

TIDE-1220

New Orleans & Hurricanes

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Lessons Learned from Katrina and Reducing Vulnerability Fall 2011

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Why did the Levees/Floodwalls Fail During Katrina?

Contributing Factors

1. Katrina Storm Surge - increased pressure on bottom of canals & on levees & floodwalls
2. Weak Materials in the foundations of the levees and floodwalls, such as Permeable Sands, Peat, and Weak Clay
3. Trees uprooted by hurricane force winds
4. No armoring of tops of levees to prevent erosion after overtopping
5. Poor design of levees & floodwalls - did not consider all of the above!
(I walls instead of T-walls, Low Factor of Safety, Short sheet pilings, not enough consideration of complex and variable geological environment)

What could have prevented the failures? - Mitigation of Contributing Factors

1. Storm Surge - Keep the Storm Surge Out of the Canals -
Gates at the mouth of Canals on Lake Pontchartrain
Pumps at Lake to pump water over Lakefront levees
2. Weak Materials - Drive sheet pilings deep enough to cut off possible seepage to outboard side of canals
Use T-walls instead of I-walls
3. Trees uprooted by hurricane force winds - Don't allow trees with roots that may penetrate levees - remove existing trees
4. No armoring of levees to prevent erosion after overtopping - Armor tops of levees to prevent erosion
5. Poor design of levees & floodwalls - did not consider all of the above!
Better oversight of design & construction of protection systems

Examples of Problems

Levee overtopping, while it does allow water in to the protected area, is not as serious as levee/floodwall breaching (Figure 1)

