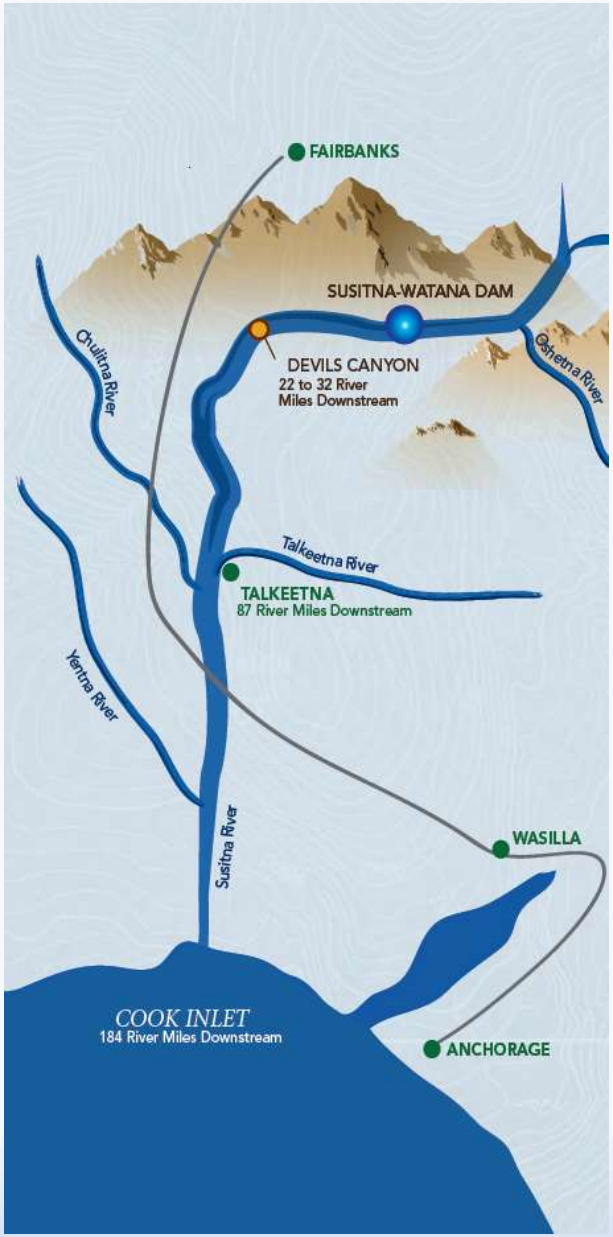


Initial Study Report Meeting

Study 6.6 Fluvial Geomorphology Modeling below Watana Dam

October 16, 2014

Prepared by

Tetra Tech, Inc

Study 6.6 Objectives

- **Develop calibrated models** to predict the magnitude and trend of geomorphic response to the Project
- **Apply the** developed **models** to estimate the potential for channel change for **with-Project operations compared to existing conditions**
- **Coordinate with the Geomorphology Study** to integrate model results with the understating of geomorphic **processes and controls** to identify potential Project effects that require interpretation of model results
- **Support** the evaluation of Project effects by **other studies** in their resource areas providing channel output data and assessment of **potential changes** in the geomorphic features that help comprise the aquatic and riparian habitats of the Susitna River

Study 6.6 Components

- Bed Evolution Model Development, Coordination, and Calibration
  (ISR Part A, Section 4.1; pg 7)

- Model Existing and with-Project Conditions
  (ISR Part A, Section 4.2; pg 48)

- Coordination and Interpretation of Model Results
  (ISR Part A, Section 4.3; pg 51)

Study 6.6 Variances

- There were no variances to the 2013 Study Plan.

  While land access was not available for portions of the river and tributaries adjacent to Cook Inlet Regional Working Group (CIRWG) lands, this was not considered a variance because this study was designed to collect data over multiple years.

Study 6.6 Summary of Results in ISR (ISR Study 6.6, Part A – Section 5)

Bed Evolution Model Development

- 1-D HEC-RAS (Version 5.0) selected for reach-scale modeling below Watana Dam
  Modeling in process at time of ISR

- 2-D SHR-2D selected for local-scale models of Focus Areas
  Modeling of FA-104 (Whiskers Slough) in process at time of ISR

Study 6.6 Summary of Results in ISR (ISR Study 6.6, Part A – Section 5)

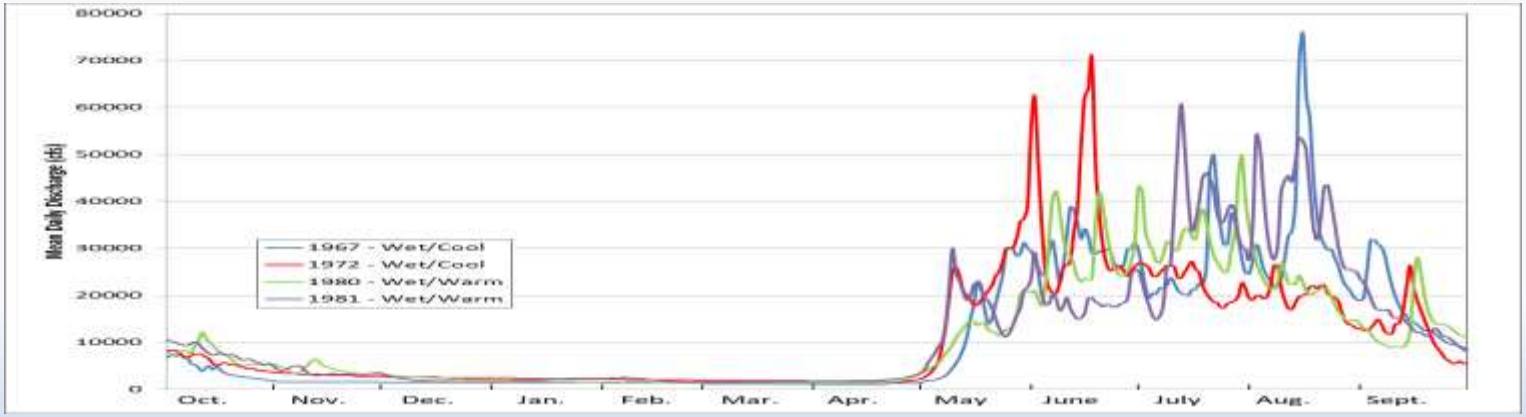
Bed Evolution Model Development

- 2013 Field Data
  - Cross sections (Study 8.5)
  - Bathymetry (Study 8.5)
  - LiDAR (Study 6.6)
  - Bed and Bank material sampling (Study 6.6 Appendices A - C)
  - Substrate mapping (Study 8.5)
  - Water surface elevations (Studies 8.5 and 6.6 Appendix D)
  - ADCP (velocity and discharge) (Study 8.5)
  - Stage hydrographs (Study 7.5)
  - Sediment transport (USGS) (analysis in Study 6.5)
  - Tributary surveys and bed materials (Study 6.6)
  - Geomorphic mapping (Study 6.5)
  - Winter bed sampling pilot (Study 6.6 Attachment A Field Report)

