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Hurricane Katrina: Who's In Charge of the New Orleans Levees?

Statement of

The American Society of Civil Engineers

Before the

Committee on Homeland Security and Governmental Affairs

U.S. Senate

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Madame Chairman and Members of the Committee:

The American Society of Civil Engineers (ASCE) is pleased to offer this statement for the record of the hearing on *Hurricane Katrina: Who's In Charge of the New Orleans Levees?* ASCE commends the Committee for continuing its important work on the disaster that struck New Orleans in August 2005 and its consequences.

Background

The history surrounding Hurricane Katrina and the New Orleans levees is well known to this Committee. We will summarize the main issues briefly.

Hurricane Katrina was a catastrophic storm that made landfall in the Gulf Coast near the Louisiana and Mississippi border on the morning of August 29, 2005, with wind speeds near 150 miles per hour. But the damage in New Orleans due to the high winds and rain paled in comparison to the devastation resulting from the flooding.

The hurricane produced a storm surge that varied considerably depending on location, including the combined effects of orientation, geography, and topography with respect to the forces of the passing storm. Hydraulic modeling of the surge, verified by the most part by field observations of high water marks, show that essentially two significantly different levels of storm surge impacted the levee system.

ASCE's Levee Assessment Team found that, where the storm surge was most severe, causing massive overtopping, the levees experienced a range of damage from complete obliteration to intact with no signs of distress. Much of the difference in the degree of damage can be attributed to the types of levees and the materials used in their construction. The majority of the most heavily damaged or destroyed earthen levees that we inspected were constructed of sand or "shell fill," which was easily eroded.

At some of these locations the earthen embankments were simply gone. Those with embedded sheetpiles fared only marginally better and were often breached as well.

Further inland, in the western portion of the Mississippi River Gulf Outlet (MRGO) and along the Inner Harbor Navigation Canal, the degree of overtopping was less severe but again resulted in a number of breaches.

Many of these breaches occurred through I-wall structures that were severely scoured on the landside as a result of overtopping. These scour trenches undermined the support of the levee floodwalls and reduced the ability of the walls to withstand the forces of the water on their outer surfaces. Localized concentrations of overtopping water flow or possible localized weaker soils may have been responsible for why certain portions of the system were breached while others remained intact.

Another commonly observed problem was the frequent presence of “transitions” between different sections of the levees. There were a number of different types of these transitions that appeared to have caused problems, including inconsistent crest heights, change in levee type (I-wall vs. T-wall), change in material (concrete, steel sheetpile, earth), and transitions where certain rights-of-way resulted in penetrations of the flood control system.

Defense Secretary Donald H. Rumsfeld announced in October the creation of an independent panel of national experts under the direction of the National Academies of Science to evaluate the performance of hurricane protection systems in New Orleans and the surrounding areas.

Under the National Academies, the National Research Council will assemble a multi-disciplinary, independent panel of acknowledged national and international experts from the public and private sectors and academia. This panel will perform a high-level review and issue a final set of findings based primarily on the data gathered by another organization, the Interagency Performance Evaluation Task Force (IPET).

The IPET will include a broad interagency participation, private sector and academic expertise. The IPET is to obtain the facts by collecting, analyzing, testing, and modeling data and information on the performance of the New Orleans hurricane protection system during Hurricane Katrina.

Secretary Rumsfeld also authorized ASCE to convene an external review panel to conduct continuing expert peer review of the work performed by the IPET. The ASCE external review panel will also report findings directly to the National Research Council.

Who’s in Charge of the New Orleans Levees?

Although the original levee system was built in the 19th century, the modern system was designed in the late 1950s by the U.S. Army Corps of Engineers. Today, the main stem levee system, comprised of levees, floodwalls, and various control structures, is 2,203 miles long. Approximately 1,607 miles lie along the Mississippi River itself and 596 miles lie along the south banks of the Arkansas and Red rivers and in the Atchafalaya Basin.

The levee system in and around New Orleans is composed of two separate arrangements: the Mississippi River Levees (MRL) and the Lake Pontchartrain and Vicinity Hurricane Protection Levees (LPV). Significantly, the MRL is designed to protect from river flooding and it is an entirely federal project under the control of the Mississippi River Commission. The LPV provides storm surge protection and is subject to a multitude of local levee boards. Also, the design criteria for the MRL are the Maximum Probable Flood, a very high standard, whereas the LPV is designed for the Standard Project Hurricane, which is roughly a Category 3 hurricane. Katrina came ashore as a Category 4 storm, and we are suffering the consequences.

The levees are constructed by the federal government and are maintained by local interests, except for government assistance as necessary during major floods. Periodic inspections of maintenance are made by the U.S. Army Corps of Engineers and local levee and drainage districts.

The Louisiana levee system has evolved over many generations, with projects being constructed by the Corps of Engineers under local sponsorship. Each parish (county) has a levee district, a political subdivision of the state “organized for the purpose [,] and charged with the duty [,] of constructing and maintaining levees,” LA. REV. STAT. ANN. § 281 (WEST 2005). Acting under state law, many local jurisdictions in Louisiana have constructed their own levees outside the federal framework.

