

Initial Study Report Meeting

Study 8.6 Riparian Instream Flow Study

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Prepared by

R2 Resource Consultants



Study 8.6 Status

ISR Documents (ISR Part D, Section 4)

- ISR Parts A, B, and C (Jun 3, 2014)
- Dam Effects on Downstream Channel and Floodplain Geomorphology and Riparian Plant Communities and Ecosystems – Literature Review Tech Memo (Nov 14, 2014)
- 2014 – 2015 Study Implementation Report (Nov 5, 2015)
- ISR Part D (Nov 6, 2015)

Status

- Year 1 seed dispersal survey was completed and preliminary models were developed (ISR Part A, Section 5.3.1).
- Three years of balsam poplar and willow seedling establishment and survival surveys were completed across five Focus Areas.
- White spruce establishment patterns were sampled on seven mid-channel islands in the Middle River.
- A systematic riverbank survey of tree ice scars was conducted from PRM 102.2 through PRM 145.8 and 48 ice scarred trees were sampled for dendrochronologic analysis.

Study 8.6 Status

Status

- Tree and shrub composition and abundance were measured, and tree dendrochronologic studies conducted, at 80 ITU and mid-channel island plots in the Middle and Lower River Segments in collaboration with Riparian Vegetation Study (11.6).
- Riparian Groundwater/Surface Water studies included collection of samples for isotopic analysis of plant tissue, precipitation, river water and groundwater water sources at FAs 104 & 128.
- Transpiration rates of trees, small shrubs and herbaceous species were measured at at FAs-104 & 128.
- Floodplain sedimentation dates were measured using radioisotope and stratigraphic techniques to assess open water vs ice dam backwater flood sedimentation.
- Meeting April 2014 to develop Project effects metrics integrating Riparian IFS (8.6), Riparian Vegetation (11.6), Groundwater (7.5), Fluvial Geomorphology (6.6), and Ice Processes (7.6) studies.

Objectives

- Synthesize historic physical and biological data for Susitna River floodplain vegetation, including 1980s studies, studies of hydro project impacts on downstream floodplain plant communities, and studies of un-impacted floodplain plant community successional processes, (hereafter, Literature Review of Dam Effects on Downstream Vegetation)
- Delineate sections of the Susitna River with similar environments, vegetation, and riparian processes, termed *riparian process domains* (RPDs), and select representative areas within each riparian process domain, termed *Focus Areas*, for use in detailed field studies (hereafter, Focus Area Selection-Riparian Process Domain Delineation)
- Characterize seed dispersal and seedling establishment groundwater and surface water hydroregime requirements. Develop a predictive model of potential Project operational impacts to seed dispersal and seedling establishment (hereafter, Seed Dispersal and Seedling Establishment)
- Characterize the role of river ice in the establishment and recruitment of dominant floodplain vegetation. Develop a predictive model of potential Project operational impacts to ice process regimes and dominant floodplain vegetation establishment and recruitment (hereafter, River Ice Effects on Floodplain Vegetation)
- Characterize the role of erosion and sediment deposition in the formation of floodplain surfaces, soils, and vegetation. Develop a predictive model of Project operations changes to erosion and sediment deposition patterns and associated floodplain vegetation (hereafter, Floodplain Stratigraphy and Floodplain Development)
- Characterize natural floodplain vegetation groundwater and surface water maintenance hydroregime. Develop a predictive model to assess potential changes to natural hydroregime and potential floodplain vegetation (hereafter, Riparian GW/SW Hydroregime)
- Develop floodplain vegetation study synthesis, scaling of Focus Areas to riparian process domains, and Project operations effects modeling (hereafter, Riparian Vegetation Modeling Synthesis and Project Area Scaling)

Components

1. Literature Review of Dam Effects on Downstream Vegetation
2. Focus Area Selection-Riparian Process Domain Delineation
3. Seed Dispersal and Seedling Establishment
4. River Ice Effects on Floodplain Vegetation
5. Floodplain Stratigraphy and Floodplain Development
6. Riparian GW/SW Hydroregime
7. Riparian Vegetation Modeling Synthesis and Project Area Scaling

Variances

- **No variances occurred during the 2014 study season (SIR Section 4).**
- The following variances were reported in the June 2014 ISR:
 - Completion of the literature review, originally scheduled for Q4 2013, was submitted in Q4 2014.
 - The first year (0+) balsam poplar and willow establishment study was restricted to documenting current cohort of seedlings less than 1 year old rather than to all woody plants less than 1 meter in height. A clonal reproduction study will be done to characterize asexual recruitment patterns (see ISR Part A, Section 4.3.2).



