

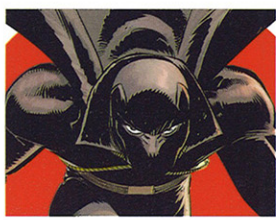
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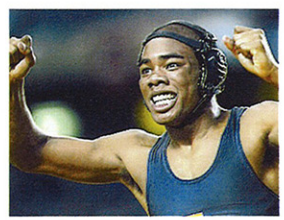
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The Seattle Times  
Sunday  
Seattle Post-Intelligencer

FEBRUARY 20, 2005  
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SPORTS  
TICKER

Back on track: Huskies rout Cougars in Pullman

Pinpointing devastation  
if Seattle Fault ruptures

From a devastated economy to thousands of deaths or injuries, the effects of a potential earthquake are mapped out in the most detailed study of its kind in the country. Its conclusion: We must act now to minimize the damage.

BY SANDI DOUGHTON  
Seattle Times staff reporter

The most damaging earthquake in state history strikes on a weekday, shortly before noon.

In downtown Seattle, the violent lurching knocks pedestrians off their feet. Drivers struggle to hold their cars on the road. A 14-mile rupture splits the ground from Elliott Bay to Issaquah, with one side thrusting six feet into the air.

By the time the shaking stops — 30 sickening seconds later — 1,600 people are dead or dying. More than 24,000 are injured as brick buildings crumble, freeway bridges buckle, ferry terminals slump into the water and the Alaskan Way Viaduct collapses.

More than 45,000 families are forced out of their shattered homes, and nearly 10,000 commercial buildings and houses are destroyed. Another 183,500 buildings are moderately to severely damaged.

The toll on the state's economy is a staggering \$33 billion in property damage and lost income, on a par with the country's most costly natural disaster to date: the 1994 Northridge earthquake in Southern California.

The Seattle quake is still fictional, of course. But if it does occur, it will take years for the region to recover, according to a new report based on the most comprehensive earthquake scenario ever devised in the United States. The report urges state and local governments to accelerate the pace of upgrades to highways, buildings and other structures vulnerable to an earthquake.

"When you start talking about numbers like this, you realize the impacts are huge and we're not ready for it," said Craig Weaver, a U.S. Geological Survey seismologist.

The scenario, which will be unveiled in a daylong workshop in Bellevue on Feb. 28, uses a sophisticated computer model and the collective expertise of dozens of local engineers, scientists and emergency managers to forecast the devastation that would be wrought by a magnitude 6.7 earthquake on the Seattle Fault.

The 30-mile-long fault runs through the heart of Seattle and Bellevue. In the past 3,000 years, it has violently rearranged the lo-

Please see > EARTHQUAKE, A8

SEATTLE FAULT is old, active — and close to the surface > A8

The scenario

Modeled after a historic quake in the same area along the Seattle Fault, the scenario quake:

- Is magnitude 6.7
- Is shallow with severe ground shaking
- Ruptures the surface for 14 miles from Harbor Island to area east of Lake Sammamish.
- Raises south side of fault 6.5 feet.

The impacts

BUILDINGS

1. Brick buildings in Pioneer Square and Chinatown International District badly damaged or collapsed. Concrete warehouses south of downtown partially collapsed.
2. Low- to midrise buildings in Mercer Island, Bellevue and Issaquah closed for up to a month for inspection and repairs.
3. Windows shatter in downtown Seattle and Bellevue high-rises. About half of high-rises built before 1975 suffer extensive damage.

TRANSPORTATION

4. Alaskan Way Viaduct heavily damaged or collapsed, severing power lines that run along the structure.
5. All major freeways seriously damaged, leading to partial closures that last months or years.
6. Seawall and ferry docks are damaged or collapsed, closing the Seattle and Fauntleroy terminals.

UTILITIES

7. Water and sewer lines break, spilling sewage into Lake Washington, Lake Sammamish and the Green River. West Point and Renton sewage plants damaged.
8. Mercer Island water supply possibly cut off when water lines rupture. Widespread power and natural-gas outages last from days to weeks throughout the area.

