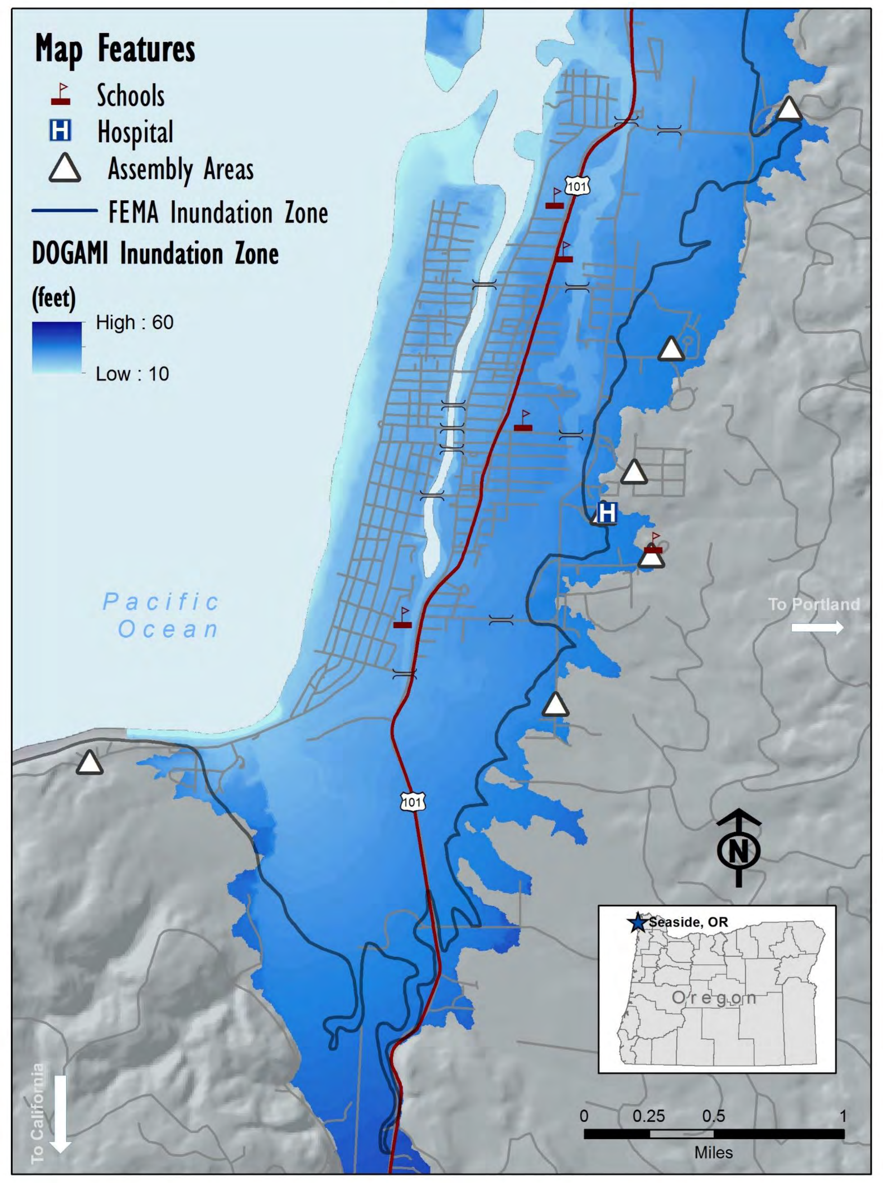
GET OUT: A Service Area Analysis of Tsunami Evacuation Times by Foot in Seaside, Oregon

