36-hour (later, 20-hour) FEMA course that equipped volunteers with disaster response skills, such as first aid, search and rescue, fire suppression, and utilities control. Each year, the city held two courses and graduated 50 to 80 volunteers. In 2015, it began offering shorter community-emergency-response modules that focused on specific skills such as first aid and light search and rescue. The changes sharply expanded the program. The OEM could host an average of three 2-hour classes a month. And instead of training only 80 people a year, the office was now training closer to 1,000.

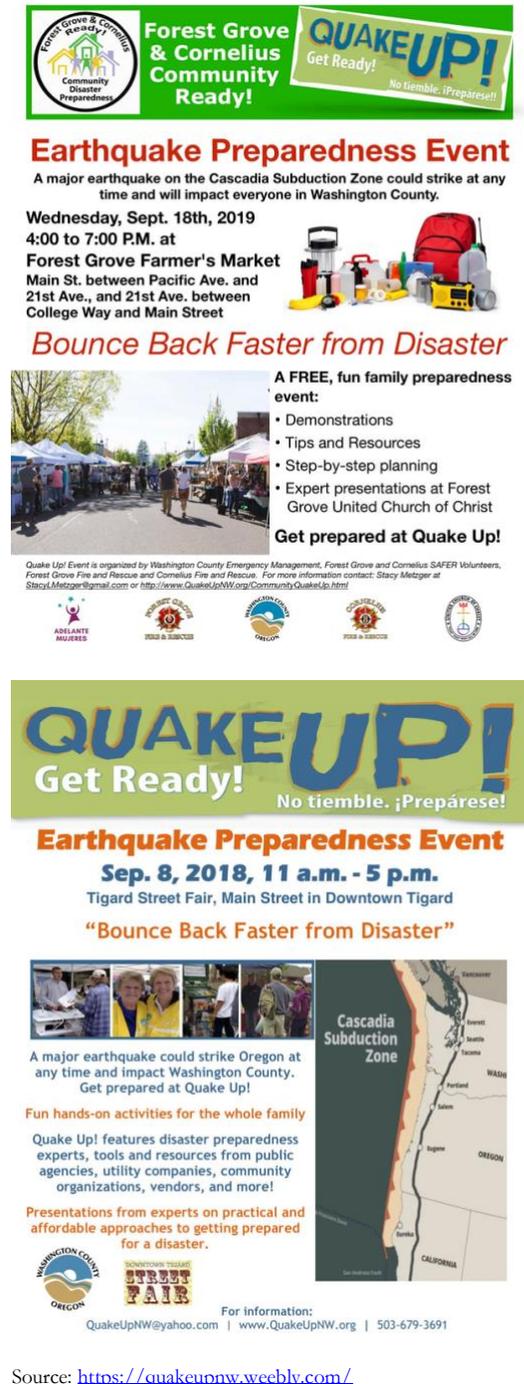
Many Seattle residents and organizations requested information and disaster preparedness training from the OEM. But they were usually people with free time who were thinking about preparedness already and were least likely to need instruction. The challenge was to reach those who did not request the training, many of whom tended to be members of low-income, non-English-speaking, or otherwise vulnerable populations less likely to be aware of the city’s seismic risk. In the early 2010s, the OEM began increasing its efforts to reach members of those groups.

In 2015, the OEM launched the Community Safety Ambassadors program to reach immigrant and refugee communities and those with low English proficiency. OEM public education coordinator Matt Auflick and his staff identified leaders or otherwise well-connected persons in those communities and hired them. OEM paid them a stipend and trained them to lead disaster preparedness and conduct courses focused on lifesaving skills in their communities—in foreign languages and tailored in a way that would resonate.

“We make the message relevant,” said Auflick. “Someone who just moved to the city from Myanmar and is figuring out things like where to get groceries and how to ride the bus—if we jump right in to talking about a catastrophic earthquake, that’s not especially relevant to that person. So, as an entry point, we incorporate

things that aren’t traditionally in our wheelhouse—like how to dial 911, how to find an interpreter, how to do CPR. Most people have a hard time imagining an earthquake, but they can imagine a scenario in which a loved one has a heart attack.” (Figure 6)

Figure 6. Flyers Advertising Disaster Preparedness Event



Source: <https://quakeupnw.weebly.com/>

By 2019, the OEM had 15 Community Safety Ambassadors who could provide training in Amharic, Burmese, Cantonese, Chin, Hindi, Khmer, Lao, Mandarin, Nepali, Oromo, Romanian, Somali, Spanish, Swahili, Thai, Tigrinya, and Vietnamese. The program expanded to train not just individuals but organizations as well. For instance, the OEM trained staff of the International Rescue Committee, a global refugee-support nonprofit, which began including basic preparedness and hazard awareness in the new-immigrant orientations it conducted every few weeks.

