Soil Amplification/Liquefaction Potential Map

Cooperatively Produced By:

Association of Central United States Earthquake Consortium (CUSEC) State Geologists

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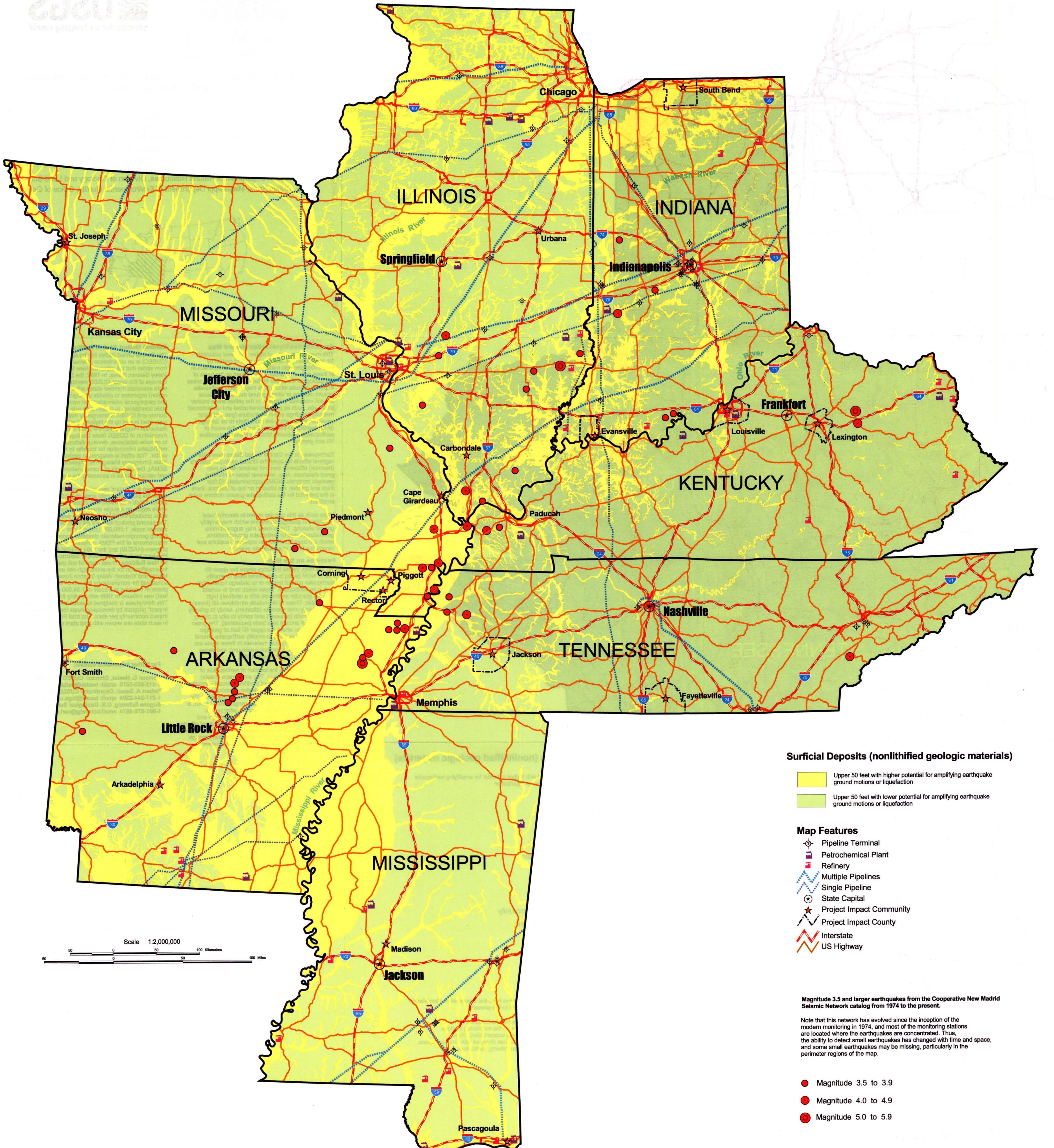

Amplification/liquefaction Hazard Map

This map shows areas of higher and lower potential for amplification of earthquake ground motion by nonlithified geologic materials (soils) or for liquefaction of these soils. The areas were defined on the basis of the geology of the upper 50 feet. On this map, the areas in yellow indicate where soils may amplify earthquake ground motions or where ground motion may cause the soil materials to liquefy. In the yellow areas weaker structures, such as poorly constructed and unreinforced masonry buildings and infrastructure (gas and water pipelines, roads, etc.), are more likely to be damaged (in comparison to the green areas) in the event of earthquakes producing Modified Mercalli Intensities VII and greater.

