Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Riparian Instream Flow Study
Study Plan Section 8.6

2014-2015 Study Implementation Report

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

R2 Resource Consultants

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

LIST OF ACRONYMS AND SCIENTIFIC LABELS

Abbreviation	Definition
2-D	Two Dimensional
AEA	Alaska Energy Authority
cfs	cubic feet per second
DBH	Diameter at Breast Height
ENRI	University of Alaska Anchorage's Environment and Natural Resources Institute
ET	Evapotranspiration
FA	Focus Area
FERC	Federal Energy Regulatory Commission
GIS	Geographic Information System
GPS	Global Positioning System
GW	Groundwater
ILP	Integrated Licensing Process
ISR	Initial Study Report
ITU	Integrated Terrain Unit
LAI	Leaf Area Index
LiDAR	Light Detection and Ranging
LR	Lower Susitna River Segment, PRM 102.4 to PRM 0
MR	Middle Susitna River Segment, PRM 187.1 to PRM 102.4
PM	Penman/Monteith
PRM	Project River Mile
Project	Susitna-Watana Hydroelectric Project, FERC No. 14241
QC	Quality Control
RIFS	Riparian Instream Flow Study 8.6
RSP	Revised Study Plan
SIR	Study Implementation Report
SW	Surface Water
TM	Technical Memorandum
TWG	Technical Workgroup

1. INTRODUCTION

This Riparian Instream Flow Study (RIFS), Section 8.6 of the Revised Study Plan (RSP) approved by the Federal Energy Regulatory Commission (FERC) for the Susitna-Watana Hydroelectric Project (Project), FERC Project No. 14241, focuses on the methods for assessing the effects of the proposed Project and its operations on the floodplain plant communities in the Susitna River basin.

A summary of the development of this study, together with the Alaska Energy Authority's (AEA) implementation of it through the 2013 study season, appears in Part A, Section 1 of the Initial Study Report (ISR) (AEA 2014) filed with FERC in June 2014 (AEA 2014). As required under FERC's regulations for the Integrated Licensing Process (ILP), the ISR describes AEA's "overall progress in implementing the Study Plan and schedule and the data collected, including an explanation of any variance from the Study Plan and schedule." (18 CFR 5.15(c)(1)).

Since filing the ISR in June 2014, AEA has continued to implement the FERC-approved Study Plan for the RIFS. Major RIFS activities completed in 2014 and 2015 included:

- Completion of literature review (Revised Study Plan [RSP] Section 8.6.3.1) in coordination with Fluvial Geomorphology (Study 6.6) and preparation of a Technical Memorandum (TM), filed with FERC November 14, 2014 (R2 and Tetra Tech 2014)
- Completion of the second and third years of field surveys for the longitudinal willow-cottonwood sexual reproduction seedling study (RSP Section 8.6.3.3.2)
- Completion of a second season of aerial ice break-up observations and river ice scar surveys in the Middle Susitna River Segment (MR) and Lower Susitna River Segment (LR) of the Susitna River (RSP Section 8.6.3.4).
- Continuation of field data collection for the Floodplain Stratigraphy and Floodplain Development study (RSP Section 8.6.3.5) and Riparian GW/SW study (RSP Section 8.6.3.6)
- On October 17, 2014, AEA held an ISR meeting for the Riparian Instream Flow Study.

In furtherance of the next round of ISR meetings and FERC's Director's Study Determination expected in 2016, this Study Implementation Report (SIR) describes AEA's overall progress in implementing the RIFS from October 2013 through September 2015. Rather than a comprehensive reporting of all field work, data collection, and data analysis since the beginning of AEA's study program, this report is intended to supplement and update the information presented in Part A of the ISR for the RIFS efforts through September 2015. The SIR describes the methods and results implemented in the 2014 and 2015 field efforts and discusses the results in terms of the seven stated objectives of the RIFS (Study 8.6).

2. STUDY OBJECTIVES

As stated in ISR Study 8.6, the goal of the RIFS is to provide a quantitative, spatially explicit model to predict potential impacts to downstream floodplain vegetation from Project operational flow modification of the natural Susitna River flow, sediment, and ice regimes. To meet this goal, a physical and vegetation process modeling approach is being applied. First, existing Susitna River groundwater (GW) and surface water (SW) flow, sediment, and ice regimes are being measured and modeled relative to floodplain plant community establishment, recruitment, and maintenance requirements. Second, predictive models are being developed to assess potential Project operational impacts to floodplain plant communities and to provide operational guidance to minimize these impacts. Third, the predictive models are being applied spatially in a Geographic Information System (GIS) to the riparian vegetation map produced by the Riparian Vegetation Study (Study 11.6) to produce a series of maps of predicted changes under alternative operational flow scenarios.

Seven RIFS objectives were established in RSP Section 8.6.1 as follows:

1. 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 (RSP Section 8.6.3.1).
2. Delineate sections of the Susitna River with similar environments, vegetation, and riparian processes, termed riparian process domains, and select representative areas within each riparian process domain, termed Focus Areas[1] (RSP Section 8.6.3.2).
3. Characterize seed dispersal and seedling establishment GW and SW hydroregime requirements. Develop a predictive model of potential Project operational impacts to seed dispersal and seedling establishment (RSP Section 8.6.3.3).
4. 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 (RSP Section 8.6.3.4).
5. 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 (RSP Section 8.6.3.5).
6. Characterize natural floodplain vegetation GW and SW maintenance hydroregime. Develop a predictive model to assess potential changes to natural hydroregime and potential floodplain vegetation (RSP Section 8.6.3.6).
7. Develop floodplain vegetation study synthesis, scaling of Focus Areas to riparian process domains, and Project operations effects modeling (RSP Section 8.6.3.7).

[1] Focus Areas are intensive study areas representing specific sections of the Middle Segment of the Susitna River that will be investigated across resource disciplines to provide for an overall understanding of interrelationships of river flow dynamics on the physical, chemical, and biological factors that influence fish habitat (AEA 2012).

3. STUDY AREA

As established in RSP Section 8.6.2, the RIFS study area includes the Susitna River active floodplain that would be affected by the operation of the Project downstream of the proposed Watana Dam site (PRM 187.1). The active floodplain is the valley bottom flooded under the current climate. The lateral extent of the Riparian Vegetation Study (Study 11.6) area was defined by the extent of the riverine physiographic region generated by the Susitna River. Riverine physiography includes: 1) those areas of the valley bottom, including off-channel water bodies, that are directly influenced by regular (0–25 year) to irregular (25–100 year) overbank flooding; and 2) those areas of the valley bottom influenced indirectly by GW associated with the Susitna River. The riverine physiographic map has undergone review and refinement by the principal investigators leading the RIFS, Riparian Vegetation Study (Study 11.6), and associated physical processes studies (GW Study 7.5, Ice Processes Study 7.6, and Fluvial Geomorphology Modeling Study 6.6). The longitudinal extent of the study area for the RIFS has been defined in coordination with the Riparian Vegetation Study 11.6, Fluvial Geomorphology Modeling Study 6.6, and GW Study 7.5. The study area includes those riparian areas downstream of the Project proposed dam Site to a point at which the effects of altered stage and flow effects expected in the Susitna River would not be ecologically significant (i.e., the expected hydraulic alterations would be overridden by the input from other rivers and/or the effects of tidal fluctuations from Cook Inlet). Following the completion of the Open-water Flow Routing Model in Q1 2013 and after receiving input from the Technical Workgroup (TWG), the downstream extent of the study areas for the riparian studies, including the Riparian Vegetation Study, was extended to Project River Mile [PRM] 29.9 (R2 2013). As established in the Study Plan, the Susitna River is characterized by three segments (Figure 3-1). The RIFS study area includes the MR, which extends from the proposed dam Site at PRM 187.1 downstream to the Three Rivers Confluence at PRM 102.4, and a portion of the LR, which extends from the Three Rivers Confluence to PRM 29.9 just below the confluence with the Yentna River (Figure 3-1).

4. METHODS AND VARIANCES

The RIFS is divided into seven study components listed in Section 3. This section provides an update of activities related to each of the objectives that have occurred following reporting provided in the June 2014 ISR. The June 2014 ISR reports on work that occurred through October 2013. The SIR reports on work completed after October 2013 which was not included in the June 2014 ISR. Only objectives for which work has been completed in this period are discussed in detail in this SIR; others are cross-referenced back to the methods and results in the ISR.

4.1. Literature Review of Dam Effects on Downstream Vegetation

AEA prepared a TM which combined the RIFS (Study 8.6) and Geomorphology Studies (Studies 6.5 and 6.6) reviews of the scientific literature concerning downstream effects of dams titled *Dam Effects on Downstream Channel and Floodplain Geomorphology and Riparian Plant Communities and Ecosystems−Literature Review* (R2 and Tetra Tech 2014), filed with FERC November 14, 2014. The objective of the TM was to synthesize studies of hydro project impacts on downstream floodplain plant communities, studies of un-impacted floodplain plant community successional processes, and historic physical and biologic data for the Susitna River floodplain vegetation, including 1980s studies (RSP Section 8.6.3.1). As such, this literature review summarizes reported study results and findings, presented as general background information, to inform potential responses of the Susitna River channel, floodplain and riparian ecosystem to Project operational flow modifications. The literature review was presented in three sections: 1) introduction, including nature and scope of the question, theoretical framework, riverine─riparian ecosystems, and definition of dams and hydroregulation; 2) review of 1980s Susitna River riparian studies; and 3) review of literature concerning dam effects on downstream channel and floodplain geomorphology and riparian plant communities and ecosystems. An annotated, searchable bibliography summarizing more than 110 peer-reviewed articles was provided in Appendix A of the TM.

The results of this study task provide a state-of-the-science background to the Project regarding reported peer reviewed, and non-peer reviewed, literature concerning dam effects on downstream channel and floodplain geomorphology and riparian plant communities and ecosystems.

4.2. Focus Area Selection─Riparian Process Domain Delineation

Study 8.6 ISR, Part A, Section 4.2 describes the approach and methodology used to develop the riparian process domain map and RIFS Focus Area selection process. As described in Study 8.6 ISR, Part A, Section 4.2, AEA implemented the methods associated with this study element in accordance with the Study Plan. There has been no substantive activity on this element since completion of the June 2014 ISR. No updates to the preliminary riparian process delineation mapping were completed in 2014.

4.3. Seed Dispersal and Seedling Establishment Studies

In this study task, dominant woody species seed dispersal and seedling establishment hydrologic requirements will be determined through field surveys and GW and SW interaction measurement and modeling. The study task has two subtasks: 1) seed dispersal, hydrology, and local Susitna River valley climate synchrony study task, and 2) seedling establishment study task. As described in Study 8.6 ISR, Part A, Section 4.3, AEA implemented the methods associated with this study element in accordance with the Study Plan.

4.3.1. Synchrony of Seed Dispersal, Hydrology, and Local Susitna River Valley Climate

Methods for the seed dispersal study task are described fully in Study 8.6 ISR, Part A, Section 4.3.1. No additional field efforts or data analyses were completed for this study objective subsequent to the ISR.

4.3.2. Seedling Establishment and Recruitment Study

The goal of the seedling establishment and recruitment study task is to identify, measure, and model potential impacts of Project operational changes to the GW, SW, sediment, and ice regimes, and to assess the effects of these impacts on seedling establishment and recruitment within the active channel margin / floodplain environment. As described in Study 8.6 ISR, Part A, Section 4.3.2, AEA implemented the methods associated with this study element in accordance with the Study Plan.

As described in the Study 8.6 ISR, Part A, Section 4.3.2 willow and poplar seedling establishment data (2013-2015) was collected. Methods and results of the 2013 data collection effort are provided in Study 8.6 ISR, Part A, Section 4.3.2.1 and 5.3.2.1. Methods and preliminary results of the three year willow and poplar seedling establishment data are described below.

Second year seedling establishment study task sampling efforts occurred from July 29, 2014 through August 4, 2014 and from August 30, 2014 through September 4, 2014. Third year seedling establishment study task sampling efforts occurred from July 21, 2015 to July 25, 2015 and August 28, 2015 to September 3, 2015. The methods used in the 2014 and 2015 study were identical to the 2013 field effort described in Study 8.6 ISR, Part A, Section 4.3.2.1.1. Using transects and plot locations established in 2013 (Study 8.6 ISR, Part A, Section 4.3.2.1.1.), 0.25-square-meter (2.7-square-foot) quadrats were laid out at 1-meter (3.3-foot) intervals along randomly located transects along a baseline established parallel to the channel. Transects established in 2013 were relocated in 2014 and again in 2015. Transects extended normal to the channel from lowest extent of seedling occurrence (typically the edge of water) to full vegetative canopy cover in adjacent floodplain forest or shrub community. Nearly all the transect rebar pins placed in 2013 were relocated during the 2014 and 2015 efforts. Several sites had significant erosion or deposition at one end of the transect so rebar mid-points were used to start or end transects. Within each plot, second year seedlings were counted to ascertain longitudinal survival from 2013-2015. Poplar and willow first-year germinants/seedlings were counted to estimate abundance and density of new recruit cohort in 2014 and again 2015. In addition to counting target woody seedlings, all herbaceous plant cover within the plots was estimated. Aerial percent cover and stem heights for tree or shrub seedlings were measured. At each 0.25-square-meter (2.7-square-foot) quadrat the following data were collected in 2014 and 2015:

- Sediment texture was recorded as percent cover of quadrat gravel or cobble vs. percent cover by sand or silt.
- Depth to gravel/cobble layer was measured using a 2-meter (6.6 feet) tile probe (AMS, Inc.).
- Elevation of each quadrat was surveyed with a level. Transect quadrat points were surveyed to the intermediate benchmark set in 2013 and tied into the Project datum.

4.3.2.1. Variances

AEA implemented the methods as described in the Study Plan with exception of methods for documentation of clonal reproduction for willow and cottonwood recruitment as described in Study 8.6 ISR, Part A, Section 4.3.2.2.

4.4. River Ice Effects on Floodplain Vegetation

In this study task, multiple lines of evidence are being used to evaluate how vegetation responds to the influence of ice shearing in the Susitna River floodplain, including observations of ice vegetation impacts (distribution map and dendrochronologic ages of tree ice-scars), gravel floodplain deposit evidence, results from the Ice Processes modeling (Study 7.6), and historic accounts (anecdotal and recorded) of ice dam generated flood events. As described in Study 8.6 ISR, Part A, Section 4.4, AEA implemented the methods associated with this study element in accordance with the Study Plan.

Observations of ice effects on floodplains have been completed in 2012, 2013, 2014, and 2015. Methods and results of the 2012 and 2013 data collection efforts are summarized in Study 8.6 ISR, Part A, Section 4.4.1 and 5.4.1. Maps showing tree ice scar observations from 2013 field efforts are provided in Study 8.6 ISR, Part A, Figure 5.4.4 and 5.4.5.

In 2014, additional field observations were made but were limited to spring break-up observations from a helicopter, and an aerial and boat-based Lower River ice scar reconnaissance survey to determine the downstream extent of ice scars.

In 2015, Middle River tree ice scar mapping was completed by helicopter and use of a jet dinghy to access shallow water areas previously inaccessible by jet boat. Surveys were conducted from PRM 187 to PRM 102 with coverage including Middle River mainstem channel, secondary channels and side sloughs. Mapping was conducted using a Trimble Geo 7x with added laser rangefinder and mounted external antenna. As in 2013 surveys, the 2015 survey protocol was to make observations at approximately 0.2 mile intervals. If scars were present, the nearest tree with an ice-scar was surveyed using the laser. If no ice-scarred trees were visible, the floodplain surface elevation was surveyed. Tree ice-scar measurements included: 1) height of tree ice-scar; 2) height of floodplain surface at the base of the tree; 3) height of floodplain above the water surface; and 4) horizontal location of the tree or floodplain surface. In 2015, the jet dinghy and helicopter allowed access to channel reaches that were previously mapped as inaccessible in 2013. In addition, areas which were marked with no ice scars in 2013 were resampled on foot and by boat to confirm or revise the 2013 determinations. All Global Positioning System (GPS) location data were post-processed with differential corrections using Trimble software and mapped on aerial photographs.

4.4.1. Variances

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

4.5. Floodplain Stratigraphy and Floodplain Development

Methods and results of the 2013 data collection efforts are summarized in Study 8.6 ISR, Part A, Section 4.5.1 and 5.5.1. As described in Study 8.6 ISR, Part A, Section 4.5, AEA implemented the methods associated with this study element in accordance with the Study Plan.

4.5.1. Variances

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

4.6. Riparian Floodplain Vegetation Groundwater and Surface Water Hydroregime Study (i.e., Riparian GW/SW Study)

Installation methods and locations followed methods described in Study 8.6 ISR, Part A, Section 4.6.1 for 2013 field efforts. As described in Study 8.6 ISR, Part A, Section 4.6, AEA implemented the methods associated with this study element in accordance with the Study Plan.

During the 2014 field season, field work was restricted to collecting continuous sap velocity measurements using sap flow sensors. In 2014, however, the number of total sensors was reduced in several trees. The total number of sensors and sensor types differed between the two years for given trees and thus data is reported in two separate databases. Methods and results of the 2013 data collection effort are provided in Study 8.6 ISR, Part A, Sections 4.6.2.4 and 5.6.3.

Stomatal conductance and leaf area index (LAI) measurements were collected in 2013, as components of the Penman/Monteith (PM) equation, to be used to produce transpiration curves for herbaceous and wood shrubs. Methods are provided in Study 8.6 ISR, Part A, Section 4.6.2.4. Additional limited data analysis has occurred since the June 2014 ISR. Specifically, a preliminary PM model was developed with 2013 results using the standard FAO Penman/Monteith approach to calculate evapotranspiration (ET) on an hourly basis (Allen et al. 1998). As described in Study 8.6 ISR, Part A, Section 4.6, AEA implemented the methods associated with this study element in accordance with the Study Plan. No additional field efforts occurred in 2014 or 2015 on stomatal conductance or LAI, sediment, plant and water isotope or root depth sampling.

Preliminary surface water modeling was completed using a riparian floodplain mapping exercise utilizing a water surface plane from the Fluvial Geomorphology Modeling Study (Study 6.6). This geomorphology model was run for a 100-year flood (~98,000 cubic feet per second [cfs] at the Gold Creek Gage) from ~PRM 154 to PRM 103, and the resulting water surface plane was overlaid atop the 2013-2014 Light Detection and Ranging (LiDAR) digital elevation model. A map of the extent of flooding caused by the 100-year flood was obtained by subtracting the elevation of the underlying terrain from this 100-year water surface plane.

Next, this 100-year flood extent was laid over top of the riparian floodplain map, which was delineated for the Riparian Vegetation Study (Study 11.6) from approximately PRM 108 to the proposed Dam Site (PRM 187.1). The riparian floodplain map was then further delineated into wet and dry sections, based on whether or not a given area overlapped with the 100-year flood extent. The result produced two map layers from ~PRM 154 to PRM 108: 1) mapped riparian areas that are wetted by the 100-year flood, and 2) mapped riparian areas which remain above the 100-year flood.

4.6.1. Variances

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

4.7. Riparian Vegetation Modeling Synthesis and Project Area Scaling

As described in Study 8.6 ISR, Part A, Section 4.7, AEA implemented the methods associated with this study element in accordance with the Study Plan. An RIFS TWG Meeting was held on April 29 and 30, 2014 (http://www.susitna-watanahydro.org/meetings/past-meetings/) in which an integrated modeling proof of concept and Project effects metrics were presented and discussed.

4.7.1. Variances

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

5. RESULTS

Field data that has been QA/QC'd, and used in developing: 1) ISR Study 8.6 and 2) SIR Study 8.6 are available on the GINA website at the links below.

- http://gis.suhydro.org/isr/08-Instream_Flow/8.6-Riparian_Instream_Flow/
- http://gis.suhydro.org/SIR/08-Instream_Flow/8.6-Riparian_Instream_Flow/

See Table 5-1 for a listing of data files pertaining to this SIR on the GINA website.

