# STREAM HABITAT SURVEYS OF PROPOSED BRIDGE CROSSINGS ON THE BROOKS EAST CORRIDOR

Prepared for

**DOWL HKM**
4041 B Street
Anchorage, AK 99503

by

**ABR, Inc.—Environmental Research & Services**
P.O. Box 240268
Anchorage, AK 99524

July 2014

## INTRODUCTION

The Ambler Mining District Access Project is a State of Alaska undertaking with the objective of identifying, designing, and constructing an access and transportation corridor to the Ambler mineral belt. Of the several preliminary corridors that were initially evaluated for development potential, 1 has been selected for field work in preparation for regulatory requirements defined by the National Environmental Policy Act (NEPA) process. The selected corridor, referred to as the Brooks East Corridor, extends east from the Ambler mineral belt through Bettles to the Dalton Highway (Figure 1). DOWL HKM contracted ABR, Inc.—Environmental Research & Services (ABR) on behalf of the Alaska Industrial Development and Export Authority (AIDEA) to characterize fish and aquatic habitat resources along the Brooks East Corridor.

In 2012, ABR conducted field surveys to sample for the presence of resident and anadromous fish species in streams crossed by the proposed corridor (Lemke et al. 2013). Fish species not previously described in the area were reported to the Alaska Department of Fish & Game (ADFG) for inclusion in the "Catalog of Waters Important for the Spawning, Rearing, or

Migration of Anadromous Fishes," known as the Anadromous Waters Catalog (AWC; ADFG 2013). As a result of the 2012 surveys, 175.5 km of streams were identified for nomination to the AWC for Pacific salmon (Lemke et al. 2013). Furthermore, 272.6 km of stream were identified as potential Dolly Varden (*Salvelinus malma*) habitat for inclusion in the ADFG Alaska Freshwater Fish Index (AFFI) (Lemke et al. 2013). Official AWC nominations from the 2012 sampling occurred in September 2013 and the catalog will reflect these nominations in the spring of 2014 (Appendix A) (ADG 2013).

In 2013, ABR's summer field survey efforts focused on stream and riparian habitat assessments at proposed bridge crossings along the corridor. Fish sampling was not conducted in 2013. This report summarizes the 2013 stream habitat surveys and integrates these results with data on known fish assemblages in those waterbodies.

## BACKGROUND

The Magnuson-Stevens Fishery Conservation and Management Act is federal legislation mandating conservation and protection of fishery resources while optimizing harvests of commercial fish stocks. Among the Act's mandates is a requirement for the protection of Essential Fish Habitat (EFH) utilized by fish species, including Pacific salmon, which have been assigned a federal management plan. For anadromous salmon in Alaska, EFH includes both freshwater and marine habitats. Where Pacific salmon are present in Alaskan freshwaters, the National Oceanic and Atmospheric Administration (NOAA) Fisheries Service (NOAA Fisheries) is the agency with primary management authority over the fish and their habitat.

In addition to federal management, the Alaska state constitution describes the state's mandate to maintain proper functioning and connectivity of aquatic habitats, along with proper management of harvests to preserve sustained yields of anadromous fish. Consequently, in Alaska, habitats that are used by migrating, spawning, or rearing anadromous fish are protected under multiple administrative jurisdictions, including the Alaska Statute (AS) 16.05.877 (the Anadromous Fish Act) (Buckwalter 2010). Furthermore, the ADFG AWC serves to designate these anadromous habitats in Alaska.

The following survey was conducted with the notion that the state and federal permits necessary to proceed with the Ambler Mining District Access Project will require knowledge of potential impacts to any fish habitat that may be traversed by the proposed road.

## OBJECTIVES

- Objective 1: Document the stream habitat conditions in waterbodies associated with potential bridge crossings along the Brooks East Corridor
- Objective 2: Integrate stream habitat and fish presence data from the study area to determine potential impacts of bridge construction on stream habitat

## STUDY AREA

The Brooks East Corridor crosses numerous rivers, large creeks, and smaller waterbodies along its ~200 mile length. As defined in the United States Geological Survey's National Hydrography Dataset (USGS NHD) (USGS 2013), the proposed Brooks East Corridor crosses 7 subbasins (NHD fourth level: the Middle Kobuk River, Upper Kobuk River, Alatna River, Allakaket, Upper Koyukuk River, Koyukuk Flats, and South Fork Koyukuk River) and 19 watersheds (NHD fifth level; Figure 2). The current corridor is described as a "preferred" route with alternative routes along 2 relatively short stretches: a 23-km "northern option" near the western end of the corridor which runs roughly parallel to, and north of the Manuleak River (the preferred route runs roughly parallel to, and south of the Manuleak River) and a 94-km "southern option" near the middle of the corridor where it passes through the Gates of the Arctic National Preserve (Figure 2). Survey locations for the 2013 sampling effort were preselected by DOWL HKM personnel at 18 bridge crossings that have been identified and studied to some degree by Project personnel between the Shungnak River and the Jim River, though additional potential bridge crossings undoubtedly will be identified going forward.

# METHODS

Aquatic sampling surveys occurred during 12–23 August 2013 and coincided with a period of low river flow which facilitated the differentiation of habitat segments and allowed safe wading by Project personnel. The ABR survey team was composed of 3 aquatic biologists who were accompanied by a local subsistence advisor, Allen A. Tickett, courtesy of DOWL HKM,

with special knowledge of the study area. The survey team accessed each sample location by Bell 407 helicopter operated by Bristow Group, Inc. Surveys were generally conducted from west to east in the Brooks East Corridor, starting at the Shungnak River and ending at the Jim River (Figure 1). Sampling priority was given to bridge crossings along the preferred corridor, followed by the northern and southern road options.

ABR stream habitat surveys focused on the largest waterbodies along the corridor and occurred approximately 1,000 ft upstream and 1,000 ft downstream of each proposed bridge crossing unless ground or water conditions reduced accessibility and dictated a shorter survey segment. Upon arriving at sample locations, the survey team flew over the entire 2,000 ft river survey reach centered on the proposed bridge crossing from an altitude of ~50–100 ft. During flight, video footage of the waterbody was collected using a Lumix TS3 digital camera and a GoPro Hero 3. This fly-over allowed the survey team to make an initial assessment of stream and riparian habitat, select possible habitat transect locations, and locate helicopter landing zones. Once on the ground, survey team members walked as much of the 2,000 ft reach as feasible, sketching a rough map along the way. These sketches served to highlight instream substrate transition zones, run-riffle-pool sequences, riparian vegetation, and other stream features (e.g., exposed gravel bars). GPS coordinates were recorded using a DeLorme Earthmate PN-60 to demarcate transition zones and notable reach characteristics. Additional photo-documentation was completed to compliment stream sketches.

After the initial assessment of stream features, the survey team selected 1–3 instream cross-sectional habitat transects at various points along the stream reach. Reaches with uniform flow regimes and homogeneous substrate generally warranted a single habitat transect. Reaches with heterogeneous instream features warranted 2–3 transects. Once habitat transect locations were identified, survey team members recorded the date, time, and latitude and longitude (decimal degrees) of each transect. Next, ambient water quality measurements were collected using a YSI Professional Plus multiparameter meter. Variables measured were temperature (° C), pH, specific conductance (µS/cm), and dissolved oxygen (mg/L and %). A 250 ml water sample was collected for measurement of turbidity (in nephelometric turbidity units; NTU) using a Hach 2100P Turbidometer. The 48-hour precipitation level (low, medium, high), water color (clear,

ferric, glacial-high turbidity, glacial-low turbidity, humic, muddy), and stream stage (dry, low, medium, high) were assessed qualitatively and recorded.

Instream channel characteristics along the habitat transect were recorded using a measuring tape, survey rod, and clinometer. Variables collected were wetted width (m), bankfull width (m), thalweg depth (m), stream gradient (%), and bank angle (°). Instream substrate composition was recorded along the transect after walking from bank to bank. Substrate was recorded as a percentage of bedrock, boulder, cobble, gravel, sand, silt, and clay and totaled 100%. Depending on flow and turbidity, substrate photos were taken along each transect. Instream channel cover was assessed for the presence of filamentous algae and periphyton, macrophytes, large woody debris (diameter greater than 0.3 m), small woody debris (diameter less than 0.3 m), live tree roots, overhanging vegetation, undercut bank, boulders, and artificial structures. Each parameter was expressed as a qualitative percentage of the total stream cover within 10 m upstream and downstream of the habitat transect and noted as absent (0%), sparse (less than 10%), moderate (10–40%), moderately abundant (40–75%), and abundant (greater than 75%).

Riparian vegetation was described for the left and right bank (facing downstream) within 10 m of the water's edge width along the habitat transect. Riparian vegetation was categorized as ground cover (vegetation less than 0.5 m), understory (0.5–5 m), and canopy (greater than 5 m). Vegetation type (coniferous, deciduous, or mixed) and percent cover were recorded for ground cover, understory, and canopy using the same qualitative percentage scale as instream channel cover.

Flow (m/s) and depth (m) were measured at up to 10 equally spaced points along the transect using a Marsh McBirneyFlo-Mate 2000 portable flow meter and top-setting wading rod. Stream discharge ($m^3/s$) for each sample site was calculated from the cross sectional water velocities and depth data. At least 4 photos were taken from the middle of each stream transect of the surrounding habitat looking upstream, downstream, towards left bank, and towards right bank. Following completion of habitat surveys at any given sample location, additional high-definition video was recorded from the air between proposed bridge crossings along the road corridor.

## RESULTS AND DISCUSSION

ABR surveyed a total of 28 instream habitat transects in 14 waterbodies over 11 days of sampling during August 2013 field studies on the Brooks East Corridor Project (Figure 1, Appendix B). The waterbodies surveyed in the Project corridor include or flow into 1 of 2 major drainages; the Kobuk River or the Koyukuk River. Most streams in the Project corridor follow a general north to south flow before reaching the Kobuk River or Koyokuk River (Figure 1). Habitat results are first presented for stream crossings along the preferred option, followed by stream crossings along the northern option and then the southern option. Some streams are crossed by more than one potential proposed corridor option. Detailed photographic records were kept at each stream crossing (see Plates). Additionally, a total of 3 hours of video footage was recorded of the corridor, including stream crossings, and is included as a supplemental DVD attached to the final report. Recent aerial photography obtained by DOWL HKM in 2012 was juxtaposed with aerial imagery from the 1970s and 1980s for each stream crossing (Appendix C), allowing a comparison of habitat changes (or lack thereof) over time. Finally, ambient water chemistry parameters were sampled at each stream crossing and provide a snapshot of stream conditions during August 2013 surveys (Appendix D). The following is a summary of habitat survey findings for each of the 18 stream crossings.

### PREFERRED ROUTE

#### SHUNGNAK RIVER

The westernmost significant river crossing of the Brooks East Corridor is the Shungnak River (Figure 1). The Shungnak River flows ~95 miles from its headwaters in the Brooks Range to its confluence with the Kobuk River near the village of Kobuk. During 2012 fish surveys (Lemke et al. 2013), Slimy Sculpin (*Cottus cognatus*) and Arctic Grayling (*Thymallus arcticus*) were caught on the main body of the Shungnak River. Slimy Sculpin and Arctic Grayling were also captured on nearby Ruby Creek, a tributary to the Shungnak River. No Pacific salmon were caught or observed during those surveys. During physical habitat surveys in 2013, survey crew members observed juvenile Arctic Grayling in the 2,000-ft reach. The AWC shows no record of Pacific salmon in the Shungnak River as of November 2013 (Table 1).

ABR mapped and characterized the stream crossing reach and performed 3 instream habitat transect surveys on 12 August 2013 (Figure 3, Appendix B) (Plates 1–3). Most of the 2,000-ft reach at the Shungnak River crossing is a shallow (less than 1 m) riffle-run flow regime composed of boulder, cobble, gravel, and sand substrate. However, Transect 1 (SH-T1-13) is representative of the slackwater pool habitat available in this reach and substrate composition was dominated by fine sediment (80% silt and clay) rendering most of this transect unwadeable due to the soft bottom. Transects 2 (SH-T2-13) and 3 (SH-T2-13) were upstream in shallow riffle-run habitat and substrate was dominated by gravel (40%) and cobble (30–35%). The majority of the reach provides good fish spawning habitat in the form of mixed gravel and cobble substrate. The downstream portion in the area of Transect 1 provides more slow moving water and fish refuge habitat than most of the sampled reach. Average flow measured at 2 transects was ~10.5 $m^3/s$ (Table 2).

Instream cover was sparse to moderately abundant. Transect 1 had moderate cover of macrophytes with sparse woody debris, filamentous algae, boulders, and overhanging vegetation. Transect 2 had sparse small woody debris, boulders, and overhanging vegetation. Transect 3 had moderate filamentous algae, overhanging vegetation, and undercut bank with sparse woody debris, live tree roots, and boulders. Most instream cover in this stream reach would provide refuge to smaller fish.

On all 3 transects, tall (greater than 5 m height) riparian canopy of black spruce (*Picea mariana*) occurred on one bank and no tall cover occurred on the opposite bank. Willow (*Salix* spp.) and tall grasses made up the majority of the understory (0.5–5 m in height), though a high percentage (30%) of understory at Transect 2 was composed of shrubs and berry plants. Ground cover vegetation (less than 0.5 m in height) varied by transect. Most of the stream margin shade was located in the middle portion of the reach. Bank stability appeared to be good as the channel has not changed markedly since 1978 (Appendix C).

KOGOLUKTUK RIVER

The next major river crossing on the Brooks East Corridor is the Kogoluktuk River, a ~98-mile-long river which flows into the Kobuk River east-northeast of the village of Kobuk (Figure 1). During 2012 fish surveys, ABR electrofished the mainstem of the river, capturing Slimy

Sculpin. Juvenile Dolly Varden (*Salvelinus malma*) were captured in baited minnow traps on Riley Creek, a tributary to the Kogoluktuk River and Slimy Sculpin and Arctic Grayling also were observed on an unnamed tributary to Riley Creek (Table 1). In 2013, ABR observed several Arctic Grayling (*Thymallus arcticus*) in a side channel near a habitat survey transect and at least one adult Arctic Grayling was caught by the Project subsistence advisor using rod and reel. The AWC lists spawning Chum Salmon (*Oncorhynchus keta*), Dolly Varden, and whitefish (*Coregonus* spp.) as present in the Kogoluktuk River. No Pacific salmon were observed by ABR during either 2012 or 2013 surveys.

ABR mapped and characterized the stream crossing reach and performed 2 instream habitat transect surveys on 13 August 2013 (Figure 4, Appendix B) (Plates 4–6). The segment of stream covered by the 2,000-ft reach was generally shallow, wadeable, and wide throughout (Appendix B). Both transects measured over 100 m bankfull width. The downstream end of the stream reach separated into a main and side channel. The main channel in this segment of stream was ~1 m deep but unwadeable due to high flow rates.

Instream substrate throughout the reach was relatively uniform, with a mixture of sand, gravel, and cobble. Transect 1 (KG-T1-13) crossed the main channel of the river, over a sand bar, and through side-channel habitat. The sand bar would be completely inundated at slightly higher water levels. Instream substrate on Transect 1 was composed of more sand (90%) than other parts of the 2,000-ft reach, perhaps because of its location downstream of a bend in the river where reduced water velocity allows sand to settle out. Transect 1 also crossed a side-channel where cobble and gravel made up ~45% of substrate (Table 2, Appendix B). The stream was relatively shallow in the area of Transect 2 (KG-T2-13) and the substrate was divided nearly evenly between cobble (30%), gravel (30%), and sand (40%). These mixed substrates may provide significant spawning habitat for fish. Furthermore, the run-pool flow regime of most of the 2,000-ft reach would provide abundant refuge habitat for fish. Average estimated discharge for the 2 transects was 23.86 $m^3/s$.

Instream cover was generally sparse or absent in both Transect 1 and Transect 2. Some small woody debris was present in both transects, and sparse boulders were present at Transect 1. At Transect 2, there was sparse overhanging vegetation but moderate amounts of filamentous

algae. Most of the available instream cover at the Kogoluktuk River crossing would be suitable for smaller fishes (e.g., Slimy Sculpin) in the form of mixed cobble and gravel.

At Transect 1, there was no riparian tall canopy within 10 m of the river on the left bank, while riparian tall canopy covered 50% of the ground within 10 m of the river on the right bank. Understory cover on the left bank was minimal (10%) and consisted of willow and tall grasses. On the right bank, the understory was dominated by willow, alder, and tall grass/shrubs. Ground cover was limited on the left bank with 75% of the ground bare. On the right bank, ground cover was 90% and composed of grasses and small shrubs. At Transect 2, tall riparian cover on the left and right bank of the river covered 10% of the ground. Understory cover was composed of willow, alder, and tall grasses and was complete on the left bank moderate on the right bank. Ground cover on the left and right banks was abundant with grasses, shrubs, and saplings (90–95%). During the summer months, shade refuge would be most available to fish in the middle portion of the reach along the right bank of the bend in the river (Figure 4). The channel in the crossing reach does not appear to have changed markedly between 1978 and 2012 (Appendix C).

MAUNELUK RIVER

The next Brooks East Corridor crossing is the Mauneluk River, a ~114-mile-long tributary that flows into the Kobuk River ~16 miles east of the village of Kobuk (Figure 1). During 2012 surveys of the Mauneluk River and its tributaries, Chum Salmon, Dolly Varden, Slimy Sculpin, Northern Pike (*Esox lucius*), and Arctic Grayling were observed. Past nominations to the AWC reference whitefish and Chum Salmon on the Mauneluk River. ABR submitted nominations to extend the known upstream presence of Chum Salmon on the Maneuluk River by 84.2 km based on 2012 survey results (Table 1, Appendix A). Numerous large Arctic Grayling were caught using rod and reel by the subsistence advisor during ABR habitat field surveys in 2013. Additionally, Chum Salmon were observed spawning at the downstream extent of the surveyed reach near a point where the river braids into 3 sections (Figure 5).

ABR performed partial habitat surveys at observation points on 13 August 2013 (Figure 5, Appendix B) (Plates 7–8). Transects could not be conducted from bank to bank due to unwadeable conditions on most of the 2,000-ft reach. Efforts to find a suitable crossing in the reach by floating the stream with a packraft were unsuccessful due to a combination of high

water velocities or the presence of deep pools. Discharge was measured downstream at an area where the stream braids into 3 channels, though this area lies outside the survey reach. Discharge was estimated at 34.4 $m^3/s$ (Table 2).

Within the 2,000-ft reach, downstream portions of the left bank were unwadeable due to deep pools while upstream portions of the right bank were unwadeable due to water velocity. Thus, 2 partial transects were completed at stream observation points. Instream substrate at the upstream observation point (MN-T1-13), located in the middle to upper portion of the survey reach, was composed primarily of cobble and gravel (85%) with some sand (15%) and appeared typical of most of the rest of the reach. The second observation point (MN-T2-13) was located downstream of MN-T1-13 at a transition zone before the stream split into multiple channels. In this area of stream the channel widened and water velocities diminished somewhat allowing sand to settle. The percentage of sand increased to 40% and cobble and gravel decreased to 60% in this part of the reach (Table 2, Appendix B). Most of the reach provides excellent mixed gravels as spawning substrate for fish along with deep pools for resting or refuge.

Instream cover along the partial transects differed by location. MN-T1-13 had moderate cover of filamentous algae along with sparse big and small woody debris, live tree roots, and overhanging vegetation. This partial transect was representative of much of the reach, suggesting plentiful cover for fish and other stream organisms. MN-T2-13 had moderate cover by filamentous algae and overhanging vegetation with sparse cover by macrophytes and woody debris, but was less representative of the reach as a whole.

At MN-T1-13, riparian cover was almost completely absent within 10 m of shore on the right bank and it was clear that this area is submerged at higher flows. The left bank had limited spruce and alder (30%) canopy while the understory cover was 100% and consisted of willow, alder, and spruce. Ground cover of small grasses and saplings was almost 100%. The left bank of the proposed bridge crossing appears to have good stability due to vegetation and provides stream shade for fish. The proposed crossing passes through side-channel habitat where rearing fish likely are present (Figure 5). At the downstream extent of the reach, at MN-T2-13, there was no canopy on the right bank while spruce, alder, and birch made up 80% of canopy cover on the left bank. Willow and alder dominated the understory on both banks. There was little bare ground on either bank with small grass and herbaceous vegetation dominating both banks

providing additional bank stability. The channel appears to have widened slightly in the upper and lower portions of the reach and sand bars appear to have grown somewhat in the period between 1981 and 2012 (Appendix C).

BEAVER CREEK

Beaver Creek is a ~84-mile stream that joins the Kobuk River between the confluences of the Mauneluk River and Reed River. Its confluence with the Kobuk River occurs just west of the Reed River, ~7 miles south of Lake Minakokosa (Figure 1). The area of the proposed bridge crossing occurs west of Sun Camp, a seasonal mining support encampment with an airstrip. In 2012, ABR biologists sampled Beaver Creek and several unnamed tributaries. Dolly Varden and Burbot (*Lota lota*) were captured in tributaries while Slimy Sculpin and Arctic Grayling were captured in Beaver Creek. No fish were observed during the 2013 physical habitat surveys. The AWC lists Chum Salmon as present in Beaver Creek (Table 1).

The stream reach was a roughly straight, shallow segment of stream with a riffle-run flow regime (Figure 6). Limited pool habitat available was available in the reach, with the most significant pool located near the inlet to an ephemeral side channel which had no water and was not sampled during our survey. The reach was shallow (less than 1 m deep) and water velocities slow enough that the stream was completely wadeable. Discharge estimates averaged 7.8 $m^3/s$. ABR performed 2 habitat transect surveys on 14 August 2013 (Figure 6, Appendix B) (Plates 9–10). Transect 1 (BV-T1-13) was located in a shallow run in which the substrate was composed of cobble (50%), gravel (25%), and boulder (15%). Transect 2 (BV-T2-13) was located upstream near a pool-riffle-run sequence with nearly equal parts boulder, cobble, gravel, and sand. With high quantities of boulder and cobble, the reach may not be ideal spawning habitat for salmon.

Instream cover was widely available in the stream reach. Abundant filamentous algae and periphyton were present at both habitat survey transects. Sparse macrophyte cover, small woody debris, and undercut banks with moderate overhanging vegetation and boulder cover were present at both habitat transects. Sparse live tree roots were present along the stream banks at Transect 2. The reach would provide good cover for fish throughout, particularly with the addition of side channel habitat at higher flows (Table 2, Figure 6).

Riparian cover varied by transect location. A low percentage of spruce canopy (10%) was present at both transects. There was significant understory cover (90%) at Transect 1 composed of willow, short spruce, tall grasses, and herbaceous vegetation. Understory cover was only 30% on Transect 2. There was very little ground cover in the riparian zone of either transect (Appendix B). However, stream banks appear to be stable and the channel does not appear to have changed markedly since 1981 (Appendix C). High cliff banks were present throughout most of the middle portion of the reach on the right bank and in downstream portions of the reach on the left bank, providing additional stream shade.

REED RIVER

The Reed River is a ~96-mile stream located in the Gates of the Arctic National Park between Beaver Creek and Walker Lake. Its confluence with the Kobuk River occurs ~5 miles east of Lake Minakokosa (Figure 1). During 2012 fish survey, ABR observed Chum Salmon (juvenile and adult), Slimy Sculpin, Arctic Grayling, and Burbot. Spawning Chum Salmon were observed during August 2013 habitat surveys. The AWC does not currently list Chum Salmon in the Reed River (Table 1). A nomination form has been submitted for the Reed River to add 30.3 km of anadromous waters to the AWC (Appendix A).

ABR performed 1 transect survey during stream habitat characterization on 15 August 2013 (Figure 7, Appendix B) (Plate 11). Waters within the 2,000-ft reach were a riffle-run-pool flow regime with significant pools formed at the outside bends in the river. A packraft was used to make a general characterization of the stream and its habitat and to determine the best location for the survey transect. Most waters in this reach were less than 1 m deep but only 1 completely wadeable transect was found. Stream substrate was relatively uniform throughout the reach and was composed of gravel (35%), sand (35%), cobble (20%), and boulder (10%). Discharge was estimated to be 26.5 $m^3/s$. Substrates in large pools located at the outside of bends of the reach appeared to have a high composition of sand, suggesting lower stream velocities at those points the river (Table 2). In general, spawning habitat for fish was abundant as confirmed by observations of spawning Chum Salmon.

Instream cover was even throughout the crossing reach. Filamentous algae were present in moderate portions. Macrophytes, small woody debris, live tree roots, overhanging vegetation,

and boulders were sparse. Thus, fish cover is somewhat limited in this stream. Waters were clear and visibility was excellent during surveys, confirming the uniform nature of instream habitat availability. Deep pools probably provide the best fish refuge in this section of the Reed River.

Riparian habitat varied by location in the reach. Most canopy occurred on the inside of the river bends and was composed of spruce. No canopy was observed within 10 m of shore on the left bank as water levels were low and exposed a significant sandbar. Beyond the sandbar, a large spruce stand was present. On the right bank, there was sparse spruce canopy. Willow, alder, and small spruce provided about 60% cover in the understory. The ground was ~30% bare. Several high banks along with some spruce provide shade cover for fish. The absence of significant riparian vegetation and steep banks might suggest some bank instability, though no major change in the channel occurred between 1981 and 2012 (Table 2, Appendices C and D).

KOBUK RIVER

The Kobuk River is a ~280-mile river whose headwaters begin high in the Brooks Range. The river flows generally north to south past the east shores of Walker Lake and eventually winds through the Project corridor before turning west and advancing to the Chukchi Sea. All streams located west of this crossing in the Brooks East Corridor eventually flow into the Kobuk River (Figure 1). During 2012 fish surveys, ABR observed or captured Chum Salmon (juvenile and adult), Slimy Sculpin, Dolly Varden, and Arctic Grayling near the proposed crossing of the Kobuk River. Arctic Grayling also were observed by ABR in 2013. The AWC currently lists Chum Salmon, Chinook Salmon (*Oncorhynchus tshawytscha*) , Dolly Varden, Sheefish, and whitefish in the Kobuk River (Table 1).