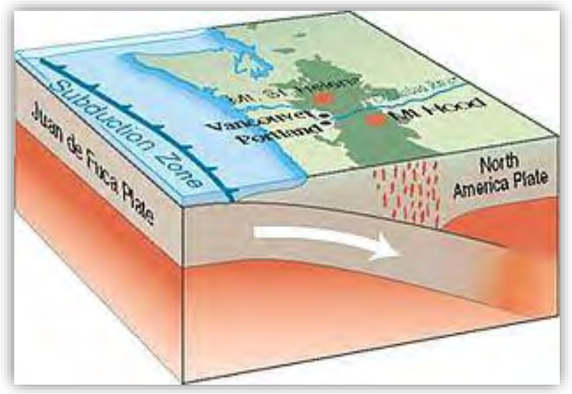
Study Area

Seaside, OR



Seaside is located along the northern part of the Oregon coast in Clatsop County. The majority of the city sits at sea level with the upper most elevation being just over 17 feet. According to the 2010 census, Seaside has a population of 6453 permanent residents (Priest, *et al*, 2015). During the summer months it is a favorite coastal retreat and has the hotel and vacation rental capacity to accommodate approximately 14,400 visitors (rental data). During the height of the tourist season Seaside can have a maximum of 21,000 people on any given day. In the event that a Cascadia Subduction Event occurred on a busy summer day when populations are at their highest, thousands of people will need to evacuate the hazard area in a very short amount of time.

Geologic Background



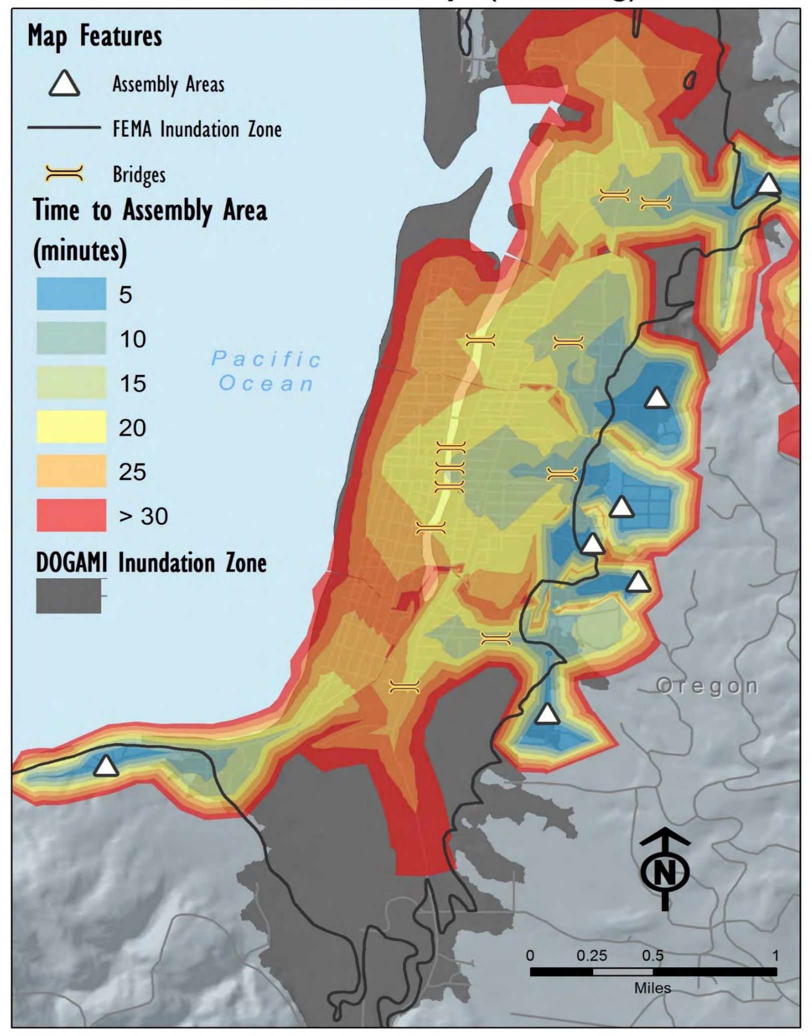
Source: USGS

Off the coast of Oregon and Washington two tectonic plates are converging at a rate of about 40mm/year. The Juan de Fuca plate is sliding under North American Plate in a process called subduction. The fault at which these two plates meet is called the Cascadia subduction Zone. When plates subduct, billions of tons of rock is forced down into the mantle. In the case of the Cascadia and other subduction zones the plates can become locked, resulting in stored potential seismic energy. The built up stress from the Cascadia locked subduction zone is the root cause of major earthquakes that occur in the PNW every 300 to 600 years (Bishop).

