Liquefaction Hazard Mapping
In Memphis Tennessee

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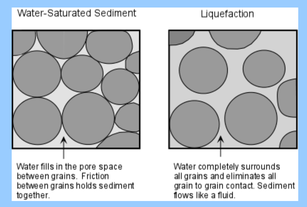
Introduction

Soil liquefaction is a geotechnical phenomenon in which earthquake motion causes the soil to behave as a liquid. When shaken, sandy soil located below the groundwater table will expand and become fluid. The soil will quickly lose its capacity to hold engineered structures such as buildings, bridges, and roadways. Slope failure, the primary cause of devastating landslides, is also triggered by soil liquefaction. The dangerous and costly implications of liquefaction have propelled engineers to create hazard maps of liquefaction potential.

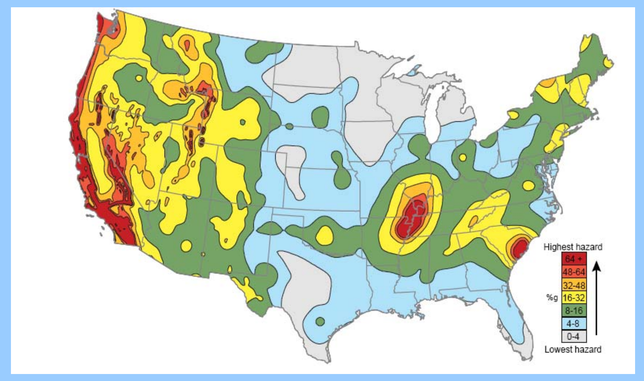


Hazard maps are useful for:

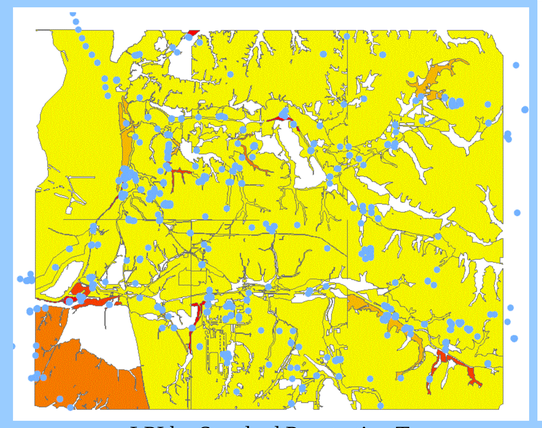
- urban planning and development
- disaster response preparation
- civil engineering projects

The New Madrid Seismic Zone is the most seismically active region in the central and eastern United States spanning five states including the study region within Tennessee. The city of Memphis is located in the western portion of the state and has a high population density lying along an active fault zone.

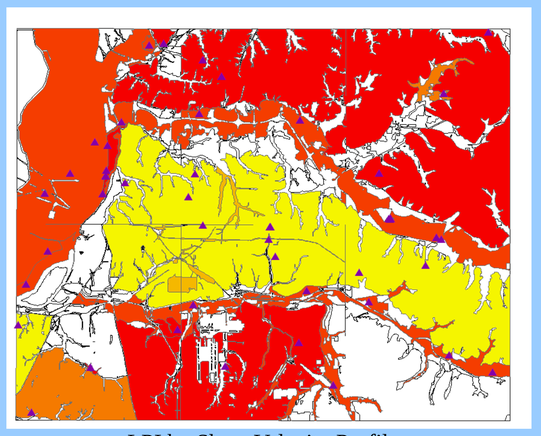
The city's risk of moderate earthquakes and location along the Mississippi River make it highly susceptible to liquefaction. Historical accounts of liquefied soils in the area are numerous and attest to the current potential.



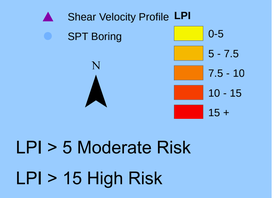
The New Madrid Seismic Zone, located in the central United States, is an active seismic region.



LPI by Standard Penetration Tests

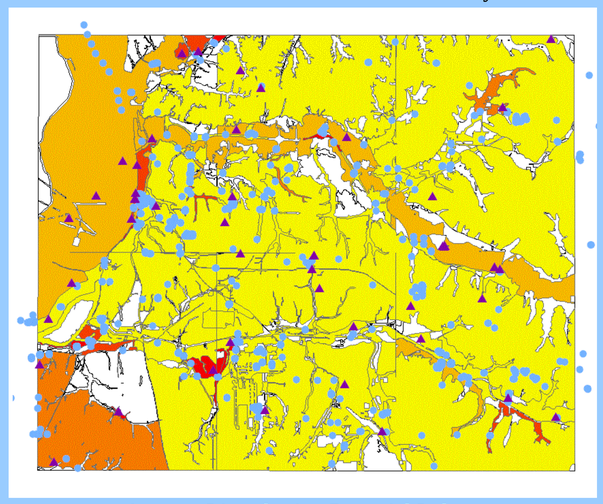


LPI by Shear Velocity Profile



LPI > 5 Moderate Risk

LPI > 15 High Risk



Average Liquefaction Potential Index

Objectives

- Create a liquefaction hazard map with previously unused shear velocity data
- Compare the results of the addition of shear velocity profiles to hazard maps

Will the data produce more accurate mapping useful for planning and development?

Methods

In this project, hazard maps were created using two types of engineering soil tests, the standard penetration test and shear velocity profiles. A Liquefaction Potential Index (LPI) was calculated for each of the 908 test sites. LPI was interpolated within a geological unit of similar soil type using GIS.

Results

The addition of the shear velocity profiles increased the data count in sixteen geological units. The average LPI in three of the units increased significantly enough to raise the classification from low hazard to moderate hazard. The major geological units to change are the Nonconnah Creek and Wolf riverbeds. The loose sandy soil deposits along riverbeds are prime areas for liquefaction to occur.

Maps incorporating more data will usually strengthen the end result, as was the case in this project. While the shear velocity profiles did not bring more definition to downtown Memphis, a growing urban area, liquefaction potential was validated in other Shelby County locations. As data is continually collected in the county for similar projects, the hazard maps can be easily updated using GIS.

The hazard maps produced in this project validate previous maps and provide a better resource for urban planning and disaster mitigation.

Sources

Rix and Romero. "Liquefaction Potential Mapping In Memphis and Shelby County"
United States Geological Survey
Youd et al. "Liquefaction Resistance of Soils"

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