

Measuring Disaster Risk Around Portland College Campuses

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Environmental Studies
Non-Thesis**

Natural Disasters and Vulnerability

Natural disasters are a hazard to every urban area on the globe (Alexander, 2011). The amount of hazard imposed by natural disasters varies between cities and between the numerous types of people within a city. Vulnerability to hazards stems from **not only** the hazards but also the societal forces that increase or decrease the vulnerability of specific populations (Wisner et al, 2012). With a solid understanding of who is vulnerable, the best planning, response, and recovery measures can be applied to the address the vulnerability.

←← Cascadia Subduction Zone →→

The Cascadia Subduction Zone is a major hazard to the Pacific Northwest Region of the United States. The faultline mirrors the geologic forces that generated massive magnitude 9.0 earthquakes in both the 2011 Tohoku, Japan, earthquake and the 1960 great Chilean earthquake. The question is **not** “*if* the earthquake will happen”, the question is “*when* will the earthquake happen”.



Portland Oregon

Portland, Oregon, has seen some pretty big EQ's...

Problem is, the last one happened before Portland was built. Ignorant of the threat for so long, the city's residents, infrastructure, and resources are extremely vulnerable (Oregon Resilience Plan). A large Cascadia earthquake would absolutely devastate the Pacific Northwest, Oregon, and Portland. We know the buildings pose significant hazards and opportunities for vulnerable populations... **what can we do?**

Finding the need for improvised shelter structures

College campuses have a key and perceivable role in communities. If a large number of residents in the surrounding area are without food, shelter, or water, they will begin seeking these basic survival needs. How is the earthquake *disaster risk* distribution around Portland college campuses impacting the need for improvised shelter structures?



Interpreting “Disaster Risk” around college campuses

Disaster Risk = Vulnerability * Hazards (Wisner et al, 2012)

- Vulnerability defined through populations with fragile livelihoods.
 - Minors
 - Elderly
 - Unemployed
 - Limited English proficiency
- Hazards defined through:
 - Peak Ground Acceleration - **PGA** - of a magnitude 9.0 Cascadia earthquake scenario
 - Number of unreinforced masonry buildings - **URMs**
 - Cascadia Damage Potential

Progression of Vulnerability Framework: Portland

My methods will answer this question with the assumptions of disaster risk outlined by the *Progression of Vulnerability* framework from Wisner et al (2012). This framework will be justified in finding the need for improvised shelter structures by its feature of interpreting physical, social, and economic vulnerabilities. The disaster risk present will shed light on the need for improvised shelter structures, which I argue highlights the earthquake resilience present in the area.

Need for improvised shelter increases with vulnerability



Root Causes

Historical & Culture

- Portland's infrastructure

Social & Economic Structure

- Residents

Dynamic Pressures

College emergency Planning and communication efforts for surrounding community

- Online emergency planning resources

Livelihoods and unsafe locations

Dangerous locations

URM buildings

limited skills

Nonenglish speaking

Minors

fragile health

Elderly

Limited social networks

Nonenglish speaking

Minors

Low income levels

Unemployed

Disaster Risk

=

Hazard *
Vulnerability

Earthquake Hazard



Peak Ground Acceleration

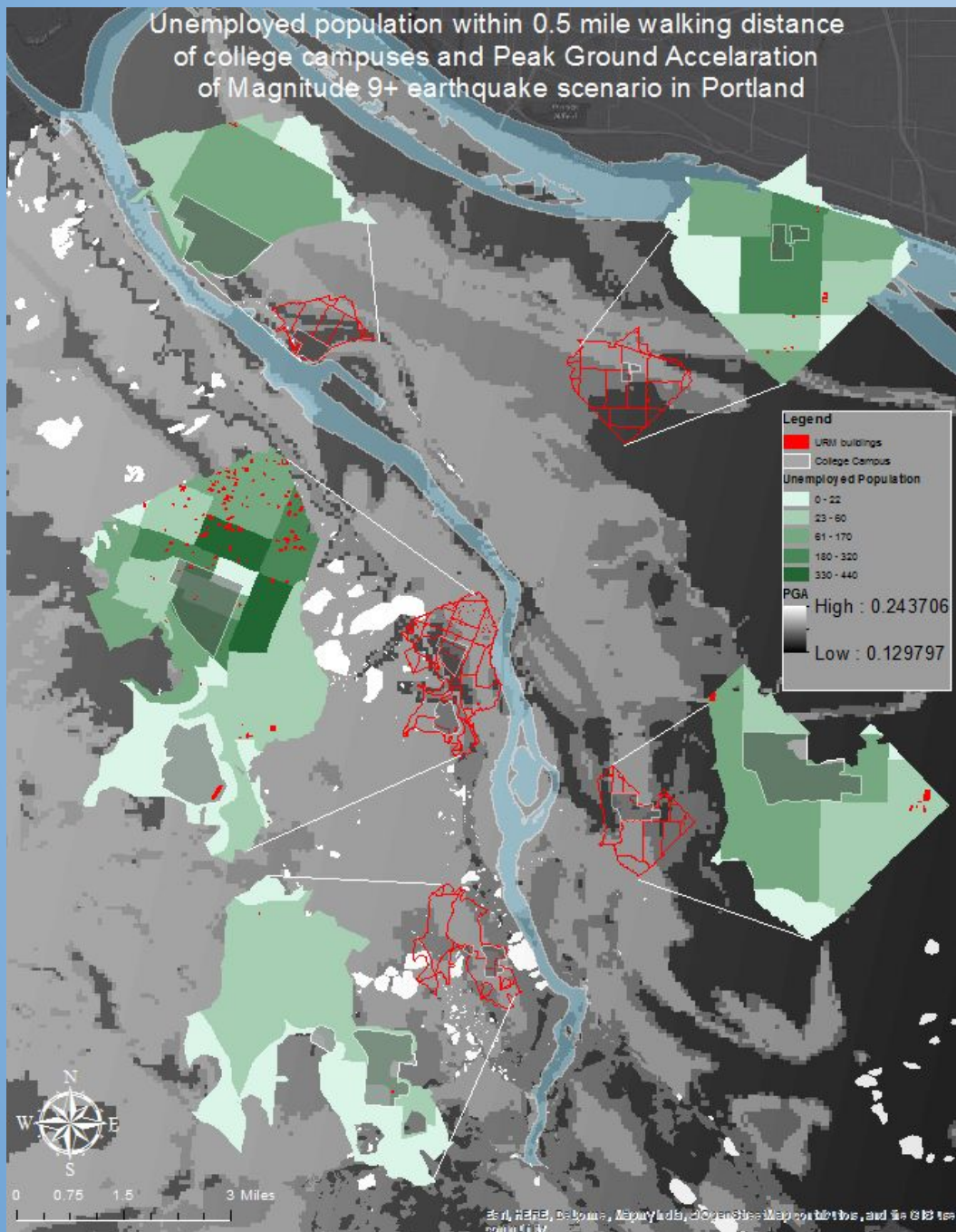
Cascadia Damage Potential

Unemployed Population

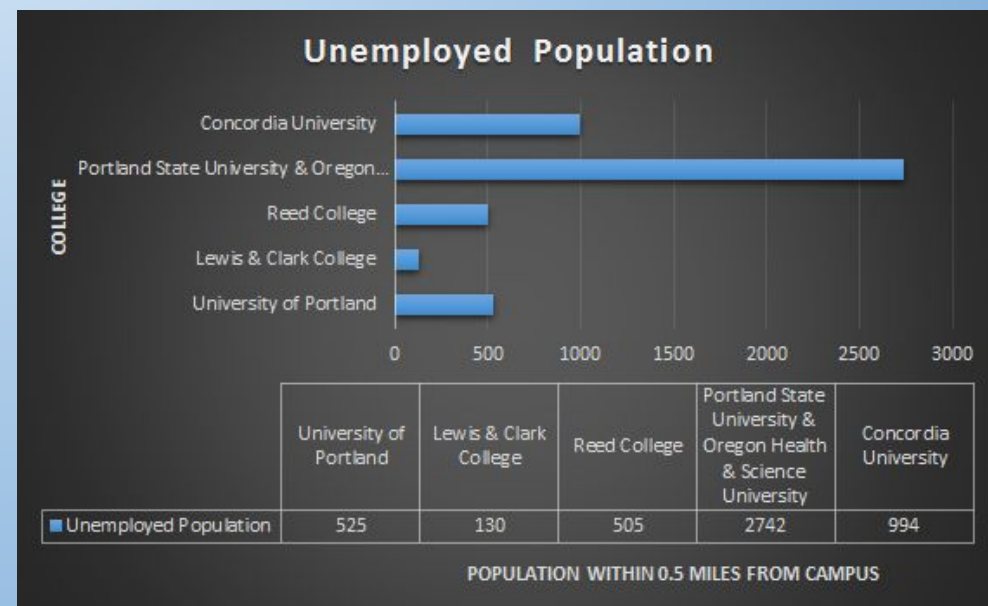
- Unemployment/poverty is included as a characteristic of a vulnerable population because much of coping with the earthquake post-disaster will be related to the resources one has access to.
- Families with unemployed members find themselves significantly more in poverty during the reconstruction period after a disaster event (Huafeng, 2016).
- In “normal” times, unemployment can seem insignificant to one’s resilience to a hazard, possibly due to assistance like food stamps and/or welfare services. However, this can provide a false sense of security for a post-disaster situation (Huafeng, 2016).
- Lack of income in a recovery period after a disaster, when improvised shelters will be needed, can lead to more suffering.



