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APPENDIX B: UPPER SUSITNA RIVER SEGMENT REMOTE LINE HABITAT MAPPING TECHNICAL MEMORANDUM

APPENDIX C: UPPER RIVER MAINSTEM SURVEYS, 2013

Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Characterization and Mapping of Aquatic Habitats (9.9)

Appendix B
Upper Susitna River Segment Remote Line Habitat Mapping Technical Memorandum

Initial Study Report

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

R2 Resource Consultants, Inc.

February 2014 Draft

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Abbreviation	Definition
ADF&G	Alaska Department of Fish and Game
AEA	Alaska Energy Authority
FERC	Federal Energy Regulatory Commission
GIS	Geographic Information System
ILP	Integrated Licensing Process
NEPA	National Environmental Policy Act
PRM	Project River Mile(s)
Project	Susitna-Watana Hydroelectric Project
RSP	Revised Study Plan
TWG	Technical Workgroup
UR	Upper River

1. UPPER RIVER MAINSTEM HABITAT MAPPING

1.1 Introduction

The Alaska Energy Authority (AEA) is preparing a License Application that will be submitted to the Federal Energy Regulatory Commission (FERC) for the Susitna-Watana Hydroelectric Project (Project) using the Integrated Licensing Process (ILP). The Project is located on the Susitna River, an approximately 300-mile-long river in Southcentral Alaska. The Project's dam site will be located at project river mile (PRM) 187.1 of the updated GIS-based hydrography.

This study provides information to serve as the basis for the 2013–2014 formal study program, for preparing Exhibit E of the License Application, and for use in FERC's National Environmental Policy Act (NEPA) analysis for the Project license.

AEA will initiate aquatic studies in 2013 to characterize fish distribution within the Upper Susitna River (RSP Section 9.5). To efficiently perform this work within a narrow seasonal window an approach to subsample representative habitat has been proposed.

Historical habitat mapping studies from the 1980s occurred in the mainstem Susitna River. Channel morphology was identified and the mainstem habitat types were representative of distinct functional hydrology. The approach to the study (i.e., classification system) was informative; however, these existing data may not reflect current conditions because of habitat changes in this dynamic river over the last 30 years.

In October 2012, this was identified as a data need. The study team determined that the best pathway for characterizing the frequency and proportion of habitat in the mainstem Upper River was to use geo-rectified aerial imagery in combination with available aerial videography to map available habitat. A hierarchical and nested classification system developed specifically for the Susitna River with input from the Fish and Aquatics Technical Workgroup (TWG) was used to classify habitat (see RSP Section 9.9 and Table 9.9-4). Applying this methodology allowed for habitat to be mapped remotely during winter months when additional on-the-ground mapping could not occur. The product of this effort is presented within this report.

1.2 Study Goals and Objectives

The goal of this study was to determine the composition and frequency of mainstem aquatic habitats and delineate the proportion of habitat in the Upper Susitna River from aerial imagery in combination with aerial videography.

The objective was to measure, using geo-rectified imagery, river habitat in the Upper Susitna River. A spatial database of the length and composition of habitat would be developed by drawing the beginning and end point of each specific habitat unit (i.e. remotely habitat map). The study is intended to provide baseline data for supporting the approach for fish distribution site selection.

1.3 Study Area

The study area for the Upper River mainstem habitat mapping encompassed the mainstem Susitna from the Watana Dam Site[1] (PRM 186.7) to PRM 234.5. The effort also included identifying tributaries to the mainstem Susitna River up to PRM 247.7. The tributaries were identified within a 0.5 mile buffer from a centerline of the mainstem Susitna River. The 0.5 mile buffer extent was used because it was considered a conservative standard buffer to sufficiently represent the confluence of tributaries to the mainstem Susitna River.

2. STUDY METHODS

Remote line mapping of habitats in the Upper River was conducted using hierarchically-nested habitat typing adapted to feasible identification levels based on the use of aerial still imagery, LiDAR (Light Detection And Ranging), and low-elevation high definition aerial videography collected in 2012.

The aerial videography was collected from September 7–11, 2012. During the video collection, mean daily discharge from Gold Creek steadily declined from 16,500 cfs on September 7 to 10,800 cfs on September 11, 2012.

A linear network was created in GIS (geographic information system) by drawing vector-lines (segments) along the stream channel center line as viewed by aerial imagery or LiDAR. The reference imagery was collected at river flows generally ranging from 10,000 to 12,000 cfs, which was considered representative of relatively lower to mid-flow levels for mapping. Divided channels had multiple segments representing that stream section.

Main channel, tributary, and off-channel habitats were uniquely identified and delineated into segments. The lengths of the segments were based on mesohabitat classification for the main channel and macrohabitat classification for off-channel or tributary habitat (Table 1). Each individual vector line segment provided a length and a hierarchical-tiered habitat classification organized in "levels". Not all lines connected into a contiguous or flow-based network, as that resulted in excessively long segments for small habitat units.

The habitat classification hierarchy was composed of four levels representing: (1) major hydrologic segment; (2) geomorphic reach; (3) mainstem habitat type; and (4) main channel mesohabitat. Table 1 summarizes the levels and provides brief definitions of each habitat classification level used during the effort. Level 1 identified the Upper River. Level 2 identified one of four unique reaches established from the channel's geomorphic characteristics (developed from the Geomorphology Study [see RSP Section 6.5]). Level 3 classified the mainstem habitat type of main, off-channel, and tributary habitat using a slightly modified approach from the 1980s historical habitat mapping definitions (ADF&G 1983a). All off-channel and tributary habitats were classified to Level 3 and all main channel habitats were identified to Level 4 mesohabitat type (riffle, pool, run, etc.).

[1] The current dam site is PRM 187.1, but was only recently revised, following the development of this report. This minor difference will not substantially affect the results reported here.

2.1 GIS Habitat Mapping

Habitat in the Upper River hydrologic segment was mapped using GIS from aerial still imagery viewed at a range of scales from 1:1,000 to 1:12,000 in order to locate line segments and habitat boundaries. All habitat segments were identified using a mid-channel line, which was measured to provide habitat length. In channels that were only partially inundated or where water was present in sloughs, the line segments followed the wet areas. Polygons were drawn to demark the boundaries of tributary mouth and backwater habitat in order to characterize available fish habitat. Area mapping was generated separately from the linear database, but all data is summarized below.

Several controls were established to ensure that the habitat mapping effort was both precise and accurate. Examples of specific aerial images of habitat as related to the levels were created. These examples were reviewed and confirmed by the technical lead and provided a voucher reference to help identify habitat types. Final habitat typing was reviewed by the technical lead to ensure consistency and accurate habitat mapping.

The exact location of habitat boundaries often required professional judgment on the part of the mapper, such as the boundary between a riffle and run or glide. Due to lack of resolution in the GIS imagery and shadows along the left bank of the river, some habitat features such as tributary mouths were confirmed by referring to aerial video as a secondary reference. The aerial video was also used to confirm the more permanent gravel bars that showed some vegetation, which was sometimes not evident in the GIS imagery. If the aerial video indicated a bar had vegetation on it, but vegetation was not evident in the GIS imagery, the island was considered vegetated and the main channel line segments were split around the island.

Tributaries were delineated in the GIS imagery up to 0.5 miles from the centerline of the mainstem confluence. Tributaries were differentiated from upland sloughs based on their gradient characteristics and if they originated above the general floodplain. The exact locations of some tributary segments were difficult to determine using the imagery in heavily forested areas. As such, locations were estimated based on visual cues in the canopy. Tributary mouths were mapped using a single line segment showing the length of the wetted area of the tributary mouth that extended from the vegetation line out to the edge of the gravel bank. In some of the larger tributaries, the mouth habitat was extended inland beyond the vegetation line based on habitat breaks visible between the tributary channel and the alluvial gravel areas at the mouth.

Mainstem habitats were classified as main channel when only a single dominant channel was present; split main channel when the flow was dispersed into two relatively evenly sized channels such as around a central island; and multiple split main channel when the mainstem split into three or more separate channels each carrying a significant portion of the flow. Mesohabitats were classified from interpretation of both the GIS imagery and aerial video. Riffles were distinguished from areas of wind waves or standing waves by the presence of white water and protruding boulders in the area that indicate the water is relatively shallow and passes over cobbles and boulders. Whitewater in a reach was classified as a run, if only one or two protruding boulders were producing isolated areas of turbulence.

The presence of clear or turbid water was used as a main indicator to differentiate between side sloughs and side channels. Side sloughs had clear water and were open to main channel flow at both ends, but water was connected at only one end of the slough during the time of the survey.

These areas could be partially dry but showed evidence that they were inundated regularly during high flows by lack of vegetation. Upland sloughs had similar characteristics in that the water was relatively clear, but these were not open to the main channel at both ends as indicated by the presence of vegetation in the area between the upstream end of the slough and the main channel.

Side channels were either completely inundated with turbid water connected at both upstream and downstream ends to the main channel or contained portions that held turbid water. The dry portions of the channel were delineated based on gravel bed and lack of any vegetation indicating that water periodically inundated the channel during higher flow periods. The distance that the side channel line segments extended into the main channel were determined by an estimation of the continuation of the vegetated or high water shoreline on either side of the mouth of the side channel.

Only mainstem habitat was further classified into mesohabitats consisting of run/glide, pool, riffle, or rapid (Table 1). Off-channel habitat (which includes side and upland sloughs) and tributaries were not classified into mesohabitats due to the lack of resolution of aerial imagery and the confounding presence of shadows or riparian cover.