Summary of Results

Highlighted Results in ISR Part A

- Seed dispersal was surveyed at four seed dispersal study sites and preliminary models were developed (ISR Part A, Section 5.3.1).
- First year (0+) balsam poplar and willow seedling establishment were documented with thirty-five transects and 824 plots across five Focus Areas. Counts of established seedlings were completed in late-July through early August and again in September 2013. To characterize white spruce establishment patterns, twelve eight-meter-wide (26.25 feet wide) belt transects were surveyed covering approximately 3.5 hectares (8.7 acres) on seven mid-channel islands in the Middle River Segment.
- A systematic riverbank survey of tree ice scars was conducted from PRM 102.2 through PRM 145.8 between September 15 and 29, 2013. A total of 222 ice scarred trees, 190 locations with no visible ice-scars, and 29 locations with signs of ice damage that were not measurable were surveyed. In addition, 48 ice scarred trees were sampled for dendrochronologic analysis of ice floodplain vegetation interaction frequency and magnitude.
- Tree and shrub composition and abundance were measured at 80 ITU and mid-channel island plots in the Middle and Lower River Segments. Tree core samples for dendrochronologic analysis were collected at all ITU plots.
- Riparian Groundwater/Surface Water studies included collection of 659 plant samples, 545 soil samples, and 100 water samples for isotopic analysis of water source. Transpiration of woody species was measured with TDP sensors installed at 21 trees at FA-104 (Whiskers Slough) and 27 trees at FA-128 (Slough 8A). Transpiration by herbaceous and small shrub species was measured through collection of 3,602 individual stomatal conductance measurements, including measurements from 1,747 herbaceous plants (11 species), 1,771 shrubs (11 species), and 79 trees (3 species).

Summary of Results



Highlighted Results since ISR

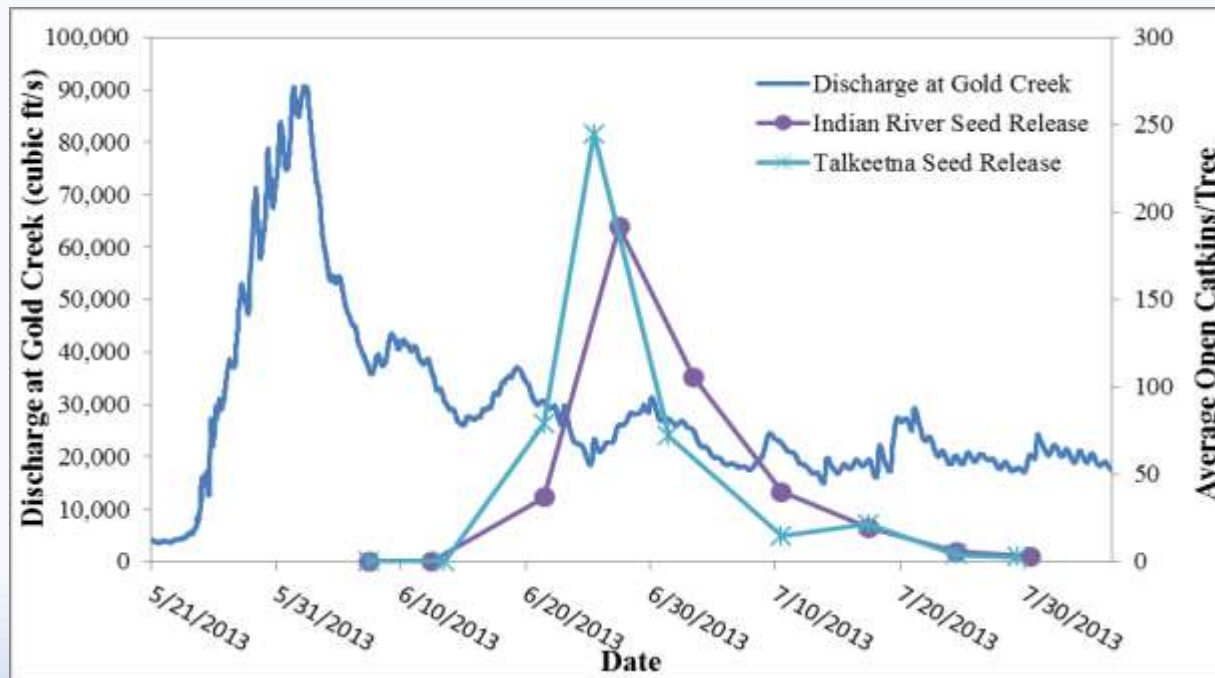
Completion of literature review (RSP Section 8.6.3.1) in coordination with Fluvial Geomorphology Modeling (Study 6.6) **Dam Effects on Downstream Channel and Floodplain Geomorphology and Riparian Plant Communities and Ecosystems—A Critical Literature Review Technical Memorandum** (R2 and Tetra Tech 2014).



Summary of Results

Seed Dispersal (ISR Part A, Section 5.3.1)

- Catkins releasing seed from six female balsam poplar (*Populus balsamifera*) trees and six to twelve female willow (*Salix* spp.) shrubs were counted weekly at each of four seed release study sites distributed across the Middle and Lower River segments.
- Depending on site, the peak period of seed release for poplar began 17 to 20 days following peak discharge (ISR Part A, Section 5.3.1).



