College of Applied Sciences-Nepal

Tribhuvan University

Bishwa Prakash Puri

Hydrological Modelling using HEC-HMS and HEC-RAS

work.bishwapuri@gmail.com

9843314630

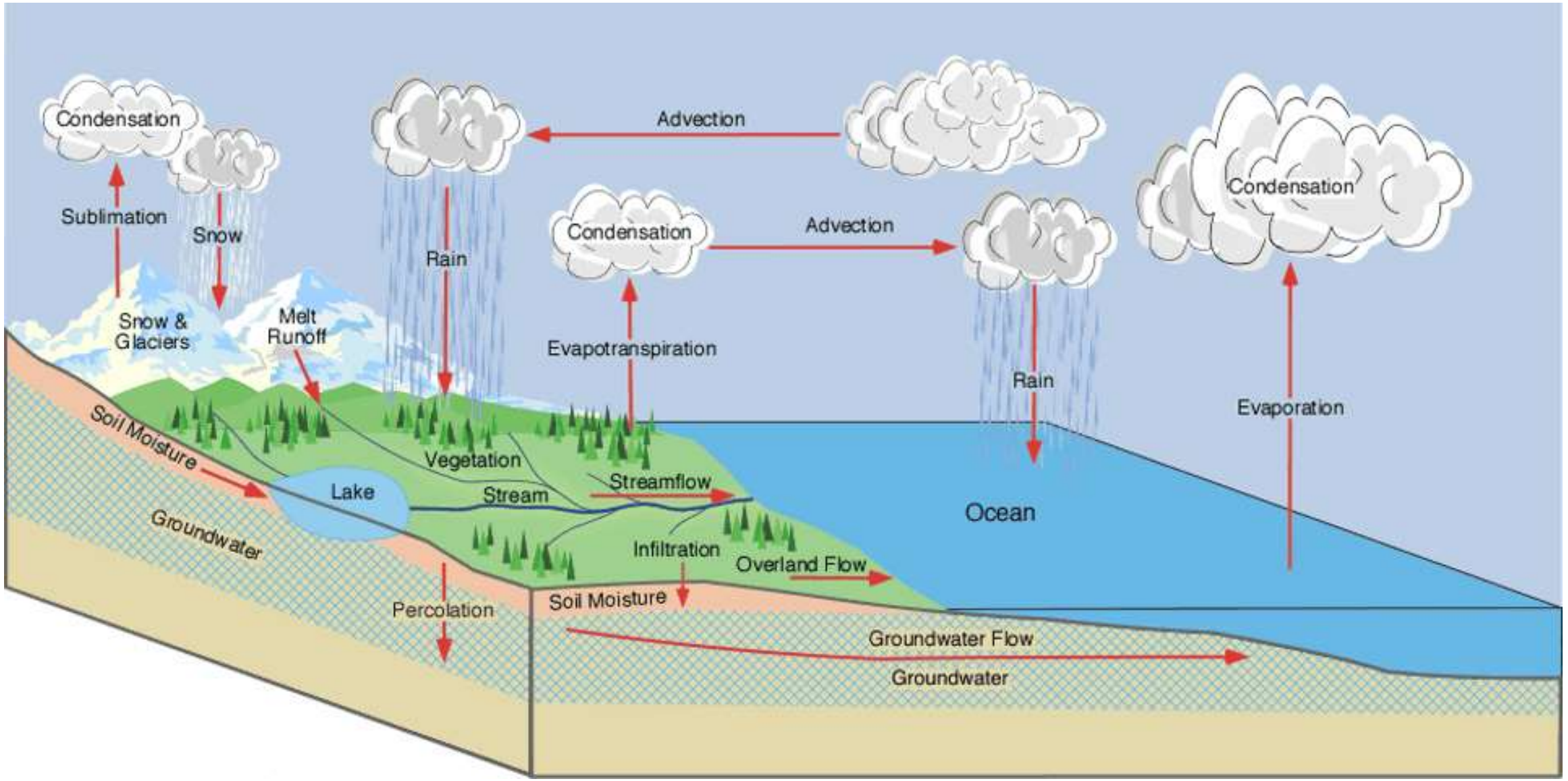
What will we cover?

