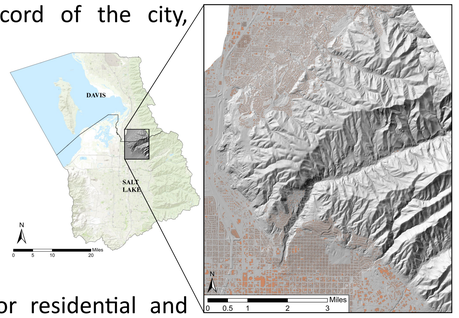
Earthquake Hazard Assessment:

The Wasatch Fault, Salt Lake City, UT

INTRODUCTION

The Wasatch Fault is an active normal fault, in which the blocks of rock on either side of the fault plane move vertically relative to each other. The fault zone runs along the base of the Wasatch Mountain Front and through Salt Lake City. USGS research approximated the recurrence interval of an earthquake event at every 350 years. The last known earthquake occurred approximately 400 to 600 years ago. Geologic forecasts currently predict an earthquake of magnitude up to 7.5 within a 25% certainty window.

Because of the seismic stability of the area in the modern historic record of the city, building codes and construction standards do not fully account for the possibility of a major earthquake event. The natural geologic formations along the Wasatch front make the area attractive for residential and commercial developments. However, the geology of the mountain side places those developments at a greater risk than those on the valley floor. The purpose of this project is to assess potential risk zones to buildings due to earthquake-induced slope failure along the Wasatch Front. The sample location used in this study is a prominent residential/mixed use location that spans an area across the Salt Lake and Davis County borders. (Map 1)



Map 1

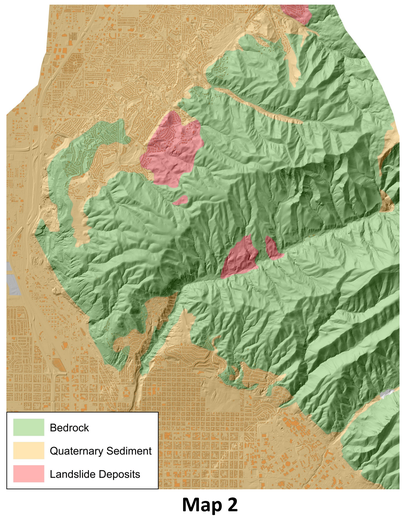
METHODS

Determining the risk of slope failure in this project is based on three factors; geologic units, slope angle, and proximity to a fault segment.

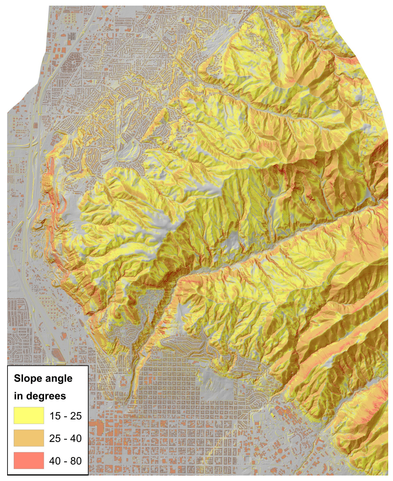
1) Geologic unites were classified into three categories: **Solid bedrock**, mostly in areas that remained above the shoreline of Lake Bonneville that existed in the area until approximately 15,000 years ago. This classification is considered the least hazardous.

Quaternary sediments, the majority of which are poorly lithified lacustrine sediment from Lake Bonneville alluvial fans and terraces, as well as talus and colluvium piles. This classification is considered mid-hazardous.

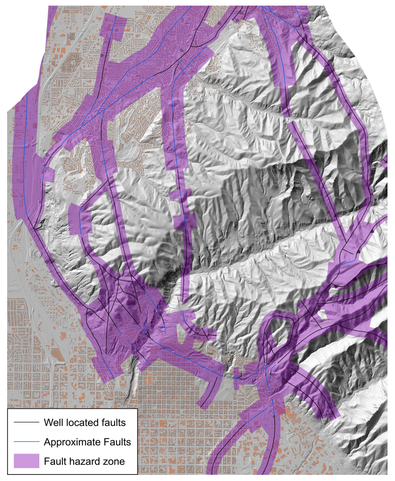
Landslide deposits are quaternary units that are indicative of past landslide events in the area. Due to the explicit evidence of the occurrence of a large scale mass movement event in the past, this unit is classified as the most hazardous. (Map 2)



Map 2



Map 3



Map 4

2) The slope angles were calculated from the 0.5m resolution DEM. The results were broken down into three ranges that reflect proximity to angle of repose for loose sediment (25 – 40 degrees). Higher angles represent more hazardous slopes. (Map 3)