Earthquakes in the Central United States have wide regional effects because the lithified geologic materials (bedrock) efficiently transmit seismic waves over great distances. Also, wherever loose nonlithified geologic materials (NGM), approximately 10 feet thick and greater, are situated on top of bedrock, there is the potential for the earthquake ground motions to be amplified.

Maps such as this one are meant to describe local variations in geologic conditions which may amplify ground shaking. These maps may augment more generalized maps of earthquake ground motions, which are based primarily on expected locations and recurrence times of earthquake events.

Features on the Map

On this map, yellow indicates where the upper 50 feet of NGM (soils) is considered likely to amplify earthquake ground motion or to undergo liquefaction during an earthquake. These areas tend to consist of loose granular sediments with a relatively high water table. These NGM include windblown silt (loess), silty to sandy river deposits (alluvium), sandy to gravelly glacial deposits (outwash) and sandy to silty to clayey sediments of ancient lake beds (lacustrine). The green indicates areas where the upper 50 feet of geologic materials are less likely to amplify earthquake ground motion or liquefy. Typical materials in these areas are bedrock, weathered bedrock (residuum), and dense glacial deposits (ice-compacted tills).

This map also shows the location of earthquakes of magnitude 3.5 and higher. Two small maps (insets) show the general outlines of Modified Mercalli Intensities for the October 31, 1895 Charleston, Missouri and the November 9, 1968 Broughton, Illinois earthquakes. The Modified Mercalli Intensity Scale, ranging from I to XII, is based on observable effects such as what people experienced, and what level of property damage and ground deformations occurred. Brief descriptions of effects for various levels of intensity are shown in the table in the lower right-hand corner of this map. In general, damage to structures occurs with earthquakes that produce intensities of VII or greater.

Central United States Earthquake Consortium

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This map is a second version of our first product completed under the program. A map scale of 1:2,000,000 (about 1 inch = 32 miles) was chosen to show the whole region on a single sheet and to help plan for larger scale products for FEMA and SEMA exercises. The second product will be a set of maps published at a larger scale, 1:250,000 (about 1 inch = 4 miles) having geologic materials classified according to requirements of the FEMA computer loss-estimation program (HAZUS) and the 1994 NEHRP Recommended Provision for the Development of Seismic Regulations for New Buildings. These maps of soil classification for amplification for the entire high-risk area of New Madrid and Wabash Valley Seismic Zones are scheduled for completion by the end of 1999. A third phase of mapping at a scale of 1:24,000 (1 inch = 2,000 feet) was initiated in 1999 with funding through NEHRP. This third phase is designed to assist in FEMA's "Project Impact" program by developing maps for one Project Impact community per state. The total Project Impact cities in each state are shown with gold stars on the map.

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Surficial Deposits (nonlithified geologic materials)

- (yellow) Upper 50 feet with higher potential for amplifying earthquake ground motions or liquefaction
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Map Features

- Pipeline Terminal
- Petrochemical Plant
- Refinery
- Multiple Pipelines
- Single Pipeline
- State Capital
- Project Impact Community
- Project Impact County
- Interstate
- US Highway