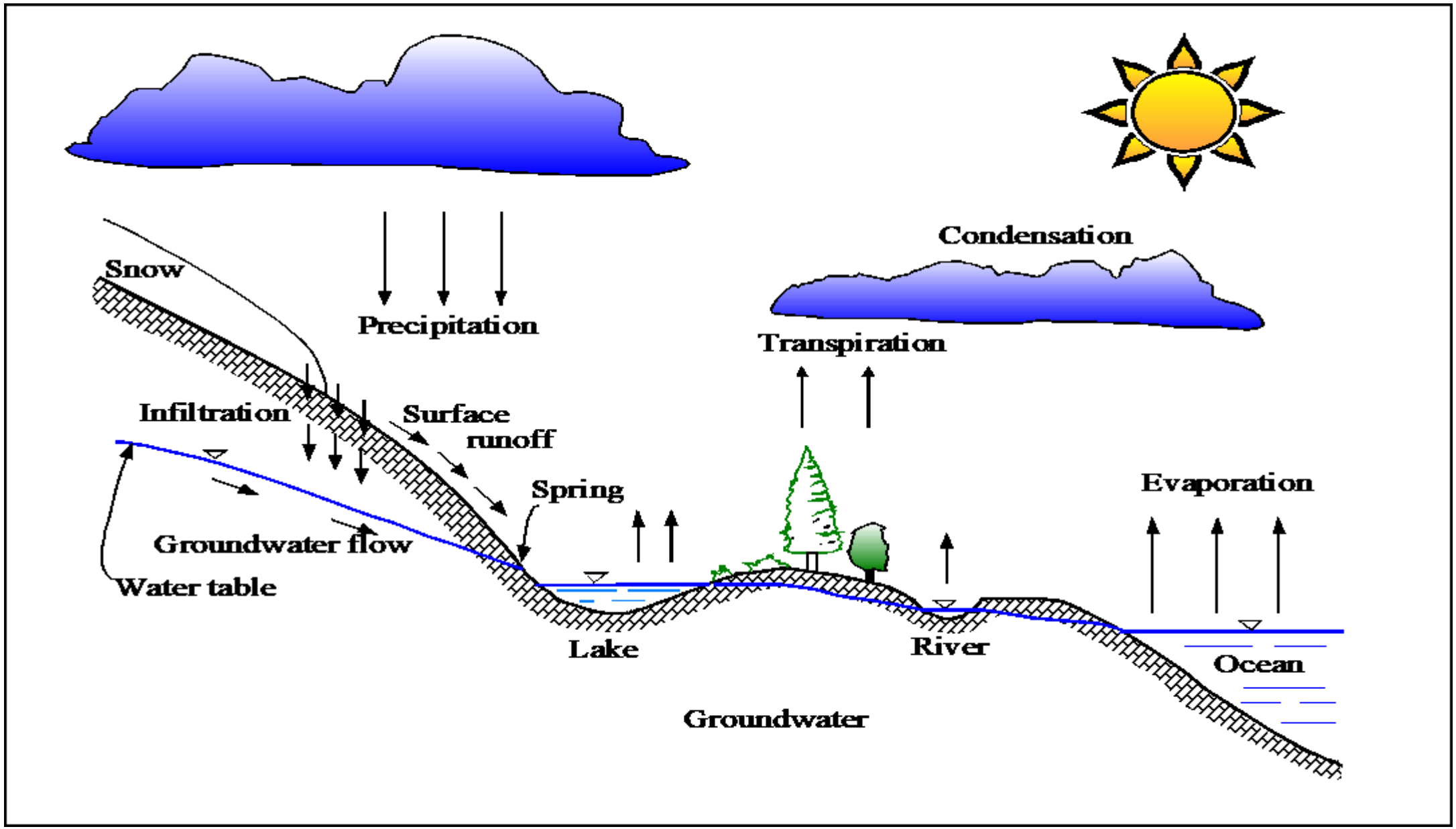
- Hydrological modelling (~~snowmelt model~~, rainfall-runoff model, ~~SWAT~~)