Study 6.6 Summary of Results in ISR (ISR Study 6.6, Part A – Section 5)

Model Existing Conditions and with-Project Conditions

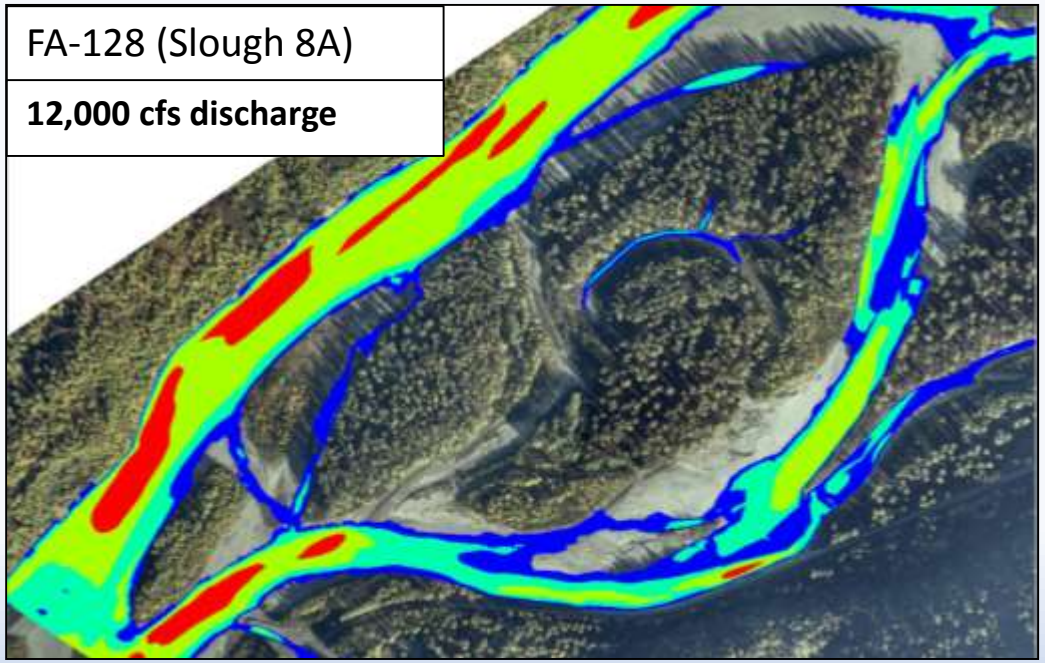
- 50-year subset selected from 61-year extended flow record
- Representative dry, average, and wet years selected in conjunction with Studies 8.5 and 7.6
  (Appendix E of ISR Study 6.6 includes these results)
- Fluvial Geomorphology Modeling Approach TM June 2013
- 2-D Hydraulic Modeling for IFS Proof-of-Concept



Study 6.6 Summary of Results in ISR (ISR Study 6.6, Part A – Section 5)

Coordination in Interpretation of Model Results

- Continuous internal coordination on Geomorphology
- Frequent external coordination with other studies
- Proof-of-Concept (IFS) meeting (April 2014) was initial demonstration



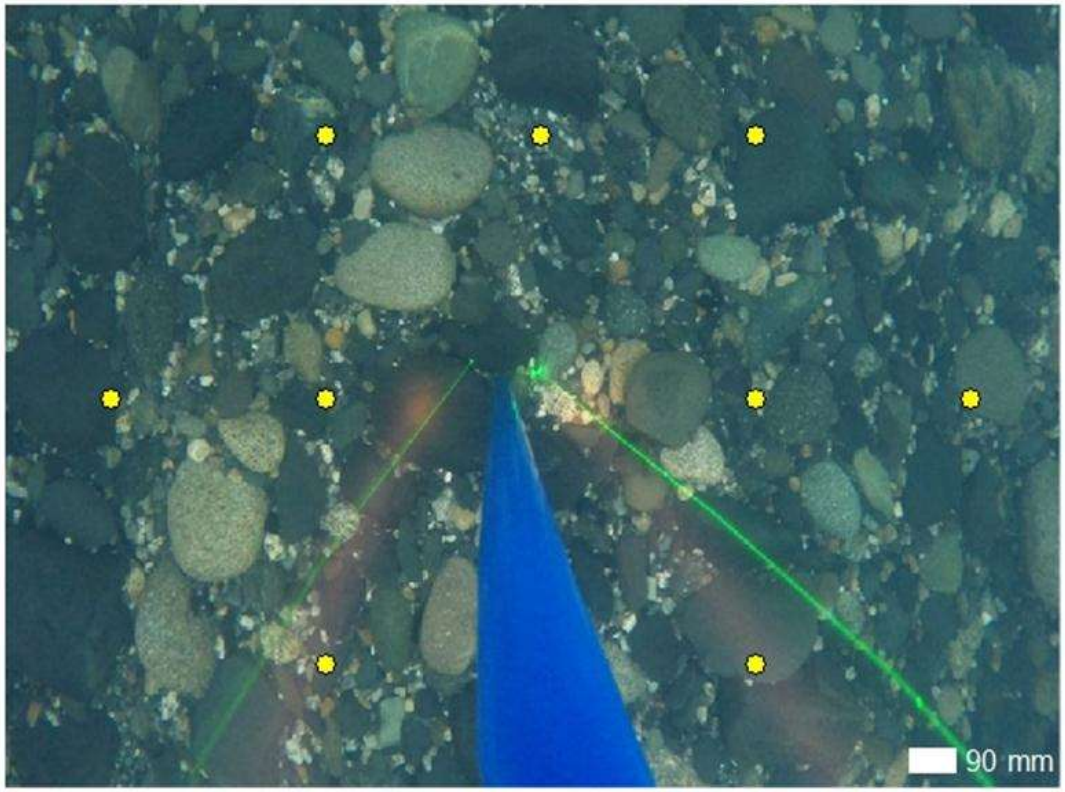
Study 6.6 Summary of Results since ISR Technical Memorandums

