

Hydrologic Analysis for Ecosystem Restoration

Davis, California

Objectives: To provide participants with: 1) an understanding of the issues in restoration studies; 2) an overview of Corps policies and analysis methods for riverine ecosystem restoration studies; 3) an understanding of the role and analytical processes of hydrologic engineering required during the conduct of the studies; and 4) insights into the applicability of a range of tools for the various hydrologic analyses necessary in planning and design of these features.

Monday

8:00 – 8:45 a.m.	Welcome, Introductions, and Course Preliminaries
8:45 – 9:00 a.m.	Break
9:00 – 10:15 a.m.	1.1 Lecture Principles of Restoration Ecology Overview of a variety of wetland types with a focus on understanding the linkages between wetland hydrology and restoration ecology. Constraints on wetland restoration efforts are emphasized.
10:15 – 11:15 a.m.	1.2 Lecture Hydrologic Methods for Ecosystem Restoration Studies including Groundwater-Surface Water Interaction Principles Hydrologic principles, analysis methods, and tools relevant to restoration studies will be presented. Emphasis placed on ground/surface water interactions and methods and tools used in their evaluation.
11:15 – 12:00 p.m.	1.3 Lecture Statistical Primer – Analyzing flow time series Use of statistics to analyze flow frequency, flow duration, and other basic methods for investigating high and low flows.
12:00 – 1:00 p.m.	Lunch
1:00 – 2:00 p.m.	1.4 Lecture Tools for Working with Time Series – HEC-DSSVue and The Nature Conservancy's IHA A demonstration of two software tools used to manage and analyze time series. The IHA will be used in a workshop this afternoon. DSSVue is designed to plot, tabulate, archive, and perform math functions on time

series and paired series data (DSS, which stands for Data Storage System, is the underlying database for most HEC software).

IHA (Indicators of Hydrologic Alteration) is designed to analyze and assess changes in daily hydrologic data in ecologically meaningful terms.

2:00 – 3:30 p.m. 1.5 Workshop **Using IHA**

Workshop provides an introduction and opportunity to run the newest version (V7) of the Indicators of Hydrologic Alteration (IHA) software.

3:30 – 3:45 p.m. Break

3:45 – 5:00 p.m. 1.6 Lecture **Ecohydrology Challenges and Commonalities**

Lecture draws upon experience in several systems (Everglades, Mississippi River, Lake Titicaca, water development in Australia and Brazil, and water quality issues in Brazil) to describe a range of challenges related to ecology and hydrology. Commonalities, especially as related to Corps projects, are highlighted.

Tuesday

- 8:00 – 9:00 a.m. 2.1 Lecture **Linking the hydrological regime with river ecosystem processes and developing environmental flow recommendations**
- The hydrologic regime strongly influences a range of river ecosystem processes and shapes aquatic species' habitat and population dynamics. This presentation examines the linkages between specific components of the flow regime and a species' life history requirements. The session then describes processes for developing environmental flow recommendations, including one method in which scientists focus on linkages between the flow regime, ecosystem processes, and species' life history requirements.
- 9:00 – 9:15 a.m. Break
- 9:15 – 11:00 a.m. 2.2 Workshop **Defining Environmental Flows – A Small Group Exercise**
- The class will be divided into small groups for a hands-on exercise in defining environmental flow requirements for different ecosystem components and addressing the challenge of developing an integrated flow prescription.
- 11:00 – 12:00 p.m. 2.3 Workshop **Using HEC-RPT**
- HEC-RPT (Regime Prescription Tool) is designed to help groups of people reach agreements about how to manage the flow regime of a river. This workshop uses results of the ecosystem flow workshop (2.2) to experiment with HEC-RPT.
- 12:00 – 1:00 p.m. Class photo, Lunch
- 1:00 – 1:45 p.m. 2.4 Lecture **Intro to the Ecosystem Functions Model (HEC-EFM)**
- The EFM is a tool that uses hydrologic and hydraulic input to help make decisions about biological responses. An overview of the Ecosystem Functions Model (EFM) will be presented.
- 1:45 – 3:00 p.m. 2.5 Workshop **Formulating EFM Relationships**
- Class exercise to create EFM relationships that link hydrology and ecology.
- 3:00 – 3:15 p.m. Break
- 3:15 – 3:30 p.m. 2.6 Lecture **HEC-EFM Demo**
- Demonstration of EFM use. This exercise is a primer for the next workshop.
- 3:30 – 5:00 p.m. 2.7 Workshop **Using Statistical Features of HEC-EFM to Assess Eco-change**
- Class exercise to analyze the EFM relationships formulated in the previous session. Statistical results will be analyzed to compare ecological change for multiple flow regimes.