5.1. Literature Review of Dam Effects on Downstream Vegetation

AEA prepared and submitted to FERC a TM titled *Dam Effects on Downstream Channel and Floodplain Geomorphology and Riparian Plant Communities and Ecosystems−Literature Review* (R2 and Tetra Tech 2014). This study objective has been met.

5.2. Focus Area Selection–Riparian Process Domain Delineation

No additional work has been completed on this study task after the June 2014 ISR. Refer to Study 8.6 ISR, Part A, Section 5.2.

5.3. Seed Dispersal and Seedling Establishment Studies

5.3.1. Synchrony of Seed Dispersal, Hydrology, and Local Susitna River Valley Climate

No additional work has been completed on this study task since the June 2014 ISR. Refer to Study 8.6 ISR, Part A, Section 5.3.1.

5.3.2. Seedling Establishment and Recruitment Study

In 2013, across all transects, more than 45,000 first year (0+) poplar and willow seedlings were counted. Since the June 2014 ISR, additional seedling establishment surveys have been conducted. In July of 2014, the first round of seedling sampling recorded 383 poplar, 23 willow, 13,398 undifferentiated poplar/willow, and 78 alder year 0+ seedlings and 493 poplar, 1,329 willow, and 25 alder year 1+ seedlings (Table 5-2). During the second round of sampling in September 2014, 5,586 poplar, 411 willow, 51 undifferentiated poplar/willow, and 10 alder year 0+ seedlings and 235 poplar, 1,083 willow, and 5 alder year 1+ seedlings were recorded.

General survival rates between July and September sampling events for year 0+ poplar and willow year seedlings was 44%, and year 0+ alder was 12%. Survival rates of year 1+ seedlings in 2014 were 48%, 39%, and 20% for poplar, willow, and alder respectively (Table 5-2 and Table 5-3). During the July 2015 survey, 6,715 poplar, 1,731 willow, 32 undifferentiated poplar/willow, and 947 alder year 0+ seedlings were recorded. In addition, 989 poplar, 2,476 willow, and 140 alder year 1+ seedlings were recorded. Surveys conducted along these transects in September 2015 recorded 1,604 poplar, 1,400 willow, 11 undifferentiated poplar/willow, and 1,133 alder year 0+ seedlings and 410 poplar, 961 willow, and 43 alder year 1+ seedlings. General year 0+ seedling survival rates between July and August 2015 were 24%, 81%, and 34% for poplar, willow, and differentiated poplar/willow respectively, Establishment of alder seedlings appears to continue later in the growing season as alder year 0+ seedlings increased by 86 seedlings between July and September 2015. Average Year 1+ seedling survival rates were 42%, 39%, and 31% for poplar, willow, and alder respectively (Table 5-2 and Table 5-3).

Survival trends were highly variable among all tree species and between transects. Total seedling counts observed at individual transects in 2014 and 2015 for Year 0+ and Year 1+ seedlings are shown in Figure 5-1 and Figure 5-2. Figure 5-3 through Figure 5-8 provide examples of seedling survivals across specific transects within Focus Areas FA-104 (Whiskers Slough), FA-128 (Slough 8A), FA-138 (Gold Creek) (FA-104 STR 3, FA-128 STR 2, and FA-138 STR 3).

Throughout the course of the study, plot elevation remained fairly consistent for most transects. However, sediment erosion, whether by ice plowing or sheer stress, and sediment deposition was observed at a number of transects. Examples of transect elevation comparisons from 2013 through 2015 are presented in Figures 5-9 through Figure 5-14. In addition to plot elevation surveys, depth to cobble and GW elevation were measured during July 2014 and in both July and September of 2015.

Ocular estimates of surface substrate (sand/silt versus gravel/cobble) and vegetation leaf cover (herbaceous and woody) were conducted at each plot during each sampling period. Substrate varied among transects and geomorphic locations. However, silt and sands were the overall dominate substrates along seedling transects. Cobble/Gravel was predominantly found along lower elevations of transects (Table 5-4). Overall vegetation cover varied across transects. Both herbaceous and woody vegetation cover increased along higher elevations along transects (Table 5-5). Additional statistical analyses will be conducted following the completion of all interrelated studies to assess the relative importance of environmental factors on seedling survival.

5.4. River Ice Effects on Floodplain Vegetation

On May 2, 2014, a 1-day ice break-up aerial reconnaissance and photographic survey, was conducted by helicopter to observe ice-floodplain vegetation interactions. The 2014 thermal breakup provided the opportunity to observe conditions that were very different from the 2013 dynamic river breakup where numerous ice dams were observed. The helicopter flight was conducted by flying the Susitna River mainstem from Talkeetna (PRM 102) to the proposed Dam Site at PRM 187.1. On May 2, 2014, slowly melting ice was observed throughout the main channel, and no main channel ice dams were observed except at Whiskers Slough PRM 104. The PRM 104 ice dam caused significant backwater flooding throughout the Whiskers Slough floodplains, with ice tree interactions occurring along the river banks.

Additional tree ice scar wedges were sampled during field surveys on August 5-7, 2014 for dendrochronologic analysis at FA-113 (Oxbow 1) and FA-115 (Slough 6A), a reach known historically for ice dam formations, and on September 3-5, 2014 at FA-104 (Whiskers Slough) and FA-128 (Slough 8A). Figure 5-15 through Figure 5-18 summarize the locations of tree ice scar wedge samples collected in Focus Areas in 2013 and 2014. Figure 5-19, Figure 5-20, Figure 5-21, Figure 5-22, and Figure 5-23 show the compilation of all tree ice scars observed relative to the zone of floodplain ice influence at each Focus Area.

A determination of the geographic extent of tree ice scar occurrence along the Lower Susitna River main channel was independently conducted by the RIFS study team, September 2014, and Fluvial Geomorphology Modeling Study (Study 6.6) study team, August 2014, leads by jet boat from the

Three Rivers Confluence (PRM 102.4) to Little Willow Creek (PRM 54.5). The first Susitna River main channel tree ice scar was mapped at PRM 102.5, September 2014, immediately upriver of the confluence of the Susitna and Chulitna rivers (Figure 5-15, see inset). Neither study lead observed any tree ice scars from the Three Rivers Confluence to the confluence of Little Willow Creek.

Tree ice scar mapping was also completed from PRM 102 to PRM 187 during late September 2015. Focus Area examples of mapped tree ice scars and the reach scale lateral extent of river ice floodplain influence are depicted in Figure 5-19 [FA-104 (Whiskers Slough)], Figure 5-20 [FA-113 (Oxbow 1)], Figure 5-21 [FA-115 (Slough 6A)], Figure 5-22 [FA-128 (Slough 8A)], and Figure 5-23 [FA-138 (Gold Creek)]. The vertical extent of ice dam back-water flooding relative to the open water 2-year event (approximately 50,000 cfs) and the 100-year event (100,000 cfs) is illustrated in Figure 5-24, Figure 5-25, and Figure 5-26. These examples show that the highest surface water elevations on the MR of the Susitna River are associated with ice dam back-water flooding.

5.5. Floodplain Stratigraphy and Floodplain Development

Field data collection on floodplain formation was conducted in 2013, 2014, and 2015. Methods and results of the 2013 data collection efforts are summarized in ISR Study 8.6, Section 4.5.1 and 5.5.1.

Since the June 2014 ISR, field data collection was limited to a September 22-28, 2014 riparian sediment sampling survey that was conducted along the Susitna River corridor downriver from the proposed Dam Site. Sediment cores were collected for sediment isotope geochronological analysis at 38 sites along the MR between PRM 104 and 144.

Tree-core samples for tree age characterization were collected at all Integrated Terrain Unit (ITU) plots in coordination with the Riparian Vegetation Study (Study 11.6) as reported in the June 2014 ISR. Preliminary tree core aging data was completed after the June 2014 ISR for all samples. Results are provided in Table 5-6. Locations of these samples are summarized in Figure 5-27. Preliminary tree age data for FA-104 (Whiskers Slough) and FA-128 (Slough 8A) are presented in Figure 5-28 and Figure 5-29.

Sediment core ^{210}Pb and ^{137}Cs laboratory geochronology analyses were conducted in 2014; however, the results will not be presented until final analyses and interpretation is conducted.

5.6. Riparian Floodplain Vegetation Groundwater and Surface Water Hydroregime Study (i.e., Riparian GW/SW Study)

In 2014, a full season of sap flow measurements with associated GW well data was collected for a suite of floodplain trees and shrubs. As described above, in 2014, the number of total sensors was reduced relative to 2013 protocols in several trees. Results of the 2013 data collection effort are provided in ISR Study 8.6, Sections 5.6.3.

Stomatal conductance and LAI measurements were collected in 2013, as components of the Penman/Monteith (PM) equation, to be used to produce transpiration curves for herbaceous and wood shrubs. Results from the 2013 field season are provided in ISR Study 8.6, Section 5.6.3. A preliminary PM model shows the July 2013 evapotranspiration results for *Matteuccia* *struthiopteris* at FA-104 (Whiskers Slough) (Figure 5-30). All sap flow instrumentation was removed from the field in September 2015.

During the 2013 field effort, the RIFS field team collected 370 soil samples, 661 plant samples, and 100 water samples during June, July, and September for stable isotope analysis of oxygen18 and deuterium. Raw samples were delivered to University of Alaska Anchorage's Environment and Natural Resources Institute (ENRI) Stable Isotope Lab beginning in August 2013, and cryogenic vacuum extraction of plant and soil samples began in February 2014. Results of the 2013 data collection effort are provided in ISR Study 8.6, Sections 5.6.1. Complete modeling could not be done without the additional data; however, after the June 2014 ISR a preliminary model of July 2013 proportional plant water uptake by soil depth for plants species at FA-128 (Slough 8A) in open alder cover type was prepared (Figure 5-31).

The surface water modeling floodplain mapping exercise utilizing a water surface plane from the Fluvial Geomorphology Modeling Study (Study 6.6) effort produced two map layers from ~PRM 154 to PRM 108: 1) mapped riparian areas that are wetted by the 100-year flood, and 2) mapped riparian areas which remain above the 100-year flood. Figure 5-32, Figure 5-33, and Figure 5-34 show results of this analysis at FA-113 (Oxbow 1) and FA-115 (Slough 6A), FA-128 (Slough 8A), and FA-138 (Gold Creek).

5.7. Riparian Vegetation Modeling Synthesis and Project Area Scaling

A Technical Work Group (TWG) meeting was held April 29-30, 2014 in which elements of the conceptual model of riparian floodplain vegetation were discussed. Presentations from RIFS (Study 8.6), Riparian Vegetation (Study 11.6), GW (Study 7.5), Ice Processes (Study 7.6), and Fluvial Geomorphology Modeling (Study 6.6) studies are available on the Project website (http://www.susitna-watanahydro.org/meetings/past-meetings/). In these meetings, a conceptual design and formulation of dynamic spatially-explicit floodplain vegetation models were presented for simulating floodplain vegetation response to Project operation modification of the natural flow, sediment and ice processes regimes. The outcome of further modeling synthesis and Project area scaling efforts are to provide guidance to Project operations to minimize modeled floodplain vegetation effects. No additional work has been completed on this study task after the ISR. Refer to ISR Study 8.6, Section 5.7.

6. DISCUSSION

6.1. Literature Review of Dam Effects on Downstream Vegetation

This study task is complete. Refer to Study 8.6 ISR, Part A, Section 6.1 and the November 15, 2014 TM titled *Literature Review of Dam Effects on Downstream Vegetation* (R2 and Tetra Tech 2014).

6.2. Focus Area Selection–Riparian Process Domain Delineation

No additional work has been completed on this study task since that reported in the June 2014 ISR. Refer to Study 8.6 ISR, Part A, Section 6.2.

6.3. Seed Dispersal and Seedling Establishment Studies

6.3.1. Synchrony of Seed Dispersal, Hydrology, and Local Susitna River Valley Climate

No additional work has been completed on this study task since that reported in the ISR. Refer to Study 8.6 ISR, Part A, Section 6.3.1.

6.3.2. Seedling Establishment and Recruitment Study

Fluvial processes are essential component of riparian plant successional changes on floodplain surfaces. Seasonal changes in water level control sediment transport, GW elevation, soil moisture, silt deposition, and seedling burial and scouring. All these things have been well established in directly affecting the success of riparian seedling establishment. To date, seedling establishment study has met the objectives outlined in the Study Plan by completing three years of seedling establishment counts two times during the growing season to capture the long-term seedling survival for a river system that has an average bimodal summer discharge. Throughout this study, established seedling transects were visited two times during the growing season where seedling survival counts, floodplain elevations, depth of sediment layer, and GW/SW elevations were all recorded.

Across all sampling years, seedling survivorship varied across Focus Areas, geomorphic features, and transects. In general, all three years consistently showed large mortality rate for year 0+ seedlings between the two sampling events. Early seedling establishment occurs on moist alluvial surfaces following the peak in the hydrograph. Based on field observations, large numbers of year 0+ mortality was a result of desiccation do to drying surfaces as river stage decreases. However, trends show an increase of year 1+ seedlings survival from July 2014 through September 2015. We believe this is partly due to the fact there has only been one significant peak flow event over the course of the study, which occurred in late August of 2013. This event was observed to have scoured out many year 0+ seedlings between the first and second sampling. In addition, both 2014 and 2015 experienced mild thermal breakups, reducing the severity of back water flooding and ice scouring attributed to more dynamic breakups. The impacts of high water events and ice to seedling survival are also evident through erosion and sediment deposition observed along transects.

By standardizing seedling survival by elevation and incorporating shear stress and GW elevation into the analysis, the results of the seedling establishment study task will model spatially where seedling establishment will occur with Project operations flow regimes. The effects metric to be developed will be a spatially explicit projection of potential seedling encroachment, or mortality due to erosion, throughout the Project area. The results of the seedling study task, and metrics developed in collaboration with the Fluvial Geomorphology Modeling Study (Study 6.6), will be a key element in the Fluvial Geomorphology Modeling Study team’s 50+ year alluvial terrain model projection. The results, and vegetation encroachment or erosion metrics, will predict where and to what extent vegetation encroachment along the channel margins is likely to occur.

6.4. River Ice Effects on Floodplain Vegetation

The objective of the ice effects vegetation study task is to quantitatively describe the role and degree of influence ice processes have on the composition, abundance, age, and spatial pattern of riparian vegetation along the Susitna River.

The data that has been collected throughout the three years of field efforts will provide the necessary data to meet study objectives outlined in the Study Plan. During this time, a large dendrochronology effort was undertaken in 2013 to map out the age of various floodplain surfaces. In addition, a complete map of the Middle River provides the location and elevation in which ice interacts with vegetation. Ice scar wedge samples collected at certain Focus Areas, provide a historic record of large ice events. The data of this study while be integrated into the hydrological models and the results will be used to assess how floodplain vegetation pattern and process may change with Project operation alterations of the natural ice process regime. Finally, the riparian vegetation process analysis will support the projected Project impacts analysis providing metrics for wildlife habitat studies.

6.5. Floodplain Stratigraphy and Floodplain Development

The Floodplain Stratigraphy and Floodplain Development (RSP Section 8.6.3.5) study task results will be used to measure the Project operations impacts on riparian vegetation establishment, maintenance, and succession. The sediment isotope sedimentation rate analyses will be used to develop change metrics for the Fluvial Geomorphology Modeling Study (Study 6.6) floodplain evolution model. The results metrics will be utilized in the Riparian Vegetation Study (Study 11.6) and wildlife habitat studies. Additional sediment core data was collected and preliminary tree age data were determined subsequent to the ISR. No additional analyses have been completed on this study task since that reported in the June 2014 ISR. Refer to Study 8.6 ISR, Part A, Section 6.3.5.

6.6. Riparian Floodplain Vegetation Groundwater and Surface Water Hydroregime Study (i.e., Riparian GW/SW Study)

It is widely accepted that a river's hydroregime can have many effects on the existence of certain riparian plant species. Changes in river hydrology can affect the composition and distribution of riparian species. The goal of the Riparian Floodplain Vegetation Groundwater and Surface Water Hydroregime Study (RSP Section 8.6.3.6) was to collect the necessary data to be able to statistically model relationships between individual riparian plant species, floodplain plant community types, and natural GW/SW hydroregime.

The study is progressing toward meeting objectives set in the Study Plan to collect the necessary data needed to build transpiration curves for MODFLOW modeling and is awaiting associated Quality Control (QC) level data from inter-related studies. In 2013 and 2014, both field and analytical progress to build transpiration curves for MODFLOW modeling were accomplished through the collection of sap flow measurements across a full growing season and the construction of preliminary PM models for dominant herbaceous species. In addition, a large number of water isotope samples have been analyzed providing the necessary data needed to understand both the general location riparian plant species uptake water from and the relative amount of water taken from each source.

The final results of the riparian GW/SW study task will be used to predict potential changes in the hydrological cycle during Project operations and its possible impacts to the composition of floodplain vegetation communities. By identifying the physical hydrological boundaries which help maintain current Susitna River floodplain conditions, the results from this study task are designed to form the basis for recommended flow prescriptions necessary to support floodplain vegetation establishment, recruitment, and maintenance.

6.7. Riparian Vegetation Modeling Synthesis and Project Area Scaling

The TWG meeting was held April 29-30, 2014 in which elements of the conceptual model of riparian floodplain vegetation were discussed. No additional work has been completed on this study task since that reported in the June 2014 ISR. Refer to Study 8.6 ISR, Part A, Section 5.7.

7. CONCLUSION

The following conclusions are presented sequentially by study section.

7.1. Literature Review of Dam Effects on Downstream Vegetation

The Literature Review of Dam effects on Downstream Vegetation (RSP Section 8.6.3.1) has been completed and submitted to FERC November 14, 2014.

7.2. Focus Area Selection–Riparian Process Domain Delineation

Initial analyses have been accomplished. Preliminary riparian process domain delineation and RIFS Focus Area selection was completed using an iterative process starting with a multidisciplinary approach, statistical analyses, and analysis of Viereck Level III vegetation types and type abundance along digitized transects. The final riparian process domain delineation will be completed for the MR and LR in a final statistical analysis incorporating final tree ice scar mapping data, ice process modeling results, and open-water floodplain inundation frequency modeling results.

7.3. Seed Dispersal and Seedling Establishment Studies

7.3.1. Synchrony of Seed Dispersal, Hydrology, and Local Susitna River Valley Climate

Field data collection and preliminary climate day model analysis was accomplished in 2014. An additional year's worth of seed dispersal data is necessary to complete the study. Final synchrony modeling will be conducted once final fieldwork is accomplished.

7.3.2. Seedling Establishment and Recruitment Study

Three years (2013, 2014, and 2015) of seedling survival sampling was finished in September 2015. Next steps to finalize the study are to: (1) incorporate Fluvial Geomorphology Two-Dimensional

(2-D) bed shear stress modeling results for all sample transects, and (2) complete the statistical analysis of the field data and modeling results.

7.4. River Ice Effects on Floodplain Vegetation

Tree ice scar field mapping was finished in September 2015. Next steps to finalizing the study include: (1) analysis of tree ice scar map and dendrochronologic data throughout the MR, (2) quantitatively compare ice-influenced and non-ice-influenced floodplain plant communities to assess the role and degree of ice process influence, and (3) comparison analysis of Ice Process Study river modeling results with the empirical tree ice scar mapping.

7.5. Floodplain Stratigraphy and Floodplain Development

Sediment stratigraphy field work was completed in 2013, 2014 & 2015. Final laboratory isotope analysis has not yet been completed.. Final steps to finish the study include: (1) analysis of Fluvial Geomorphology Study channel migration study results with Riparian Vegetation Study vegetation map and RIFS dendrochronologic analyses, (2) analysis of sediment isotope study results with open water floodplain frequency model and tree ice scar study area mapping, (3) incorporation of Riparian Vegetation Study successional models with results of Fluvial Geomorphology channel and floodplain evolution models, and (4) assess/model how Project operation induced changes in sediment transport and soil development will affect floodplain development and plant community succession.