Unemployed Population: Portland



- The unemployed populations around the college campuses range from 0 - 440 residents based on my method of spatial analysis.
- The campuses of Concordia University and PSU have a large number of unemployed residents in close proximity to the campus.
- PSU's surrounding area also includes the large hazard of many URM buildings.
- The need for improvised shelter structures based on the vulnerability of unemployed residents is greatest around the PSU campus.



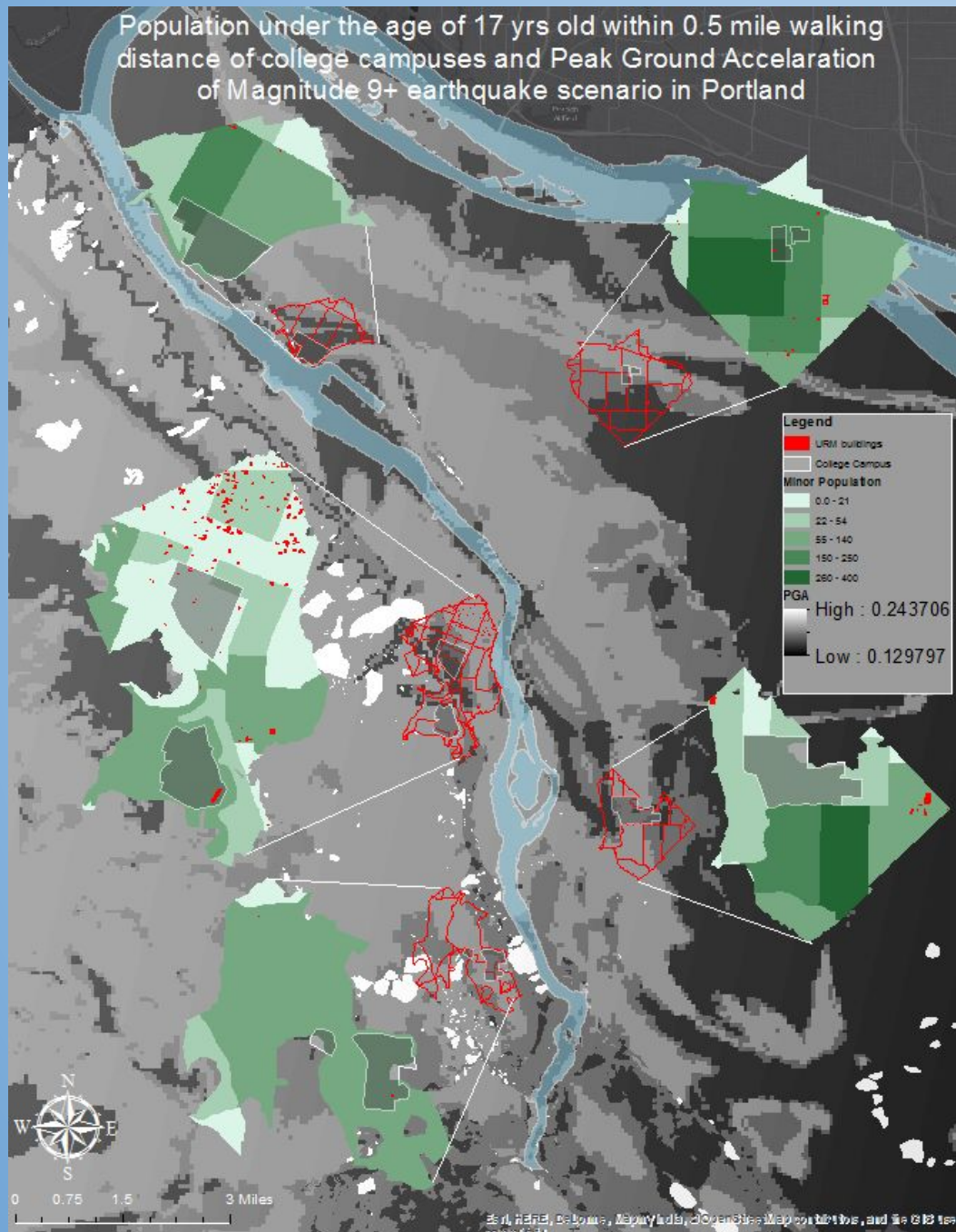
Minor Population

- Minors or children are defined by the United Nations Convention on the Rights of the Child as persons age 18 and younger. The data I used for minors was categorized by an age group of 0 - 17.
- Psychological health is a big concern for minor populations, likely due to an absence or disappearance of support systems that were there before the disaster (Peek, 2008).
- Very young children are a highly vulnerable group. Their dependence on adults makes them physically vulnerable to both the fast onset and dangerous disaster events (Peek, 2008).
- Moreover, disasters in urban areas where people commute far distances, can separate children from their family members and friends. Such occurrences in unfamiliar environments can lead to consequences of the child's short and long term physical, emotional, and intellectual well being (Peek, 2008).



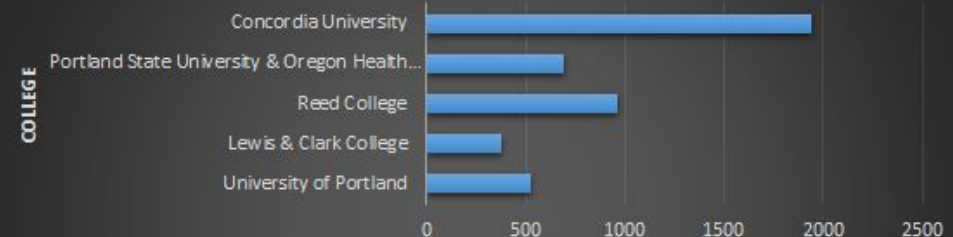
Minor Population: Portland

Population under the age of 17 yrs old within 0.5 mile walking distance of college campuses and Peak Ground Accelaration of Magnitude 9+ earthquake scenario in Portland



- The populations under 17 years old around the college campuses range from 0 - 400 residents based on my method of spatial analysis.
- The campuses of Concordia University and Reed College have a large number of minor residents in close proximity to the campus.
- The need for improvised shelter structures based on the vulnerability of minor residents and hazards present is greatest around the Concordia campus.

Minors Population (Ages 0 -17)



	University of Portland	Lewis & Clark College	Reed College	Portland State University & Oregon Health & Science University	Concordia University
Minors (0-17)	526	379	964	690	1944

