

Earthquake Regional Impact Analysis

RDPO Stakeholder Briefing



Background

The Pacific Northwest is vulnerable to earthquakes generated by the Cascadia Subduction Zone (CSZ) and local crustal faults. Understanding of earthquake risks in the Portland Metropolitan Region (PMR) has increased significantly since the Oregon Department of Geology and Mineral Industries (DOGAMI) first analyzed anticipated earthquake impacts in 1998. Since then, advances have also occurred in loss estimation tool capabilities¹ and the LIDAR² technology that allows for improved geologic and natural hazard mapping.

In 2016, the Regional Disaster Preparedness Organization (RDPO) commissioned DOGAMI to conduct an enhanced analysis of anticipated earthquake impacts in our five-county metropolitan region. The project is broken into two phases: Phase 1 (2016-2017) analyzed the earthquake impacts for the three most populous counties: Clackamas, Multnomah and Washington Counties in Oregon; Phase 2 (2018-2019) will deliver the same analysis for Clark County (Washington) and Columbia County (Oregon). Funding for this project was provided to our Portland Metropolitan Region under the Urban Areas Security Initiative (UASI) grant for FY2015.

Methodology

A team of Geohazard Analysts, Engineering Geologists, and Geographic Information System (GIS) Analysts at DOGAMI completed the following efforts:

- (1) **Building and Infrastructure Database:** A detailed inventory of all building types, footprints, and occupancies mapped; electric power transmission structures mapped; population densities mapped.
- (2) **Geotechnical Mapping Updates:** Earthquake-induced landslide and liquefaction susceptibilities, as well as soil classifications.³
- (3) **Ground Motion and Ground Deformation Updates:** Mapping local ground motion and ground failure.
- (4) **Earthquake Damage Estimates:** Quantifying impacts to buildings and the people that occupy them, the region's designated emergency transportation routes, and the electrical grid.

SCENARIOS ANALYZED

- Cascadia Subduction Zone M 9.0 earthquake
- Portland Hills Fault M 6.8 earthquake
- Wet season (saturated soils)
- Dry season (dry soils)
- Daytime (2 PM)
- Nighttime (2 AM)

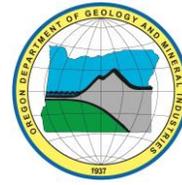
¹ Hazus, FEMA Hazard Modeling GIS Software

² Light Detection and Ranging Technology (LIDAR)

³ NEHRP (National Earthquake Hazard Reduction Program) soil classification

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Phase 1: Results

The results captured in this briefing are for the M 9.0 Cascadia Subduction Zone earthquake only, as it has a much higher frequency of recurrence (it's a question of when, not if). The other scenario analyzed, the Portland Hills fault, recurs with far less frequency (it is a question of if this fault will rupture again).

The CSZ results are presented as a range because when the earthquake strikes, impacts will vary depending on time of year (whether the ground is dry or rain-saturated), as well as time of day (whether people are by-and-large safe in their wood-frame homes or at work/school in a less flexible building type).

The risks for earthquake-induced landslide and liquefaction increase with higher ground saturation, and the risks for human injury increase with more people inside less resilient buildings (single-family residential wood-frame homes are flexible and more resilient in earthquakes than some other types of buildings).

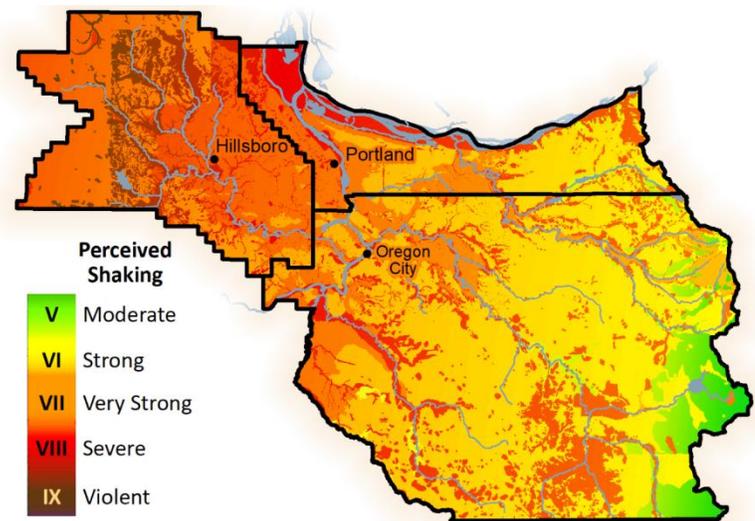


Image 1. Modified Mercalli Intensity Scale map for CSZ M 9.0 in the 3-County region

The following is also important when considering the results of the analysis:

- (1) **These are estimates:** The model provides a range of potential impacts for an area. It should not be interpreted as exactly what will happen, rather what could happen.
- (2) **Impacts vary widely throughout the region:** Areas will be impacted differently depending on many factors: proximity to the earthquake epicenter, soil types, and other geologic factors. Impacts to our infrastructure and the humans within them are influenced by seismic building codes, building construction types, and the soil upon which they reside, among other factors.
- (3) **Impacts are local and regional:** Results are available at the Census Block Group level (similar to neighborhood level). However, it is important to recognize that even if a particular area's impacts are estimated to be lower than other areas, we are all interconnected and dependent upon many of the same lifelines (i.e. electricity, roads, communications, etc.) that will be impacted. We will all be affected.

