

Study Title	Study Objectives	Potential Study Methods	Relevant 2012 Components	2012 Study Titles	Purpose
Flow Routing Study	1) Develop a calibrated/validated routing model for the Susitna River downstream of Watana Dam.	1a) Select a routing model that can be used to route flow releases from Watana Dam and tributary inflows/accretions. The model must be able to accurately account for the travel time, attenuation, and elevation of flow releases along the length of the river with and without the presence of ice. The model must be capable of $\leq 1$ hour time steps. Coordinate with the Ice Processes Study. 1b) Develop the routing model using cross-section data collected in the WR-S1 Study. 1c) Calibrate the routing model to observed water surface elevation data, ice elevation data, and observed natural flow fluctuations in the Susitna River. 1d) Validate the routing modeling using natural flow fluctuation data observed in the Susitna River in both with and without ice conditions. 1e) Model example load following scenarios to test the model and assess the predicted attenuation of flow fluctuations with and without ice conditions.	<ul style="list-style-type: none"> <li>• Updated (replaced) 1981 cross-section information for Middle Susitna River reach for use in the current modeling;</li> <li>• New transect locations and data at representative locations from RM 97 to RM 75 in the in the upper portion of the Lower river;</li> <li>• Water surface elevation and roughness data sets for model calibration and verification.</li> </ul>	WR-S1: River Flow Routing Model Transect Data Collection Study	<ul style="list-style-type: none"> <li>• Provide a method to estimate discharge and water surface elevation along the length of the Susitna River based on Existing and alternative with-Project stream flows with and without ice conditions;</li> <li>• Provide discharge and water surface elevation input data for other studies (e.g., Fluvial Geomorphology Modeling, Instream Flow, Instream Flow Riparian, Productivity, Ice Processes, Water Quality, and Fish Passage studies); and</li> <li>• Provide a basis for impact assessment; developing A/P measures; developing PME measures; and developing resource management / monitoring plans.</li> </ul>
	2) Provide time series of existing and alternative with-Project flows and water surface elevations that can be used as the basis of other modeling efforts, as appropriate.	2) Model time series data sets of flow and elevation along the length of the river with and without ice conditions. Coordinate with other studies (ice processes, instream flow, instream flow riparian, fluvial geomorphology, fish passage and water quality) to obtain data inputs and provide flow/elevation data as needed for existing and alternative with-Project analyses.			
Ice Processes Study	1) Document ice processes in the Susitna River.	1) Monitor and record existing ice processes in the Susitna River RM 0 to RM 250 (timing and progression of ice formation and breakup; ice cover elevation and thickness; documentation of ice process on channel morphology, riparian vegetation, and aquatic habitats). Include the extensive ice process observations in the 1980s studies.	<ul style="list-style-type: none"> <li>• Documentation of the timing and progression of breakup and ice cover formation on the Susitna River between RM 0 and RM 250.</li> <li>• Measurements of ice cover, elevation and thickness.</li> <li>• Documentation of the interaction between river ice processes and channel morphology, riparian vegetation and aquatic habitats.</li> <li>• Identification of the river reaches most likely to experience changes in river ice formation as a result of Project construction and operation.</li> </ul>	WR-S2: Documentation of Susitna River Ice Breakup and Formation Study	<ul style="list-style-type: none"> <li>• Provide a method to model existing and alternative with-Project ice processes in the Susitna River (timing and progression of ice formation and breakup; ice cover elevation and thickness; effects on channel morphology, vegetation, and aquatic habitats);</li> <li>• Provide ice processes input data for the Fluvial Geomorphology Modeling, Instream Flow, Instream Flow Riparian, Productivity, and Fish Passage studies; and</li> <li>• Provide a basis for impact assessment; developing A/P measures; developing PME measures; and developing resource management / monitoring plans.</li> </ul>
	2) Model ice processes in the Susitna River downstream of the proposed Watana Dam site and estimate the potential for changes for a range of with-Project operations.	2a) Review and summarize existing hydropower projects (pertinent the Susitna River) with respect to winter operations, ice process issues, and minimization of ice process impacts. 2b) Select and develop an appropriate Susitna River ice processes modeling approach that includes dynamic routing capability or can use dynamic routing data inputs. Coordinate with the Flow Routing Study. 2c) Calibrate and validate the river ice processes modeling approach. Coordinate with the Water Quality Modeling Study to obtain input water temperature data for with-Project conditions. 2d) Predict existing and a range of alternative with-Project operations ice processes, including timing and progression of ice formation and breakup, extent of ice cover, ice cover elevation and thickness; effects on channel morphology, riparian vegetation, and aquatic habitats.			
	3) Coordinate with other studies to provide ice processes data. Coordinate with the Water Quality Modeling study to assist with reservoir ice predictions, as needed.	3) Coordinate with the Instream Flow, Instream Flow Riparian, and Fluvial Geomorphology studies to provide ice processes data as needed for existing and alternative with-Project analyses. Evaluate the Watana Reservoir water quality model predictions of reservoir ice formation, persistence, and melting. If needed, assist with the reservoir ice modeling.			

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Upper Susitna River Basin Glacier and Hydrologic Runoff Model Study	1) Develop a glacier/hydrologic runoff model of the upper Susitna River basin (above RM 184).	1a) Compile data, review glacier wastage & watershed hydrology. 1b) Process remote sensing imagery. 1c) Monitor glacier mass balance. 1d) Collect summer glacier balance measurements. 1e) Collect winter glacier balance measurements. 1f) Develop map(s) of glacier extent variation. 1g) Develop the glacier and hydrological model.	NA	NA	<ul style="list-style-type: none"> <li>• Provide a simulation of future changes to the quantity and seasonality of the river runoff in the upper Susitna River basin;</li> <li>• Provide hydrology input data for the operations modeling and other resource studies; and</li> <li>• Provide a basis for impact assessment; developing A/P measures; developing PME measures; and developing resource management / monitoring plans.</li> </ul>
	2) Simulate future changes in quantity and seasonality of river runoff in the upper Susitna River basin.	2) Simulate the Susitna River response to changing climate through 2100.			