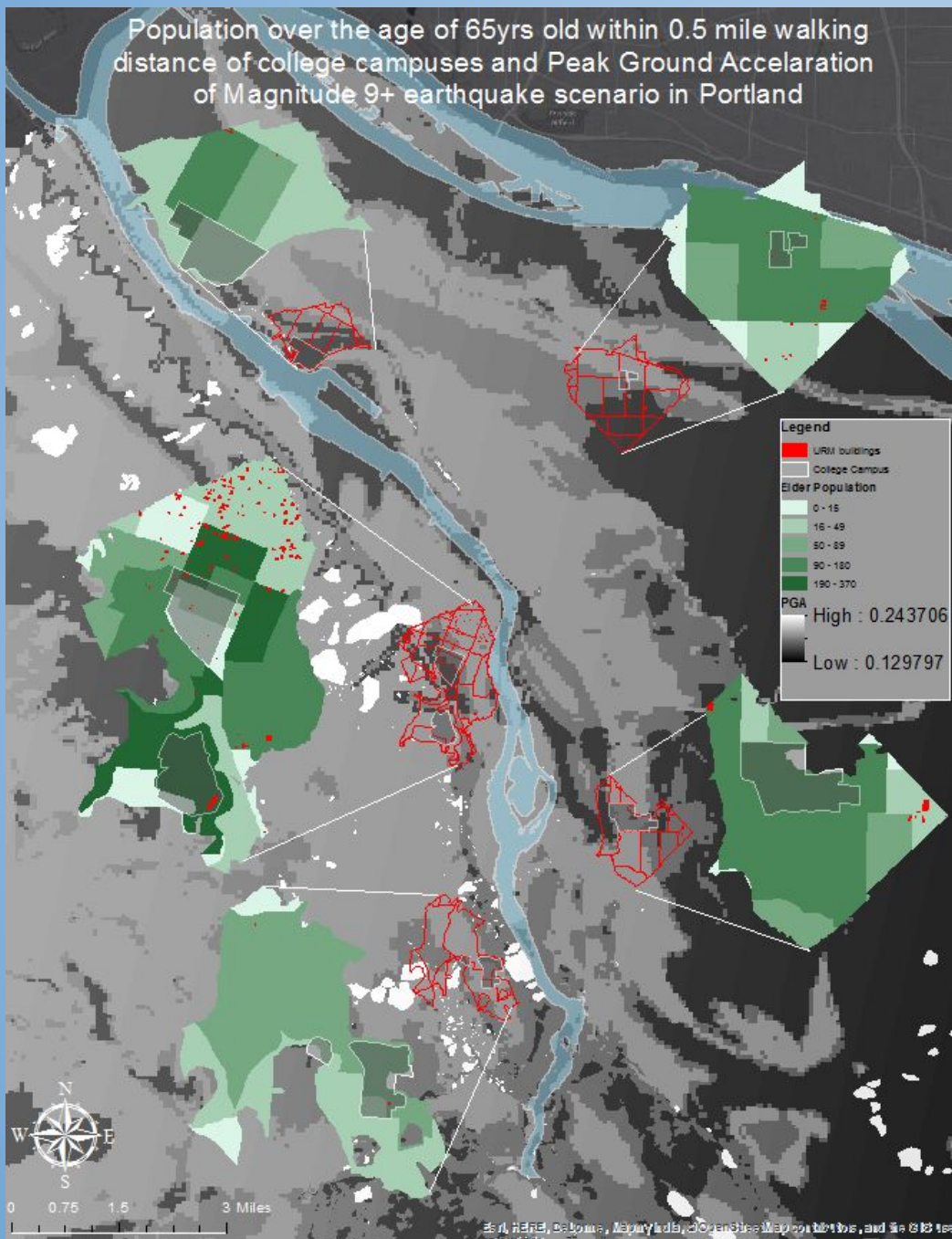
POPULATION WITHIN 0.5 MILES FROM CAMPUS

Elderly Population

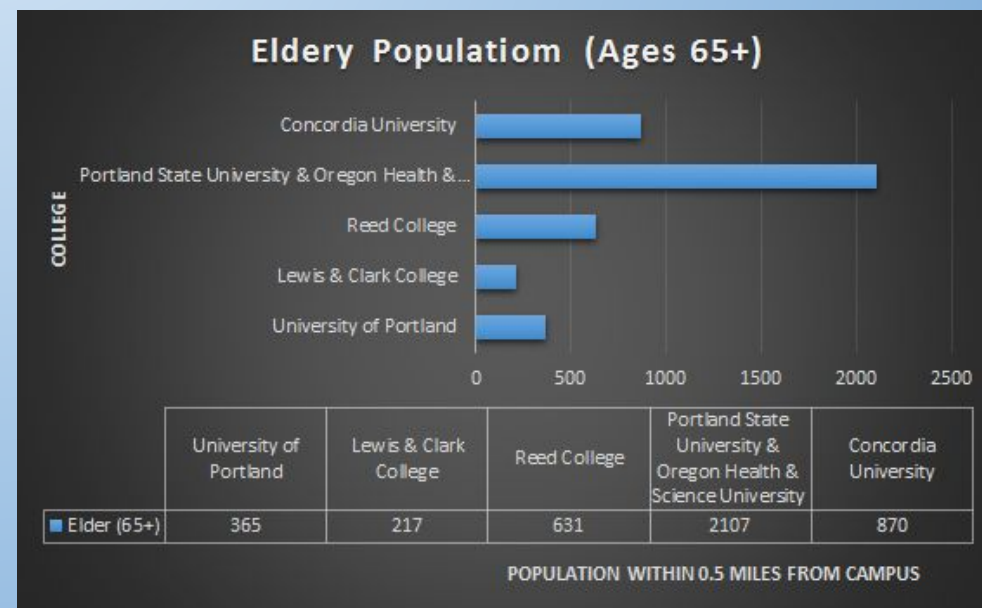
- Residents with the age of 65 and over are included as a vulnerable population because much of coping of the earthquake disaster will be self reliant.
- Elderly people are more likely to embody characteristics that prevent them from properly preparing for a disaster or coping during and after a disaster (Aldrich and Benson, 2007)
- Communication is bigger issue for older individuals who may have trouble seeing and hearing (Aldrich and Benson, 2007)
- Understanding specific needs for elderly such as assistive devices, medication, proper nutrition and water can have a major impact on their well being after a disaster. Moreso, with older people the consequences for the absence of such necessities can be detrimental for some cases.



Elderly Population: Portland



- The populations over 65 years old around the college campuses range from 0 - 370 residents based on my method of spatial analysis.
- The campuses of PSU/OHSU have a large number of elderly residents in close proximity to the campus.
- The need for improvised shelter structures based on the vulnerability of elderly residents and hazards present, is greatest around the PSU campus.



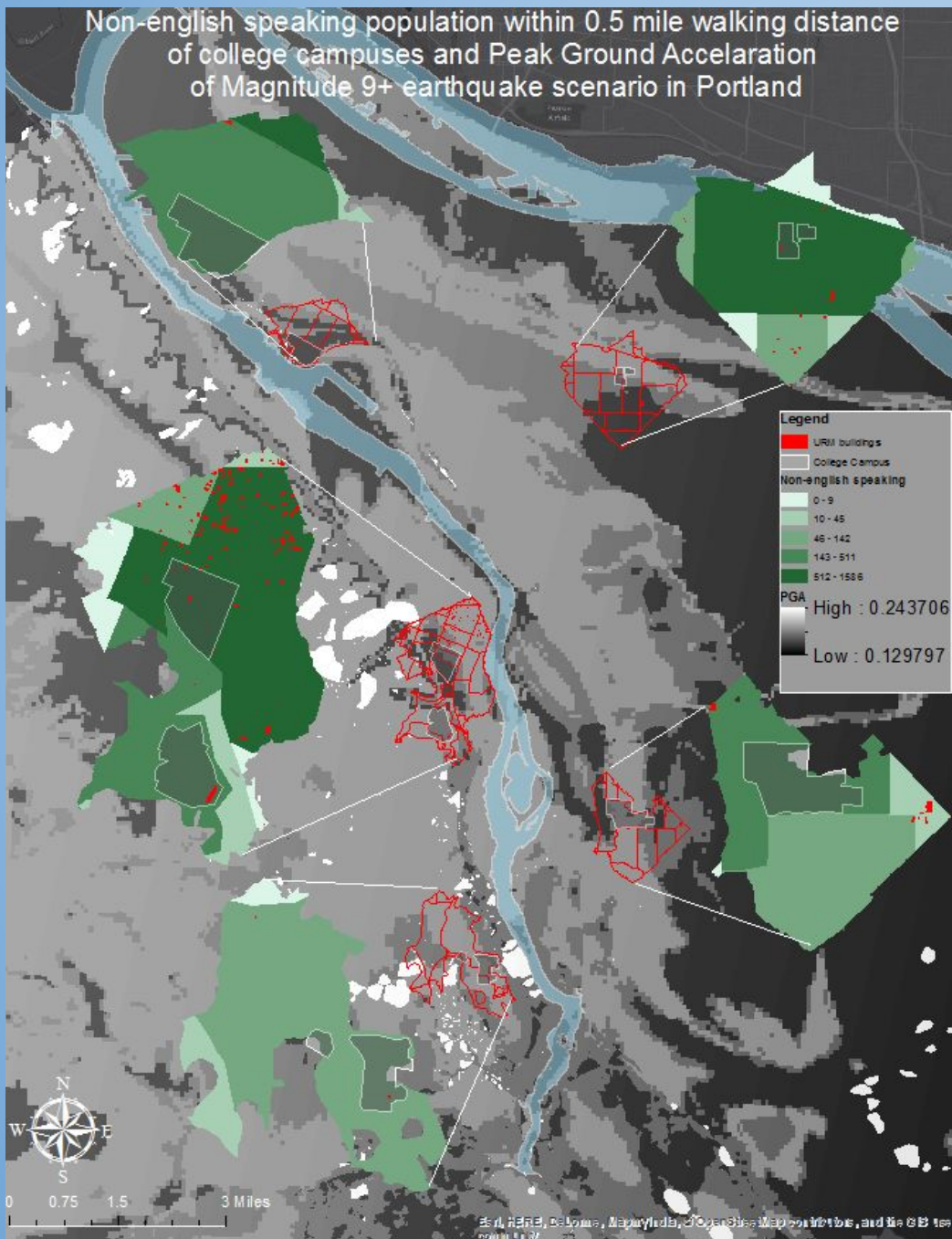
Limited English Proficiency Population

- Limited English proficiency: Individuals with limited English proficiency are described as those whose primary language is not English and have a limited ability to read, write, speak, or understand the English language.
- Social vulnerability can be exacerbated by language barriers. Racial disparities often coincide with societal vulnerabilities such as a lack of access to resources, cultural differences, and marginalization of certain populations (Cutter et al, 2003).
- Non-white or non-anglo race and ethnicities increases the vulnerability of the population due to how important language is to communicating relevant hazard information before and after a disaster event (Cutter et al, 2003).

