Susceptible Landslide Environments Along the Gig Harbor Shoreline

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After a two week field study in England on the coastal geology, various areas were identified as landslide regions thus changing the landscape and creating hazards for individuals in towns along the coast. Due to the limited accessibility of data in the UK, the project extent has changed from the coast of England to regions within the Puget Sound. These areas are important to stabilize for both human and environmental protection. The exposure from landslides can be detrimental to those who live in the local area and beneficial for scientists interested in this landscape. By exploring the prior landslide locations, soil taxonomy, elevation and impervious surface predictions can be made for future risks of landslides along the coast around the Puget Sound by mapping regions that are geologically susceptible. This landslide hazard mapping will provide visualization along the Key Peninsula and Gig Harbor area, showing the significance between areas that have previously been impacted by landslides given the geology and prior stability of coastal slopes. The data that is presented in the analysis of susceptible landslide regions is slope stability, soils, impervious surfaces, elevation, and shoreline environment. By classifying secondary data, then overlaying the data and using raster calculator, the final product will illustrate the cartographic display of these susceptible regions in relation to the shoreline environment. In discussing the mapped results, the significance of hazard mapping will be analyzed and acknowledgement of any limitations within the process, such as other potential factors and local knowledge, will be considered.

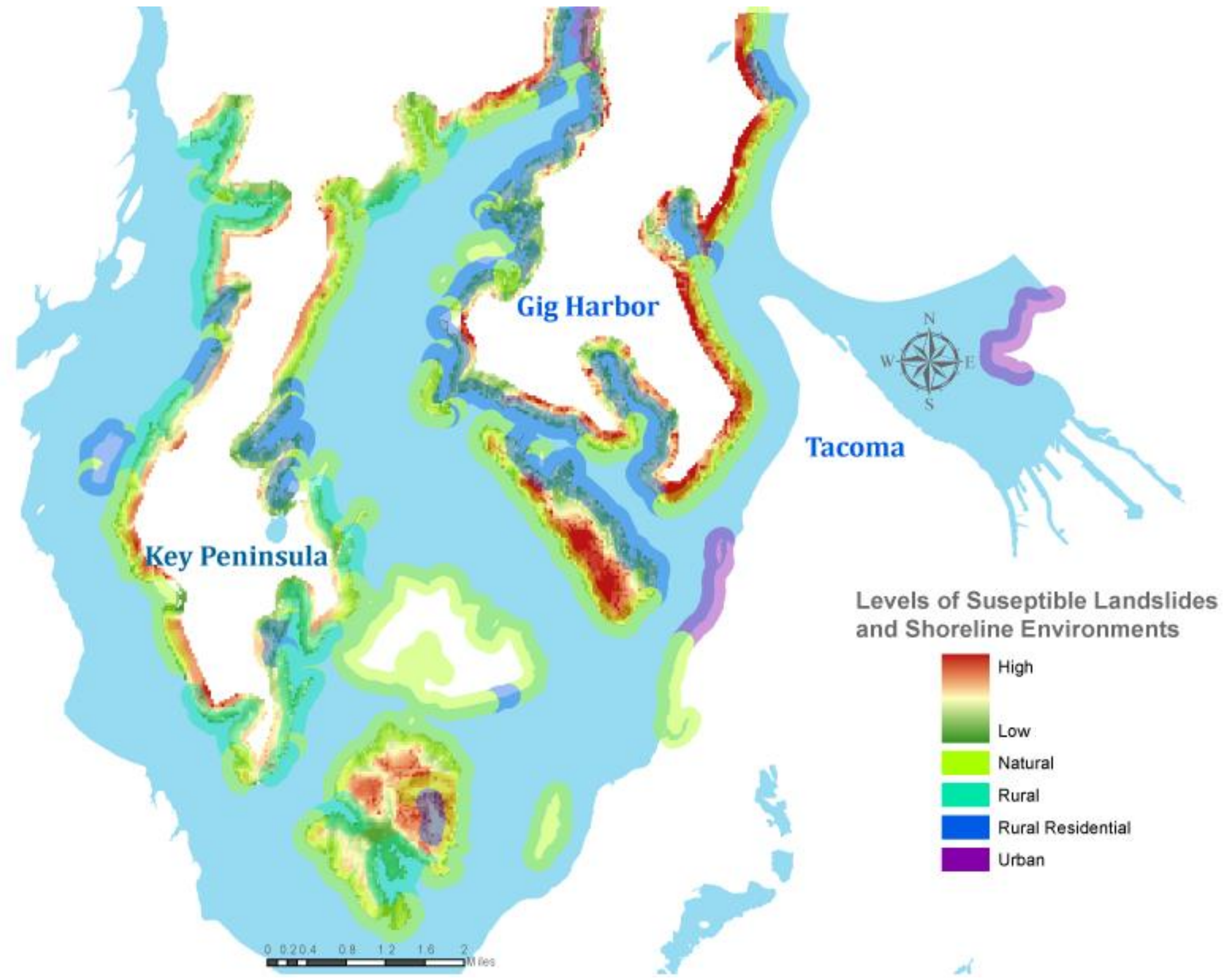
Data Collected:

- Soils
- Slope Stability
- Impervious Surface
- Elevation
- Shoreline Environments
- Pierce County Basemap

Methods:

ArcMap
- Basemap created for Gig Harbor-Key Peninsula from Pierce County map by selecting by location and exporting
- Vector data clip to basemap
- Raster data mask to basemap
- Create .25 mile Buffer on Shoreline Environment
- Vector data classification
- Fields Added
- Vector feature to raster
- Raster calculator ([elevation*.30]+[soil*.25]+[slope_stability*.25]+[imp_surface*.20])
- Activate layer for Shoreline Environment and New Calculation Layer
- Layout tools and Symbology
- Export as .AI

Adobe Illustrator
- Layout and Editing



Figures 1: Overall Gig Harbor and Key Peninsula region comparing shoreline environment and four factors of susceptibility

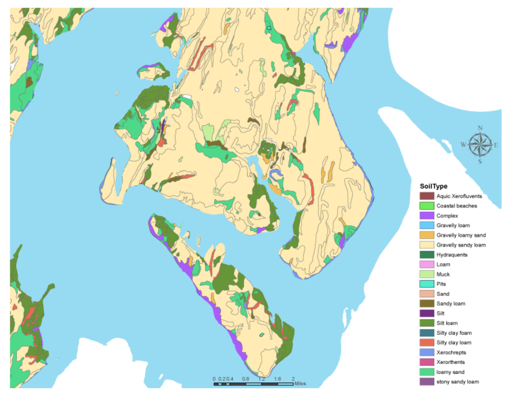


Figure 2: Prior to conversion of feature to raster, the classes of slope stability on the shorelines

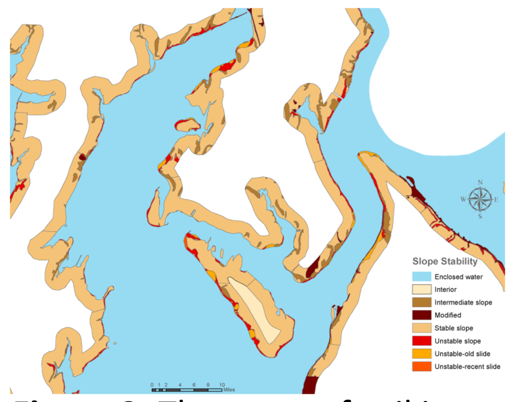


Figure 3: The types of soil in the Gig Harbor area that show types of permeability before conversion to raster

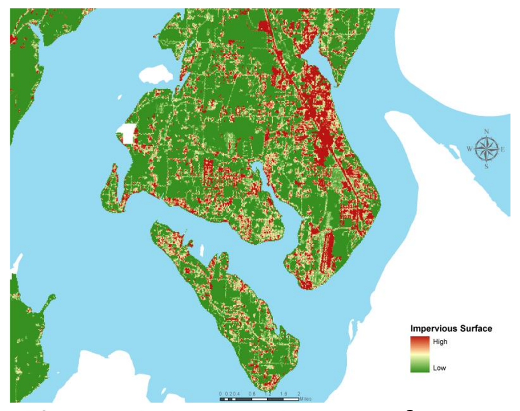


Figure 4: Impervious surface in Gig Harbor, red levels showing the areas of larger impact

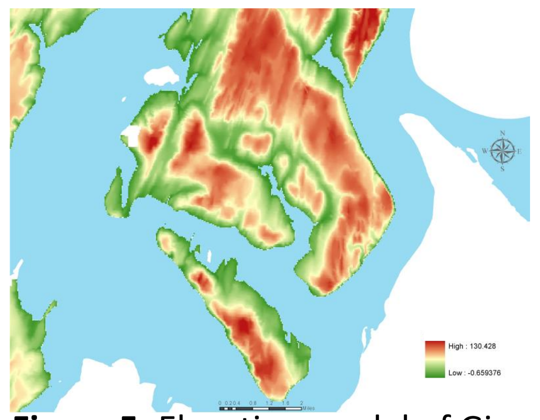


Figure 5: Elevation model of Gig Harbor showing the highest elevation (in feet)

