Revision to Flood Hazard Assessment at the Savannah River Site

R. L. Buckley and D. W. Werth, Savannah River National Laboratory

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Project Objective

- Determine flood hazard probability for areas of interest at the Department of Energy's (DOE) Savannah River Site (SRS)
- Consider return periods from 50 to 100,000 years:
  - 6-hr accumulated precipitation
  - 24-hr accumulated precipitation (examples provided here)

Background

DOE directive, DOE Order 420.1, Facility Safety
+Address Natural Phenomena Hazard (NPH) mitigation
+Determine flood elevations as a function of return period

SRS contains nuclear facilities spread out over 800 km^2 area
Prior analyses performed in 1999, 2000

Four main basins (and associated lakes) at SRS
- Upper Three Runs Creek
- Fourmile Branch
- Tims Branch
- Pen Branch

Methodology

Take new design hyetographs (rainfall depth time-series):

(1) Use hydrologic modeling system (HEC-HMS) to find *peak discharge*
(2) Use water surface profile model (WSPRO) to find *peak flood elevations* based on peak discharge

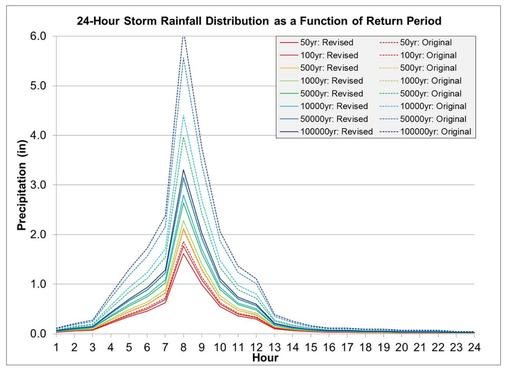
Design Hyetograph

Design hyetograph based on extreme value theory (Werth et al. 2013)*

$$I_{ij} = aF_iR_j$$

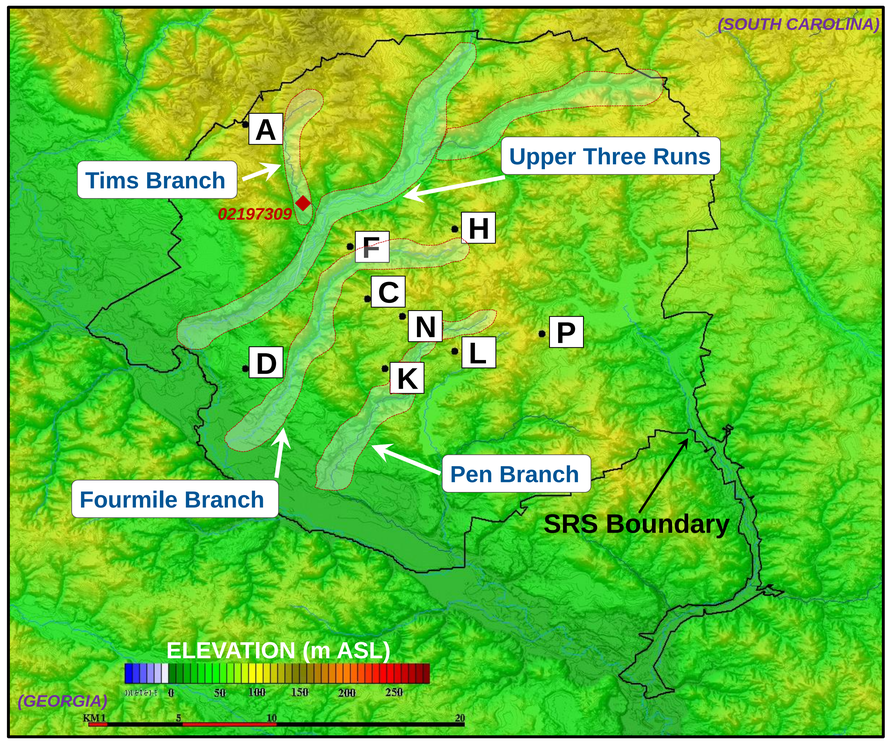
where:

a = conversion factor from point to regional rainfall (unity for 24-hr period)
I_{ij} = rainfall (in) in hour "i" (i = 1, 6 or 1, 24) for j-year return period
F_i = fraction of rainfall in hour "i" for a 6-hr or 24-hr storm
R_j = accumulated 6-hr or 24-hr storm rainfall (in) for j-year return period



Revised totals (solid lines) are lower than prior totals (dashed)