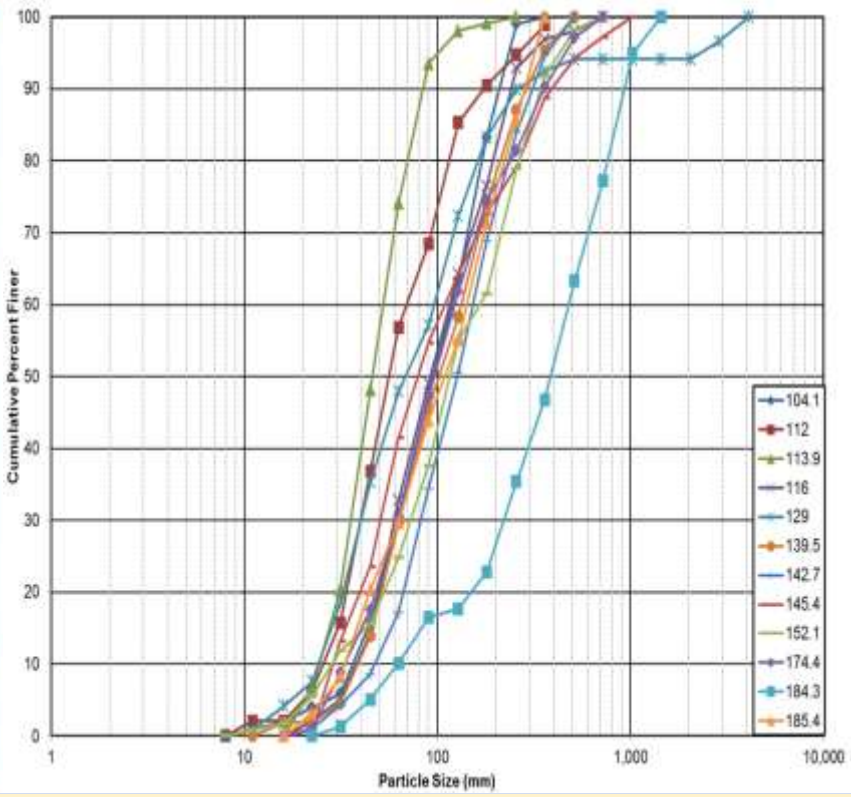
- **Winter Sampling of Main Channel Bed Material** – TM in September 2014 (ISR Part C, Section 7.2.1.1.9)

- Decision Point on **Fluvial Geomorphology Modeling of the Susitna River below PRM 29.9** – TM in September 2014 (ISR Part C, Section 7.1.1.1.2)

Study 6.6 Summary of Results since ISR
Winter Bed Sampling TM (September 2014)

- Middle Susitna River: Bed nearly twice as coarse as bar heads
- Lower Susitna River: Bed similar to bar heads

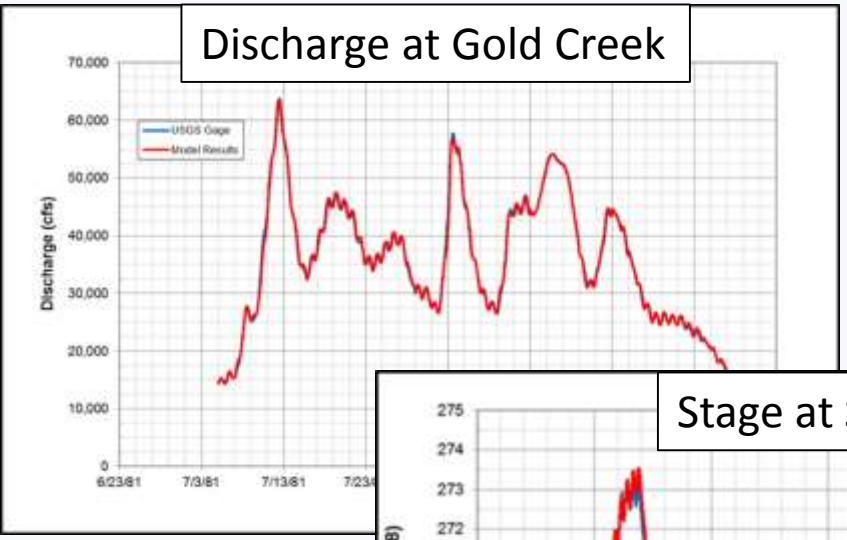




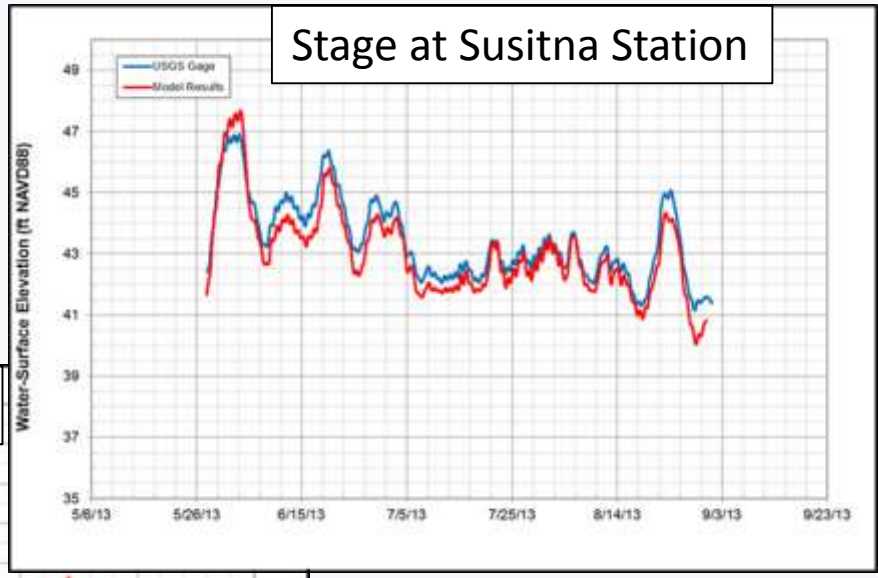
Study 6.6 Summary of Results since ISR
Modeling in support of Decision TM (Sept. 2014)