Summary of Results

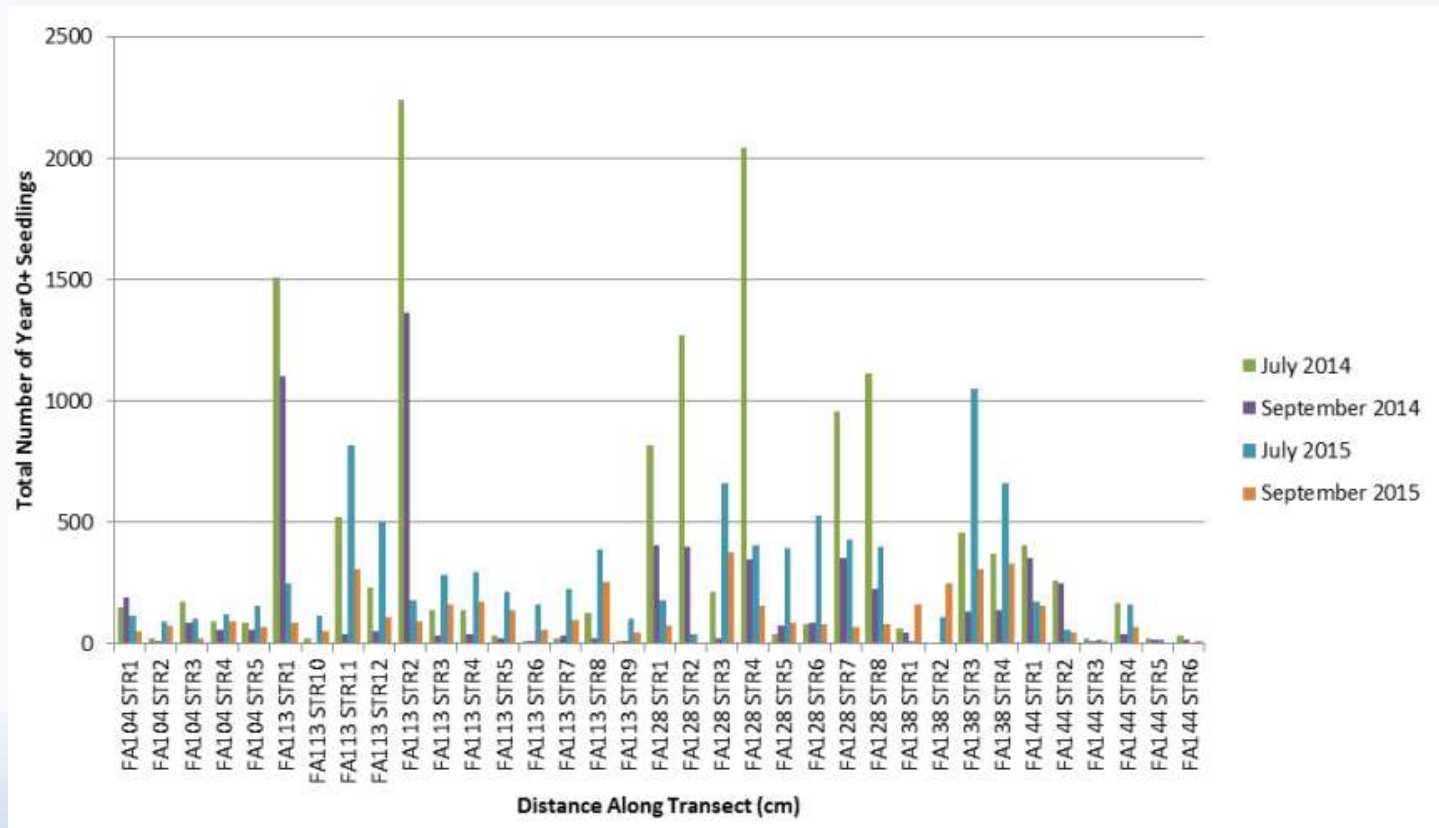
Seedling Establishment and Recruitment (ISR Part A, Section 5.3.2)

- Significant mortality was observed as a result of the mid-August peak flow (48,000 cfs). Seedling survival occurred in sheltered terrain positions whereas high seedling mortality was observed resulting from both channel bed scour and sediment burial in exposed lateral channel margins.
- Seedling establishment study identified previously unreported White spruce establishment in Tall Alder seral stage. White spruce was shown to establish throughout early floodplain forest successional stages.
- Only Balsam poplar and willow year 0+ seedlings were observed in woody seedling reconnaissance surveys.
- Clonal reproduction of Balsam poplar appears to be a significant recruitment process in high ice flow disturbance zones. What appeared to be poplar sexual reproduction in these terrain areas is not. This finding has potential significance relative to assessment of Project operations effects on ice regime interactions with riparian vegetation, an assessment objective of the vegetation ice processes study.