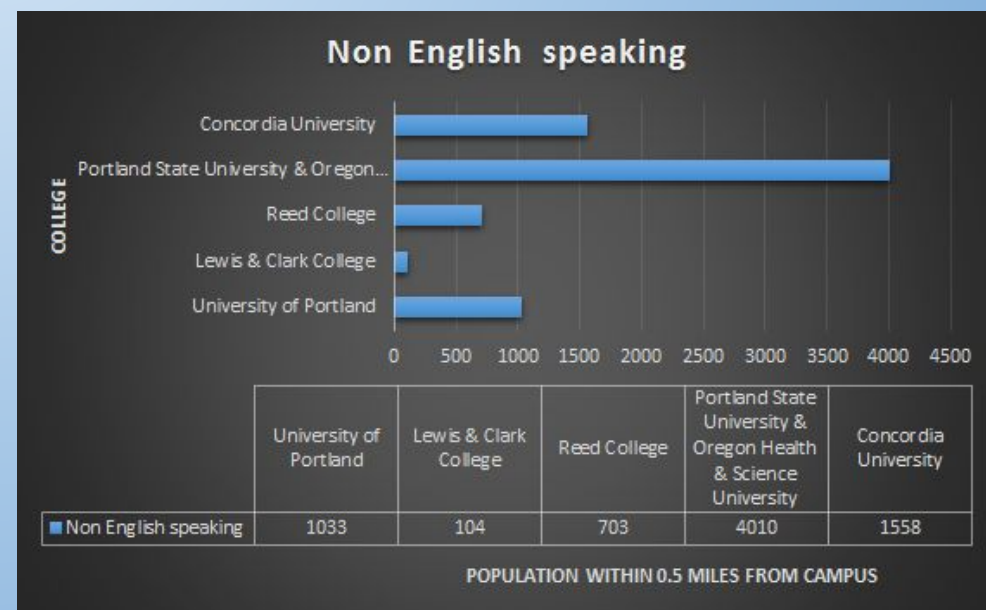


Limited English Proficiency Population: Portland

Non-english speaking population within 0.5 mile walking distance of college campuses and Peak Ground Acceleration of Magnitude 9+ earthquake scenario in Portland



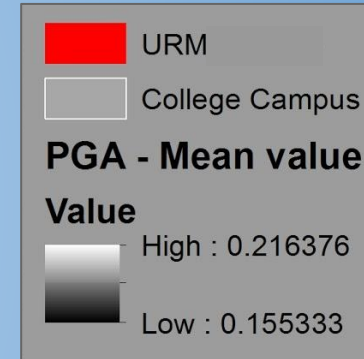
- The populations with limited english proficiency around the college campuses range from 0 - 1586 residents based on my method of spatial analysis.
- The campuses of Concordia University and PSU have a large number of minor residents in close proximity to the campus.
- The need for improvised shelter structures based on the vulnerability of residents with limited english proficiency and the hazards present, is greatest around the PSU campus.



Mean PGA values around the college campuses

Peak Ground Acceleration (g) - PGA - is a quantitative measure of ground shaking that may occur from an earthquake and is commonly used by the engineering community for both analysis and design. The maps below display the mean value of PGA expected from a 9.0 Cascadia earthquake for each block group. These maps were intended to show the mean of all the shaking the would occur in these areas and gives some key insights into what these residents may experience.

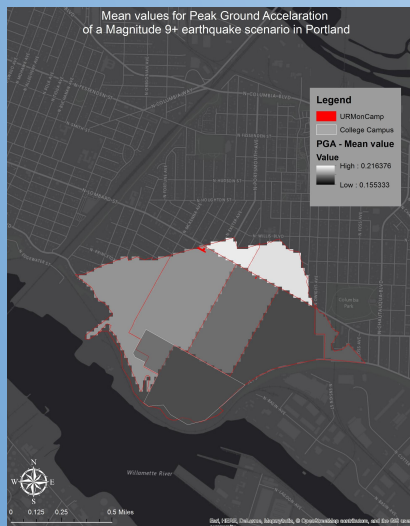
The mean PGA expected from a 9.0 Cascadia earthquake in the maps below range from 0.16g to 0.22g of shaking. These values of shaking correlate with “Moderate” → “Moderate/Heavy” Cascadia damage potential. In the white colored block groups, we can expect to see steering of cars affected; extensive damage to unreinforced masonry buildings, including partial collapse; fall of some masonry walls; twisting and falling of support beams (Burns and Madin, 2012). In the gray to black colored block groups, we can expect to see a difficulty in standing or walking; furniture broken; damage to poorly built masonry buildings; weak chimneys break; plaster, loose bricks, cornices, unbraced parapets and porches fall; some cracks in better masonry buildings. (Burns and Madin, 2012).