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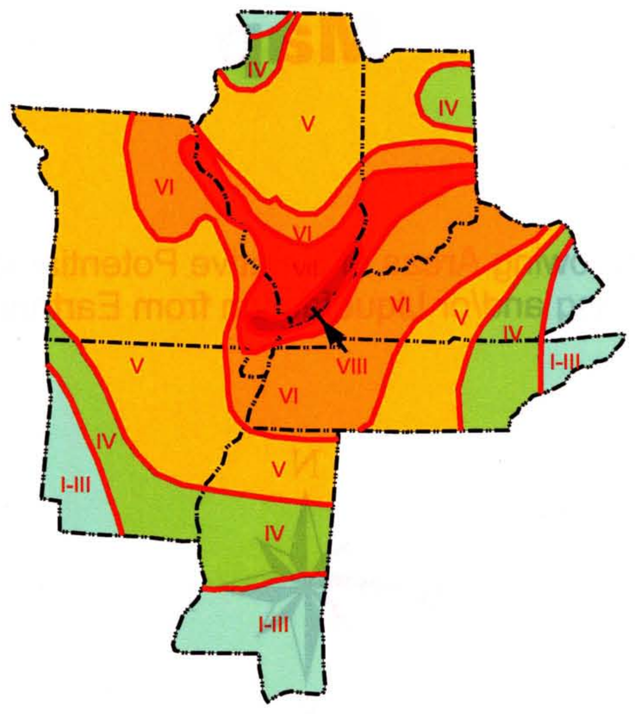
Magnitude 3.5 and larger earthquakes from the Cooperative New Madrid Seismic Network catalog from 1974 to the present.

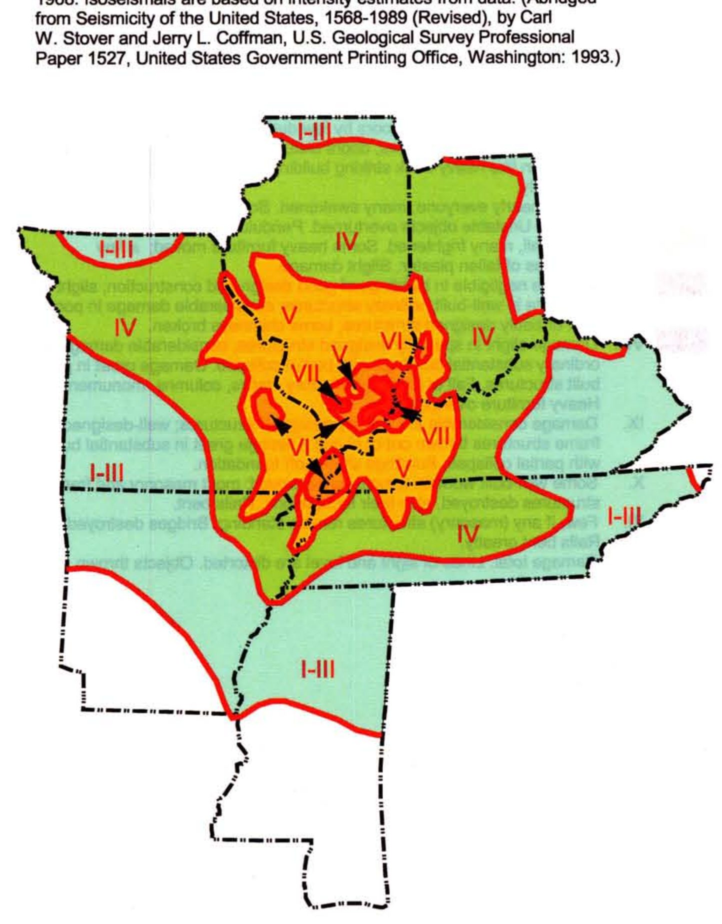
Note that this network has evolved since the inception of the modern monitoring in 1974, and most of the monitoring stations are located where the earthquakes are concentrated. Thus, the ability to detect small earthquakes has changed with time and space, and some small earthquakes may be missing, particularly in the perimeter regions of the map.

- Magnitude 3.5 to 3.9
- Magnitude 4.0 to 4.9
- Magnitude 5.0 to 5.9

Isoseismal map for the Charleston, Missouri earthquake of October 31, 1895. Isoseismals are based on intensity estimates from data (Hopper, M.G., and S.T. Algermissen, 1980, An Evaluation of the Effects of the October 31, 1895, Charleston, Missouri, Earthquake: U.S. Geological Survey, Open-File Report 80-778, 42p.)



Isoseismal map for the Southern Illinois earthquake of November 9, 1968. Isoseismals are based on intensity estimates from data. (Abridged from Seismicity of the United States, 1568-1989 (Revised), by Carl W. Stover and Jerry L. Coffman, U.S. Geological Survey Professional Paper 1527, United States Government Printing Office, Washington: 1993.)