Summary of Results

Seedling Establishment and Recruitment

- Three year longitudinal survey field data collection effort is complete.
- Example data showing total number of Year 0+ Seedlings by transect for each study period - July 2014 through September 2015.



Summary of Results

Highlighted Results (SIR Section 5.3.2, page 8).

Completion of three-year longitudinal willow-cottonwood seedling establishment and survival field surveys.



Summary of Results

River Ice Effects on Floodplain Vegetation

(ISR Part A, Section 5.4; and SIR Section 5.4)

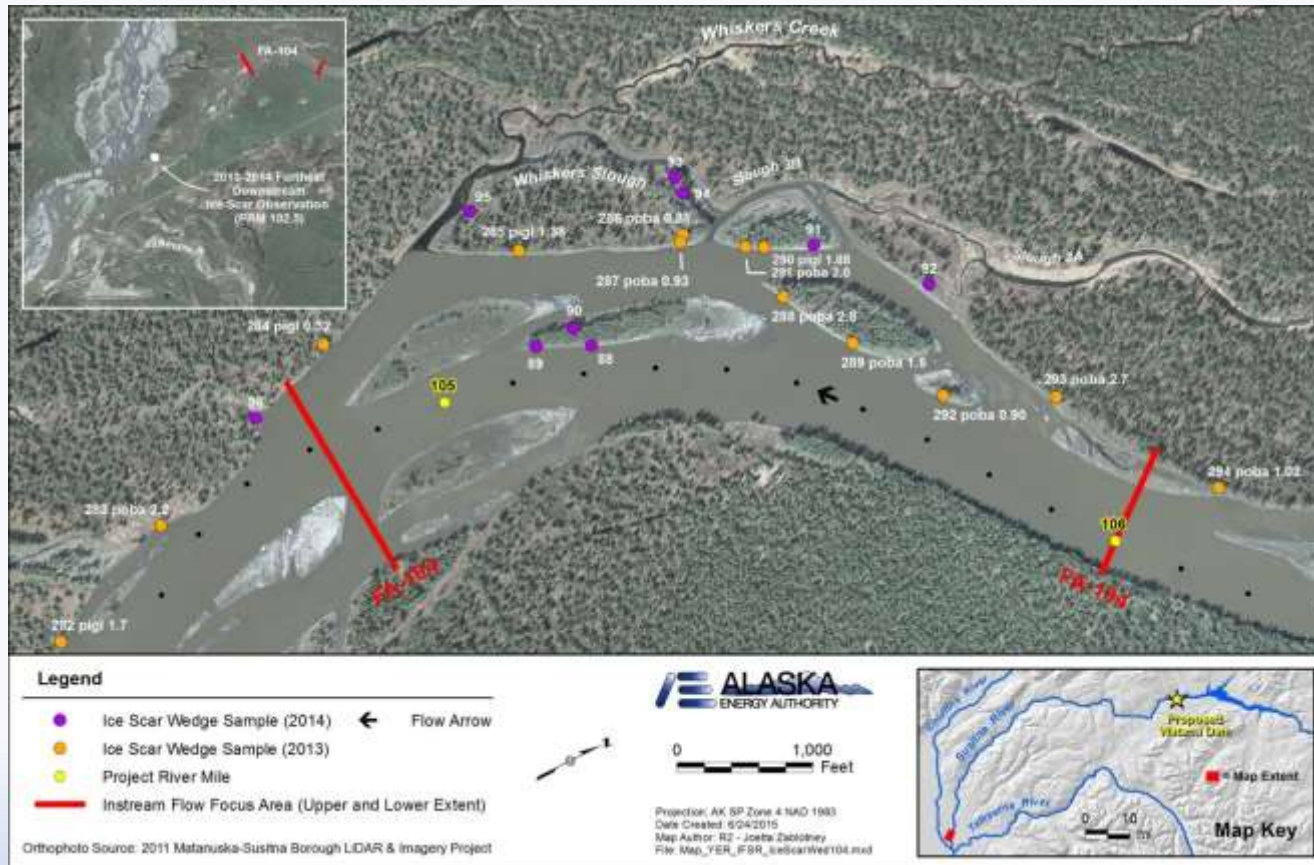
- A systematic riverbank survey of tree ice scars was conducted from PRM 102.2 through PRM 145.8 between September 15 and 29, 2013. A total of 222 ice scarred trees, 190 locations with no visible ice-scars, and 29 locations with signs of ice damage that were not measurable were surveyed. In addition, 48 ice scarred trees were sampled for dendrochronologic analysis of ice floodplain vegetation interaction frequency and magnitude. An additional 25 ice scarred trees were sampled in August 2014.
- Ice dam backwater flooding was observed to deposit up to 20-30 cm of fine sand burying existing floodplain vegetation. Sediment deposition during ice dam backwater was observed to be a local phenomena associated with ice dam backwater floods. Ice process generated floodplain sediment deposition is potentially a significant driver of local floodplain vegetation pattern.