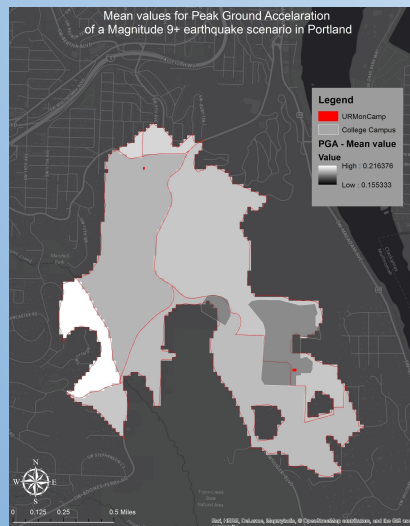
Least

Cascadia earthquake hazards based on mean PGA and URM buildings

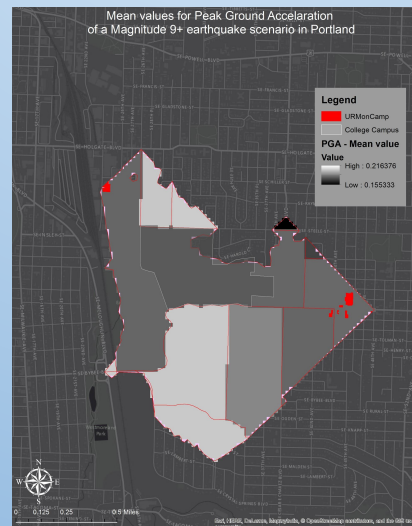
Greatest



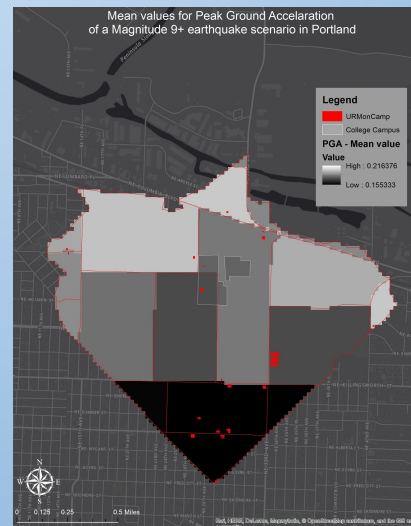
UP



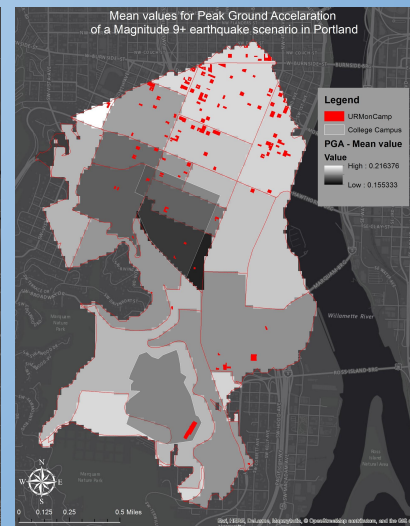
LC



Reed



Concordia

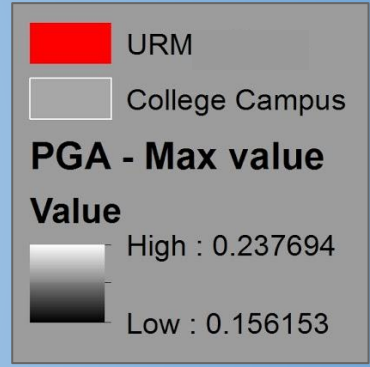


PSU/OHSU

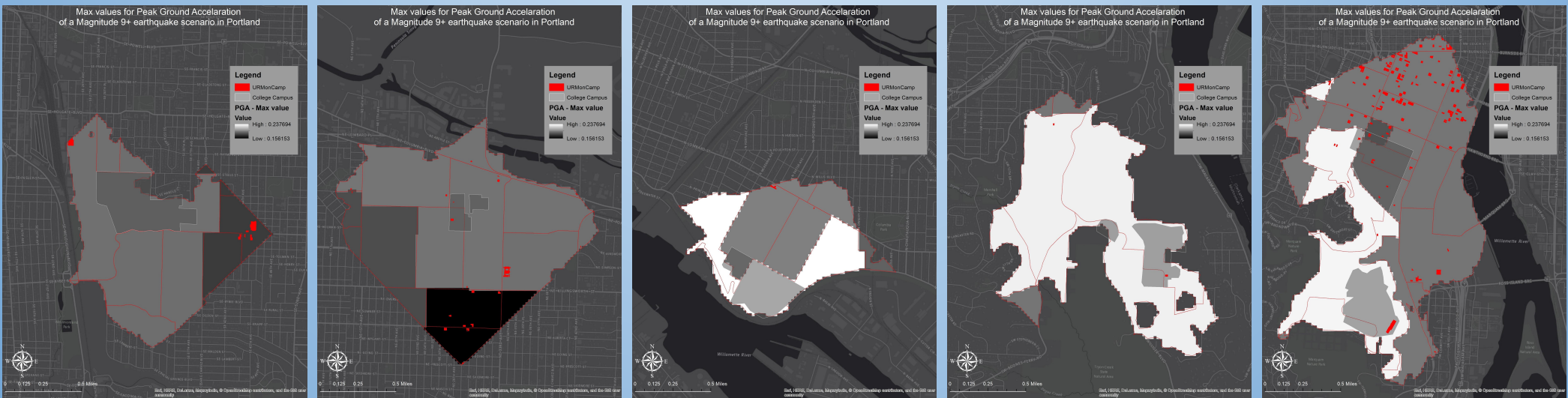
Max PGA values around the college campuses

Peak Ground Acceleration (g) - PGA - is a quantitative measure of ground shaking that may occur from an earthquake and is commonly used by the engineering community for both analysis and design. The maps below display the max value of PGA expected from a 9.0 Cascadia earthquake for each block group. These maps were intended to show the maximum of all the shaking the would occur in these areas and gives some key insights into what these residents may experience in the worst case scenario.

The max PGA expected from a 9.0 Cascadia earthquake in the maps below range from 0.16g to 0.24g of shaking. These values of shaking correlate with “Moderate” → “Moderate/Heavy” Cascadia damage potential. In the white colored block groups, we can expect to see steering of cars affected; extensive damage to unreinforced masonry buildings, including partial collapse; fall of some masonry walls; twisting and falling of support beams (Burns and Madin, 2012). In the gray to black colored block groups, we can expect to see a difficulty in standing or walking; furniture broken; damage to poorly built masonry buildings; weak chimneys break; plaster, loose bricks, cornices, unbraced parapets and porches fall; some cracks in better masonry buildings. (Burns and Madin, 2012).



Least Greatest Cascadia earthquake hazards based on mean PGA and URM buildings



Reed

Concordia

UP

LC

PSU/OHSU

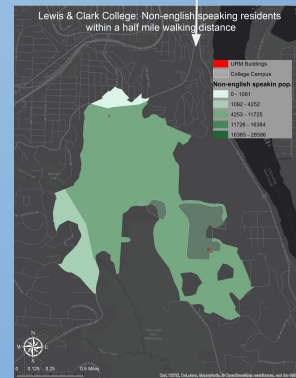
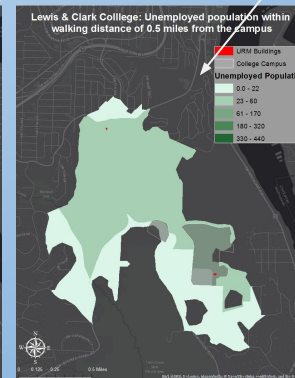
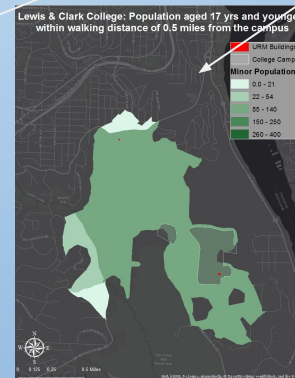
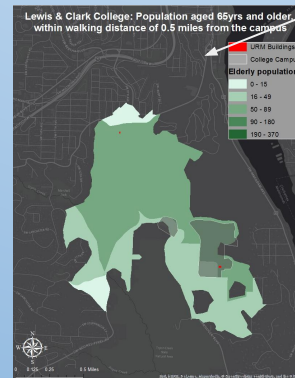
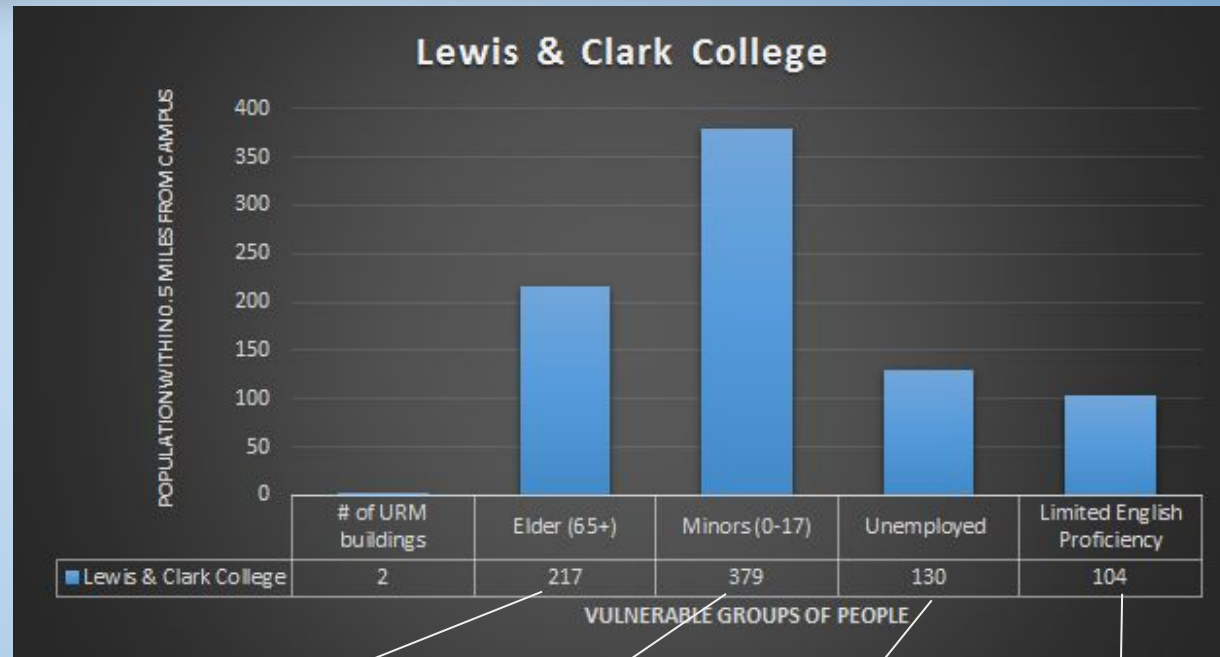
Lewis & Clark College: Need for improvised shelter structures

College's initiatives for reducing disaster risk

A major element of vulnerability is simply how informed the public is in regards to the hazards (Wisner et al, 2012). People who are informed of their vulnerability, are more likely to take initiative to help themselves. The more residents help themselves, the less the college will need to assist in their well-being in a post-disaster situation. Lewis & Clark College has great emergency planning information available to the public on their website. It outlines all the major hazards and the plans the college has in place; leading from planning to respond, and then recovering. From what I've seen so far the website is only in English and would not be useful for people who have poor English proficiency.

Overview

Overall, The vulnerable residents surrounding Lewis & Clark College have the least degree of disaster risk than the other college campuses. The vulnerable residents are located on top of a moderate zone of hazard, but there are only 2 URM buildings that would be affected by a large earthquake. If shaking does occur, hazardous buildings are not prominent in their surrounding area. The school plans to use its website and radio channel to post updates after an emergency situation. This could be helpful for the vulnerable residents who have access.