Introduction

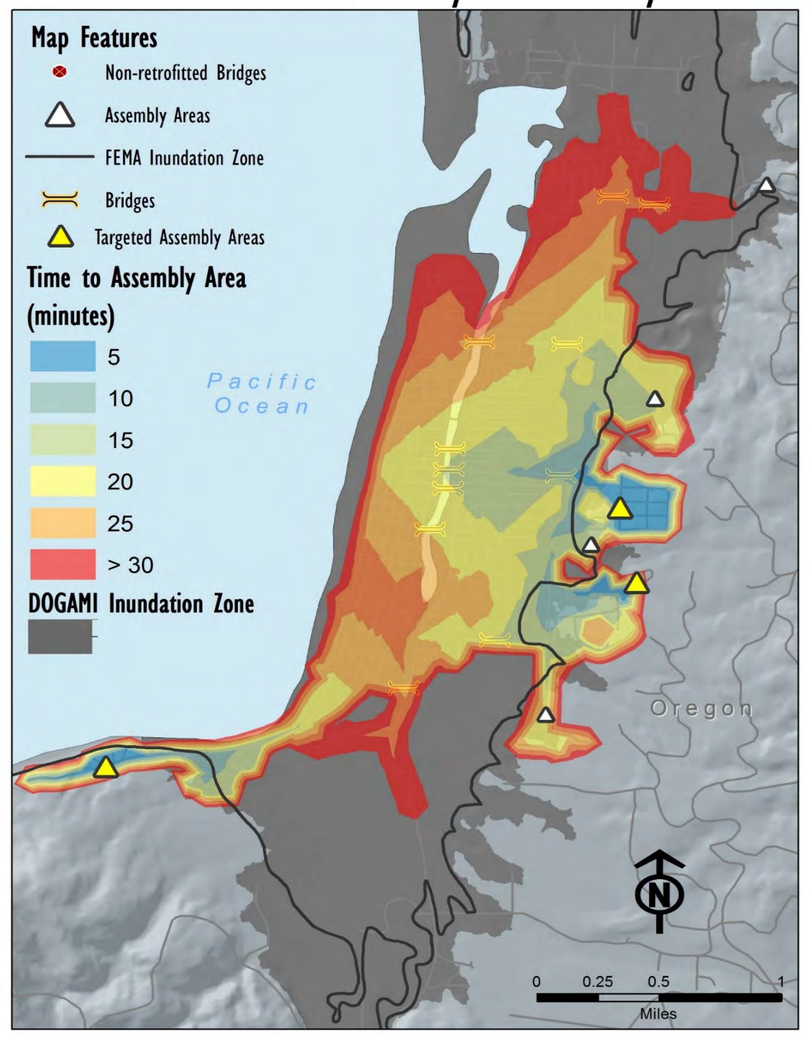
Along with earthquakes being destructive on their own, coastal cities also have the additional worry of the inevitable tsunamis that follow. In the event of a Cascadia earthquake, the city of Seaside could be catastrophically devastated due to the earthquake and subsequent tsunami. The damage could be amplified because of where Seaside sits along the coast, its elevation, and the two coastally impacted streams that run through the town center. After a major Earthquake, it is estimated that a person in the affected area would have between 10 and 15 minutes to get higher ground. Because of potential earthquake damage to local infrastructure and bridges, roadways may be inaccessible and evacuation by foot is recommended. Within this project, we explored a service area analysis using the network analyst toolset from ArcMap to create different scenarios using various impedances to get a better understanding of what areas of Seaside are the most vulnerable, at most at risk when people will be needing to evacuate as quick as possible by foot (Priest, *et al*, 2015).