WATERFRONT

9. Shaking triggers thousands of landslides, generating local tsunamis.
10. Boeing Field and Renton airports damaged by liquefaction to their runways, but Seattle-Tacoma International Airport fares much better.
11. Half of Harbor Island may slide into Elliott Bay, creating a tsunami. Cranes at the container terminals are damaged or toppled.



Sources: City of Seattle, USGS, Washington Department of Natural Resources and Shannon & Wilson, 2004

Insurgents  
target Shiite  
celebrants  
on holy day

SUICIDE BOMBERS  
KILL 55,  
WOUND 150

Fewer casualties  
than a year ago

BY DEXTER FILKINS  
The New York Times

BAGHDAD, Iraq — Five suicide bombers, including one on a bicycle, hurled themselves into crowds and set off explosives yesterday, killing 55 people and wounding 150 in a wave of mayhem intended to disrupt Ashoura, the holiest day in Shiite Islam.

The attacks came on a day of huge and often delirious cel-

ebrations around the country by tens of thousands of Iraqi Shiites, marking the seventh-century martyrdom of the prophet Muhammad's grandson Hussein.

The celebrations, banned during the time of Saddam Hussein, are a symbol of the religious and political resurgence of the Shiites, a long-suppressed majority now poised to take political power for the first time. That resurgence was codified by the victory in nationwide elections on Jan. 30.

The coming political dominance of the Shiites is viewed by many Sunni Arabs here as a direct threat to their power, which was buttressed by Saddam. Please see > IRAQI, A20

New state import:  
Thai farmworkers



COURTESY OF GLOBAL HORIZONS

These workers from Thailand were among 170 who picked Yakima Valley apples and cherries during last year's record harvest. Hiring the "guest workers" was a first for state growers.

**FARM LABOR** | Some Yakima Valley fruit growers have found poor Asian farmers are reliable guest workers, and their visas bypass the uncertainties of hiring illegal immigrants. But critics doubt claims of a labor shortage and worry about abuses.

BY LORNET TURNBULL  
Seattle Times staff reporter

The 170 Thai workers imported into the Yakima Valley to harvest apples and cherries last season were a curiosity in this part of the state where Latinos, not Asians, have been a familiar presence.

The men, mostly poor farmers from rural Thailand, were the first foreign workers brought to Washington to pick fruit under a decades-old federal guest-worker program meant to fill labor shortages in agriculture.

The Thais' sudden appear-

ance in the orchards of Eastern Washington could signal the start of a shift in the state's agricultural work force.

Fruit growers and farm-labor contractors like California-based Global Horizons, which employed the Thais, are expected to bring at least 1,000 workers from overseas into Washington this year.

Global said as many as a dozen growers in Eastern Washington are interested in using the company's workers this year.

Controversy over continued Please see > GUEST WORKERS, A18

Bush to face a more distant Europe on visit

**DIPLOMACY** | The president will try to boost ties on a continent where he remains unpopular and the U.S. has become less relevant.

BY HOWARD LAFRANCHI  
The Christian Science Monitor

BRUSSELS — They are called Generation E, for a generation of young Europeans growing up with a single European currency, living within a single European border,

and debating a single European foreign policy. Compared with their parents and grandparents, their emotional and historical attachment to the U.S. is weakening.

A similar estrangement is occurring in America, where links to Eu-

rope are loosening as family ties to the old Continent fall further back in time and new immigrant ties are more often to other continents. In the post-cold-war years and especially since 9/11, atten-

Please see > VISIT, A22



**FORECAST**  
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60% of The Seattle Times newspaper contains recycled fiber. The inks are also recycled.



## &lt; Earthquake | FROM A1

## PINPOINTING DEVASTATION FROM QUAKE

## Scenario event would be up to 8 times more destructive than Nisqually temblor

cal landscape as many as four times — or every 750 years, on average. The last of those quakes came 1,100 years ago, and geologists estimate there's at least a 5 percent chance the fault will let loose again within the next 50 years.

The scenario group invested three years and almost 4,000 hours of volunteer labor in the project. It recommends the state establish an independent seismic safety board that would report directly to the governor and would push for more highway retrofits and tougher building codes.