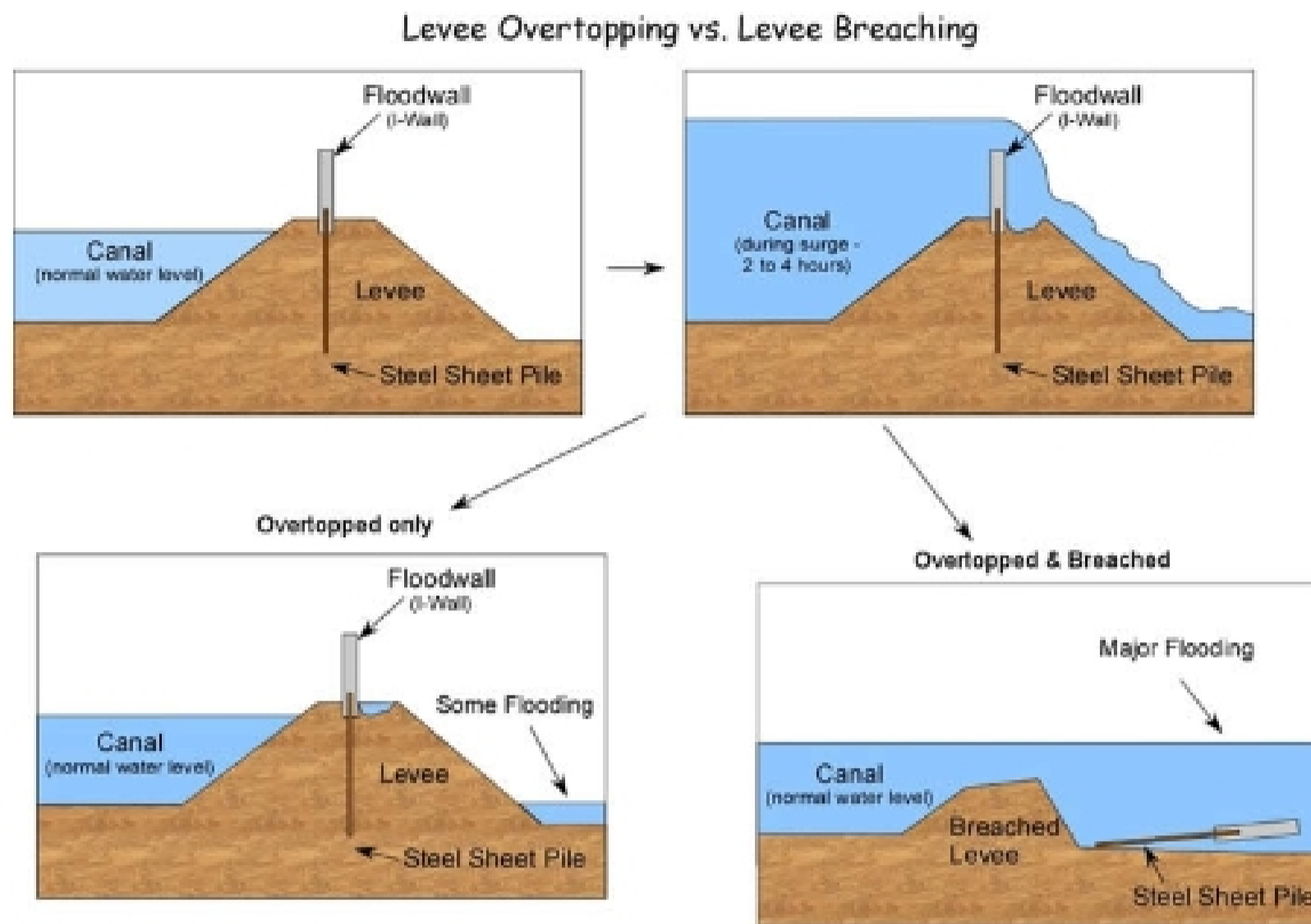


Figure 1

During Katrina, Mississippi River - Gulf Outlet (MR_GO) levees were overtopped resulting in breaching. This resulted in severe flooding in St. Bernard Parish. The levees were made of easily erodable spoil dredged from the shipping channel. The levees were not armored to prevent erosion (Figure 2).