- Models calibrated well hydraulically

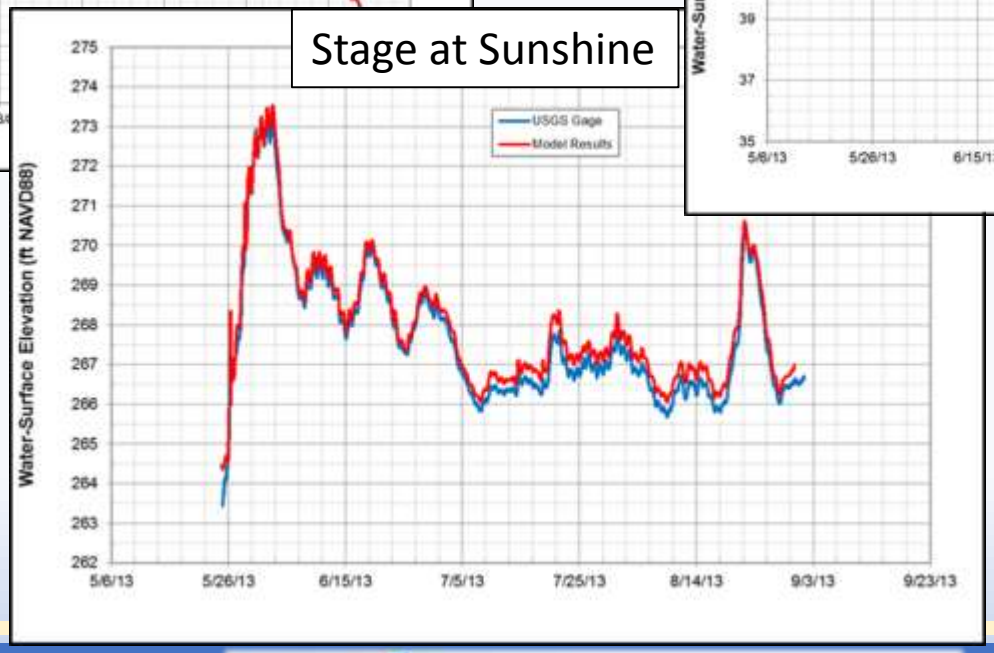
Discharge at Gold Creek



Stage at Susitna Station



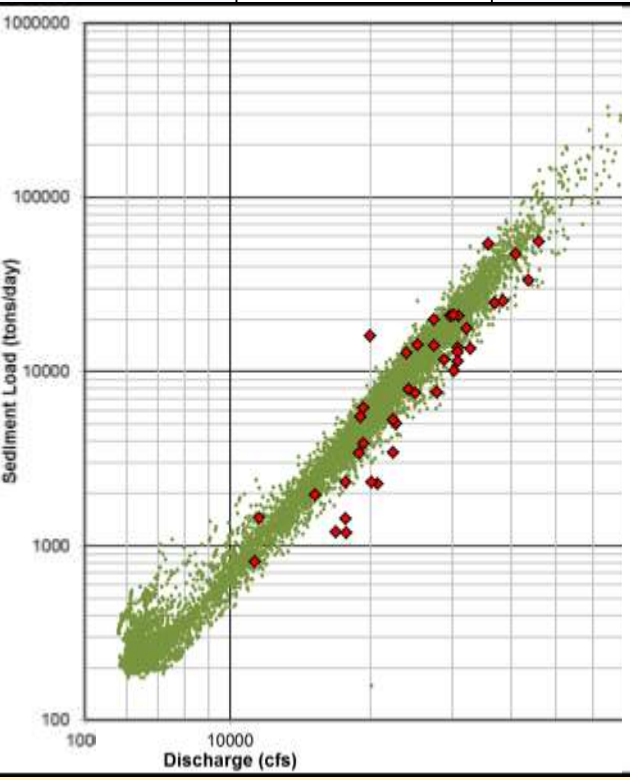
Stage at Sunshine



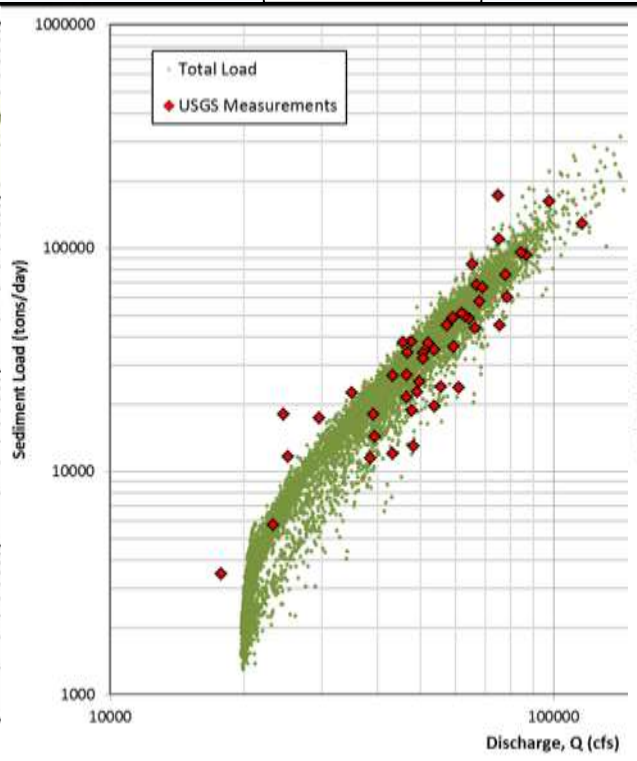
Study 6.6 Summary of Results since ISR Modeling in support of Decision TM (Sept. 2014)

- Models calibrated well for sediment transport (USGS measured vs. Model total loads)