Objectives

- To determine the flood frequency analysis and flood plain analysis by using Gumbel's Distribution Method
- To determine flood return period of 2, 100, 500 years of Balkhu River Basin.
- To create river channel geometry of Balkhu River Basin using HEC-RAS.
- To study and determine land-use change analysis

Complexity of Hydrology




Snow
Precipitation
Condensation
Transpiration
Infiltration
Surface
runoff
Spring
Groundwater flow
Water table
Lake
River
Evaporation
Ocean
Groundwater

Hydrology and Hydraulics

- What is hydrology?

• Hydrology is the study of the circulation of water and its constituents through the hydrologic cycle or the quantification of flows that are ultimately produced by precipitation. It deals with precipitation (rain, snow, sleet, hail, etc.), evaporation, infiltration, groundwater flow, surface runoff, streamflow, and the transport of substances dissolved or suspended in flowing water. Hydrology typically refers to the rate of precipitation, the quantity of water, the rate of surface runoff, and the timing of its arrival at a point of interest.

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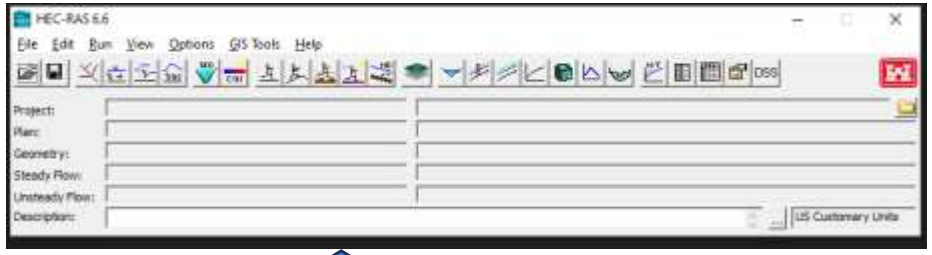
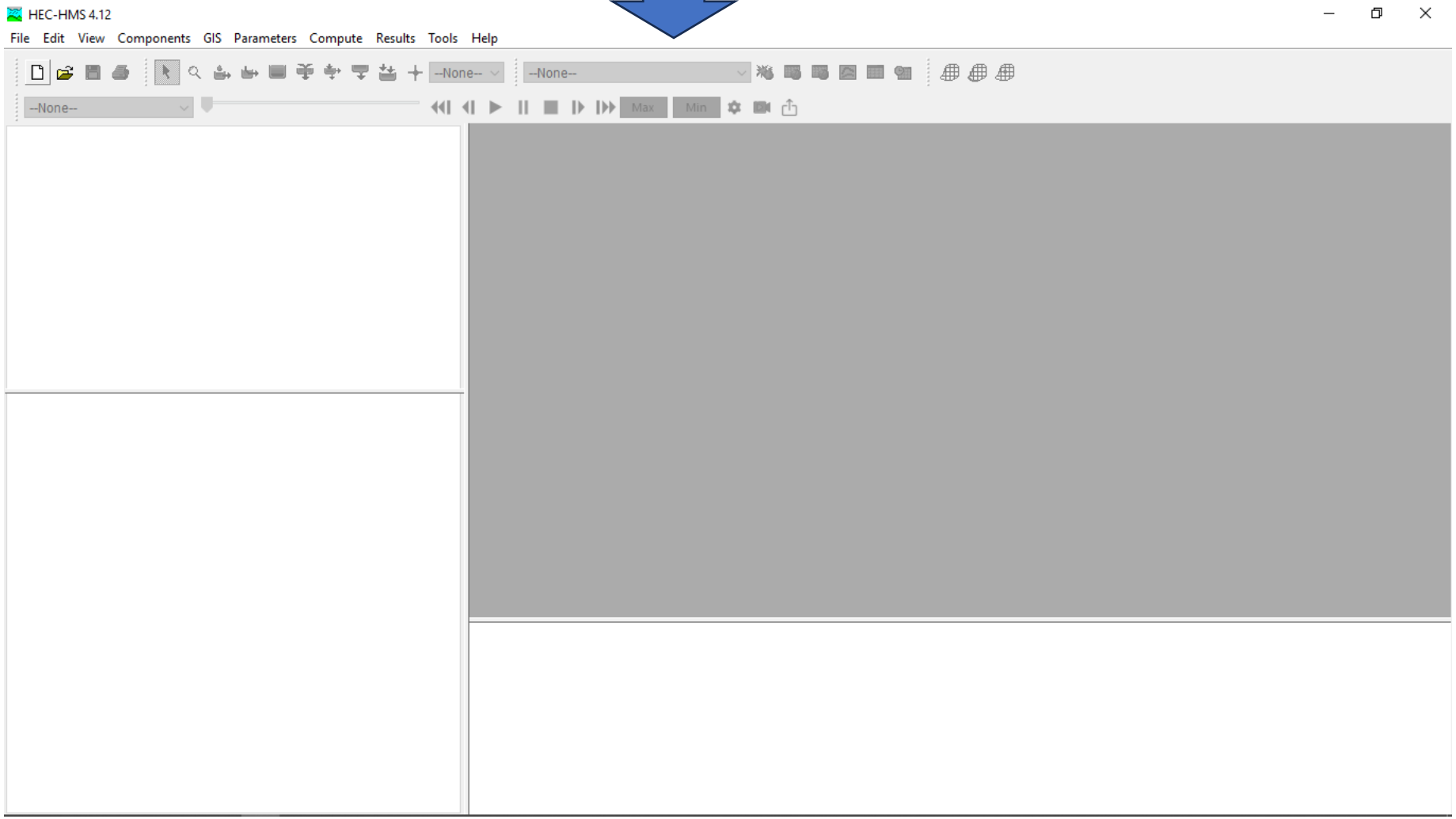
• What is hydraulics?