7.6. Riparian Floodplain Vegetation Groundwater and Surface Water Hydroregime Study (i.e., Riparian GW/SW Study)

In 2013 and 2014, both field and analytical progress to build transpiration curves for MODFLOW modeling were accomplished through the collection of tree sap flow measurements across a full growing season and the construction of preliminary Penman Monteith models for dominate herbaceous species. In addition, a large number of water isotope samples have been analyzed providing the necessary isotope data needed to understand both riparian plant species water sources and the relative amount of water taken from each source. Final steps to finish the study include: (1) laboratory analysis of plant, soil and water isotope samples, (2) additional year of GW samples at Focus Areas, (3) additional root depth sampling, and (4) GW/SW analysis and modeling.

7.6.1. Modifications to Study Plan

During the April 2014 RIFS TWG Meeting it was discussed that further evapotranspiration (ET) measurements were not necessarily warranted given that the Susitna Valley region is not a precipitation limited region. Therefore a second year of sap-flow and stomatal conductance measurements will not be conducted. ET modeling will use the results of 2013-2014 measurements.

7.7. Riparian Vegetation Modeling Synthesis and Project Area Scaling

A TWG meeting was held April 29-30, 2014 in which a synthesis of the various elements of the riparian floodplain vegetation conceptual model were presented representing RIFS (Study 8.6), Riparian Vegetation (Study 11.6), GW (Study 7.5), Ice Processes (Study 7.6), and Fluvial Geomorphology Modeling (Study 6.6) studies. Conceptual design and formulation of dynamic spatially-explicit floodplain vegetation models and projects effects metrics for simulating floodplain vegetation response to Project operation modification of the natural flow, sediment and ice processes regimes were presented. No additional work has been completed on this study task since that reported in the June 2014 ISR.

8. LITERATURE CITED

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9. TABLES

Table 5-1. Summary of the QC3 data files used in support of this SIR and its appendices that have been delivered to GINA and are publically available (http://gis.suhydro.org/SIR/08-Instream_Flow/8.6-Riparian_Instream_Flow/).

Component[1]	Data File Name	Description
2	SIR_8_6_RIFS_ProcessDomains_20151106.shp	GIS shapefile of riparian process domains
3	SIR_8_6_RIFS_SeedReleaseDatabase_20151106.xlsx	Excel file with single year of willow and poplar seed release observation data
3	SIR_8_6_RIFS_SeedlingEstablishmentStudyDatabase_20151106.xlsx	Excel file with willow, alder, poplar seedling establishment data for 2013-2015 field seasons
4	SIR_8_6_RIFS_IceScarDatabase_20151106.xlsx	Excel file with ice scar observation data from 2013-2015
6	SIR_8_6_RIFS_VegetationGWSW_20151106.xlxs	Riparian GW/SW study sap flow data
6	SIR_8_6_RIFS_ PorometerandLAIDatabase_20151106.xlsx	Riparian GW/SW study porometer and LAI field data
6	SIR_8_6_RIFS_GWSW_WaterIsotopeDatabase_20151106.xlsx	Riparian GW/SW study water isotope sample data
3, 5, 6	SIR_8_6_RIFS_StudyLocations_20151106.xlsx	Riparian study site locations as point features
3, 5, 6	SIR_8_6_RIFS_StudyTransects_20151106.shp	GIS shapefile of riparian study transect locations

Notes:

Component 1: Literature Review of Dam Effects on Downstream Vegetation (RSP Section 8.6.4.1)

Component 2: Focus Area Selection−Riparian Process Domain Delineation (RSP Section 8.6.4.2)

Component 3: Seed Dispersal and Seedling Establishment (RSP Section 8.6.4.3)

Component 4: River Ice Effects on Floodplain Vegetation (RSP Section 8.6.4.4)

Component 5: Floodplain Stratigraphy and Floodplain Development (RSP Section 8.6.4.5)

Component 6: Riparian GW/SW Hydroregime (RSP Section 8.6.4.6)

Componen 7: Riparian Vegetation Modeling Synthesis and Project Area Scaling (RSP Section 8.5.4.7)

Table 5-2. Total Year 0+ Poplar, Willow, Undifferentiated Poplar/Willow and Alder Seedlings Counted from 2013-2015.

	Sum Poplar Year 0+	Sum Willow Year 0+	Sum of Poplar/Willow Seedling Year 0+	Sum of Alder Year 0+	Totals
August 2013	41553	7643	0	0	**49196**
September 2013	11498	4882	0	3	**16383**
July 2014	383	23	13398	78	**13882**
September 2014	5586	411	51	10	**6058**
July 2015	6715	1731	32	947	**9425**
September 2015	1604	1400	11	1133	**4148**

Table 5-3. Total Year 1+ Poplar, Willow, and Alder Seedlings Counted from 2013-2015.

	Sum Poplar Year 1+	Sum Willow Year 1+	Sum of Alder Year 1+	Totals
August 2013	Did not sample	Did not sample	Did not sample	Did not sample
September 2013	Did not sample	Did not sample	Did not sample	Did not sample
July 2014	493	1329	25	**1847**
September 2014	235	1083	5	**1323**
July 2015	989	2476	140	**3605**
September 2015	410	961	43	**1414**

Table 5-4. Percent Substrate Cover along Transects.

Distance along Transect (cm)	FA-104 STR3				FA-128 STR2				FA-138 STR3			
	Average Sand/Silt Cover		Average Gravel/Cobble Cover		Average Sand/Silt Cover		Average Gravel/Cobble Cover		Average Sand/Silt Cover		Average Gravel/Cobble Cover	
	Percent Cover %	StdDev	Percent Cover %	StdDev	Percent Cover %	StdDev	Percent Cover %	StdDev	Percent Cover %	StdDev	Percent Cover %	StdDev
50	24.7	28.2	75.3	28.2	36.7	49.3	63.3	49.3	35.0	28.3	70.8	29.1
150	25.0	22.6	75.0	22.6	58.3	44.0	50.0	43.6	25.2	12.9	79.0	15.4
250	16.2	9.3	83.8	9.3	66.7	48.0	40.0	50.5	17.6	8.3	85.3	10.3
350	51.7	13.7	48.3	13.7	61.7	45.4	46.0	46.2	45.8	25.0	54.2	25.0
450	19.2	10.7	80.8	10.7	61.7	42.2	46.0	42.2	92.5	9.9	7.5	9.9
550	37.5	28.9	62.5	28.9	68.3	45.8	38.0	48.2	70.8	35.3	29.2	35.3
650	66.7	32.5	33.3	32.5	78.3	29.9	26.0	31.3	73.3	34.4	26.7	34.4
750	95.8	10.2	4.2	10.2	88.3	16.0	14.0	16.7	77.5	12.5	22.5	12.5
850	100.0	0.0	0.0	0.0	80.0	25.3	24.0	26.1	97.2	4.0	3.4	4.2
950	93.3	16.3	3.3	8.2	97.5	4.2	3.0	4.5	85.8	14.3	14.2	14.3
1050	53.3	34.3	46.7	34.3	86.7	20.7	16.0	21.9	100.0	0.0	0.0	0.0
1150	93.0	12.9	5.0	12.2	92.5	16.0	9.0	17.5	99.7	0.8	0.4	0.9
1250	99.2	2.0	0.0	0.0	100.0	0.0	0.0	0.0	99.7	0.8	0.4	0.9
1350	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	99.5	1.2	0.6	1.3
1450	100.0	0.0	0.0	0.0	91.7	20.4	10.0	22.4	100.0	0.0	0.0	0.0
1550	100.0	0.0	0.0	0.0	68.3	45.8	38.0	48.2	100.0	0.0	0.0	0.0
1650					44.0	43.8	56.0	43.8	100.0	0.0	0.0	0.0
1750					67.5	19.9	32.5	19.9	100.0	0.0	0.0	0.0
1850					80.0	25.3	0.0	0.0	100.0	0.0	0.0	0.0
1950					55.0	34.5	45.0	34.5	100.0	0.0	0.0	0.0
2050					100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
2150					100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
2250					100.0	0.0	0.0	0.0	99.2	2.0	0.0	0.0
2350					100.0	0.0	0.0	0.0				
2450					100.0	0.0	0.0	0.0				
2550					100.0	0.0	0.0	0.0				
2650					100.0	0.0	0.0	0.0				
2750					97.5	6.1	2.5	6.1				

Table 5-5. Percent Vegetation Cover along Transects.

Location along Transect (cm)	FA-104 STR3				FA-128 STR2				FA-138 STR3			
	Herbaceous Plant Cover		Woody Plant Cover		Herbaceous Plant Cover		Woody Plant Cover		Herbaceous Plant Cover		Woody Plant Cover	
	Percent Cover %	StdDev	Percent Cover %	StdDev	Percent Cover %	StdDev	Percent Cover %	StdDev	Percent Cover %	StdDev	Percent Cover %	StdDev
50	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
150	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
250	0.0	0.0	0.0	0.0	0.4	0.9	0.0	0.0	0.0	0.0	0.0	0.0
350	3.8	2.6	0.0	0.0	0.4	0.9	0.0	0.0	4.3	1.2	0.0	0.0
450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.8	25.0	7.5	11.7
550	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	20.7	19.9	0.0	0.0
650	3.2	2.6	0.0	0.0	0.0	0.0	0.0	0.0	6.8	4.8	0.0	0.0
750	0.2	0.4	17.5	14.4	0.0	0.0	0.0	0.0	20.7	12.1	0.0	0.0
850	3.8	5.8	3.3	5.2	0.0	0.0	0.0	0.0	21.5	20.2	0.0	0.0
950	8.7	4.5	16.8	14.5	0.0	0.0	0.0	0.0	17.7	7.4	0.0	0.0
1050	9.8	4.7	0.0	0.0	0.0	0.0	0.0	0.0	18.5	11.5	0.7	1.2
1150	6.6	5.3	60.0	47.0	0.0	0.0	0.0	0.0	32.2	25.2	2.7	4.1
1250	13.0	4.0	5.8	12.0	2.0	4.5	0.0	0.0	20.7	10.4	0.0	0.0
1350	4.3	3.7	29.2	30.7	1.4	2.2	0.0	0.0	15.2	6.0	23.3	27.5
1450	2.5	2.7	88.3	13.7	9.0	6.5	0.0	0.0	16.4	8.5	15.0	36.7
1550	0.8	2.0	105.8	12.8	21.4	20.5	19.0	20.7	16.8	9.4	26.7	41.8
1650					3.1	4.4	74.2	37.5	20.9	16.2	35.0	41.7
1750					2.8	2.6	39.2	47.6	18.3	9.8	15.5	24.8
1850					10.9	8.2	26.7	38.8	16.8	10.2	51.7	37.6
1950					0.3	0.4	12.2	21.5	8.7	5.7	11.3	11.8
2050					4.6	4.6	53.3	37.8	32.0	19.5	13.3	32.7
2150					15.1	11.7	65.0	38.3	17.7	12.5	15.8	22.9
2250					11.0	8.2	83.3	16.3	17.8	10.6	36.7	25.0
2350					10.2	7.6	60.0	33.5				
2450					8.0	4.8	87.5	17.8				
2550					11.0	6.9	78.3	24.0				
2650					9.4	4.7	84.7	16.4				
2750					1.5	2.1	84.2	22.9				

Table 5-6. Tree age data for field samples collected in 2012 and 2013. Note that this data has not been corrected for age to height of core above tree root collar.

Tree Species	Tree Diameter at Breast Height (DBH) (cm)	Latitude	Longitude	Height of core above collar (cm)	Year of establishment	2013 Age (years)
					Values not corrected for height of core above collar	
Alnus incana ssp. *tenuifolia*	13.1	62.37592382	-150.1736146	32	1988	25
Alnus incana ssp. *tenuifolia*	12.8	62.3785855	-150.170866	20	1991	22
Alnus incana ssp. *tenuifolia*	8.8	62.3785855	-150.170866	45	1997	16
Alnus incana ssp. *tenuifolia*	12.3	62.51826681	-150.1285175	44	1963	50
Alnus incana ssp. *tenuifolia*	15.2	62.51826681	-150.1285175	20	1957	56
Alnus incana ssp. *tenuifolia*	11	62.49722312	-150.1034488	34	1959	54
Alnus incana ssp. *tenuifolia*	16.1	62.527667	-150.114712	41	1973	40
Alnus incana ssp. *tenuifolia*	17.2	62.527667	-150.114712	45	1976	37
Alnus incana ssp. *tenuifolia*	6.3	62.385278	-150.164847	20	1990	23
Alnus incana ssp. *tenuifolia*	11.3	62.385278	-150.164847	120	1991	22
Alnus incana ssp. *tenuifolia*	7	62.25121577	-150.1473657	24	1996	17
Alnus incana ssp. *tenuifolia*	11.6	62.47195059	-150.1175162	27	1983	30
Alnus incana ssp. *tenuifolia*	10.8	62.47195059	-150.1175162	111	1984	29
Alnus incana ssp. *tenuifolia*	N/A	62.325479	-150.140126	N/A	2001	12
Betula papyrifera	51	62.37652	-150.16694	34	1899	114
Betula papyrifera	30.8	62.37342124	-150.1651724	23	1910	103
Betula papyrifera	40.7	62.78558104	-149.6584431	19	1951	62
Betula papyrifera	15.4	62.78558104	-149.6584431	18	1960	53
Betula papyrifera	19	62.37592382	-150.1736146	16	1978	35
Betula papyrifera	24.5	62.37592382	-150.1736146	29	1894	119
Betula papyrifera	32.5	62.37740189	-150.1745112	22	1912	101
Betula papyrifera	25.9	62.37740189	-150.1745112	36	1923	90
Betula papyrifera	15.5	62.38078809	-150.1741396	67	1938	75
Betula papyrifera	22.9	62.38078809	-150.1741396	37	1903	110
Betula papyrifera	35.6	62.38032877	-150.1661723	51	1921	92
Betula papyrifera	34.6	62.38032877	-150.1661723	52	1941	72
Betula papyrifera	34.1	62.38226775	-150.1643814	40	1917	96
Betula papyrifera	39	62.38226775	-150.1643814	45	1932	81
Betula papyrifera	33.3	62.38377624	-150.1536686	47	1870	143
Betula papyrifera	14.5	62.51826681	-150.1285175	22	1977	36
Betula papyrifera	17.7	62.51826681	-150.1285175	27	1977	36
Betula papyrifera	9.5	62.51860083	-150.126904	12	1980	33
Betula papyrifera	34.2	62.3849093	-150.1491894	24	1955	58
Betula papyrifera	51	62.3849093	-150.1491894	21	1921	92
Betula papyrifera	37	62.3855192	-150.1489759	75	1956	57
Betula papyrifera	30.3	62.3855192	-150.1489759	38	1957	56
Betula papyrifera	25	62.3878462	-150.150655	24	1953	60
Betula papyrifera	18.6	62.3878462	-150.150655	23	1955	58
Betula papyrifera	48.3	62.530895	-150.114009	57	1918	95
Betula papyrifera	31	62.5248715	-150.1228237	47	1899	114
Betula papyrifera	27	62.5248715	-150.1228237	21	1888	125
Betula papyrifera	48.7	62.5246056	-150.124250	45	1892	121
Betula papyrifera	38.7	62.531976	-150.113418	40	1923	90
Betula papyrifera	44.5	62.531976	-150.113418	38	1876	137
Betula papyrifera	54	62.526997	-150.115877	45	1877	136

Tree Species	Tree Diameter at Breast Height (DBH) (cm)	Latitude	Longitude	Height of core above collar (cm)	Year of establishment	2013 Age (years)
					Values not corrected for height of core above collar	
Betula papyrifera	44	62.526997	-150.115877	45	1912	101
Betula papyrifera	27.3	62.522653	-150.117096	39	1968	45
Betula papyrifera	21.6	62.522653	-150.117096	20	1961	52
Betula papyrifera	20.1	62.520321	-150.130267	26	1876	137
Betula papyrifera	22.3	62.520321	-150.130267	50	1880	133
Betula papyrifera	24.5	62.521097	-150.129336	26	1912	101
Betula papyrifera	21.9	62.521097	-150.129336	28	1943	70
Betula papyrifera	37.4	62.522758	-150.126772	37	1888	125
Betula papyrifera	41.2	62.522758	-150.126772	41	1884	129
Betula papyrifera	38.6	62.388893	-150.163350	45	1886	127
Betula papyrifera	34.2	62.388893	-150.163350	48	1892	121
Betula papyrifera	27.4	62.390361	-150.157489	24	1911	102
Betula papyrifera	30.7	62.390361	-150.157489	23	1871	142
Betula papyrifera	46.5	62.387701	-150.148731	50	1933	80
Betula papyrifera	39.5	62.387701	-150.148731	50	1932	81
Betula papyrifera	47	62.51899324	-150.1252551	22	1930	83
Betula papyrifera	42.2	62.69704	-149.835744	22	1966	47
Betula papyrifera	24	62.468811	-150.121384		1905	108
Pinus glauca	32	62.51826681	-150.1285175	40	1809	204
Pinus glauca	42	62.3849093	-150.1491894	19	1826	187
Pinus glauca	42.5	62.376507	-150.169146	40	1837	176
Pinus glauca	27.8	62.38078809	-150.1741396	21	1841	172
Pinus glauca	33.1	62.514191	-150.114209	27.5	1846	167
Pinus glauca	33.7	62.520321	-150.130267	36	1848	165
Pinus glauca	28.1	62.387701	-150.148731	39	1852	161
Pinus glauca	51.2	62.38124122	-150.1568733	33	1858	155
Pinus glauca	54.9	62.376507	-150.169146	50	1858	155
Pinus glauca	36	62.387701	-150.148731	48	1862	151
Pinus glauca	38.4	62.38226775	-150.1643814	29	1865	148
Pinus glauca	46.5	62.530895	-150.114009	51	1865	148
Pinus glauca	16.4	62.513867	-150.115286	31	1865	148
Pinus glauca	18	62.521097	-150.129336	26	1866	147
Pinus glauca	49.6	62.667012	-149.906416	33	1869	144
Pinus glauca	20.5	62.521097	-150.129336	27	1870	143
Pinus glauca	31.3	62.38377624	-150.1536686	23	1874	139
Pinus glauca	17.5	62.518987	-150.116599	27	1874	139
Pinus glauca	30	62.388893	-150.16335	28	1876	137
Pinus glauca	34.8	62.388893	-150.16335	40	1878	135
Pinus glauca	31.1	62.468811	-150.121384		1878	135
Pinus glauca	38	62.5080139	-150.1088219	43	1879	134
Pinus glauca	54	62.38124122	-150.1568733	23	1884	129
Pinus glauca	40	62.028985	-150.133263	33	1884	129
Pinus glauca	31.1	62.520321	-150.130267	25	1885	128
Pinus glauca	24.8	62.508235	-150.109330	25	1885	128
Pinus glauca	26.7	62.518987	-150.116599	22	1889	124
Pinus glauca	15	62.51507128	-150.1140557	16	1890	123
Pinus glauca	28.3	62.522758	-150.126772	22	1892	121
Pinus glauca	22.5	62.513253	-150.114524	32	1898	115