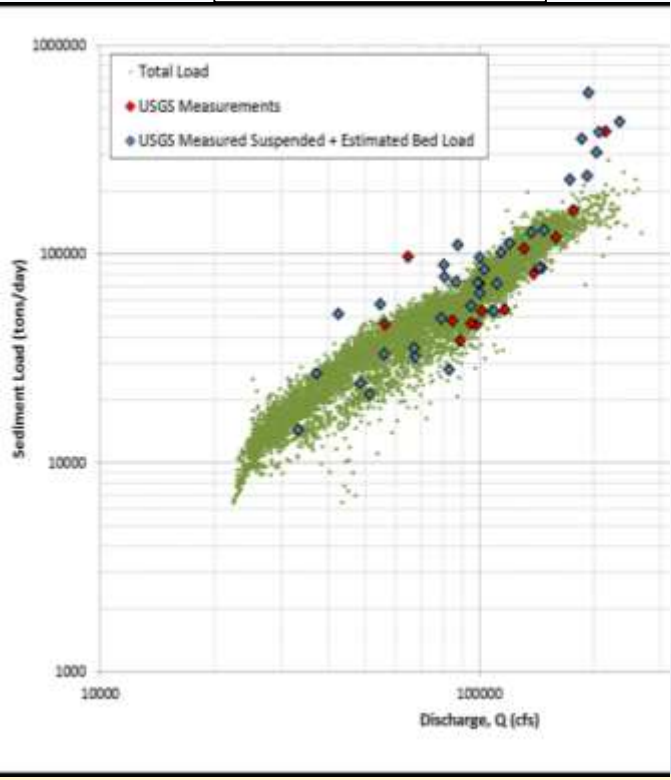
Gold Creek



Sunshine



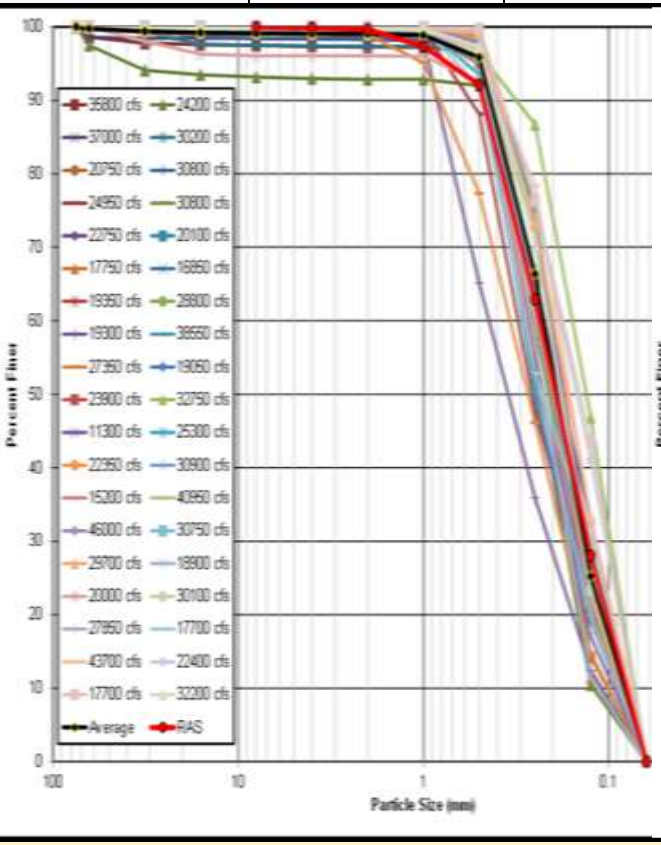
Susitna Station



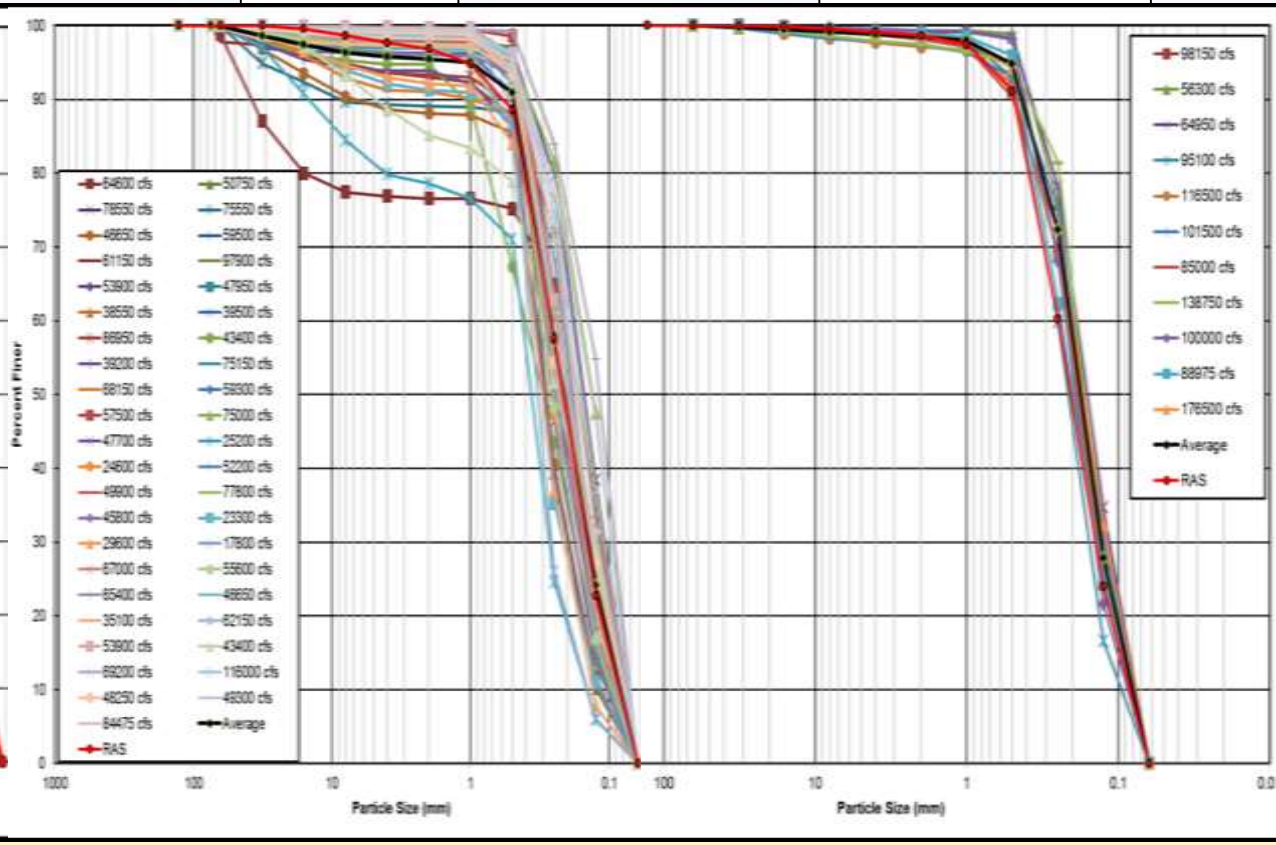
Study 6.6 Summary of Results since ISR Modeling in support of Decision TM (Sept. 2014)

- Models calibrated well for sediment transport
  (USGS measured vs. Model transported gradation)

Gold Creek



Sunshine



Susitna Station

AEA Proposed Modifications to Study 6.6 in ISR (ISR Study 6.6, Part C – Section 7.1.2)

7.1.2.1. Bed Evolution Model Development, Coordination, and Calibration

- Introduction of point sources in the **2-D open-water period hydraulic model** to account for **groundwater inflows**

7.1.2.2. Model Existing and with-Project Conditions

- Dimensionless critical shear may not be available as a parameter for the sensitivity analysis as originally indicated in the RSP (based on selection of sediment transport equation)
- The **PDO (Pacific Decadal Oscillation) is not a significant factor affecting the hydrologic characteristics during the open-water period** of the representative years

7.1.2.3. Coordination and Interpretation of Model Results

- There are no variances from 2013 or proposed modifications to the Study Plan for 2014/2015 for this study component

Decision Points from Study Plan (ISR Study 6.6, Part C – Section 7.1.1)

Decision Point on **Fluvial Geomorphology Modeling of the Susitna River below PRM 29.9** – TM in September 2014 (ISR Part C, Section 7.1.1.1.2)

