Cascadia Earthquake Response Staging area analysis
Identifying and comparing portland site suitability

Introduction:

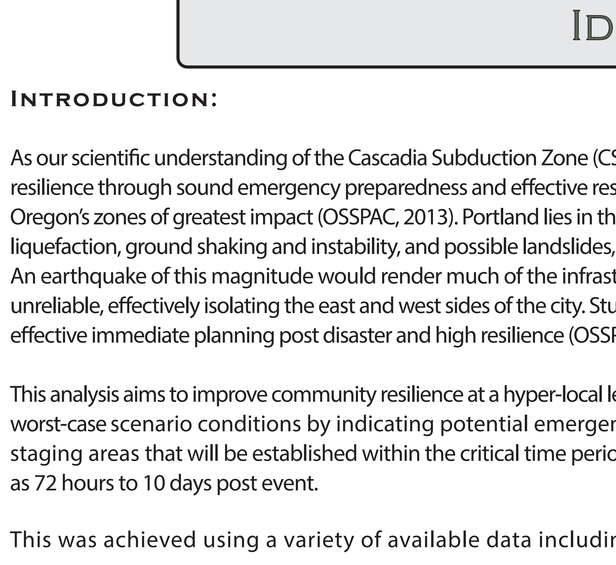
As our scientific understanding of the Cascadia Subduction Zone (CSZ) earthquake improves, so does the opportunity to improve community resilience through sound emergency preparedness and effective response plans. Recent studies have shown a low resilience rating throughout Oregon's zones of greatest impact (OSSPAC, 2013). Portland lies in the Valley Impact Zone, which is expected to face severe damage due to liquefaction, ground shaking and instability, and possible landslides, under the "worst-case" scenario, 9.0+ magnitude CSZ earthquake. An earthquake of this magnitude would render much of the infrastructure necessary for adequate response unreliable, effectively isolating the east and west sides of the city. Studies indicate an association between effective immediate planning post disaster and high resilience (OSSPAC, 2013).

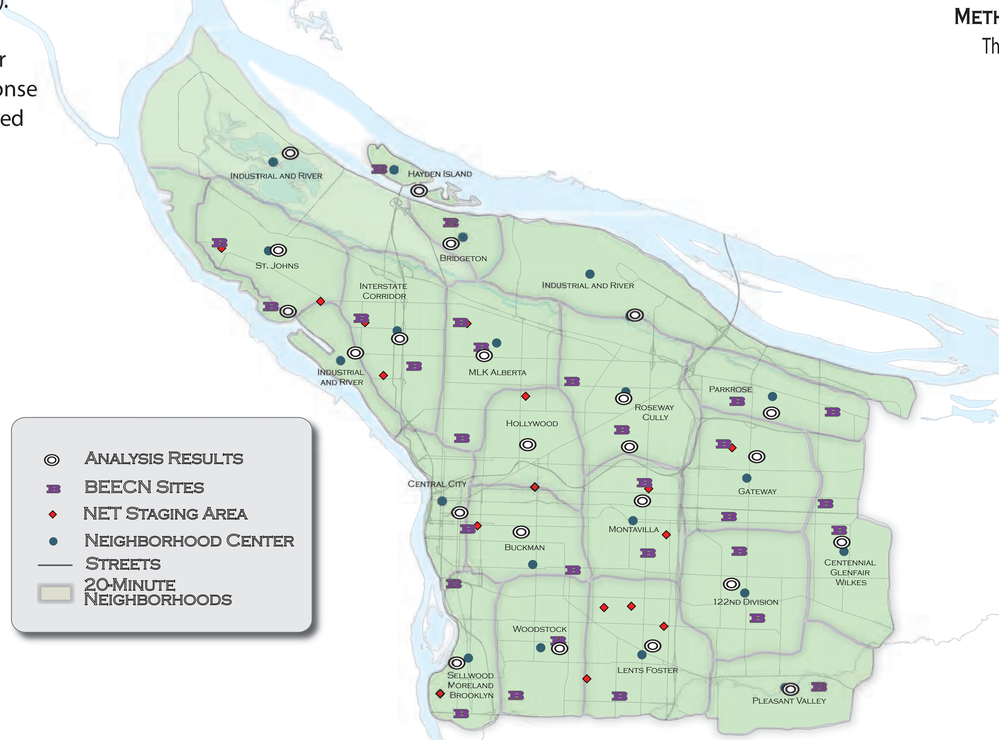
This analysis aims to improve community resilience at a hyper-local level under worst-case scenario conditions by indicating potential emergency response staging areas that will be established within the critical time period identified as 72 hours to 10 days post event.

This was achieved using a variety of available data including:

- Location of parks and greenspaces (including schools)
- First response resources (proximity to fire stations and hospitals)
- Designated "20-minute neighborhoods" (neighborhood groupings based on walking time, as identified by PBEM)
- Food resources (proximity to grocery stores)
- Accessibility (transportation infrastructure)
- Neighborhood centroids
- Seismic hazards

These criteria were then used to rate and assess potential locations by performing a suitability analysis using the Arc Spatial Analyst toolset.





Study Area:

The study area comprises portions of Portland east of the Willamette River including the North Portland neighborhoods. A few assumption underlie how the study area was established:

- A functioning transportation network is key to emergency response operations in the immediate aftermath of a CSZ earthquake, as well as in the recovery phase as life returns to "normal" in Portland.
  - The transportation network in Portland will be highly disrupted following a "worst-case" 9.0 magnitude earthquake. Specifically, many of the bridges spanning the Willamette River will be non-functioning following the earthquake (OSSPAC, 2013; Multnomah County, 2015).