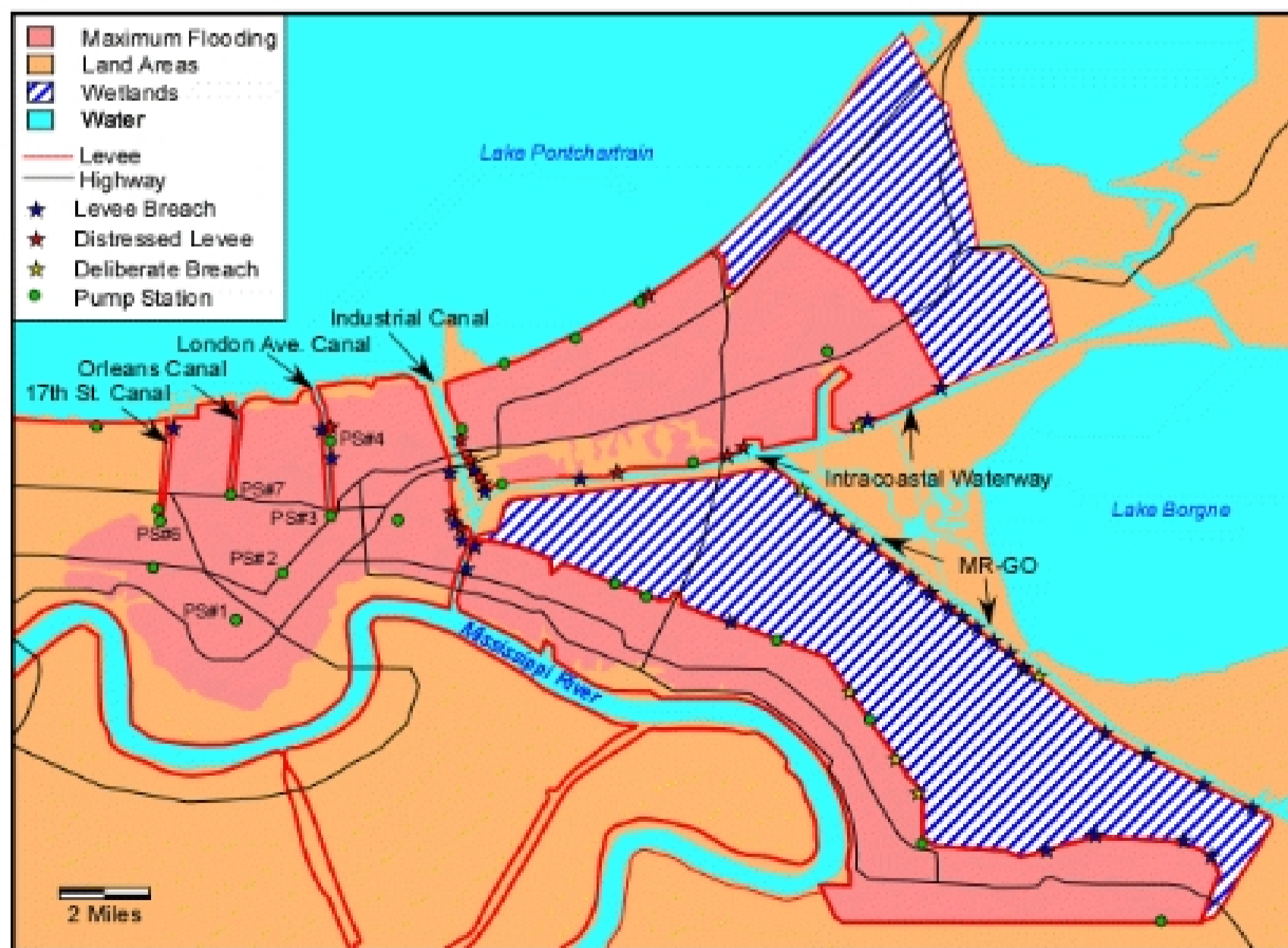


Figure 2

In the New Orleans Hurricane Protection System, no armoring was present at the base of floodwalls to prevent erosion if the floodwall was overtopped.

This resulted in erosion of the levees at the base of overtopped floodwalls (Figure 3).



Figure 3

Trench at base of floodwall on Lakefront levee in New Orleans East.

This also contributed to failures along the Industrial Canal (See Figures, 14, 15, 16, 17, & 18 in the Katrina Field Trip Guide - <http://www.tulane.edu/~sanelson/Katrina>)

The other contributing factor in the case of the Industrial Canal levee floodwall failures was a mechanism of I-wall failure discovered after these floodwalls were built.

In 1985 Army Corps of Engineers research branch conducted tests on sheet pile flood walls with the same design that they were using for New Orleans' hurricane protection system. Found that they would likely fail! (Figure 4)

Reference:

Jackson, R.B., E99 Sheet Pile Wall Field Load Test Report, Technical Report No. 1, U.S. Army Engineer Division, Lower Mississippi Valley, June 1988, Vicksburg, MS, 83 pp.

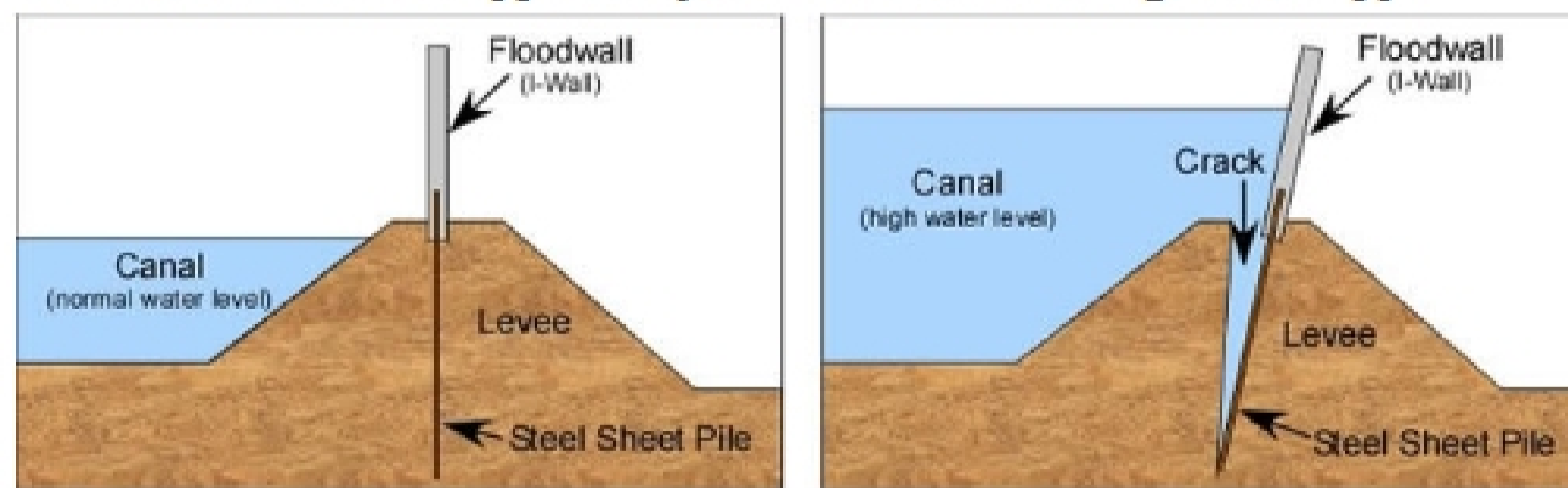


Figure 4

The combination of erosion due to the waterfall that resulted from overtopping and the force of the water acting to push the floodwall over, appears to have been largely responsible for the failure of the floodwalls on the east side of the Industrial Canal bordering the Lower 9th Ward (Figure 5)