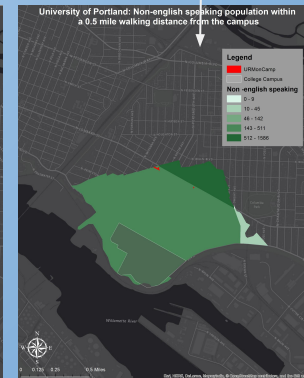
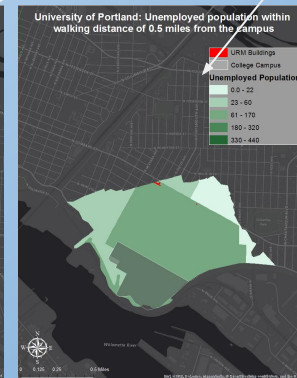
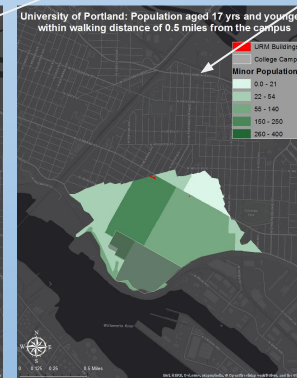
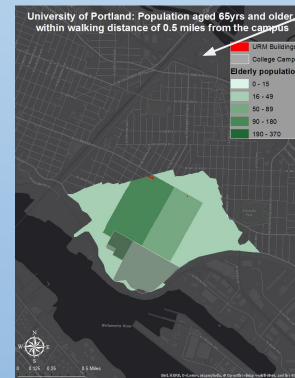
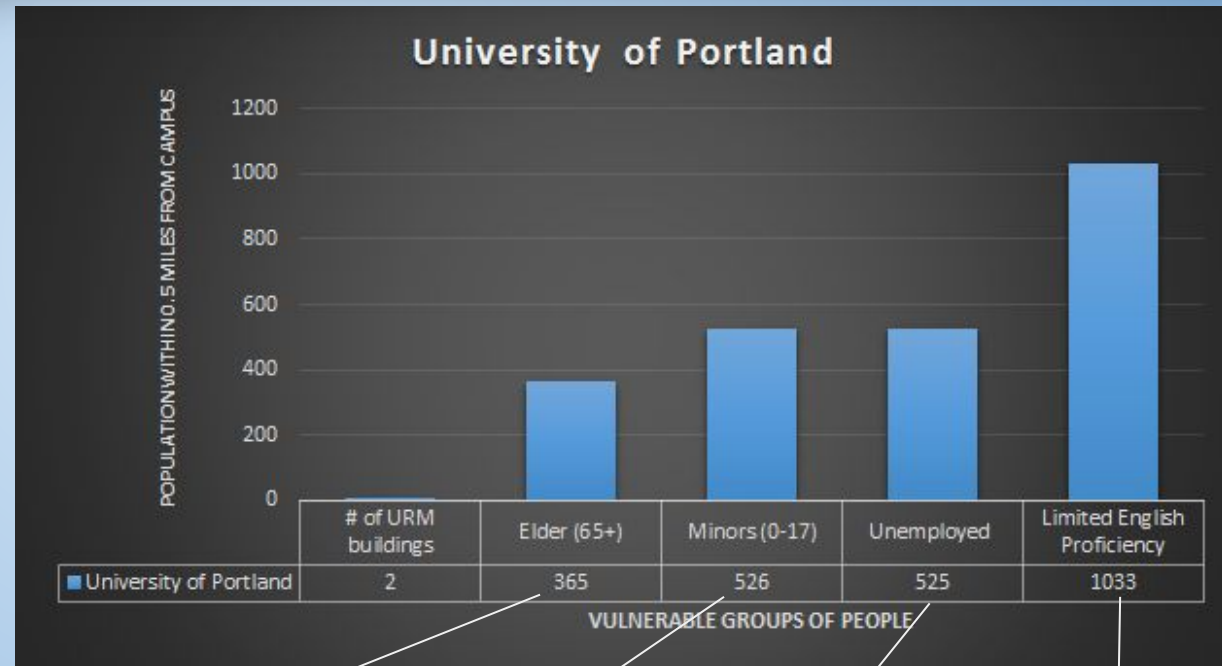
University of Portland: Vulnerable populations and disaster risk

College's initiatives for reducing disaster risk

University of Portland's online site information about emergency responses is plentiful, however, it is dispersed and not easily found if someone wanted to see the college's plans. The information on earthquake events is good in that it provides information regarding what to do before, during and after the earthquake. The resource guide asks students not to leave and states: "The campus is prepared to provide emergency care and shelter in partnership with the American Red Cross" (12). The information is only available in English and wouldn't be useful for poor English proficiency populations.

Overview

Overall, University of Portland does not have the least amount of disaster risk, mainly due to the areas that have URM buildings and the shaking expected to occur, but it is still less than other colleges based on the hazards and vulnerabilities present. The College does a good job in offering emergency preparedness resources for the public.



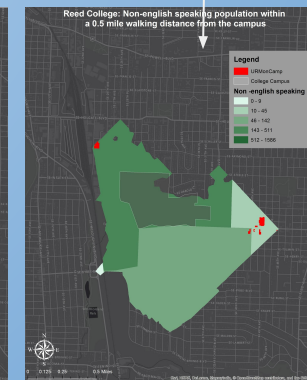
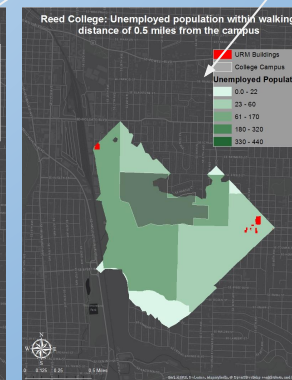
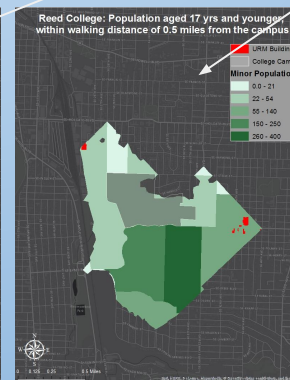
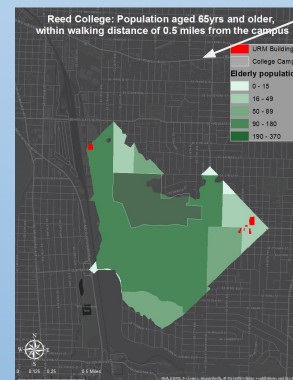
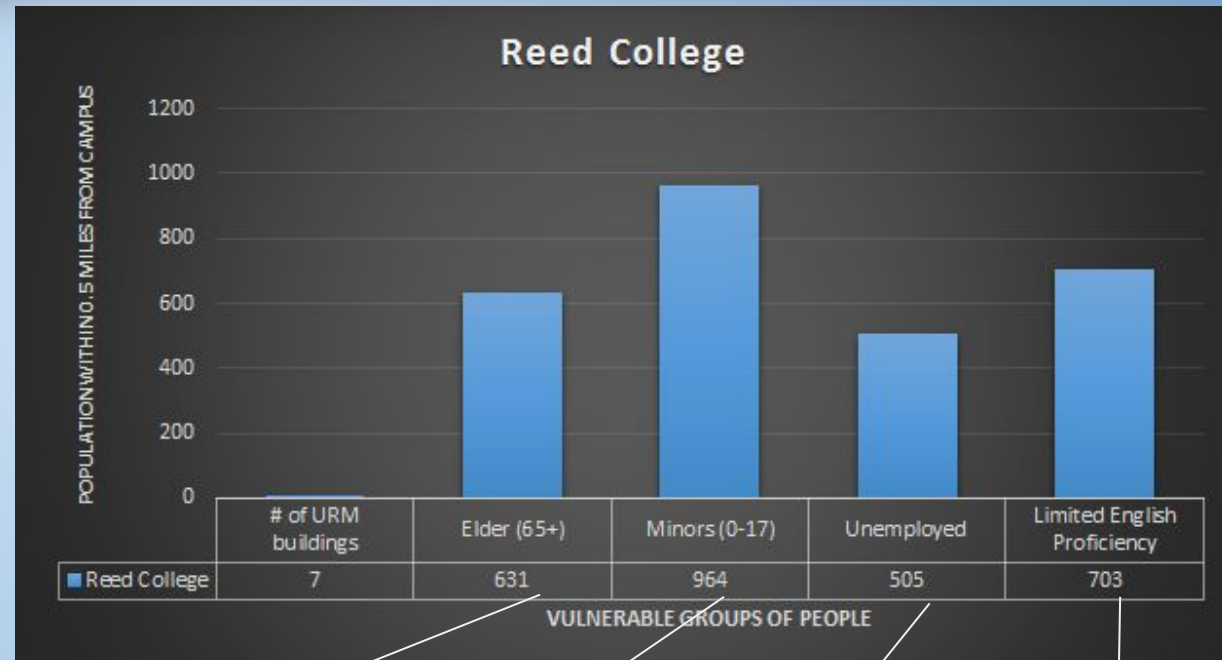
Reed College: Vulnerable populations and disaster risk

College's initiatives for reducing disaster risk

Reed college has some fairly good information available to the public regarding the plans in place for an earthquake situation. It is good in that it gives the public a responsibility in taking part in the recovery process such as “assisting emergency response crews” and “keeping streets, fire lanes, hydrants, and walkways clear for emergency vehicles and crews”. However, the information is short and provides little information on what the school’s ability to provide resources after an earthquake event. The information provided is in English and wouldn’t be useful for the limited English proficiency population.