Due to deep waters, ABR was unable to conduct a thorough ground survey of instream substrate throughout the 2,000-ft reach on the Kobuk River. Instead, the stream reach was observed from a hovering helicopter before landing downstream of the reach where waters were shallow enough to perform a sampling transect. Although outside the reach, the transect location appeared representative of habitat upstream in the reach (Figure 8, Appendix B) (Plates 12–13). Waters within the crossing reach were a riffle-run flow regime and discharge was estimated as 29.7 $m^3/s$ on 15 August 2013 (Table 2). Significant side-channel habitat would be available to fish at higher water levels but this habitat was dry during our visit. On Transect 1 (KB-T1-13),

substrate was composed of cobble (35%), gravel (35%), sand (25%), and boulders (5%). While flying over the reach, boulders appeared evenly scattered throughout the stream and there was no indication that substrate in the rest of the reach was different from that observed on Transect 1. The evenly mixed substrate in the stream reach appeared ideal for fish spawning.

In general, instream habitat available to fish in the reach was evenly distributed and sparse to moderately abundant. On Transect 1, instream cover of macrophytes, small woody debris, live tree roots, undercut banks, and boulders was sparse. Filamentous algae and overhanging vegetation were moderately abundant (Table 2).

Riparian vegetation cover was similar throughout the reach but differed from left to right bank at any given location. Transect 1 left bank canopy was limited to willow and alder (25%), while the right bank had a dense cover (70%) of spruce, birch, and alder. The left bank understory was composed of grasses, willow, and berries and provided 50% cover while the right bank understory provided 100% cover from willow, alder, and spruce. Ground cover was nearly complete with herbaceous material, grass, and willow on both banks as well as some moss. In general, there was significant shade provided by canopy throughout the reach and good bank stability. Despite the appearance of meandering side-channels, the channel experienced only slight changes between 1981 and 2012 (Appendix C).

ALATNA RIVER

The ~338-mile-long Alatna River is the western-most major stream crossing in the Brooks East Corridor that flows into the Koyukuk River. The Alatna River joins with the Koyukuk River near the village of Allakaket (Figure 1). During 2012 fish surveys, ABR observed only Slimy Sculpin in the Alatna River. On tributaries to the Alatna River, including Helpmejack Creek and 2 unnamed streams, ABR observed Dolly Varden, Chum Salmon, Chinook Salmon, and Arctic Grayling. The AWC currently lists Chum Salmon, Chinook Salmon, and whitefish in the Alatna River. ABR did not observe any fish during 2013 habitat surveys on the Alatna River (Table 2).

ABR conducted habitat surveys of the crossing reach on the Alatna River on 17 August 2013 but found that waters were unwadeable and too deep to conduct instream surveys. Data were collected during low-level flights over the reach, on the ground at 2 observation points (AL-T1-13 and AL-T1-13) on the right bank of the reach, and observations made from a

packraft. These observations revealed a uniform run-pool flow regime which might alternatively be referred to as glide habitat (Figure 9, Appendix B) (Plates 14–15). Discharge was not measured on the Alatna River. Substrate composition appeared to be uniform throughout the reach and was composed of sand (35%), cobble (25%), silt (20%), boulders (10%), and gravel (10%). Though the substrate was composed of ~55% sand and fine material, there appeared to be sufficient mixed gravel and cobble to provide good spawning habitat for salmon in the reach (Table 2).

Habitat evaluation during the packraft float revealed limited instream cover, although sparse small woody debris was present and boulders were moderately abundant. Several deep pools were also present, providing limited boulder and pool habitat for fish refuge.

Riparian vegetation within 10 m of shore was uniform throughout the reach (Figure 9, Appendix B). Steep, exposed banks on either side of the river composed much of the immediate riparian zone and thus canopy was non-existent. However, beyond bankfull width, both sides of the river were vegetated with a thick spruce canopy. Some small alder and grass understory was present along the stream banks throughout the reach, along with sparse grass cover. Between 60% and 80% of the 10-m riparian zone was bare ground. Nonetheless, bank stability appeared good as very little change in the stream channel is discernible between 1981 and 2012 imagery. Deep pools and boulders, along with shade provided by spruce beyond the high banks of the river, probably provide ample refuge and shade for fish in this stream section.

MALAMUTE FORK ALATNA RIVER

The Malamute Fork Alatna River is a 61-mile-long river which flows roughly east to west and parallel to the Brooks East Corridor before turning south and joining with the Alatna River near Helpmejack Creek (Figure 1). During 2012 surveys, ABR observed various combinations of Coho Salmon (*Oncorhynchus kisutch*), Chinook Salmon, and Chum Salmon on Tobuk Creek and 2 unnamed tributaries to the Malemute Fork Alatna River, but did not sample in the river itself. The AWC lists Chum Salmon and Chinook Salmon in the Malamute Fork Alatna River. ABR nominated an additional 2 km of stream to the AWC for tributaries to the Malamute Fork Alatna River in 2013 (Appendix A). In 2013, ABR observed Chum Salmon during habitat surveys in the Malamute Fork Alatna River (Table 2).

ABR mapped and characterized the stream crossing reach on 17 August 2013. Habitat in the reach was relatively uniform with a riffle-run flow regime and only a small amount of pool habitat (Figure 10, Appendix B) (Plate 16). Waters were generally wadeable and discharge was estimated at ~12.3 $m^3$/s. A single habitat survey transect (MF-T1-13) revealed that stream substrate was composed of a nearly even mix of gravel (35%), sand (35%), and cobble (25%) with sparse boulders (5%). Substrate in the reach appears to be ideal salmon spawning habitat (Table 2).

Instream cover in the reach was limited but uniform throughout. Sparse amounts of filamentous algae, small woody debris, overhanging vegetation, undercut banks, and boulders were present. Thus, most available refuge habitat was appropriate for smaller fish. A small amount of pool habitat also would provide refuge (Figure 10).

Riparian vegetation cover was relatively uniform throughout the reach, with dense cover within 10 m of shore on the left bank and open canopy on the right bank, giving way to dense spruce habitat beyond. Tall cover on the left bank was primarily composed of alder (Appendix B). Most shade available to fish appeared to occur on the left bank. Understory cover on both banks was 70–75% and was composed of willow, alder, and tall grasses. Small grasses, willow and alder saplings, and herbaceous material made up 75–80% of ground cover. The stream channel appears to have changed very little between 1981 and 2012 (Appendix C).

UN18

UN18 is an unnamed tributary which flows ~22 miles to the Malamute Fork Alatna River near Bedrock Creek (Figure 1). UN18 was the smallest stream sampled by ABR in 2013. No previous records of fish have been recorded on this waterbody and ABR did not perform fish surveys in this stream in 2012. The AWC does not have a record of anadromous fish for this stream. ABR observed juvenile Northern Pike during habitat surveys in 2013 (Table 1).

ABR mapped and characterized stream habitat in UN18 on 16 August 2013. The stream is distinguished from other waterbodies surveyed in 2013 both in terms of its low average discharge (~0.5$m^3$/s) and its sinuosity (Figure 11, Appendix B) (Plates 17–18). ABR collected data at 2 habitat survey transects (UN18-T1 and UN18-T2-13) representative of the mostly riffle-run-pool flow regime. Transect 1 was located in a shallow (less than 35 cm deep) riffle with

instream substrate composed of boulder (50%), cobble (30%), gravel (15%), and sparse sand (5%). The substrate at Transect 1 did not appear to be appropriate for spawning salmon. Transect 2 was located just beyond a riffle in a large pool and substrate was evenly composed of boulder (25%), cobble (25%), gravel (25%), and sand (25%) and appeared to be higher quality salmonid spawning habitat (Table 2).

Instream cover was generally abundant throughout the reach. Filamentous algae was moderate to abundant and cover by overhanging vegetation was moderate throughout the reach. Small woody debris, undercut banks, and live tree roots were sparse to moderately abundant. Depending on the section of river, boulders were sparse to abundant. Though no fish surveys have been conducted here, the presence of juvenile Northern Pike suggests that the stream is excellent habitat for rearing fish.

Tall riparian vegetation cover varied depending on location in the stream but ranged from sparse spruce trees to dense alder, spruce, and birch, with some willow. Understory cover ranged from moderate to abundant, comprising willow, alder, and spruce. Ground cover was generally abundant with grasses, moss, and herbaceous material, though there was a large amount of bare ground associated with a sand bar on the right bank just upstream of Transect 2. The generally dense vegetation provides good shade cover throughout the reach and would appear to provide channel stability. However, comparison of imagery between 1982 and 2012 indicates that there were notable changes in the stream channel in the area of the proposed bridge (Appendix C).

KOYUKUK RIVER

The Koyukuk River is a 425-mile tributary to the Yukon River; it is the last major tributary entering the Yukon River before it meets the Bering Sea. ABR did not sample the Koyukuk River during 2012 fish surveys (Lemke et al. 2013). No fish observations were made during physical habitat sampling in 2013 (Table 1). Sheefish, whitefish, and 4 species of Pacific salmon are listed in the AWC for the Koyukuk River (Table 1). The Brooks East Corridor has 2 proposed bridge crossings on the Koyukuk River, both near the former (old) site of the village of Bettles (Figure 1).

ABR mapped and characterized the stream crossing reach on 22 August 2013 but did not perform an instream habitat transect survey because the stream was unwadeable due to deep

water and strong flow. The entire stream reach was a mix of run and glide flow regime. Instream substrate and riparian habitat were characterized at 3 observations points along the stream's left bank (Figure 12, Appendix B) (Plate 19). ABR floated the reach in a packraft to determine if wadeable transects were present, but none were observed. At the most upstream observation point, at a downstream inside bend in the river, substrate visible from the bank was predominantly sand, as might be expected at such a location where velocity decreases and sand settles out of the water column. Significant gravel and cobble instream substrate could be observed from the left bank along with moderate amounts of large and small woody debris. The left bank in this reach was composed of a large sand bar with little vegetation. Riparian vegetation on the right bank was dense and composed mainly of spruce and willow. The substrate at the second observation point, downstream between 2 proposed bridge crossings was composed of mostly sand, but transitioned to cobble, gravel, and boulder shortly downstream. Between the first and second observations points, the right bank vegetation transitioned from spruce to alder. Substrate composition at the farthest downstream observation point appeared to be composed of primarily of cobble, gravel, and boulder. Overall, this reach likely provides plentiful spawning and refuge habitat to many fishes, including salmon. The channel in this reach appears to have changed slightly between 1981 and 2012, mostly in the form of growing sandbars in upper and lower portions of the stream reach (Appendix C).

SOUTH FORK KOYUKUK RIVER

The South Fork Koyukuk River is a large tributary to the Koyukuk River and joins with the main fork ~15 miles south of the village of Bettles (Figure 1). ABR did not sample the South Fork Koyukuk River during 2012 fish surveys (Lemke et al. 2013). Chum Salmon, Chinook Salmon, and whitefish species are known to inhabit the South Fork Koyukuk, according to the AWC (Table 1). In 2013, the ABR survey crew made one observation of a dead Burbot (Table 1).

ABR mapped and characterized the stream crossing reach and performed 1 stream habitat transect survey on 22 August 2013 (Figure 13, Appendix B) (Plates 20–21). The flow regime in the stream crossing reach was dominated by a mix of run and pool habitat, with run-riffle habitat in the mid-section of the reach. Flow was estimated to be 13.75 $m^3/s$ (Table 2). Transect 1 (SF-

T1-13) was located at the proposed bridge crossing. Substrate along the transect was composed of cobble (40%), gravel (30%), boulder (15%), and sand (15%). This transect appeared to be representative of much of the reach which should provide excellent spawning substrate for salmon. Instream cover along the habitat transect was sparse with some small woody debris. Thus, only sparse amounts of cover were available and suitable mostly for smaller fish.

Large exposed sand banks were present on both right and left banks of the reach. The left bank provided very little riparian vegetation cover. The canopy was absent and the understory only provided 15% cover from willow, herbaceous material, and fireweed. Ground cover was composed of exposed cobble, gravel, and sand (90%) with small patches of fireweed and willow (10%). The right bank vegetation was heavily affected by the presence of a winter trail and canopy cover was only 10%, by spruce, birch, and willow. The understory was dense with poplar, fireweed, herbaceous material, tall grasses, and willow, which together provided 70% cover. Ground cover was 75%, comprising herbaceous vegetation, moss, and poplar saplings. Limited canopy shade was available to the stream due to the distance from water. Numerous pools probably provide most refuge for fish in the reach. The sample reach channel on the South Fork Koyukuk River appears to be less stable than the reaches assessed on most other streams in this study. The channel appears to have shifted slightly to the west in the area of the proposed bridge crossing between 1981 and 2013 (Appendix C).

JIM RIVER

The Jim River is the easternmost significant river crossing before the proposed Brooks East Corridor joins the Dalton Highway (Figure 1). ABR did not sample the Jim River during fish surveys in 2012 (Lemke et al. 2013). The AWC lists Chum Salmon as present in the Jim River (Table 1). During 2013 stream habitat surveys, the ABR survey team observed Chum Salmon and Arctic Grayling.

ABR mapped and characterized the stream crossing reach and performed 1 instream habitat transect survey on 22 August 2013 (Figure 14, Appendix B) (Plates 22–24). The reach had a diversity of stream flow habitat types including riffle-run-pool and run-glide sequences as well as side channel and backwater pool habitat. Transect 1 (JM-T1-13) was located immediately downstream of the proposed bridge crossing within a long run. The substrate was representative

of much of the run and run-glide sequences and consisted of gravel (45%), cobble (35%), sand (15%), and boulder (5%) which should provide excellent fish spawning habitat. Instream cover was sparse along the transect but consisted of filamentous algae, large and small woody debris, and boulders. However, abundant pool habitat would provide good refuge for fish. Discharge was among the lowest estimated for streams surveyed on this Project at 5.06 $m^3/s$ (Table 2).

Canopy cover was absent from both the left and right banks of the habitat transect, because the stream channel bankfull width extended well beyond the wetted width at the low flows observed in August 2013. The understory varied and was composed of willow and fireweed on the right bank (15%) and willow, alder, birch, and fireweed (60%) on the left bank. Right bank ground cover primarily was composed of exposed gravel and cobble (90%) along with sparse fireweed and willow. Ground cover on the left bank was composed of moss, herbaceous vegetation, and woody shrubs (50%) with bare ground visible throughout (50%). Good shade cover appeared to be scattered evenly about the reach, but bare ground and numerous sand bars indicated significant potential for bank erosion. The channel in this reach appears to have changed more than most streams surveyed in this study since 1979 (Appendix C). However, the channel at the proposed bridge crossing appears to have changed little compared to the rest of the reach.

**NORTHERN OPTION**

UN30

UN30 is an unnamed tributary to the Mauneluk River which is crossed by the northern option of the Brooks East Corridor (Figure 1). Spawning Chum Salmon were observed on UN30 in 2012. Spawning Chum Salmon and Dolly Varden also were observed on several other unnamed tributaries to the Mauneluk River in 2012 (Table 1). Chum Salmon and whitefish are known to occur on the Mauneluk River according to the AWC (ADFG 2013). ABR nominated less than a mile of Chum Salmon habitat to the AWC in 2013 (Appendix A). The ABR survey team did not observe fish in UN30 during 2013 physical habitat sampling.

ABR mapped and characterized the stream reach and performed 1 instream habitat transect survey on 21 August 2013 (Figure 15, Appendix B) (Plates 25). The slightly sinuous stream reach was marked by predominance of run-riffle habitat with. Discharge was relatively low

compared to other streams surveyed (3.85 $m^3/s$) (Table 2). Instream substrate at Transect 1 (UN30-T1-13n) was representative of the reach as a whole and was composed of boulder (50%), cobble (35%), gravel (15%), and sand (5 %). This substrate provides good spawning habitat for salmon as evidenced by the observation of spawning Chum Salmon in 2012. Instream cover was generally abundant and relatively uniform within the reach, providing good habitat for rearing fish. Filamentous algae and overhanging vegetation were sparse while there was moderately abundant small woody debris, and abundant boulder habitat.

Riparian vegetation varied by bank but was consistent throughout the reach. The left bank was composed of a large sand bar and thus no tall cover was present. Paper birch, spruce, willow, and alder provided approximately 30% canopy cover on the right bank. The understory vegetation cover was dominated by willow on the left bank (30%) and a combination of willow, alder, spruce, and herbaceous vegetation (50%) on the right bank. On the left bank sand bar, ground cover was ~50% exposed soil, while the right bank had near complete ground cover of moss, small grasses, and woody shrubs (Appendix B). On the whole, stream shade was abundantly available in the sample reach on UN30. The stream channel appears to have changed little since 1981 (Appendix C).

MAUNELUK RIVER

The Mauneluk River has proposed bridge crossings at 2 locations, with the second crossing located on the northern option of the Brooks East Corridor (Figure 1). No fish observations were made during 2013 sampling on the Mauneluk River northern option (Table 1). However, ABR observed Chum Salmon, Slimy Sculpin, and Arctic Grayling during 2012 fish surveys and during 2013 habitat surveys on the Mauneluk River at the river crossing associated with the preferred option (see above). As stated previously, Chum Salmon and whitefish are listed in the AWC for the Mauneluk River (Table 1).

ABR mapped and characterized the stream crossing reach and performed 1 instream habitat transect survey on 21 August 2013 (Figure 16, Appendix B) (Plates 26–27). The flow regime of the reach was marked by almost uniform run-pool habitat with some riffle habitat in the downstream portion of the reach. Due to deep water (greater than 1 m) and what appeared to be uniform instream habitat, only 1 transect was surveyed in August 2013. Transect 1 (MN-T1-13n)

was located in run-pool habitat representative of most of the reach. Discharge at the transect was 15.46 $m^3/s$ (Table 2). Substrate along Transect 1 was composed of gravel (65%), cobble (15%), sand (15%), and boulder (5%) and would appear to provide good spawning habitat for salmon. Instream cover was generally limited within the reach. Small woody debris, overhanging vegetation, undercut banks, and boulders were sparse and cover by filamentous algae was moderate. Most of the available instream cover for fish occurred as deep pools or as cobble and boulders suitable mainly for smaller fish.

Riparian canopy cover was absent from both the right and left banks for much of the reach. Understory vegetation cover (40%) was uniform throughout the reach. Throughout the stream reach, the riparian zone on one bank was composed of steep, bare sand bars with cobble, gravel and sand substrate and no understory while the opposite bank featured moderate understory composed of willow. Despite the abundance of bare ground on steep banks, the stream channel does not appear to have altered greatly since 1981 (Appendix C).

**SOUTHERN OPTION**

REED RIVER

The Reed River has proposed bridge crossings on both the preferred and southern options of the Brooks East Corridor (Figure 1). The ABR survey team observed Chum Salmon on the preferred bridge crossing during both 2012 and 2013 sampling events. No fish were observed in the downstream southern option in 2013 (Table 1). The AWC did not previously list Pacific salmon in the Reed River (Table 1). ABR nominated ~19 miles of Chum Salmon spawning and rearing habitat to the AWC in 2013 (Appendix A).

ABR mapped and characterized the stream crossing reach and performed 2 instream habitat transect surveys on 19 August 2013 (Figure 17, Appendix B) (Plates 28–30). The flow regime of the reach was composed of a long run which transitioned to a riffle at the downstream extent of the reach. Additional riffle and pool habitat were also present upstream in side channel habitat. Both Transects 1 (RD-T1-13s) and 2 (RD-T2-13s) were located in long run habitat. Transect 2 also traversed a small portion of side channel habitat. Instream substrate in Transect 1 was composed of cobble (40%), sand (30%), gravel (20%), and boulder (10%). Substrate in the main channel on Transect 2 was cobble (35%), gravel (30%), sand (30%), and boulder (5%). Side-

channel substrate was composed of sand (60%), gravel (30%), and cobble (10%). The relatively uniform main channel provides good fish spawning gravels, while the side channels provide better rearing habitat (Table 2).

Instream cover at both transects was minimal. Filamentous algae, small woody debris, and boulder cover were sparse on both transects. Sparse overhanging vegetation and undercut bank habitat were present on Transect 2. Discharge estimates averaged 22. 2 $m^3$/s. Side channel discharge was low (1.85 $m^3$/s) in Transect 2, providing refuge from higher flows for juvenile fish (Appendix B).

At Transect 1, birch and spruce provided 40% tall riparian cover on the left bank, while the right bank was devoid of canopy. The opposite was true at Transect 2, where primarily spruce canopy cover was 30% on the right bank with no canopy on the left bank. Ample shade habitat for fish was provided by tall canopy throughout the reach. Cover by understory vegetation at Transect 1 was 40% on the left bank and 70% on the right bank and was composed of willow, alder, and grasses. Understory cover was similar on Transect 2, but 65% on the left bank and 80% on the right bank. Ground cover also was similar on both banks at the 2 transects, with 20–50% bare ground and a mix of woody shrubs, grasses, moss, and herbaceous material. Despite the amount of side-channel habitat and exposed banks, the channel has changed little since 1979 (Appendix C).

KOBUK RIVER

The Kobuk River has proposed bridge crossings on both the preferred and southern options of the Brooks East Corridor (Figure 1). ABR observed spawning Chum Salmon upstream of both proposed crossings during 2012 fish surveys. The AWC lists Chum and Chinook salmon on the Kobuk River (Table 1). No fish were observed during 2013 physical habitat surveys on the southern option.

ABR mapped and characterized the stream crossing reach and performed 1 instream habitat transect survey on 19 August 2013 (Figure 18, Appendix B) (Plate 31). The reach had a relatively homogenous glide-run flow regime with minimal riffles. Discharge was estimated at 28.22 $m^3$/s. Transect 1 (KB-T1-13s) passed through both run and riffle habitat downstream of the proposed bridge crossing. Substrate was composed of gravel (50%), cobble (35%), sand (10%),

and boulder (5%) and provides excellent mixed gravel salmon spawning habitat. Substrate in the transect appeared representative of substrate throughout most of the reach. Instream cover was limited, with moderately abundant filamentous algae and sparse small woody debris and boulders (Table 2).

Vegetation cover measured in the transect appeared to be representative of the entire reach, particularly for the left bank. Riparian canopy cover on both banks was mostly absent within 10 m of shore but some spruce occurred in the middle portion of the reach on the left bank. Most shade cover is available for fish in this section of the reach. On the left bank, understory also was absent. On the right bank, understory cover was 50% and was composed of a combination of willow, spruce, fireweed, and blueberry (50%). Ground cover on the left bank was mostly absent with only small patches of herbaceous vegetation and grasses. Ground cover on the right bank was more dense (40%) and consisted of woody shrubs, herbaceous vegetation, and blueberry (Appendix B). The stream channel in this reach of stream has changed very little from 1979 to 2012 (Appendix C).

HOGATZA RIVER

The Hogatza River is a 120-mile tributary of the Koyukuk River that starts in the Gates of the Arctic National Park and Preserve and flows southwest to the Koyukuk River. The Hogatza River is crossed by the southern option of the Brooks East Corridor (Figure 1). The ABR survey team observed spawning Chum Salmon and Slimy Sculpin during 2012 fish surveys (Table 1). The ABR habitat crews observed Arctic Grayling in 2013. The AWC lists Chum Salmon, Sockeye Salmon (*Oncorhynchus nerka*), Chinook Salmon, Coho Salmon, and whitefish present in the Hogatza River.

ABR mapped and characterized the stream crossing reach and performed 2 instream habitat transect surveys on 20 August 2013 (Figure 19, Appendix B) (Plates 32–34). The Hogatza River is sinuous with a general run-riffle-pool flow regime and abundant side channel habitat. ABR measured an average discharge of 0.67 $m^3/s$ during August sampling. Transect 1 (HG-T1-13) was located upstream of the proposed bridge crossing in a run-riffle transition zone. Transect 2 (HG-T2-13MCs and HG-T-13SCs) was split by an island complex and passed through main channel (MC) and side channel (SC) pool and riffle habitat. Instream substrate at Transect 1 was

composed of a mix of cobble (40%), gravel (35%), sand (15%), and boulder (10%). Instream substrate in the main channel at Transect 2 was very similar, with cobble (40%), gravel (40%), sand (15%), and boulder (5%). Instream substrate in the side channel on Transect 2 was gravel (50%), sand (25%), and cobble (20%) with little boulder (5%). Most of the substrate in the surveyed reach was ideal salmon spawning habitat. During sampling, numerous Arctic Grayling were seen resting in the pool at the Transect 2 side channel.

Instream cover at both transects included sparse live tree roots, undercut banks, and boulder cover as well as moderately abundant overhanging vegetation, filamentous algae, and small woody debris (Table 2). Sparse large woody debris also was observed at Transect 1. In general, the sample reach would provide good refuge habit for rearing juvenile fish, as well as sufficient pools for larger fish.

At Transect 1, tall canopy riparian cover was mostly absent on the right bank due to the presence of a large gravel bar, although understory cover on the bar was 15%, primarily willows. Ground cover also was sparse in the immediate riparian zone on the right bank at Transect 1. On the left bank of Transect 1, canopy cover was 20% and was composed of spruce which increased in density beyond 10 m from shore. The understory was dense on the left bank, with 80% cover from willows, alders, berries, and tall grasses, and ground cover was nearly complete in the form of short grasses.

Riparian cover was greater at Transect 2 than it was at Transect 1, but similarly comprised mostly understory and ground cover, with moderate canopy cover. Transect 1understory cover was primarily willow, alder, and tall grasses and ground cover (90% on the right bank and 10% on the left bank) was composed of grasses, herbaceous vegetation, and moss. Transect 2 understory cover ranged between 30–50% and was composed of willow, alder, and tall grasses. Bare ground at Transect 2 was minimal (10–30%) with cover from grasses, saplings, herbaceous vegetation, and moss. In general, there was good shade available from canopy and understory cover. However, the cover in the area of the proposed bridge crossing at Transect 1 provides little stream shade. Despite the sinuous nature of the stream channel in the crossing reach, very little channel alteration appears to have occurred since 1981.