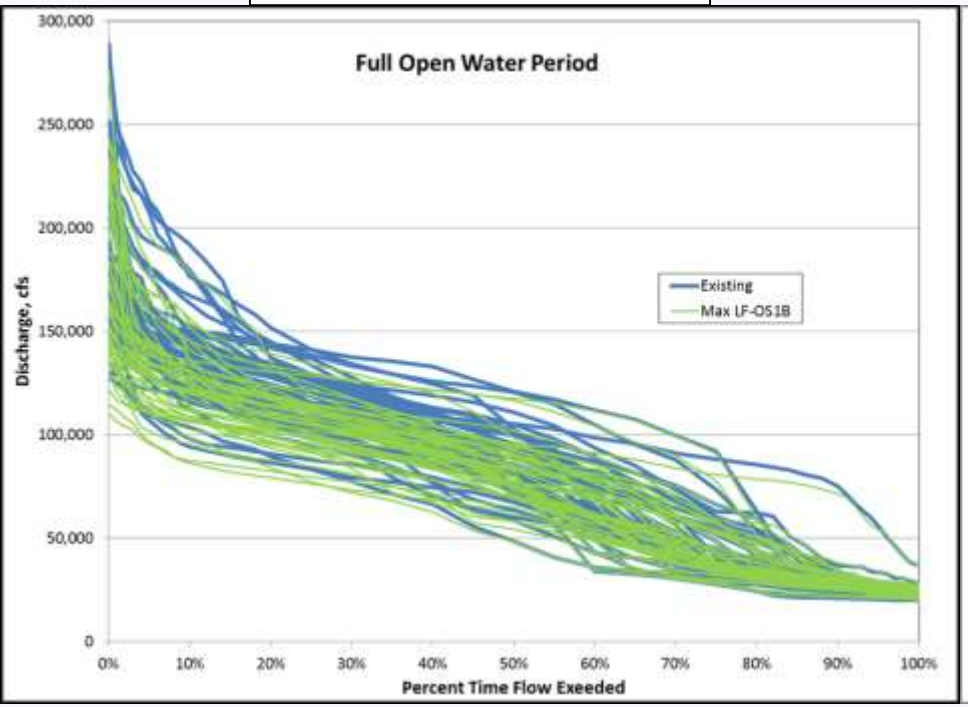
Decision based on with-Project (Max LF OS-1b) change relative to natural variability in four criteria (change in:)

1. Flow and associated potential for width adjustment
2. Sediment transport volume (bed material)
3. Bed elevations (aggradation and degradation)
4. Flow depths and velocities

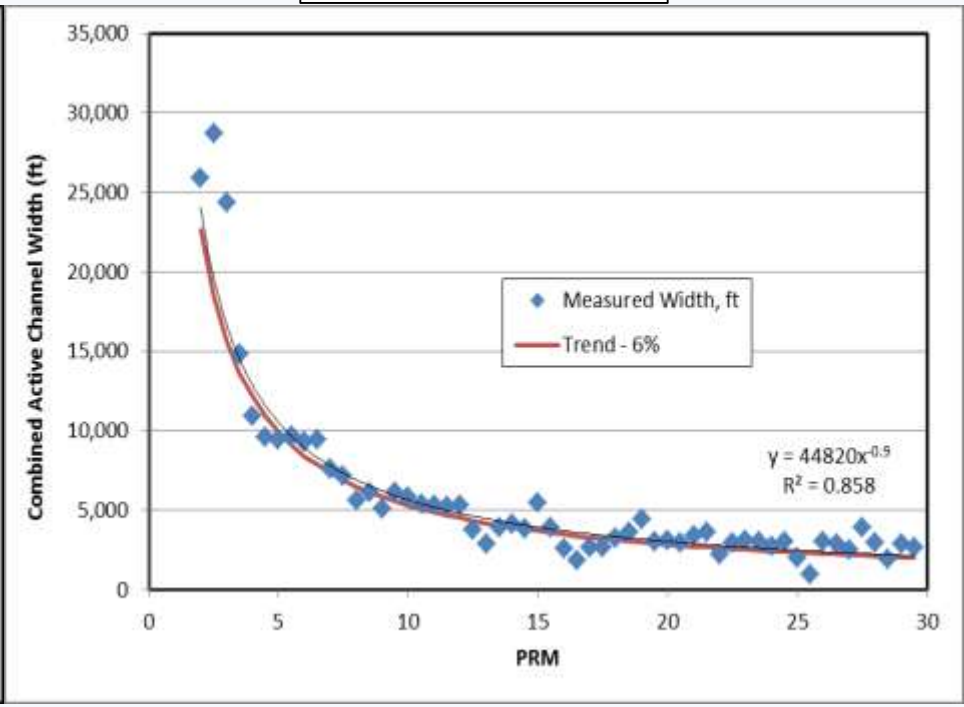
Decision Points from Study Plan
Extend FGM below PRM 29.9?