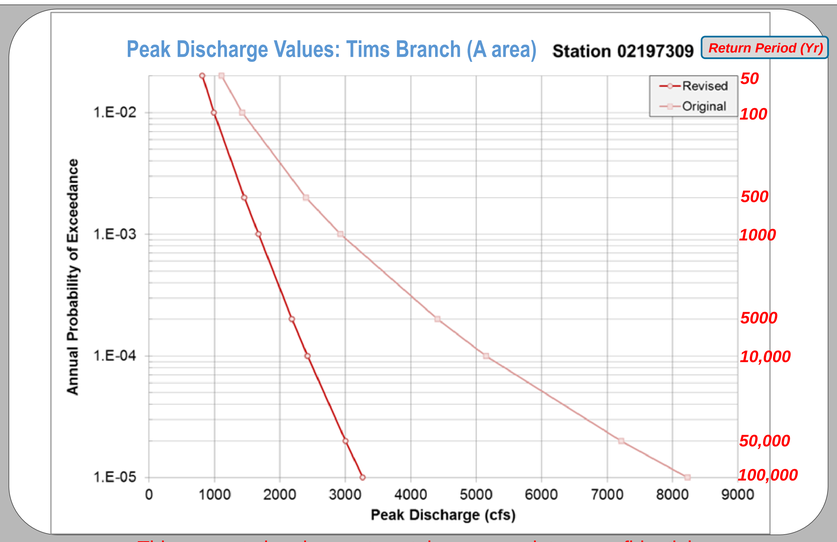
*Werth, D., A. Weber and G. Shine, November 2013: Probabilistic Hazard Assessment for Tornadoes, Straight-line Wind, and Extreme Precipitation at the Savannah River Site. SRNL-STI-2013-00664.



SRS map showing topographic elevation relative to various basins

Hydrologic Modeling (HEC-HMS)

- Use Hydrologic Modeling System (HEC-HMS) to calculate basin peak flow based on new hyetograph (return) **50, 100, 500, 1000, 5000, 10000, 50000, and 100000 years**
- Calibration performed from prior study based on storm data. Basin properties assumed same as prior study as well. Only input variations were the hourly precipitation values from the new hyetographs.



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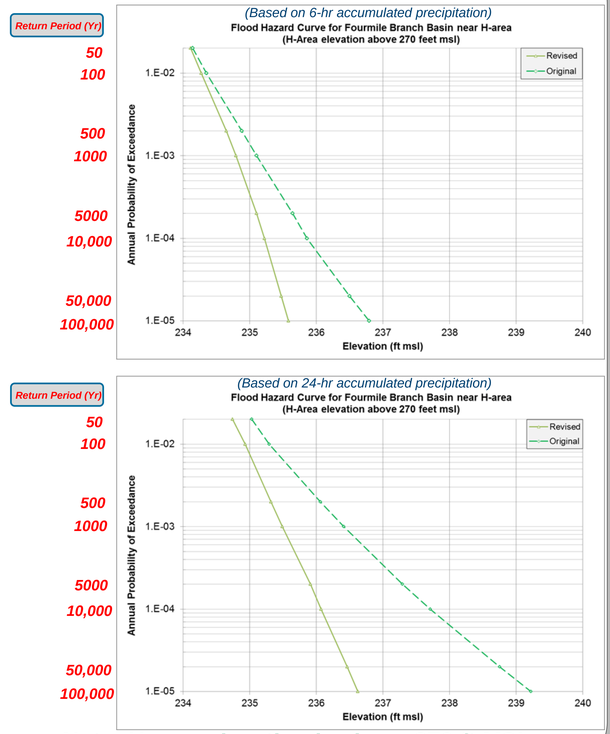
Open Channel Modeling (WSPRO)

- Use Computer Model for Water Surface Profile Computations (WSPRO) to calculate flood water elevations
- Assume cross-sections along each basin as in 1999/2000 studies. *Peak discharge* from HEC-HMS and *initial water elevations* differ from previous study.
- Some basins (Upper Three Runs) straightforward since no bridges or culvert overflow. Others (Fourmile Branch) required extra calculations for overflow.

Flood Hazard Curve for H-area (Fourmile Branch Basin)



- *Note: H-area elevation is above 270 ft MSL*

Project Summary

- DOE requires assessment of *natural phenomena hazards*, including potential for *flooding*. In a revision to prior work, assessments were generated (as required) for return periods as large as **100,000 years**.
- Primary input revision is a new design hyetograph, incorporating additional precipitation data (2000-2012) and extreme value theory. The new hyetograph contained lower precipitation rates.
- Numerous SRS locations of interest were re-examined for potential flooding. Reduced precipitation rates (relative to prior studies) led to *lower peak discharge rates*, which in turn led to *lower flood elevation levels*.
- In all cases, the probability of flooding at SRS is negligible. The 100,000 year return period flood levels were not exceeded at any location of interest