

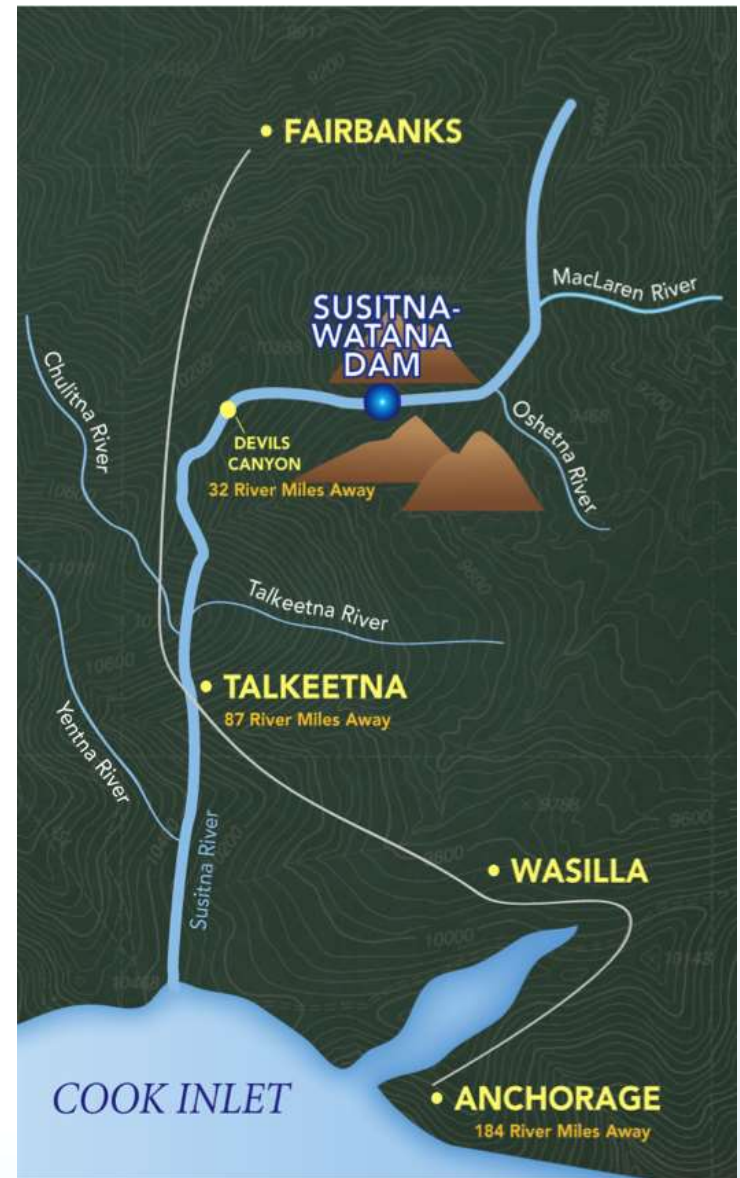
Reservoir Operation Modeling

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Reservoir Operations Modeling Outline

- Reservoir operation models – Overview
 - Purpose
 - Input
 - Output
 - Schedule
 - Input dependencies
 - Output interface



Models and Purpose

Models

- HEC-ResSim – Developed by the U.S. Army Corps of Engineers, Hydrologic Engineering Center
 - A standard, publicly available reservoir operation model with hydroelectric generation capabilities
- MWH-ROM – Reservoir operation model developed by MWH
 - Can be programmed to model unique or complex operations, can iteratively maximize firm energy, runs fast

Purpose

- Previously – Reservoir and powerhouse sizing, firm power and average energy determination, provide detail on reservoir outflows and elevations
- Currently – focus is on outflows for various operating scenarios and instream flow requirements
- Water quality parameters are not modeled



