3/24/22

Hydrologic Analysis for Ecosystem Restoration

28 March - 01 April 2022

Virtual (https://usace1.webex.com/meet/john.hickey)

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.

Time: To accommodate participants in multiple time zones, core instruction hours are 8:00 a.m. to 2:00 p.m. pacific standard time (P) / 11:00 a.m. to 5:00 p.m. eastern standard time (E). Each full course day, M-Th, will conclude with a 1.5-hour “FLEX” workshop that can be done either at the end of that day or the beginning of the next day. Both options will be staffed with instructors. HEC-hosted virtual machines with required data and software are provided for participants.

HEC Instructors

David Ho
Beth Faber
Karl Tarbet
John Hickey
Sara O’Connell
Julia Slaughter
Stanford Gibson
Cam Ackerman

Guest Instructors

Paul Gagnon, IWR
Julie DeMeester, TNC
Kristen Blann, TNC
Heidi Mehl, TNC
Jim Howe, TNC
Barbara Charry, TNC
Dave Crane, CENWO
Viv Bennett, TNC
Shelly Morris, TNC

Monday, March 28

(start) 8 P / 11 E **Welcome, Introductions, and Course Preliminaries (30 min)**

8:30 P / 11:30 E 1.1 Lecture **Principles of Restoration Ecology (60 min)**

An overview of various wetland types with a focus on both: 1) the importance of hydrology for plant survival and growth and 2) the necessity of restoring ecosystem processes in successful ecological restoration *(Paul Gagnon, IWR).*

9:30 P / 12:30 E 1.2 Lecture **Hydrologic Methods for Ecosystem Restoration Studies including Groundwater-Surface Water Interactions (60 min)**

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 *(David Ho, HEC).*

10:30 P / 1:30 E 1.3 Lecture **Statistical Primer – Analyzing flow time series (60 min)**

Use of statistics to analyze flow frequency, flow duration, and other basic methods for investigating high and low flows *(Beth Faber, HEC).*

11:30 P / 2:30 E Break **(30 min)**

12 P / 3 E 1.4 Lecture **Considering History in Ecological Restoration (60 min)**

Restoration requires some understanding of ecosystem and site history. This section is an overview of human modifications to North American ecosystems before and since the arrival of European settlers, with a special focus on the Mississippi Alluvial Valley *(Paul Gagnon, IWR).*

1 P / 4 E 1.5 Lecture **Tools for Working with Time Series – HEC-DSSVue (30 min) and The Nature Conservancy's IHA (30 min)**

A demonstration of two software tools used to manage and analyze time series.

DSSVue is designed to plot, tabulate, archive, and perform math functions on time series and paired series data. DSS (Data Storage System) is the underlying database for most HEC software *(Karl Tarbet, HEC).*

IHA (Indicators of Hydrologic Alteration) is designed to analyze and assess changes in daily hydrologic data in ecologically meaningful terms. IHA will be used in a workshop following this lecture *(Julie DeMeester, TNC).*

FLEX 1.6 Workshop **Using IHA**

Workshop provides an introduction and opportunity to run the newest version (V7) of the Indicators of Hydrologic Alteration (IHA) software *(Julie DeMeester and Kristen Blann, TNC, and John Hickey, HEC).*

FLEX SESSIONS are from 2:00 to 3:30 p.m. pacific standard time and 9:30 to 11:00 a.m. eastern standard time the next morning.

Tuesday, March 29

(start) 8 P / 11 E 1.6 Workshop **Using IHA: Recap (30 min)**

Review of IHA workshop and opportunity for questions *(Julie DeMeester, TNC).*

8:30 P / 11:30 E 2.1 Lecture **Linking the hydrological regime with river ecosystem processes and developing environmental flow recommendations (60 min)**

Hydrologic regimes strongly influence a range of river ecosystem processes and shapes aquatic species' habitat and population dynamics. Presentation examines linkages between specific components of the flow regime and species' life history requirements. Session then describes environmental flow processes, including a method in which scientists focus on linkages between the flow regime, ecosystem processes, and species' life history requirements *(Heidi Mehl, TNC).*

9:30 P / 12:30 E 2.2 Workshop **Defining Environmental Flows – A Small Group Exercise**

Class will split 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 *(Julie DeMeester, Heidi Mehl, and Jim Howe, TNC, and John Hickey, HEC).*

9:30 P / 12:30 E 2.3 Workshop **Using HEC-RPT (120 min, 2.2 and 2.3 combined)**

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 explore HEC-RPT *(Julie DeMeester, Heidi Mehl, and Jim Howe, TNC, and John Hickey, HEC).*

11:30 P / 2:30 E Class photo, break **(30 min)**

12 P / 3 E 2.4 Lecture **Intro to the Ecosystem Functions Model (HEC-EFM; 30 min)**

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 *(John Hickey, HEC).*

12:30 P / 3:30 E 2.5 Workshop **Ecological Performance Measures using Statistics (75 min)**

Class exercise to create performance measures that link hydrology and ecology *(John Hickey, Julia Slaughter, and Sara O'Connell, HEC).*