Tree Species	Tree Diameter at Breast Height (DBH) (cm)	Latitude	Longitude	Height of core above collar (cm)	Year of establishment	2013 Age (years)
					Values not corrected for height of core above collar	
Pinus glauca	35.2	62.5080139	-150.1088219	36	1903	110
Pinus glauca	32.7	62.38226775	-150.1643814	28	1905	108
Pinus glauca	16.9	62.522758	-150.126772	22	1905	108
Pinus glauca	27.9	62.38070855	-150.1590193	15	1906	107
Pinus glauca	30.6	62.509115	-150.109170	37	1906	107
Pinus glauca	16.3	62.38377624	-150.1536686	48	1907	106
Pinus glauca	26.5	62.38112412	-150.1616836	42	1908	105
Pinus glauca	48.2	62.33495132	-150.1397751	29	1912	101
Pinus glauca	26.9	62.390361	-150.157489	32	1912	101
Pinus glauca	35.9	62.5246056	-150.1242497	34	1913	100
Pinus glauca	18	62.37740189	-150.1745112	27	1915	98
Pinus glauca	35.2	62.38132244	-150.1581059	32	1915	98
Pinus glauca	26.5	62.507907	-150.108986	30	1923	90
Pinus glauca	42	62.51899324	-150.1252551	3	1929	84
Pinus glauca	21.8	62.38078809	-150.1741396	23	1939	74
Pinus glauca	31.9	62.3878462	-150.150655	22	1939	74
Pinus glauca	11.3	62.471290	-150.109410	29	1939	74
Pinus glauca	39.4	62.531976	-150.113418	45	1940	73
Pinus glauca	14.7	62.47132732	-150.1094839	32	1942	71
Pinus glauca	37.3	62.3849093	-150.1491894	35	1942	71
Pinus glauca	28	62.59631775	-150.0316515	27	1944	69
Pinus glauca	22.2	62.51507128	-150.1140557	22	1945	68
Pinus glauca	23	62.37341847	-150.165286	20	1946	67
Pinus glauca	25.6	62.5248715	-150.1228237	16	1949	64
Pinus glauca	25.6	62.59631775	-150.0316515	28	1950	63
Pinus glauca	36	62.51860527	-150.1209339	27	1950	63
Pinus glauca	41.4	61.77902572	-150.1922578	24	1951	62
Pinus glauca	15.7	62.47132732	-150.1094839	34	1952	61
Pinus glauca	24.1	62.470725	-150.109568	21	1952	61
Pinus glauca	29.5	62.37652	-150.16694	28	1955	58
Pinus glauca	14	62.49838393	-150.103414	30	1955	58
Pinus glauca	21.2	62.470542	-150.109408	24	1955	58
Pinus glauca	14.2	62.49722312	-150.1034488	23	1956	57
Pinus glauca	48	62.59631775	-150.0316515	36	1958	55
Pinus glauca	20.1	62.471589	-150.109154	26	1958	55
Pinus glauca	11.4	62.49722312	-150.1034488	22	1959	54
Pinus glauca	20	62.37420226	-150.1637481	12	1960	53
Pinus glauca	27.5	62.37592382	-150.1736146	29	1960	53
Pinus glauca	19.9	62.470928	-150.109483	23	1962	51
Pinus glauca	7.2	62.470878	-150.109531	26	1962	51
Pinus glauca	8.6	62.49838393	-150.103414	30	1963	50
Pinus glauca	11.8	62.37625969	-150.162004	12	1964	49
Pinus glauca	25.3	62.5246056	-150.1242497	23	1965	48
Pinus glauca	21.5	62.662034	-149.927085	25	1965	48
Pinus glauca	19.9	62.3855192	-150.1489759	19	1966	47
Pinus glauca	10.9	62.7203859	-149.7799213	18	1968	45
Pinus glauca	54.4	61.77902572	-150.1922578	49	1969	44
Pinus glauca	17	62.662034	-149.927085	33	1972	41

Tree Species	Tree Diameter at Breast Height (DBH) (cm)	Latitude	Longitude	Height of core above collar (cm)	Year of establishment	2013 Age (years)
					Values not corrected for height of core above collar	
Pinus glauca	11.8	on ice jam island near PRM 134 - exact lat/long not known		25	1973	40
Pinus glauca	21	62.37341847	-150.165286	15	1975	38
Pinus glauca	8	62.508864	-150.109662	26	1978	35
Pinus glauca	13.1	62.509709	-150.116485	23	1980	33
Pinus glauca	10.3	61.62133462	-150.3692625	26	1981	32
Pinus glauca	4.5	62.659675	-149.939883	38	1987	26
Pinus glauca	12.2	61.62133462	-150.3692625	22	1990	23
Pinus glauca	5.1	62.25104585	-150.1438387	27	1993	20
Pinus glauca	6	62.659990	-149.939938	27	1993	20
Pinus glauca	10.3	61.62166252	-150.3682398	26	1995	18
Pinus glauca	30.6	62.667012	-149.906416	38	tree older than 1825	N/A
Pinus glauca	41.5	62.51826681	-150.1285175	46	tree older than 1855	N/A
Pinus glauca	18.6	62.37740189	-150.1745112	24	tree older than 1860	N/A
Pinus glauca	33.9	62.509709	-150.116485	42	tree older than 1864	N/A
Pinus glauca	46.4	62.37342124	-150.1651724	20	tree older than 1870	N/A
Pinus glauca	30.3	62.664702	-149.910262	34	tree older than 1880	N/A
Pinus glauca	40.4	62.37592382	-150.1736146	29	tree older than 1890	N/A
Pinus glauca	27.9	62.3855192	-150.1489759	22	tree older than 1890	N/A
Pinus glauca	43.7	62.5248715	-150.1228237	42	tree older than 1894	N/A
Pinus glauca	57.1	62.3878462	-150.150655	55	tree older than 1895	N/A
Pinus glauca	34.9	62.38070855	-150.1590193	72	tree older than 1915	N/A
Pinus glauca	30.6	62.390361	-150.157489	7	tree older than 1915	N/A
Pinus glauca	27.6	62.38112412	-150.1616836	19	tree older than 1920	N/A
Pinus glauca	31.1	62.531976	-150.113418	35	tree older than 1920	N/A
Pinus glauca	51	62.767403	-148.832306	42	tree older than 1925	N/A
Pinus glauca	27.1	62.508475	-150.109498	31	tree older than 1925	N/A
Pinus glauca	28.9	62.38132244	-150.1581059	28	tree older than 1935	N/A
Pinus glauca	34.6	62.33495132	-150.1397751	18	tree older than 1940	N/A
Pinus glauca	9	62.509686	-150.109773	35	tree older than 1975	N/A
Populus balsamifera	39.9	62.49838393	-150.103414	44	1924	89
Populus balsamifera	4.9	62.49804354	-150.1054514	27	2005	8
Populus balsamifera	11	62.25121577	-150.1473657	31	1996	17
Populus balsamifera	11	62.25121577	-150.1473657	29	1993	20
Populus balsamifera	11	62.25332578	-150.1618839	33	1988	25
Populus balsamifera	11.5	62.325479	-150.140126	28	1987	26
Populus balsamifera	12	62.323834	-150.135411	31	1984	29
Populus balsamifera	16.5	62.25332578	-150.1618839	22 or 24	1990	23
Populus balsamifera	18.5	62.699886	-149.847921	26	1992	21
Populus balsamifera	20	62.509261	-150.116294	22	1993	20
Populus balsamifera	20.1	61.94982257	-150.1143957	39	1966	47
Populus balsamifera	20.2	62.6593104	-149.9403894	28	1978	35
Populus balsamifera	22	62.38132244	-150.1581059	42	1847	166
Populus balsamifera	23.3	62.509261	-150.116294	48	1991	22
Populus balsamifera	23.5	62.02789	-150.13635	32	1983	30
Populus balsamifera	23.9	61.94982257	-150.1143957	31	1971	42
Populus balsamifera	27.1	62.37341847	-150.165286	42	1929	84

Tree Species	Tree Diameter at Breast Height (DBH) (cm)	Latitude	Longitude	Height of core above collar (cm)	Year of establishment	2013 Age (years)
					Values not corrected for height of core above collar	
Populus balsamifera	27.2	62.3734185	-150.165286	18	1987	26
Populus balsamifera	27.7	62.38070855	-150.1590193	98	1825	188
Populus balsamifera	27.8	62.324453	-150.136971	28	1979	34
Populus balsamifera	28	62.3734185	-150.165286	17.5	1990	23
Populus balsamifera	28.2	62.49722312	-150.1034488	28	1954	59
Populus balsamifera	31.5	62.6593104	-149.9403894	23	1979	34
Populus balsamifera	32	62.49722312	-150.1034488	25	1954	59
Populus balsamifera	33.1	62.49838393	-150.103414	55	1954	59
Populus balsamifera	36	62.37734682	-150.1612654	50	1957	56
Populus balsamifera	37.5	62.38132244	-150.1581059	35	1847	166
Populus balsamifera	37.8	62.25104585	-150.1438387	27	1974	39
Populus balsamifera	37.8	62.78558104	-149.6584431	22.5	1957	56
Populus balsamifera	39.2	62.47132732	-150.1094839	27	1922	91
Populus balsamifera	39.7	62.78558104	-149.6584431	9	1955	58
Populus balsamifera	41.5	62.38112412	-150.1616836	63	1883	130
Populus balsamifera	43.7	62.47132732	-150.1094839	42	1924	89
Populus balsamifera	43.8	62.5086294	-150.1097566	55	1906	107
Populus balsamifera	44	61.62133462	-150.3692625	72	1970	43
Populus balsamifera	45.2	62.7203859	-149.7799213	31	1946	67
Populus balsamifera	45.8	62.37341847	-150.165286	64.5	1923	90
Populus balsamifera	46.6	62.37341847	-150.165286	48	1912	101
Populus balsamifera	47.8	62.38124122	-150.1568733	29	1855	158
Populus balsamifera	48.4	62.7203859	-149.7799213	44	1948	65
Populus balsamifera	48.5	62.5086294	-150.1097566	37	1908	105
Populus balsamifera	48.5	62.38112412	-150.1616836	43	1874	139
Populus balsamifera	48.8	62.5080139	-150.1088219	46	1866	147
Populus balsamifera	49	62.662034	-149.927085	35	1965	48
Populus balsamifera	52.5	62.38124122	-150.1568733	22	1860	153
Populus balsamifera	53.6	61.62133462	-150.3692625	35	1947	66
Populus balsamifera	55	62.37625969	-150.162004	28	1920	93
Populus balsamifera	57.3	61.62166252	-150.3682398	54	1971	42
Populus balsamifera	57.5	62.5080139	-150.1088219	NA	1864	149
Populus balsamifera	58	62.59631775	-150.0316515	47	1915	98
Populus balsamifera	58.4	62.662034	-149.927085	51	1951	62
Populus balsamifera	60.5	62.522653	-150.117096	38	1907	106
Populus balsamifera	63.2	62.523692	-150.11616	47	1939	74
Populus balsamifera	67.5	61.62133462	-150.3692625	60	1971	42
Populus balsamifera	69.3	61.77902572	-150.1922578	125	1857	156
Populus balsamifera	N/A	62.699886	-149.847921	25	1991	22
Populus balsamifera	N/A	62.358338	-150.146652	N/A	1991	22
Populus balsamifera	N/A	62.604274	-150.026936	N/A	1977	36
Populus balsamifera	N/A	62.35726	-150.147113	N/A	1972	41
Populus balsamifera	N/A	62.604274	-150.026936	N/A	1926	87
Populus balsamifera	56.5	62.59631775	-150.0316515	38	tree older than 1953	N/A
Populus balsamifera	67.8	62.523692	-150.11616	65	tree older than 1936	N/A
Populus balsamifera	86.6	62.667012	-149.906416	34	tree older than 1901	N/A
Populus balsamifera	75.5	62.667012	-149.906416	34	tree older than 1835	N/A
Populus balsamifera		62.357899	-150.14821		tree older than 1990	N/A

Tree Species	Tree Diameter at Breast Height (DBH) (cm)	Latitude	Longitude	Height of core above collar (cm)	Year of establishment	2013 Age (years)
					Values not corrected for height of core above collar	
Salix alba	10.5	62.25121577	-150.1473657	46	1994	19
Salix alba	10.3	62.25121577	-150.1473657	10	1993	20
Salix alba	Cored Shrub	62.70048545	-149.8467152	15	1991	22
Salix alba	unknown	62.671843	-149.894408	NA	1974	39

10. FIGURES

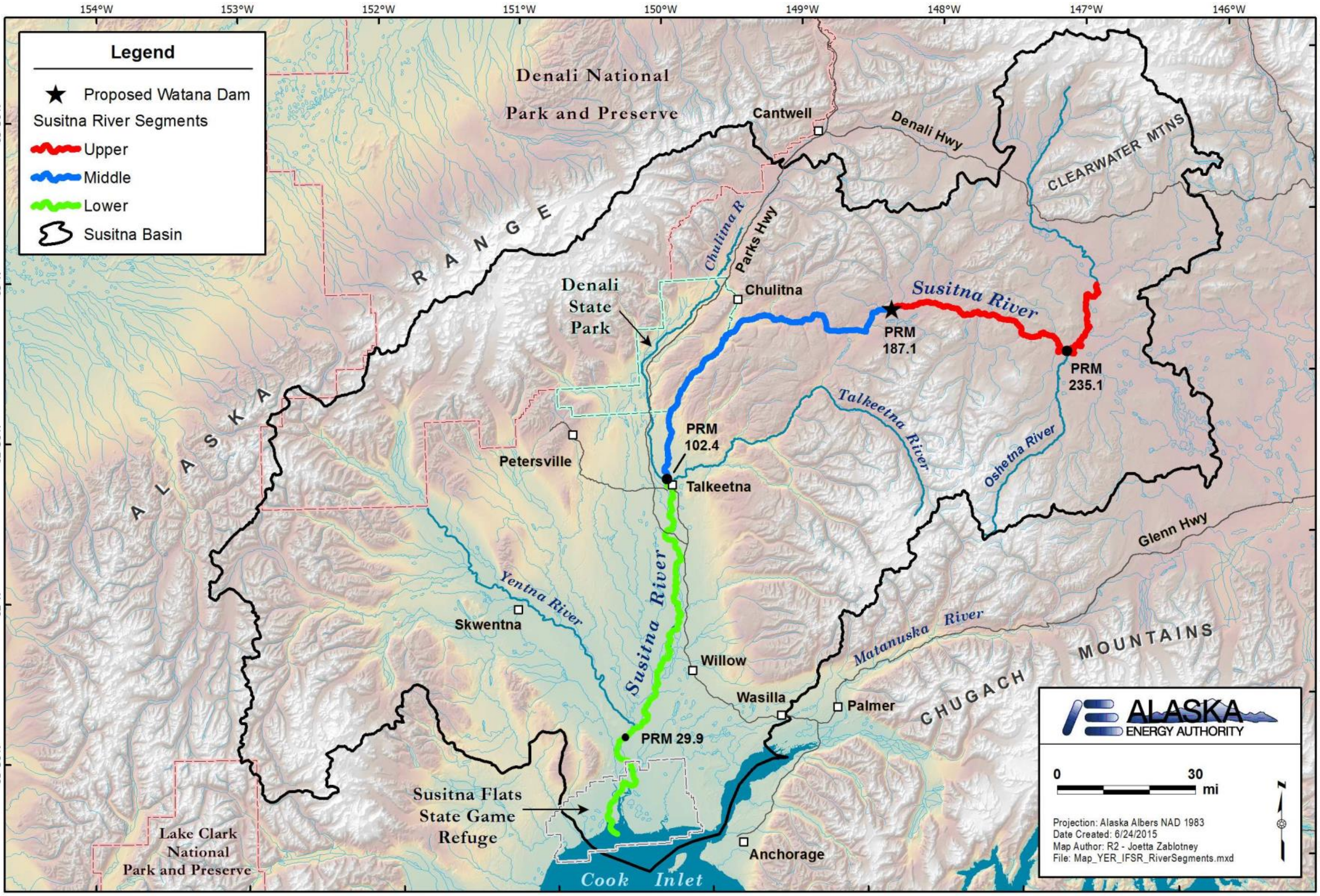

Figure 3-1. Map depicting the Upper, Middle and Lower Segments of the Susitna River potentially influenced by the Susitna-Watana Hydroelectric Project.

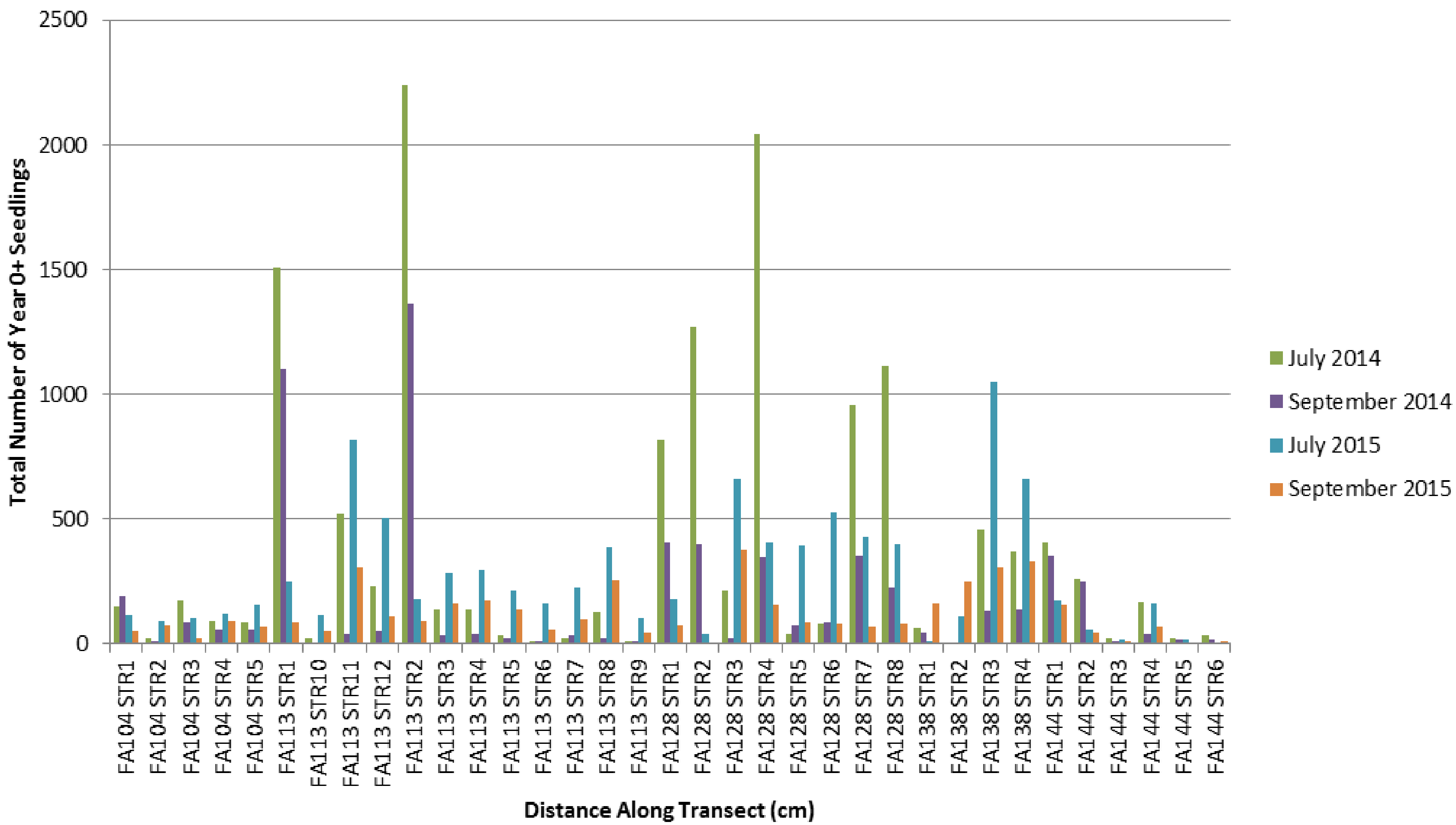

Figure 5-1. Total Number of Year 0+ Seedlings by transect from July 2014 to September 2015.