The following gives damage descriptions for the Modified Mercalli Intensity Scale.

Intensity	Description of Effects
I.	Not felt except by a very few under especially favorable conditions.
II.	Felt only by a few persons at rest, especially on upper floors of buildings.
III.	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to passing of a truck. Duration estimated.
IV.	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V.	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI.	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Slight damage.
VII.	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII.	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX.	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings with partial collapse. Buildings shifted off foundation.
X.	Some well-built wooden structures destroyed; most masonry and frame structures destroyed, also their foundations. Rails bent.
XI.	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII.	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Soil Amplification/ Liquefaction Potential Map

Showing Areas of Relative Potential for Shaking and/or Liquefaction from Earthquakes

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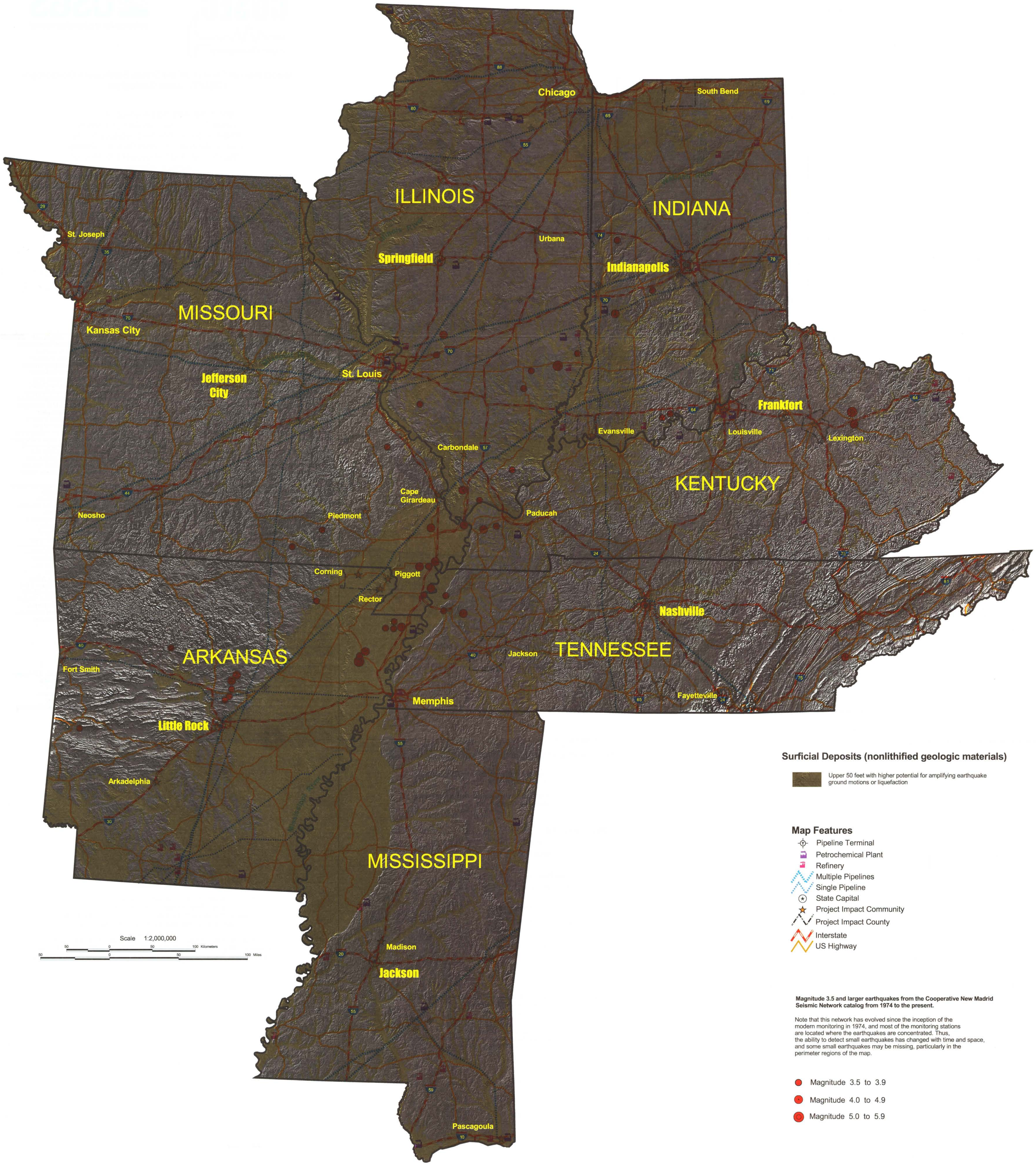
INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1999

