

# Initial Study Report Meeting

## *Study 5.6 Water Quality Modeling*

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## Study 5.6 Objectives

- Implement (with input from licensing participants) an appropriate **reservoir and river water temperature model** for use with **past and current monitoring data**
- Using the data developed as part of the Baseline Water Quality Study, **model water quality conditions in the proposed Watana Reservoir**, including (but not necessarily limited to) temperature, DO, fine suspended sediment and turbidity, chlorophyll-a, nutrients, ice, and metals
- **Model water quality conditions in the Susitna River** from the proposed site of the Watana Dam downstream, including (but not necessarily limited to) temperature, DO, fine suspended sediment and turbidity, chlorophyll-a, and nutrients. **Ice processes effects** are accounted for using output **from the River 1D Ice Processes Model** (in coordination with the Ice Processes Study)

## *Study 5.6 Components*

- Model Description (ISR Part A, Section 4.1; pg 2)
- Reservoir and Downstream River Modeling Approaches (ISR Part A, Section 4.2; pg 3)
- Focus Area Modeling (ISR Part A, Section 4.3; pg 5)
- Scales for Modeling and Resolution of the Output (ISR Part A, Section 4.4; pg 5)

## *Study 5.6 Variances*

- AEA implemented the methods as described in the Study Plan with no variances

## *Study 5.6 Summary of Results in ISR (ISR Study 5.6, Part A – Section 5)*

- Consistent state variables between 3-D reservoir and 2-D river models
- Hydrodynamics
  - Water surface elevation
  - Velocity
- Water Quality
  - Temperature including ice cover in reservoir
  - TSS (very fine sand, silt, and clay size material)
  - Dissolved oxygen
  - Phytoplankton and periphyton
  - Dissolved and particulate organic carbon, nitrogen and phosphorous
  - Ammonia, nitrite+nitrate-nitrogen, inorganic phosphorous
- Toxic and Mercury State Variables
  - Dissolved and particulate phases of selected metal
  - Dissolved and particulate elemental, divalent, and methyl mercury

## *Study 5.6 Summary of Results in ISR (ISR Study 5.6, Part A – Section 5)*

- Reservoir Model Configuration
  - Approximately 1400 horizontal cells and 20 layers
  - 400 to 800 m longitudinally, 75 to 150 m laterally
- Reservoir Modeling Results
  - Demonstrated annual time scale hydrodynamic and temperature simulation with 45 m variation in pool level
- River Model Configuration
  - Approximate 1000 horizontal grid cells between PRM 80 and 189 with a 500 m longitudinal resolution and three cells across channel

## *Study 5.6 Summary of Results in ISR (ISR Study 5.6, Part A – Section 5)*

- River Modeling Results
  - Demonstrated annual time scale hydrodynamic and temperature simulation under pre- and post-Project conditions
  - Pre-Project river model will be calibrated with 2012 through 2014 field observations
- River Focus Area Modeling
  - Focus Area modeled as embedded high resolution regions of the full river model
  - Anticipated 100 m longitudinal and 30 m lateral resolution
  - Demonstrated approach for FA-115 (Slough 6A)

# Study 5.6 Summary of Results since ISR

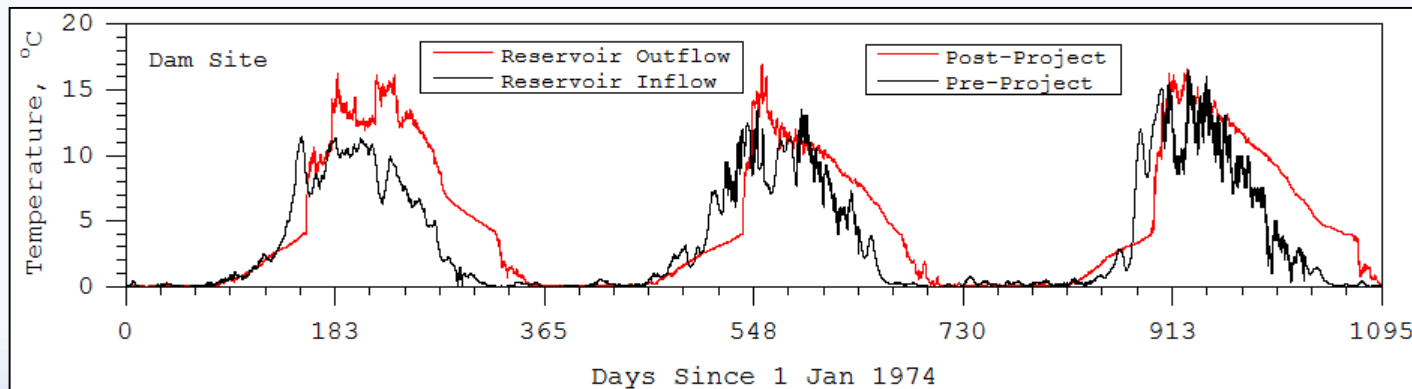
(Water Quality & Lower River Modeling Tech Memo, September 2014)

## Reservoir Model Configuration Updated

- Configured model for simulation of two 3-year periods, 1974-76 and 1979-81 using maximum load following flow scenario
- Outflow level based to proposed operation of shutters
- Developed loading to simulate very fine sand and silt-clay size material

## Reservoir modeling results

- Robust performance over the 3-year simulation period
- Summer reservoir outflow temperatures are 1-2°C higher than pre-project temperatures at the dam site (**scenario using top-water withdrawal from the reservoir**)
- Fine sand entirely trapped by reservoir
- Significant retention of silt-clay size material