Wednesday

- 8:00 – 11:30 a.m. 3.1 Field Trip **Field Trip to the Yolo Bypass Wetlands**
- Field trip to Yolo Basin wetland with presentation on the history, features, and hydrologic investigation of the study.
- 11:30 – 1:30 p.m. Lunch
- 1:30 – 2:30 p.m. 3.2 Lecture **Hydraulic Analysis Methods for Restoration**
- An overview of analysis methods and analytical tools for planning and designing ecosystems will be presented. Steady, unsteady and multi-dimensional flow applicability and analysis tools will be defined.
- 2:30 – 2:45 p.m. Break
- 2:45 – 3:15 p.m. 3.3 Lecture **Introduction to HEC-RAS and RAS Mapper**
- Basic concepts and program use are covered to provide information about these tools and as background material for the next two workshops.
- 3:15 – 5:00 p.m. 3.4 Workshop **Using HEC-RAS and RAS Mapper to Investigate Ecosystem Change**
- Statistical results from yesterday's EFM workshop will be simulated with HEC-RAS and RAS Mapper to investigate spatial aspects of ecosystem changes with GIS. Multiple flow regimes and ecosystem dynamics will be compared.

Thursday

- 8:00 – 8:30 a.m. 4.1 Lecture **Sediment Transport and Management Considerations**
- Erosion and deposition of sediment is an important consideration for ecosystem restoration projects. Sediment dynamics are significantly altered by human works such as dams and levees. This presentation discusses sediment transport from an ecological perspective and introduces sediment modeling capabilities of HEC-RAS.
- 8:30 – 10:00 a.m. 4.2 Workshop **Application of Hydraulic Principles for Stream Restoration**
- Workshop details and applies HEC-RAS to a stream restoration problem involving the reintroduction of meanders to a previously channelized stream, establishing a sediment budget, and impacts of a grade control structure in sediment dynamics and channel sizing.
- 10:00 – 10:15 a.m. Break
- 10:15 – 11:00 a.m. 4.3 Lecture **Ecosystem Goods and Services (EGS)**
- Ecosystem services are the benefits people obtain from ecosystems. This includes goods such as food and timber, cultural services such as recreation and aesthetics, and many others. This presentation describes the concept of EGS and explains how different aspects of ecosystems and ecological processes affect human well-being.
- 11:00 – 11:45 p.m. 4.4 Lecture **EGS Resources and Potential for use in Planning**
- EGS is a field of study that is active and still taking shape. It has ecological and economic implications. The diversity of goods and services provided by ecosystems makes systematic and comprehensive accounting difficult. Notable projects and resources will be described. Useful literature will be highlighted. Discussion connects EGS concepts with the potential to apply resources to restoration planning.
- 11:45 – 12:45 p.m. Lunch
- 12:45 – 1:15 p.m. 4.5 Lecture **Introduction to HEC-GeoEFM**
- GeoEFM is the spatial accessory for EFM. It helps users 1) manage spatial data, 2) compute habitat areas, and 3) assess habitat connectivity. This lecture introduces GeoEFM and details how it is applied in support of restoration projects.
- 1:15 – 3:00 p.m. 4.6 Workshop **Using HEC-GeoEFM**
- Spatial results from yesterday's RAS and GeoRAS workshop are used in GeoEFM to assess habitat areas and connectivity. Multiple flow regimes and relationships will be compared.
- 3:00 – 3:15 p.m. Break
- 3:15 – 3:30 p.m. 4.7 Lecture **Mapping Habitat based on 2D River Hydraulics Output**
- EFM can apply ecological criteria to 2D river hydraulics model output. This lecture details this feature and introduces the workshop.
- 3:30 – 5:00 p.m. 4.8 Workshop **Using EFM with 2D River Hydraulics Models**
- Spatial output from a 2D river hydraulics model will be used in EFM to map habitat

for floodplain plant communities. Habitat will be visualized in GIS. An alternative will be assessed.

Friday

- 8:00 – 9:00 a.m. 5.1 Lecture **The Nature Conservancy, the Corps, and ESWM**
- Introduction to The Nature Conservancy (TNC), explanation of TNC's interests in and work related to freshwater biodiversity conservation and sustainable water management, and summary of TNC's collaboration with the Corps in ecosystem restoration.
- 9:00 – 9:15 a.m. Break
- 9:15 – 9:30 a.m. 5.2 Lecture **Introduction to HEC-EFMSim**
- EFMSim is a new software tool that uses spatial and temporal data sets to predict changes in ecological communities. It allows modelers to test the effects of land management practices, water management decisions, water quality concerns, and any other spatial and temporal variable of interest. This work is intended to simulate ecosystems for large spatial areas and long periods of record and is significantly expanding the computational abilities of HEC ecological software.
- 9:30 – 11:00 a.m. 5.3 Workshop **Using EFMSim**
- EFMSim has the ability to simulate both stationary and mobile ecological communities. In this workshop, spatial and temporal data will be used to: 1) define a study area and model layout, 2) create variables, 3) and simulate ecosystem dynamics for vegetative (stationary) and animal (mobile) communities.
- 11:00 – 11:30 p.m. Post-course Test and Critique