HELPMEJACK CREEK

Helpmejack Creek, a ~37-mile tributary to the Alatna River, is the last significant waterbody crossed by the southern option of the Brooks East Corridor (Figure 1). ABR observed Dolly Varden and Arctic Grayling in Helpmejack Creek during 2012 fish surveys (Table 2). No fish observations were made during 2013 physical habitat surveys. Pacific salmon are not listed in the AWC for Helpmejack Creek (Table 1).

ABR mapped and characterized the stream crossing reach and performed 3 instream habitat transect surveys on 18 August 2013 (Figure 20, Appendix B) (Plates 35–38). Helpmejack Creek is a sinuous stream with a riffle-run-pool flow regime. Transect 1 (HJ-T1-13s) was representative of pool habitat in the reach and instream substrate was composed of sand (40%), cobble (30%), silt (25%), and boulder (5%). While this is good refuge habitat it would not provide good substrate for spawning salmon due to the high percentage of silt present. Transect 2 (HJ-T1-13s) was located in a run section of stream and represented better fish spawning habitat with substrate composed of cobble (40%), boulder (30%), gravel (20%), sand (5%), and silt (5%). Transect 3 was located in a mixed run-pool habitat and was representative of the reach as a whole with substrate composed of cobble (50%), gravel (20%), silt (20%), and boulders (10%). In general, we saw more silt and sand on Helpmejack Creek than at other sample reaches in the corridor and habitats appeared to be less than ideal for spawning salmon. Discharge averaged 1.87 $m^3/s$ (Table 2).

Instream cover at the 3 transects was sparse to moderately abundant. Transect 1 had sparse cover of filamentous algae, large woody debris, overhanging vegetation, undercut banks, and boulders with moderate cover by small woody debris. Transect 2 had sparse filamentous algae, small woody debris, overhanging vegetation, and undercut banks with moderate boulder cover. Transect 3 had sparse overhanging vegetation, small woody debris, and undercut banks. Instream cover at Helpmejack Creek would provide good refuge for juvenile and small fishes as well as resting habitat in deep pools for larger Arctic Grayling and Dolly Varden.

Riparian canopy vegetation was limited and varied from bank to bank, typically providing no cover on one bank while the opposite bank had between 20% and 40% spruce canopy. The understory was composed of moderate to heavy alder, willow, and grass. The ground cover

varied greatly with between 5% and 80% of the ground being bare while grass, herbaceous vegetation, young willow, and moss provided between 20% and 95% cover. Stream shading was good in the crossing reach as a whole because of the small channel width, and despite the low abundance of tall ground cover (Appendix D). Bank stability appeared to be good as the stream channel has altered very little since 1982 (Appendix D).

## SUMMARY

During the 11 days of stream and riparian zone habitat surveys at proposed bridge crossings on the Brooks East Corridor, ABR conducted 28 habitat transects at 18 stream crossing reaches on 14 waterbodies. Most stream reaches surveyed were in known fish bearing streams and provided habitat for at least a portion of the life history of several salmonid species. Salmonid spawning habitat was available to some degree at almost all of the waterbodies sampled. Streams visited during 2013 habitat surveys represent only a small portion of the total number of waterbodies crossed by the Brooks East Corridor and most were large river systems. However, the vast majority of additional waterbodies crossed by the Brooks East Corridor are small relative to the streams surveyed in 2013. These small streams would require culverts as opposed to bridges during construction of the proposed road. Finally, streams surveyed in 2013 showed remarkable channel stability over the last 30 years as evidenced from aerial imagery. Fish presence, stream flow regimes, spawning substrates, refuge habitat, and riparian zone vegetation are important considerations prior to permitting and construction of any road project. This information will ultimately allow resource managers to determine potential impacts on fish and fish habitat and allow for determination of proper protocols for impact avoidance during the construction phase of the Brooks East Corridor.

## ACKNOWLEDGMENTS

ABR would like to thank DOWL HKM for their support on this project. Kristen Hansen, Erin Gora, Emily Creely, Dwight Stuller, and Jessica Christianson provided invaluable logistic, field, and office support. We thank Allen A. Tickett, our subsistence advisor, for providing local knowledge and expertise during physical habitat surveys. The ABR crew is grateful to Betty, Al, and Chelsea from the Sourdough Lodge as well as Jay and Judy Jepson from Brooks Range

Aviation for their hospitality during our 8-day stay in Bettles, Alaska. We are very grateful for the support of everyone at the NOVAGOLD Dahl Creek Camp during our 5-day stay at their camp. We appreciate 2 weeks of safe helicopter flights with Brent from the Bristow Group.

## LITERATURE CITED

Alaska Department of Fish and Game (ADFG). 2013. Catalog of waters important for the spawning, rearing or migration of anadromous fishes. Available online at: [http://www.sf.adfg.state.ak.us/SARR/awc/index.cfm/FA/main.overview]. November 2013.

Buckwalter, J.D., J.M. Kirsch, and D.J. Reed. 2010. Fish inventory and anadromous cataloging in the lower Yukon River drainage, 2008. Fishery Data Series No. 10-76. Alaska Department of Fish and Game, Divisions of Sport Fish and Commercial Fisheries, Anchorage, Alaska. 603 pp.

Lemke, J.L, J.M. Gottschalk, D. Dissing, R.M. Burgess, and J.C. Seigle. 2013. Anadromous fish surveys within the Brooks East Corridor survey area, Alaska. Report by ABR, Inc.—Environmental Research & Services, Anchorage, AK for DOWL HKM, Anchorage, AK. 86 pp.

United States Geological Survey (USGS). 2013. The national map viewer. Available online at: [http://viewer.nationalmap.gov/viewer/nhd.html?p=nhd]. November 2013.







Plate 1. Stream channel characteristics, riparian habitat, and instream substrate composition at transect SH-T1-13, Shungnak River, Brooks East Corridor, Alaska, August 2013.

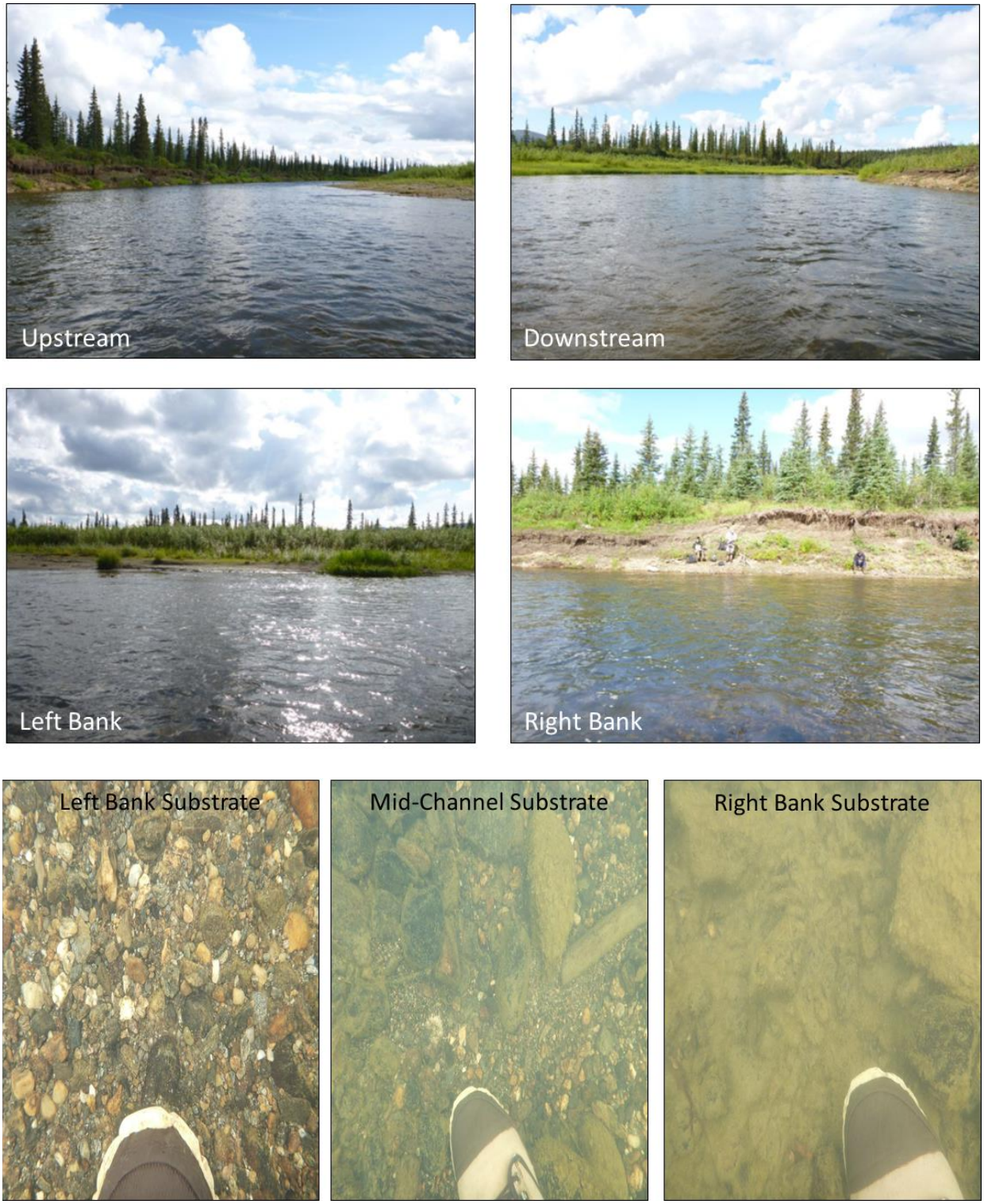



Plate 2. Stream channel characteristics, riparian habitat, and instream substrate composition at transect SH-T2-13, Shungnak River, Brooks East Corridor, Alaska, August 2013.







Plate 3. Stream channel characteristics, riparian habitat, and instream substrate composition at transect SH-T3-13, Shungnak River, Brooks East Corridor, Alaska, August 2013.





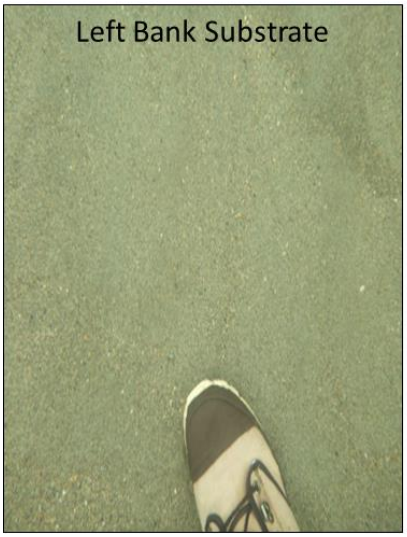





Plate 4. Stream channel characteristics, riparian habitat, and instream substrate composition at transect KG-T1-13, Kogoluktuk River, Brooks East Corridor, Alaska, August 2013.





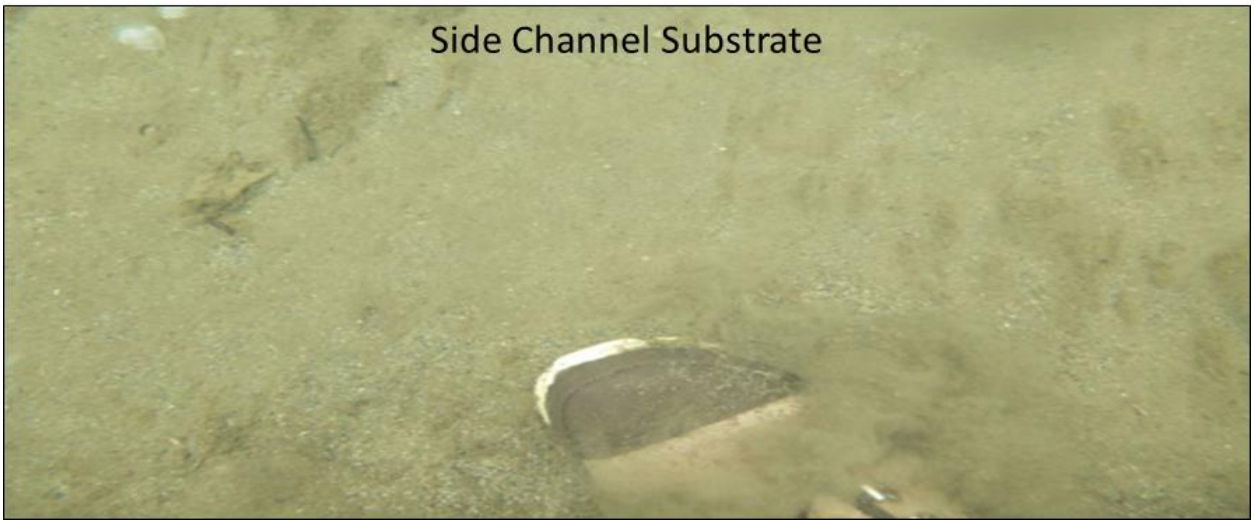



Plate 5. Stream channel characteristics, riparian habitat, and instream substrate composition of side-channel habitat at KG-T1-13, Kogoluktuk River, Brooks East Corridor, Alaska, August 2013.







Plate 6. Stream channel characteristics, riparian habitat, and instream substrate composition at transect KG-T2-13, Kogoluktuk River, Brooks East Corridor, Alaska, August 2013.






Plate 7. Stream channel characteristics, riparian habitat, and instream substrate composition at partial transect (MN-T1-13) on the Mauneluk River, Brooks East Corridor, Alaska, August 2013.







Plate 8. Stream channel characteristics, riparian habitat, and instream substrate composition at partial transect (MN-T2-13) on the Mauneluk River, Brooks East Corridor, Alaska, August 2013.






Plate 9. Stream channel characteristics, riparian habitat, and instream substrate composition at transect BV-T1-13, Beaver Creek, Brooks East Corridor, Alaska, August 2013.

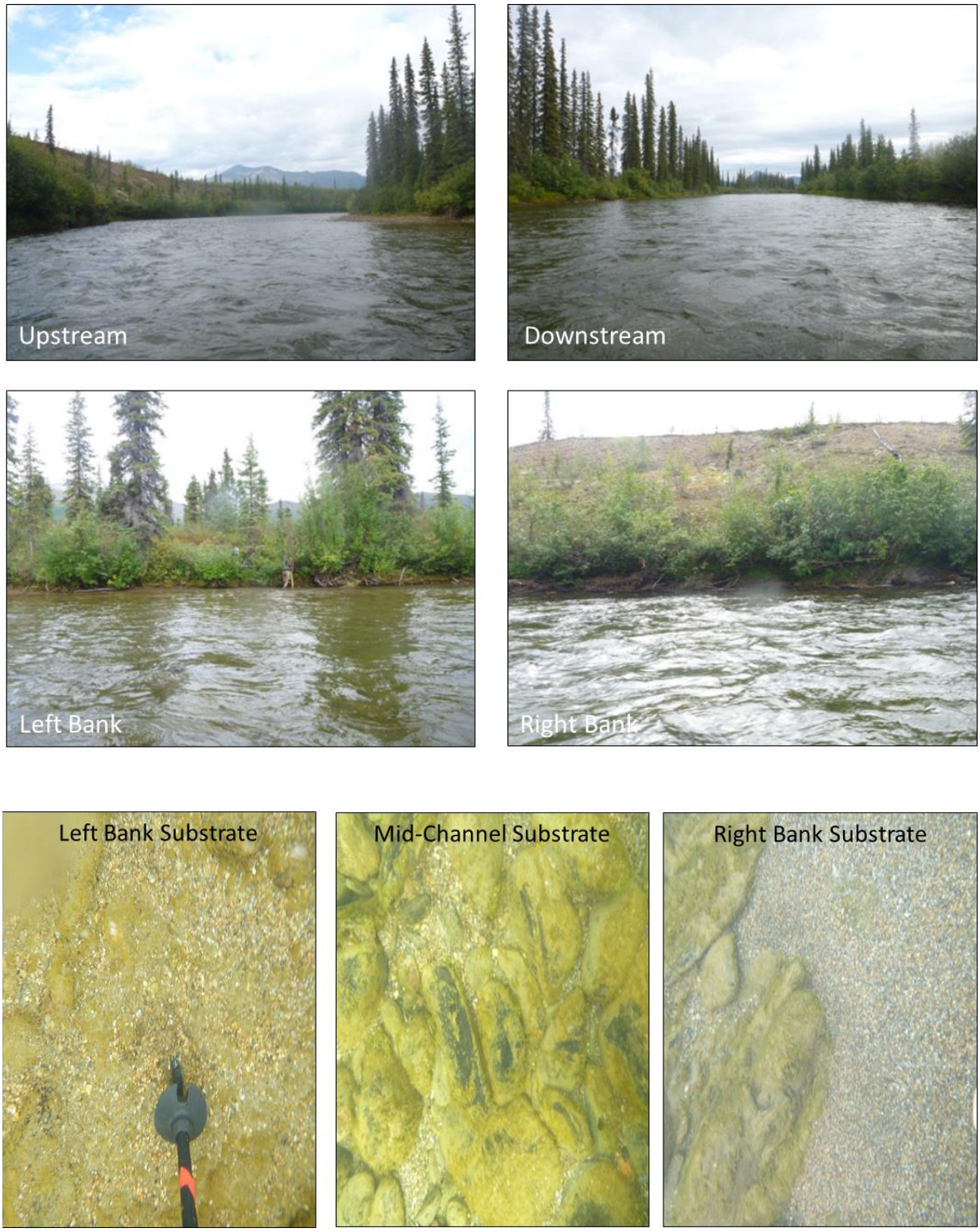



Plate 10. Stream channel characteristics, riparian habitat, and instream substrate composition at transect BV-T2-13, Beaver Creek, Brooks East Corridor, Alaska, August 2013.

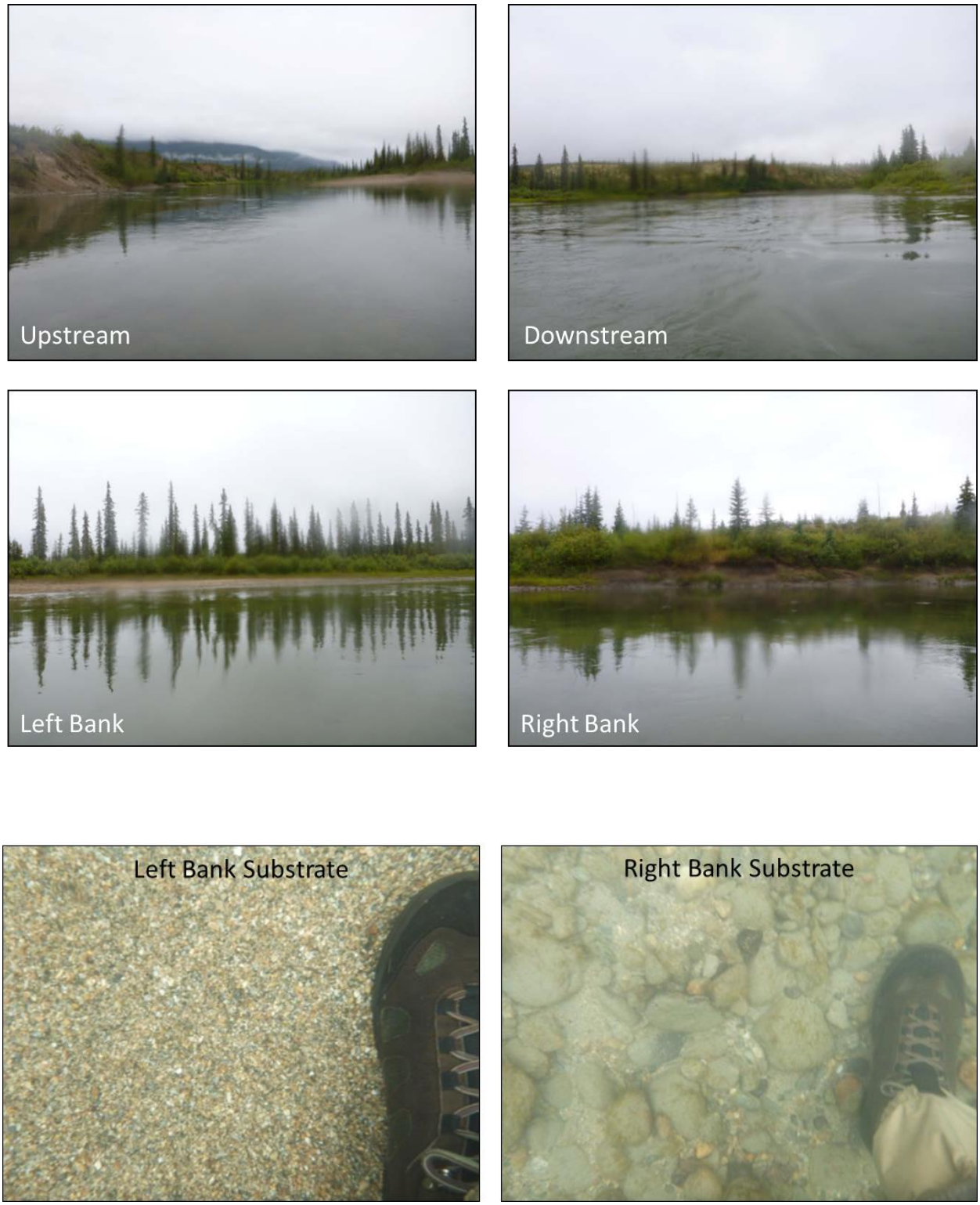
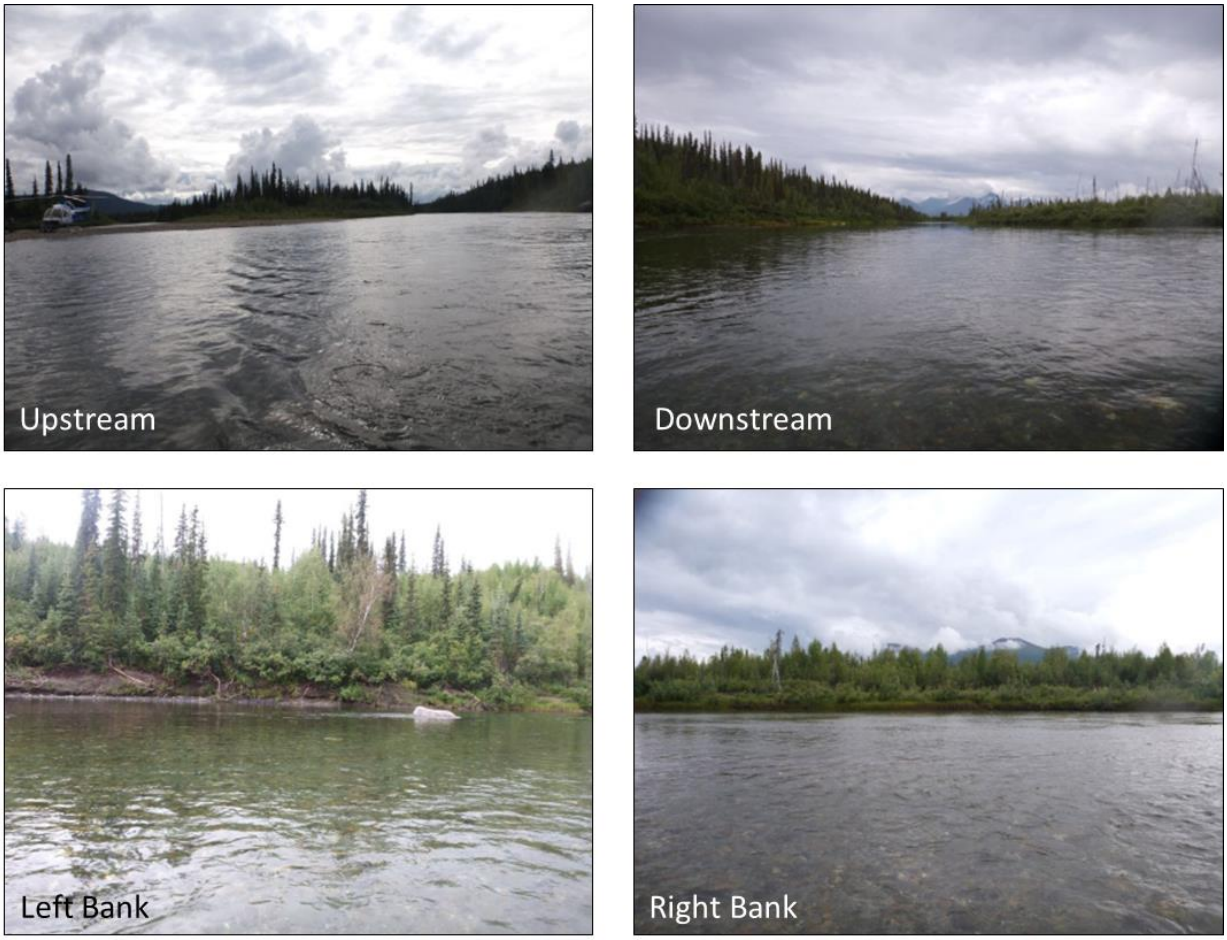



Plate 11. Stream channel characteristics, riparian habitat, and instream substrate composition at transect RD-T1-13, Reed River, Brooks East Corridor, Alaska, August 2013.