Summary of Results

River Ice Effects on Floodplain Vegetation (SIR Section 5.4)

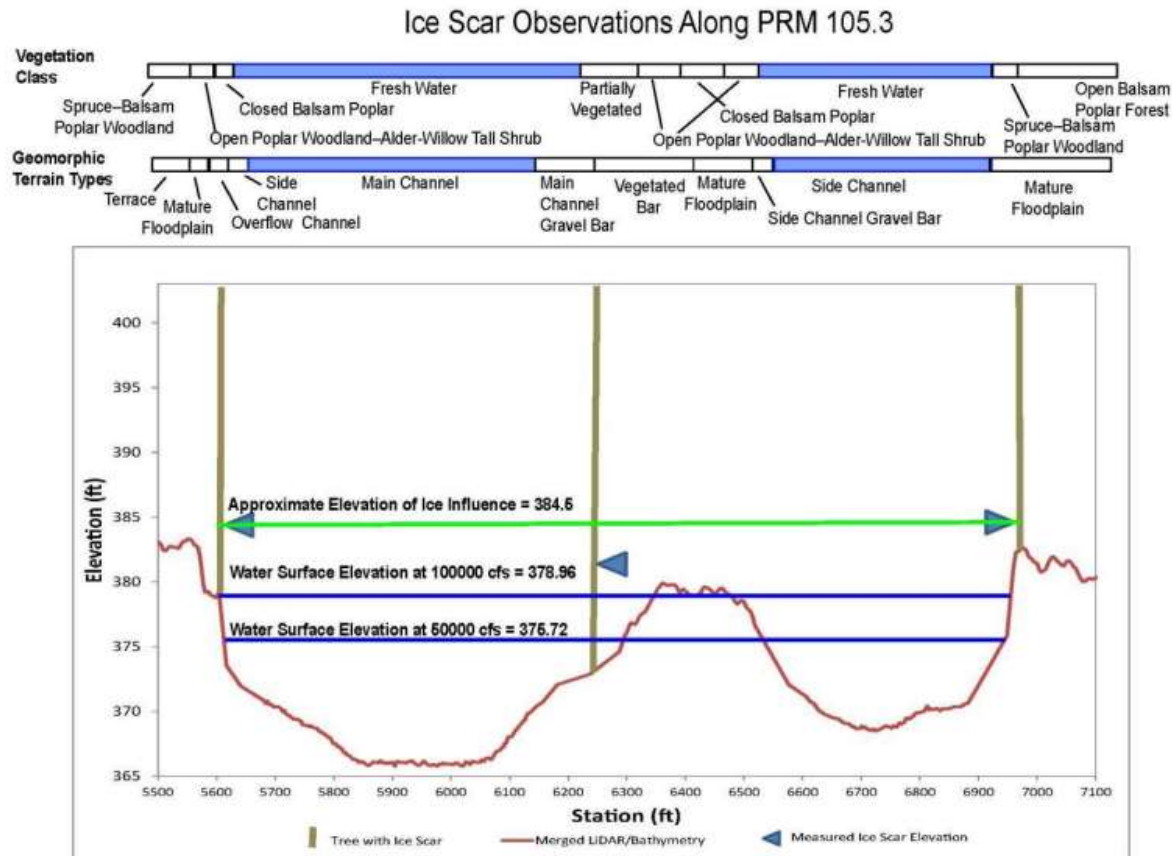
- Map showing downstream extent of ice scar observed to date at PRM 102.5 and ice scar observations at FA-104 (Whiskers Slough).



Summary of Results

River Ice Effects on Floodplain Vegetation (SIR Section 5.4)

- Flow routing cross-section, tree ice survey, and plant communities FA-104 (Whiskers Slough).



Summary of Results

Highlighted Results (SIR Section 5.4, page 9)



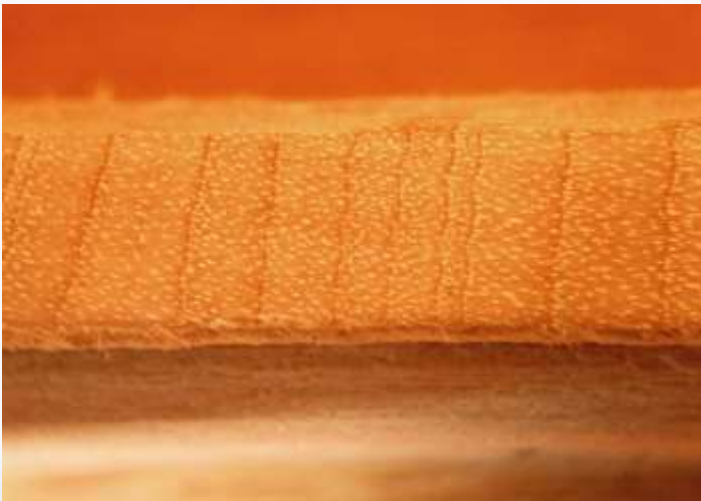
- Second season of aerial ice break-up observations and completion of river ice scar surveys in the Middle River and Lower River.