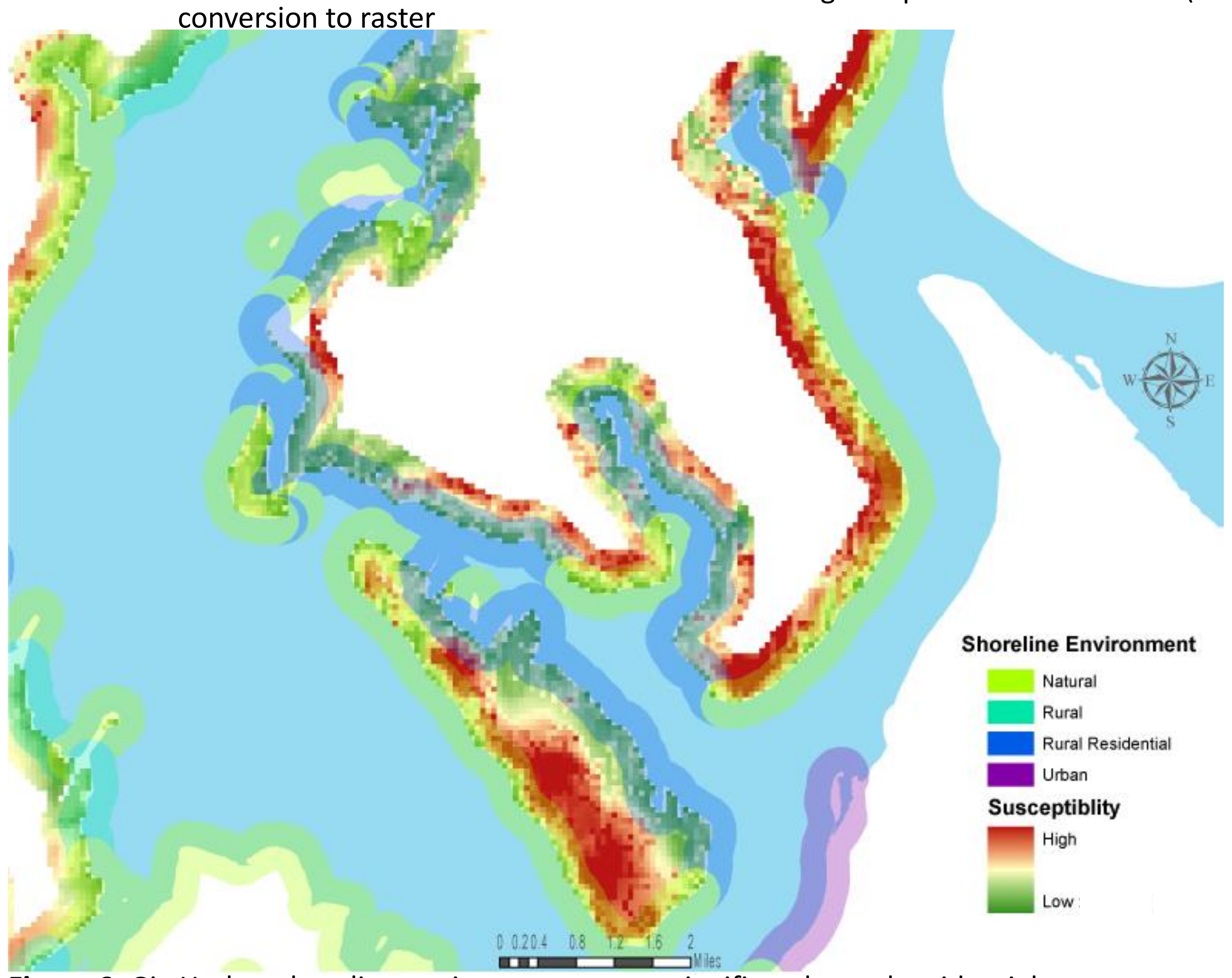


Figure 6: Gig Harbor shoreline environments, most significantly rural residential and natural in the red, more susceptible areas

Discussion

The outcomes of the maps created with the use of GIS show that the variables present along the shoreline of the mapped region that are most susceptible, classified on the scale of 1-5, were less permeable soils, unstable slopes, at high levels of elevation and impervious surface. The soils that were classified as moderately-high and high in susceptibility were Aquic Xerofluvents, Complex, Muck, Silt, Silty Loam, Silty Clay Loam, Xerocherpts and Xerothents which all have poor drainage and/or fine particle size allowing less water to flow freely. The slopes that were classified as a high level of susceptibility were marked as unstable, unstable due to an old slide, and unstable due to a new slide (Figure 2). Both of the raster datasets, impervious surface and elevation are represented in red classifying the higher levels of vulnerability (see Figure 4 and 5).

Since this research specifically identifies with the soil and type of environment in the given area, some data is unspecified, such as land cover that can be a viable part of maintaining slopes along coastal regions. Data such as slope stability, which has classifications of old and new landslides, unstable, stable, and modified and intermediate slope, is assumed to acknowledge the landscape in determining the classifications (see Figure 2). Also, the shoreline environment shows the areas that are natural which would tend to have more vegetation then that of rural, rural residential and urban areas. Contrary to the idea that the presence of human activity has a large role in affecting the shoreline erosion process and slope failure, the shoreline environments show that the rural residential and natural areas along the shore both have areas of landslides. Since the extent is looking at Gig Harbor specifically, the amount of true urban area is very limited and is more present within the interior of the natural landscape. The different surficial soil drainage does not necessarily apply the other soil types that are beneath the uppermost layers which could have more or less permeability.

Future Studies

Given this process was completed in a less urban area; it would be interesting to apply similar and additional constraints to an area such as Tacoma. Other factors that would be ideal to factor into the raster equation would be soil depth, land cover, seasonal precipitation and potentially parcel data. Each of these applied to the equation would change the formula and percentages that could show a different variance along the shoreline environments. This study could look further at potential outcrops that expose both bedrock and soil to identify the corresponding relationships that may exist.

Acknowledgments

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