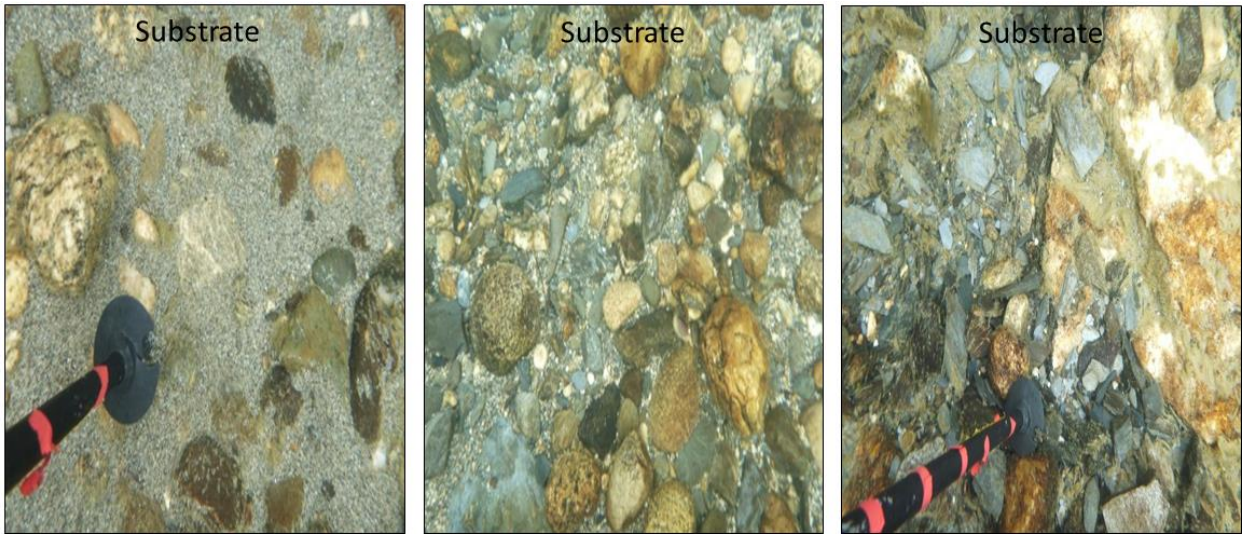




Plate 12. Stream channel characteristics, riparian habitat, and instream substrate composition at transect KB-T1-13, Kobuk River, Brooks East Corridor, Alaska, August 2013.

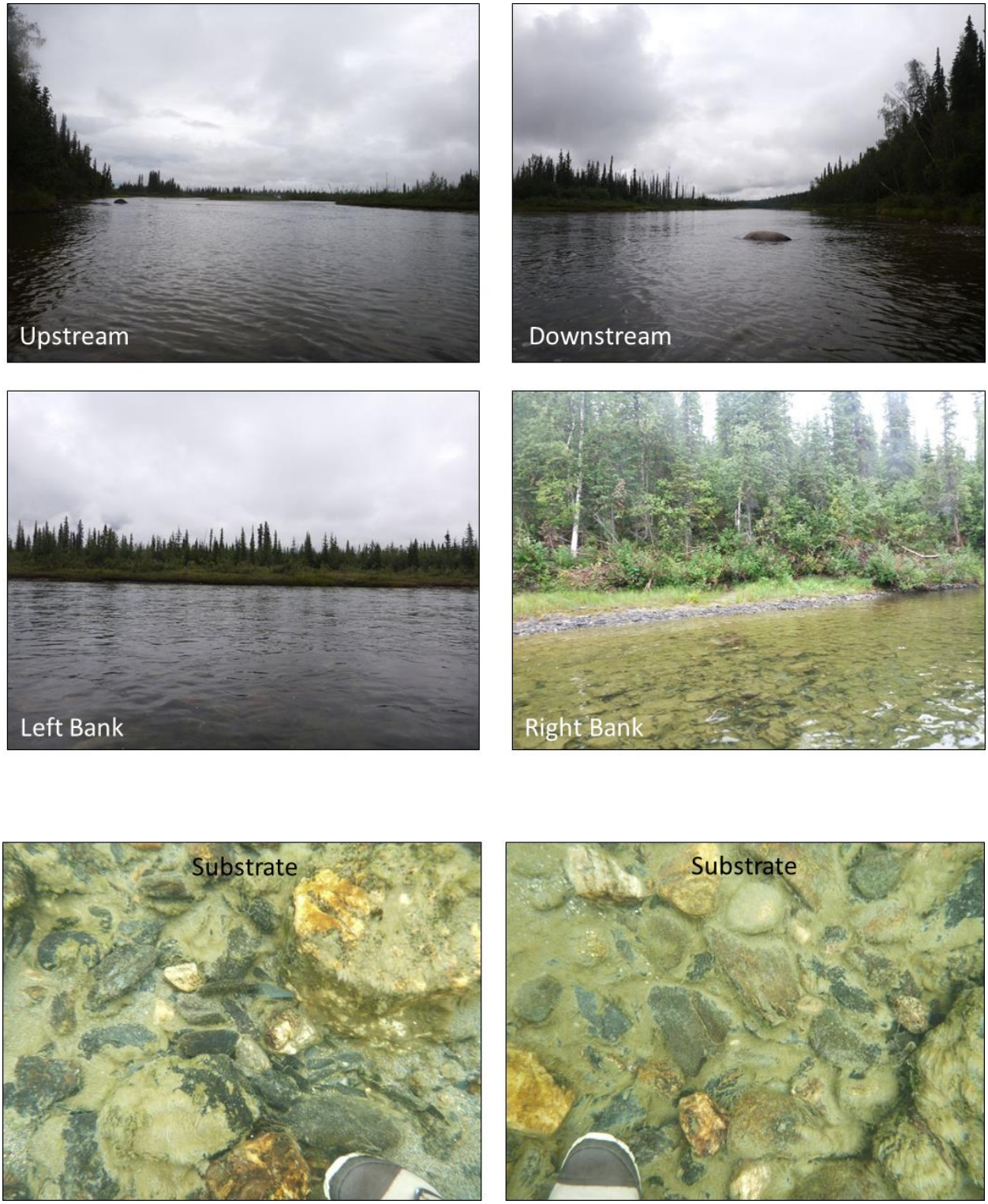



Plate 13. Stream channel characteristics, riparian habitat, and instream substrate composition at an observation point on the Kobuk River, Brooks East Corridor, Alaska, August 2013.


Plate 14. Stream channel characteristics and riparian habitat at observation point AL-T1-13 on the Alatna River, Brooks East Corridor, Alaska, August 2013.

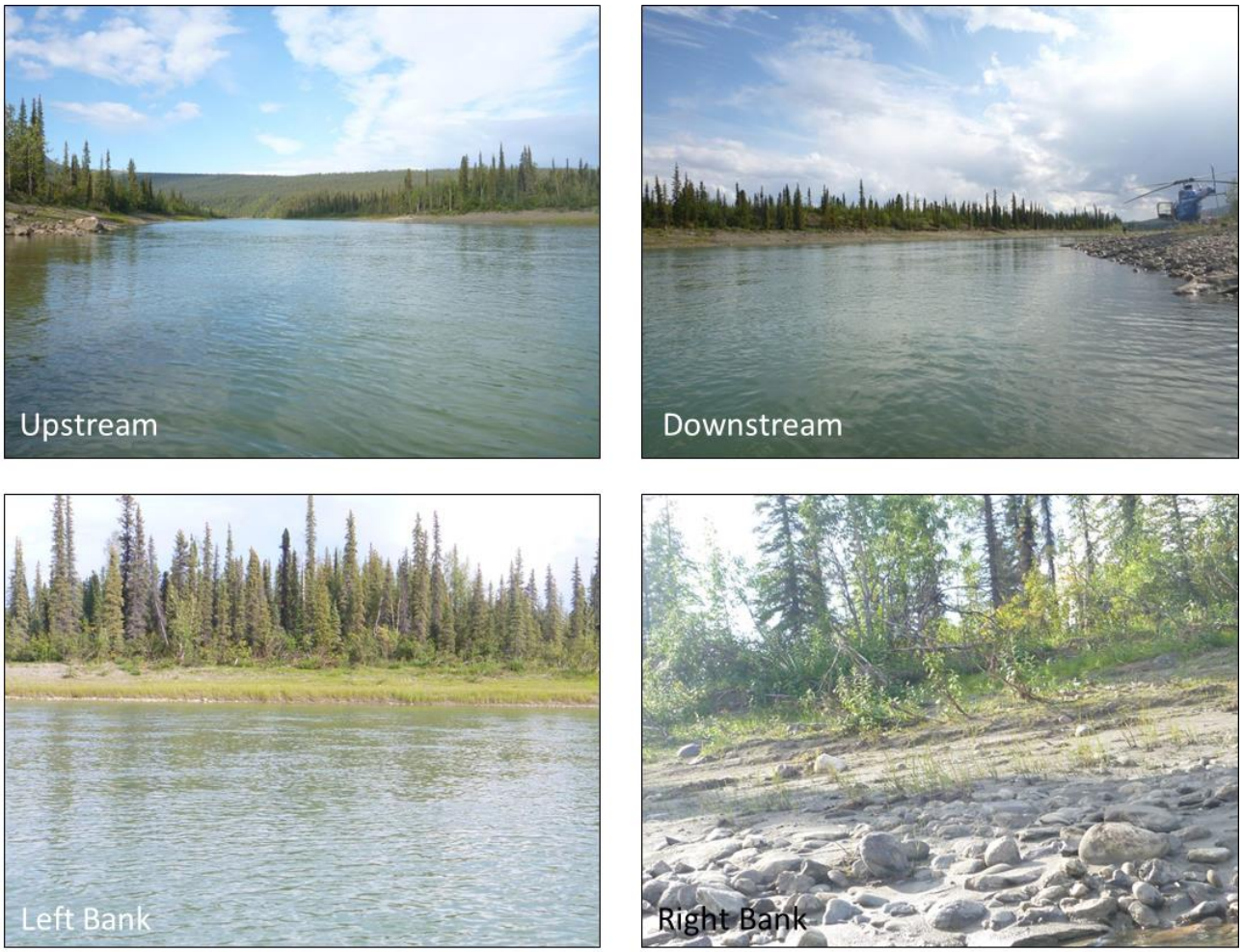



Plate 15. Stream channel characteristics and riparian habitat at observation point AL-T2-13, Alatna River, Brooks East Corridor, Alaska, August 2013.





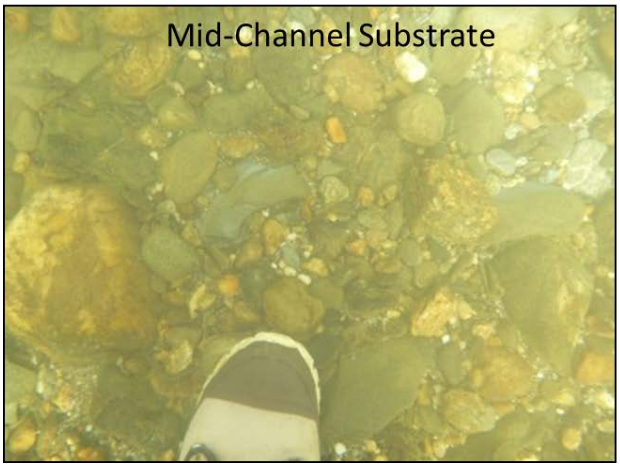




Plate 16. Stream channel characteristics, riparian habitat, and instream substrate composition at transect MF-T1-13, Malamute Fork Alatna River, Brooks East Corridor, Alaska, August 2013.







Plate 17. Stream channel characteristics, riparian habitat, and instream substrate composition at transect UN18-T1-13, unnamed tributary to the Malamute Fork Alatna River, Brooks East Corridor, Alaska, August 2013.

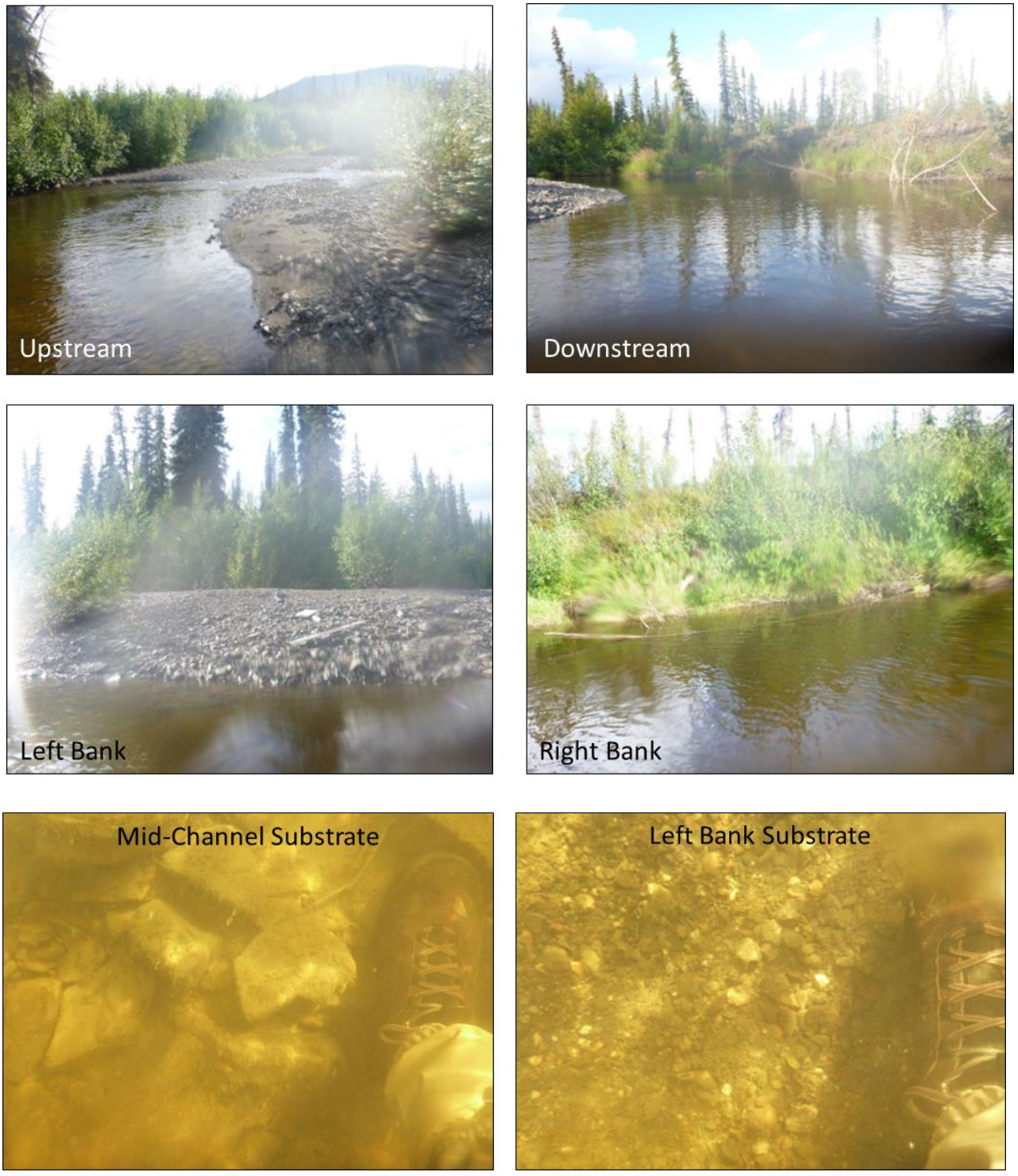



Plate 18. Stream channel characteristics, riparian habitat, and instream substrate composition at transect UN18-T2-13, unnamed tributary to the Malamute Fork Alatna River, Brooks East Corridor, Alaska, August 2013.


Plate 19. Stream channel characteristics, riparian habitat, and instream substrate composition at observation points on the Koyukuk River, Brooks East Corridor, Alaska, August 2013.

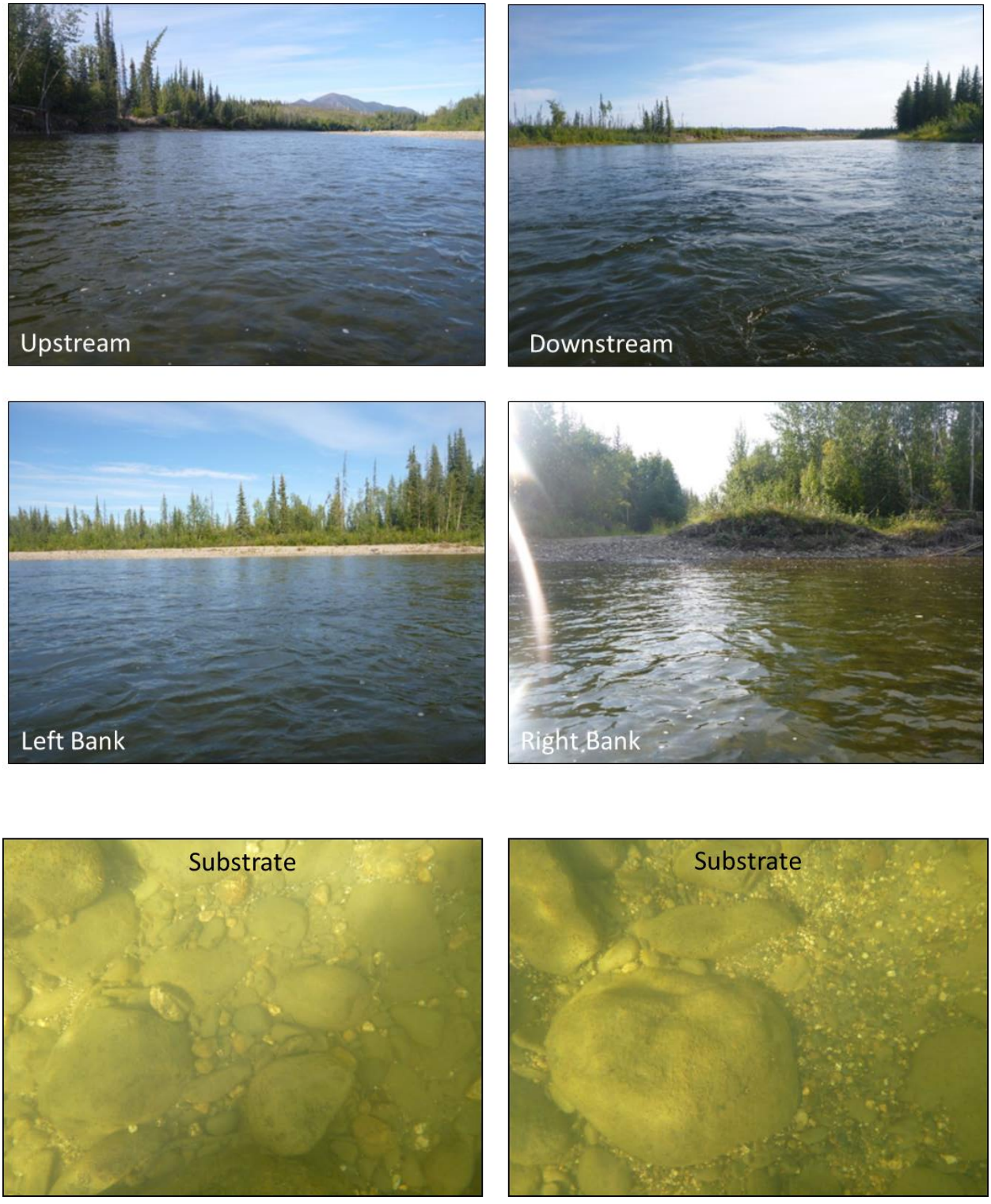



Plate 20. Stream channel characteristics, riparian habitat, and instream substrate composition at transect SF-T1-13, South Fork Koyukuk River, Brooks East Corridor, Alaska, August 2013.


Plate 21. Stream channel characteristics and riparian habitat at observation points on the South Fork Koyukuk River, Brooks East Corridor, Alaska, August 2013.


Plate 22. Stream channel characteristics, riparian habitat, and instream substrate composition at transect JM-T1-13, Jim River, Brooks East Corridor, Alaska, August 2013.


Plate 23. Stream channel characteristics and riparian habitat at upstream observation points on the Jim River, Brooks East Corridor, Alaska, August 2013.

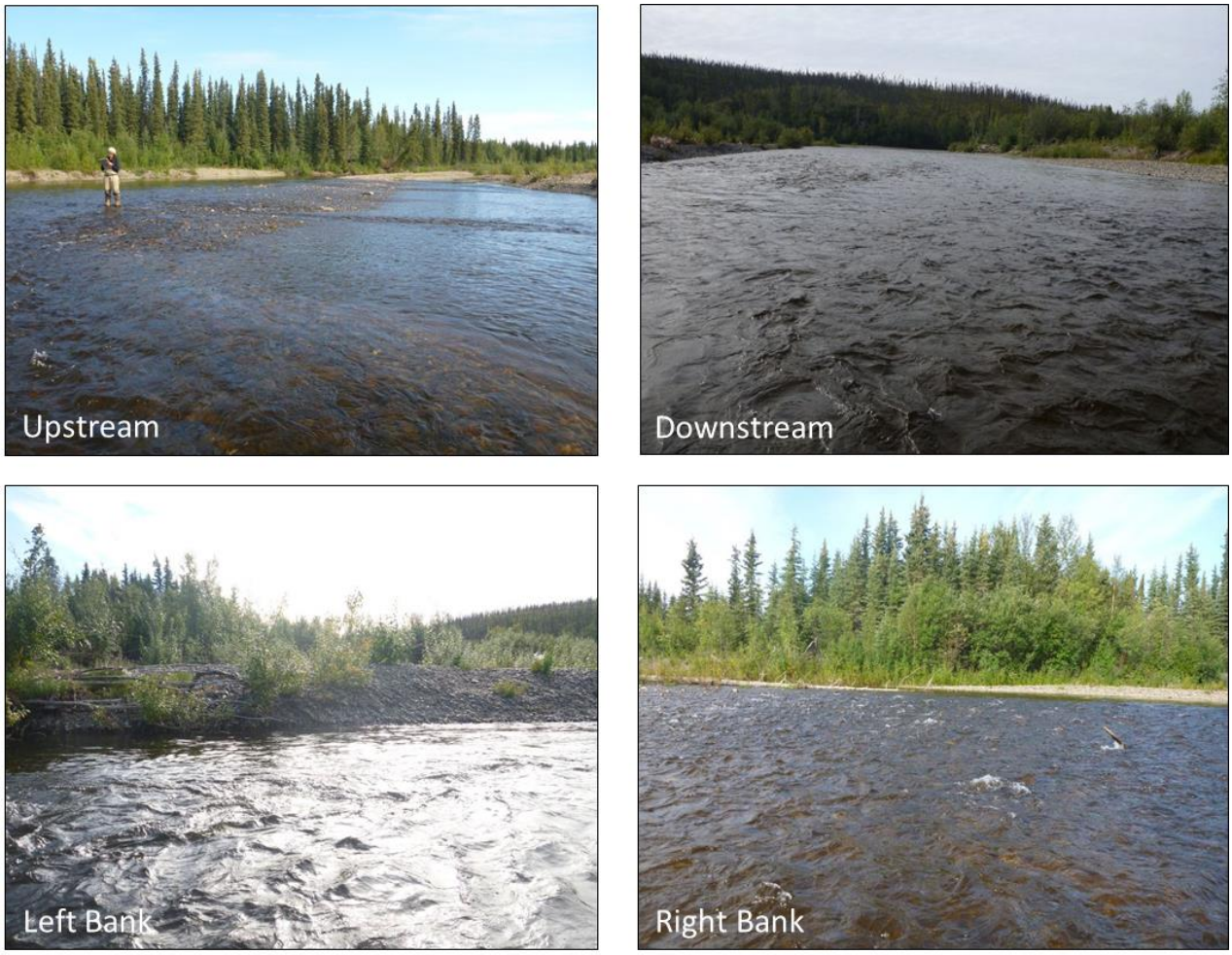



Plate 24. Stream channel characteristics and riparian habitat at downstream observation points on the Jim River, Brooks East Corridor, Alaska, August 2013.







Plate 25. Stream channel characteristics, riparian habitat, and instream substrate composition at transect UN30-T1-13n, unnamed tributary to the Mauneluk River, Brooks East Corridor, Alaska, August 2013.

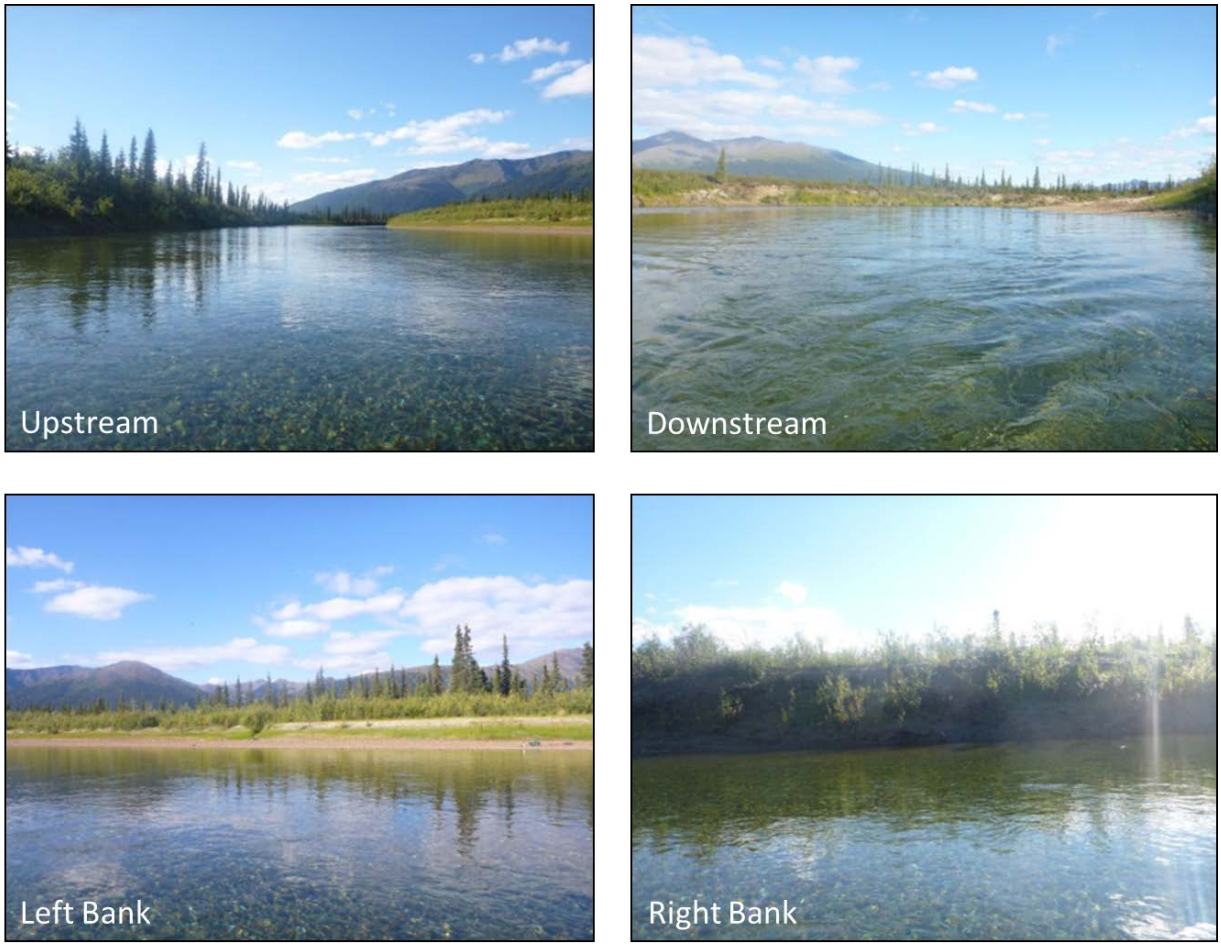



Plate 26. Stream channel characteristics, riparian habitat, and instream substrate composition at transect MN-T1-13n, Mauneluk River (northern option), Brooks East Corridor, Alaska, August 2013.