The state’s levee system itself is founded in the Louisiana Constitution. The Constitution created local levee and drainage districts (with taxing authority over property in the district’s flood-prone areas) to build and maintain levees.

For the purpose of constructing and maintaining levees, levee drainage, flood protection, hurricane flood protection, and for all other purposes incidental thereto, the governing authority of a levee district may levy annually a tax not to exceed five mills, except the Board of Levee Commissioners of the Orleans Levee District which may levy annually a tax not to exceed two and one-half mills, on the dollar of the assessed valuation of all taxable property situated within the alluvial portions of the district subject to overflow.

LA. CONST. ART. 6, § 39 (1974).

ASCE and the NSF found that, where levees were overtopped, the weaker material at the point of transition (i.e., earth to concrete, sheetpile to concrete, earth to sheetpile) would be more susceptible to failure. Many of the problems appeared to have been related to transition details and were often exacerbated by inconsistent crest heights, particularly where the weaker material had the lower height. Many of these transitions were found at sections where infrastructure elements designed and maintained by multiple authorities; where their multiple protection elements came together, the weakest (or lowest) segment or element controlled the overall performance. The American Society of Civil Engineers and the National Science Foundation, *Preliminary Report on the Performance of the New Orleans Levee Systems in Hurricane Katrina on August 29, 2005* (Nov. 2, 2005).

This finding was confirmed recently by the Corps' own investigators.

A common problem observed throughout the flood protection system was the scour and washout found at the transition between structural features and earthen levees. In some cases, the structural features were at a higher elevation than the connecting earthen levee, resulting in scour and washout of the levee at the end of the structural feature. *At these sites, it appears the dissimilar geometry concentrated the flow of water at the intersection of the levee with the structural feature, causing turbulence that resulted in the erosion of the weaker levee soil.* A practical approach to integrating protection in these transitions would reduce vulnerability of failure in the future.

Interagency Performance Evaluation Task Force, *Summary of Field Observations Relevant to Flood Protection in New Orleans, LA 6-7* (Dec. 5, 2005) (emphasis added).¹

The short answer to the question raised by this Committee is, everyone—and no one—is in charge of the New Orleans levee system. The duties and responsibilities of building and maintaining the city's levees are dispersed over a host of federal, state, and local authorities.

Policy Considerations for the Future

The results are clear: New Orleans has not been flooded from the river for almost 100 years. New Orleans sustained widespread flooding in 1965 (Betsy) and 2005 (Katrina) from hurricane storm surges. These project distinctions and the results of the hurricanes bolster the need to federalize the management of all levees and to raise the standard of protection.

Federal and state lawmakers must arrive at a consensus for the future that emphasizes the creation of an overarching state levee authority with the sole power to regulate, authorize, design, build, and maintain Louisiana's levee system. Because the federal government has invested heavily in the levee building program, the Corps of Engineers, accountable to the President and Congress, must have real and sweeping supervisory powers over the state levee program, including the power to veto a state or local project, to ensure that the levees are located, built, and maintained in the national interest.

¹ These "transitions" between different sections of levees and "inconsistent crest heights" need further explanation. In some cases these transitions are appropriate. Every engineer working in South Louisiana has to carefully consider settlement. For large structures the long-term settlement due to consolidation of underlying soils can be significant. An earthen levee is soil-supported and can be easily "dressed" to regain design height after 10 or 20 years. But structures such as gates and pumping stations cannot be easily raised. Thus, structures are designed in year zero to have additional height so that they will settle to the design height in year 50 or more, depending on the design life of the project. Levees are constructed with additional height for short-term settlement only. Soil-supported earthen levees have a significant load and will settle much more than a pile-supported structure. Geotechnical and life-cycle cost analyses are used to determine the best initial height and a maintenance plan to "dress" the levees periodically during their design life. Thus, it is not uncommon to see structures and levees adjacent and in the same hurricane protection system with different crest heights. Obviously, the transitions need to be more carefully controlled, but they are not, as some think, errors in design.

In the short term, Congress must enact a “National Levee Safety Program.” This program would be modeled on the highly successful National Dam Safety Program.

At a minimum, the levee safety legislation must include requirements for (1) regular safety inspections, possibly every five or 10 years, for all levee systems in the United States; (2) a national inventory of levees built, funded, or maintained by any federal government, state, or local agency or levee district; (3) a national levee safety review board, which will have the power to monitor the implementation of the levee safety program; and (4) an interagency committee on levee safety composed of federal executive branch heads to oversee levee safety programs.

We believe the levee safety program must be designed and carried out to ensure that new and existing levees are safe by encouraging the development of technologically and economically feasible programs and procedures for hazard reduction relating to levees; to support acceptable engineering policies and procedures to be used for levee site investigation, design, construction, operation and maintenance, and emergency preparedness; to promote the establishment and implementation of effective levee safety programs in every state based on state standards; to develop and support public education projects to increase public acceptance and support of state levee safety programs; to develop technical assistance materials for federal and state levee safety programs; to develop methods of providing technical assistance relating to levee safety to non-federal entities; and to develop technical assistance materials, seminars, and guidelines to improve the security of levees in the United States.

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