The group also is calling for upgrades to facilities such as hospitals, schools and fire stations. And it wants rules that would mandate improvements for the most vulnerable buildings — those made of unreinforced brick or concrete.

"We've been plodding along in Washington," said Don Ballantyne, a Seattle civil engineer who specializes in earthquake-resistant designs and was a leading organizer of the project. "This makes it clear we're at significant risk, and we should be working hard to manage those risks."

**Much worse than Nisqually**

A magnitude 6.7 earthquake on the Seattle Fault would be up to eight times more destructive than the magnitude 6.8 Nisqually earthquake that caused about \$2 billion worth of damage four years ago this month, Weaver said.

Like most quakes in Washington's modern history, including large ones in 1949 and 1965, the Nisqually quake originated deep underground, which dampens effects on the surface.

But the Seattle Fault is much shallower, and distance would not mute the fury of a quake there.

For the Puget Sound area, a quake along the Seattle Fault would even be worse than the other type of seismic hazard hanging over the region: A quake on the Cascadia subduction zone off the coast, where one tectonic plate dives beneath another. While that zone has unleashed massive earthquakes and tsunamis in the past, the shaking would be diminished by the time it reached the state's most populated urban corridor.

"With the Seattle Fault, the strongest shaking will be right in the middle of where we live and work," said Weaver, whose office is at the University of Washington.

**Why an earthquake scenario?**

The Seattle Fault earthquake scenario is the brainchild of Dave Swanson, a structural engineer with Reid Middleton in Everett. Inspired by a less-detailed scenario for an earthquake on the Hayward Fault in the San Francisco area, he began trying to assemble a team to take an in-depth look at a Seattle Fault earthquake.

The Earthquake Engineering Research Institute, a nonprofit society that works to reduce earthquake risks, offered \$50,000 for administrative expenses. The state kicked in \$30,000 to publish the report, and the U.S. Geological Survey is helping pay for a Feb. 28 meeting where it will be unveiled. But expert volunteers did most of the work. The meeting is not open to the public, but the group hopes to offer public sessions on the scenario later this year.

**Report recommendations**

Create a state seismic safety board, reporting directly to the governor, to recommend policies and programs to reduce the earthquake risk in Washington.

Identify critical public facilities — hospitals, schools, police and fire stations — at high seismic risk and establish long-range plans to improve their safety.

Develop local and state funding and legislation that requires upgrades to high-risk buildings, such as unreinforced masonry and concrete tilt-up structures.

Quicken the pace of upgrades to highways and freeways vulnerable to earthquake damage.

**Information online**

<http://geology.wr.usgs.gov/wgmt/pacnw/rescaspl.html>

[www.crew.org/about/intro.html](http://www.crew.org/about/intro.html)

[www.cityofseattle.net/emergency\\_mgt/gettingPrepared/gettingPrepared.htm](http://www.cityofseattle.net/emergency_mgt/gettingPrepared/gettingPrepared.htm)

A magnitude 6.7 quake isn't even the worst-case scenario for the Seattle Fault.

The quake 1,100 years ago was a magnitude 7.3 behemoth that uplifted the bluffs that ring Alki Beach and parts of Bainbridge Island.

"This scenario is not the big one," Weaver said. "We chose it because earthquakes of that size occur more frequently."

The new report has an important message for people who might feel complacent after the Nisqually quake, said Ines Pearce, a program manager with Seattle's emergency-management department.

"I think a lot of people who went through Nisqually are thinking: My house made it through in 2001 — maybe '65 and '49, too — so I don't have to worry," she said. "This report shows that's not true."

**"It's pretty ugly"**

The scenario takes data from the census and other sources on the region's buildings, population, business districts, utilities and transportation networks and overlays it onto maps that estimate how hard the ground would shake in different areas.

A computer model called HAZUS, developed by the Federal Emergency Management Agency, spits out estimates of fatalities, injuries and the number of buildings destroyed or damaged.

"It's pretty ugly," said Mark Stewart, a hazards specialist with the Washington State Emergency Management Division.

The Seattle seawall would probably crumble, taking out ferry terminals and docks. Thousands of landslides would roar down the area's steepest slopes and slop into Puget Sound, triggering local tsunamis that could swamp waterfront homes and buildings.