Plate 27. Stream channel characteristics and riparian habitat at observations points on the Mauneluk River (northern option), Brooks East Corridor, Alaska, August 2013.








Plate 28. Stream channel characteristics, riparian habitat, and instream substrate composition at transect RD-T1-13s, Reed River (southern option), Brooks East Corridor, Alaska, August 2013.





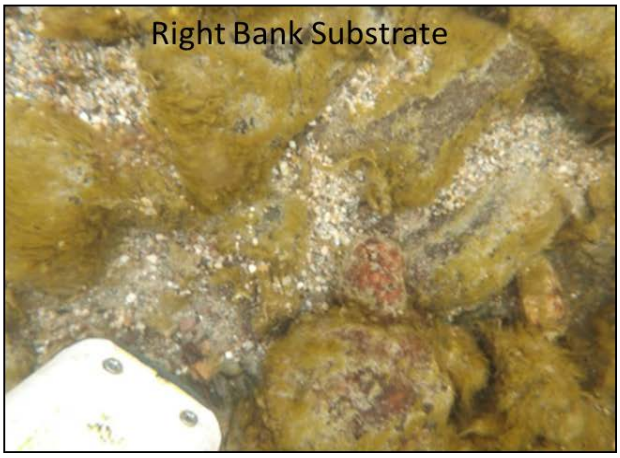
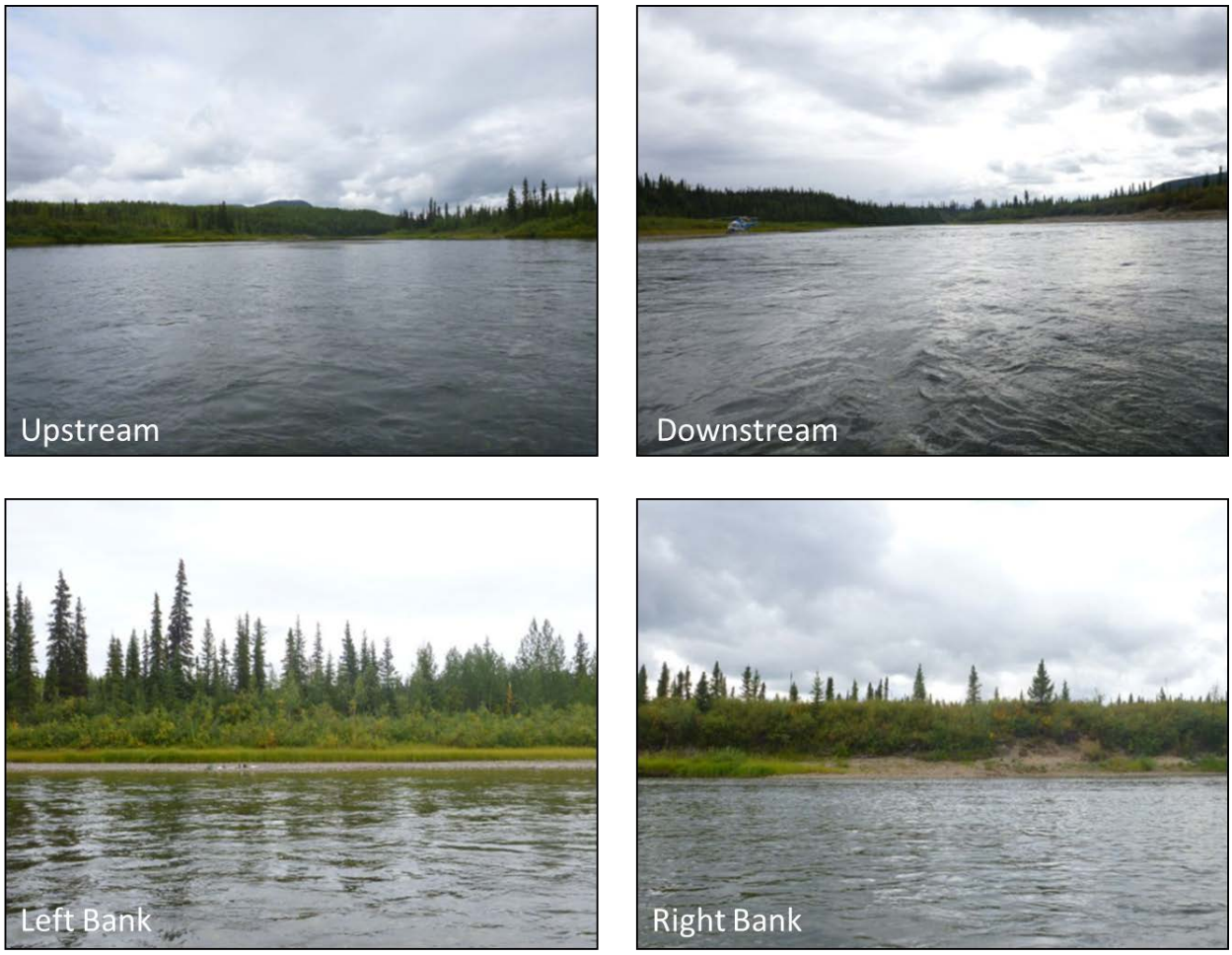




Plate 29. Stream channel characteristics, riparian habitat, and instream substrate composition at transect RD-T2-13s, Reed River (southern option), Brooks East Corridor, Alaska, August 2013.






Plate 30. Stream channel characteristics, riparian habitat, and instream substrate composition of side-channel habitat at transect RD-T2-13s, Reed River (southern option), Brooks East Corridor, Alaska, August 2013.



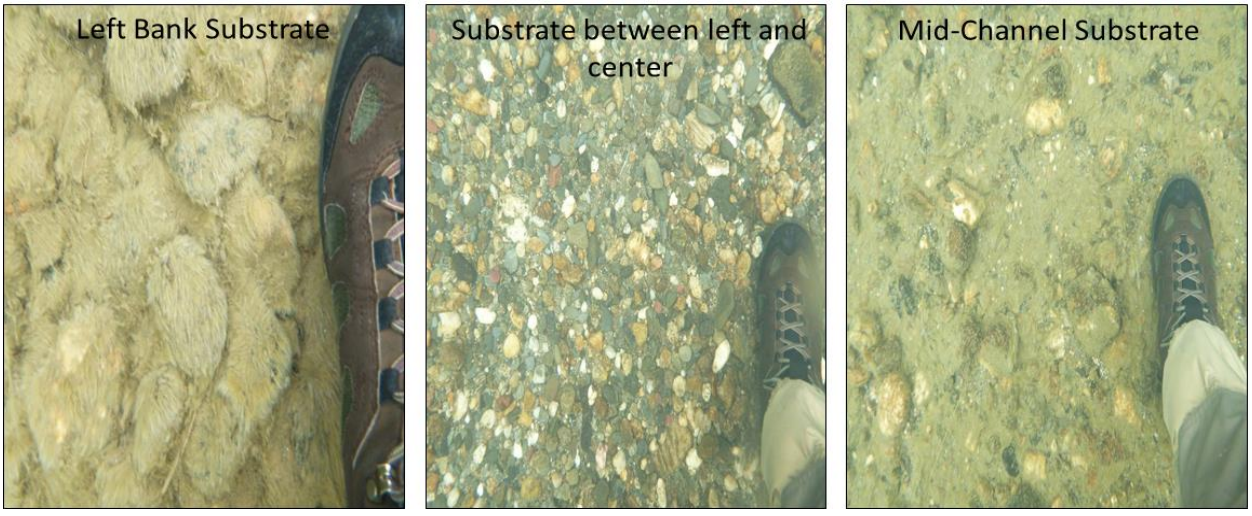




Plate 31. Stream channel characteristics, riparian habitat, and instream substrate composition at transect KB-T1-13s, Kobuk River (southern option), Brooks East Corridor, Alaska, August 2013.

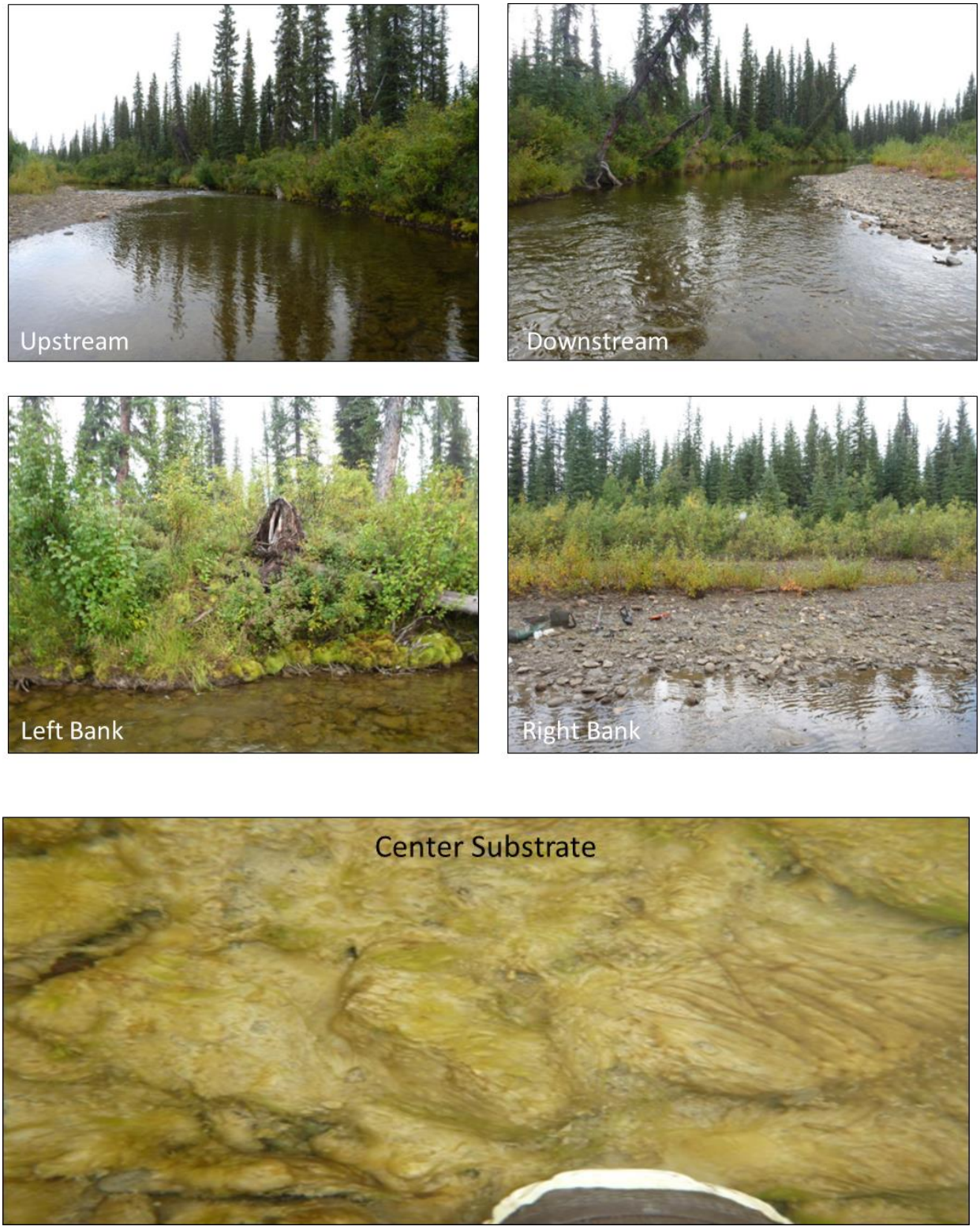



Plate 32. Stream channel characteristics, riparian habitat, and instream substrate composition at transect HG-T1-13s, Hogatza River (southern option), Brooks East Corridor, Alaska, August 2013.

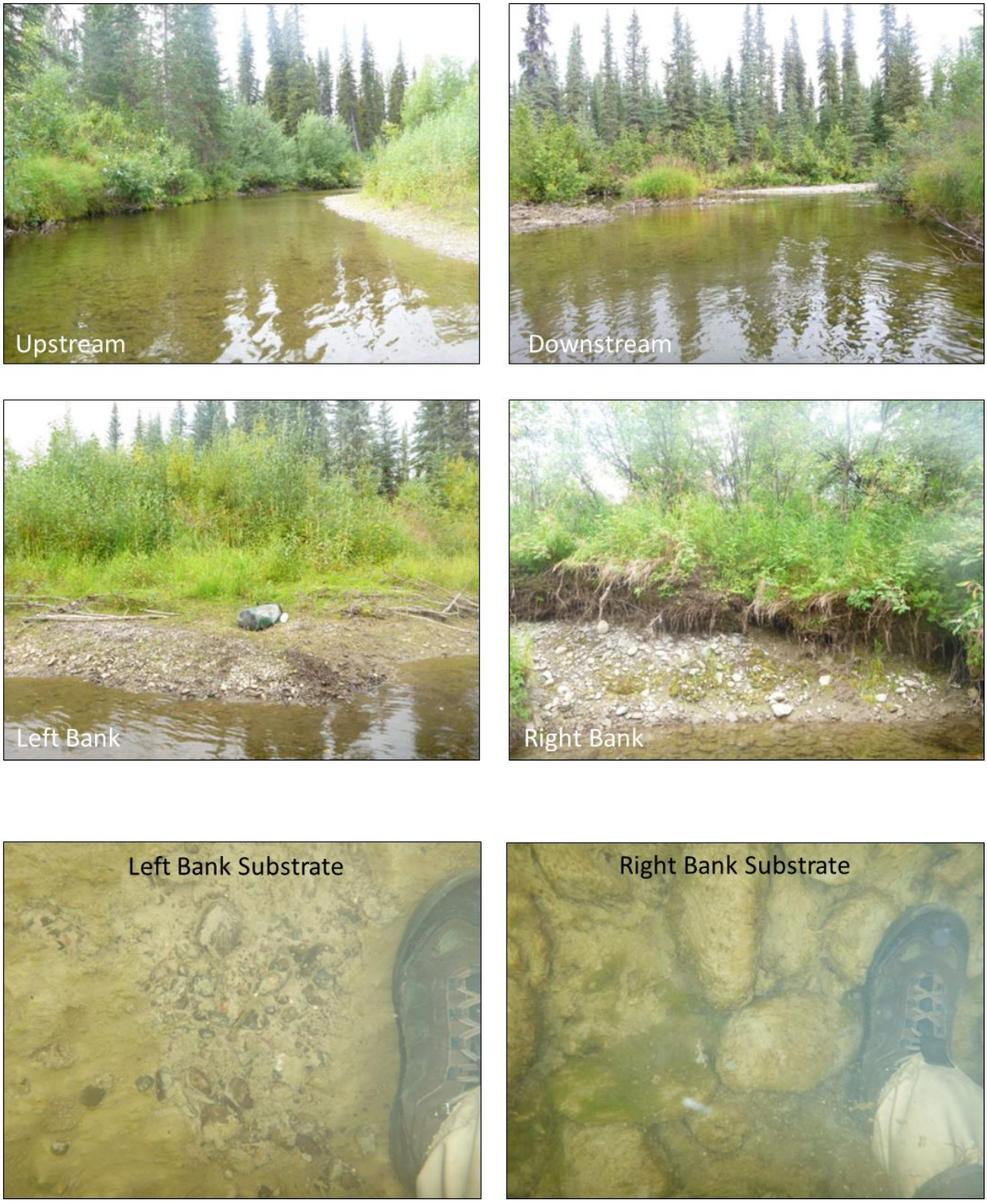



Plate 33. Stream channel characteristics, riparian habitat, and instream substrate composition at transect HG-T2-13MCs, Hogatza River (southern option), Brooks East Corridor, Alaska, August 2013.


Plate 34. Stream channel characteristics, riparian habitat, and instream substrate composition at transect HG-T2-13SCs, Hogatza River (southern option), Brooks East Corridor, Alaska, August 2013.






Plate 35. Stream channel characteristics, riparian habitat, and instream substrate composition at transect HJ-T1-13s, Helpmejack Creek (southern option), Brooks East Corridor, Alaska, August 2013.






Plate 36. Stream channel characteristics, riparian habitat, and instream substrate composition at transect HJ-T2-13s, Helpmejack Creek (southern option), Brooks East Corridor, Alaska, August 2013.


Plate 37. Stream channel characteristics and riparian habitat at transect HJ-T3-13s, Helpmejack Creek (southern option), Brooks East Corridor, Alaska, August 2013.


Plate 38. Stream channel characteristics, riparian habitat, and instream substrate composition at 3 observation points on Helpmejack Creek, Brooks East Corridor, Alaska, August 2013.

Table 1. Anadromous and freshwater fish species observed during surveys of the Brooks East Corridor, Alaska, 2012 and 2013, and current Alaska Department of Fish and Game Anadromous Waters Catalog (AWC) records.

| Waterbody Name | Tributary to | Anadromous Fish Observations[a] | | Freshwater Fish[a,b] | | 2013 AWC records[a] |
|---|---|---|---|---|---|---|
| | | 2012 | 2013 | 2012 | 2013 | |
| Shungnak River | Kobuk River | – | – | SC, AG | AG | – |
| Ruby Creek | Shungnak River | – | ns | SC, AG | ns | – |
| Kogoluktuk River | Kobuk River | – | – | SC, AG | AG | CS, DV, WF |
| Unnamed tributary | Kogoluktuk River | – | ns | SC, AG | ns | – |
| Canyon Creek | Kogoluktuk River | – | ns | DV, SC | ns | – |
| Riley Creek | Kogoluktuk River | – | ns | DV | ns | – |
| Maunelak River | Kobuk River | CS | CS | SC | AG | CS, WF |
| Unnamed tributary | Mauneluk River | – | ns | DV, SC | ns | – |
| Unnamed tributary | Mauneluk River | – | ns | DV | ns | – |
| Unnamed tributary | Mauneluk River | – | ns | DV | ns | – |
| Unnamed tributary | Mauneluk River | – | ns | DV | ns | – |
| Unnamed tributary | Mauneluk River | CS | ns | SC, NP | ns | – |
| UN30 | Mauneluk River | CS | ns | AG | ns | – |
| Unnamed tributary | Mauneluk River | – | ns | DV, SC | ns | – |
| Beaver Creek | Kobuk River | – | – | SC, AG | – | CS |
| Unnamed tributary | Beaver Creek | – | ns | DV | ns | – |
| Unnamed tributary | Beaver Creek | – | ns | DV, SC | ns | – |
| Unnamed tributary | Beaver Creek | – | ns | SC, BB | ns | – |
| Unnamed tributary | Beaver Creek | – | ns | SC | ns | – |
| Reed River | Kobuk River | CS | CS | SC, AG, BB | SC | – |
| Unnamed tributary | Reed River | – | ns | SC | ns | – |
| Kobuk River | None | CS | – | SC | AG | CS, KS, DV, SF, WF |
| Unnamed tributary | Kobuk River | – | ns | DV, SC | ns | – |
| Unnamed tributary | Kobuk River | – | ns | SC, AG | ns | – |
| Unnamed tributary | Kobuk River | – | ns | DV | ns | – |
| Unnamed tributary | Kobuk River | – | ns | SC | ns | – |
| Alatna River | Koyukuk River | – | – | SC | – | CS, KS |
| Unnamed tributary | Alatna River | CS | ns | – | ns | – |
| Unnamed tributary | Alatna River | KS | ns | – | ns | – |
| Malamute Fork Alatna River | Alatna River | ns | CS | ns | – | CS, KS |
| Tobuk Creek | Malamute Fork Alatna River | SS, KS | ns | – | ns | – |

Table 1. Continued.

| Waterbody Name | Tributary to | Anadromous Fish Observations[a] | | Freshwater Fish[a,b] | | 2013 AWC records[a] |
|---|---|---|---|---|---|---|
| | | 2012 | 2013 | 2012 | 2013 | |
| Unnamed tributary | Malamute Fork Alatna River | – | ns | SC | ns | – |
| Unnamed tributary | Malamute Fork Alatna River | SS | ns | – | ns | – |
| Unnamed tributary | Malamute Fork Alatna River | SS, CS | ns | – | ns | – |
| UN18 | Bedrock Creek | – | – | – | NP | – |
| Koyukuk River | None | ns | – | ns | – | CS, SS, KS, RS, SF, WF |
| South Fork Koyukuk River | Koyukuk River | ns | – | ns | BB | CS, KS, WF |
| Unnamed tributary | Koyukuk River South Fork | – | ns | SC | ns | – |
| Unnamed tributary | Koyukuk River South Fork | – | ns | SC, AG | ns | – |
| Jim River | Koyukuk River | ns | CS | ns | AG | CS, KS |
| Unnamed tributary | Jim River | SS | ns | SC | ns | – |
| Unnamed tributary | Jim River | SS, KS | ns | AG, SC | ns | – |
| Hogatza River | Koyukuk River | CS | – | SC | AG | CS, SS, KS, WF |
| Unnamed tributary | Hogatza River | – | ns | SC, BB | ns | – |
| Unnamed tributary | Hogatza River | – | ns | AG | ns | – |
| Helpmejack Creek | Alatna River | – | – | DV, AG | ns | – |
| Unnamed tributary | Helpmejack Creek | – | – | DV, SC | ns | – |

[a] DV = Dolly Varden; SS = Coho Salmon; KS = Chinook Salmon; SC = Slimy Sculpin; AG = Arctic Grayling; BB = Burbot; NP = Northern Pike; CS = Chum Salmon; RS = Sockeye Salmon; WF = Whitefish species; SF = Sheefish; ns=not sampled

[b] Dolly Varden observed during ABR surveys are treated as freshwater resident fish because it cannot be shown that they are anadromous without additional analysis

Table 2. Instream physical habitat parameters for waterbodies sampled in the Brooks East Corridor, Alaska, August 2013. Values in parentheses represent side-channel habitat.

