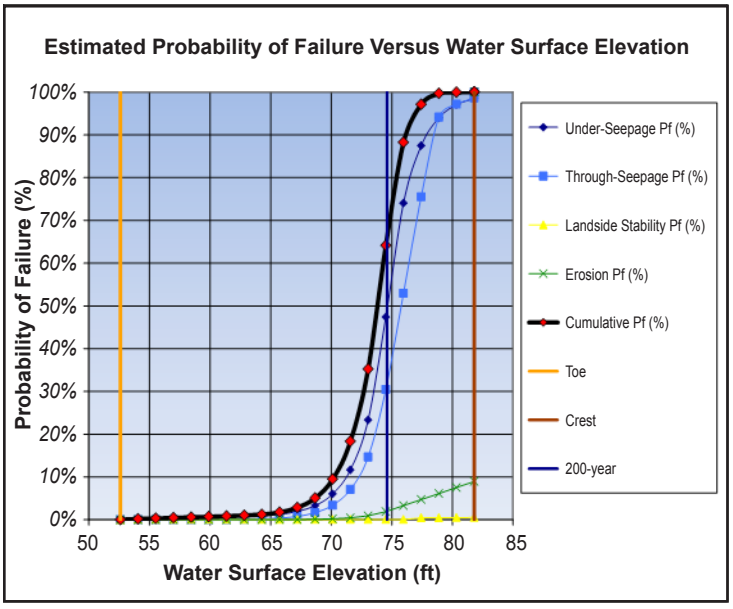
ULE/NULE Geotechnical Performance Curves

The Purpose of Performance Curves

In accordance with subsection (b) of the California Water Code Section 9120, the California Department of Water Resources (DWR) shall prepare an estimate of the risk of levee failure on infrastructure making up the State Plan of Flood Control (SPFC). DWR's major effort on this endeavor is the Levee Evaluation Program which produced a profound, comprehensive understanding of the geotechnical performance of the SPFC levees throughout the Central Valley of California.

In order to identify the risk to lives and property, DWR needed to assess the performance of the existing flood control infrastructure for a variety of water level conditions against the levees (moderate to severe events). Derivation of performance curves allowed DWR to articulate anticipated system performance under various hydraulic loads. The performance curves are based on physical and geotechnical parameters of the flood control infrastructure, in this case levees, and their predicted performance under four dominant failure mechanisms: seepage (under- and through-seepage), levee stability, and erosion. The performance curve is a composite curve representing the levee's anticipated performance as a probability of failure P(f) versus water surface elevation.



2017 CFVPP Update Performance Curves Statistics

- 165 index points with performance curves associated with 103 economic basins
- 44 urban levee performance curves
- 121 non-urban levee performance curves
- 90 performance curves in the Sacramento River Basin
  - Urban: 11
  - Non-urban: 57
- 75 performance curves in the San Joaquin River Basin
  - Urban: 11
  - Non-urban: 64
- Extent of coverage from the Sacramento River north of the commnity of Butte City to the San Joaquin River south of the community of Firebaugh (approximately 250 miles)

Performance curve failure probability starts at 0% at the levee's landside toe elevation (water surfaces below this elevation exhibit no water level [hydraulic loading] against the levee body), and is 100% at the elevation of the levee crest (water surfaces above the crest elevation "overtop" the levee and spill into the floodplain unimpeded). This condition generally results in a breach in the levee system and loss of flood protection to the nearby area.

Performance curves (for planning purposes) are derived for two types of levee categories: urban levees and nonurban levees. The geotechnical performance parameters are characterized differently between urban and nonurban levees, resulting in two varying approaches to identify the performance expectations.

Urban Levee Evaluation Performance Curves

Performance curves for urban levees are based on a combination of deterministic and qualitative analyses. Acceptable performance criteria for levees protecting urban areas is specified in DWR's Urban Levee Design Criteria (ULDC), May 2012. ULDC can be found at http://www.water.ca.gov/floodsafe/leveedesign/.

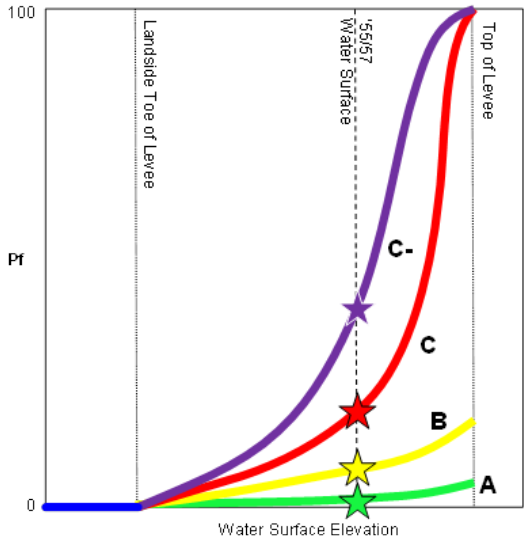
Deterministic analyses are applied by the geotechnical engineer to evaluate the amount of water than can seep through and underneath the levee for various water levels in the waterway and to evaluate how stable the levee body is for these same water levels at maintaining its geometric dimensions (height, bottom width, crest width, and side slopes) against slumping, or rotational failures of large sections of the levee body. Thus, three of the dominant failure mechanisms (through-seepage, underseepage and stability) are characterized in performance curves by deterministic means.

The fourth failure mechanism, erosion, is assessed qualitatively by the geotechnical engineer based on field observations and documented historical performance of the levee's ability to resist erosion throughout historical flood events.

For the analyzed levee, these four failure mode performance curves are mathematically combined to produce a single composite performance curve for that levee that represents the probability of failure P(f) versus water surface elevation (water level) against the levee.

Non-urban Levee Evaluation Performance Curves

Performance parameters are based on the four dominant failure mechanisms previously noted. Geotechnical performance of non-urban levee segments is based on the water level equivalent to the 1955/1957 flood event. The performance is designated as A (good), B (moderate), C (poor), C- (critical) or LD (lacks data) for each failure mechanism by qualitative assessment by the geotechnical engineer based on the review of maintenance personnel observations and documented historical performance. In unique situations where a localized deficiency in the levee segment had been identified by DWR's Flood System Repair Project a critically degraded, the designated identifier is labeled a C- (critical).



The four failure mode curves are then mathematically combined to produce a composite levee performance curve for each selected levee segment.

More detailed performance curve information can be found in the following DWR publications:

- *2014 Performance Curve Development Technical Memorandum*. DWR, January 2015.
- *Fragility Curve Development Technical Memorandum*. DWR, November 2011.

For further general DWR information, please contact FloodSAFE California: floodsafe@water.ca.gov

http://www.water.ca.gov/floodsafe/

Reference sources for this document are available at http://www.dwr-lep.com/auth

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