**Project Title:** Predicting Erosion Impact on Safety of Highway and Railroad Bridge Substructures

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**Project Summary:** Aging bridges located on or crossing highway, railway, and transit routes constitute a major component of our transportation system vital to its functionality, sustainability, and its role in economic development. The performance and viability of these critical components depend on the proper functioning of the primary engineering components, superstructure and substructure, and the underlying soils and geological materials on which the substructures are founded. Geotechnical parameters are ordinarily part of the foundation design but the ability of the geological materials to resist erosion through time is typically not considered. The proposed study will evaluate the differing rates of erosion of these foundation materials by measuring total erosion from bridge completion to the present. These rates of erosion will then be related to the geological unit on which the bridge is founded. The physical characteristics and related the erosion potential of a particular geological unit should allow the erosion vulnerability characteristic to be interpolated to other regions with a similar exposure of critical infrastructure.

Erosion is accentuated at stream crossings where bridges confine the surface stream flow and forms an erosive jet downstream of the bridge. This erosion, once initiated, migrates up stream and often beneath the bridge that initiated the erosion. This migration of erosion may remove significant amounts of supporting materials from around the bridge piers and potentially compromise the long-term stability of the structure itself. As part of this proposed work, bridges with significant evidence of erosion will be modeled by integrating the geological conditions at the bridge with the structure itself. The benefit of this methodology is to aid in formulating a strategy for protection from this natural hazard and formulate best engineering practices to mitigate the erosion vulnerability at future bridge locations and ensure safety and long term performance of the multimodal transportation system.

The study will focus on a region of approximately 250 square miles centered on Blue Springs, Mississippi, the home of the recently operational Toyota car manufacturing plant. The area has been geologically mapped in 2011 in sufficient detail to allow the geological materials at each bridge site to be assigned to a formation. Toyota relies heavily on rail transport for its finished products and both the vehicular and rail systems for car components. Significant development is expected in this area because of the Toyota plant which will depend on a reliable transportation system. The corridor of the future I-22 will pass through the study area, and results from this work could benefit the bridge designers. Also key to the development plan are state highways MS 2, 6, 9, 15, 30, and 348 as well as a number of county roads with aging bridges.

The engineering aspects of select bridges in the study area will be identified for detailed analysis to determine the effect of erosion depth on design and inspection practices. The study area is exposed to a moderate earthquake hazard due to its proximity to both the New Madrid Fault Zone as well as some closer but smaller fault systems that have generated smaller events in recent years. Computational simulation models incorporating soil-structure interaction will be constructed to establish the effect of erosion on the structural integrity of these bridges.