Hydraulics and Hydrology for Dam Safety Studies

March 9 – 13, 2020
Hydrologic Engineering Center
Davis, CA

<u>Objective</u>

The objective of the course is for participants to perform hydrologic and hydraulic modeling in support of Dam Safety studies. Course participants will be required to run HEC-HMS, HEC-SSP, and HEC-RAS.

Topics presented will include: Development of Probable Maximum Precipitation (PMP); Hydrologic Modeling for PMP/PMF Events; Hydrologic Loading; Flow Frequency; HEC-RAS Model Geometry Development, Developing Dam Breach Parameters; Dam Breaching Analysis using HEC-RAS; Unsteady Flow Modeling with HEC-RAS; and Using RAS-Mapper for Inundation Mapping. Each participant will have the opportunity to prepare model input and analyze model output during course workshops.

Course Prerequisites: Students who come to this class should have knowledge on how to use HEC-HMS and HEC-RAS. This knowledge can be in the form of a basic training class or on the job experience. The preparation of basic input data and analysis of the output from these software packages will not be covered. Experience in unsteady flow modeling is a plus but is not required.

<u>HEC Instructors</u>
Cam Ackerman
Mike Bartles
Tom Brauer
Gary Brunner
Matt Fleming
Stanford Gibson
Greg Karlovits
Alex Kennedy
Alex Sanchez

<u>Monday, 9 March</u>

8:00	9:00		**COURSE INTRODUCTIONS/ADMINISTRATIVE** (Dunn, Karlovits)
9:00	10:00	1.1 Lecture	**OVERVIEW OF H&H FOR DAM SAFETY** (Karlovits) This lecture provides an overview of the process for performing the Hydrology, Hydraulics, and Mapping studies for a dam safety study. A discussion of Hydrologic Loading for Risk Assessment is included.
10:00	10:15	**BREAK**	
10:15	11:15	1.2 Lecture	**DEVELOPMENT OF THE PROBABLE MAXIMUM PRECIPITATION** (Fleming) Procedures for development of the probable maximum precipitation for the various regions of the United States are described.
11:15	12:15	**LUNCH**	
12:15	13:45	1.3 Workshop	**DEVELOPMENT OF PMP** (Fleming, Brauer) This workshop will demonstrate how to develop a PMP event for the eastern half of the U.S. using HMR51 and HMR52.
13:45	14:00	Review	1.3 Workshop (Fleming)
14:00	14:15	**BREAK**	
14:15	15:15	1.4 Lecture	**HYDROLOGIC MODELING FOR PMP/PMF EVENTS** (Bartles) Discussion of modeling rainfall, infiltration, runoff transform, and baseflow methods focused towards PMF level events. Overview of reservoir routing options within HEC-HMS.
15:15	16:45	1.5 Workshop	**ESTIMATING THE PMF WITH NO EXISTING MODEL** (Brauer, Fleming) This workshop illustrates a method for developing the IDF given existing information in a reservoir regulation manual and historic flows at a USGS gage.
16:45	17:00	Review	1.5 Workshop (Brauer)

Tuesday, 10 March

8:00	9:30	2.1 Workshop	**ESTIMATING THE PMF WITH AN EXISTING MODEL** (Brauer, Fleming) This workshop provides an example for developing the Probable Maximum Flood (PMF) using an existing HEC-HMS model.
9:30	9:45	Review	2.1 Workshop (Brauer)
9:45	10:00	**BREAK**	
10:00	10:30	2.2 Lecture	**PMF ROUTING** (Fleming) Discussion of initial reservoir conditions and assumptions/tools for routing the PMF hydrograph through a reservoir model to compute reservoir stage.
10:30	11:30	2.3 Workshop	**PMF ROUTING** (Fleming, Karlovits) Workshop for application of HEC-HMS to route the PMF hydrograph through the reservoir element. Description for setting the initial reservoir storage/elevation, configuring the reservoir elements, and determining peak stage are included.
11:30	11:45	Review	2.3 Workshop (Fleming)
11:45	12:45	**LUNCH**	
12:45	14:00	2.4 Lecture	**HYDROLOGIC LOADING** (Karlovits) Role of hydrologic loading in the dam safety risk assessment process; development of hydrologic hazard curves; tools for hazard curve development.
14:00	14:15	**BREAK**	
14:15	15:15	2.5 Lecture	**FLOW FREQUENCY FOR DAM SAFETY STUDIES** (Bartles) This lecture describes how flow- and volume-frequency curves are developed and used within dam safety studies. Detailed discussions of data acquisition, data modification, Bulletin 17C procedures, and results interpretation are included.
15:15	16:45	2.6 Workshop	**FLOW FREQUENCY FOR DAM SAFETY STUDIES** (Bartles, Karlovits) This workshop demonstrates how HEC-SSP can be used to perform typical flow- and volume-frequency analyses for use within dam safety studies.
16:45	17:00	Review	2.6 Workshop (Bartles)