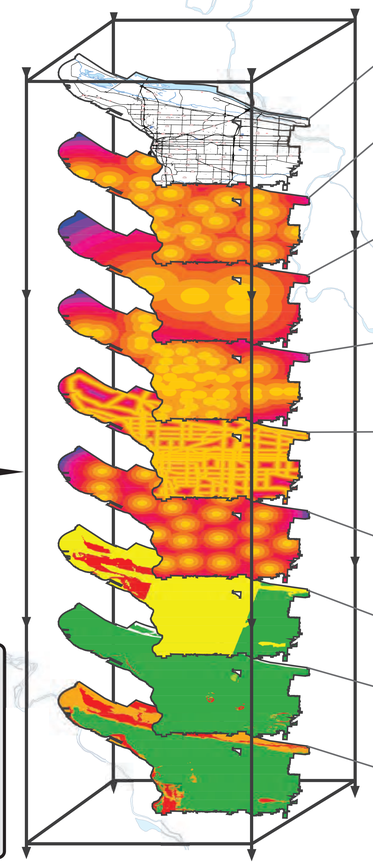
Methods:

The Basic Emergency Operations Plan Earthquake Response Appendix defines action steps intended for post disaster designed to identify emergency response staging areas. PBEM intends to use Portland parks as response staging areas because they are "ready to use" open spaces situated well within existing neighborhoods. The intent of this analysis is to validate a portion of this plan specifically applied to East Portland. Additionally it seeks to find areas that are potentially better suited for response staging based on a more robust set of criteria than those identified by PBEM for site selection.

Multi-criteria Analysis:

For this analysis we employed a Multi-criteria Suitability Analysis to select optimal sites for staging response and recovery sites based on PBEM criteria. The resulting suitability raster was used to locate one staging site for each Portland neighborhood (based on the 20-minute walkable neighborhood). We used various shapefile datasets to create input rasters for the Weighted Overlay tool in ArcMap Spatial Analyst extension. These input rasters were weighted based on the importance of that variable to the suitability of staging areas, Table 1 shows this weighting scheme.

The Weighted Overlay tool takes input rasters that have been reclassified to a common scale, in this case we will use a 9-point scale ranging from "1" as the least suitable to "9" as the most suitable. Table 1 describes the relationship between real world values for each input raster and the scale value used for the weighted overlay.



Parameter	Weight	Real Value	Scale Value
Unreinforced Masonry Buildings	1%	Not In Debris Zone	9
		Within Debris Zone	Restricted
Distance to Neighborhood Center	24%	0 – 800	9
		801 – 2,500	8
		2,501 – 5,000	5
		5,001 – 10,000	3
		10,001 – 15,500 feet	1
Distance to Hospitals	12%	0 – 7,161	9
		7,162 – 11,815	7
		11,816 – 16,291	5
		16,292 – 21,841	3
		21,842 – 45,652 feet	1
Distance to Grocery Stores	12%	0 – 250	9
		251 – 500	7
		501 – 1,000	5
		1,001 – 2,500	3
		2,501 – 22,889 feet	1
Distance to Arterials	7%	0 – 20	9
		21 – 150	7
		151 – 300	5
		301 – 600	3
		601 – 5,100 feet	1
Distance to Fire Stations	12%	0 – 250	9
		251 – 500	7
		501 – 1,000	5
		1,001 – 2,500	3
		2,501 – 22,276 feet	1
Groundshaking Potential	12%	Strong	9
		Very Strong	6
		Severe	1
Landslide Susceptibility	8%	Low	9
		Moderate	1
		High	Restricted
		Very High	Restricted
Liquefaction Hazard	12%	None	9
		Low	3
		Moderate	1
		High	Restricted

Table 1.

Results:

The centroids of each 20-minute neighborhood east of the Willamette River were used to calculate the most central and suitable parks. Proximity to the center of the neighborhood, suitability based on the analysis and area (at least half an acre) were used as metrics for comparing the newly chosen staging sites to the BEECN sites and NET staging areas.
Table 2 shows the results of this comparison, particularly that the staging sites have a higher acreage and suitability rating on average, as well as being closer on average to the center of the 20-minute neighborhoods.

	Number of Sites	Number of Neighborhoods	Average Suitability Rating	Average Size	Average Distance to Center
Our Staging Sites	21	21	6	9.14 acres	1653 feet
NET Sites	17	11	5	5.69 acres	4416 feet
BEECN Sites	31	18	5	8.08 acres	4259 feet

Portland Basic Earthquake Emergency Communications Node Guidelines. 2014. Portland Bureau of Emergency Management. Accessed: 14 April 2016. https://www.portlandoregon.gov/pbem/article/557545. Web.

Regional Land Information System (Multiple datasets). 2016. Oregon Metro. Accessed: 20 April 2016. http://rlisdiscovery.oregonmetro.gov/?resourceID=1. Web.

The Oregon Resilience Plan: Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami. 2013. Oregon Seismic Safety Policy Advisory Commission. Accessed: 10 April 2016. http://www.oregon.gov/OMD/OEM/osspac/docs/Oregon_Resilience_Plan_Final.pdf. Web.

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