Overview

Overall, the disaster risk surrounding Reed College is showing a need for the college to provide improvised shelter structures. The area has 7 URM buildings that could cause major harm but is not a hazard to a majority of the vulnerable populations. The college provides decent public information regarding its plans for after an earthquake event but is not useful in reducing the disaster risk since it does not address the vulnerabilities present.



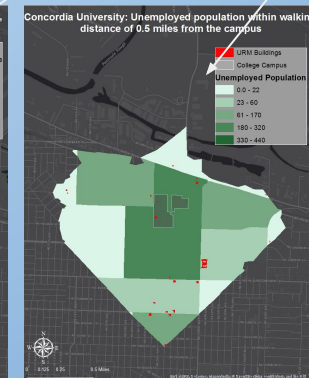
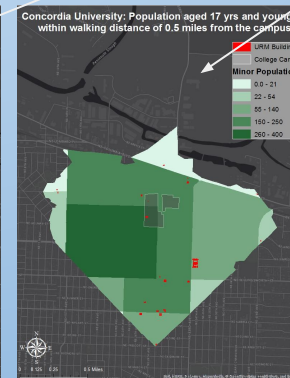
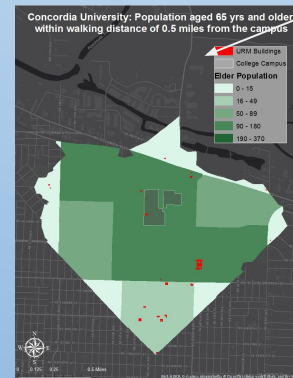
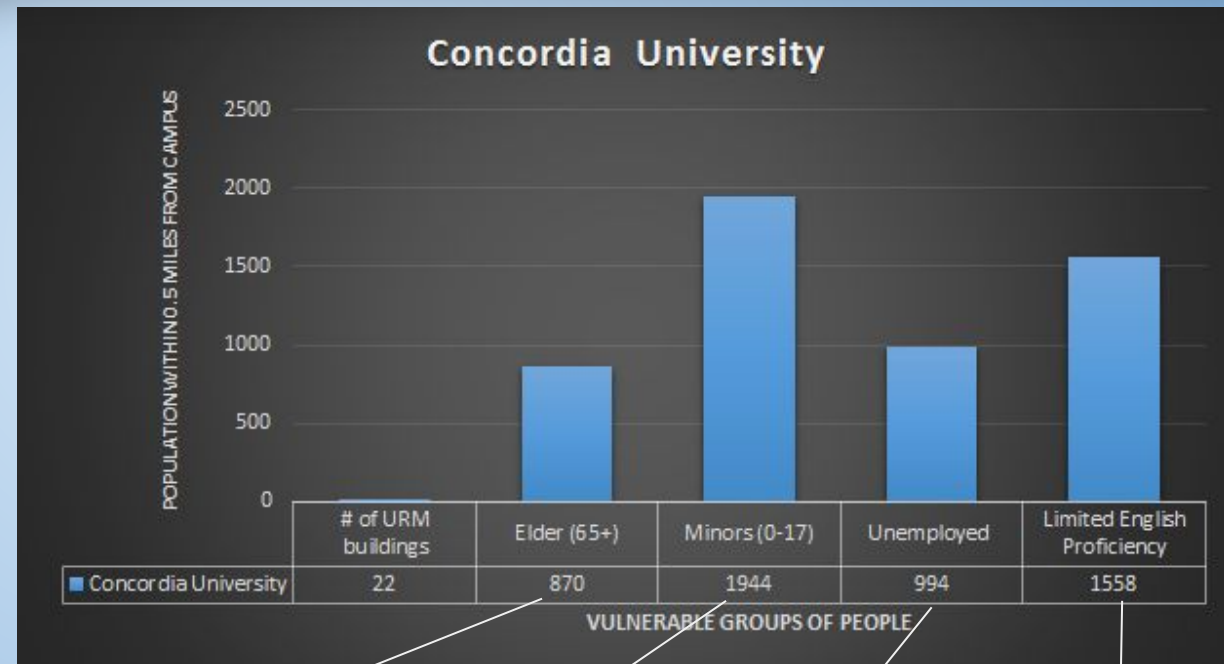
Concordia University: Vulnerable populations and disaster risk

College's initiatives for reducing disaster risk

Concordia University has good communication measures in place regarding its emergency management. There is little information on helping people prepare for an event but the college provides real-time communication during an event using the "CU Alert", which is a "automated communication system using Blackboard Connect that has the ability to simultaneously send voice, text, and email messages to students, faculty and staff to notify you in the event of a campus emergency" (6). Whether this is accessible to residents off campus is unknown and the information on their site and resources is only in English, which would not be useful for the poor English proficiency population.

Overview

Overall, Concordia University is surrounded by a fair amount of disaster risk and the need for it to be an improvised shelter structure is prominent. The information from their website for the public is not plentiful in preparation or helpful to the vulnerable populations surrounding the campus. There are 22 URM buildings in the surrounding area and also a large majority of minors.



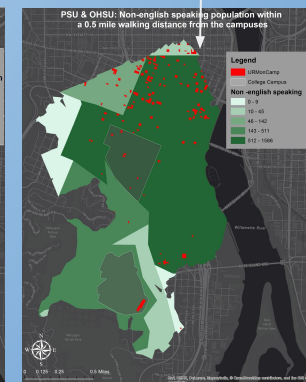
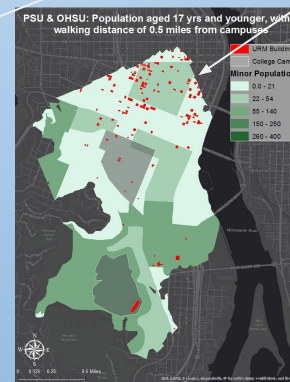
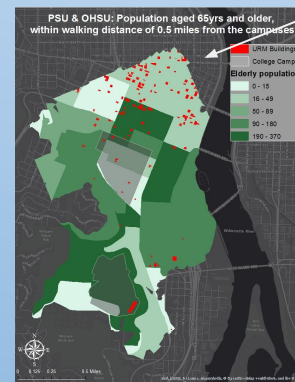
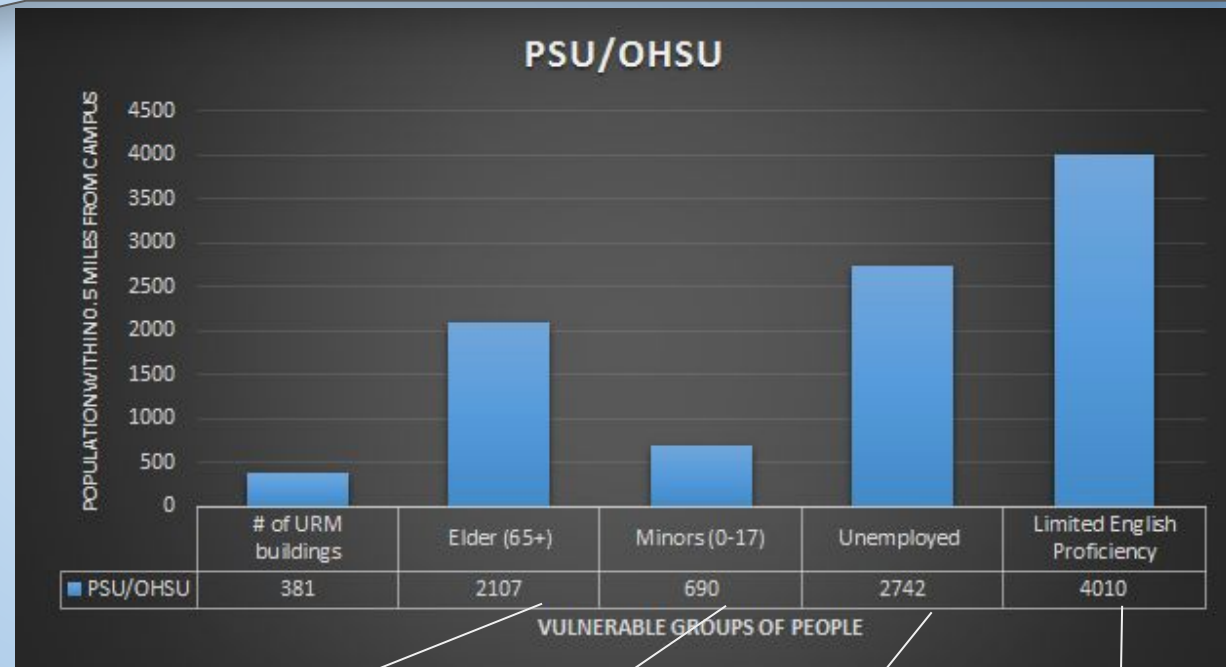
PSU/OHSU: Vulnerable populations and disaster risk