Brick buildings in Pioneer Square and the Chinatown International District would tumble. Also at high risk are the scores of concrete warehouse-type buildings in the Sodo district and further south that house megastores, light industry and other businesses.

In river valleys and low-lying areas built on fill, the shaking would turn loose soils to mush, destroying foundations and breaking buried water pipes and utility lines. The Olympic Pipeline, which carries gasoline and jet fuel from northern refineries, crosses the Seattle Fault in Bellevue and passes through unstable soils in the Renton and Kent valleys.

A big chunk of Harbor Island, in the heart of the Port of Seattle, could slide into Elliott Bay, taking with it container terminals, cranes and docks.

Up to 40 percent of schools could be unusable as a result of the earthquake, and damage to hospitals could slash the number of available patient beds by 75 percent in the first days after the quake.

One of the biggest blows to the economy would be traffic snarls that could take years to unravel.

The day after the 2001 Nisqually quake shut down the Alaskan Way Viaduct, a five-mile commute from West Seattle took two hours. In a quake on the Seattle Fault, portions of Interstate 5, I-90, I-405 and all other major highways would be closed, and repairs could take a year or more. If the Alaskan Way Viaduct is destroyed, it will take up to six years to replace and cost more than \$4 billion — an amount that isn't included in the scenario's \$33 billion economic-impact estimate.

With ports and ferries crippled and highways impassable, many businesses might be forced to leave the area. To understand the impact, scenario writers looked to Kobe, Japan, where a magnitude 6.9 earthquake on a similar fault in 1995 drove business to other cities.

The Port of Kobe saw its ranking among world container ports drop from No. 6 to No. 17 after the quake, and manufacturing operations suffered for years.

**Informed estimates**

Aside from the rickety viaduct, which already is scheduled for replacement if the money can be found, the scenario doesn't include enough detail to single out specific buildings or bridges, said Gregory MacRae, professor of civil engineering at the UW.

And the numbers the model generates should be viewed as estimates — not absolutes.

"This is a very rough tool, but it's better than anything we've ever had before," he said.

Despite the uncertainty, the scenario makes clear the need for more aggressive preparations, said Ballantyne, the civil engineer.

The region's preparedness has improved over the past several decades, with cities, businesses and the state upgrading older buildings and bridges, and stricter building codes being phased in.

But efforts have been piecemeal and spotty, the report says.

The Washington Department of Transportation estimates it will take until 2070 to complete on-

## Putting the squeeze on Puget Sound

The Seattle Fault and several other Puget Sound-area faults formed because the region is being squeezed by a chain reaction of tectonic forces.

1 Dragged by the motion of the Pacific Plate, a chunk of California called the Sierra Nevada Block is moving northwest.

2 At the same time, the small Juan de Fuca plate off the coast is diving under the North American plate and pushing in a northeasterly direction.

3 The combination of those forces pushes on the Oregon Coastal Block, which rotates northward.

4 The Oregon block in turn pushes on the Puget lowland, which is jammed up against the immobile bulk of British Columbia.

The resulting squeeze causes the Earth's crust to deform, creating faults. The Puget Sound area is being compressed by about a quarter of an inch a year, adding to pressure on the faults. That pressure will be released in the next earthquake.

Source: Ray E. Wells, U.S. Geological Survey



A truck lies on its side after plunging from a road near Kobe, Japan, following a January 1995 quake. Researchers looked to Kobe to help understand possible effects of a Puget Sound quake.

going bridge upgrades at a rate of about \$5 million a year.

After the Nisqually earthquake, the city of Seattle considered requiring retrofits to brick buildings and other unreinforced masonry structures, but backed off for lack of money.

The Transportation Department's top priority for its limited budget is maintaining the state's aging highway system, rather than retrofitting for earthquakes that may not occur for decades or centuries, said agency spokeswoman Linda Mullen.

That conflict between immediate needs and future disasters sums up the basic challenge in earthquake preparedness, and the reason the state needs an independent seismic safety board, the report concludes. In California, Oregon, Utah and Alaska, such boards have kept quake initiatives from stalling and have pressed for better funding and stricter building codes, said Mark Pierepiekarz, president of the Structural Engineers Association of Washington.