Summary of Results

Floodplain Stratigraphy and Floodplain Development (SIR Section 5.5)

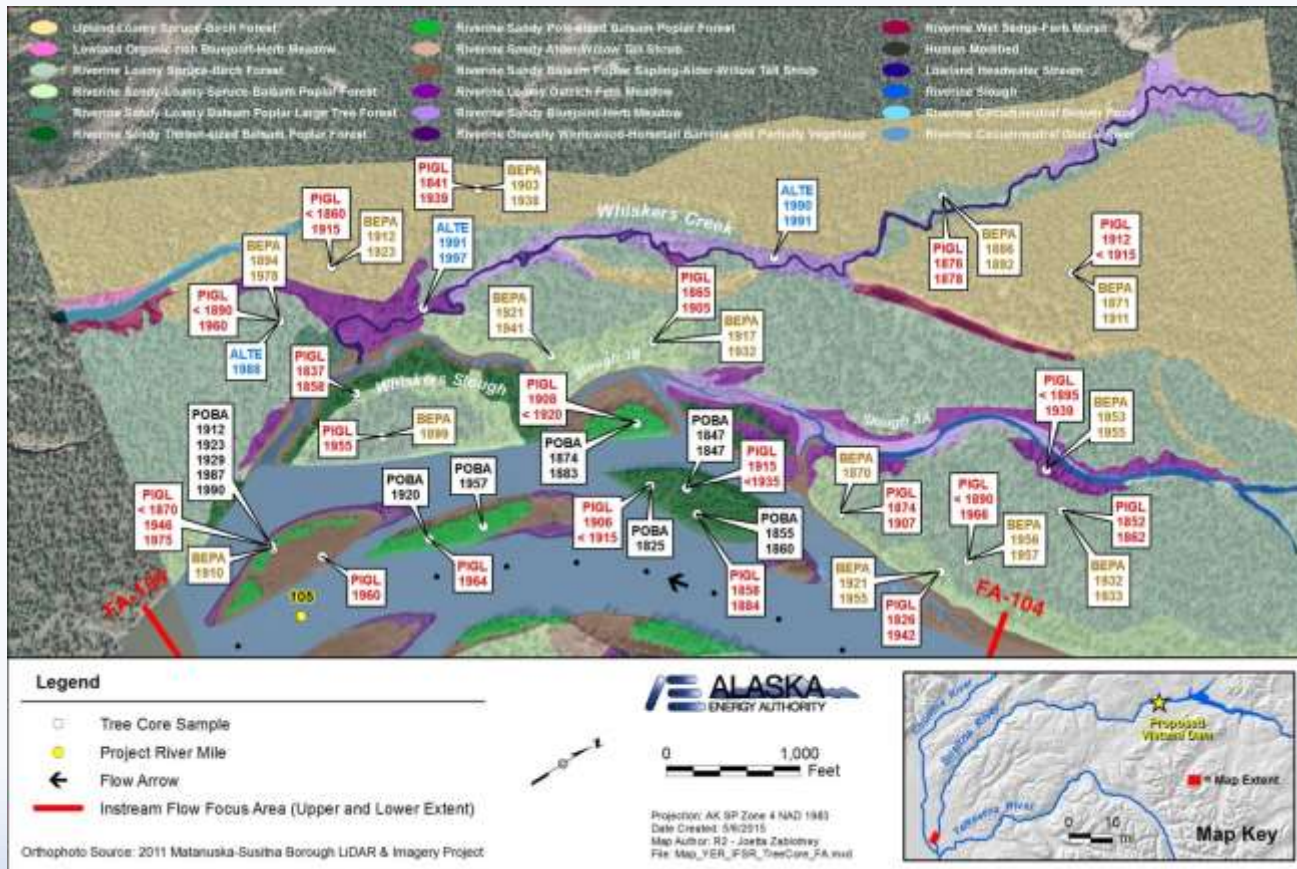
- Tree and shrub composition and abundance were measured at 80 ITU and mid-channel island plots in the Middle and Lower River Segments. Tree core samples for dendrochronologic analysis were collected at all ITU plots.



Summary of Results

Floodplain Stratigraphy and Floodplain Development study (SIR Section 5.5)

- Preliminary tree aging was completed from the Middle River Segment Focus Areas.