2.2 Study Deviations

The development of the current study came about through a collaborative and adaptive process in October of 2012. Initially, there was an expectation to potentially mesohabitat map tributary and off-channel habitat types. As the mapping effort progressed it became clear that many of these units could not be mapped to the mesohabitat level and that only main channel habitat could be entirely mapped to the mesohabitat level. This limitation was a result of the quality of the aerial imagery, small size of the habitat unit, and potential for vegetative canopy that obstructed overhead viewpoints.

Finally, mapping the mainstem habitat to the mesohabitat level was challenging for certain habitat types that include differentiating run and glide habitat and identifying pool habitat. Run and glide habitat was closely examined through aerial stills and videography to make a professional judgment of the habitat type; however, it is realized that wind-waves and glare can confound the typing of these habitats. Pool habitat required identifying a hydraulic control and was only found in the Devils Canyon area, where the control was very obvious. Small, less obvious pools may have been missed using this methodology.

3. RESULTS

The Upper River was divided into six geomorphic reaches based on geomorphic characteristics established from the Geomorphology Mapping Study (Figure 1, Table 2). Reaches were numbered sequentially from Upper River 1 (UR-1) at the upstream end to Upper River 6 (UR-6) at the downstream end at the proposed Watana Dam site. The two uppermost reaches (UR-1 and UR-2) were outside the study area and therefore were not mapped. Reaches UR-1 and UR-2 were classified to main channel, off-channel, and tributary. The reaches are not equally distributed in length, but separated based on the presence of distinct geomorphic processes and channel characteristics as described in RSP Section 6.5. Note that since there are multiple macrohabitat types laterally distributed at any one time within the channel, the total distance of habitat is significantly greater than the actual length of the reach alone.

3.1 Main Channel Habitat

Main-channel habitat varied by geomorphic reach and generally increased in complexity from upstream to downstream locations (Figure 2, Table 3). The single confined channel type represented the majority of habitat found in all four reaches. Side channel was well represented in the lowest reach (UR-6) and made up a small portion of habitat in the other reaches. Split main channel was represented in all but the uppermost reach (UR-3). Tributary mouth was a small component of each reach. Clear water plume was only represented in UR-3 and UR-4.

Mesohabitat in the main channel was generally dominated by a mixture of run and glide habitats (Figure 3, Table 4). Run and glide habitats were not distinguished from each other at this level of classification and were combined into a single element referred to as 'glide or run'. This included smooth-flowing, low turbulence reaches as well as areas with some standing or wind waves and occasional solitary protruding boulders. Riffle habitat was most prevalent in UR-3.

Many side channels were not completely inundated with flowing water and so identification of riffle or run habitat was not possible; these were classified as unidentified and were most prevalent in all reaches except UR-5 (Table 4). 'Glide or run' was the dominant mesohabitat in UR-5 and was also represented in UR-4 and UR-6. Riffle was represented in all reaches except UR-3.

The habitat associated with the confluence of tributaries with the main channel river was documented as tributary mouth and clear water plume (Table 3). Small tributaries, where the vegetation line was close to the mainstem, did not fan out and create the areas classified as tributary mouth habitat. These areas were most frequent in the larger tributaries within UR-4, but were represented in each reach. Named tributaries by geomorphic reach are identified in Table 5. The largest total tributary mouth habitat area was in UR-4.

Clear water plume habitat was marked in areas along the shoreline of the main channel where the water remained clear for some distance downstream prior to mixing with the turbid main channel waters. These habitats resulted from the outflow of tributaries and commenced at tributary mouths and extended downstream. Small tributaries or tributaries that flowed into fast moving or turbulent sections of the mainstem did not produce these clear water plumes. Clear water plumes were documented in UR-3 and UR-4. Over a mile of clear water plume habitat was found in UR-4. Associated named tributaries in each of the identified reaches are identified in Table 5.

3.2 Off-channel Habitats

Off-channel habitat was identified in all reaches except UR-2 and UR-5. Reach UR-1 had the most off-channel habitat (Figure 4). Off-channel macro habitat and mesohabitat were not classified in UR-1 and UR-2 as part of this analysis. Side sloughs were found throughout the Upper River reaches with the exception of UR-5 (Table 5). Side sloughs were most abundant in UR-4, followed by UR-6. Upland sloughs were most abundant in UR-4, and were found in UR-4 and UR-6. Beaver complexes were not identified in any upper river reaches. Backwater habitat was relatively rare and only represented in UR-4 (Figure 4; Table 6).

3.3 Tributary Habitat

Other than the mapping of their deltas, mouths, and plumes, tributary habitat was not mapped as part of this study. Mapping of tributary habitat is part of Study 9.9 – Characterization and Mapping of Aquatic Habitats. Tributaries were present in each reach and most prevalent in UR-1 (Figure 4). Associated named tributaries in each of the identified reaches are listed in Table 5.

4. DISCUSSION

The results of the study provide a complete index of the frequency and proportion of main channel, off-channel, and tributary habitat within the Upper River. The resolution of the data varied based on the size and visibility of each habitat unit and relied upon the professional interpretation of biologists. Nonetheless, the final product provides a tool and current resource to make informed decisions and plan for representing the Upper River for instream flow and fish distribution studies for 2013. It is important to note that this tool represents only a small portion of habitat mapping study activity for 2013. Significant on-the-ground activity is planned for 2013 that will expand the resolution and working knowledge of available habitat in the Susitna River and surrounding tributaries.

5. REFERENCES

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6. TABLES

Table 1. Upper River levels of habitat classification hierarchy. Note that mentions of the Middle and Lower River are included, but those areas were not mapped as part of this report.

Level	Unit	Category	Definitions
1	Major Hydrologic Segment	Upper, Middle, Lower River	**Defined Segment Breaks** ***Upper River*** – PRM 187.1 – 261.3 (*habitat mapping will only extend up to mainstem PRM 234.5 and will include the Oshetna River.* ***Middle River*** - PRM 102.4 – 187.1 ***Lower River - P***RM 0 – 102.4
2	Geomorphic Reach	Upper River Segment Geomorphic Reaches 1-6 Middle River Segment Geomorphic Reaches 1-8 Lower River Segment Geomorphic Reaches 1-6	Geomorphic reaches that uniquely divide the Major Hydrologic Segments based on geomorphic characteristics.
3	Mainstem Habitat	Main Channel Habitat Off-Channel Habitat Types Tributary Habitat	**Main Channel Habitat:** ***Main Channel –*** Single dominant main channel. ***Split Main Channel –*** Three or fewer distributed dominant channels. ***Multiple Split Main Channel –*** Greater than three distributed dominant channels. ***Side Channel –*** Channel that is turbid and connected to the active main channel but represents non-dominant proportion of flow[1]. ***Tributary Mouth -*** Clear water areas that exist where tributaries flow into Susitna River main channel or side channel habitats (upstream Tributary habitat will be mapped as a separate effort). **Off-Channel Habitat (also referred to as macrohabitat):** ***Side Slough -*** Overflow channel contained in the floodplain, but disconnected from the main channel. Has clear water.[1] ***Upland Slough -*** Similar to a side slough, but contains a vegetated bar at the head that is rarely overtopped by mainstem flow. Has clear water.[1.] **Tributary Habitat:** Tributary mesohabitats within the hydrologic zone of influence will be typed using the classification system described in Table 9.9-3, above.

Level	Unit	Category	Definitions
4	Main Channel, Off-channel, and Tributary	Mesohabitat	**Main Channel** ***Pool –*** slow water habitat with minimal turbulence and deeper due to a strong hydraulic control. ***Glide –*** An area with generally uniform depth and flow with no surface turbulence. Low gradient; 0-1 percent slope. Glides may have some small scour areas but are distinguished from pools by their overall homogeneity and lack of structure. Generally deeper than riffles with few major flow obstructions and low habitat complexity.[2] ***Run –*** A habitat area with minimal surface turbulence over or around protruding boulders with generally uniform depth that is generally greater than the maximum substrate size.[2] Velocities are on border of fast and slow water. Gradients are approximately 0.5 percent to less than 2 percent. Generally deeper than riffles with few major flow obstructions and low habitat complexity.[2] ***Riffle –*** A fast water habitat with turbulent, shallow flow over submerged or partially submerged gravel and cobble substrates. Generally broad, uniform cross-section. Low gradient; usually 0.5-2.0 percent slope.[2] ***Rapid*** - Swift, turbulent flow including small chutes and some hydraulic jumps swirling around boulders. Exposed substrate composed of individual boulders, boulder clusters, and partial bars. Lower gradient and less dense concentration of boulders and white water than Cascade. Moderate gradient; usually 2.0-4.0 percent slope.[2] ***Clearwater Plume*** — Discharge from a tributary that forms a pronounced area of clearwater, in contrast to the turbid water of the main channel, along the main channel shoreline. The length, breadth, and depth of the clearwater plume depend on the relative discharge between the tributary and the main channel, relative turbidity, and on mixing conditions along the shoreline. A clear water plume will be mapped as if it were a separate mesohabitat type. **Off-channel:** ***Backwater -*** Found along channel margins and generally within the influence of the active main channel with no independent source of inflow. Water is not clear. A backwater will be mapped as if it were a separate mesohabitat type. ***Beaver Complex –*** Complex ponded water body created by beaver dams. A beaver dam will be mapped as if it were a separate mesohabitat type.

[1] The terms Side Channel, Slough, and Upland Slough are similar but not necessarily synonymous with the terms for macrohabitat type as applied by Trihey (1982) and ADF&G (1983a).