3) Faults in the area were evaluated based on certainty of location and displacement. Faults were given a distance buffer to indicate the hazard zone in proximity to the fault with a 250ft area on the upthrown side of the fault and 500ft on the downthrown side. Well-located faults with no clear sense of movement were given a buffer of 500ft on either side. Approximated faults were given a 1000ft buffer on either side. (Map 4)

ANALYSIS

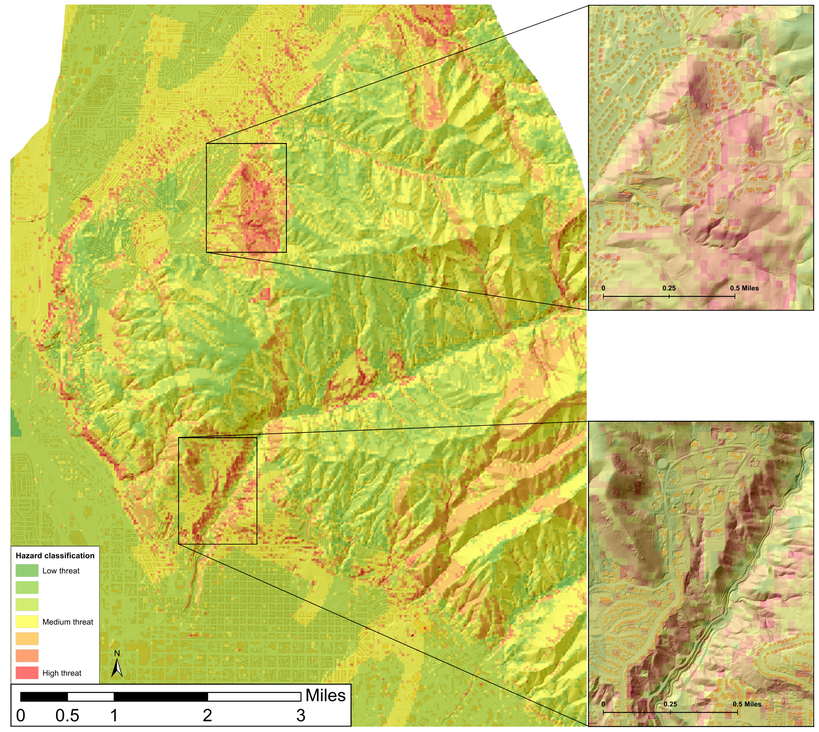
In order to evaluate the threat based on the three criteria, the geologic units, slope and fault layers were reclassified with numeric values based on hazard level as follows:

Geologic units: Bedrock (1) - Quaternary (2) - Landslide (3)

Slopes: Low slope: (1) - Medium slope (2) - High Slope (3)

Faults: Within buffer zone: (1) - Outside buffer zone (0)

The raster calculator tool was used to sum the values and produce a new raster layer with highest values representing the most hazardous zones. Zonal statistics were then used to count buildings in each hazard zone.(Map 5)



Map 5

CONCLUSION

Close ups of various zones clearly indicate immediate danger to certain buildings in the event of an earthquake. The following table summarizes the output of zonal statistics and shows the percentage of structures within zones of low, medium and high threat in the proximity of the Wasatch Fault:

Hazard Level	Building Units
Low	35%
Medium	63%
High	2%

The table represents general hazard levels to specific structures, but further research needs to take place to better estimate the potential loss to life and property in the event of a major earthquake. Understanding the full scope of the hazards is necessary to mitigate damage and prevent unnecessary loss of life.

References:

- Nelson, Stephen A. "*Slope Stability, Triggering Events, Mass Movement Hazards*." Tulane University. 2013.
- Castleton, Jessica J., Elliott, Ashley H., McDonald, Greg N. "*Geologic Hazards of the Magna Quadrangle, Salt Lake County, Utah*." Utah Geological Survey. 2011.
- "*The Wasatch Fault*." Utah Geological Survey Public Information Series 40, 1996.
- "*Utah Natural Hazards Handbook*." Utah Division of Homeland Security. 2008.
- Bauman, Richard D. "*Foundation Characteristics of Sediments: Salt Lake Metropolitan Area*." University of Utah. 1965.

Data Sources:

- DEM: OpenTopography - State of Utah Acquired LiDAR Data - Wasatch Front.
- Geologic map: Utah Geologic Survey - GIS Data.
- Building footprints - Salt Lake County: Utah Automated Geographic Reference Center.
- Building footprints - Davis County: Tufts GIS database - Jeff Baker, Davis County.

Map Projection: NAD_1983_UTM_Zone_12N

Map produced on: May 4, 2017

EOS 104 - Geologic Applications of GIS

Fatima Niazy

Tufts Earth and Ocean Sciences