Preliminary tree age data completed for FA-104 (Whiskers Slough)

Summary of Results

Highlighted Results (SIR Section 5.5)

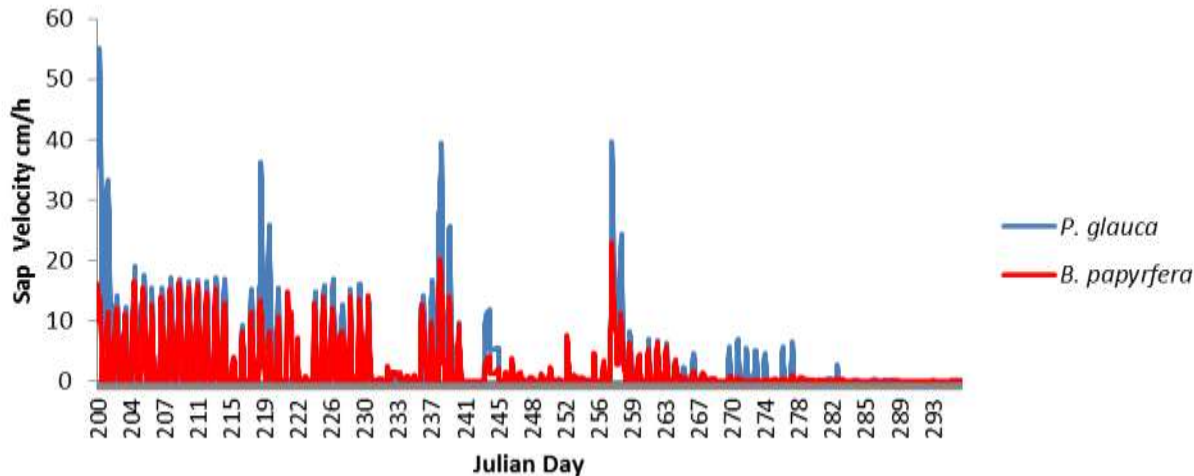
- Completion of field data collection for the Floodplain Stratigraphy and Floodplain Development study.



Summary of Results

Riparian GW/SW Hydroregime (SIR Section 5.6)

- Riparian Groundwater/Surface Water studies included collection of 659 plant samples, 545 soil samples, and 100 water samples for isotopic analysis of water source. Transpiration of woody species was measured with TDP sensors installed at 21 trees at FA-104 (Whiskers Slough) and 27 trees at FA-128 (Slough 8A). Transpiration by herbaceous and small shrub species was measured through collection of 3,602 individual stomatal conductance measurements, including measurements from 1,747 herbaceous plants (11 species), 1,771 shrubs (11 species), and 79 trees (3 species).
- FA-138 (Gold Creek) river right floodplain wetlands were shown to not be strongly influenced by surface water fluctuations associated with the Mid August peak flow. This observation was made by measuring floodplain off-channel water body surface water elevations as compared to river stage fluctuations.