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1. Casualty Estimates (Injured, Hospitalized, Fatally Wounded)

Includes any injury or need for hospitalization or surgery, as well as fatalities.

Table 1. M 9.0 CSZ Earthquake Casualty Estimates (wet and dry scenarios, by county)

	Clackamas	Multnomah	Washington	3-County TOTAL
People (dry soil, nighttime – wet soil, daytime)	500 - 3,000	3,000 - 17,000	1,000 - 8,000	4,000 -27,000 people

2. Long-Term Displaced People Estimates (Red-Tagged Homes)

Includes people who lived in homes deemed to be “red-tagged” upon inspection, meaning the homes are unsafe to re-enter. These people may need to relocate for a long period of time while the homes are repaired, demolished, rebuilt, etc. These estimates do not include people who live in yellow- or green-tagged homes, who may choose to shelter in place, stay in temporary shelters, or leave the region out of necessity.

Table 2. M 9.0 CSZ Earthquake Displaced Estimates (wet and dry scenarios, by county)

	Clackamas	Multnomah	Washington	3-County TOTAL
People (dry soil, nighttime – wet soil, daytime)	2,000 - 10,000	10,000 - 37,000	5,000 - 38,000	17,000 - 85,000 people

3. Building Repair Cost Estimates

This is purely the estimated cost to repair or replace damages to the building inventory studied, as a result of the initial M 9.0 earthquake. The estimates include the cost to repair or replace the damages to the building. These estimates do not account for damages due to aftershocks (which may likely drive up repair costs), nor do they account for fire following earthquake (which will cause further damages). They also do not account for the costs to rebuild other (non-building) infrastructure such as roads, bridges, and water/sewer pipes, among many others.

Table 3. M 9.0 CSZ Earthquake Building Repair Cost Estimates (wet and dry scenarios, by county)

	Clackamas	Multnomah	Washington	3-County TOTAL
Dollars (dry soil – wet soil)	\$3 - 5 billion	\$13 - 20 billion	\$7 - 12 billion	\$24 - 37 billion

4. Debris Estimates

Estimated debris generated just from the buildings studied. Does not include vegetative debris or debris generated by other infrastructure systems (water, sewer, or gas lines), roads, bridges, or landslides.

Table 4. M 9.0 CSZ Earthquake Debris Estimates (wet and dry scenarios, by county)

	Clackamas	Multnomah	Washington	3-County TOTAL
Tons (dry soil – wet soil)	2 million (both)	8 - 10 million	3 - 5 million	13 - 17 million tons

5. Transportation and Electricity Infrastructure Analysis

DOGAMI estimated impacts to the established Emergency Transportation Routes (ETRs)⁴ in the three counties, and many of our selected priority routes are likely to have significant impacts (ground deformation and failure) as a result of a CSZ earthquake. Impacts to some electricity infrastructure were also estimated by analyzing ground motion and ground failure at electric substations and within the transmission network structures.

⁴ ETRs are priority routes targeted during an emergency for debris-clearance and transportation corridors to facilitate life-saving and -enhancing response activities. They are established by an agreement with the Oregon and Washington Departments of Transportation, Metro, TriMet, and the three Counties.

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Takeaways from Estimated Impacts

The study points to critical gaps in our preparedness for a large-scale earthquake and emphasizes the importance of efforts already underway to improve our resilience to such a hazard. To view a snapshot of how the project findings relate to current and potential efforts, please view the document entitled “Earthquake Regional Impact Analysis: Policy and Advocacy,” which can be found at www.rdpo.org/earthquakeimpact

Project Next Steps

This first phase of the DOGAMI Earthquake Regional Impact Analysis project focused on three out of five counties in the Portland Metropolitan Region. The second phase will complete a comprehensive picture of our anticipated regional impacts by analyzing Columbia County in Oregon and Clark County in Washington.

DOGAMI’s analysis focuses on our buildings and the people inside them. There are other impacts that can be analyzed to give us a more complete understanding of anticipated impacts, including economic analysis to help us understand how damages will affect industries and small businesses throughout our region. Such analysis would help us to encourage business continuity of operations planning and plan for economic recovery. The RDPO is preparing to commission such an analysis, building on the DOGAMI analysis, to be completed in 2019-2020.

Accessing the Data

The DOGAMI Earthquake Regional Impact Analysis Phase 1 report is published as an Open File Report available to the public on DOGAMI’s website at www.oregongeology.org/pubs/ofr/p-O-18-02.htm. Full details of the analysis, including impacts by jurisdiction (county, city, neighborhood) are found within the report and accompanying appendices. Updated earthquake shaking information is available for the public on DOGAMI’s HazVu online map at www.oregongeology.org/sub/hazvu. If you are an RDPO member organization and require additional information from the DOGAMI database for your earthquake preparedness and response planning efforts, or if you need more background information on the impacts to your area, please contact us.

Questions?

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