| Survey Transect | Waterbody | Date | Bankfull Width (m) | Wetted Width (m) | Thalweg Depth (m) | Stream Channel Substrate[a] | Discharge ($m^3/s$) | Instream Cover[b,c] |
|---|---|---|---|---|---|---|---|---|
| SH-T1-13 | Shungnak River | 8/12/2013 | 59 | 52 | nm | 40% SI, 40% CY, 5% BO, 5% CB, 5% GR, 5% SA | nm | FA1, MA2, SWD1, OV1, BO1 |
| SH-T2-13 | Shungnak River | 8/12/2013 | 49 | 37 | 0.85 | 40% GR, 30% CB, 25% SA, 5% BO | 10.00 | SWD1, OV1, BO1 |
| SH-T3-13 | Shungnak River | 8/12/2013 | 40 | 49 | 0.82 | 40% GR, 35% CB, 20% SA, 5% BO | 11.06 | FA2, SWD1, LTR1, OV2, UB2, BO1 |
| KG-T1-13 | Kogoluktuk River | 8/13/2013 | 120 | 102 | 1.02 | 90% SA, 5% CB, 5% GR (50% SA, 25% GR, 20% CB, 5% BO) | 24.88 | SWD1, BO1 |
| KG-T2-13 | Kogoluktuk River | 8/13/2013 | 131 | 124 | 0.89 | 40% SA, 30% CB, 30% GR | 22.84 | FA2, SWD1, OV1 |
| MN-T1-13 | Mauneluk River | 8/13/2013 | 97 | 58 | nm | 50% GR, 35% CB, 15% SA | 34.43[d] | FA2, LWD1, SWD1, LTR1, OV1 |
| MN-T2-13 | Mauneluk River | 8/13/2013 | nm | 70 | nm | 40% CB, 40% SA, 20% GR | 13.01 | FA2, MA1, LWD1, SWD1, OV2 |
| BV-T1-13 | Beaver Creek | 8/14/2013 | 34.2 | 31.5 | 0.66 | 50% CB, 25% GR, 15% BO, 5% SA, 5% CY | 7.70 | FA4, MA1, SWD1, OV2, UB1, BO2 |
| BV-T2-13 | Beaver Creek | 8/14/2013 | 29.05 | 28 | 0.88 | 30% CB, 30% SA, 20% BO, 20% GR | 7.86 | FA4, MA1, SWD1, LTR1, OV2, UB1, BO2 |
| RD-T1-13 | Reed River | 8/15/2013 | 79 | 56 | 0.98 | 35% GR, 35% SA, 20% CB, 10% BO | 26.48 | FA2, MA1, SWD1, LTR1, OV1, BO1 |
| KB-T1-13 | Kobuk River | 8/15/2013 | 90 | 89 | 0.97 | 35% CB, 35% GR, 25% SA, 5% BO | 29.67 | FA2, MA1, SWD1, LTR1, OV2, UB1, BO1 |
| AL-T2-13 | Alatna River | 8/17/2013 | 98.5 | 75.5 | nm | 35% SA, 25% CB, 20% SI, 10% BO, 10% GR | nm | SWD1, BO2 |
| MF-T1-13 | Malamute Fork Alatna River | 8/17/2013 | 91 | 53.5 | 0.75 | 35% GR, 35% SA, 25% CB, 5% BO | 12.28 | FA1, SWD1, OV1, UB1, BO1 |
| UN18-T1-13 | Unnamed tributary to Malamute Fork Alatna River | 8/16/2013 | 15.5 | 9.6 | 0.39 | 50% BO, 30% CB, 15% GR, 5% SA | 0.60 | FA2, SWD1, LTR1, OV2, UB1, BO3 |
| UN18-T2-13 | Unnamed tributary to Malamute Fork Alatna River | 8/16/2013 | 19.5 | 7.3 | 1.08 | 25% BO, 25% CB, 25% GR, 25% SA | 0.31 | FA3, SWD2, LTR1, OV2, UB2, BO1 |
| SF-T1-13 | South Fork Koyukuk River | 8/22/2013 | 85 | 56 | 1.04 | 40% CB, 30% GR, 15% BO, 15% SA | 13.75 | SWD1, AS2 |
| JM-T1-13 | Jim River | 8/22/2013 | 65 | 23.5 | 0.71 | 45% GR, 35% CB, 15% SA, 5% BO | 5.07 | FA1, LWD1, SWD1, BO1 |
| UN30-T1-13n | Unnamed tributary to Mauneluk River | 8/21/2013 | 46 | 19.5 | 0.97 | 50% BO, 30% CB, 15% GR, 5% SA | 3.85 | FA1, SWD2, OV1, BO3 |
| MN-T1-13n | Mauneluk River | 8/21/2013 | 60 | 33.7 | 0.99 | 65% GR, 15% CB, 15% SA, 5% BO | 15.46 | FA2, SWD1, OV1, UB1, BO1 |
| RD-T1-13s | Reed River | 8/19/2013 | 65.5 | 57 | 0.93 | 40% CB, 30% SA, 20% GR, 10% BO | 21.51 | FA1, SWD1, BO1 |

| Survey Transect | Waterbody | Date | Bankfull Width (m) | Wetted Width (m) | Thalweg Depth (m) | Stream Channel Substrate[a] | Discharge ($m^3/s$) | Instream Cover[b,c] |
|---|---|---|---|---|---|---|---|---|
| RD-T2-13s | Reed River | 8/19/2013 | 80 | 46.5 | 0.81 | 35% CB, 30% GR, 30% SA, 5% BO (60% SA, 30% GR, 10% CB) | 22.91 | FA1, SWD1, OV1, UB1, BO1 |
| KB-T1-13s | Kobuk River | 8/19/2013 | 113 | 77 | 1.03 | 50% GR, 35% CB, 10% SA, 5% BO | 28.22 | FA2, SWD1, BO1 |
| HG-T1-13s | Hogatza River | 8/20/2013 | 27.5 | 9.2 | 0.42 | 40% CB, 35% GR, 15% SA, 10% BO | 0.62 | FA2, LWD1, SWD2, LTR1, OV2, UB1, BO1 |
| HG-T2-13MCs | Hogatza River | 8/20/2013 | 12.5 | 5.6 | 0.84 | 40% CB, 40% GR, 15% SA, 5% BO | 0.59 | FA1, SWD1, LTR1, OV2, UB1, BO1 |
| HG-T2-13SCs | Hogatza River | 8/20/2013 | 11.2 | 9.4 | 0.53 | 50% GR, 25% SA, 20% CB, 5% BO | 0.12 | FA2, SWD2, LTR1, OV2, UB2, BO1 |
| HJ-T1-13s | Helpmejack Creek | 8/18/2013 | 39.2 | 11.15 | 0.92 | 40% SA, 30% CB, 25% SI, 5% BO | 1.75 | FA1, LWD1, SWD2, OV1, UB1, BO1 |
| HJ-T2-13s | Helpmejack Creek | 8/18/2013 | 19.3 | 10.5 | 0.81 | 40% CB, 30% BO, 20% GR, 5% SA, 5% SI | 1.62 | FA1, SWD1, OV1, UB1, BO2 |
| HJ-T3-13s | Helpmejack Creek | 8/18/2013 | 24.2 | 10.9 | 0.69 | 50% CB, 20% GR, 20% SI, 10% BO | 2.25 | SWD1, OV1, BO1 |

[a] BO, boulder; CB, cobble; GR, gravel; SA, sand; SI, silt; CY, clay

[b] Each parameter was expressed as a qualitative percentage of the total stream cover within 10 m upstream and downstream of the water sampling site and was designated as 0=absent (0%), 1 = sparse (less than 10%), 2 = moderate (10–40%), 3 = moderately abundant (40–75%), or abundant (greater than 75%).

[c] FA = Filamentous Algae; MA = Macrophytes; LWD = Large woody debris (more than 0.3 m at diameter breast height); SWD = Small woody debris (less than 0.3 m at diameter breast height); LTR = Live Tree Roots; OV = Overhanging Vegetation; UB = Undercut Bank; AS = Artificial Structures

[d] Discharge measured downstream of transect at the end of the corridor because transect was unwadeable

nm=not measured

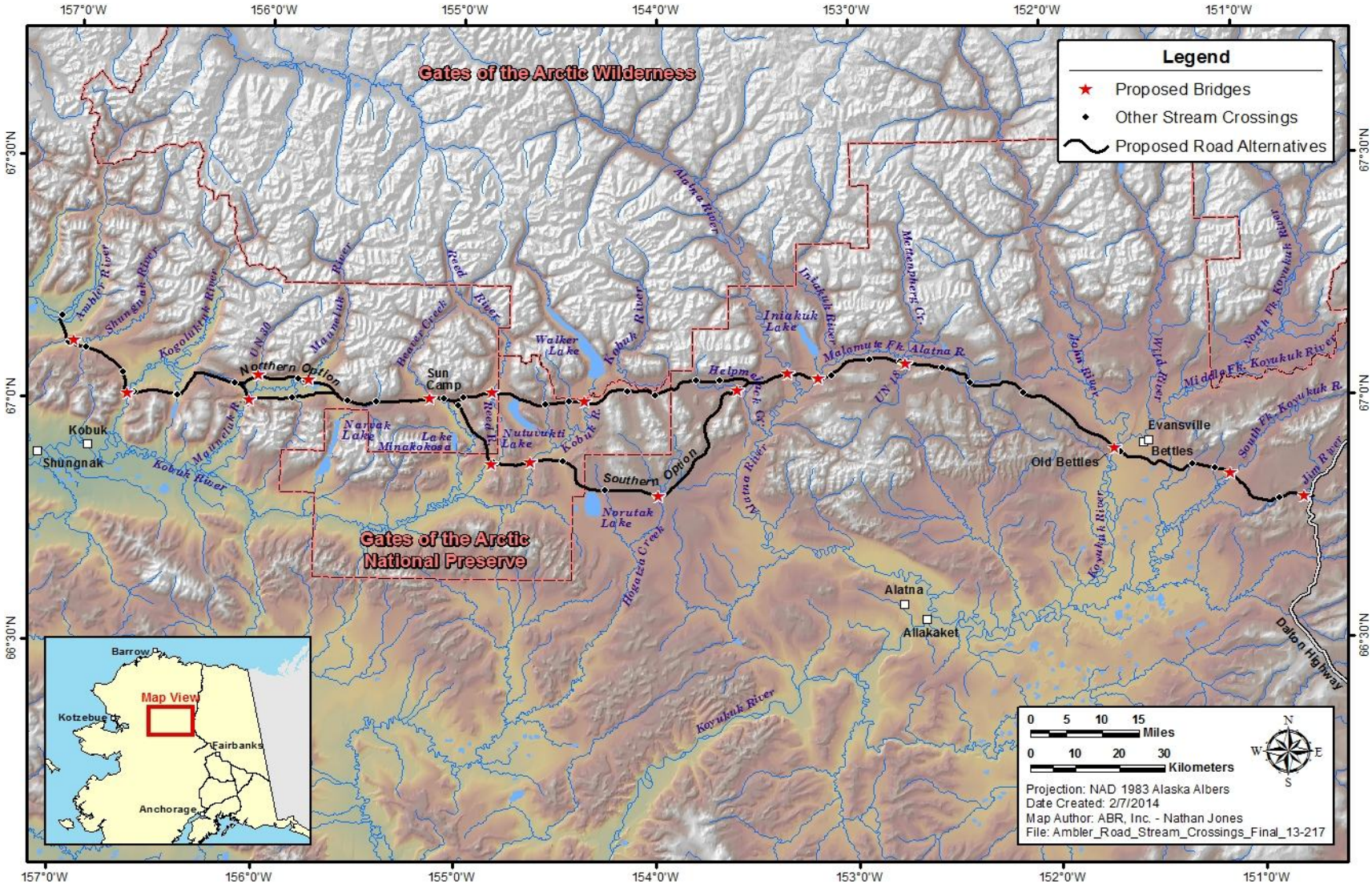



Figure 1. The Brooks East Corridor, including the northern and southern options, and proposed bridge crossings where stream habitat surveys were conducted in August 2013.

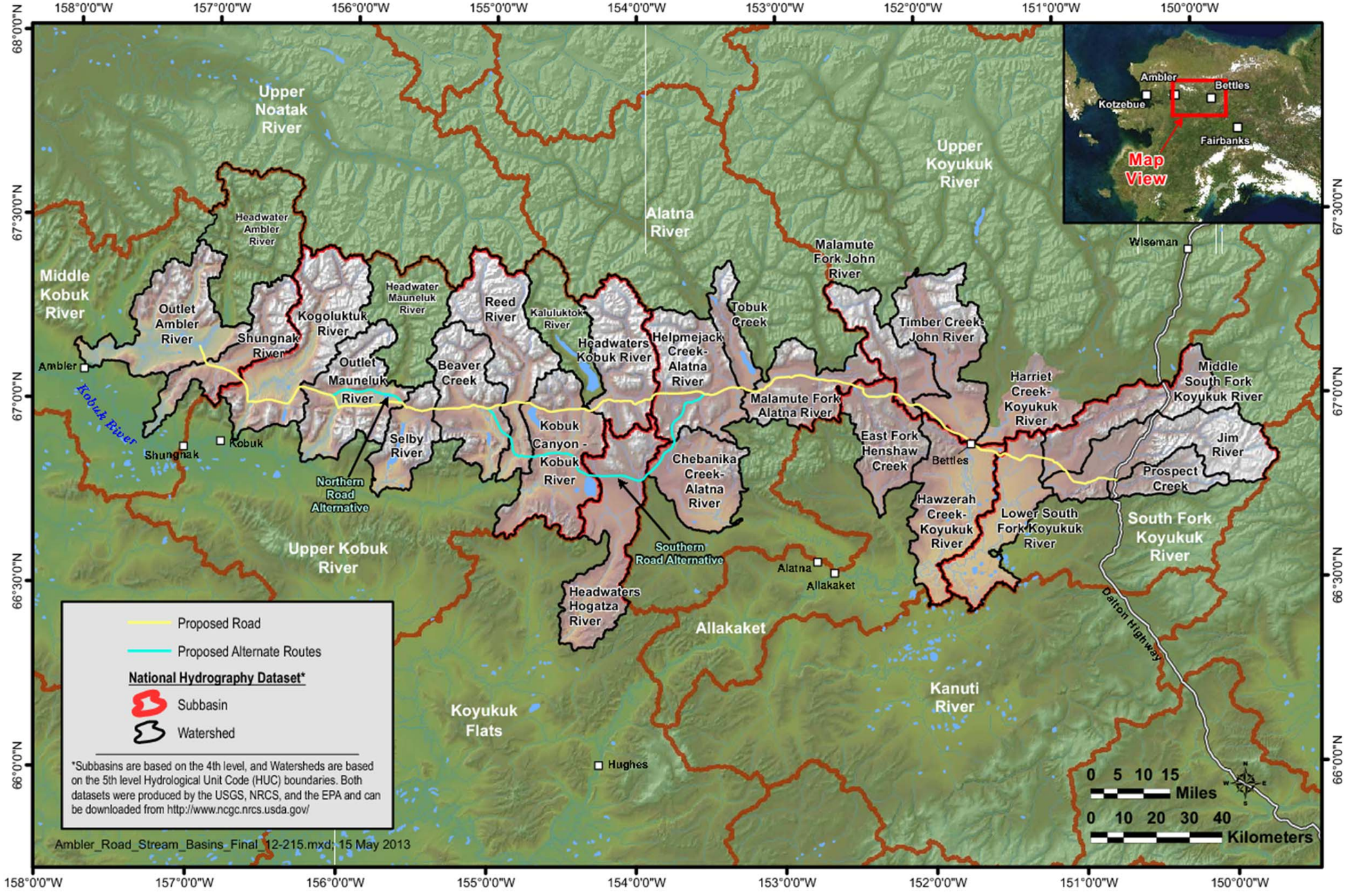



Figure 2. Subbasins and watersheds traversed by the proposed Brooks East Corridor, including the northern and southern options.

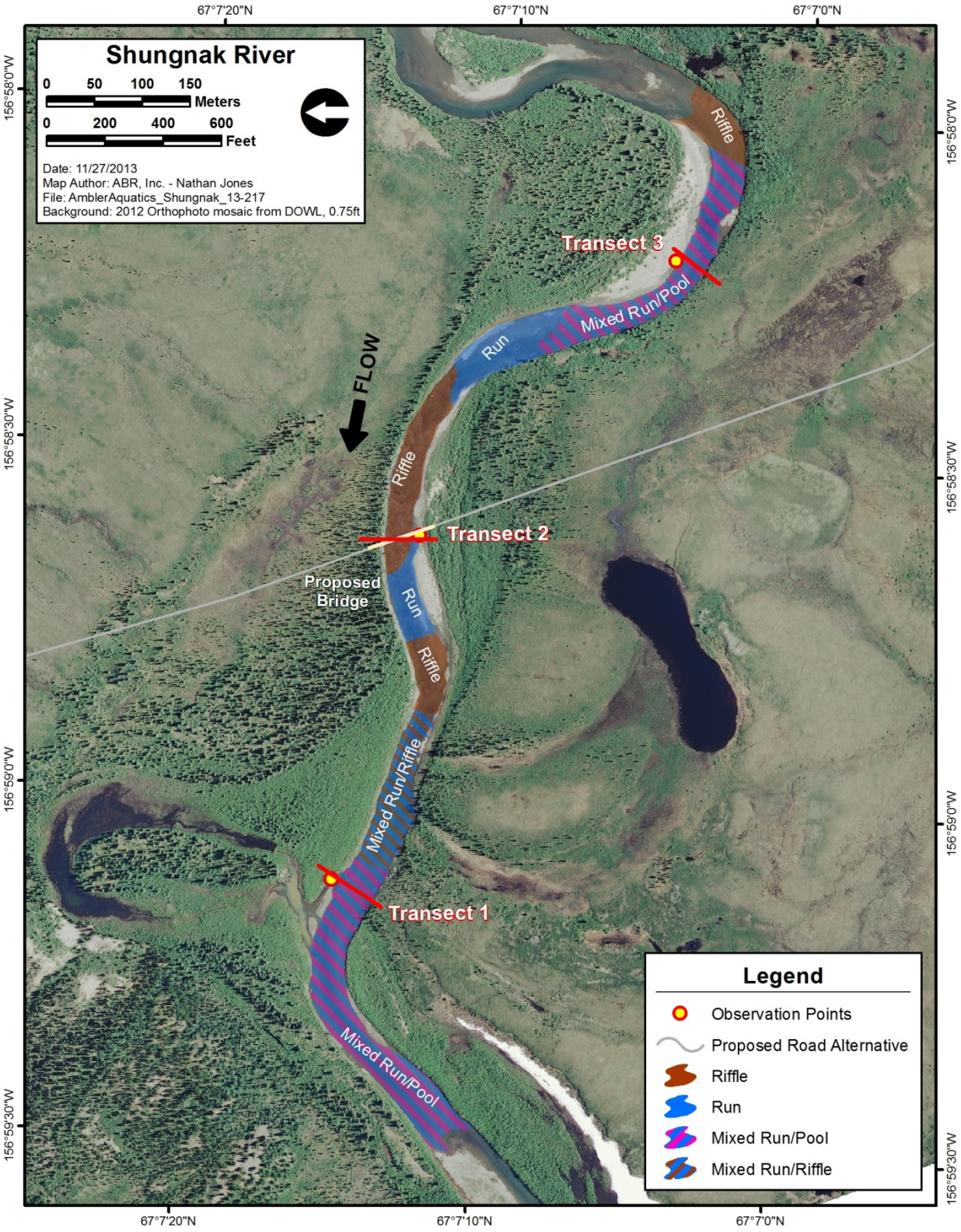



Figure 3. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Shungnak River, Alaska, August 2013.

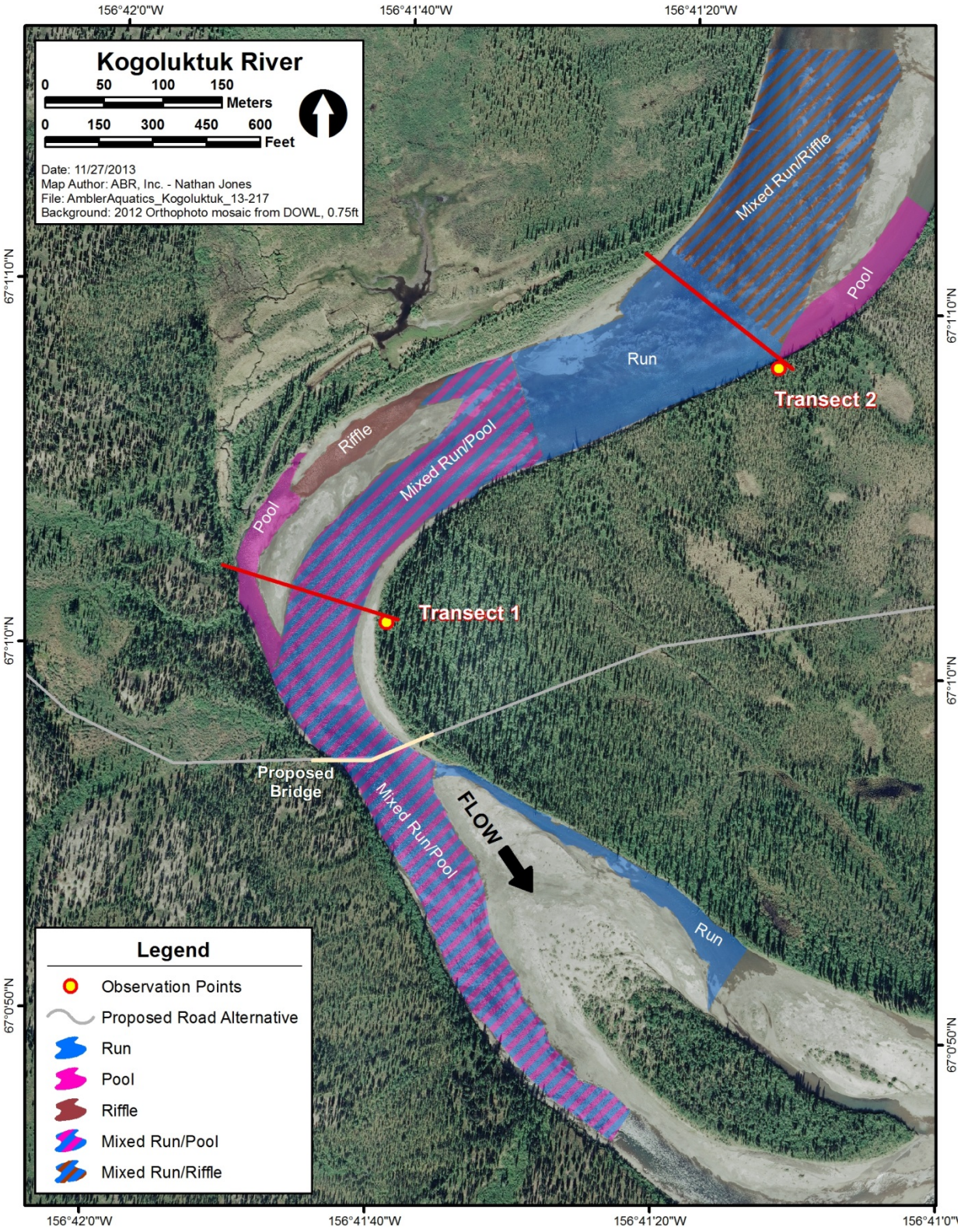



Figure 4. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Kogoluktuk River, Alaska, August 2013.

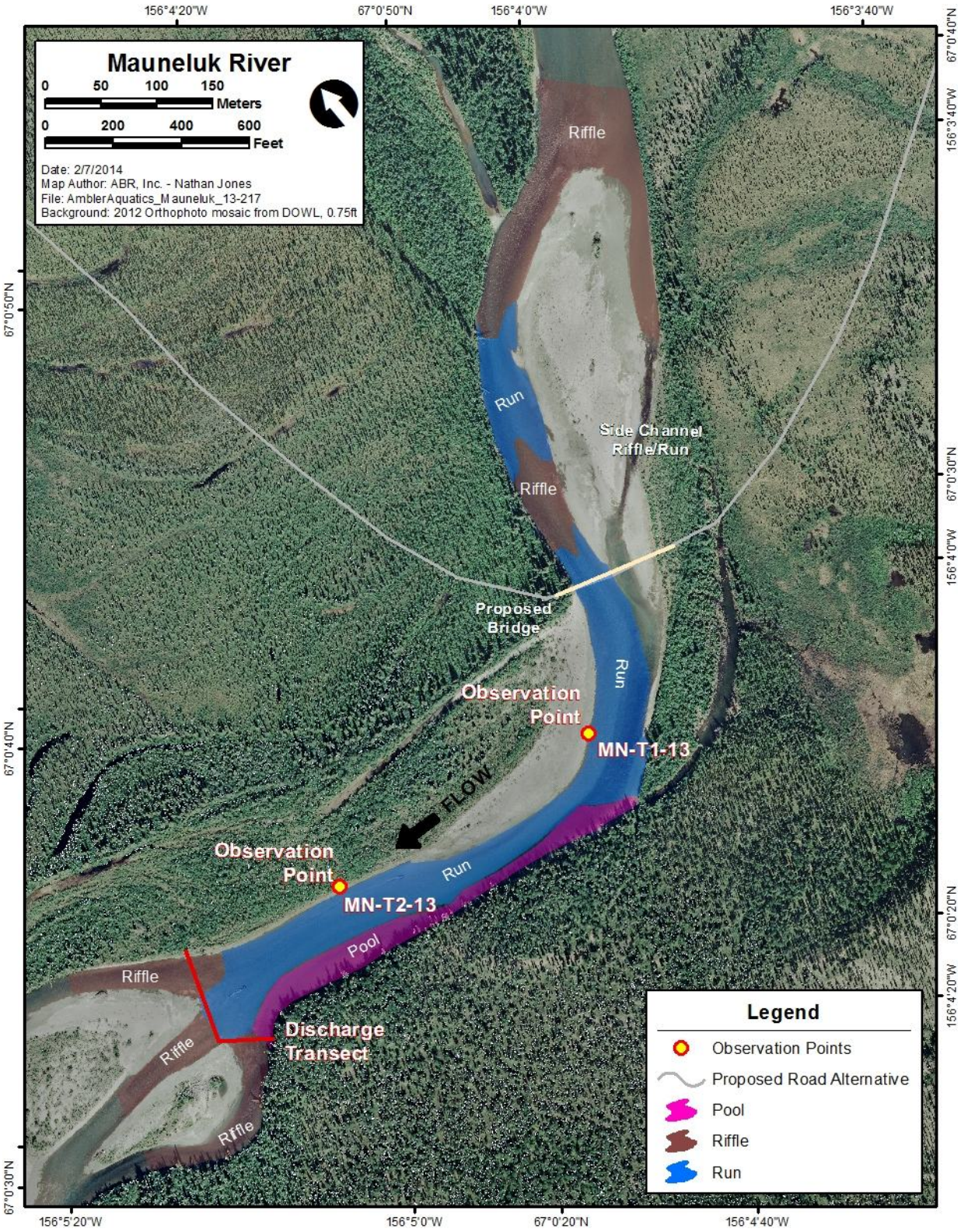



Figure 5. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Mauneluk River, Alaska, August 2013.