Auflick found other ways to make the message relevant to underreached communities. “We also wanted to reach folks who won’t come sit through a two-hour class or go to our website because, well, they’re 22-year-olds who would rather go to the bar,” he said. He partnered with a movie house in the hip, Capitol Hill neighborhood that regularly showed B movies to heckling audiences to screen a series of disaster films—such as *Sharknado* and *Twister*—with Auflick speaking for five minutes at the beginning of the screening about disaster preparedness.

The media also helped galvanize public awareness. In 2015, *New Yorker* staff writer Kathryn Schulz published a Pulitzer Prize-winning feature on the Cascadia Subduction Zone. The article triggered a surge in requests to the OEM: 252 people attended home retrofit classes—the highest total of any year—and public requests for disaster-skills classes shot up 58% to 13,298 in 2015, from 8,391 in 2014.²²

Reporting by Sandi Doughton and Daniel Gilbert at the *Seattle Times* informed the public and put pressure on elected officials. A 2016 special report on what the newspaper called the city’s and the state’s “seismic neglect” prompted Governor Jay Inslee to convene a special committee on seismic-hazard planning for Washington State.²³

Community hubs

The most-effective methods of community preparedness came from within the community

itself. Starting in 2007, Graff and her staff helped facilitate a spontaneous volunteer effort to create a network of community gathering points, called *hubs*, that would activate in the aftermath of a catastrophic earthquake.

Seattle had a history of strong neighborhood association. The area’s fractious topography—molded by glaciation into hills, waterways, and valleys—encouraged the development of distinct neighborhoods. Early residents founded local cooperatives, such as outdoor gear and sporting-goods chain REI and one of the strongest US labor movements, famous for holding a general strike in 1917. “We don’t really have a seismic culture here, like California does,” said former city council member Conlin. “But we do have a culture of collective action and of helping your neighbor.”

Graff had studied the immediate responses to recent California earthquakes—Loma Prieta in 1989, Northridge in 1994—and observed that most first responders were not trained professionals. “Regular people get out and try to help one another,” she said. “We wanted to see how we could facilitate that impulse.”

Graff’s insight gelled with a growing awareness in the national emergency management community that the key to disaster resilience was social capital: the networks and resources available to people based on their connections to others. As Daniel P. Aldrich, a political scientist specializing in disaster resilience, wrote, “Higher levels of social capital—more than such factors as greater economic resources, assistance from the government or outside agencies, and low levels of damage—facilitate recovery and help survivors coordinate for more effective reconstruction.”²⁴

“We’ve gotten away from the thinking that if you have a big enough emergency kit, you can get through anything like a superhero,” said Auflick. “What matters is who you go through the disaster with.”

In December 2006, a windstorm left nearly 1 million residents in the Greater Seattle area without power—some for as long as two weeks—disrupting businesses and services.²⁵

Cindi Barker, a Boeing employee active in her West Seattle community association, and other community group leaders agreed to designate seven emergency communication hubs spread evenly across the West Seattle and Delridge neighborhoods. The idea was to have known gathering points where residents could share information and resources during an emergency or disaster—such as where to get a hot shower or charge a cell phone or access a computer.

At the same time, community groups in two other Seattle neighborhoods had come up with similar ideas. When one of those groups applied for a city grant to develop a disaster response plan, Graff became aware of the initiatives and brought the community members from the three groups together for a meeting. “All of us had this aha moment,” recalled Barker. “There was a natural network here.”

The participants developed a template for community hubs in the form of post-disaster outdoor gathering points where community members could share information and match resources with needs. Each hub was different, but each generally had three components: (1) an information area with announcements, maps, and answers to frequently asked questions related to food, water, sanitation, and so on; (2) a message area where people could post lost-and-found notices, list missing persons, and leave notes for others; and (3) an exchange where community members could request—and offer—resources and services (“Who has a chainsaw?” “I’m a nurse; who needs medical care?”).