Example: Dam Site, 1974-1976



# Study 5.6 Summary of Results since ISR

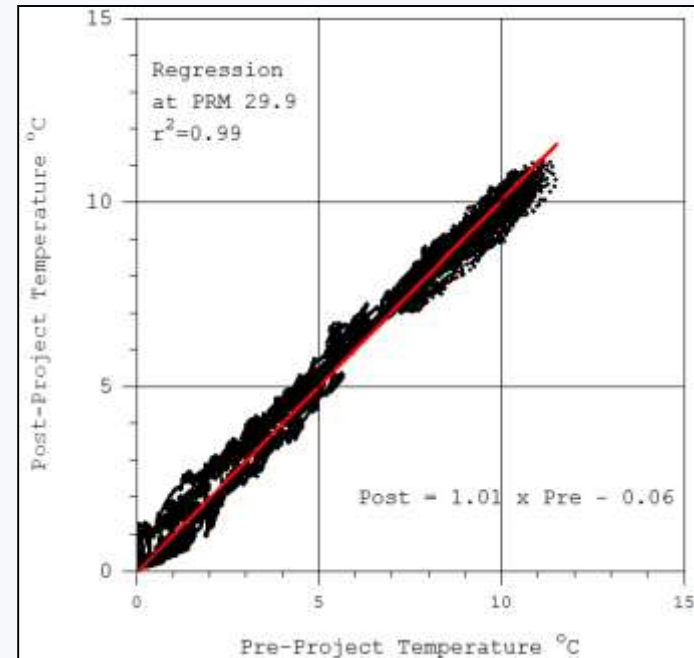
(Water Quality & Lower River Modeling Tech Memo, September 2014)

## River Model Configuration Updated

- Full river model grid extended to PRM 30
- Configured model for simulation of two 3-year periods, 1974-76 and 1979-81 for pre- and post-project conditions
- Post-Project boundary conditions based on reservoir model outflow for maximum load following flow scenario

## River Modeling Results

- Post-Project river temperatures are higher than pre-Project although the difference is less than 1 °C at PRM 29.9
- TSS in middle river is lower due to trapping all fine sand and a significant portion of silt-clay in reservoir



Example: PRM 29.9, River Temperature

# Study 5.6 Summary of Results since ISR

(Water Quality & Lower River Modeling Tech Memo, September 2014)

## Focus Area Model Configuration

- Individual high resolution models for focus areas
- Upstream and downstream boundary conditions from full river model
- Bathymetry consistent with other focus area hydrodynamic models
- Currently completing model grids for focus areas

## Focus Area Modeling Results

- Demonstrated focus area model approach for FA-128 (Slough 8A)
- May-October 1976 and 1981 simulations under pre- and post-Project conditions

## *AEA Proposed Modifications to Study 5.6 in ISR (ISR Study 5.6, Part C – Section 7.1.2)*

No modifications to the Study Plan are needed to complete the study and meet Study Plan objectives

## *Decision Points from Study Plan*

### *River Model Downstream Boundary Decision Point*

- The river model will not be extended downstream of PRM 29.9
- Decision based on model predictions of pre- and post-Project river temperature at PRM 29.9
  - Temperature results presented in preceding slides show that river temperature impacts of the dam are less than 1°C PRM 29.9
- The absence of data to support model configuration downstream of PRM 29.9 was a secondary consideration
- Document
  - Decision Points for Study 5.6: Water Quality Modeling Study, Draft Technical Memorandum, Sept. 2014

# *Current Status and Steps to Complete Study 5.6*

## **Reservoir modeling**

- Model spatial configuration and testing (2013)
- Completed final model spatial configuration (2014)
- Completed multi-year hydrodynamic, temperature and fine sediment simulation (2014)
- Complete approach for ice cover and thickness simulation (2014)
- Complete configuration of water quality model (2014-15)
- Complete configuration of toxics and mercury model (2014-15)
- Evaluate model predications for reasonableness and consistency (2014-15)
- Incorporate alternate operational scenarios for the 60 hydrologic period (2014-15)
- Scenario simulations (2015)

# Current Status and Steps to Complete Study 5.6

## River modeling

- Model spatial configuration and testing (2013)
- Completed final model spatial configuration (2014)
- Completed multi-year hydrodynamic, temperature and fine sediment simulation (2014)
- Implement procedure for importing ice cover and thickness from ice processes model (2014)
- Complete configuration of water quality model (2014-15)
- Complete configuration of toxics and mercury model (2014-15)
- Calibration model to 2012-14 observational data (2014-15)
- Incorporate alternate operational scenario outputs from reservoir model (2014-15)
- Scenario simulations (2015)

# Current Status and Steps to Complete Study 5.6

## Focus Area Modeling

- Completed spatial configuration for focus areas (2014)
- Completed coupling to full river model (2014)
- Completed open water season hydrodynamic, temperature and fine sediment simulation (2014)
- Implement procedure for importing ice cover and thickness from ice processes model (2014)
- Implement procedure to transfer model results to habitat modeling studies (2014)
- Complete configuration of water quality model (2014-15)
- Calibrate model to 2012-14 observational data (2014-15)
- Incorporate alternate operational scenario outputs from river model (2014-15)
- Scenario simulations (2015)

# *Licensing Participants Proposed Modifications to Study 5.6?*

- Agencies
- CIRWG members and Ahtna
- Public