Flow and associated potential for width adjustment

Flow Duration Curves

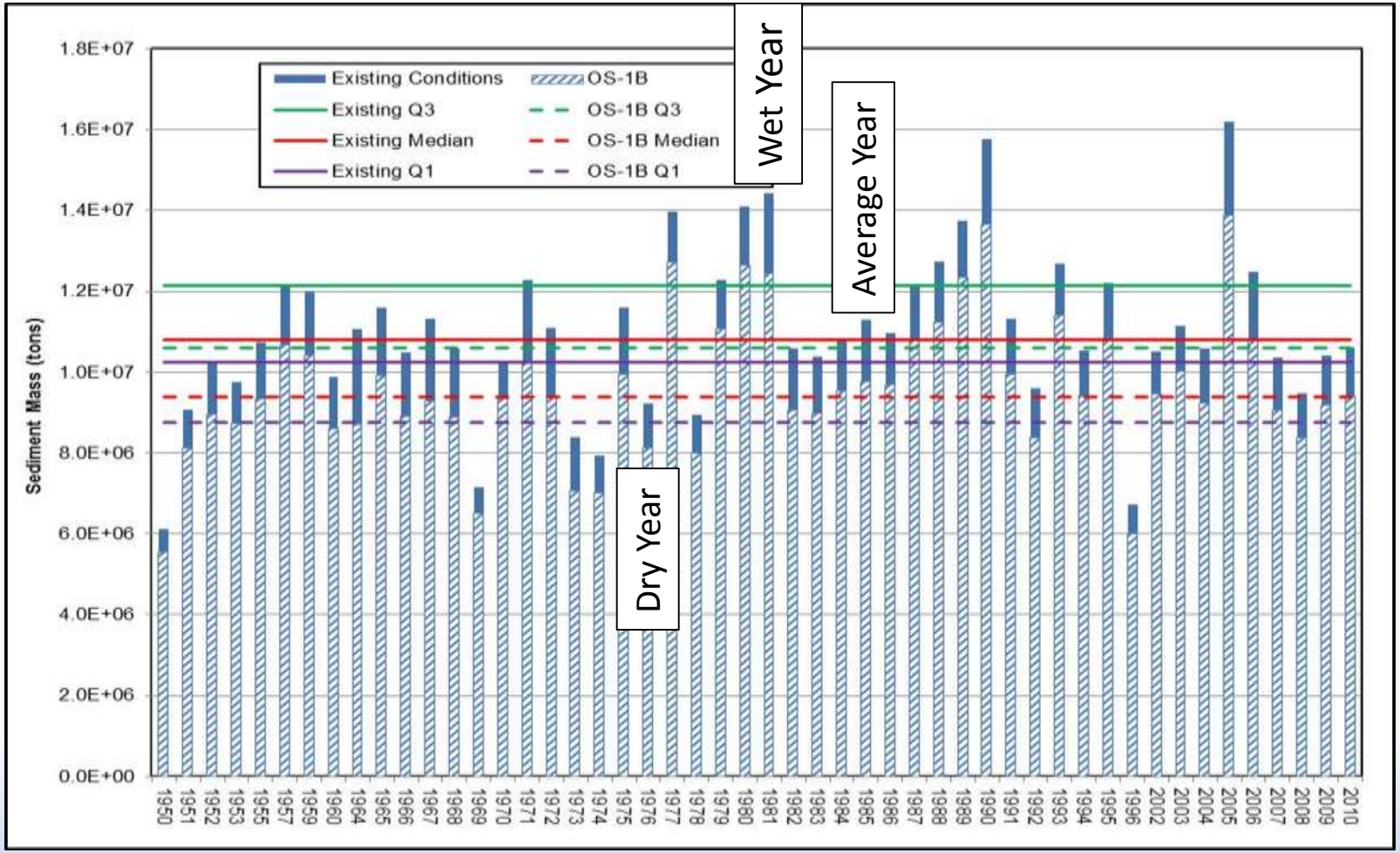


Width Variability



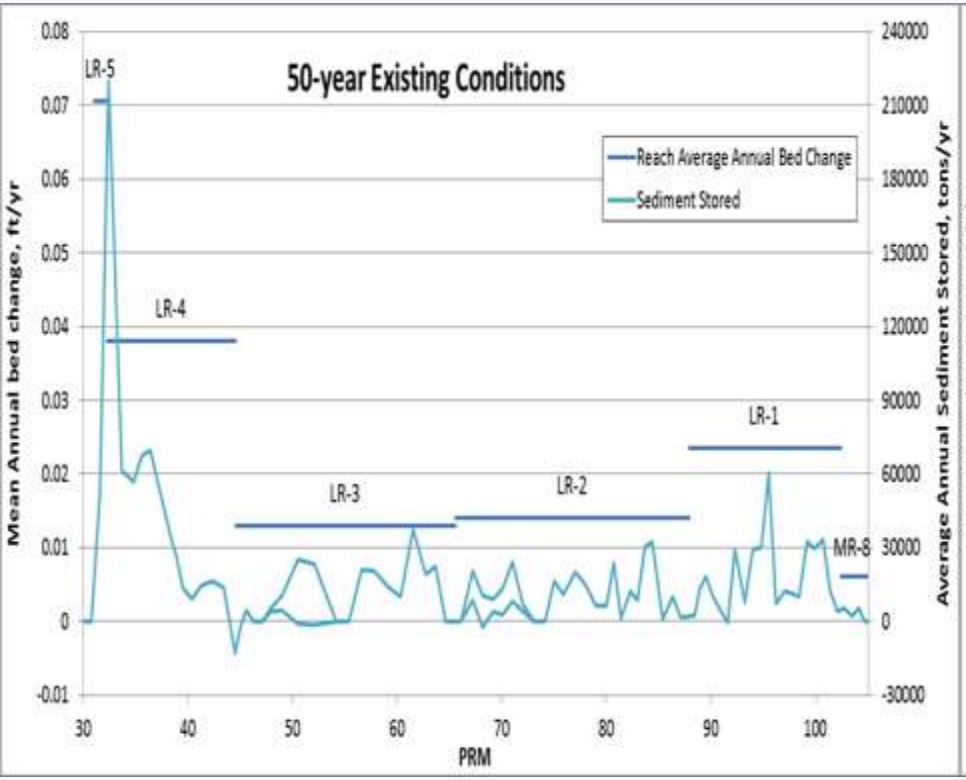
Decision Points from Study Plan
Extend FGM below PRM 29.9?

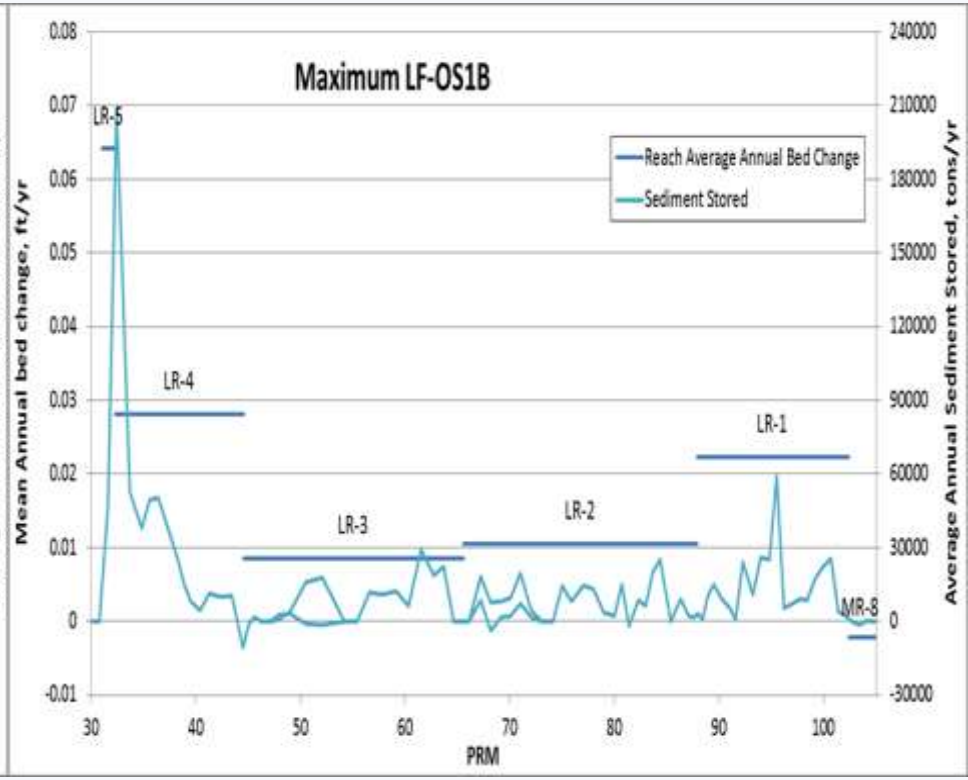
Sediment transport volume (bed material)



Decision Points from Study Plan
Extend FGM below PRM 29.9?