The three groups formed a network for sharing ideas. Barker and others went to community group meetings in other neighborhoods to share the hub idea and galvanize the creation of new ones. They piggybacked on existing community associations and social groups. When the OEM held outreach activities, Barker or other hub captains would attend. For instance, when the office sponsored disaster-skills classes for faith-based organizations, Barker attended and encouraged churches to sponsor hubs in their parking lots.

Barker held what she called Hub 101 classes, in which she would describe how to form a hub.

In 2012, Barker created the idea of *hub in a box*. Previously, the materials for a hub—a folding table, whiteboards, radios, maps, and the like—were kept by a community member who would be responsible for bringing them to the hub when the hub activated. But what if that person was incapacitated or otherwise detained? Instead, Barker proposed purchasing large metal, lockable boxes filled with the necessary supplies and placing them permanently at the hub location.

Barker procured hubs in a box with funds allocated by the city council and with matching funds from the Seattle Department of Neighborhoods, a city department founded in 1988 that facilitated local planning for neighborhood projects and provided grants of \$4,000 or less matched with in-kind contributions or volunteer hours.

Each hub had a captain and a handful of designated volunteers. Hub captains met monthly and communicated regularly with one another via an e-mail list to share ideas and best practices. They regularly held outreach events and tabletop exercises, and once a year, all the hubs conducted a field drill. There was no formal organization; these were simply self-organized community volunteers who received minimal support from the city.

The OEM’s target was for every Seattle resident to live within a half mile of a community hub. By 2012, there were 45 community hubs—far fewer than the city’s goal. Moreover, the majority of hubs were in the more-affluent areas of the city. Communities that were predominantly low income, immigrant, or minority lacked hubs.

In 2012, the OEM partnered with the Department of Neighborhoods to win a \$35,000 FEMA Community Resilience Grant that they used for establishing and supplying hubs in 18 community gardens (called P-Patches, a term specific to Seattle) in lower-income areas of southeast Seattle.²⁶ The OEM and hub captains held six trainings that were interpreted into 11 languages. In the following years, the city

designated additional P-Patches as community hubs.

By 2019, the city had 132 hubs—and nearly every Seattle resident lived within a half mile of one.

OVERCOMING OBSTACLES

Perhaps no issue underscored the political and psychological difficulty of seismic-hazard mitigation more than Seattle's 1,100 unreinforced masonry structures did. These charming, brick-and-mortar buildings, concentrated mostly in the historic heart of downtown, would partially or totally collapse in a major earthquake and kill people. The city had been aware of the risk for decades, and yet it persistently failed to retrofit them.

In 1974, not long after the 1965 deep earthquake damaged several buildings, the city council passed an ordinance mandating seismic retrofits for URMs; four years later, it repealed the ordinance over protests from private building owners. Though the city retrofit several publicly owned URMs—schools, community centers, fire stations—in the subsequent years, it had all but given up on mandating retrofits for the 950 URMs in the city that were privately owned.

Graff made creating and implementing a city URM retrofit policy a priority. She again worked closely with council member Conlin. In 2011, Conlin requested that the Department of Planning (renamed the Department of Construction and Inspections in 2016)—which set building codes and in 2008 had recommended the city adopt a retrofit standard commonly used in California—convene a URM policy committee that would develop recommendations in a mandatory retrofit program. The committee comprised 22 members, including private-building owners, a USGS geophysicist, structural engineers, and historic preservationists.²⁷

During the next five years, the URM policy committee met 15 times and developed a course of action for retrofitting the city's URMs in order of risk priority. In 2017, Graff briefed the committee's report to the mayor and the city

council, emphasizing that without a URM policy, the historic character of downtown was at risk and communities of immigrants and people of color would be disproportionately affected by an earthquake—a salient argument for a city council that considered social justice a top concern.

Still, the report triggered no action from the mayor or the council. The primary obstacle remained: finding a way to help building owners pay for retrofits. Washington was the only US state with a constitutional prohibition on the use of public funds for private benefit. That meant it was illegal for the city to provide public loans, subsidies, or any kind of financial assistance for owners of private buildings.