• Hydrologic is defined as the study of the mechanical behavior (movement/flow) of water in physical systems. Hydraulics analyzes how surface and/or subsurface flows move from one point to the next. A hydraulic analysis is used to evaluate flow in rivers, streams, storm drain networks, water aqueducts, water lines, sewers, etc.

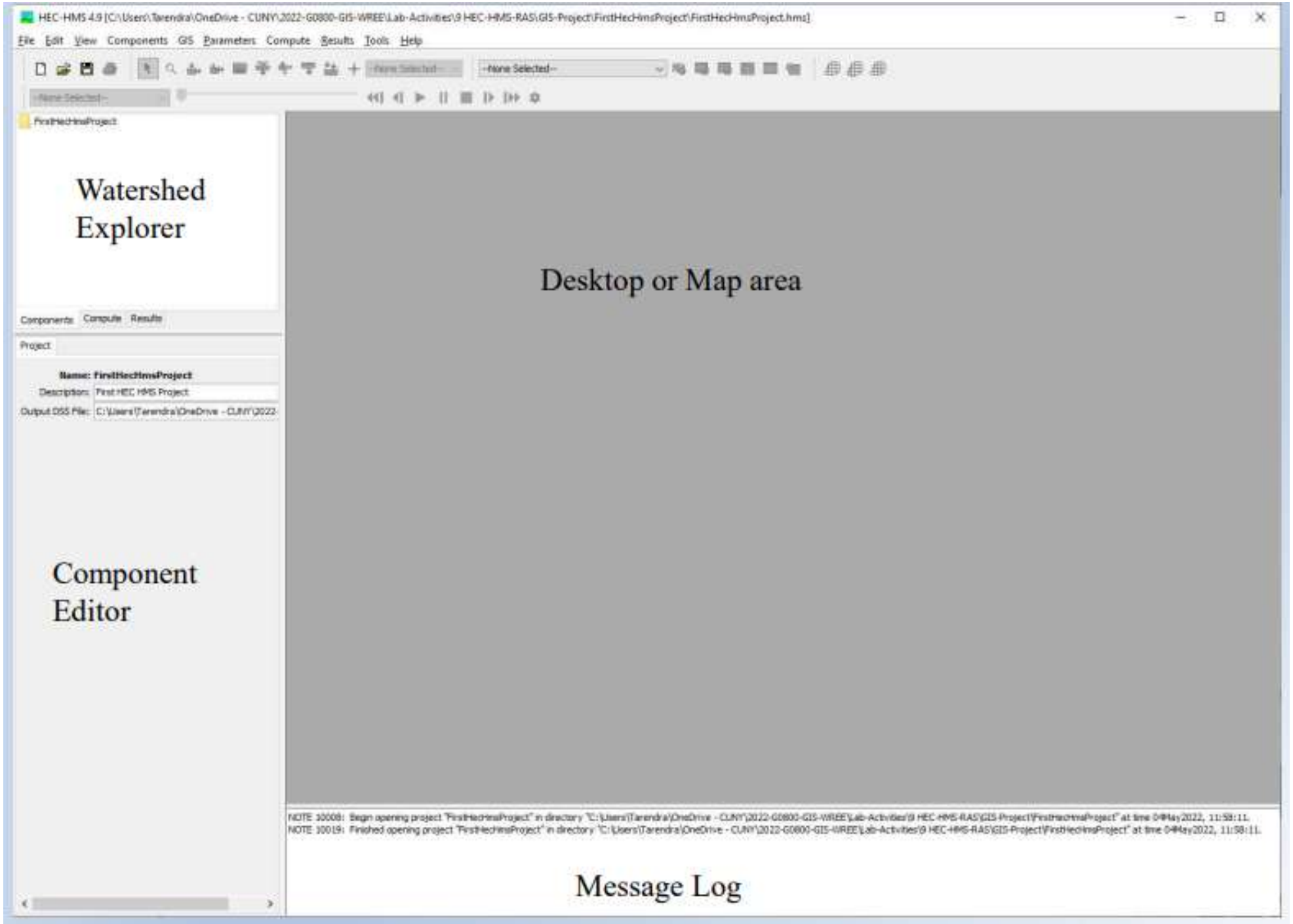


HEC-HMS is best suited for watershed-scale hydrological analysis, focusing on how rainfall translates into runoff and streamflow.