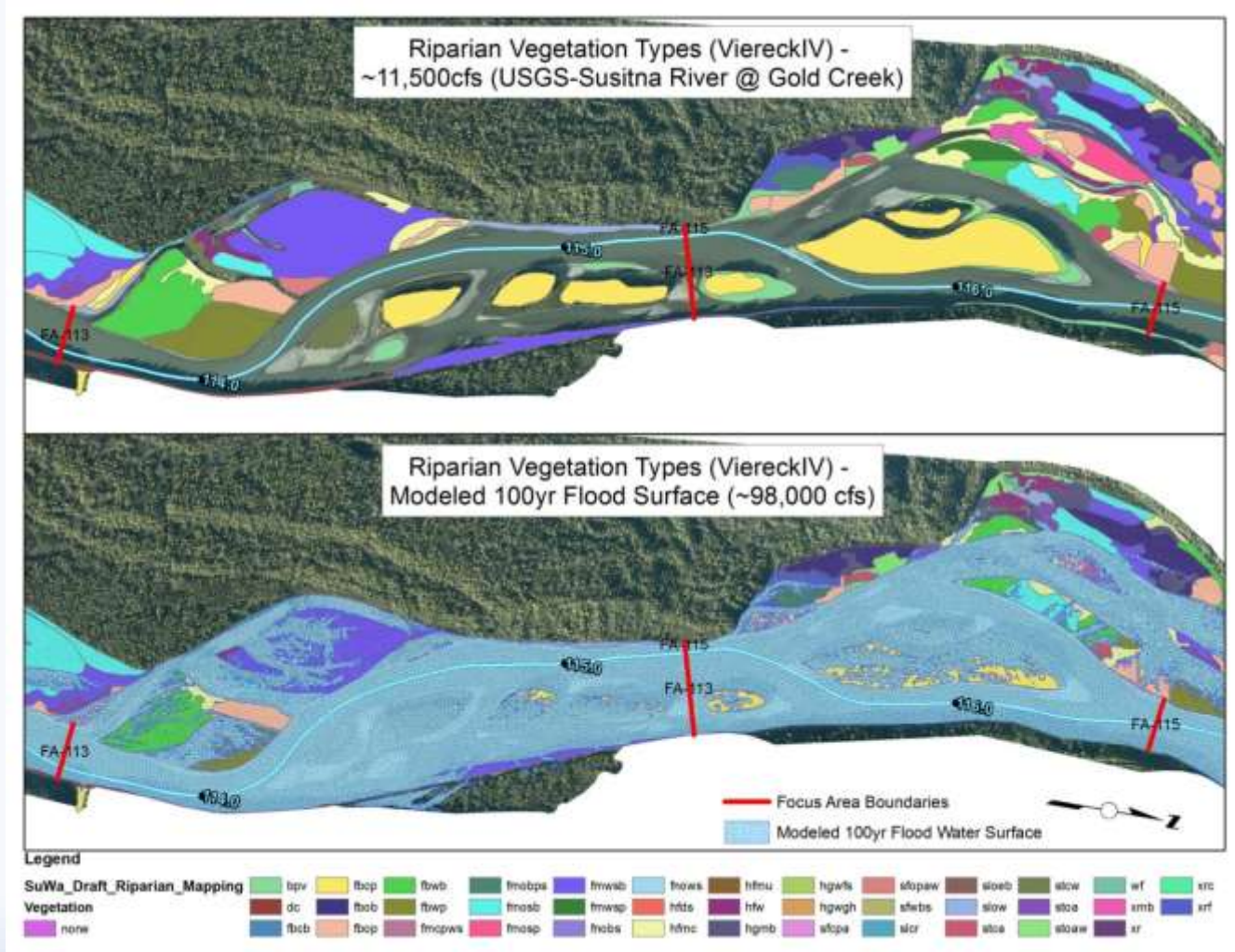


Summary of Results

Riparian GW/SW Hydroregime (SIR Section 5.6)

The surface water modeling floodplain mapping exercise utilized a water surface plane from the Fluvial

Geomorphology Modeling Study (Study 6.6) effort to produce two map layers from PRM 108 to ~PRM 154 showing 1) mapped riparian areas that are wetted by the 100-year flood, and 2) mapped riparian areas which remain above the 100-year flood.



Map results for FA-113 (Oxbow 1) and FA-115 (Slough 6A)

Summary of Results

Riparian GW/SW Hydroregime (SIR Section 5.6)

- The Riparian GW/SW collected a full season of sap flow measurements from April through mid-October in 2014 to measure tree water use relative to groundwater elevation within the Susitna floodplain



Summary of Results

Highlighted Results (SIR Section 5.6, page 10)

- Ongoing 2014 Riparian GW/SW Hydroregime tree transpiration measurements.



AEA Proposed Modifications

- Seedling Establishment and Recruitment Study (RSP Section 8.6.3.3.2)
 - Quantitatively characterize where (floodplain terrain locations) and how Balsam poplar clonal establishment and recruitment is occurring (ISR Part D, Section 7.1, Page 8).
 - Transect sampling at select Focus Area mid-channel islands and lateral floodplain margins to be determined in the field.
- During the April 2014 RIFS TWG Meeting it was discussed that **further evapotranspiration (ET) measurements were not warranted** given that the Susitna Valley region is not a precipitation limited region. Therefore, a second year of sap-flow and stomatal conductance ET measurements will not be conducted. ET modeling will use the results of 2013-2014 measurements (ISR Part D, Section 7.2, Page 9 and SIR Section 7.6.1, Page 15).

Steps to Complete

- Complete final riparian process domain analysis.
- Second season of field work for seed release study and model development to link peak seed release to local climate and discharge records.
- Additional white spruce and paper birch seedling establishment transects will be conducted on lateral floodplains, terraces, and mid-channel islands.
- Using the three-year longitudinal study of seedling survival and mortality data, a multivariate model of seedling establishment requirements will be developed. The model will be based on GW/SW interaction model results, local shear stress, soil texture, sediment transport, and alluvial terrain position.
- Complete sediment geochronology isotope sampling on sediment cores, data analysis, and final analysis report.
- Compile spatially explicit sediment isotope data to characterize rates of sediment deposition, and floodplain development, throughout the RIFS study area.
- Assess/model Project operations effects on sediment transport and floodplain soil development and subsequent effects on plant community development.
- Quantitatively describe and compare ice-influenced and non-ice-influenced floodplain plant communities to assess role of ice processes in Susitna River floodplain plant community composition and distribution.
- Provide Project operational guidance on potential effects of operations flow regime on ice formation and floodplain vegetation development.

Steps to Complete, Continued

- Additional root system characterizations will be conducted to assess plant community type rooting depths relative to groundwater.
- ITU plots surveyed by the Riparian Vegetation Study (Study 11.6) will be sampled to age trees and date the floodplain surface.
- Refinement of mapping and further interpretation of ice scar zones will be done to determine intensive ice floodplain vegetation interaction survey locations.
- Riparian GW/SW model construction will be developed.
- Final model development and continued coordination with TWG.
- Continued coordination with Riparian Vegetation (Study 11.6), Groundwater (Study 7.5), Ice Processes (Study 7.6), and Fluvial Geomorphology Modeling (Study 6.6) to integrate effects modeling efforts for modeling synthesis and project scaling from Focus Areas to project reach will occur.

Licensing Participants Proposed Modifications to Study 8.6?

- Agencies
- CIRWG members and Ahtna
- Public