During the next year, Graff searched for financing solutions. She held more than 40 different meetings with bank officers, loan agents, foundation board presidents, and others to ask for their ideas. Separately, a group of developers formed a coalition with other private and nonprofit stakeholders called the Alliance for Safety, Affordability, and Preservation. The coalition held a series of working groups to identify financing solutions for homeowners.

At the same time, Eric Pettigrew, a former Seattle OEM director who was elected to the Washington state legislature to represent a district that included Pioneer Square and the International District—neighborhoods with the greatest concentration of URMs in the city—worked to change the constitutional prohibition on using public funds for private benefit. He encountered resistance in the legislature when colleagues argued that URMs represented a strictly Seattle issue. So, in 2018, Pettigrew secured a \$200,000 budget allocation to survey all URMs in the state. The surveyors produced a map showing some 4,000 URMs were spread across Washington. Proving that it was in fact a statewide issue was a first step toward persuading other lawmakers to change the law.

But as of 2019, the law was still in place, and Seattle still lacked a policy for helping private-building owners finance retrofits. "We still don't have something, but we've made progress," said

Siu, principal engineer at the city's construction and inspections department. "We have the policy committee report, we have a growing list of financing suggestions, and we have approval from the mayor's office to move forward with the work."

"It's a complex issue that done haphazardly can disproportionately affect lower-income populations or communities of color, so our approach has been to be more thorough in conducting the building inventory, to investigate all conceivable financial incentives, and to do the right things that get us to a well-thought-out, strategic retrofit ordinance with incentives," Graff said.

ASSESSING RESULTS

National and global standards for assessing disaster preparedness and response capability were still evolving when Barb Graff took the helm at Seattle's OEM.²⁸ In the United States, FEMA, the Federal Emergency Management Agency, took responsibility for working with others to create these standards. At the international level, the UN Disaster Risk Reduction organization began to oversee adherence to the Sendai Framework for Disaster Risk Reduction, beginning in 2015. Seattle could also compare itself to other earthquake-prone cities, to help gauge its progress.

Mitigation

Despite the political difficulty of implementing seismic mitigation, Seattle made incremental progress after 2005. The Seattle Department of Transportation retrofit a dozen bridges from 2005 to 2018, and voters passed a transportation levy that, among other things, would retrofit more than a dozen more by 2024. Seattle Public Utilities, the city agency that provides water, sewer, and other services, spent tens of millions of dollars on seismic retrofits to the water system. And acting on new science from the USGS that showed basin effects would amplify the low-period ground waves from a Cascadia earthquake in such a way that would

cause tall buildings to sway more than previously believed, the Department of Construction and Inspections strengthened the seismicity requirements in its building codes in 2013 and again in 2018.

Though positive steps, adequate seismic mitigation remained a distant prospect. More than 100 of Seattle's bridges remained vulnerable. Retrofits to keep the water system flowing for fighting fires would cost billions of dollars. And thousands of buildings were at risk of partial or total collapse—not just URMs but also nonductile, concrete buildings constructed before the mid 1970s. "Lots of those have collapsed or been severely damaged in past earthquakes. We haven't even inventoried them in Seattle," said Siu. "If we can't get URMs done, we have no chance of going after those. It's much more expensive to retrofit a concrete building than a URM."

Response

First-response resources also were lacking. The Seattle Fire Department conducted a gap analysis that showed the city would need 3,000 technicians trained in structural-collapse rescue to adequately respond to the likely need. As of 2019, only 700 firefighters had received the training.²⁹

Even though mitigation measures came slowly, the Office of Emergency Management helped city departments gain awareness of the earthquake threat and the need to consider seismic preparations in planning. Under Graff's leadership, the OEM became an influential division in city government. "Barb was able to come in and turn a position that was four or five tiers down in the police department into one where she could walk in and talk directly to the mayor. And she's done that because she is a trusted agent and seen as someone who is politically neutral and not one to take sides," said OEM technology coordinator McDonald, who first joined the office in 1995. "We've become the go-to people in multiple mayoral administrations to do ad hoc coordination, collaboration, and convening."