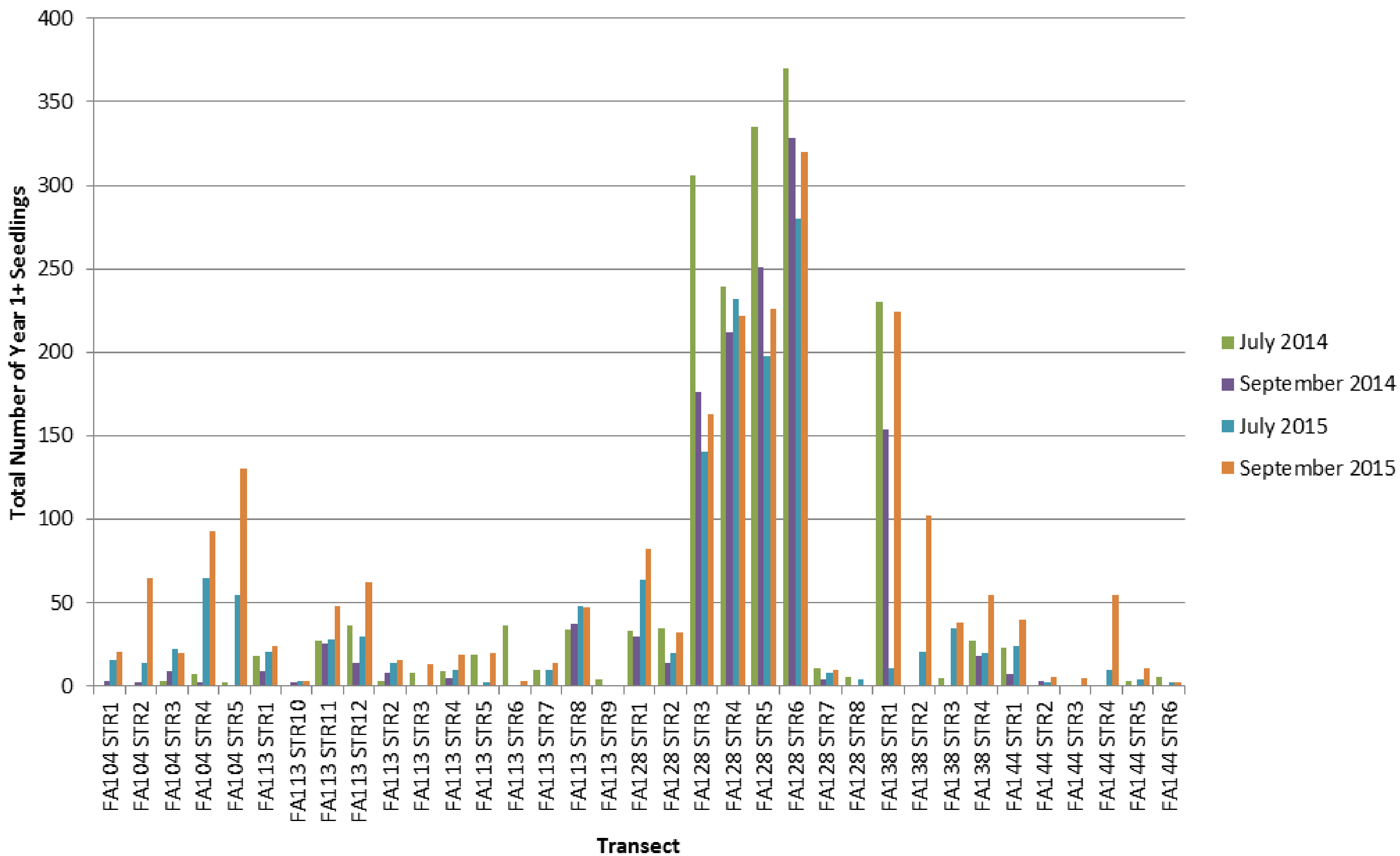

Figure 5-2. Total Number of Year 1+ Seedlings by transect from July 2014 to September 2015.

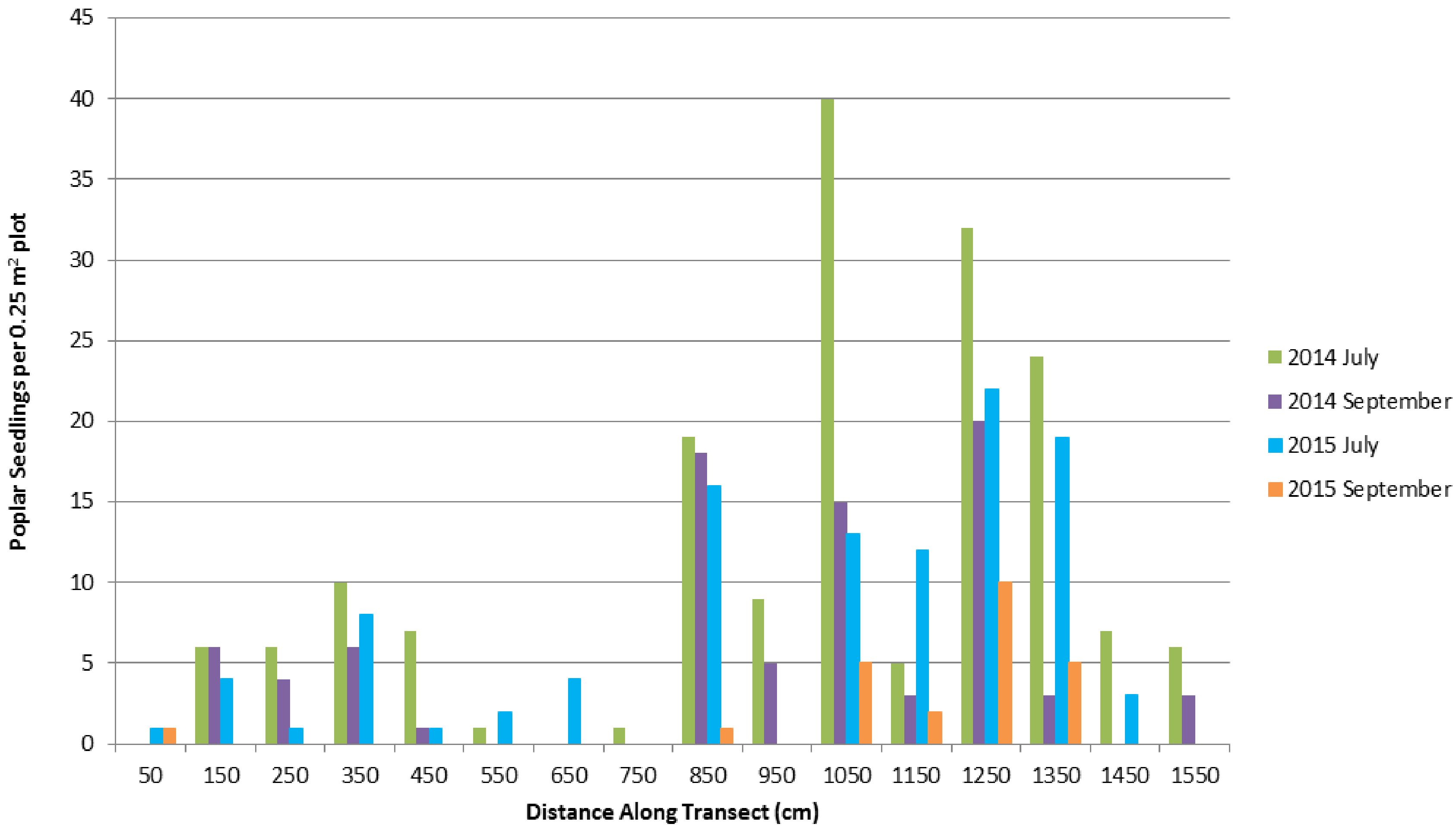

Figure 5-3. Total Number of Year 0+ Seedlings at each plot in transect FA-104 STR 3.

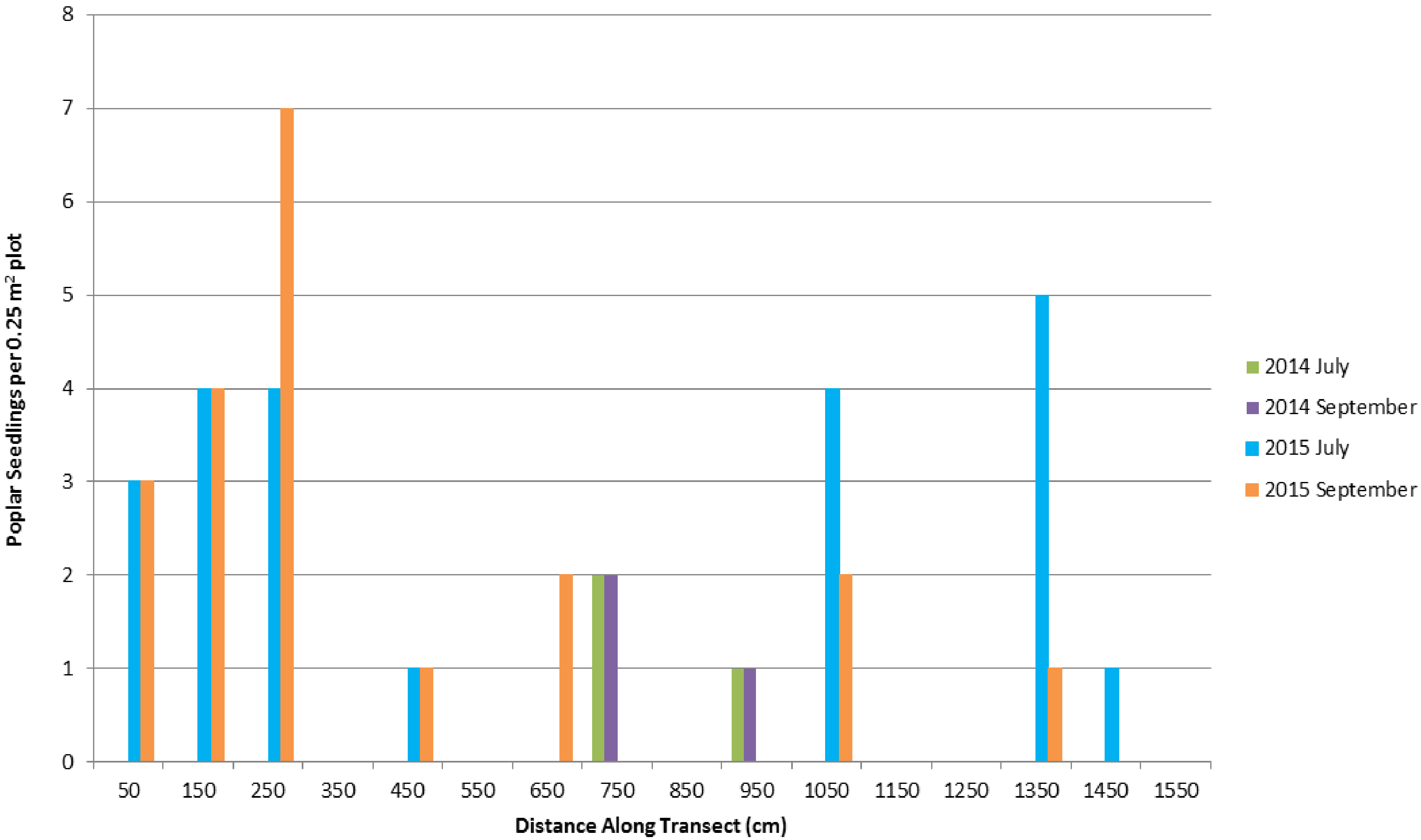

Figure 5-4. Total Number of Year 1+ Seedlings at each plot in transect FA-104 STR 3.

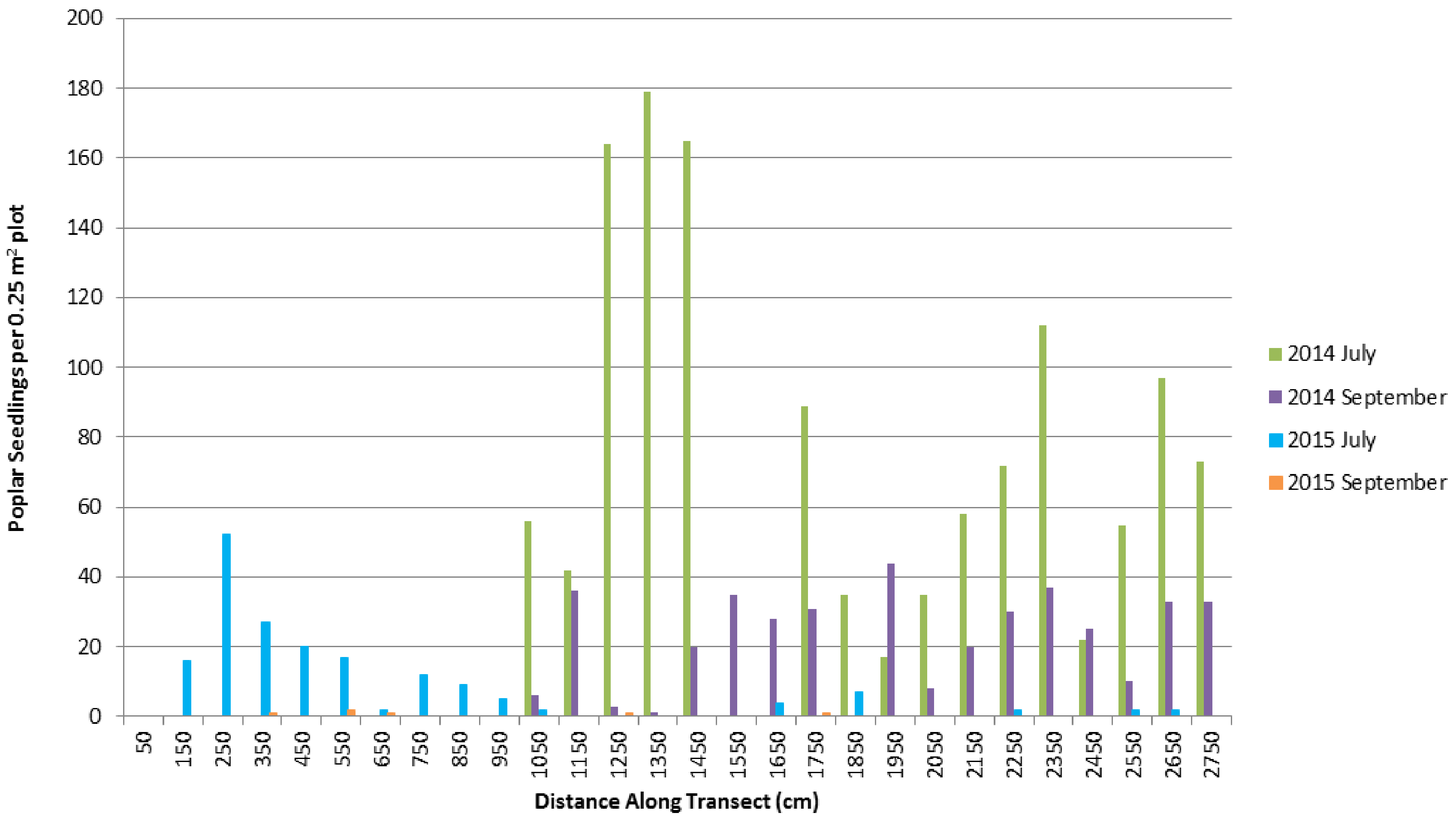

Figure 5-5. Total Number of Year 0+ Seedlings at each plot in transect FA-128 STR 2.

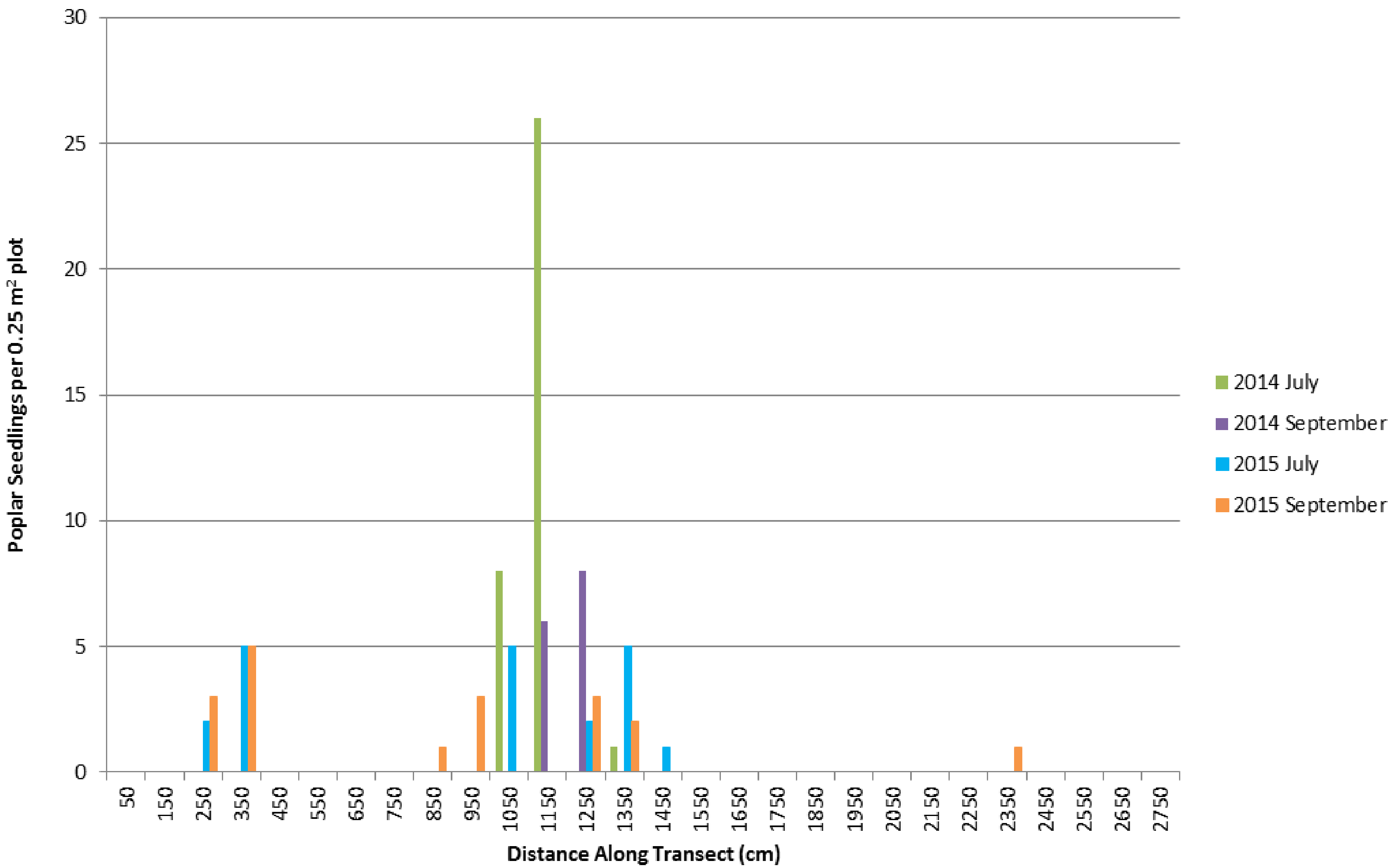

Figure 5-6. Total Number of Year 1+ Seedlings at each plot in transect FA-128 STR 2.