In Oregon, where earthquake hazards are much lower than in Washington, the commission developed bond issues approved by the public to upgrade schools, hospitals and other critical facilities.

"Without that kind of leadership here," Pierepiekarz said, "I don't think we're going to be addressing these problems."

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Damage from the magnitude 6.9 earthquake in 1995 crippled the Port of Kobe for years.

## Seattle Fault old, active and just 8 miles down

BY CHRISTOPHER SCHWARZEN  
Seattle Times staff reporter

The Seattle Fault has been one of the most active on the West Coast for millions of years — and there's little indication it's stopping any time soon.

And with Seattle and its dense population perched right above the fracture, scientists fear the fault could be the most dangerous in the Northwest.

The fault, also called the Seattle Fault Zone, is actually several faults in one. Unlike the better-known San Andreas Fault in California, which consists of a single fracture that parallels the coastline, the Seattle Fault Zone is at least four closely related fractures that run west to east for about 30 miles.

Beginning between Hood Canal and Dyes Inlet near Bremerton, scientists think the fault zone crosses underneath Bainbridge Island and Puget Sound before running through Seattle's Sodo neighborhood. It continues under Lake Washington and Bellevue before ending near Lake Sammamish and north of Issaquah, said Rick Blakeley, a U.S. Geological Survey (USGS) research geophysicist.

The fractures run parallel to each other about eight miles under the Earth's surface — considered shallow by fault standards. From north to south, the faults cover less than 5 miles.

The fault zone is the result of massive tectonic plates colliding in the Northwest.

Puget Sound sits near the western edge of the North American plate, which lies under the United States and Canada. Off the coast of Washington and Oregon, the Juan de Fuca plate, moving north and east, plunges under the North American plate. The pressure from that collision fuels Cascade volcanoes such as Mount St. Helens.

From the south, a smaller piece of the North American plate, called the Sierra Nevada Block, is drifting northwest. It's pushing into the Klamath Mountains and squeezing everything between the Oregon coast and British Columbia.

As a result, the North American plate has cracked under Puget Sound's soft crust, forming the Seattle Fault and other fault zones in the area, said Craig Weaver, a coordinator for the USGS National Earthquake Program.

Unlike the San Andreas Fault, which slips side-to-side in an earthquake, the Seattle Fault is a thrusting fault. In an earthquake, the ground releases energy by thrusting up in some spots and sinking at others.

Scientists haven't always thought the Seattle Fault Zone was dangerous. Initial studies during the 1970s suggested the faults were no longer active.

That changed in 1992 when scientists began studying Bainbridge Island's mismatched shoreline, noted by Capt. George Vancouver in his logbook as he sailed the Pacific Coast 200 years earlier. While most of the shoreline was tree lined, one section was clear of foliage.

Studies where the foliage was missing found sediments that were 1,100 years younger than the surrounding shoreline. That indicated an earthquake had pushed the underwater shoreline nearly 22 feet upward in a single moment, said Brian Sherrod, a USGS paleoseismologist and a researcher at the University of Washington's Earth and Space Sciences Department.

By 1996, the advancement of aeromagnetic mapping — which measures metallic content in solid material — showed stretches of rock unlike the surrounding environment following the suspected path of the fault. Sampling studies again showed that an earthquake 1,100 years ago likely pushed up the new rock.

Laser mapping done in 1998 also showed scarring in similar areas, another effect of uplifted rock during an earthquake. This growing body of evidence led seismologists to conclude they were seeing an active fault zone.

Sherrod and others now think that at least three, possibly four, earthquakes measuring 6.5 in magnitude or larger have occurred along the Seattle Fault during the past 3,000 years — considered recent in seismic studies.

It's probable the Seattle Fault has been active even longer, with scientists finding evidence of rock at least 13 million years old that was pushed above ground.

Scientists hope their previous and future studies will one day help them predict future seismic activity.

While nothing is definite in seismology, one thing is sure, Weaver said: "This is a dangerous fault we live on."

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