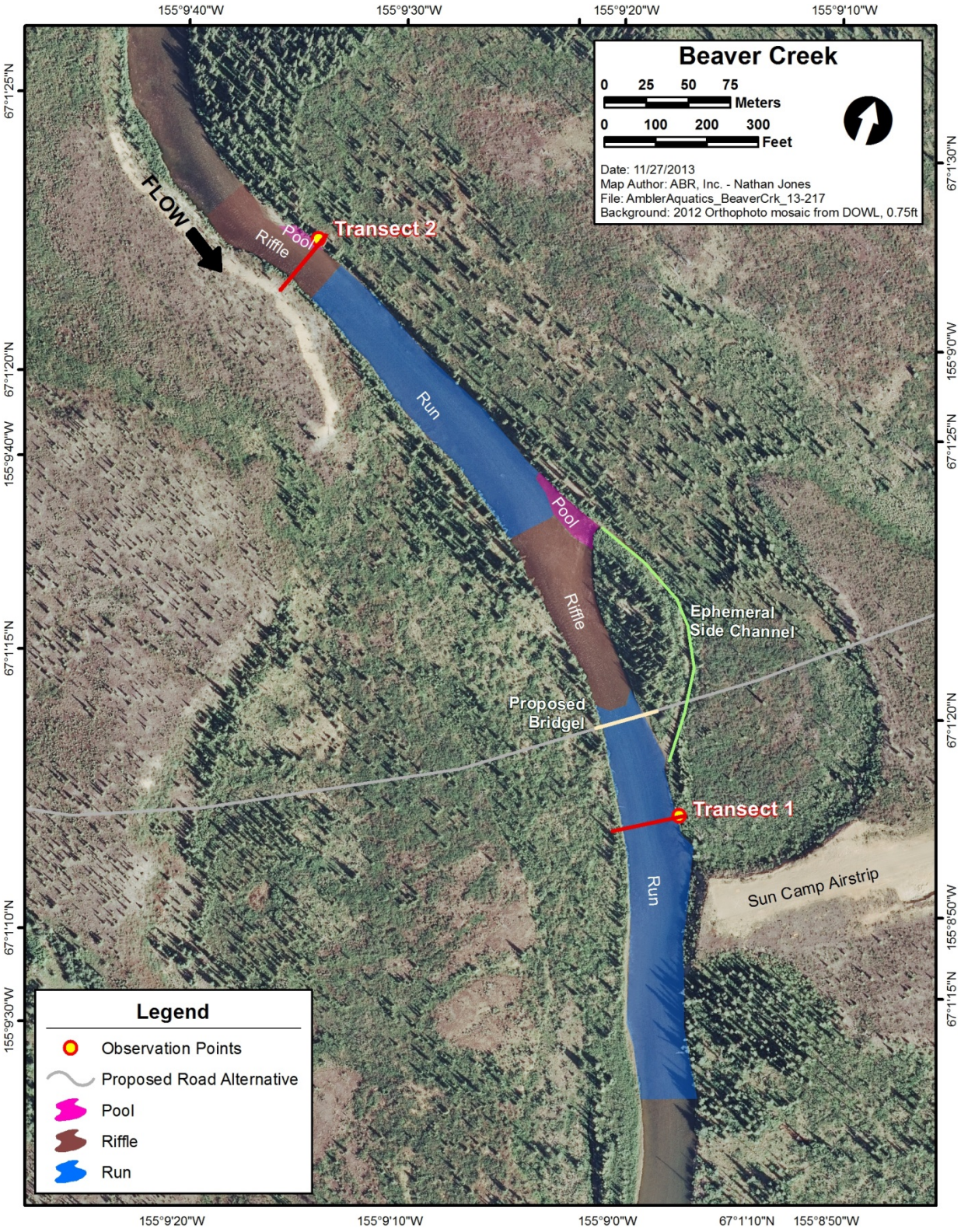



Figure 6. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Beaver Creek, Alaska, August 2013.

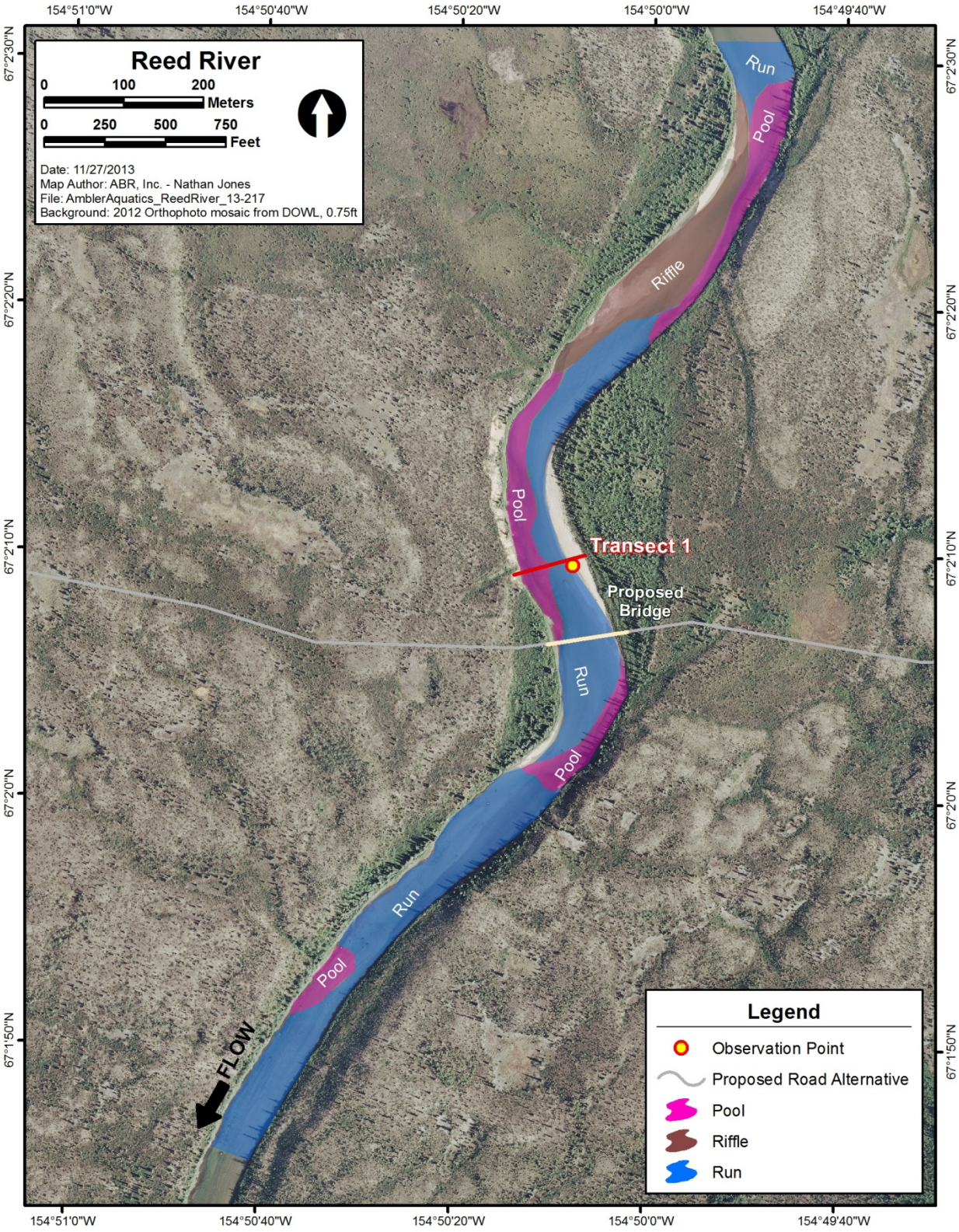



Figure 7. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Reed River, Alaska, August 2013.

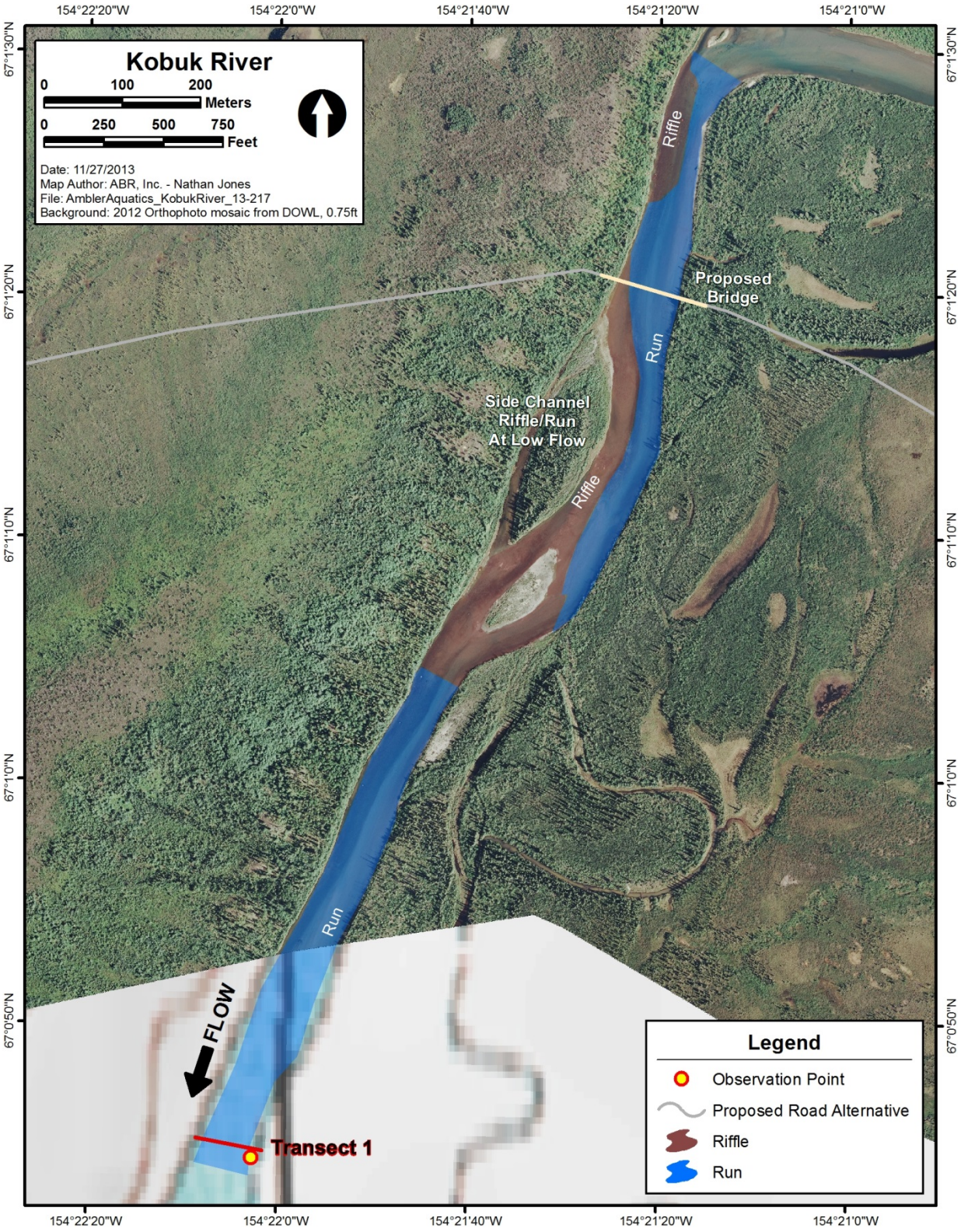



Figure 8. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Kobuk River, Alaska, August 2013.

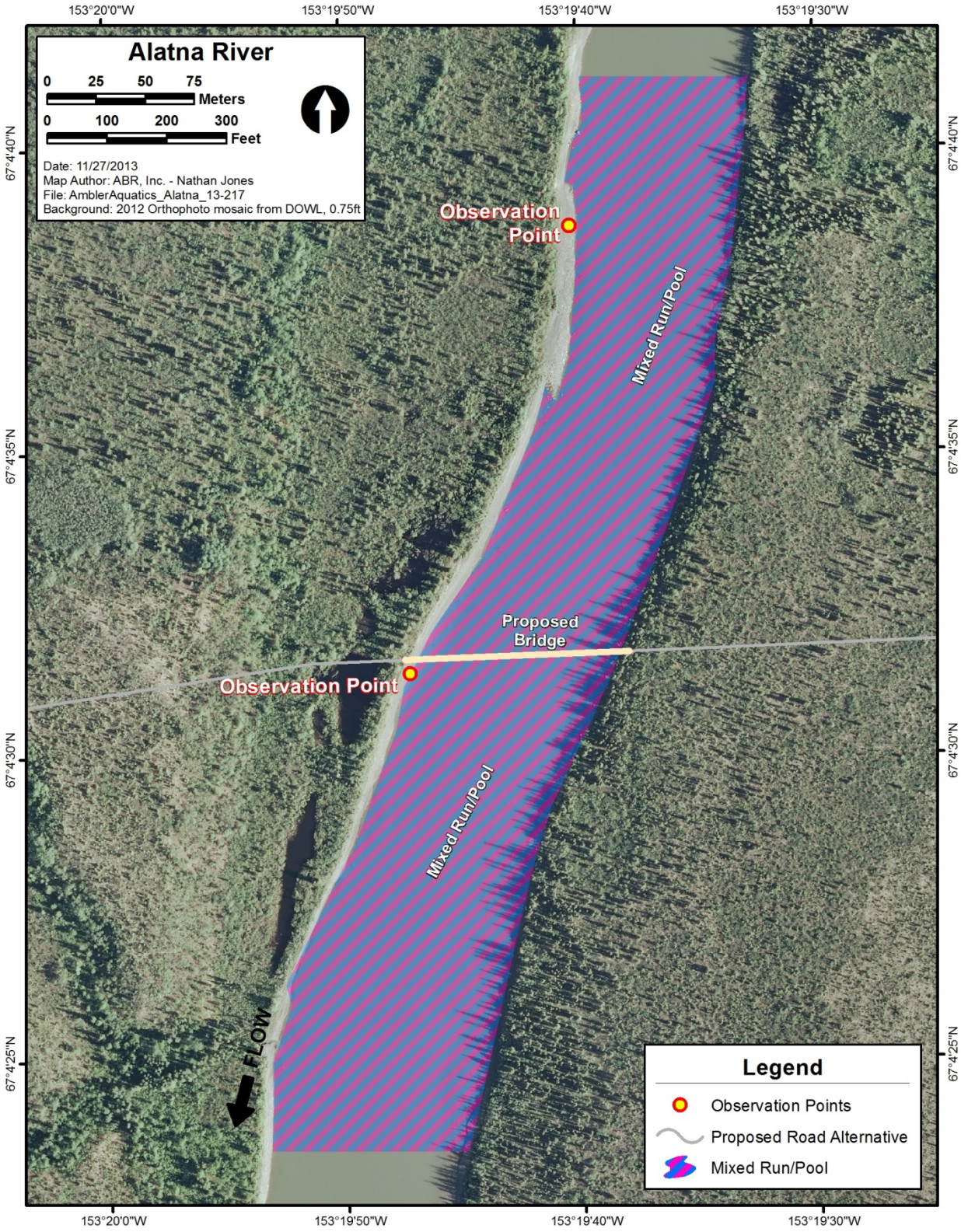



Figure 9. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Alatna River, Alaska, August 2013.

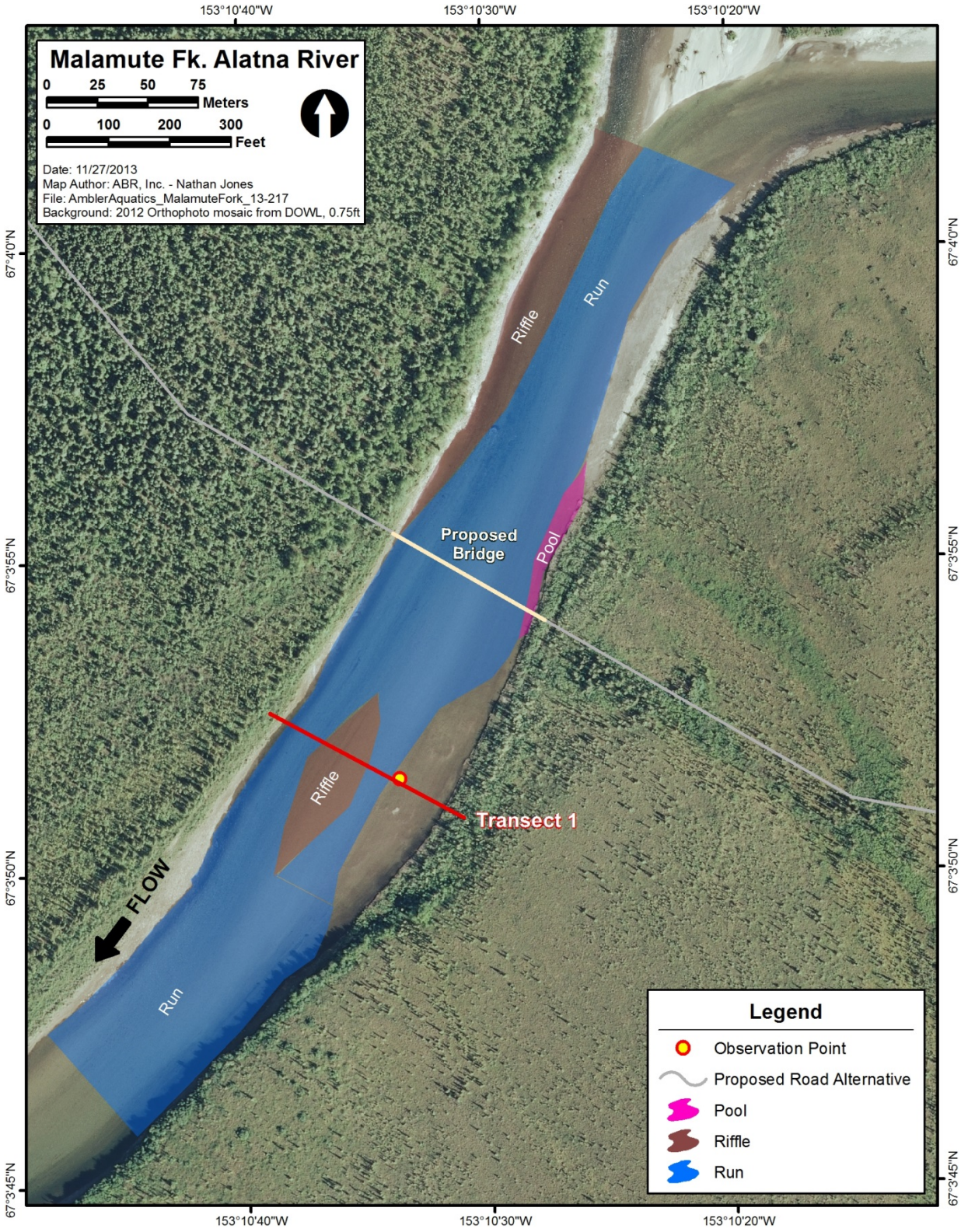



Figure 10. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Malamute Fork Alatna River, Alaska, August 2013.

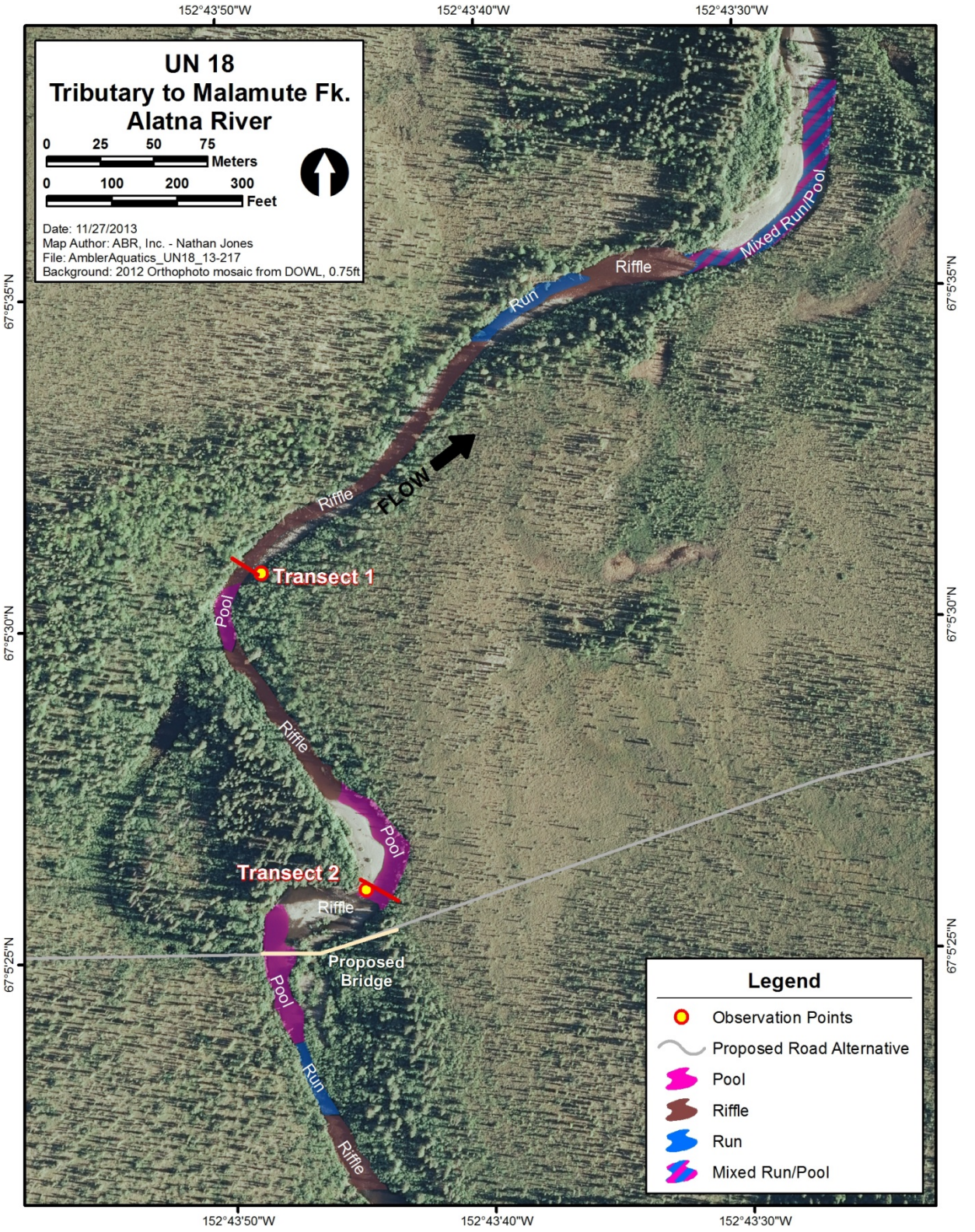



Figure 11. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of UN18, an unnamed tributary to the Malemute Fork Alatna River, Alaska, August 2013.

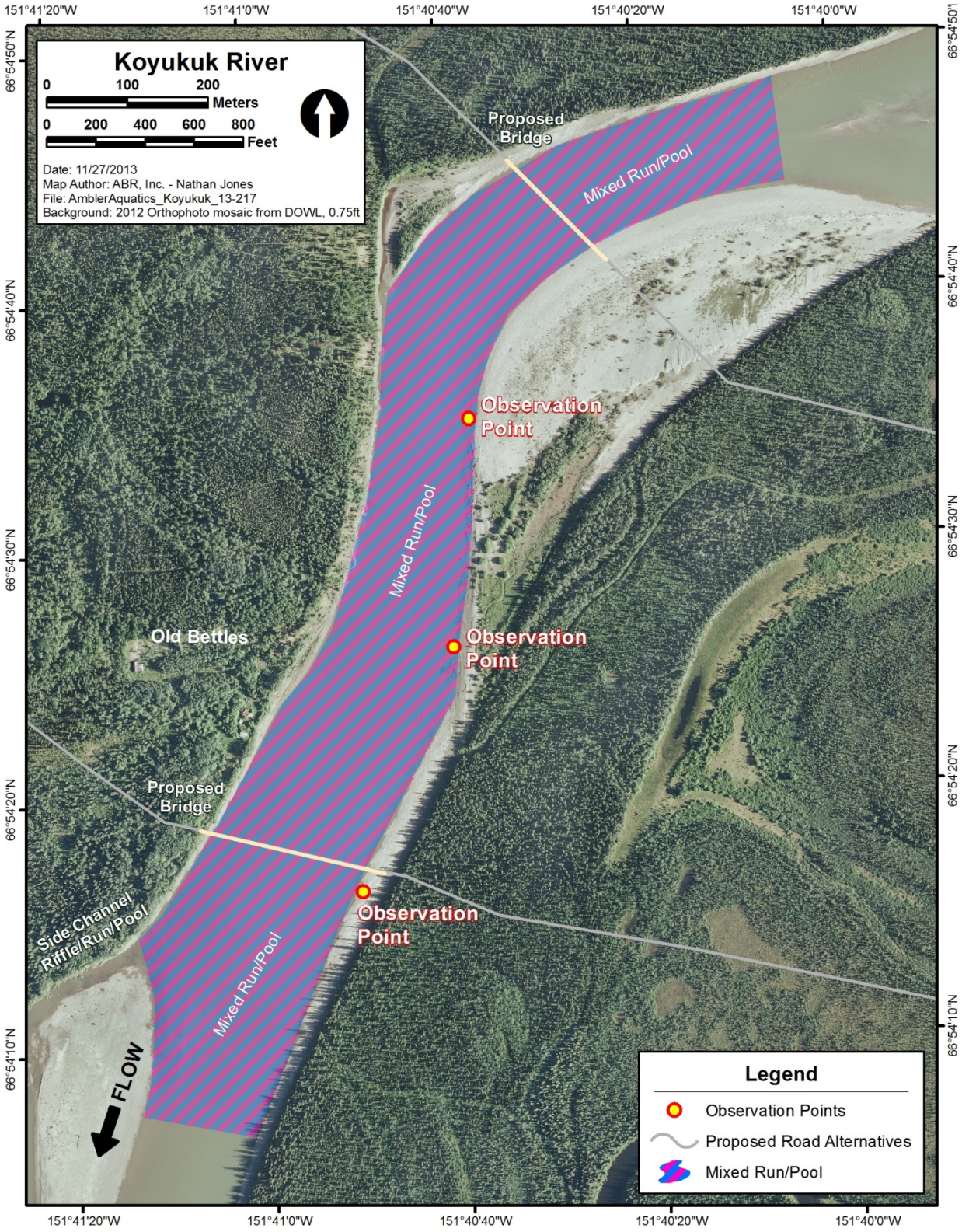



Figure 12. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Koyukuk River, Alaska, August 2013.