[2] Adapted from Moore et al. 2006.

Table 2. Locations of Upper River (UR) geomorphic reaches by Project river mile.

Geomorphic Reach	Downstream Project River Mile	Upstream Project River Mile	Length (miles)	Description
UR-1	248.6	261.3	12.7	Quaternary Basin Fill
UR-2	234.5	248.8	14.3	Quaternary Basin Fill
UR-3	224.9	234.5	9.6	Quaternary Basin Fill
UR-4	208.1	224.9	16.8	Granodiorite
UR-5	203.4	208.1	4.7	Quaternary Basin Fill
UR-6	187.1	203.4	16.3	Quaternary Basin Fill

[1] Characterization from internally updated geomorphic reach characterization

Table 3. Total length and percent composition (by geomorphic reach) of main channel habitat classifications by geomorphic reach in the Upper Susitna River.

Main Channel Type	UR-1 (PRM 261.3 - 248.6)		UR-2 (PRM 248.6 - 234.5)		UR-3 (PRM 234.5 - 224.9)		UR-4 (PRM 224.9 - 208.1)		UR-5 (PRM 208.1 - 203.4)		UR-6 (PRM 203.4 – 187.1)	
	% of Total	Total (ft)	% of Total	Total (ft)	% of Total	Total (ft)	% of Total	Total (ft)	% of Total	Total (ft)	% of Total	Total (ft)
Main Channel	--	--	--	--	92.1%	50,528	65.5%	77,725	77.9%	22,617	60.1%	84,653
Split Main Channel	--	--	--	--	0.0%	0	15.0%	17,845	11.0%	3,194	4.1%	5,745
Multi-Split Main Channel	--	--	--	--	0.0%	0	0.0%	0	0.0%	0	0.0%	0
Side Channel	--	--	--	--	4.2%	2,321	13.6%	16,085	10.4%	3,028	35.1%	49,368
Tributary Mouth	--	--	--	--	1.2%	635	1.3%	1,597	0.7%	212	0.7%	984
Clear Water Plume	--	--	--	--	2.5%	1,388	4.6%	5,429	0.0%	0	0.0%	0
Grand Total	**--**	**--**	**--**	**--**	**100%**	**54,872**	**100%**	**118,681**	**100%**	**29,051**	**100%**	**140,750**

Table 4. Total length and percent composition (by geomorphic reach) of main Channel mesohabitat classifications in the Upper Susitna River.

Main Channel Mesohabitat	UR-1 (PRM 261.3 - 248.6)		UR-2 (PRM 248.6 - 234.5)		UR-3 (PRM 234.5 - 224.9)		UR-4 (PRM 224.9 - 208.1)		UR-5 (PRM 208.1 - 203.4)		UR-6 (PRM 203.4 – 187.1)	
	% of Total	Total (ft)	% of Total	Total (ft)	% of Total	Total (ft)	% of Total	Total (ft)	% of Total	Total (ft)	% of Total	Total (ft)
Main Channel	--	--	--	--	**92.1%**	**50,528**	**65.5%**	**77,724**	**77.9%**	**22,617**	**60.2%**	**84,652**
Glide or Run	--	--	--	--	38.2%	20,966	46.3%	55,000	55.2%	16,027	52.0%	73,187
Pool	--	--	--	--	0.0%	0	0.0%	0	0.0%	0	0.0%	0
Rapid	--	--	--	--	12.9%	7,057	0.0%	0	3.6%	1,042	1.8%	2,459
Riffle	--	--	--	--	41.0%	22,505	19.1%	22,724	19.1%	5,548	3.8%	5,393
Unidentified	--	--	--	--	0.0%	0	0.0%	0	0.0%	0	2.6%	3,613
Split Main Channel	--	--	--	--	**0.0%**	**0**	**15.0%**	**17,846**	**11.0%**	**3,194**	**4.1%**	**5,745**
Glide or Run	--	--	--	--	0.0%	0	11.3%	13,439	11.0%	3,194	4.1%	5,745
Riffle	--	--	--	--	0.0%	0	3.7%	4,407	0.0%	0	0.0%	0
Multi-Split Main Channel	--	--	--	--	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**
Glide or Run	--	--	--	--	0.0%	0	0.0%	0	0.0%	0	0.0%	0
Riffle	--	--	--	--	0.0%	0	0.0%	0	0.0%	0	0.0%	0
Unidentified	--	--	--	--	0.0%	0	0.0%	0	0.0%	0	0.0%	0
Side Channel	--	--	--	--	**4.2%**	**2,321**	**4.2%**	**16,084**	**10.5%**	**3,028**	**35.0%**	**49,368**
Glide or Run	--	--	--	--	0.0%	0	4.2%	5,027	4.6%	1,329	5.2%	7,382
Pool	--	--	--	--	0.0%	0	0.0%	0	0.0%	0	0.0%	0
Riffle	--	--	--	--	0.0%	0	0.5%	611	2.2%	625	0.9%	1,261
Unidentified	--	--	--	--	4.2%	2,321	8.8%	10,446	3.7%	1,074	28.9%	40,725
Tributary Mouth	--	--	--	--	**1.2%**	**635**	**1.3%**	**1,597**	**0.7%**	**212**	**0.7%**	**984**
Clear Water Plume	--	--	--	--	**2.5%**	**1,388**	**4.6%**	**5,429**	**0.0%**	**0**	**0.0%**	**0**
Total	--	--	--	--	**100%**	**54,872**	**100%**	**118,680**	**100%**	**29,051**	**100%**	**140,749**

Table 5- List of major tributaries by geomorphic reach. Identified Project river miles for each tributary specify the mainstem Susitna River location where the tributary confluence occurs.

Geomorphic Reach	Major Named Tributaries (in order from upstream to downstream)
UR-1 (PRM 261.3 - 248.6)	Maclaren River
UR-2 (PRM 248.6 - 234.5)	Tyone River and Oshetna River
UR-3 (PRM 234.5 - 224.9)	Goose Creek
UR-4 (PRM 224.9 - 208.1)	Jay Creek and Kosina Creek
UR-5 (PRM 208.1 - 203.4)	None
UR-6 (PRM 203.4 – 187.1)	Watana Creek and Deadman Creek

Table 6. Total length and percent composition (by geomorphic reach) of off channel habitats classified in the Upper Susitna River.

Off-Channel and Tributary Habitats	UR-1 (PRM 261.3 - 248.6)		UR-2 (PRM 248.6 - 234.5)		UR-3 (PRM 234.5 - 224.9)		UR-4 (PRM 224.9 - 208.1)		UR-5 (PRM 208.1 - 203.4)		UR-6 (PRM 203.4 – 187.1)	
	% of Total	Total (ft)	% of Total	Total (ft)	% of Total	Total (ft)	% of Total	Total (ft)	% of Total	Total (ft)	% of Total	Total (ft)
Backwater	--	--	--	--	**0.0%**	**0**	**2.2%**	**1,219**	**0.0%**	**0**	**0.0%**	**0**
Side Slough	--	--	--	--	**6.2%**	**1,397**	**25.3%**	**14,114**	**0.0%**	**0**	**9.1%**	**5,077**
Beaver Complex	--	--	--	--	0.0%	0	0.0%	0	0.0%	0	0.0%	0
Side Slough	--	--	--	--	6.2%	1,397	25.3%	14,114	0.0%	0	9.1%	5,077
Tributary	--	--	--	--	**93.8%**	**21,068**	**66.9%**	**37,318**	**100.0%**	**11,524**	**89.6%**	**49,795**
Upland Slough	--	--	--	--	**0.0%**	**0**	**5.6%**	**3,115**	**0.0%**	**0**	**1.2%**	**687**
Beaver Complex	--	--	--	--	0.0%	0	0.0%	0	0.0%	0	0.0%	0
Upland Slough	--	--	--	--	0.0%	0	5.6%	3,115	0.0%	0	1.2%	687
Grand Total	--	--	--	--	**100%**	**22,645**	**100%**	**55,766**	**100%**	**11,524**	**100%**	**55,559**