Time to Safety (Walking)



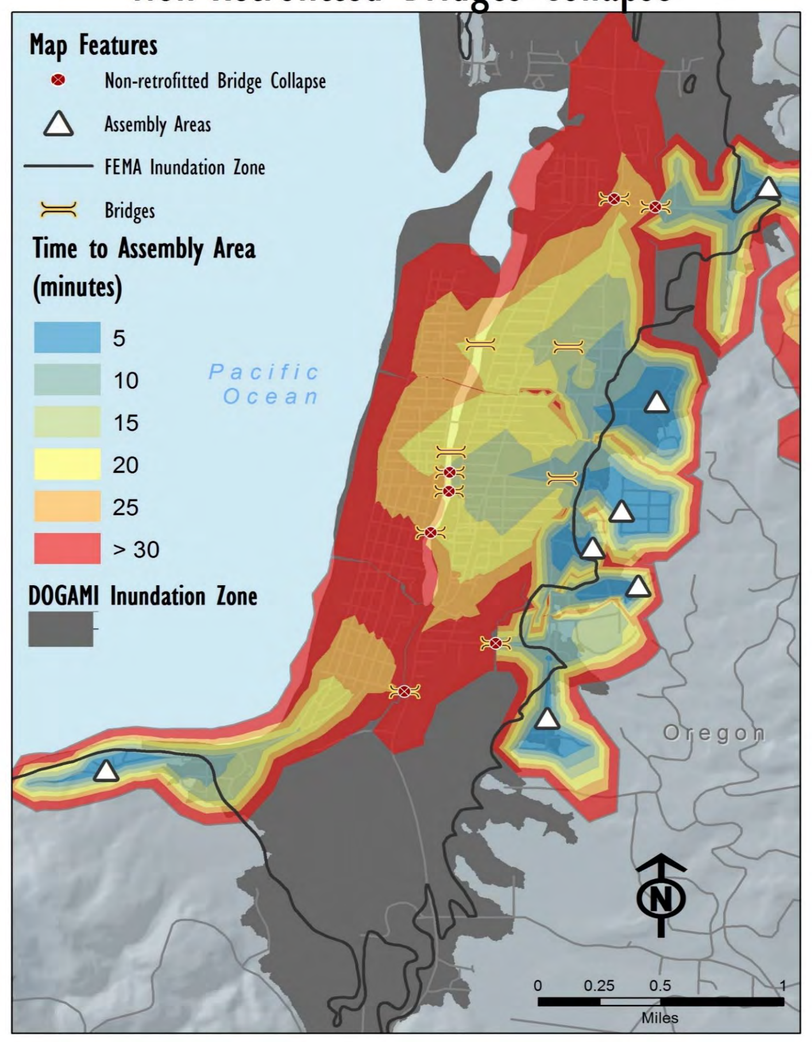
This map is a general map of evacuation times with the Assembly Areas set as the service area. It was created with no barriers or restrictions.