Through the creation of new committees and new plans, Graff got more and more city officials involved in preparedness activities. “A point of success was how Barb worked the bureaucracies in the city. For nearly all of the city’s 20-some departments, seismic preparedness was way, way down on the priority list. Getting them to participate in emergency management activities was hard, but we got that to happen. The Health Department, for instance, got excited about it. The Parks Department is even engaged now. And a lot of that is Barb. She really went out and proselytized and pushed. She got the support of the mayor and carried the ball,” said Conlin.

“You need a champion at the bureaucratic level, and she has been one. She’s organized, a good leader, keeps issues up front,” said Siu. “Having the regular meetings she organizes [of the Disaster Management Committee and Strategic Working Group] gets people talking to one another, and that’s really helpful. It helps departments in the city identify how they can help one another.” As an example, after having conversations at OEM meetings, both fire department and police department emergency-preparedness officers began developing a joint earthquake plan in which patrol officers would assist firefighters in the immediate aftermath of a quake—the first time the two departments collaborated on an earthquake response plan.

And in 2016, Seattle earned formal recognition from the Emergency Management Accreditation Program by meeting all 64 required standards.

Community-level networks had also grown. As of summer 2019, Seattle had 132 designated community hubs. Their quality varied widely, however. Some were well-known to residents and fully stocked with materials. Others were simply community gardens that few people knew doubled as emergency hubs.

The OEM reported that each year it conducted 250 outreach and preparedness programs and reached an average of 10,000 new people.³⁰ A 2015 OEM survey of 1,800 Seattleites found that 85% of respondents recognized

earthquakes were likely risks and that it was important to prepare for them. But more than 75% of respondents admitted to having only three days or less of food and water—even though they recognized they should have more.³¹

The psychological bias to not worry about low-probability events remained. “I know the dangers better than just about anyone, but am I prepared? Do I have an emergency pack? No,” said former OEM director Pettigrew. “I think about it a lot, but I haven’t done it. It’s hard to get people into that mind-set. If it’s hard for *me* to do it, imagine how hard it is for most people in the city.” (Exhibit 1)

Recovery

“If I had all the money in the world, I would put all of it into mitigation and community preparedness,” said former OEM director Jim Mullen. Seattle’s self-reliant culture and the grassroots organizing of the community hubs boded well for resilience. But what would happen when, as soon as 24 hours after an earthquake, the city’s entire water system went out? and, What would happen when damage to roads and bridges severed just-in-time shipping lines to grocery stores?

Plans called for the US government—in the forms of the Federal Emergency Management Agency and the Department of Defense—to fly emergency supplies to staging grounds, such as at McChord Field Air Force base near Tacoma south of the city, or to Lake Moses over the Cascade Mountains to the east. Trucks would then drive the supplies in along two major highways (so-called seismic lifelines), Interstate 5 running north–south, and Interstate 90 running east–west. From 1999 to 2019, the Washington State Department of Transportation had spent nearly \$200 million on seismic retrofits to bridges along those routes.³² But despite that work, the state still assessed that the bridges would be impassable for days or potentially weeks or months after a major earthquake.³³

As of 2019, however, there was a growing recognition that a top-down, federally based

response may not be the optimal solution for supplying the city. Planners and emergency managers at FEMA, King County, and the state of Washington were beginning to convene meetings with private sector grocers and retailers, companies such as Costco, Amazon, and Kroger, whose business was logistics and supply chains.

As with nearly every aspect of the city's effort to gird for the Big One, uncertainty was the elephant in the room. Ultimately, no one knew what the aftermath of a catastrophic Seattle earthquake would look like. "People will have to leave the city on foot because they are not individually prepared for disasters," predicted Holdeman, former director of the King County Office of Emergency Management. "Critical supplies like food and medicines will rapidly run out. Without potable water, people will start dying in 72 hours."

"We don't have the experience, so it's hard to know what will go wrong. Will we run out of food? I don't think so, but maybe. For water, we do have Lake Washington. Once we talked about mobilizing all the backpackers in the city to take their filters down to the lake. I don't know how realistic that is, but I'm sure we will stumble into some way to access the lake," Conlin said.

And yet, recovery was the piece Seattle appeared to be paying the least attention to. "The [Office of Emergency Management] disaster recovery plan is impressive, but it is not the centerpiece," said Scott Miles, a disaster resilience researcher at the University of Washington. "I think all disaster planning should be driven by long-term recovery planning. Understand where you want to be in the long term, and then work backward from that. All these plans Seattle has now—they're not a system, they don't link, and they might lead to a lot of decisions that might not be worthwhile for helping the community recover. Broad-brush mitigation often isn't achievable because there's only so much political and financial capital out there for this stuff."