7. FIGURES

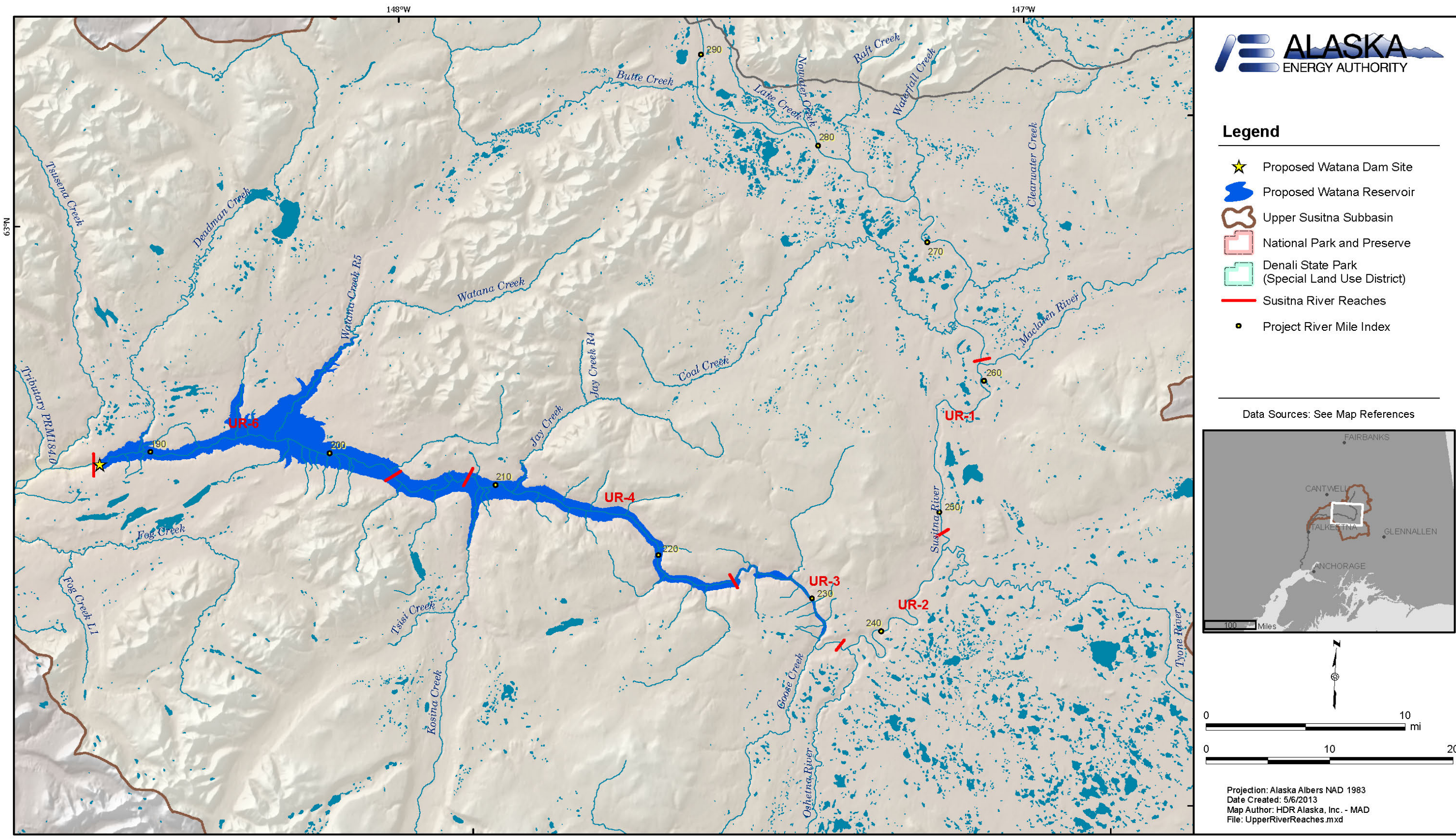

Figure 1. Geomorphic reaches in the Upper Susitna River. Note figure shows hypothetical zone of inundation.

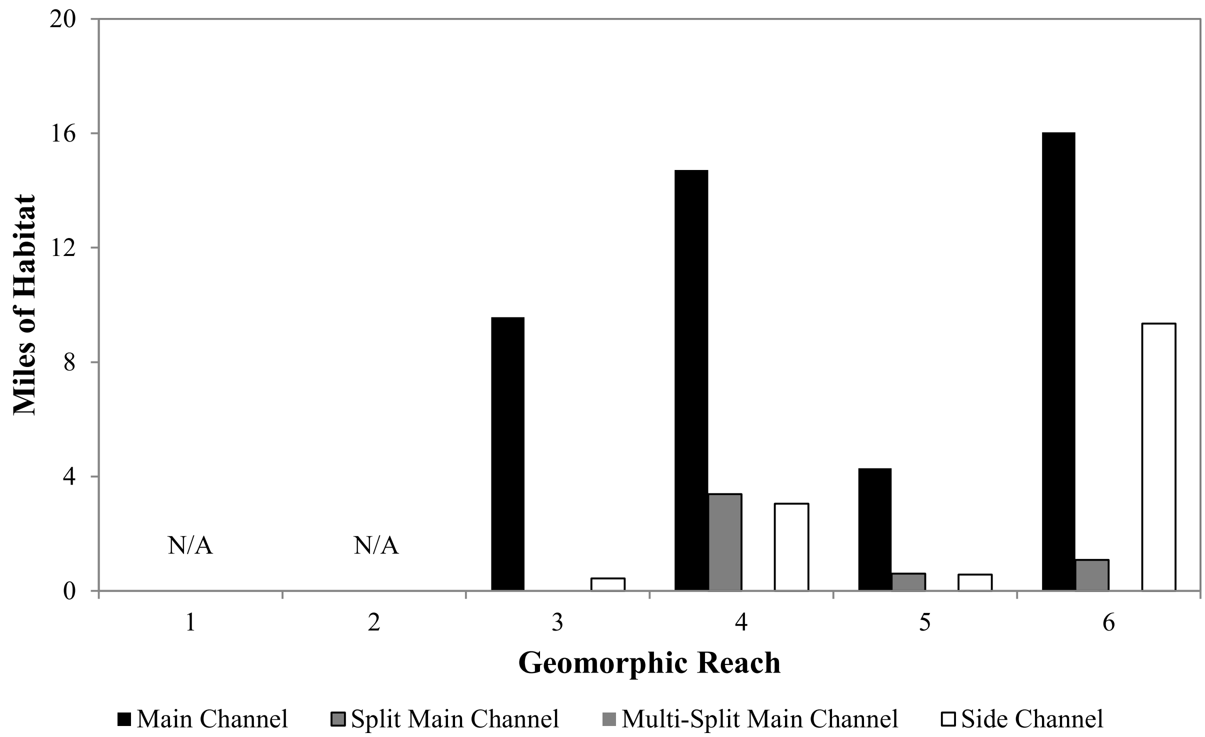

Figure 2. Main Channel Habitat classifications by geomorphic reach in the Upper Susitna River.

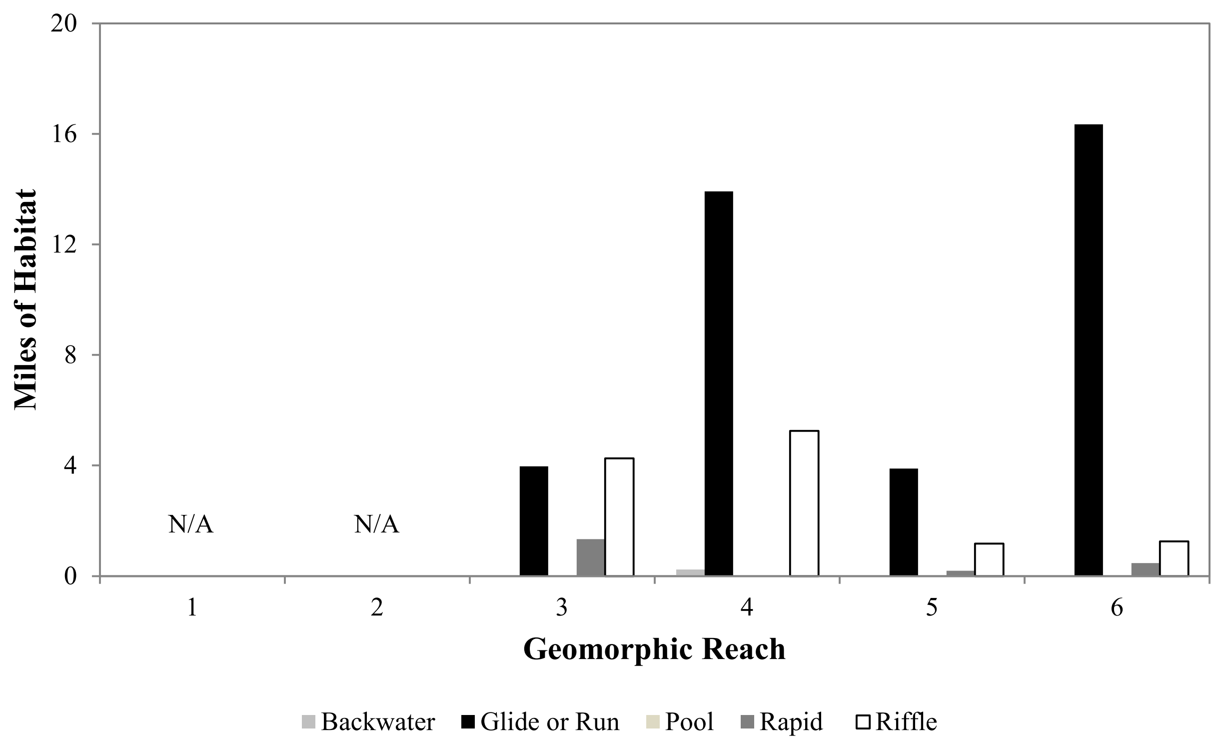

Figure 3. Mesohabitat classifications by geomorphic reach in the main and side channels in the Upper Susitna River.

