Project Title: Point Bar Systems Geophysical Characterization at Low Effective Pressure During Seasonal River Stages in the Lower Mississippi River Valley

During high water level stages in the Mississippi River, Louisiana, the protected side of the levee can experience sand boils and seeps created by hazardous groundwater pressure from the river. These conditions present a hazard to the community, public and private infrastructure. In particular, the School of Veterinary Medicine building at Louisiana State University (LSU) continues to experience yearly basement flooding from seepage despite attempts to ameliorate groundwater flow pressure by the installation of 5 pressure-relief wells. The current lack of detailed understanding of the local shallow groundwater flow regime limits the use of more accurate hydrogeological models which could assist groundwater and civil engineers to plan for the maintenance and public buildings, private properties and of critical levees. Swale-filling clays separating sandy ridges deposits are the main discontinuities found in point bar sediment materials making the upper 10 meters highly heterogeneous in soil type and thickness. As a general phenomenon, highly heterogeneous soils can lead to differential rates of compaction within the natural soil or embankment fill and can lead to the creation of zones of high strain or cracking. Under pressure and where the clay blanket is sufficiently thin, the seal between the top stratum and pervious substratum may be compromised. An integrated geophysical approach combining shear wave velocity and electrical resistivity will provide a more accurate description of soil type than the individual properties alone, providing nearly continuous measurements of physical properties that aid in the evaluation of levee safety. Furthermore, by establishing empirical relationships between effective pressure and shear wave velocities from the seismic surveys, zones that are no longer in hydrostatic equilibrium due to hazardous groundwater pressure increase from the river could be predicted. To provide context and generate a reference geological cross-section across the Mississippi flood plain sediments, I acquired and processed three 2D electrical profiles along the east, west and south sides of the LSU Veterinary School building. The preliminary study suggested a southwest dipping wedge-shaped layer of more-resistive material over less-resistive material and a general thinning towards the northeast on the uppermost less resistive layer. Because these first surveys were conducted at a high-river stage, we assume that the whole section is saturated. In this case, the differences in resistivity may be caused by grain composition, e.g., a sandy wedge over more-clay rich material with strong lateral variations. Furthermore, time-lapse seismic results overlapping a section of the east and west ERT lines have shown differences in shear wave RMS velocities during high and low river water levels on the east and west side of the Vet. School. High water levels in the Mississippi River could increase pore pressure in the buried sediments of the floodplain area, and these pore pressure variations can be translated as an effective pressure change that affects the shear wave RMS velocities obtained from the seismic reflection survey. I will collect additional seismic surveys between high and low river water levels to effectively characterize the dependence of the shear wave velocities to the effective pressure of the media. These additional surveys will serve as a reference for repeatability of the results to confirm the effective pressure and shear wave velocity relationships. Also, I will collect the ERT sections during low water level stage for performing a time-lapse analysis with the data acquired during high water level stage and capture subsurface moisture content on the upper 30 meters to identify infiltration pathways.