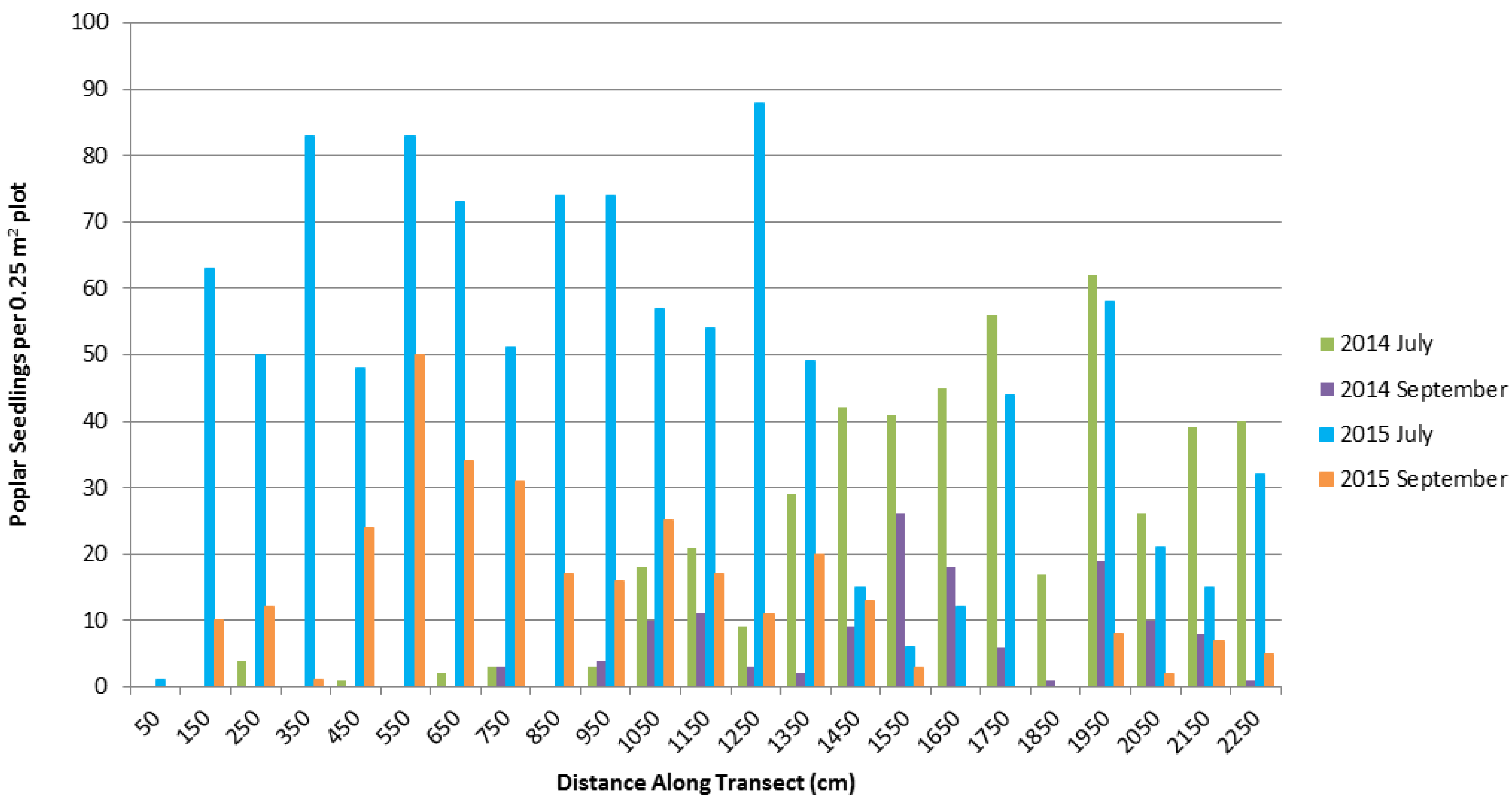

Figure 5-7. Total Number of Year 0+ Seedlings at each plot in transect FA-138 STR 3.

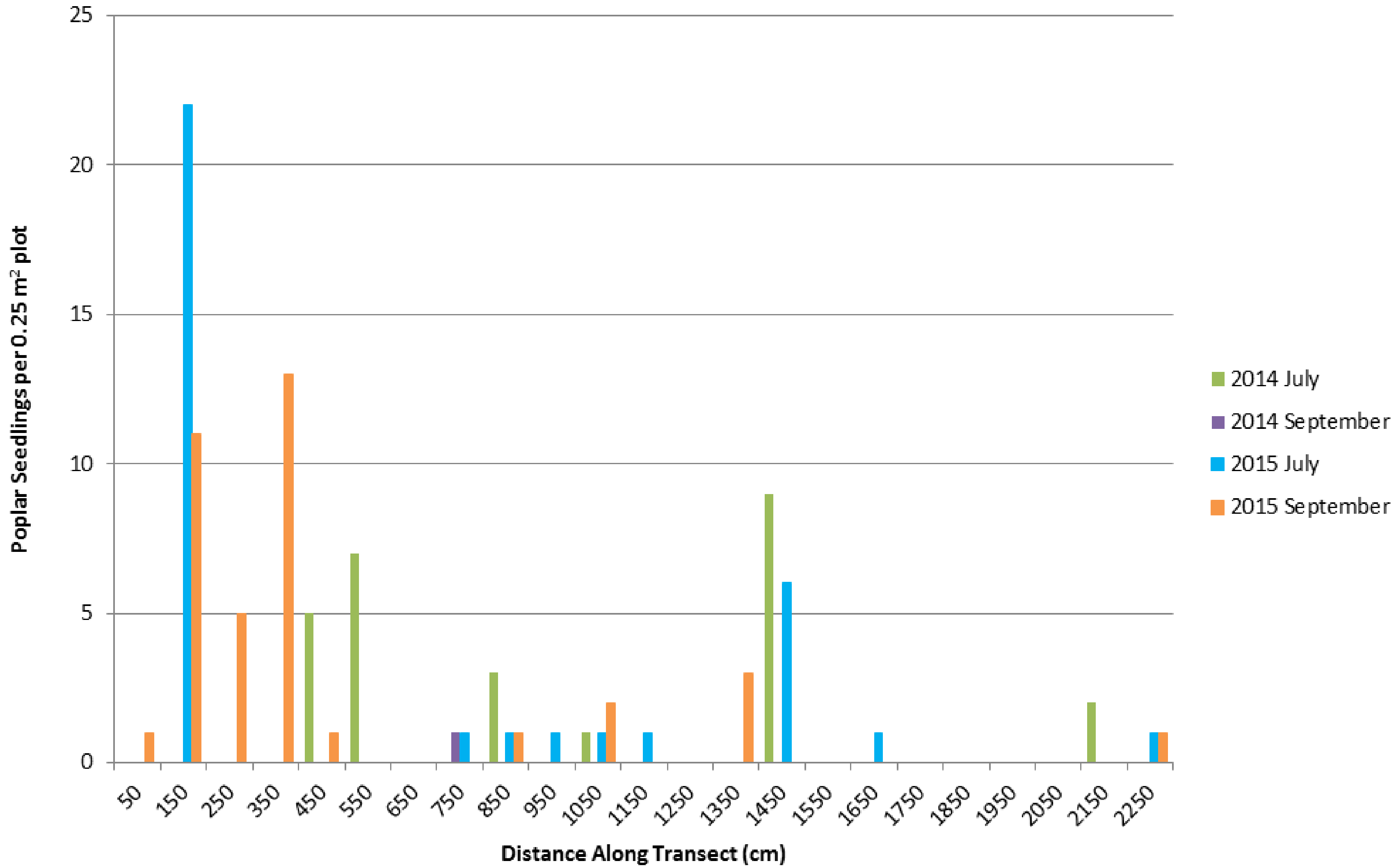

Figure 5-8. Total Number of Year 1+ Seedlings at each plot in transect FA-138 STR 3.

Figure 5-9. Photo of transect in 2013 (left) and 2015 (right) of FA-113 STR11.

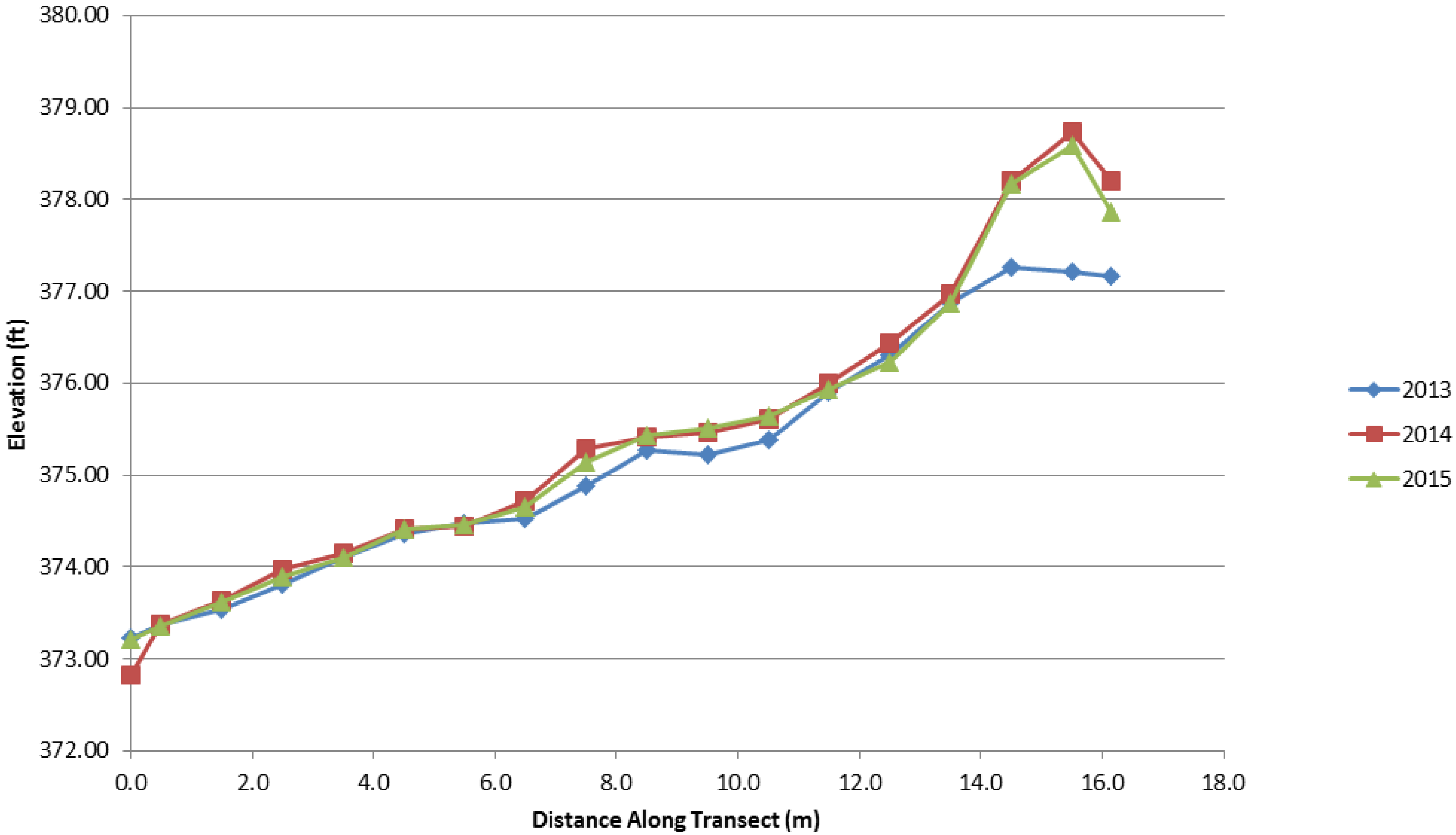

Figure 5-10. Elevation comparison of Transect FA-113 STR11.

Figure 5-11. Photo of transect in 2013 (left) and 2015 (right) of FA-128 STR2.

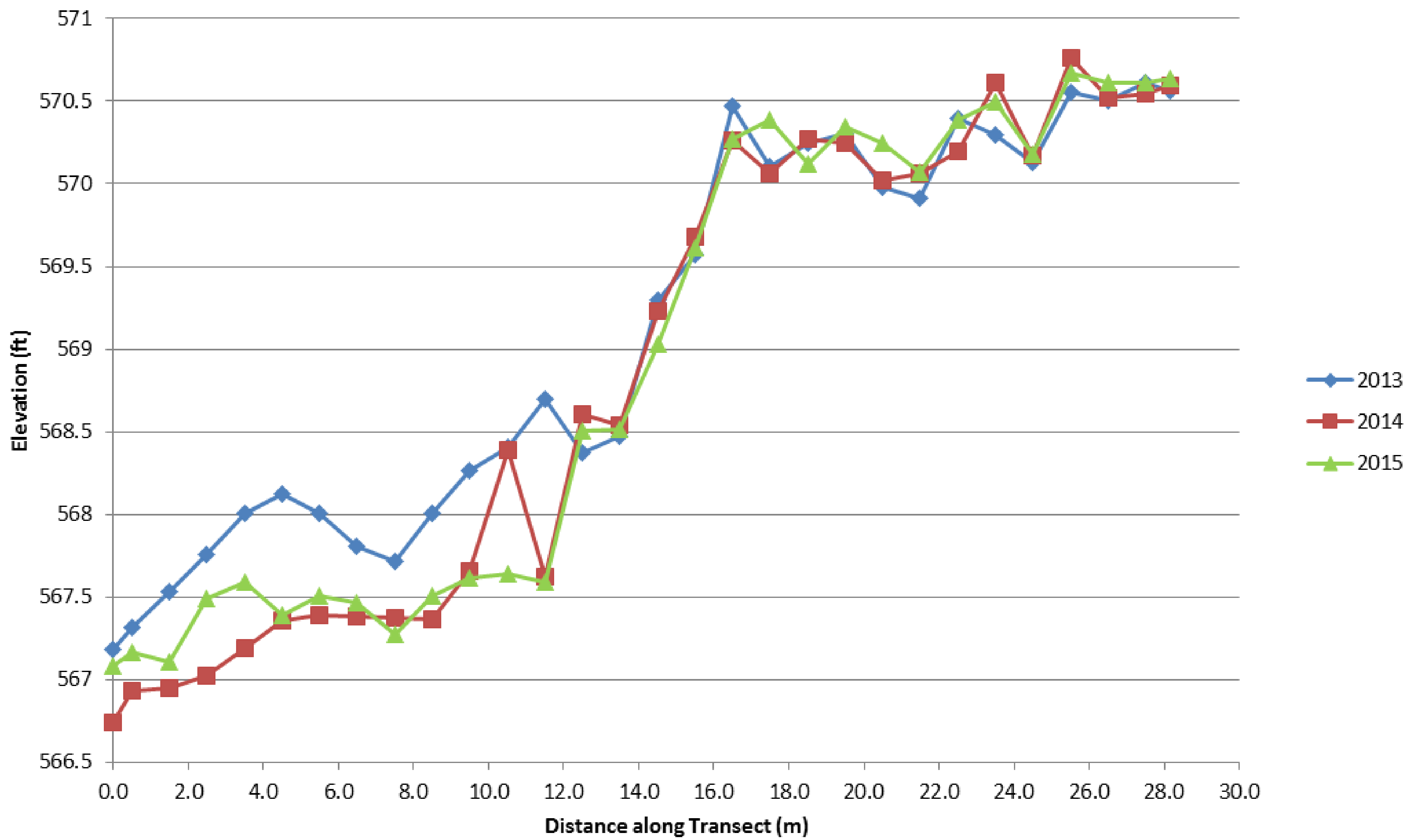

Figure 5-12. Elevation comparison of Transect FA-128 STR2.

Figure 5-13. Photo of transect in 2013 (left) and 2015 (right) of FA-138 STR3.

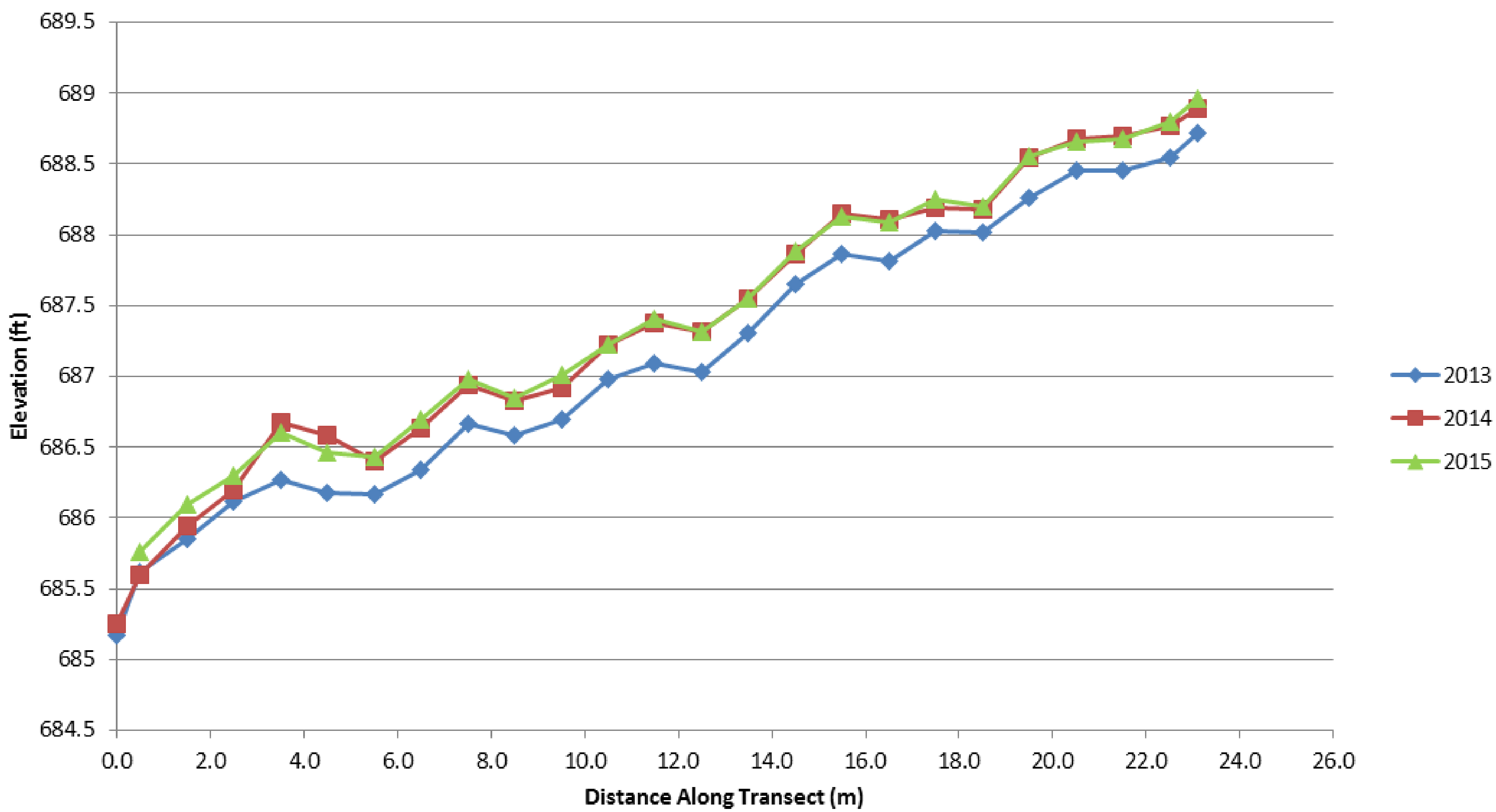

Figure 5-14. Elevation comparison of Transect FA-138 STR3.