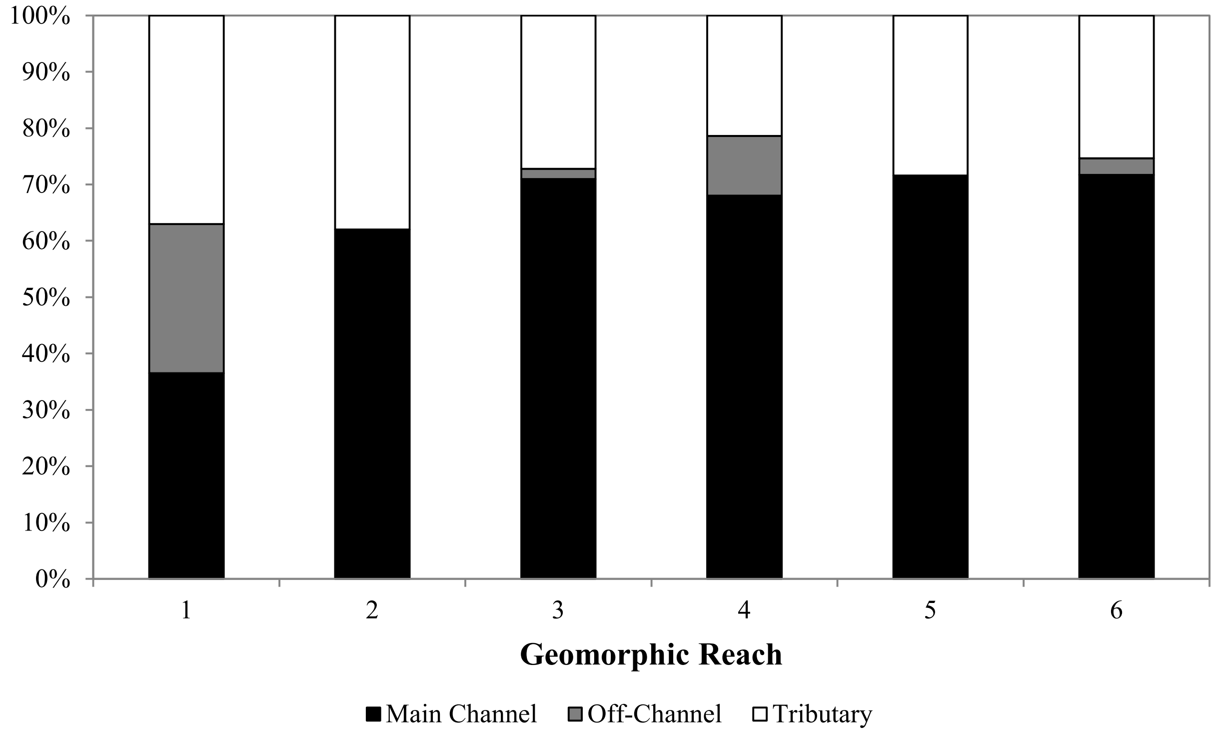

Figure 4. Summary of level 3 habitat classifications (by length) in each geomorphic reach in the Upper Susitna River.

Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Characterization and Mapping of Aquatic Habitats (9.9)

Appendix C
Upper River Mainstem Surveys, 2013

Initial Study Report

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

R2 Resource Consultants, Inc.

February 2014 Draft

Legend

- Instream Flow Focus Area (Upper and Lower Extent)
- Project River Mile
- Flow Arrow

Orthophoto Source: 2011 Matanuska-Susitna Borough LiDAR & Imagery Project

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Mesohabitat (2013)*
- Riffle
- Run
- Glide
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- Backwater
- Clearwater Plume
- Dry
- Beaver Complex

* *Preliminary Data*

Page 1 of 19

ALASKA ENERGY AUTHORITY

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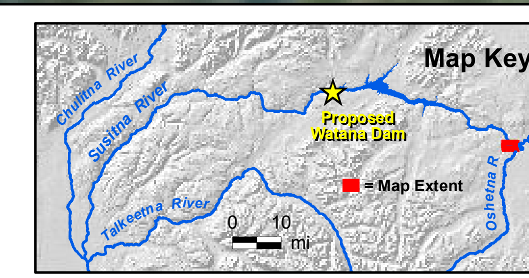


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Project River Mile
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Chulitna River
Susitna River
Talkeetna River
Oshetna R.
Proposed Watana Dam
= Map Extent
0 10 mi

Legend

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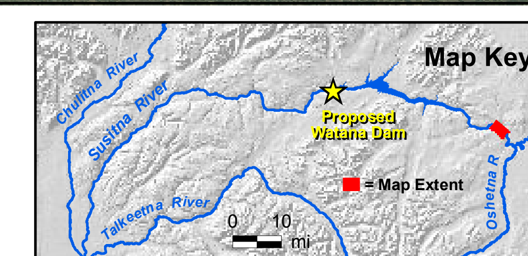


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Susitna River
Talkeetna River
Oshetna R
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mi


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Unnamed
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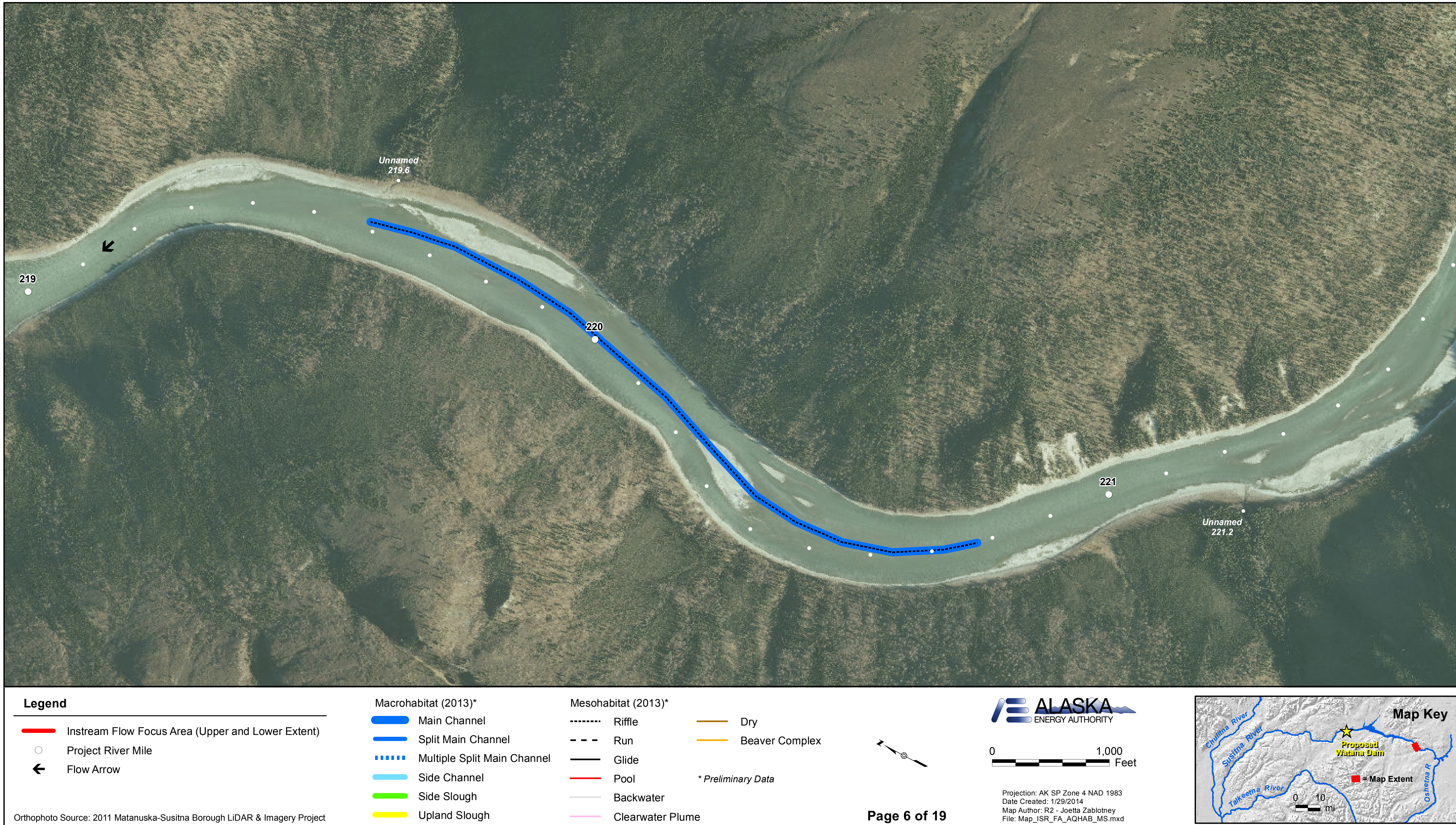
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Project River Mile
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mi

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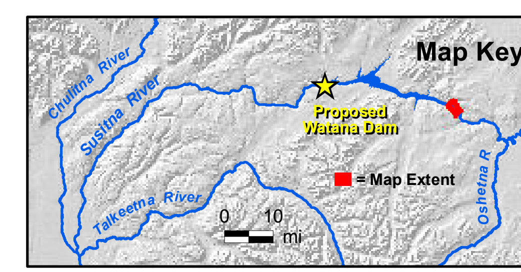

