

# Risk Assessment for Flood Risk Management Studies

Davis, California

## Course Overview

This course presents risk assessment methods and concepts, many of which are required by Corps guidance. The objective is to enable participants to readily adapt these methods and concepts to their own studies and projects after successfully completing the course. Policy issues, concepts in statistical analysis, and risk and uncertainty methods used in the evaluation of flood risk management projects are emphasized in the course. In course workshops provide participant with the opportunity to apply the courses concepts using the Hydrologic Engineering Center Flood Damage Reduction Analysis (HEC-FDA) software program.

The course is intended for persons that are or will be involved in risk assessment for flood risk management studies. It is typically expected that participants have a minimum of two years of experience in engineering, economics, planning, or project management.

Monday:

Reading Assignment: (1) Engineering Regulation (ER) 1105-2-101, titled "Risk Analysis for Flood Damage Reduction Studies" published January 2006; (2) Chapters 1-3 of Engineering Manual (EM) 1110-2-1619, titled "Risk-Based Analysis for Flood Damage Reduction Studies" published March 1996; (3) Chapters 1-3 of the HEC-FDA Users Manual.

Note: Engineering regulations and manuals can be download from the USACE publication library. The HEC-FDA User's Manual can be downloaded from the HEC website ([www.hec.usace.army.mil/software/hec-fda](http://www.hec.usace.army.mil/software/hec-fda)).

08:00 - 8:45am     **Introduction and Pretest**

08:45 - 09:45am     **Background Policy and Regulations for Risk Analysis**

This presentation provides a description of the present HQUSACE policy, risk analysis requirements and ongoing USACE activities. An overview of ER 1105-2-101, "Risk Analysis for Flood Damage Reduction Studies" will be presented.

09:45 - 10:00am     Break

10:00 - 11:30am     **Flood Risk Assessment**

This presentation provides an overview of the application of risk analysis concepts in flood risk management studies. In particular it will provide a discussion of the application of risk analysis concepts to study configuration, engineering and economic products including probability-discharge, stage-discharge and stage-damage functions with uncertainty. Plan formulation and evaluation within the risk analysis framework will also be reviewed.

11:30 - 12:30pm     Lunch: Ice Breaker at Woodstock's Pizza

12:30 - 02:30pm     **Basic Probability and Statistics**

This lecture defines and describes probability, random variables, statistics and definitions of risk and uncertainty. An emphasis is placed on defining statistical parameters, probability density functions and cumulative distribution functions.

Exercises exploring concepts in the lecture such as the use of relative frequency in the estimation of probability; and fitting probability distributions to data are interspersed throughout this lecture.

02:30 - 02:45pm     Break

Monday, continued

02:45 - 05:00pm **Incorporating Uncertainty into the Expected Annual Damage (EAD) Computation**

This presentation provide an interpretation of EAD and describes the traditional EAD computation when uncertainty parameters are not applied. Monte Carlo simulation is introduced along with its use of incorporating uncertainty in HEC-FDA inputs.

Exercises exploring statistical concepts used in risk assessment are presented in a hand-on environment. Concepts explored in these exercises include median and expected values of analytically functions used for evaluation and Monte Carlo simulation.

Tuesday:

Reading Assignment: (1) Chapters 4-6 of Engineering Manual (EM) 1110-2-1619, titled "Risk-Based Analysis for Flood Damage Reduction Studies" published March 1996; (2) Chapters 4-6 of the HEC-FDA Users Manual.

- 08:00 - 09:00am **Risk Assessment and Risk Management: Transforming the USACE**  
This presentation describes USACE Headquarters (HQUSACE) current philosophy on the practice and application of risk analysis. The future of risk analysis will be discussed, as well as methods for application in SMART planning studies.
- 09:00 - 09:45am **Bear Creek Using the HEC-FDA Program Workshop**  
In this hands-on workshop participants use HEC-FDA to define a new study, provide study information and input configuration data (e.g. streams, damage reaches, analysis years and plans) for the Bear Creek study.
- 09:45 - 10:00am Break
- 10:00 - 10:30am **The RMC and Life Safety**  
This presentations provides an overview of the USACE Risk management Center's (RMC's) approach to risk analysis. Topics include risk analysis in support of dam and levee safety program objectives with a special focus on life safety. HEC-FIA and HEC-LifeSim are introduced.
- 10:30 - 11:45am **Uncertainty in Exceedance Probability Functions**  
The presentation describes the causes of uncertainty in exceedance probability functions (e.g. frequency curves). Methods for evaluation uncertainty and computing confidence intervals are reviewed and their entry into the HEC-FDA program are described.
- 11:45 - 12:00pm Class Photo: gather on the patio
- 12:00 - 01:00pm Lunch
- 01:00 - 02:15pm **Stage-Discharge Relationship Uncertainty Derivation**  
This presentation describes approaches for estimating uncertainty in stage-discharge relationship that are defined in ER 1105-2-101 and EM 1110-2-1619. An emphasis is placed on estimating the uncertainty associated with approached used for gauged and ungauged locations.
- 02:15 - 02:30pm Break

Tuesday, continued

- 02:30 - 03:00pm **Bear Creek Hydrologic and Hydraulic Uncertainties Workshop**  
In this hands-on workshop participants use their previously generated HEC-FDA study files to input and evaluate probability-discharge and stage-discharge relationships with uncertainty.
- 03:00 - 04:15pm **Stage-Damage Relationship Uncertainty Derivation**  
This presentation describes approaches for estimating uncertainty in stage-damage relationship that are defined in ER 1105-2-101 and EM 1110-2-1619. The impact of altering stage-damage functions will also be discussed.
- 04:15 - 5:00pm **Bear Creek Stage-Damage Uncertainties Workshop**  
In this hands-on workshop participants use their previously generated HEC-FDA study files to compute and evaluate stage-damage relationship.