Soil Amplification/Liquefaction Potential Map



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USGS science for a changing world

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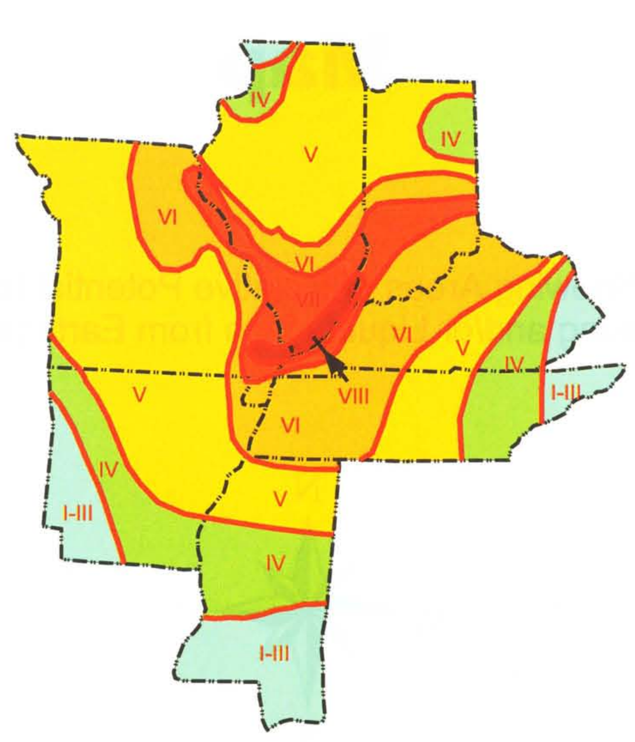

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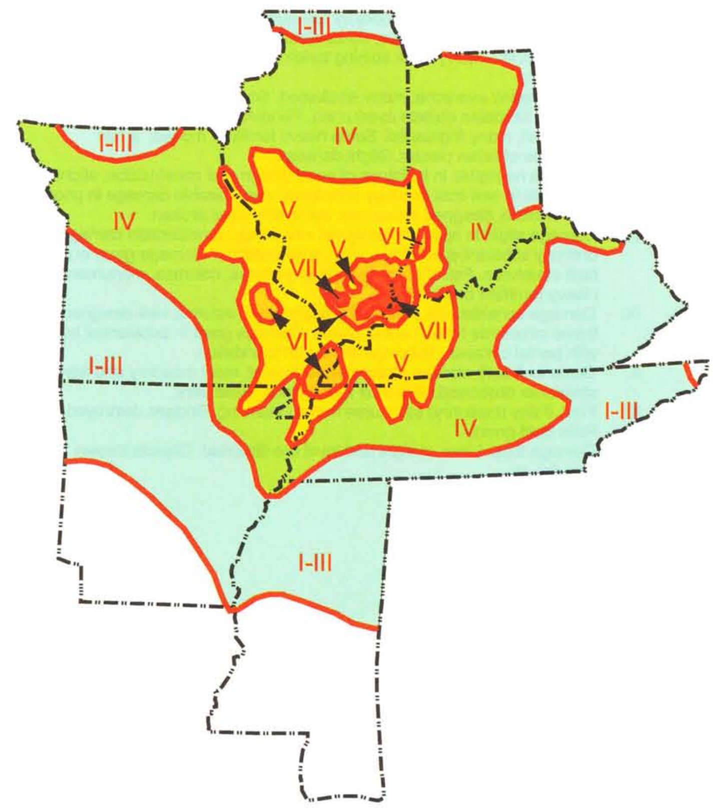

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