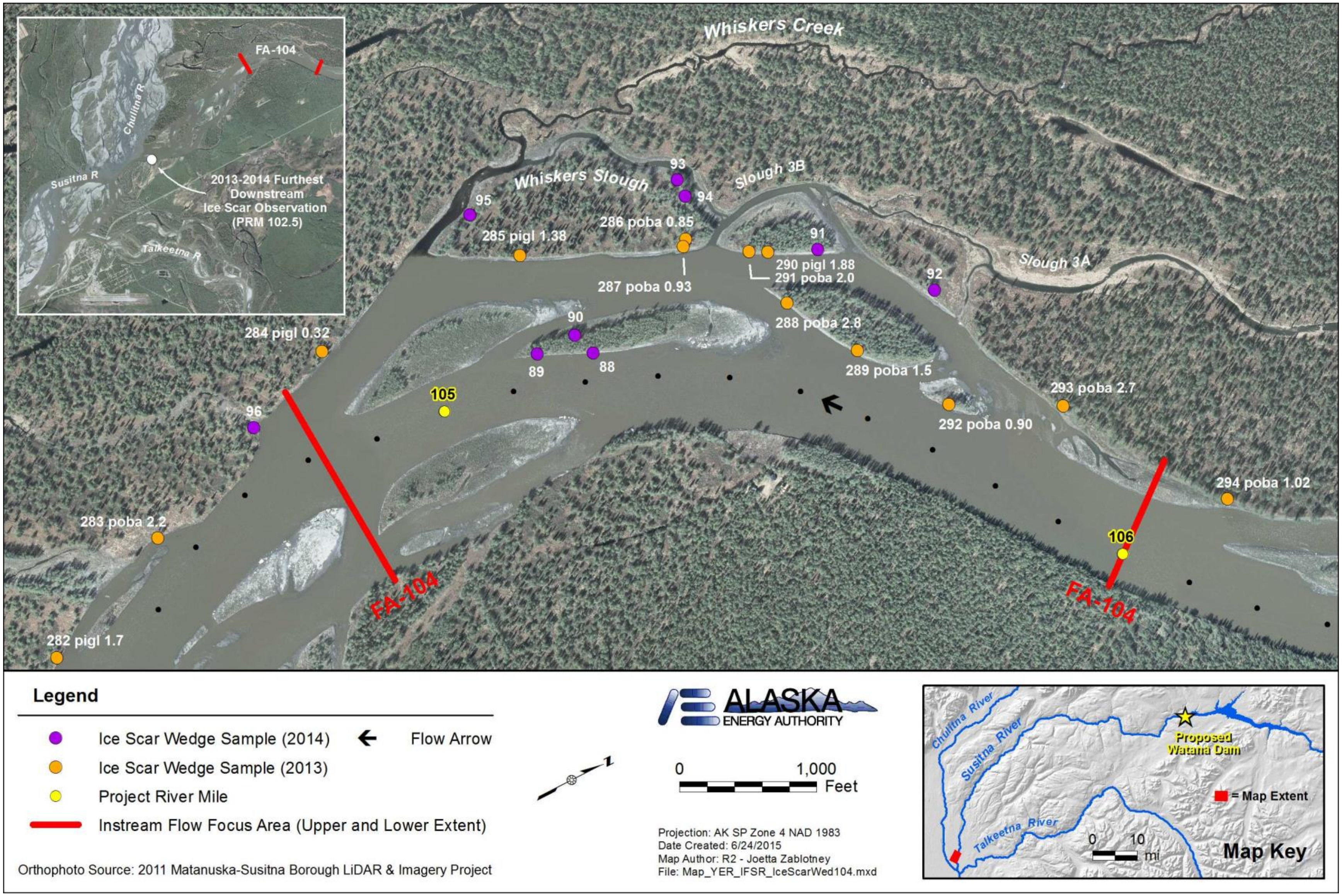

Figure 5-15. Ice scar wedge collection locations at FA-104 (Whiskers Slough). The downstream extent of river ice floodplain tree interactions was observed at PRM 102.5, just upriver of the confluence of the Susitna and Chulitna rivers.

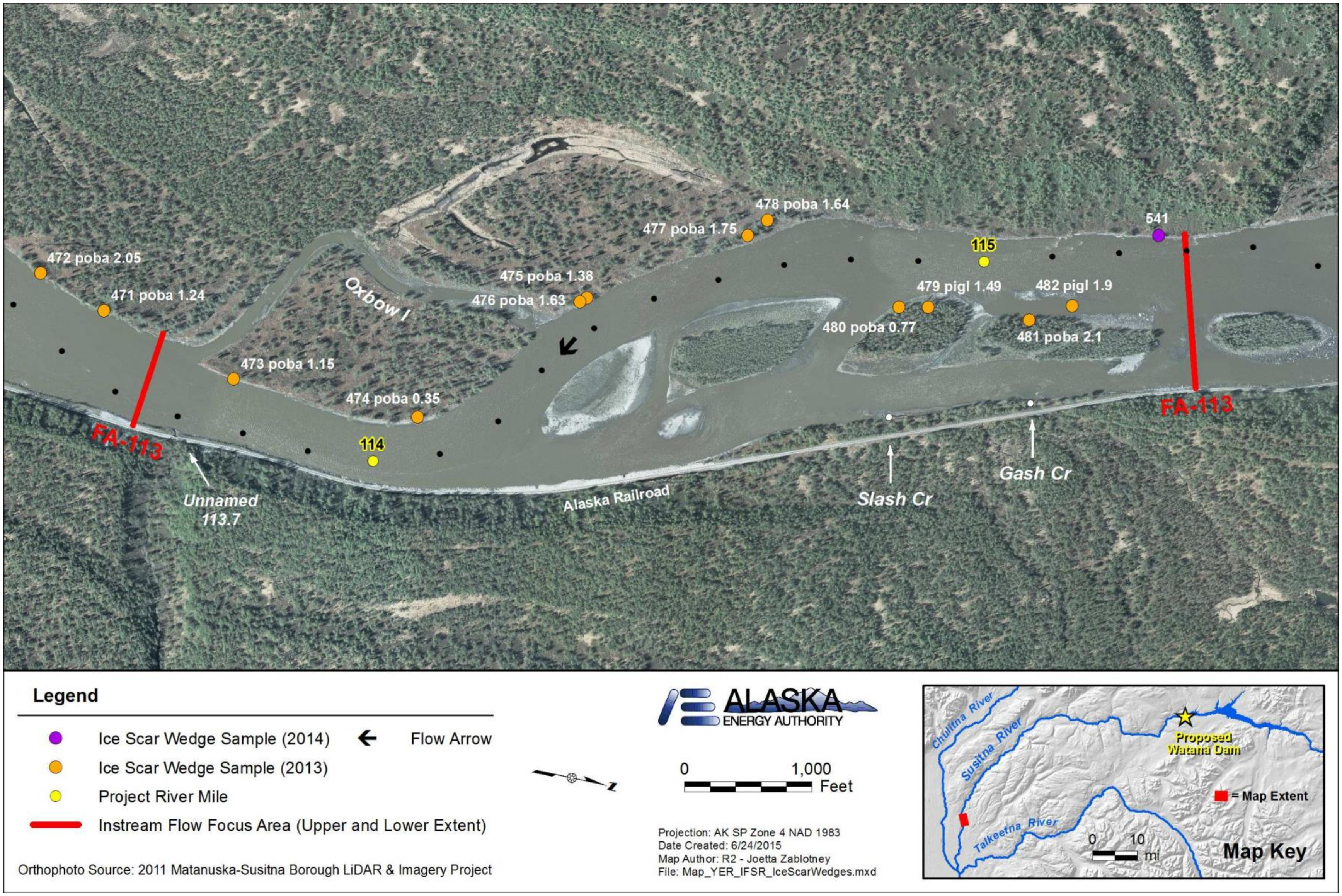

Figure 5-16. Ice scar wedge sample collection locations at FA-113 (Oxbow 1).

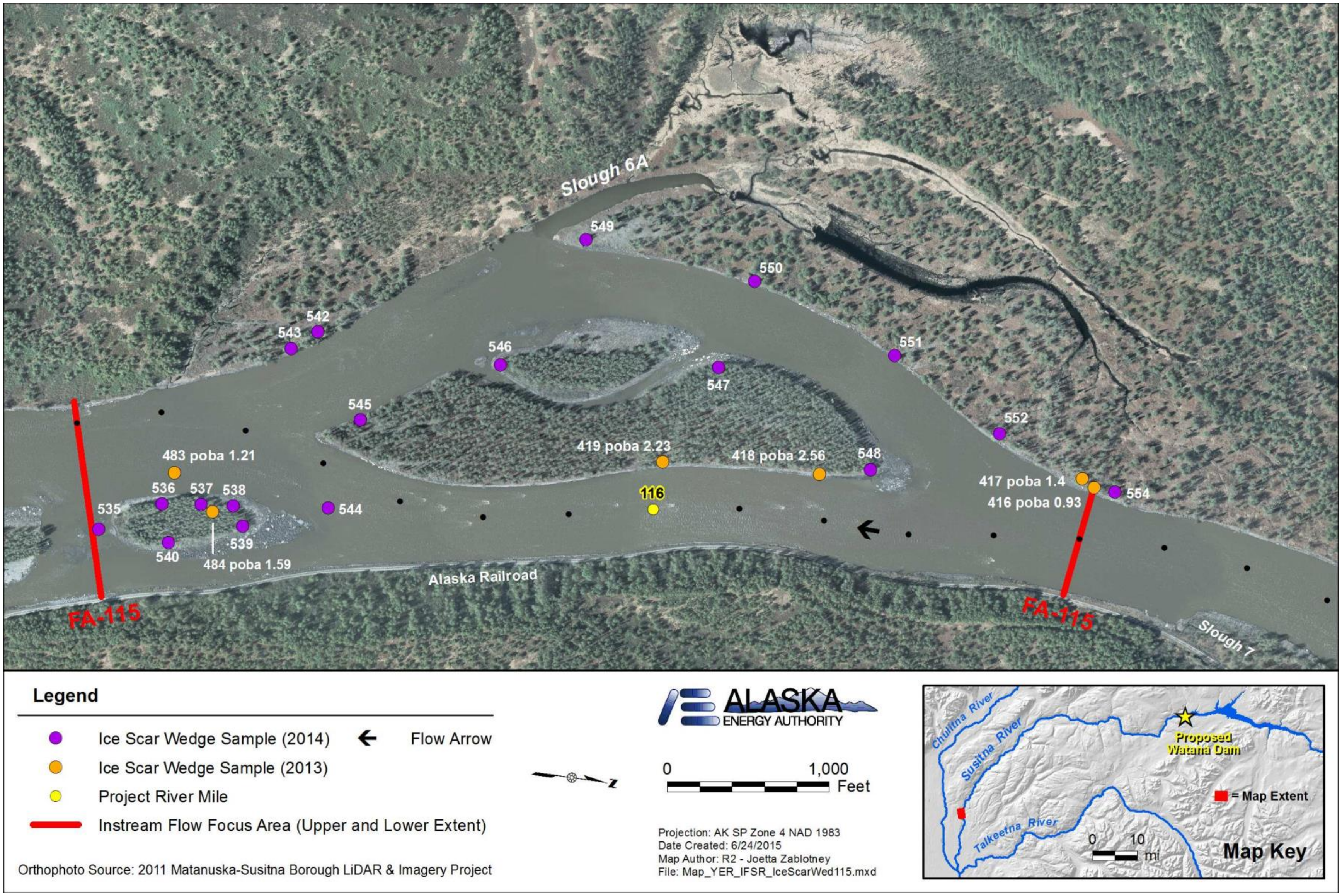

Figure 5-17. Ice scar wedge sample collection locations at FA-115 (Slough 6A).

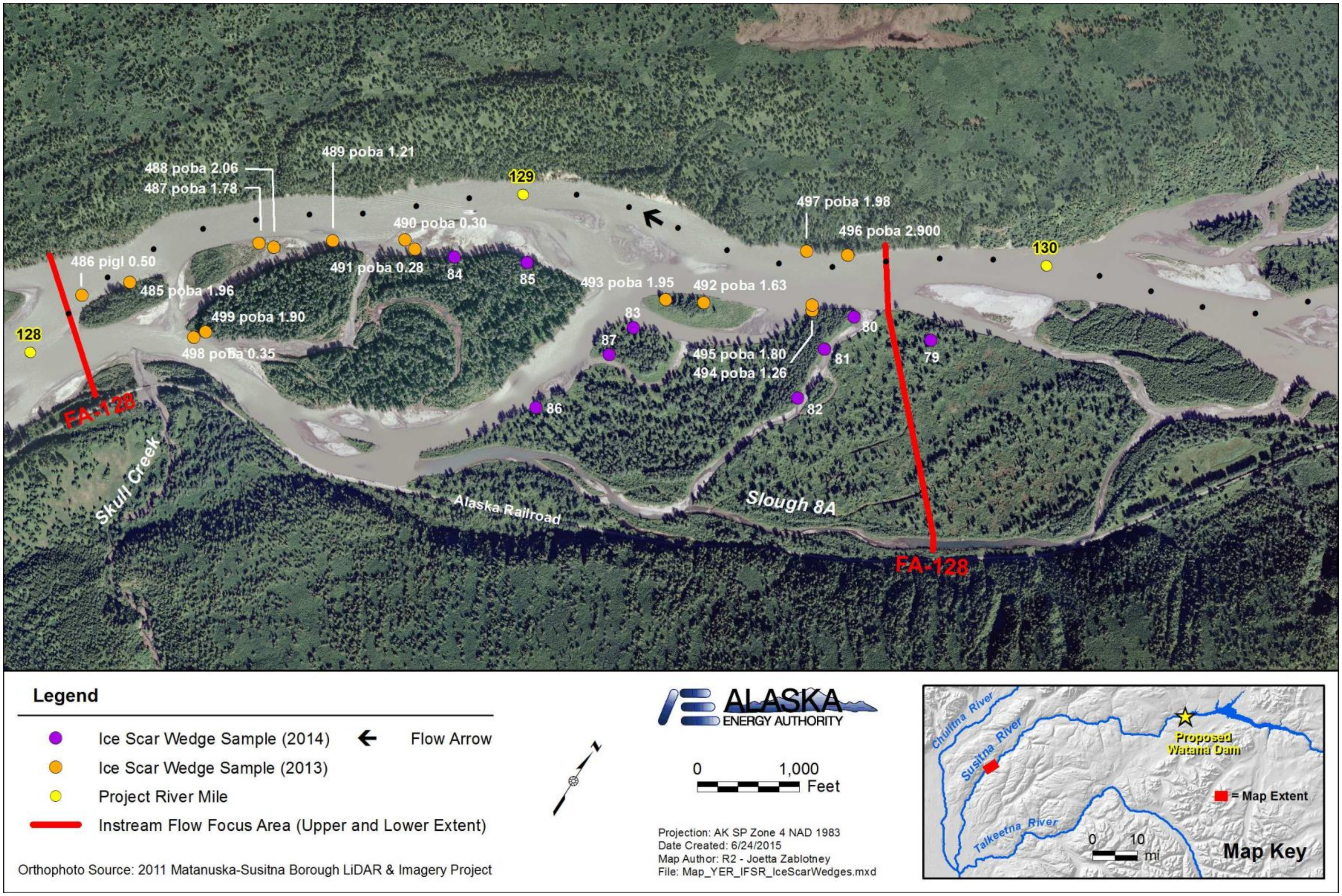

Figure 5-18. Ma Ice scar wedge sample collection locations at FA-128 (Slough 8A).

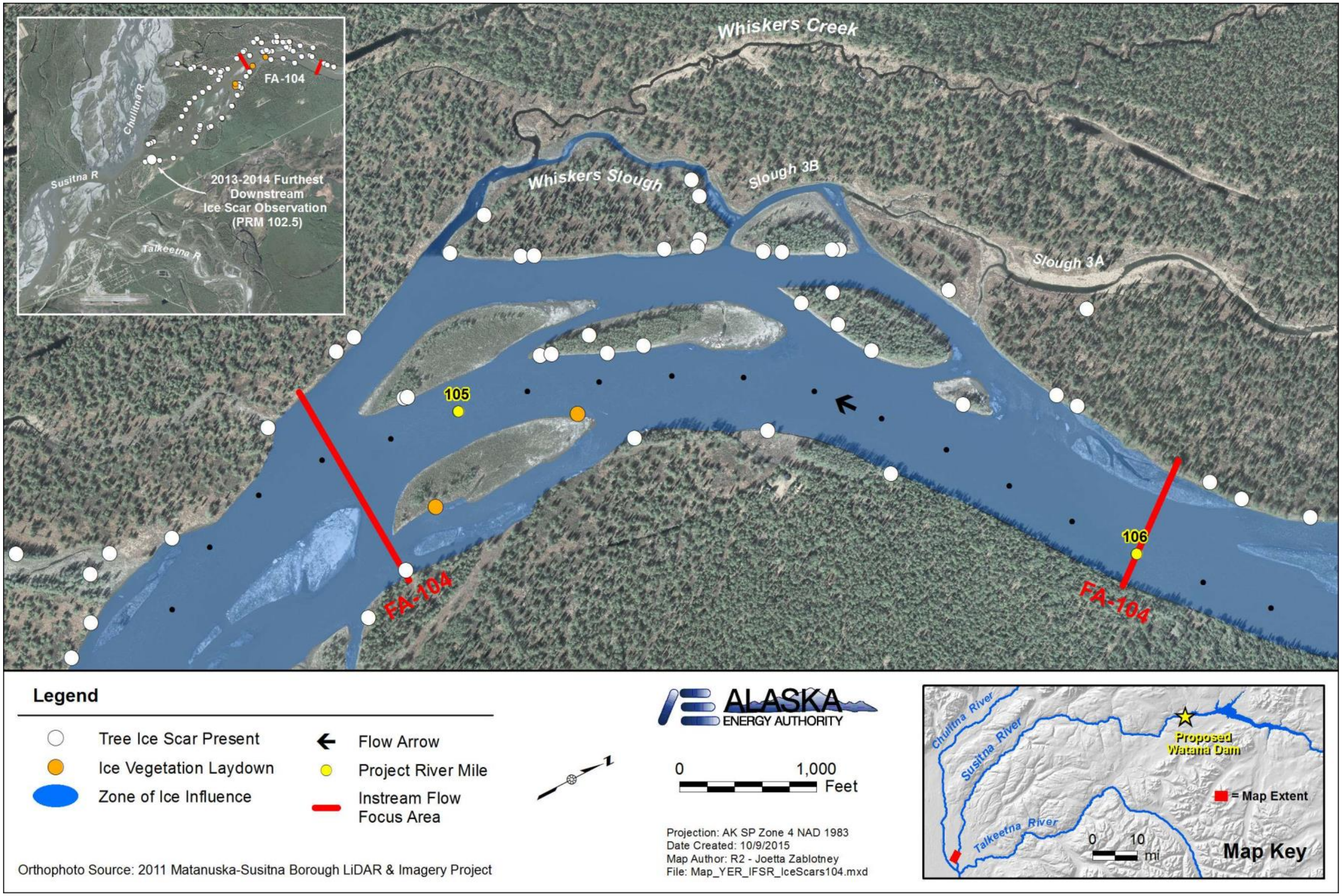

Figure 5-19. Tree ice scar and zone of floodplain ice influence, FA-104 (Whiskers Slough).

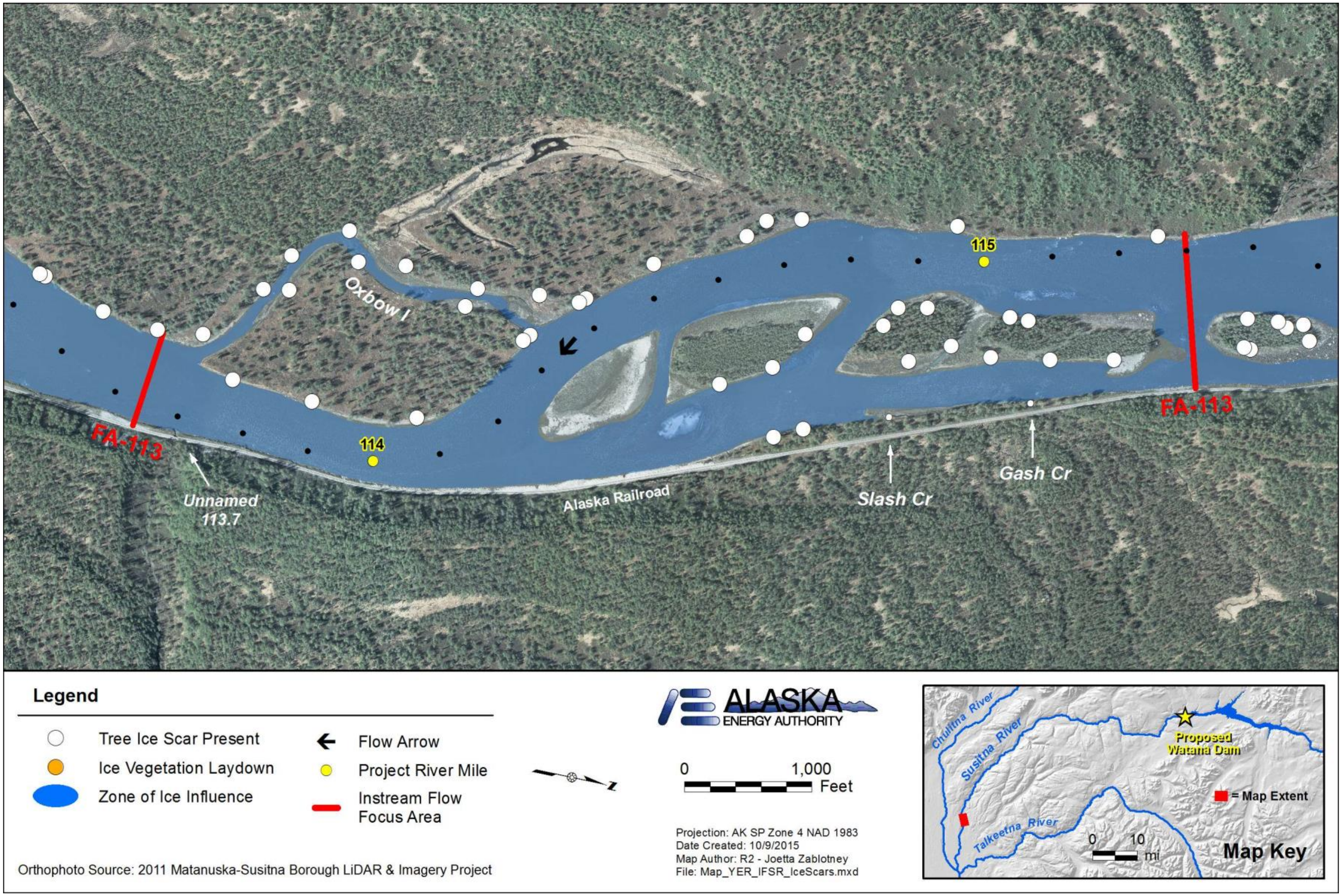

Figure 5-20. Tree ice scar and zone of floodplain ice influence, FA-113 (Oxbow 1).