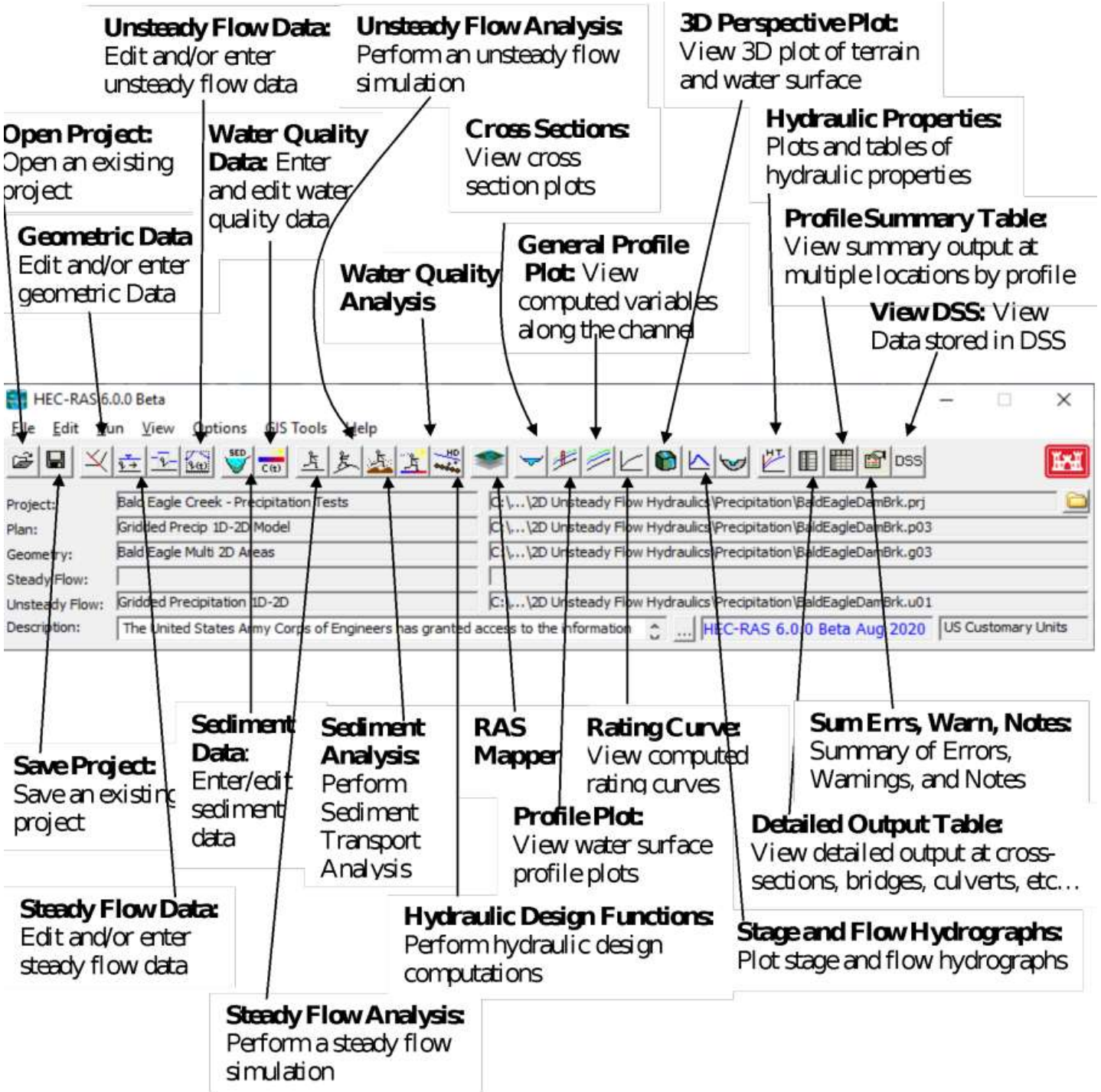
- **HEC-RAS** excels at channel and floodplain hydraulic analysis, providing detailed insights into how water flows within and beyond rivers.



HEC-HMS, how it looks like!!!



How about **HEC-RAS**, how it looks like!!!