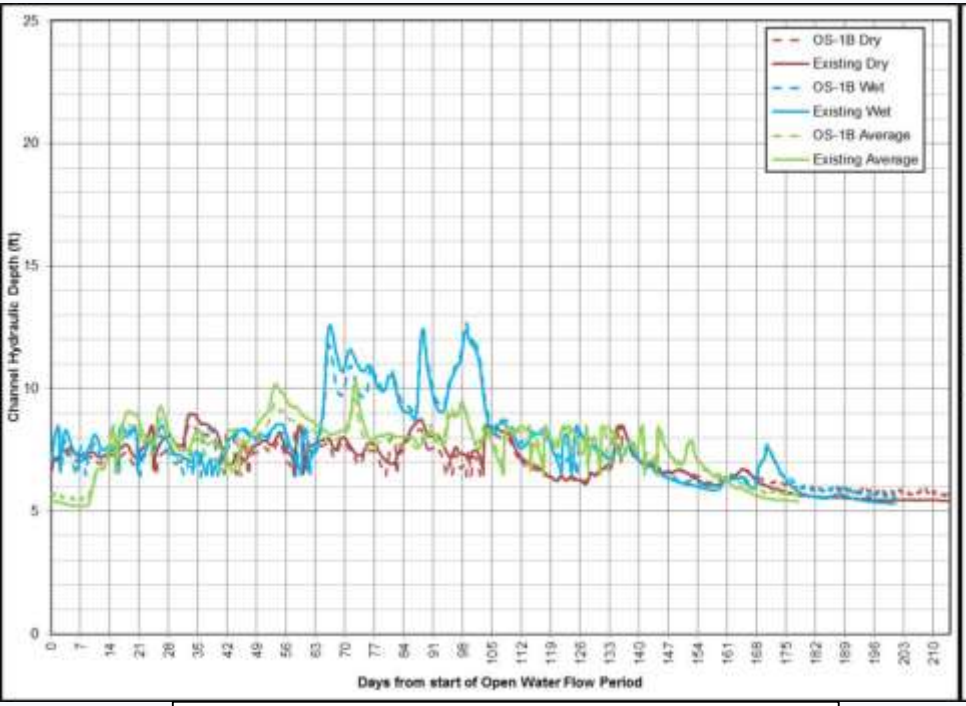
Bed elevations (aggradation and degradation)



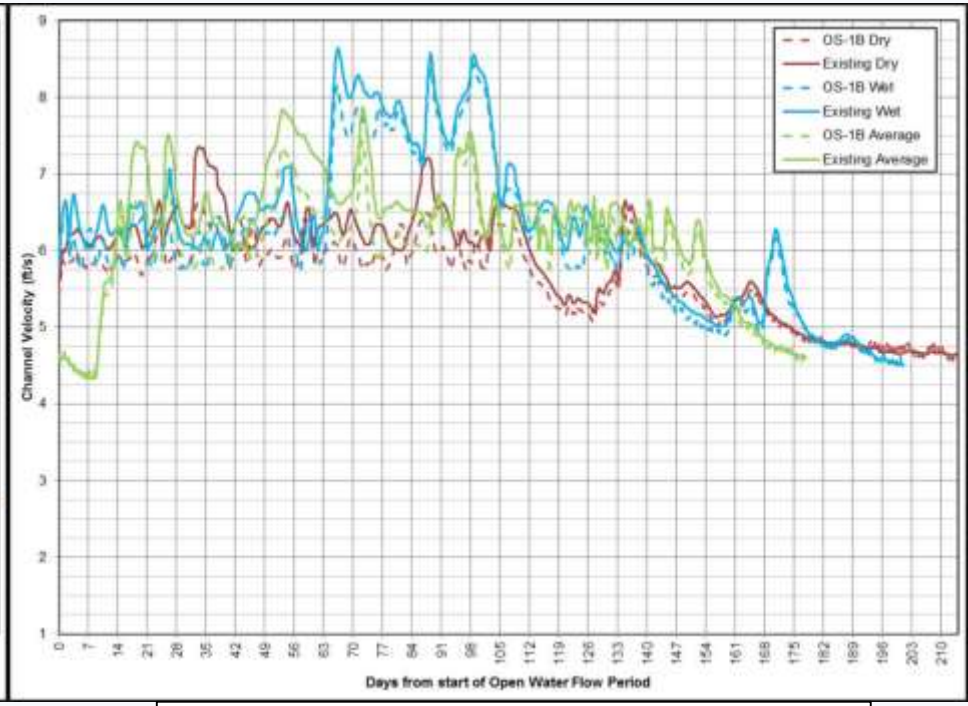


Decision Points from Study Plan
Extend FGM below PRM 29.9?

Flow depths and velocities



Depths for Representative Years for Existing and Max LF-OS1b



Velocities for Representative Years for Existing and Max LF-OS1b

Decision Points from Study Plan
Extend FGM below PRM 29.9?

Conclusions

- Change in criteria **small relative to** large range of **natural** (and with-Project) **variability**
- Criteria **infrequently outside range of natural variability** and by **small amounts**
- Channel form unchanged (**Lower River stays aggradational**)

Recommendation

- Do not extend Fluvial Geomorphology Modeling below PRM 29.9
- Do not extend associated 1-D hydraulic modeling below PRM 29.9
- Do not perform tidal hydrodynamic modeling in tidal zone

Decision Points from Study Plan (ISR Study 6.6, Part C – Section 7.1.1)

Future Decision on Identification of Focus Areas to Run **Specific 2-D Model Scenarios**

- 1-D model may show **geomorphic responses similar between scenarios** so separate 2-D models are not necessary at an FA
- There may **not be enough change** to warrant running 25- and 50-year models at all FAs
- The **response may be similar among FAs**, so modeling all FAs at the same level may not be necessary
- The **1-D model may be adequate to evaluate potential project effects** without additional 2-D modeling

Steps to Complete Study 6.6 (ISR Study 6.6, Part C – Section 7.2.1)

Status

- Successful field data collection seasons
- Characterization of groundwater inflows to lateral habitats
- LiDAR data collection completed
- 1-D modeling
  - Initial models of Middle and Lower Susitna Rivers
- 2-D Modeling
  - FA-128 (Slough 8A) used in Proof-of-Concept
  - Other FA models in development
- 2014 Fluvial Geomorphology Modeling – TM in Q4 2014) (ISR Part C, Section 7.2.1.1)

Steps to Complete Study 6.6 (ISR Study 6.6, Part C – Section 7.2.1)

Planned 2015 Activities

- **Field data collection**
  - FGM Data collection complete in 2014 – need 2015 data for 2 FAs above Devils Canyon (e.g. bathymetry, substrate)
  - Data to fill data gaps identified during modeling efforts
- **1-D and 2-D modeling**
  - Include 2014 survey, LiDAR and bed material
  - Finalize tributary water and sediment inflow
  - Calibration and validation
  - Existing conditions and operational scenarios runs
  - Sensitivity analyses

Steps to Complete Study 6.6 (ISR Study 6.6, Part C – Section 7.2.1)

Planned 2015 Activities

- **Model integration**
  - Reservoir trap efficiency (Water Quality, 5.6)
  - Ice breakup surges (Ice Processes, 7.6)
  - Groundwater in lateral habitats (IFS, 8.5 and GW, 7.5)
  - LWD (part of FGM, 6.6)
  - Turnover analysis (Geomorphology, 6.5)
  - Floodplain accretion and vegetation (Riparian, 8.6)

Licensing Participants Proposed Modifications to Study 6.6?

- Agencies
- CIRWG members and Ahtna
- Public