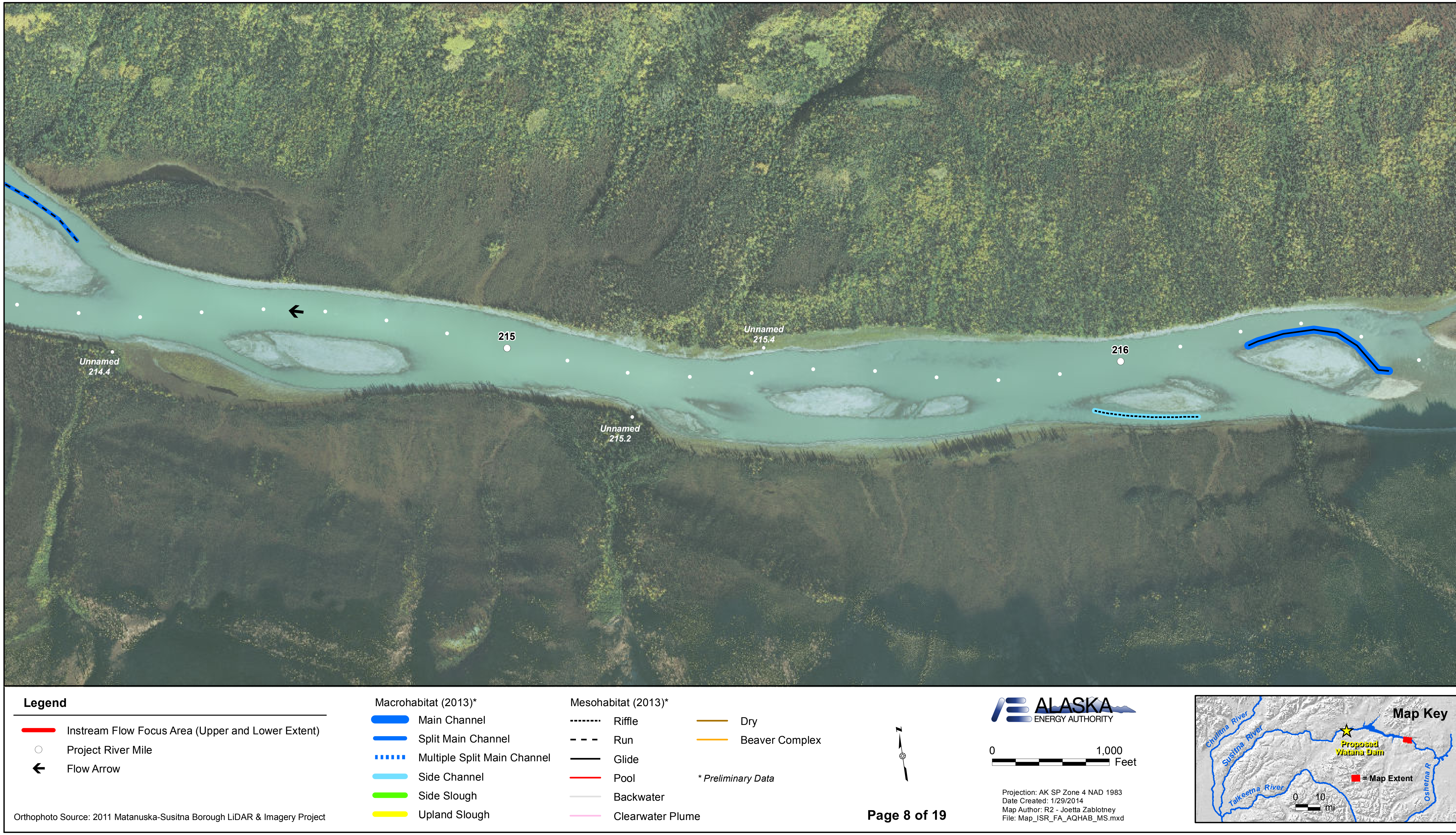
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Project River Mile
Flow Arrow
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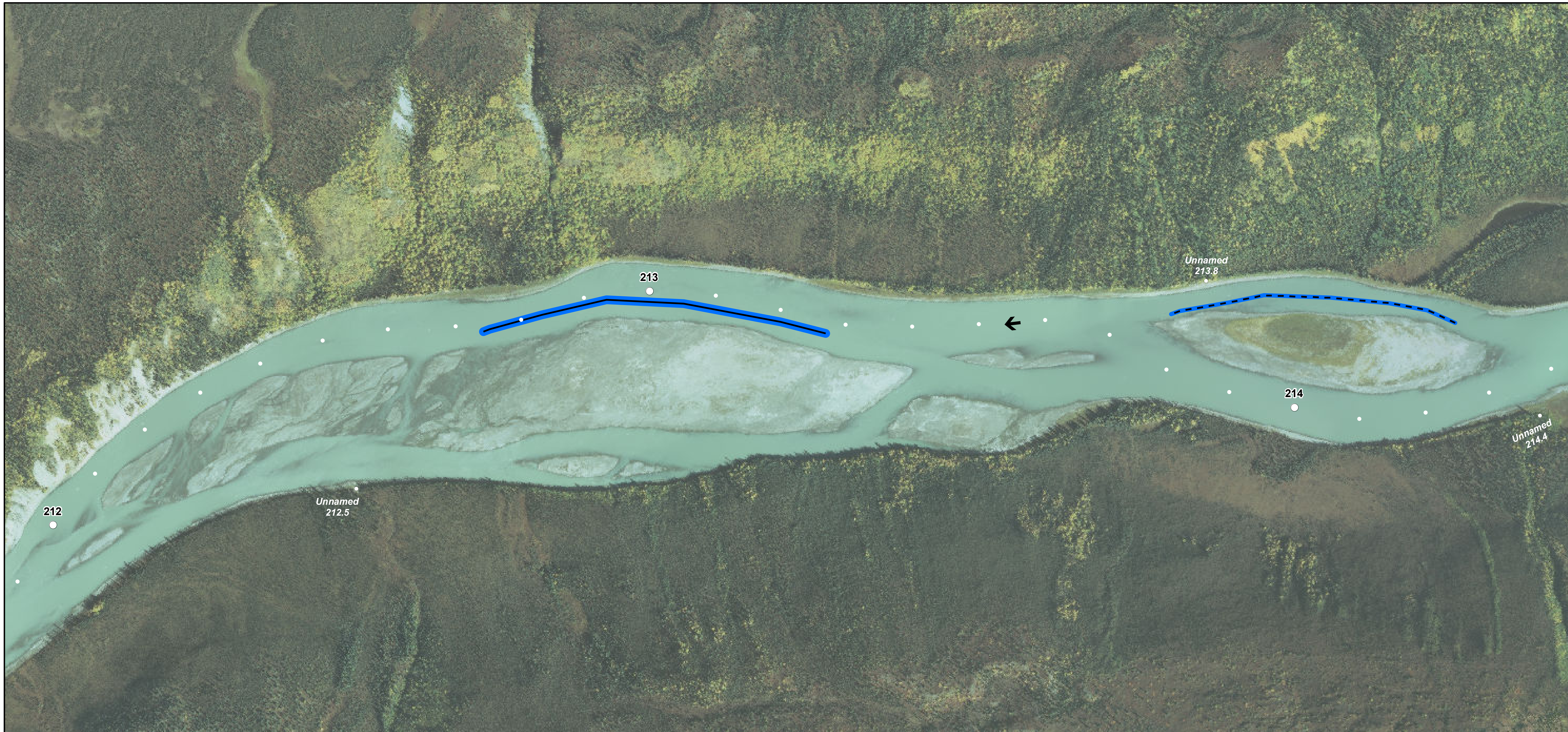

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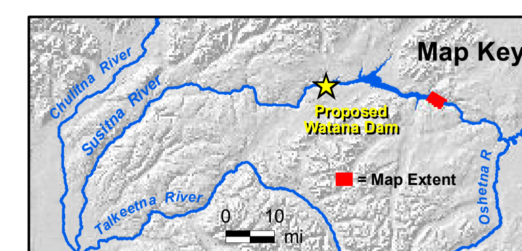