Wednesday:

Reading Assignment: Chapters 7-8 of Engineering Manual (EM) 1110-2-1619, titled "Risk-Based Analysis for Flood Damage Reduction Studies" published March 1996

08:00 - 08:30am **Uncertainty Workshops Review**

08:30 - 09:45am **Project Formulation and Evaluation Using Risk Assessment**  
This presentation describes project formulation and evaluation procedures for multiple reaches and mixed measures (levees, channels and reservoir) projects.

09:45 - 10:00am Break

10:00 - 10:30am **Interior/Exterior and Transform Flow Relationships**  
This presentation introduces the concepts of interior/exterior and transform flow relationships and their use in HEC-FDA.

10:30 - 11:45am **Bear Creek Without Project Conditions Workshop**, Penni Baker  
In this hands-on workshop participants use their previously generated HEC-FDA study files to perform a without project analysis for the Bear River Project, including the computation and evaluation of expected and equivalent annual damages.

11:45 - 12:45pm Lunch

12:45 - 01:00pm **Without Project Conditions Workshop Review**

01:00 - 02:30pm **Geotechnical Analysis**  
This presentation describes the current role of the geotechnical community in levee risk assessments. An emphasis is placed on the presenting the geotechnical aspects of risk assessment.

02:30 - 02:45pm Break

02:45 - 03:45pm **Case Study: Lower Sacramento River**  
This presentation will present a risk assessment study of the Lower Sacramento River.

03:45 - 05:00pm **Bear River Levee Assessment Workshop**  
In this hands-on workshop participants use their previously generated HEC-FDA study files to evaluate the economic feasibility and project performance of various levee alternatives. Participants recommend the "best" alternative.

Thursday:

Reading Assignment: Chapter 9 of Engineering Manual (EM) 1110-2-1619, titled "Risk-Based Analysis for Flood Damage Reduction Studies" published March 1996

08:00 - 08:30am **Levee Assignment Workshop Review**

08:30 - 09:15am **Flood Risk Management Planning Center of Expertise**

This presentation provides an overview of the Flood Risk Management Planning Center of Expertise (FRM-PCX) mission and responsibilities. Planning model certification is discussed as is the flood risk agency technical review (ATR) policies and processes.

09:15 - 10:00am **Bear Creek Plan Formulation Workshop**

In this hands-on workshop participants use their previously generated HEC-FDA study files to formulate and evaluate flood risk management for the Bear Creek study area. The workshop emphasizes formulation and evaluation of several flood risk management plans including a levee only plan, detention only plan and joint detention and levee plan.

10:00 - 10:15am Break

10:15 - 11:30am **Bear Creek Plan Formulation Workshop** continued

11:30 - 12:30pm Lunch

12:30 - 13:00pm **Plan Formulation Workshop Review**

01:00 - 02:45pm **Case Study: Southwest Coastal Louisiana Feasibility Study**

This presentation will present a risk assessment study using HEC-FDA in a coastal area for the Southwest Coastal Louisiana Feasibility Study.

02:45 - 3:00pm Break

03:00 - 04:00pm **HEC-FDA Current Releases: FDA Version 1.4 and GeoFDA**

This presentation will provide an overview of recent HEC-FDA program releases. Unique features of the Version 1.4 releases are discussed and a live demonstration of HEC-GeoFDA is provided. HEC-GeoFDA performs geospatial preprocessing tasks for HEC-FDA studies and extends the program's ability to work with 2-dimensional hydraulic information. Participants are asked to provide input and their ideas.

04:00 - 05:00pm **HEC-FDA Future Products: FDA Version 2.0**

This presentation will provide a discussion of ongoing and future development of the HEC-FDA program. A live demonstration of the early alpha version of HEC-FDA 2.0 is provided. Features that are not in the early alpha but will be in final release as well as future versions will be discussed. Participants are asked to provide input and their ideas.

Friday:

- 08:00 - 08:30am **HEC-FDA Limitations and Practical Considerations**  
HEC-FDA is not the right tool for every risk assessment study. In this presentation the limitation of the HEC-FDA program are discussed. Alternative tools and methods are also described.
- 08:30 - 09:15am **HEC-FIA**  
This presentation provides an overview of the HEC Flood Impact Analysis (HEC-FIA) software and its applications.
- 09:15 - 09:30am Break
- 09:30 - 10:30am **What is HEC-WAT with the FRA Option?**  
This presentation will cover one of the newest tools in the risk and uncertainty assessment tool box, and describe how it differs from HEC-FDA.
- 10:30 - 11:30am **Post Test, Critique and Closing**