System-Wide Water Resources Program
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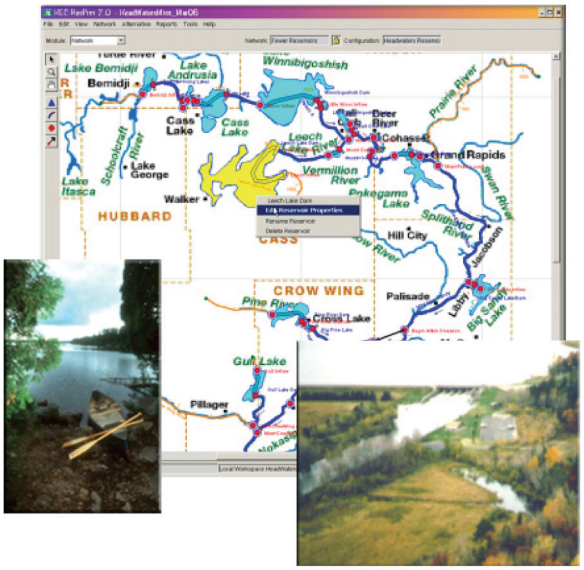
Hydrologic Engineering Center-Reservoir Evaluation System (HEC-RES)

Description: The Hydrologic Engineering Center (HEC) of the U.S. Army Corps of Engineers has built an array of tools for analyzing reservoir systems. Currently, three individual reservoir modeling tools exist, performing both simulation and optimization of reservoir system operations. The tools include: 1) Reservoir Simulation (HEC-ResSim), 2) Multi-Objective Reservoir Optimization (Prescriptive Reservoir Model, HEC-PRM), and 3) Reservoir Flood Control Optimization (HEC-FloodOpt).

HEC-ResSim is a reservoir simulation model that makes operation decisions that follow user-specified operating rules or guidelines. HEC-PRM and HEC-FloodOpt are optimization models that make operation decisions that maximize system objectives and values defined by the user. HEC combines these three modeling tools into one package, the Reservoir Evaluation System (HEC-RES). HEC-RES will allow users to easily alternate between simulation and optimization analysis, providing more robust analysis for reservoir investigations than by using one model alone. Additionally, output from the synchronized product will be more readily exported to other models for further computation.

Application: The simulation component of HEC-RES, ResSim, has received extensive use in real-time water control as part of the Corps Water Management System (CWMS). It has more recently been applied as a planning tool for studies in the Willamette and Green River basins and watersheds in Afghanistan and Iraq.



The multiobjective optimization component, HEC-PRM, has most recently been applied to the Reservoir Operation Plan Evaluation (ROPE) of the Mississippi River headwaters, an effort to develop a new plan for reservoir system operation that balances the needs of all system stakeholders and all functions of the system. The study demonstrates the symbiotic benefit of utilizing both optimization modeling and simulation modeling in a single analysis.

Benefits: The combined reservoir tools (HEC-Reservoir Evaluation System) will readily allow reservoir system analysis that utilizes both optimization and simulation techniques. A multi-objective optimization seeks to define the trade-offs between competing system objectives, achieve a user-chosen balance between them, and determine operating solutions that surpass

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incremental changes from the current system rules. A reservoir system simulation allows an analysis that can determine the results of suggested operational changes on a realistic, detailed representation of the system. Using these methods in conjunction brings the benefits of both methods for a more thorough and effective analysis. HEC-RES enables application of both modeling techniques with minimal effort and easy interchange between the models.

Future Capabilities: The finished product, HEC-RES, will offer both an advanced reservoir system optimization and a reservoir simulation tool that operate at multiple scales and time-steps. The optimization component will be upgraded to use a Mixed-Integer Programming solver with the ability to consider non-convex relationships, fixed costs, and system dynamics beyond a pure-network representation.

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