1:45 P / 4:45 E 2.6 Lecture **HEC-EFM Demo (15 min)**

Demonstration of EFM use. This exercise is a primer for the next workshop *(John Hickey and Sara O'Connell, HEC).*

FLEX 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 *(John Hickey, Julia Slaughter, and Sara O'Connell, HEC).*

Wednesday, March 30

(start) 8 P / 11 E 2.7 Workshop **Using HEC-EFM: Recap (30 min)**

Review of EFM workshop and opportunity for questions *(John Hickey, HEC).*

8:30 P / 11:30 E 3.1 Lecture **Introduction to The Nature Conservancy (15 min)**

This session explores partnerships between USACE and The Nature Conservancy, a global nonprofit with a mission of conserving the lands and waters on which all life depends *(Jim Howe, TNC).*

8:45 P / 11:45 E 3.2 Lecture **Overview of the Sustainable Rivers Program (45 min)**

The Sustainable Rivers Program is an ongoing partnership between USACE and TNC that uses science and collaboration to find new ways to operate USACE dams and infrastructure sustainably. SRP uses many of the tools and techniques explained in this week's course *(Jim Howe, TNC).*

9:30 P / 12:30 E 3.3 Lecture **Nature-Based Solutions from the Mississippi, Part 1 (60 min)**

Session takes a closer look at two public-private partnerships to implement nature-based solutions that could be replicated elsewhere. In Missouri, the L-536 levee setback along the Missouri River is the largest such setback in U.S. history. The new levee is constructed with modern design standards and provides hydraulic and economic benefits, while reconnecting over 1,000 acres of floodplain and creating 420 acres of wetlands *(Barbara Charry, TNC, and Dave Crane, CENWO).*

10:30 P / 1:30 E 3.4 Lecture **Nature-Based Solutions from the Mississippi, Part 2 (60 min)**

In Illinois, Dogtooth Bend is a 17,000-acre peninsula near the confluence of the Mississippi and Ohio Rivers. Flood events have repeatedly breached a levee to the point that local landowners have asked for alternatives to get them out of harm's way. The Nature Conservancy, USDA, USACE, and others have teamed up on a $25 million floodplain restoration effort *(Viv Bennett and Shelly Morris, TNC).*

11:30 P / 2:30 E Break **(30 min)**

12 P / 3 E 3.5 Lecture **Hydraulic Methods and HEC-RAS for Restoration (60 min)**

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 *(Stanford Gibson, HEC).*

1 P / 4 E 3.6 Lecture **HEC-RAS and RAS Mapper Demo (60 min)**

Basic concepts and program use are covered as background material for the next two workshops *(Cam Ackerman, HEC).*

FLEX 3.7 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 *(Cam Ackerman and John Hickey, HEC).*

Thursday, March 31

(start) 8 P / 11 E 3.5 Workshop **Habitat mapping with HEC-RAS: Recap (30 min)**

Review of EFM to RAS workshop *(John Hickey, HEC).*

8:30 P / 11:30 E 4.1 Lecture **Sediment Transport and Management Considerations (30 min)**

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 *(Stanford Gibson, HEC).*

9 P / 12 E 4.2 Workshop **Application of Hydraulic Principles for Restoration (90 min)**

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 *(Stanford Gibson and Cam Ackerman, HEC).*

10:30 P / 1:30 E 4.3 Lecture **Introduction to HEC-GeoEFM (30 min)**

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 *(John Hickey, HEC).*

11 P / 2 E Break **(30 min)**

11:30 P / 2:30 E 4.4 Workshop **Using HEC-GeoEFM (105 min)**

Spatial results from workshop 3.4 are used in GeoEFM to assess habitat areas and connectivity. Multiple flow regimes and relationships will be compared *(Sara O'Connell, Julia Slaughter, and John Hickey, HEC).*

1:15 P / 4:15 E 4.5 Lecture **Habitat Mapping with 2D River Hydraulics Output (45 min)**

EFM can apply ecological criteria to 2D river hydraulics model output. This lecture details this feature and introduces the workshop *(John Hickey, HEC).*

FLEX 4.6 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 *(John Hickey, Julia Slaughter, and Sara O'Connell, HEC).*

Friday, April 1

(start) 8 P / 11 E 4.6 Workshop **Using EFM with 2D Models: Recap (30 min)**

Review of EFM 2D workshop *(John Hickey, HEC).*

8:30 P / 11:30 E 5.1 Lecture **Concepts related to Ecological Population Dynamics (30 min)**

Comparing management alternatives based on fluctuations in populations of natural communities is intuitive and challenging. Intuitive because population counts and trends are easy to comprehend and challenging because population dynamics are a reflection of a myriad of physical, chemical, and biotic conditions and interactions. Consideration of population dynamics allows modelers to test the effects of land management practices, water management decisions, water quality concerns, and other variables of interest *(John Hickey, HEC).*

9 P / 12 E 5.2 Workshop **Modeling of Ecological Population Dynamics (90 min)**

Workshop explores simulation of ecological communities. Participants will: 1) delineate an area of interest, 2) create variables, 3) and simulate population dynamics for plant and animal communities *(John Hickey, Julia Slaughter, and Sara O'Connell, HEC).*

10:30 P / 1:30 E Post-course Test and Critique **(60 min)**