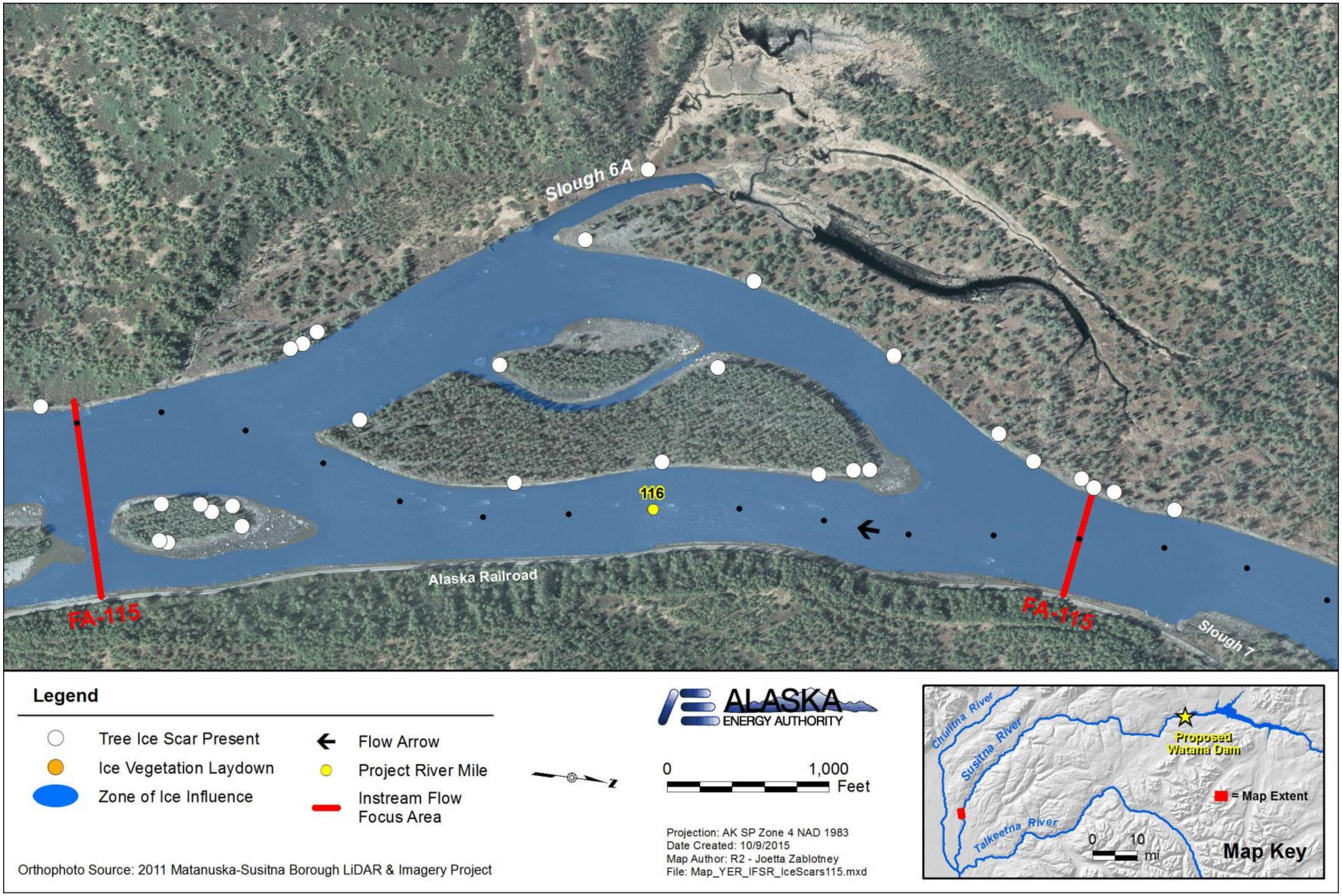

Figure 5-21. Tree ice scar and zone of floodplain ice influence, FA-115 (Slough 6A).

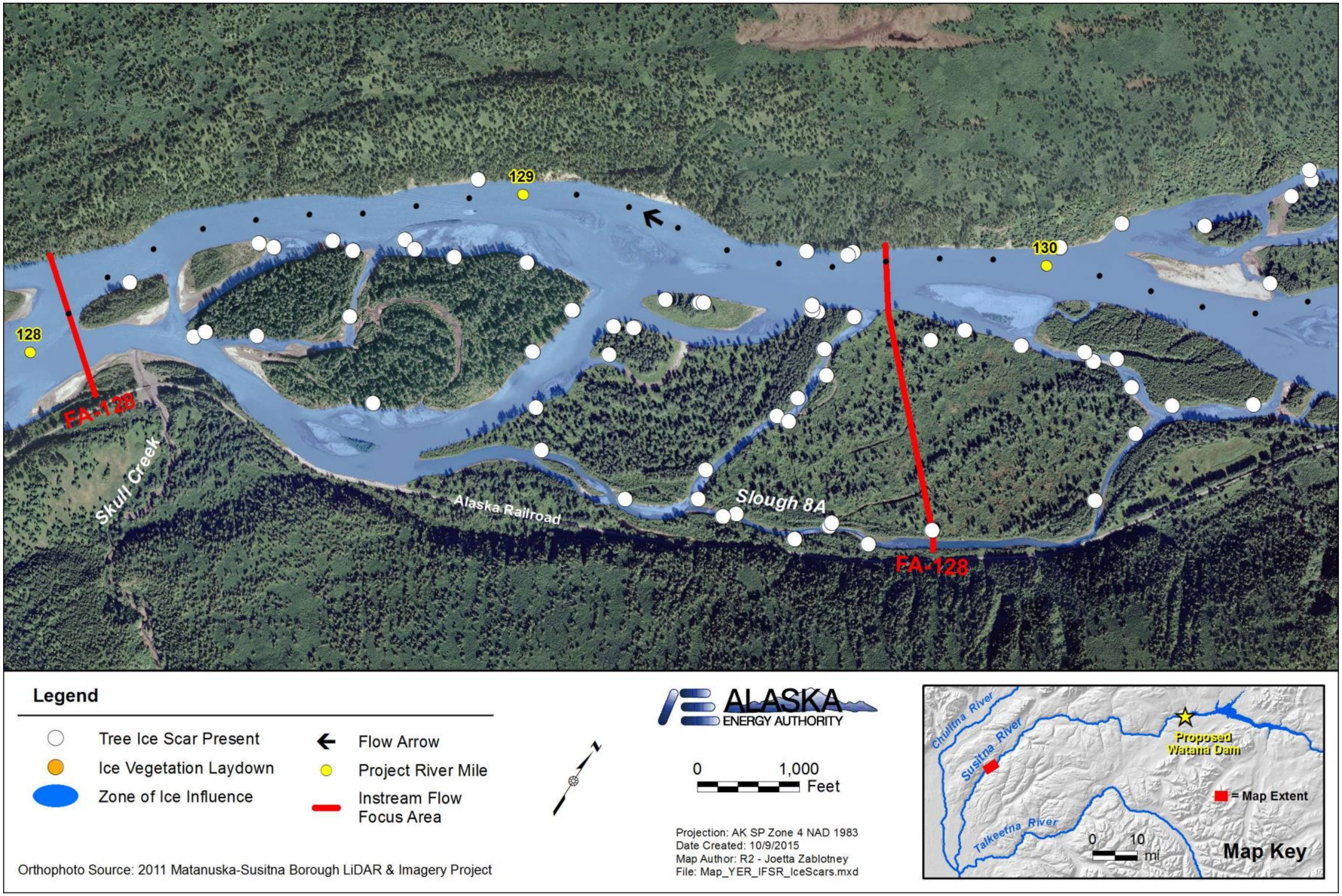

Figure 5-22. Tree ice scar and zone of floodplain ice influence, FA-128 (Slough 8A).

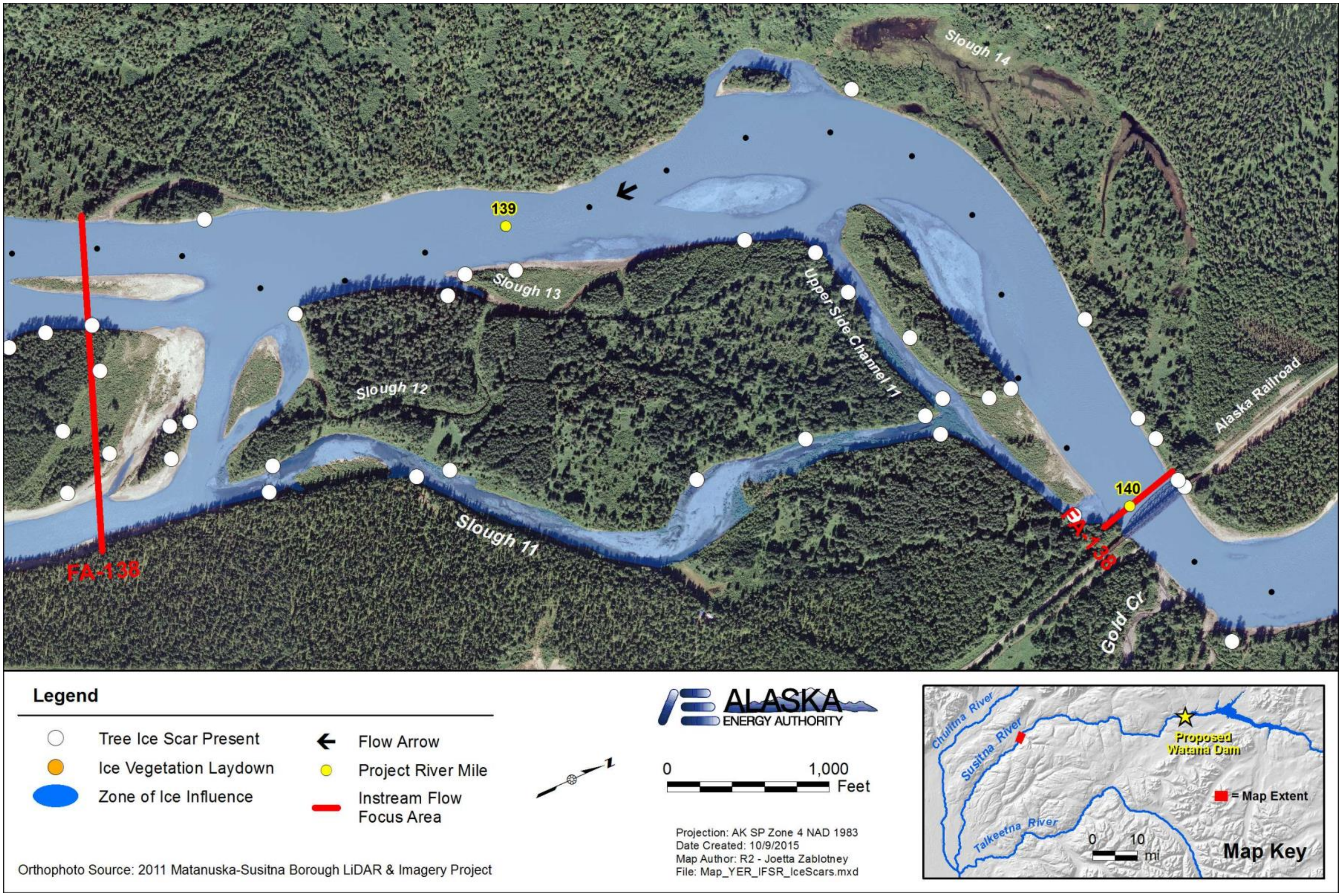

Figure 5-23. Tree ice scar and zone of floodplain ice influence, FA-138 (Gold Creek).

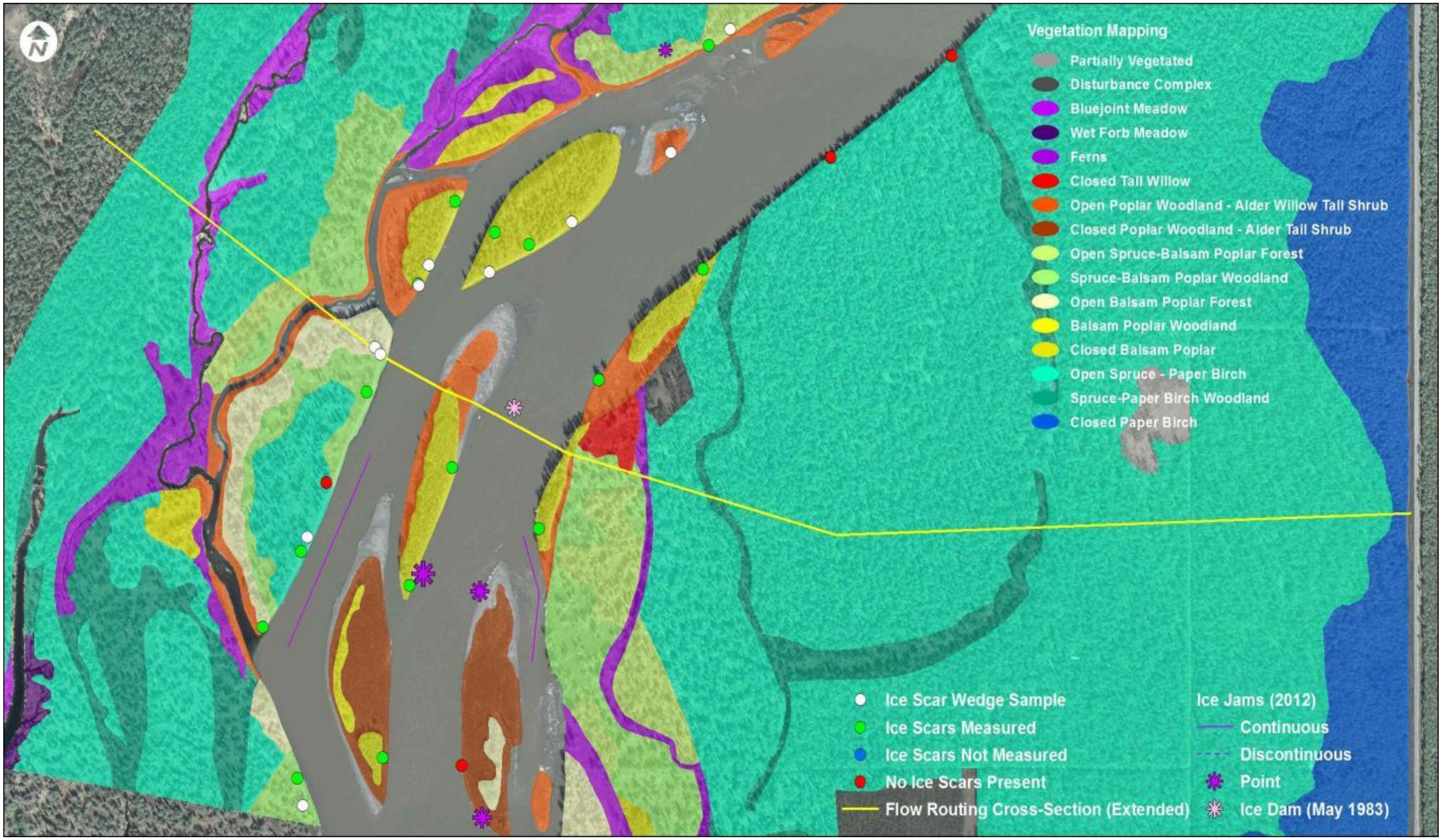

Figure 5-24. Flow routing cross-section, tree ice survey, FA-104 (Whiskers Slough).

FIGURE INCLUDED IN FILE 08.6_RIFS_ISR_SIR_2 OF 2.DOCX

Figure 5-25. Flow routing cross-section, tree ice survey, FA-104 (Whiskers Slough).

FIGURE INCLUDED IN FILE 08.6_RIFS_ISR_SIR_2 OF 2.DOCX

Figure 5-26. Flow routing cross-section, tree ice survey, and plant communities FA-104 (Whiskers Slough).

FIGURE INCLUDED IN FILE 08.6_RIFS_ISR_SIR_2 OF 2.DOCX

Figure 5-27. Tree core aging sample distribution within the Middle River Segment. Table 5-6 provides preliminary age, location and collection data for all sampled trees.

FIGURE INCLUDED IN FILE 08.6_RIFS_ISR_SIR_2 OF 2.DOCX

Figure 5-28. Preliminary tree age data for FA-104 (Whiskers Slough).

FIGURE INCLUDED IN FILE 08.6_RIFS_ISR_SIR_2 OF 2.DOCX

Figure 5-29. Preliminary tree age data for FA-128 (Slough 8A).

FIGURE INCLUDED IN FILE 08.6_RIFS_ISR_SIR_2 OF 2.DOCX

Figure 5-30. Penman-Monteith July 2013 evapotranspiration results for Matteuccia struthiopteris at FA-104 (Whiskers Slough).

FIGURE INCLUDED IN FILE 08.6_RIFS_ISR_SIR_2 OF 2.DOCX

Figure 5-31. Isotopic compositions of precipitation, surface water, and groundwater samples collected on the Susitna Middle River Segment in 2013. Global meteoric water line (GMWL) and local meteoric water line (LMWL) are shown for reference.

FIGURE INCLUDED IN FILE 08.6_RIFS_ISR_SIR_2 OF 2.DOCX

Figure 5-32. Two map layers for FA-113 (Oxbow 1) an FA-115 (Slough 6A) of all mapped riparian areas that are wetted by the 100-year flood, and mapped riparian areas which remain above the 100-year flood.

FIGURE INCLUDED IN FILE 08.6_RIFS_ISR_SIR_2 OF 2.DOCX

Figure 5-33. Two map layers for FA-128 (Slough 8A) of all mapped riparian areas that are wetted by the 100-year flood, and mapped riparian areas which remain above the 100-year flood.

FIGURE INCLUDED IN FILE 08.6_RIFS_ISR_SIR_2 OF 2.DOCX

Figure 5-34. Two map layers for FA-138 (Gold Creek) of all mapped riparian areas that are wetted by the 100-year flood, and mapped riparian areas which remain above the 100-year flood.