Model Input

Inflow Hydrology

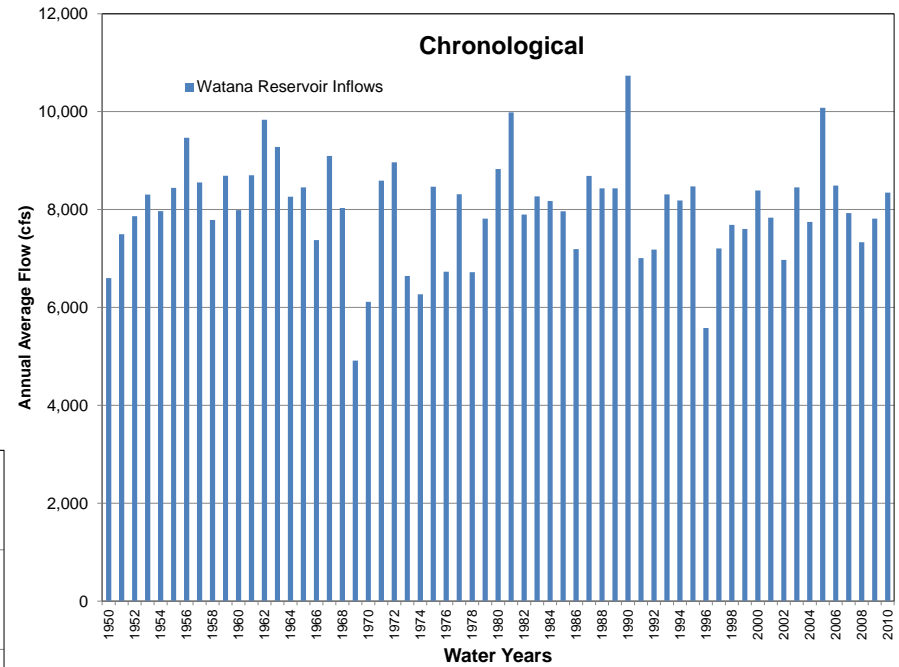
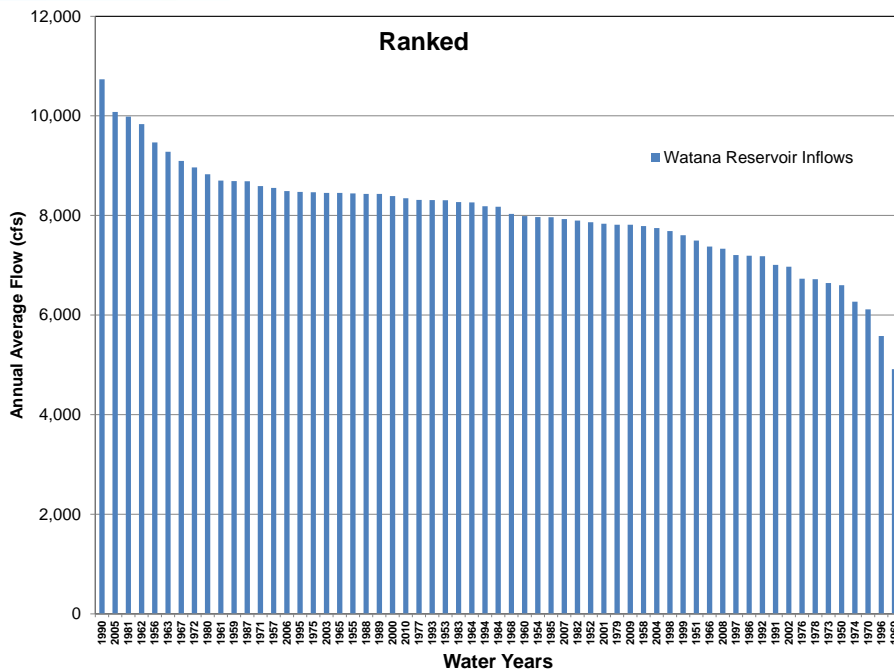
- Based on 61 water year record of daily flows developed by the USGS at gaging stations from October 1949 – September 2010
- Watana is located about half-way by drainage area between the Cantwell and Gold Creek gages.
- Inflows to Watana based on proportioning flow between Cantwell and Gold Creek by drainage area

Physical Parameters

- Maximum and minimum operating pool elevations
- Storage capacities (acre-feet) at various elevations
- Powerhouse capacities and efficiencies
- Outlet capabilities of valves and spillway
- Tailwater rating curve



Watana Reservoir Annual Inflows



Model Input (cont.)

Model Temporal Resolution – All Parameters

- Hourly – entire 61 year period of operation

Model Extent

- Watana Reservoir to Gold Creek USGS gage

Operating Parameters

- Energy load placed on Watana – hourly basis
- The energy load essentially defines the operating mode – load following, base load, etc.
- November – April firm energy reliability
- Maximized generation output
- Minimum release requirements and location – daily basis
- Operating rules – For example, may require high outflows or limit high outflows
- Different operating rules in flood control storage – above EI 2050
- Others to be developed

Model Output

Model Output Parameters

- Total generation – all generation is assumed to be usable
- Generation parameters: turbine flows, efficiencies, head
- November – April firm generation for a specified reliability
- Total reservoir outflow
- Outflows at turbine, valve, and spillway
- Reservoir elevations
- Flows at Gold Creek
- Essentially any parameter calculated by the model

Output Interface with Other Models

- Provides hourly and daily outflow at the dam for selected time periods
- Other parameters are available, if needed

Additional Model Considerations

Model Calibration – Because the reservoir does not exist, calibration data are unavailable

Model Verification – Provided by reasonable correspondence of results between HEC-ResSim and MWH-ROM models

Units – English units – cfs, feet, MWh

Input Dependencies

- Requires no input from other models
- Operating scenarios – to be developed

Schedule

- Basic models are completed
- Additional model runs as directed by AEA