

## **Vertical Settlement Questions and Answers**

**Q1. The Corps was directed by Congress to determine the degree to which the new design requirements were required because of vertical settlement of the levees and floodwalls or subsidence and the vertical changes resulting from new storm data and the technology of the new modeling systems. What's the answer?**

A1. Both factors—regional subsidence and vertical settlement—significantly contributed to the vertical deficiency of the pre-Katrina hurricane protection system. In addition, the use of new storm data and technology has led us to raise the total design heights of protection levees and floodwalls. Because public safety is the Corps' number one priority, we collaborated with our partners in the federal government, private industry and academia to develop new modeling tools and gain a better understanding of hurricanes and other storms.

**Q2. What kinds of new hurricane modeling tools have been developed?**

A2. The Corps has worked with experts from FEMA, the National Oceanic & Atmospheric Administration (NOAA), the private sector and academia to develop a new process for estimating hurricane inundation probabilities. This process is called the Joint Probability Method with Optimal Sampling (JPM-OS). Data from hurricane storm events were used to calibrate the modeling tools and develop a storm set used in the JPM-OS analysis. In this case 152 storms—some historical, some not—were modeled. The new JPM-OS method was reviewed and approved by members of the American Society of Civil Engineers (ASCE) as a method for estimating storm surge elevations.

**Q3. The Corps is raising a lot of levees. Is this because they settled?**

A3. In some cases, yes; but in many cases improved methods of storm modeling have shown that levees need to be higher than ever before to protect the lives and property of Louisiana's citizens.

**Q4. What causes subsidence?**

A4. The factors that contribute to subsidence in the South Louisiana region are numerous. Subsidence can be the result of natural (sediment loading, oxidation of organic materials) and man-made processes (such as extraction of oil and gas and pumping).

**Q5. What has caused vertical settlement of the levees?**

A5. The earth under a levee is subject to vertical load as fill is added. Earthen levees are extremely heavy. Over time, their weight may cause vertical settlement and lateral spreading of the foundation, causing the levee to be lower. When constructing levees in southern Louisiana, settlement has been a significant problem to overcome.

**Q6. Do floodwalls settle too?**

A6. Settlement of floodwalls is generally restricted to movement resulting from regional subsidence. Since floodwalls are supported by deep foundation pilings, settlement is limited.

**Q7. How does the Corps plan to deal with the settlement problem?**

A7. The Corps uses two possible solutions: build a higher levee initially, called "overbuild," or build the levee up by adding more materials to it if it settles, called "lift construction."

**Q8. The first option of building a taller levee sounds like the smart thing to do. Why bother building a levee only to have to add to it later?**

A8. A higher levee means a wider levee. Overbuilding to compensate for expected settlement requires additional resources, including higher federal appropriations and local sponsors' cost shares. Building a levee wider also requires additional land in some reaches.

**Q9. How about the second option, "lift construction?"**

A9. If vertical settlement occurs, additional height can be added over time so the levee maintains its design height. There are several advantages to the lift construction option including cost, environmental impact and less need for additional land. Additionally, the lift construction design can incorporate the gains in shear strength that will occur as the underlying foundation soils subside and consolidate over time.

**Q10. Some of the levees in Orleans Parish around Lake Pontchartrain (plate 12) and the Lakefront Airport (plate 13) are already taller than the design height. Both of those areas had extensive flooding. Why isn't the Corps building the levees even higher?**

A10. Although there was extensive flooding behind these levees after Katrina, the source of the floodwaters was not from overtopping of levees along the lakefront. As indicated in the IPET report, the source of floodwaters was further south from breaches and overtopping along the IHNC and GIWW.

**Q11. Will the Corps lower the levees to make it all even?**

A11. No, there is no need to lower those levees, so they will be left as they are.

**Q12. But won't levees at different heights result in flooding?**

A12. Absolutely not. The Corps takes a comprehensive approach and looks at the performance of the entire system. Uneven heights do not result in more or less flooding at any other point in the system. It is possible to have levees very close to one another that may have different heights but that will provide the same level of protection.

A12a. Protection is not based solely on the height of the levee; the slope of the levee is also important in preventing flooding. Designs are based on calculations that involve still water levels, storm surge, and wave run-up. These factors must be considered at each site so that the resulting levee or floodwall is built not only to the correct height but also has the right shape, and slope for its location.

**Q13. Why not just build all the levees higher to match the tallest levee in the system?**

A13. The administration asked for, and Congress authorized, protection for a 100-year flood. The LACPR study is looking at the feasibility of providing a higher level of protection. Our increased understanding of hurricanes will allow us to build a strong hurricane and storm damage risk reduction system.

**Q14. If this is the 100-year system, then why have you only considered projected conditions for the next 50 years?**

A14. The 100-year system is designed to provide that level of protection over the next 50 years, our normal design life for civil works projects. During the next 50 years, we will continually review and re-evaluate the protection system. Possible redesign of the project may be necessary to account for physical changes and scientific knowledge gained over that time frame.

**Q15. Why does the Corps pay experts to provide external review?**

A15. The ASCE conducted an extensive technical analysis of the criteria developed by the Corps and its partners. Their comments were considered and, where appropriate, incorporated into the designs. External review can be a lengthy and expensive process and experts must be compensated for their time, travel and administrative expenses. However, the Corps has neither asked for nor received preferential treatment or a biased opinion from the ASCE.