Outside Zone Assembly Area Analysis



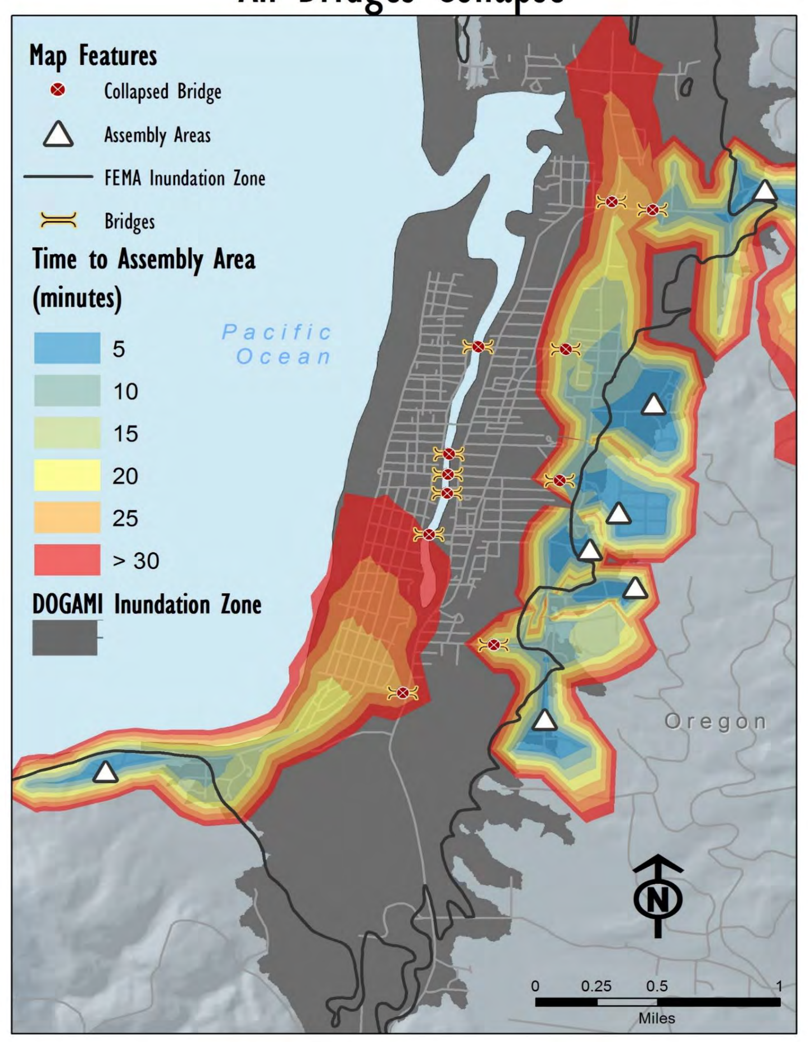
This map shows the evacuation times with only 3 of the original 7 assembly areas unaffected. The remaining 4 assembly areas were restricted.

Non-Retrofitted Bridges Collapse



This map shows the evacuation times in the event of the bridges that are not retro-fitted collapsing during the earthquake.

All Bridges Collapse



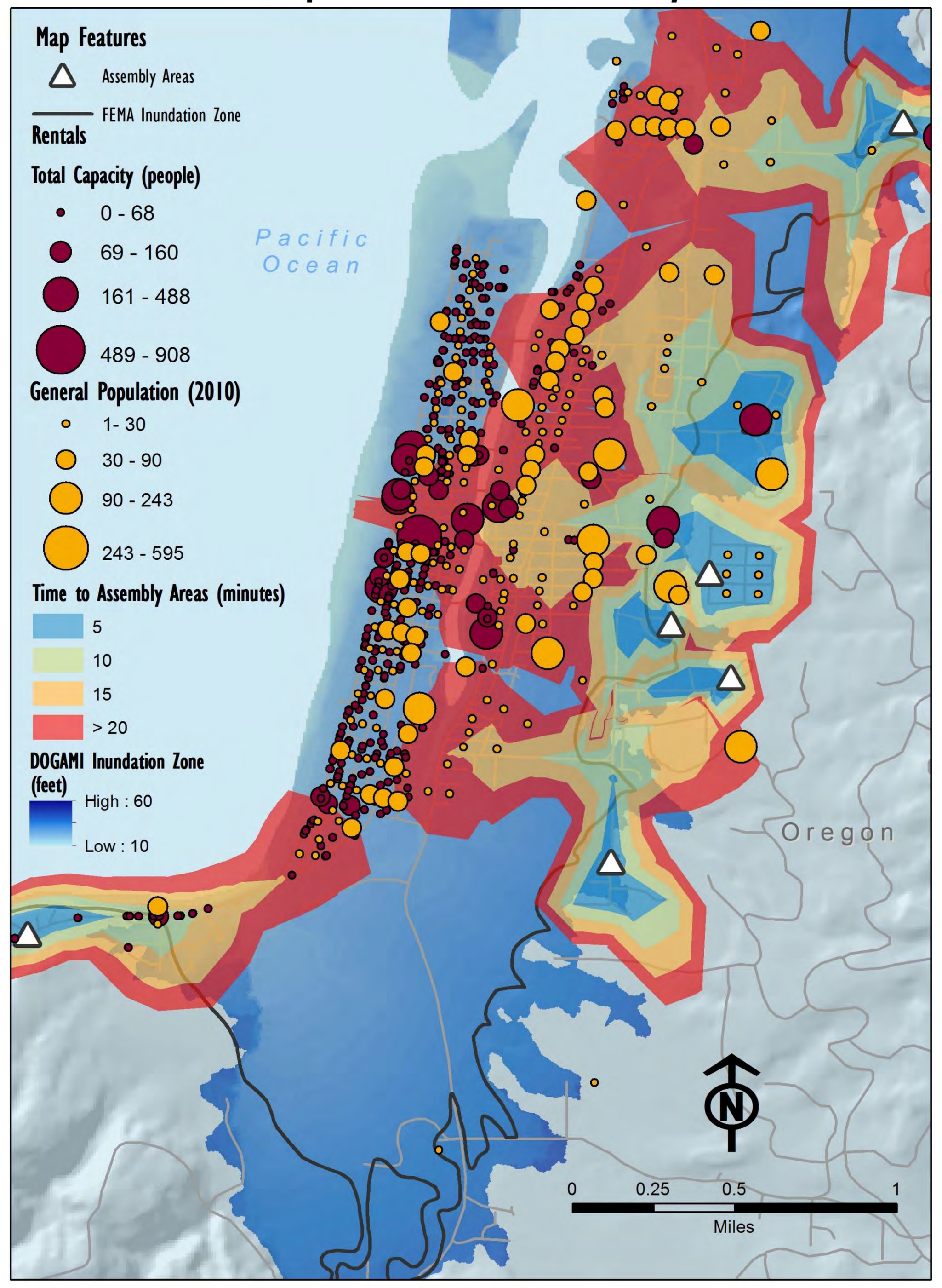
This map shows the evacuation times in the event that all of the bridges did not withstand the earthquake.