REFLECTIONS

So, given the public and political inertia that has hindered preparedness, what should Seattle do? When posed that question, Eric Pettigrew, the state representative whose district likely would sustain immense loss of life and property in a catastrophic earthquake, offered a metaphor. Some 150 miles southwest of Seattle, the Columbia River empties into the Pacific Ocean, creating violent, unpredictable waves that have wrecked thousands of ships since the 1600s, yet native inhabitants piloting wooden canoes safely navigated the seaway. They stayed along the banks and moved only with the current. When the current shifted favorably, they paddled as hard as they could. "And that's what I try to do," said Pettigrew. "When the current is moving in the right direction, when there's a new study or piece of science or an earthquake somewhere else that catches people's attention, we need to paddle like hell to try to keep the discussion moving forward and make a little bit of progress."

The city had fewer and fewer paddlers, however. In 2013, Richard Conlin had lost his seat on the city council, and no city politician—neither a mayor nor a council member—stepped up to fill Conlin's role as a champion for seismic-hazard preparedness. Politically, the issue was a loser.

Barb Graff, director of the Office of Emergency Management since 2005, had built committees and networks that pushed the city toward greater organizational recognition of the problem, but she planned to retire at the end of 2019. Late in the year, questions remain about what lies ahead for Seattle's efforts to prepare for the Big One.

"I think the big question for the future of preparedness in the city is Barb's successor," said Conlin. "[Barb] has kept the network in the city active and moving in the right direction. That network will persist if her successor is good. Otherwise, I fear it might not."

Exhibit 1. Preparedness Posters

BE PREPARED

BUILD A KIT

Plan to be on your own for at least 7-10 days

- Water (1 gallon per person, per day)
- Food (non-perishable)
- Medications
- Medical equipment
- First aid kit
- Can opener
- Sturdy shoes
- Radio
- Extra batteries
- Flashlight
- Warm clothes
- Personal hygiene items
- Fire extinguisher
- Tools
- Pet supplies
- Small bits
- Toilet paper
- Identification & important documents

Keep a 7-10 day kit at home — also have smaller kits in your vehicle and at work

WHAT TO DO DURING AN EARTHQUAKE

DURING THE SHAKING

DROP **COVER** **AND HOLD ON**

If there is no table around, get lower than the other furniture.

THINK

BENEATH **BESIDE** **BETWEEN**

AFTER THE SHAKING

CHECK YOUR HOME:

- For structural damage
- Shut off the water at the main house valve
- Shut off natural gas if you
 - Smell natural gas
 - Hear hissing
 - See the dial spinning
- Check for injuries and apply basic first aid
- Help your neighbors

FOR MORE INFORMATION

- AlertSeattle messages
- Local television
- Your closest Community Emergency Hub
- Emergency radio stations: AM 710 - AM 1000, FM 94.9 - FM 97.3 - FM 97.7
- Twitter: @CityofSeattle @AlertSeattle

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DEVELOP A COMMUNICATIONS PLAN

- Write down emergency contact information
- Texts are more likely to go through
- Have an extra cell phone charger and batteries
- An out-of-area contact can serve as a relay point for family communication

HELP EACH OTHER

Know how you'll help people and pets who normally rely on you

Form a Seattle Neighborhoods Actively Prepare (SNAP) group

seattle.gov/snap

View the Seattle Neighborlink map to connect with your Community Emergency Hub

seattle.gov/emergency

Attend free disaster skills workshops offered by Seattle Emergency Management and learn basic survival skills

See the calendar of upcoming events at seattle.gov/emergency

Community Emergency Hubs Seattle Emergency Management

BE PREPARED

MAKE A PLAN

Determine a meeting place in case you have to leave your home

LEARN ABOUT DISASTER PLANS FOR

- Your work
- Your children's school
- Your medical and/or transportation provider
- Other places where your family spends time

Sign up for emergency alerts and notifications at alert.seattle.gov

Know what hazards your home is vulnerable to by visiting seattle.gov/hazardexplorer

ALERT SEATTLE

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