Wednesday, 11 March

8:00	9:00	3.1 Lecture	**DEVELOPING GEOMETRIC DATA WITH RAS MAPPER** (Ackerman) This lecture will describe how to use HEC-RAS Mapper to prepare input data to an HEC-RAS model in support of a dam break analysis.
9:00	9:15	**BREAK**	
9:15	11:15	3.2 Workshop	**GEOMETRY DEVELOPMENT WITH RAS MAPPER** (Ackerman) Students will learn how to use HEC-RAS Mapper to prepare the geometric input data for HEC-RAS.
11:15	11:45	Review	3.2 Workshop (Ackerman)
11:45	12:45	**LUNCH**	
12:45	13:30	3.3 Lecture	**DETERMINATION OF DAM BREACH PARAMETERS** (Gibson) Tools and methods in HEC-RAS for development of dam breach parameters and breach modeling, typical problem areas in development of breach parameters.
13:30	14:30	3.4 Lecture	**UNSTEADY FLOW MODELING WITH HEC-RAS** (Sanchez) This lecture will describe how to enter unsteady flow data and boundary conditions, perform the computations, and view results of an unsteady flow analysis.
14:30	14:45	**BREAK**	
14:45	16:30	3.4 Workshop	**UNSTEADY FLOW MODELING FOR DAM SAFETY STUDIES** (Sanchez, Brunner) Students will learn how to model a dam and the downstream area using unsteady flow routing in HEC-RAS.
16:30	17:00	Review	2.6 Workshop (Sanchez)

<u>Thursday, 12 March</u>

8:00	9:00	4.1 Lecture	**USING HEC-RAS TO PERFORM A DAM BREAK ANALYSIS** (Brunner) This lecture will cover how to enter dam break parameters into HEC-RAS, performing the computations, and viewing pertinent results.
9:00	9:15	**BREAK**	
9:15	11:00	4.2 Workshop	**PERFORMING A DAM BREAK ANALYSIS WITH HEC-RAS** (Brunner, Sanchez) This workshop will have students entering dam break parameters, running the model, and viewing results. A range of breach parameters will be tested during the workshop.
11:00	11:30	Review	4.2 Workshop (Brunner)
11:30	12:30	**LUNCH**	
12:30	14:00	4.3 Lecture	**COMMON MODEL STABILITY PROBLEMS WHEN PERFORMING A DAM BREAK ANALYSIS** (Brunner) This lecture will discuss stability problems that are often encountered when applying an unsteady flow model to a dam break situation.
14:00	14:15	**BREAK**	
14:15	15:00	4.4 Lecture	**DETECTING AND FIXING MODEL STABILITY PROBLEMS** (Brunner) This lecture will discuss methods for identifying and fixing model stability problems.
15:00	16:30	4.5 Workshop	**DIAGNOSING AND FIXING COMMON STABILITY PROBLEMS** (Brunner, Sanchez) Students will be given several data sets that have at least one model stability problem. The goal is to identify the problem and to fix it.
16:30	17:00	Review	4.5 Workshop (Brunner)

Friday, 13 March

8:00	9:00	5.1 Lecture	**USING RAS MAPPER FOR INUNDATION MAPPING** (Ackerman) This lecture will describe how RAS Mapper is used to develop inundation maps from HEC-RAS model results.
9:00	10:00	5.2 Workshop	**INUNDATION MAPPING FOR DAM SAFETY STUDIES** (Ackerman) Students will gain hands on experience in using HEC-RAS results to develop inundation maps.
10:00	10:15	Review	5.2 Workshop (Ackerman)
10:15	10:30	**BREAK**	
10:30	12:00		**COURSE WRAP-UP** (Karlovits) Post-test, course critique and closing remarks.