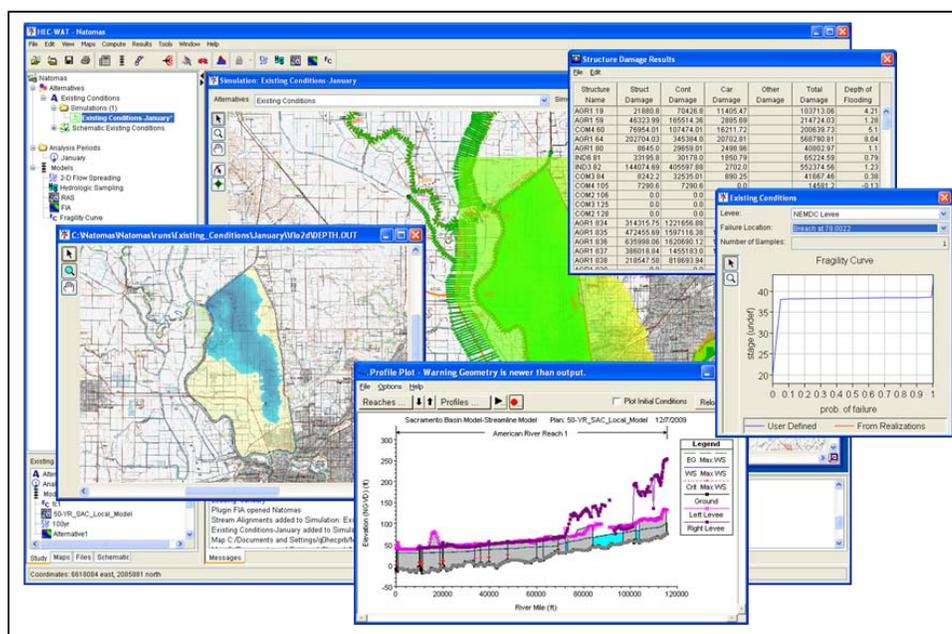




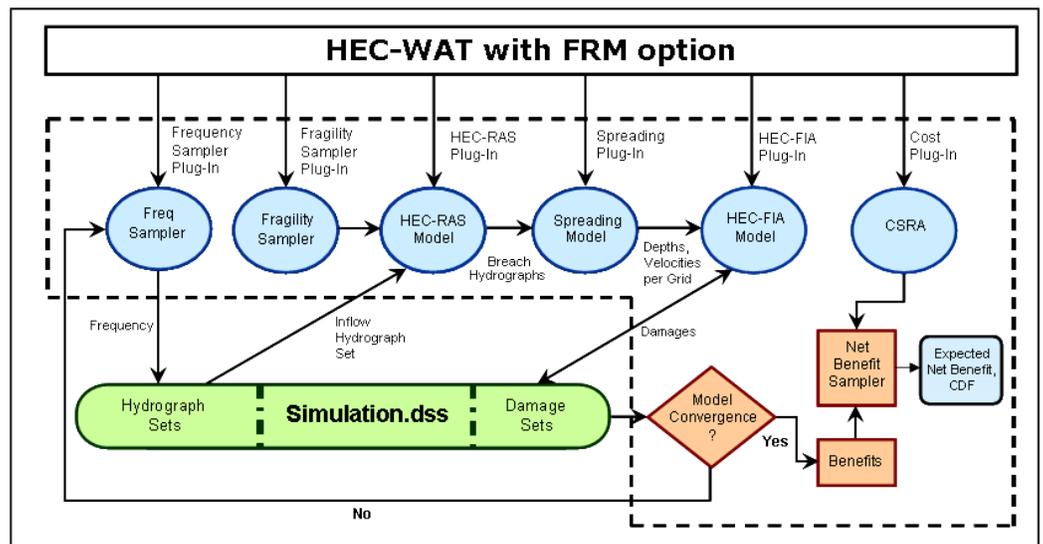
# HEC-FRM

### Description

For over two decades, the U.S. Army Corps of Engineers has required that all of their planning processes address the Nation's water resources needs in a systems context while using risk analysis. While the Corps has a requirement for systems approaches using risk analysis, there is little guidance and few tools to support these requirements. For this reason, the Corps' Institute for Water Resources, Hydrologic Engineering Center (HEC) began development of Flood Risk Management (FRM) to analyze complex riverine systems while implementing the flood risk management and systems requirements. This new tool will include a systems approach, event-based sampling, the ability to do scenario and alternative analysis, and structure-by-structure, cost, non-structural, loss-of-life, and agricultural damage analyses. FRM will provide a way for the Corps to conduct risk assessments in a systems context.



FRM will be a computation option from the HEC-WAT software that will allow a user to perform plan formulation or system performance analyses. FRM will have the capability to sample from a pre-define flow-frequency relationship with associated inflow hydrographs or utilize the HEC-HMS (Hydrologic Modeling System) and HEC-ResSim (Reservoir Simulation) models in the WAT to generate inflows to the system. A fragility sampler plug-in will set failure elevations to be used in HEC-RAS (River Analysis System) which would then route the inflow hydrographs down the system. Where failures occur, breach hydrographs will be generated and made available to a spreading model to delineate inundation areas and compute depths, velocities and duration in the consequence area of interest. Once the inundation and gridded hydraulics data is determined, that data is made available for HEC-FIA (Flood Impact Analysis) to compute consequences. The FRM process will apply the Monte Carlo simulation, a numerical-analysis procedure to help FRM compute the expected value of consequences (dollar-damage, loss-of-life, etc) while explicitly accounting for the uncertainty in the parameters



used to determine those flood inundation consequences. FRM will be configured to allow for a life-cycle type computation of consequences and associated performance indices.

**Benefits** Development of FRM will provide a systems approach for assessing risks and uncertainties in simple systems as well as complex, interdependent systems. FRM will provide a tool for reconnaissance and feasibility studies, and for levee system assessment and certification. The tool will also incorporate new computational methodologies for flood risk management, along with social and environmental consequences.

**Status** The alpha version of HEC-WAT with the FRM option was demonstrated to the Sacramento River Bank Protection Project team.

**Distribution Source(s)** The version of HEC-WAT that will have the FRM option implemented is under development and is scheduled for completion late in 2011.

**Available Documentation** There are a few presentations and papers written on the FRM option, contact the Hydrologic Engineering Center for this documentation.

**Available Training** There is currently no separate training course based solely on using HEC-WAT with the FRM option. However, the FRM concepts are introduced in lectures within the "Risk Analysis for Flood Damage Reduction Projects" class offered at HEC. To find out more about these classes, and when they are offered, visit the HEC Web site and look these classes up under the training area of the Web site.

**Available Support** Support for HEC-WAT and the FRM option will be available to all Corps employees. Corps users will be able to email or call HEC with questions and/or comments. Additionally, all users of the FRM option will be able to provide bug reports or comments with suggestions through the location provided under Distribution Source(s).

**Application** The FRM option of HEC-WAT can be used by Corps offices to conduct risk assessments in a systems context. Currently HEC is developing an HEC-WAT study for the Sacramento River Bank Protection Project (SRBPP) and an application on the Columbia River basin, using the FRM option to evaluate alternatives using EAD and other criteria.

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