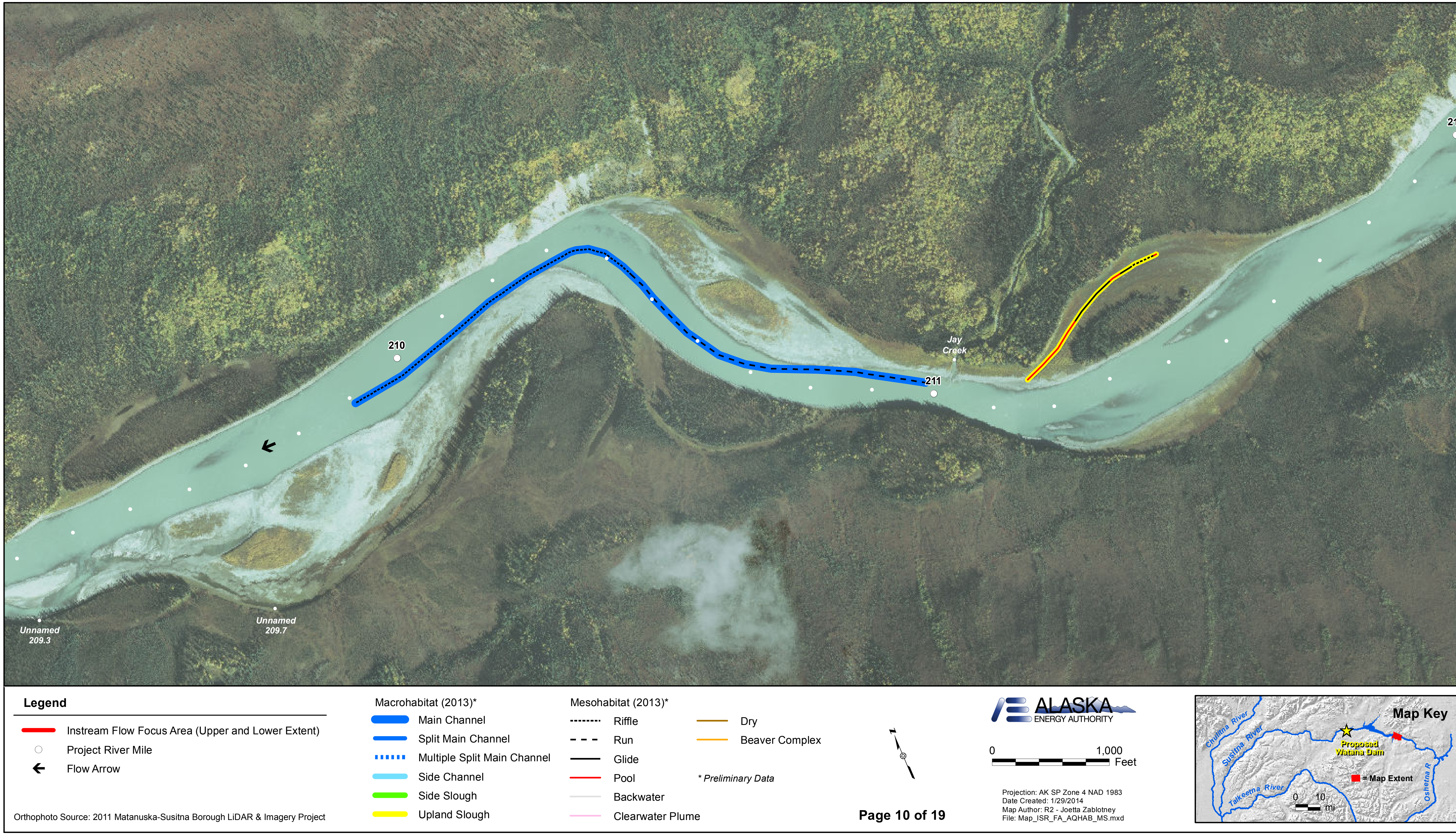
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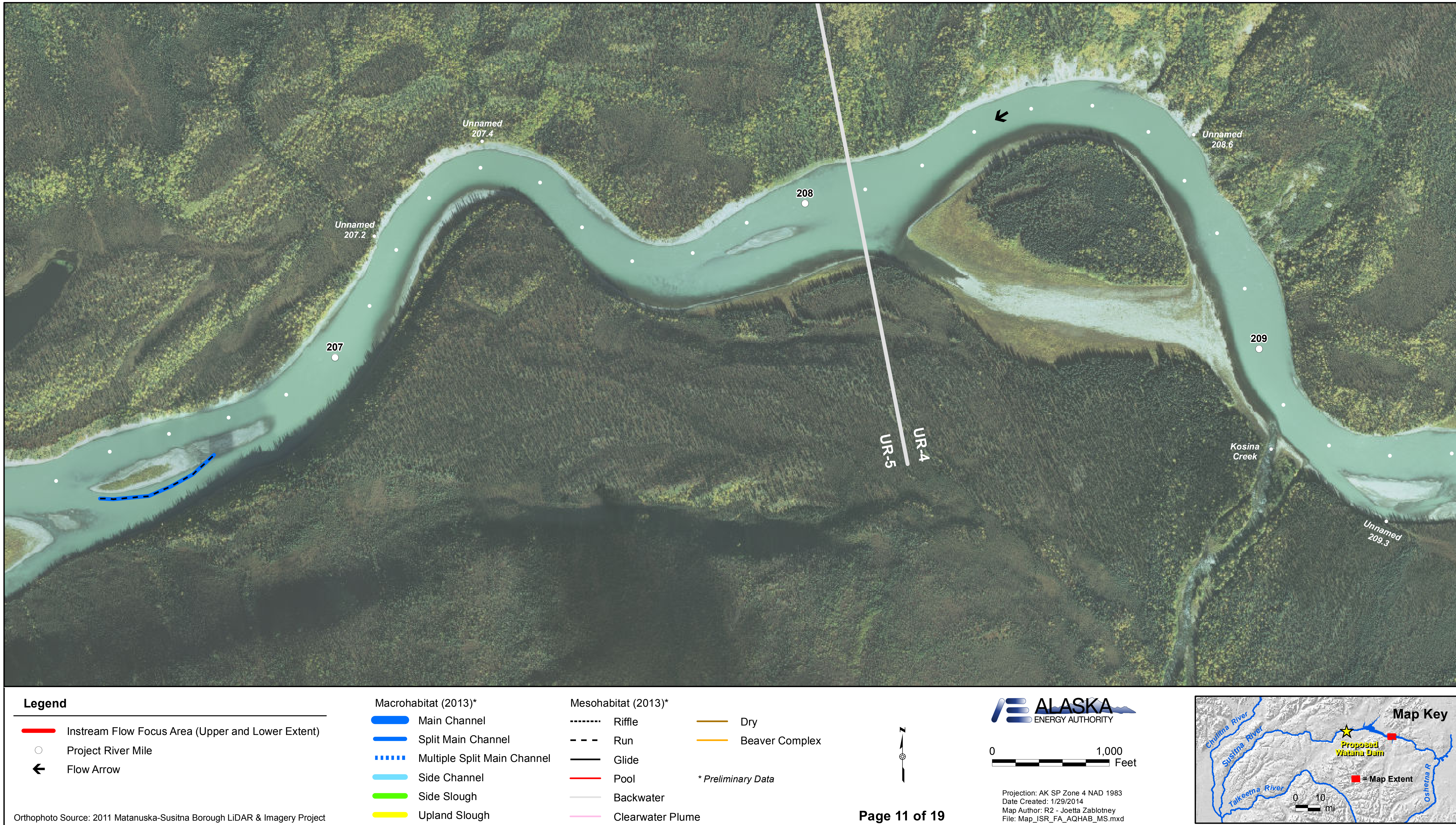
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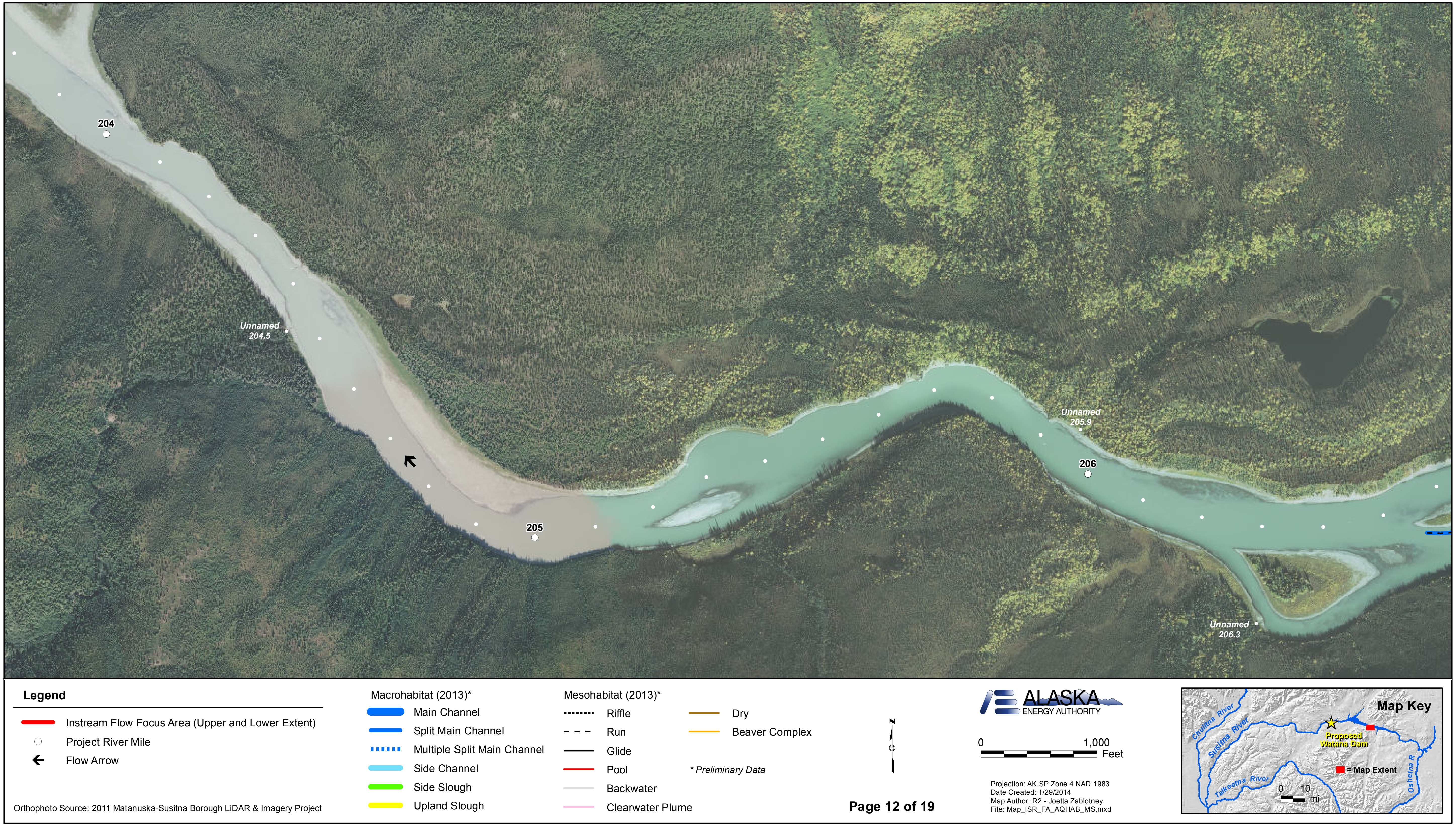
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Page 13 of 19

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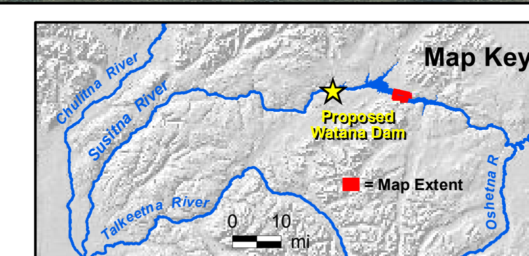