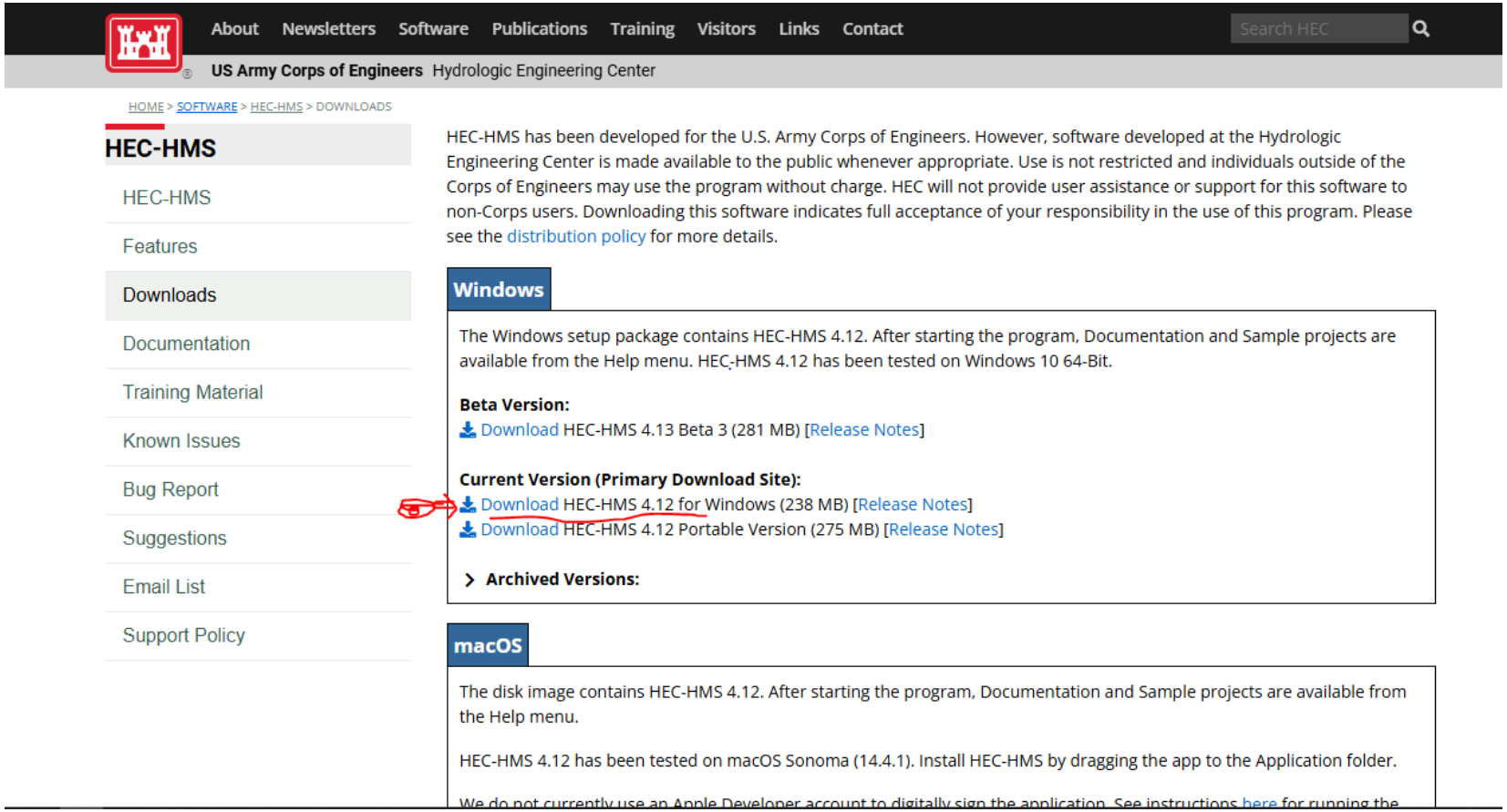


Differences

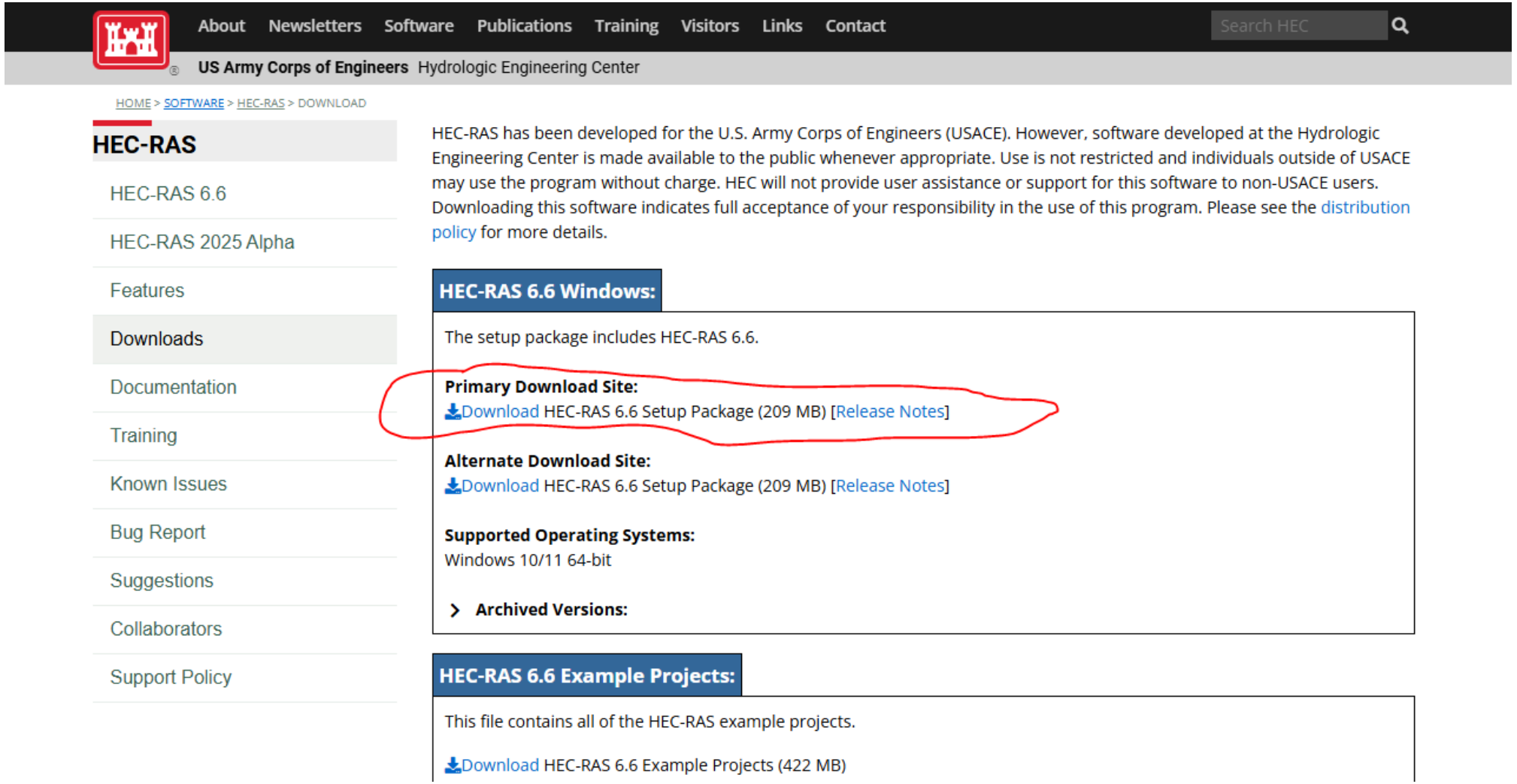
	HEC-RAS	HEC-HMS
Primary Purpose	Hydraulic modeling of water flow in rivers and channels.	Hydrologic modeling of precipitation-runoff processes in watersheds.
Key Functions	- Simulates steady and unsteady flow, sediment transport, and water quality. - Models floodplain mapping and water surface profiles.	- Simulates rainfall-runoff processes, streamflow, and reservoir operations. - Estimates peak flows, hydrographs, and watershed responses.
Input Requirements	- Geometric data (cross-sections, channel properties). - Boundary conditions (flow and stage data).	- Precipitation data, land-use data, and watershed characteristics. - Soil properties and meteorological inputs.
Output	- Water surface elevations, flow rates, velocity profiles, and flood extents.	- Hydrographs, runoff volumes, infiltration, and streamflow simulations.
Primary Applications	- Floodplain mapping, levee breach analysis, dam break studies.	- Rainfall-runoff modeling, watershed management, reservoir optimization.
Spatial Scale	- Focuses on localized, detailed hydraulic modeling (channels and floodplains).	- Basin-wide or watershed-level hydrological modeling.

Links for download

HEC-HMS: https://www.hec.usace.army.mil/software/hec-hms/downloads.aspx



HEC-RAS: https://www.hec.usace.army.mil/software/hec-ras/download.aspx



HEC-DSSVue

:https://www.hec.usace.army.mil/software/hec-dssvue/downloads.aspx