Methods

Using a service area analysis within the network analyst toolset in ArcMap, we ran different impedances to determine what areas of Seaside are most vulnerable pertaining to evacuation. For this project we decided to use the DOGAMI Inundation Zone over the FEMA line because this data was more recent. To calculate average walking times we calculated the average walking time by dividing the distance on the streets data by an average time of 1.43 m/s based on that of an unimpaired adult. (Priest, *et al*, 2016). Within the analysis settings in network analyst we set a specific day of July 4th, 2016 at 2 pm since generally this is a busy day for most coastal cities in Oregon. Each analysis was ran with five minute break values and different impedances to capture the reality of evacuation times versus the ability to actually get to somewhere safe out of the inundation zone. We used datasets from TIGER census data, DOGAMI, Oregon Spatial Library, ESRI, and PSU.

Conclusions

Population Vulnerability



Based on the results from our analysis it is clear that there are many areas within Seaside that are vulnerable to loss of life. From the maps you can see that realistically speaking, many people will not be able to make it to the assembly areas within the time from the earthquake ending and tsunami reaching shore. There has been recent research into the establishment of vertical evacuation structures that would help vulnerable populations that are near the coast but currently, this is only in the beginning planning stages (OSU).

References

Bishop, Ellen Morris. *Field Guide to Pacific Northwest Geology.* Publisher unspecified. Published Dec 31, 2011.

Priest, George R., Stimley, Laura L., Madin, Ian P., Watzig, Rudie J., *Local Tsunami Evaluation Analysis of Seaside and Gearhart, Clatsop County, Oregon.* DOGAMI, 2015.

Priest, George R., Stimley, Laura L., Wood, Nathan, J., Madin, Ian P., Watzig, Rudie J., *Beat-the-wave evacuation mapping for tsunami hazards in Seaside, Oregon, USA.* Natural Hazards, v.80, p. 1031-1056., 2016.

Stauth, David., *Oregon may build nation's first tsunami evacutation structure.* Oregon State University, 2010.

National Bridge Inventory http://www.city-data.com/bridges/bridges-Seaside-Oregon.html

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GIS2 Final Project Poster

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