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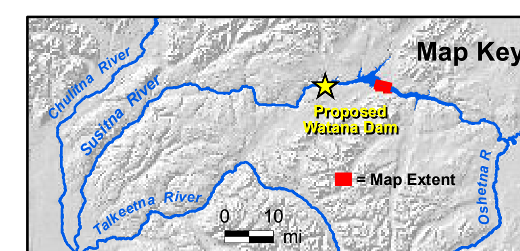

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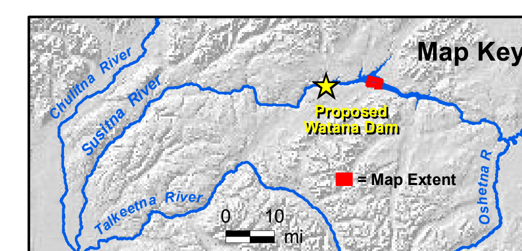

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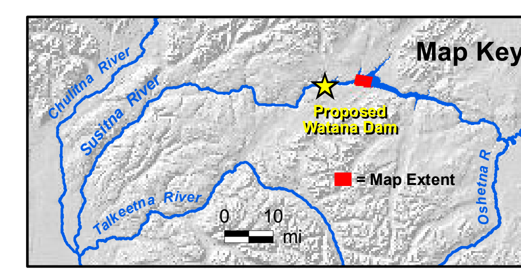

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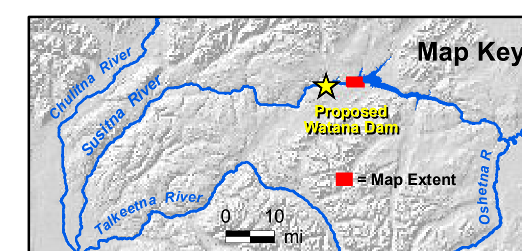

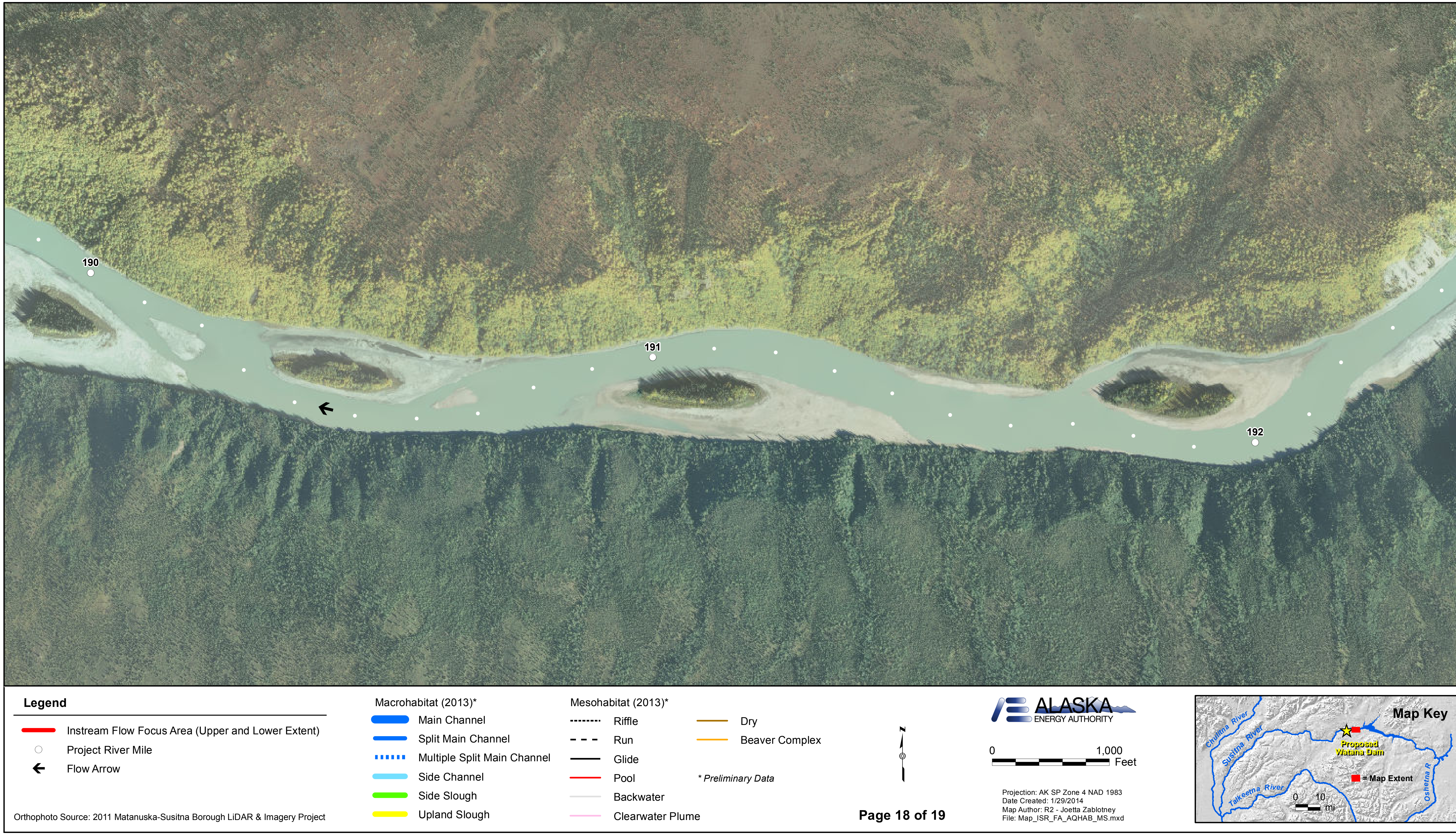
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Talkeetna River
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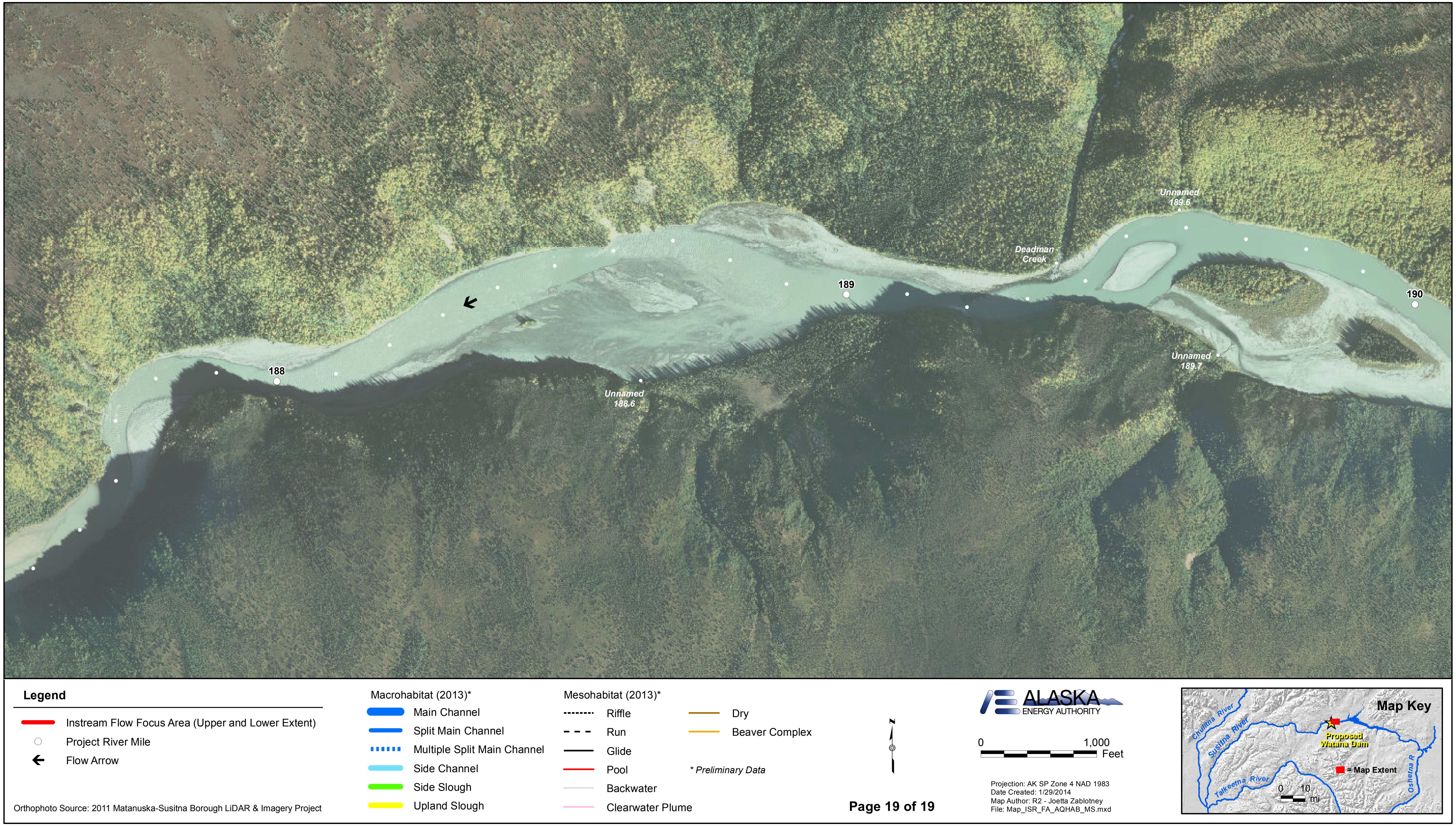
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Flow Arrow
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