College's initiatives for reducing disaster risk

OHSU has good target plans that will address the needs of people with disabilities - PWD - in disasters. This could correlate with elderly populations. PSU however, has little information for the public to use for disaster planning. OHSU also offers lots of training information on their website. On the other hand, PSU offers information to the public regarding planning or recovering from an earthquake event and training on preparedness. The PSU site shares little information on staying safe during an earthquake, seismic mitigation projects and it's alert system for people associated with the college. The information on both the OHSU and PSU site was in English and wouldn't be useful for the poor English proficiency population.

Overview

Overall, the OHSU and PSU campuses have the most vulnerable surrounding areas and the most need to provide improvised shelter structures. There are 381 URM buildings in the area and a large number of vulnerable populations. OHSU provides good information on planning, responding, and recovering from an earthquake event. PSU, provides pretty good information for the public, none addressing the URM building problem however.



Addressing the focus question:

“How is the earthquake risk distribution around Portland college campuses impacting the need for improvised shelter structures”?

Utilizing the framework of analyzing disaster risk from Wisner et al (2012), I examined the vulnerability of the residents and hazards posing threats to the residents around various Portland college campuses. The results were generated using GIS spatial maps and interpreted with the framework.

Need for improvised shelter structures

LEAST

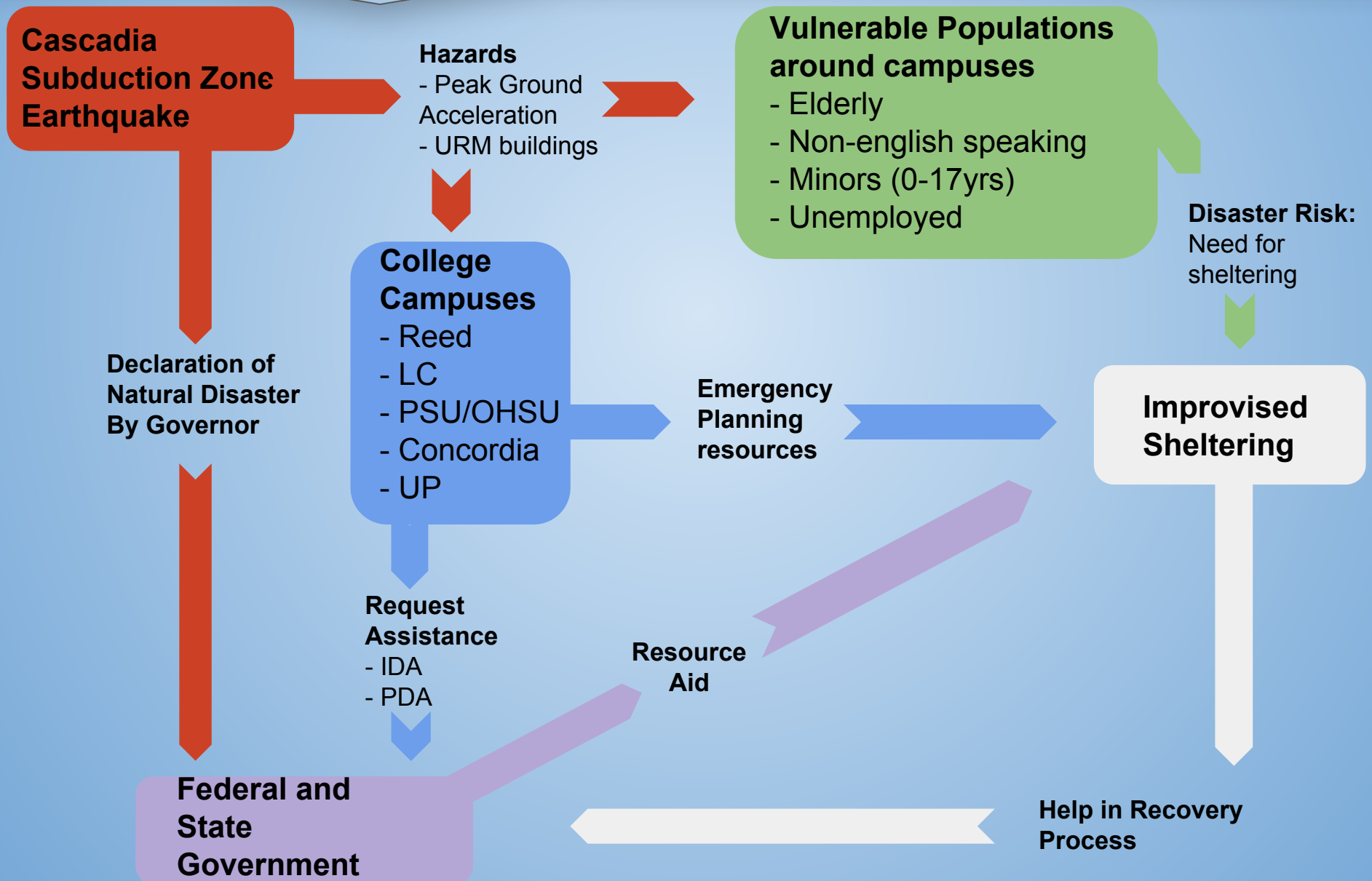
LC - UP - Reed - Concordia - PSU/OHSU

GREATEST

Improvised Sheltering on College Campuses: Portland, Oregon

During and after an earthquake disaster, mass sheltering is an issue facing college campuses. The impacts the college can have on the need for sheltering revolves around state and federal guidelines of planning, responding and recovering.

- Actors**
- Natural Disaster
 - Government
 - College Institutions
 - People
 - Possible Solution



Bibliography:

Aldrich, N., & Benson, W. (2007). Disaster Preparedness and the Chronic Disease Needs of Vulnerable Older Adults. *Preventing Chronic Disease*, 5(1), A27. https://www.cdc.gov/pcd/issues/2008/jan/07_0135.htm

Cutter, Susan L., Boruff, Bryan J., and Shirley, W. Lynn. "Social Vulnerability to Environmental Hazards *." *Social Science Quarterly* 84, no. 2 (2003): 242-261. <http://web.a.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=1&sid=50d7ac5c-d0cd-4064-a92c-604a92204ccb%40sessionmgr4006>

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Peek, Lori. "Children and disasters: understanding vulnerability, developing capacities, and promoting resilience—an introduction." *Children Youth and Environments* 18, no. 1 (2008): 1-29 <http://www.jstor.org/stable/10.7721/chilyoutenvi.18.1.0001>

Online Sources for the emergency management resources of the colleges:

Concordia:

<http://www.cu-portland.edu/sites/default/files/pdf/2017-Clery-Report.pdf>

Concordia report in which it describes a little of what the emergency management plan is and the function of it during certain occasions.

<http://www.cu-portland.edu/sites/default/files/pdf/AlertNotification.pdf>

LC:

<https://www.lclark.edu/live/files/12056-lampc-emergency-procedures>

Lewis and Clark emergency procedures plan. Not the emergency management plan, but sheds light into the procedures in place for an earthquake event

http://www.lclark.edu/about/campus_safety/crisis_management/

Website page for lclark.edu and it is great informational source for the public

Reed:

https://www.reed.edu/community_safety/emergency/earthquake.html

This website page is a comparable to the emergency procedure plans of LC. The page itself is also a great resource for the public.

https://www.reed.edu/community_safety/emergency/ERP.html

OHSU:

<https://www.ohsu.edu/xd/research/centers-institutes/oregon-office-on-disability-and-health/resources/emergency-prep.cfm>

This page is a great resource for the public as well as it shows the current efforts of the institution in creating resiliency by planning and training.

PSU:

<https://www.pdx.edu/emergency-management/>

UP:

<https://www.up.edu/publicsafety/files/up-emergency-management-resource-guide-2014.pdf>

Great guide for looking at university of portland's guide in responding to an earthquake event.