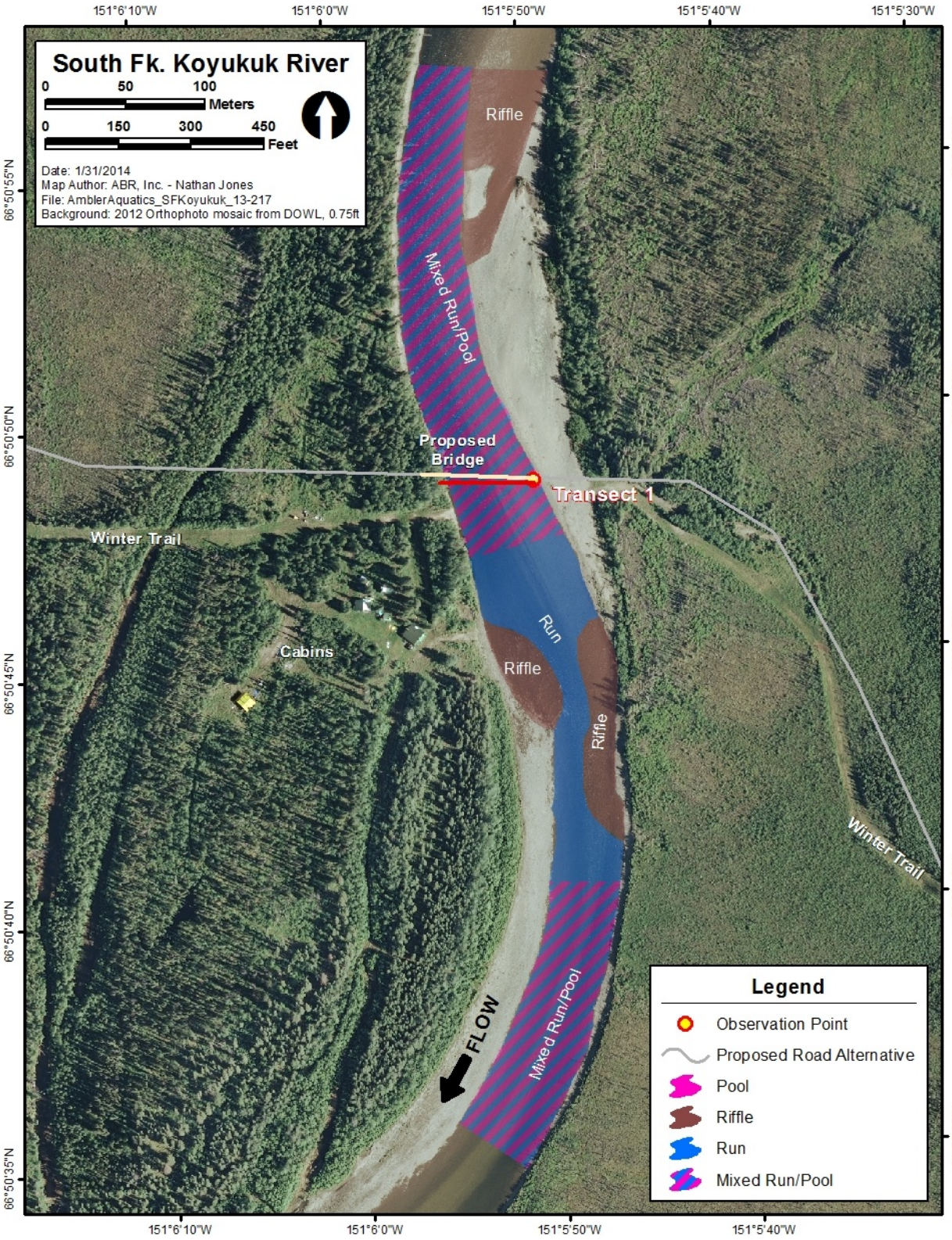



Figure 13. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the South Fork Koyukuk River, Alaska, August 2013.

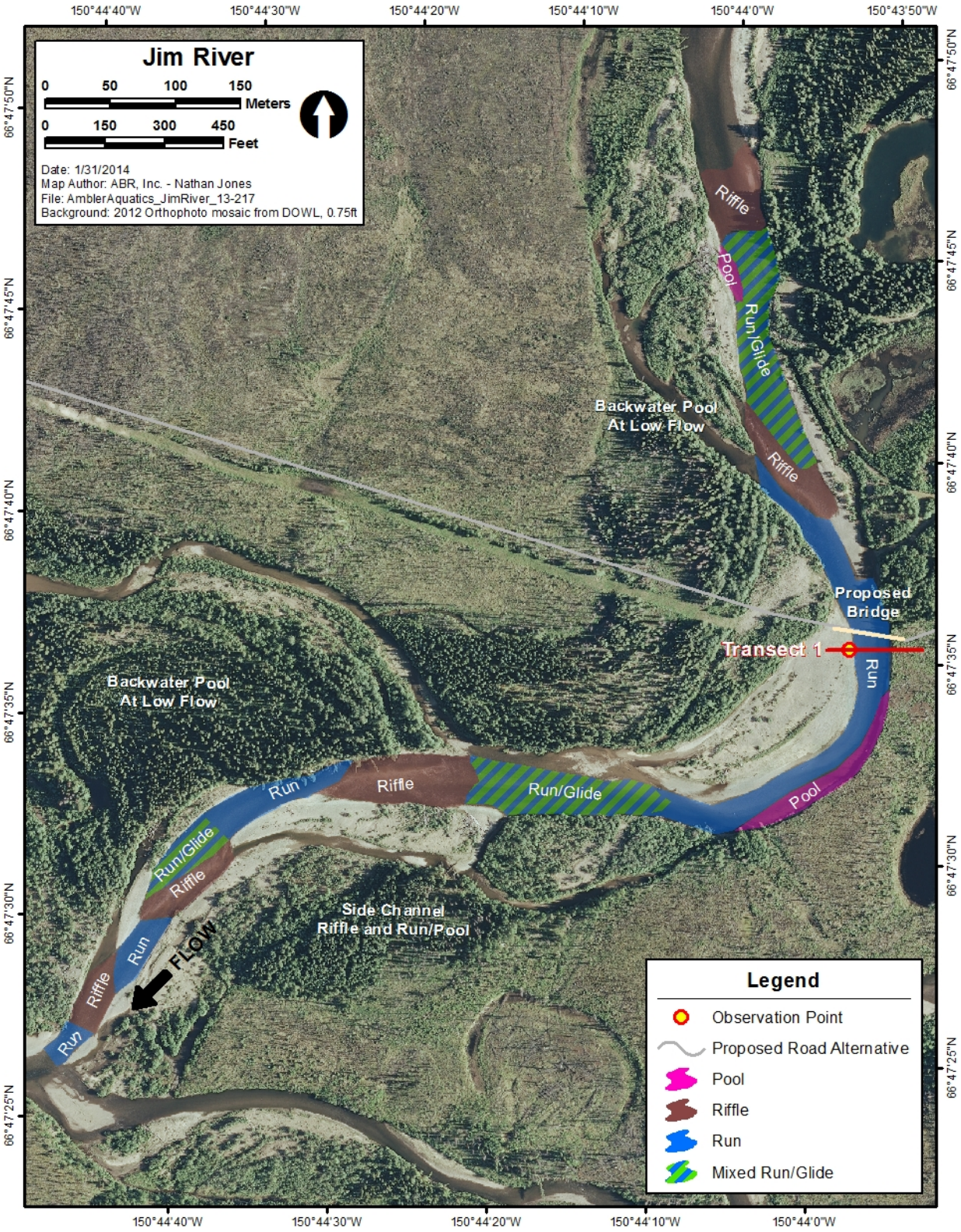



Figure 14. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the unnamed tributary to the Jim River, Alaska, August 2013.

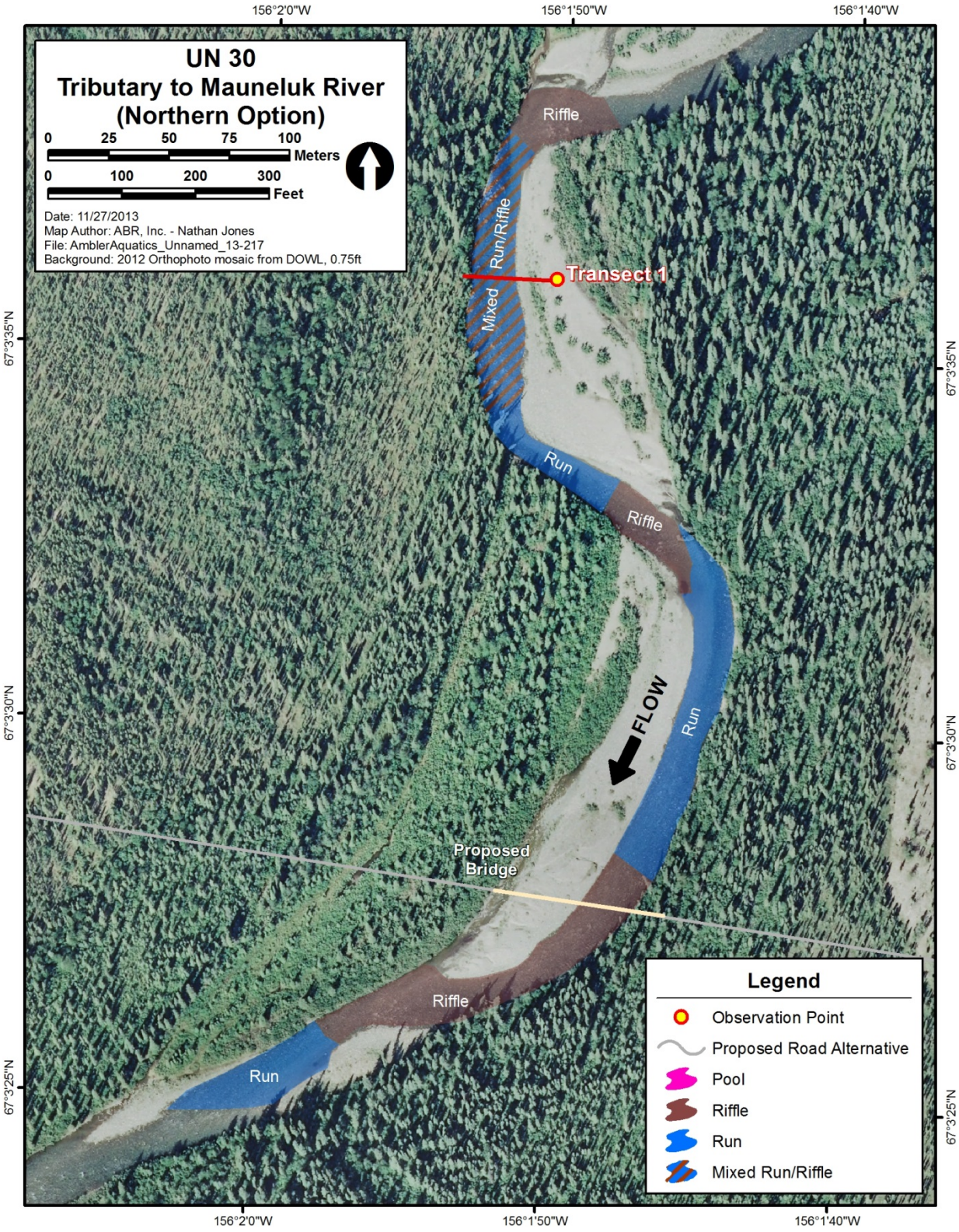



Figure 15. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of UN30, an unnamed tributary to the Mauneluk River on the northern road option, Alaska, August 2013.

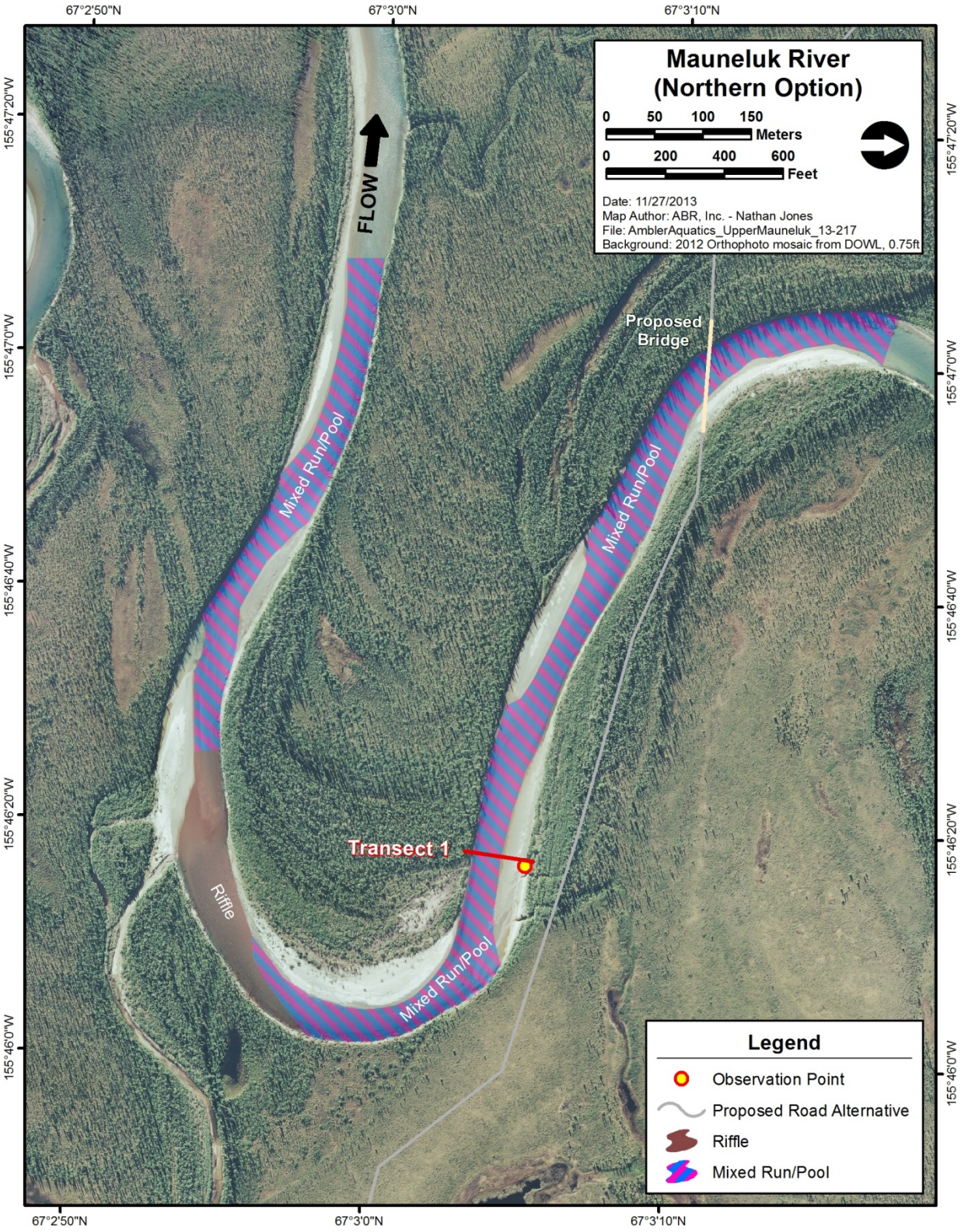



Figure 16. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Mauneluk River on the northern road option, Alaska, August 2013.

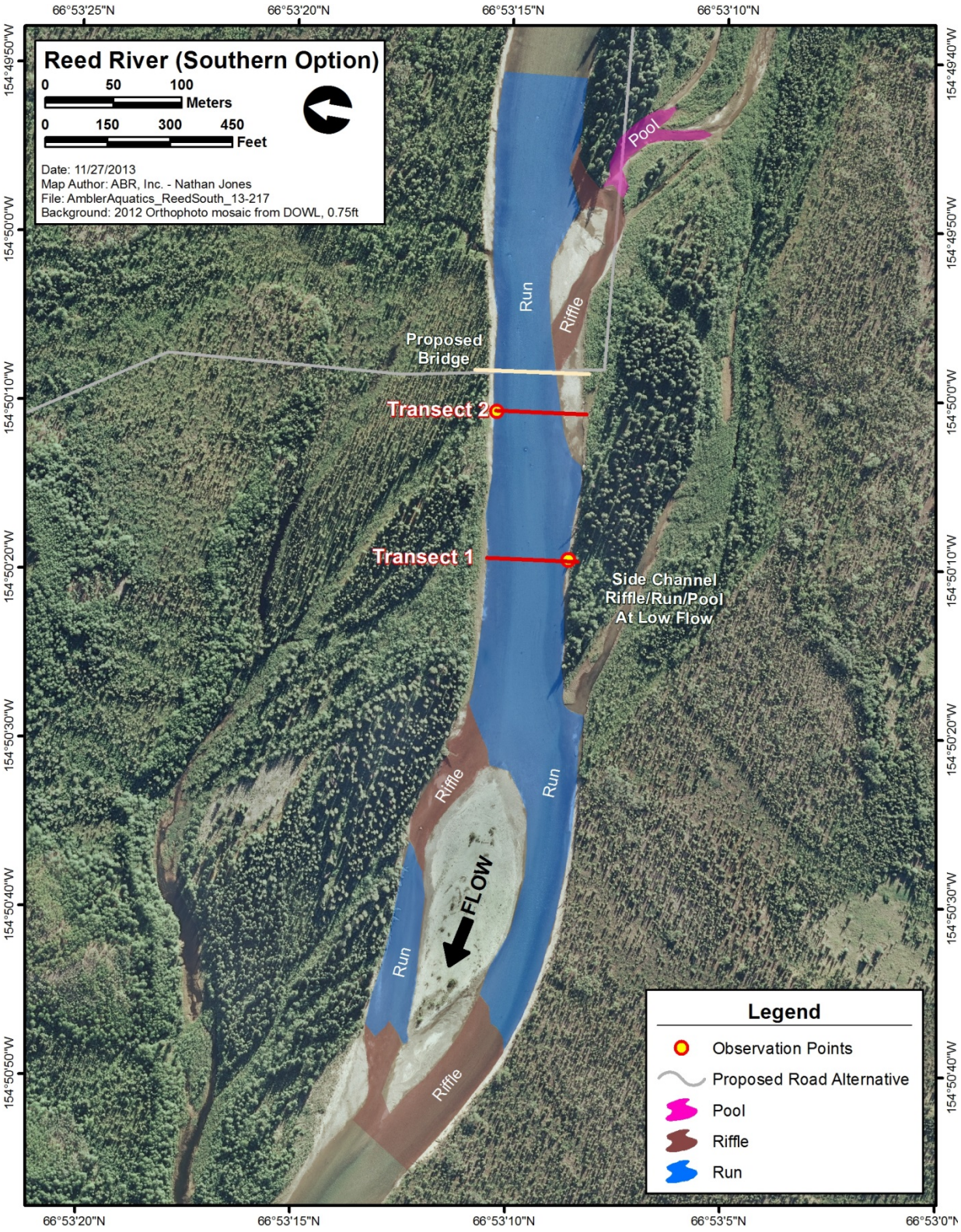



Figure 17. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Reed River on the southern road option, Alaska, August 2013.

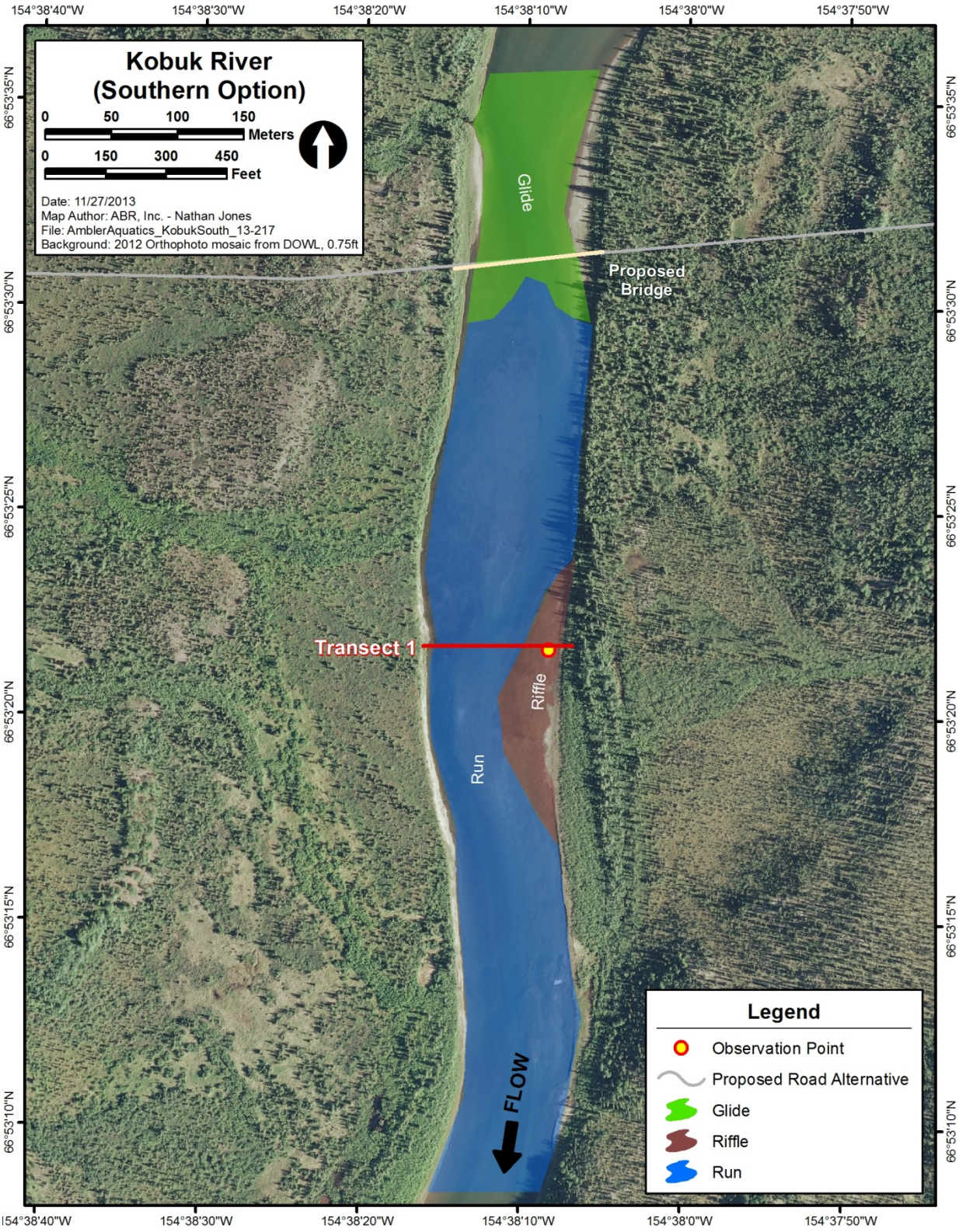



Figure 18. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of the Kobuk River on the southern road option, Alaska, August 2013.

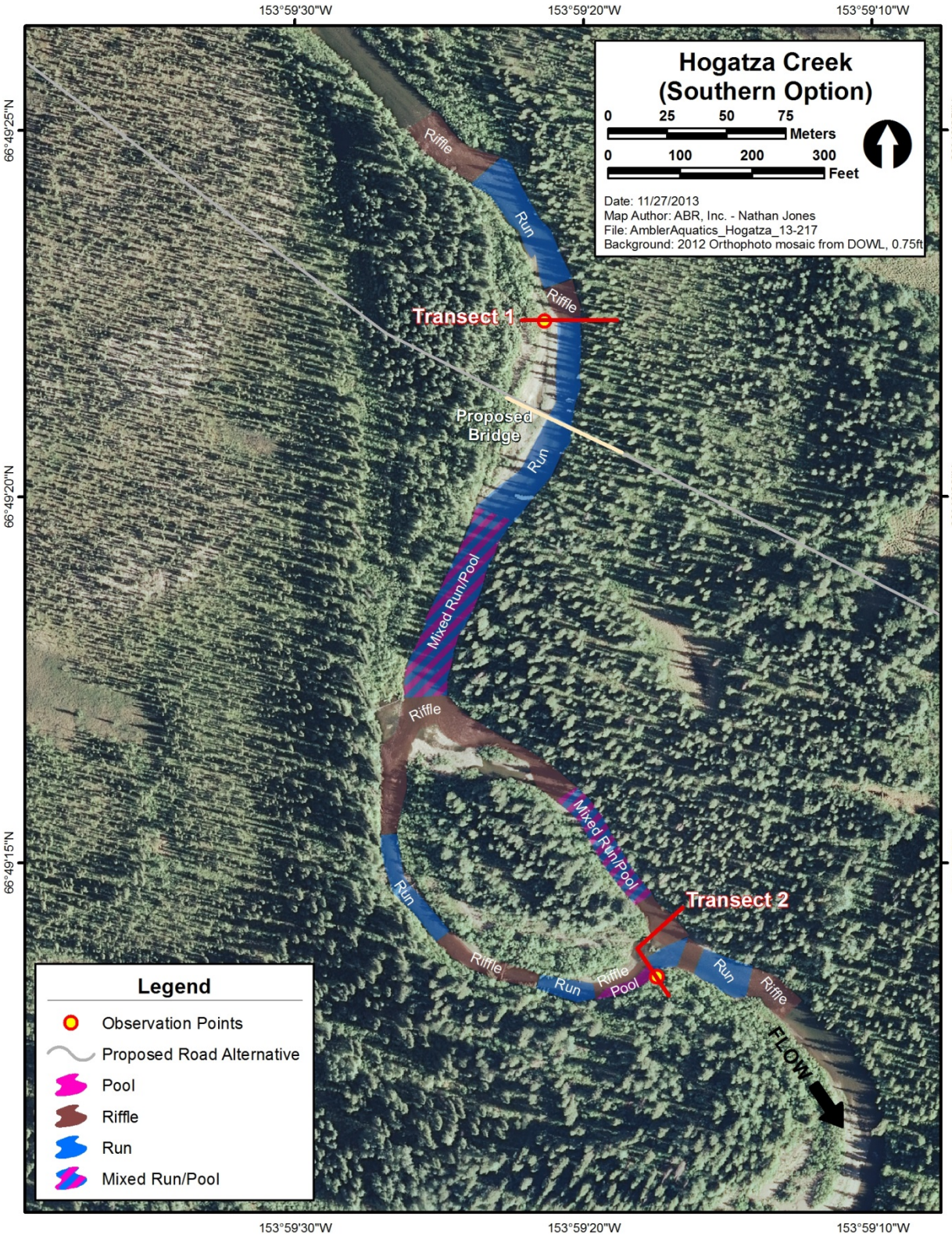



Figure 19. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of Hogatza Creek on the southern road option, Alaska, August 2013.

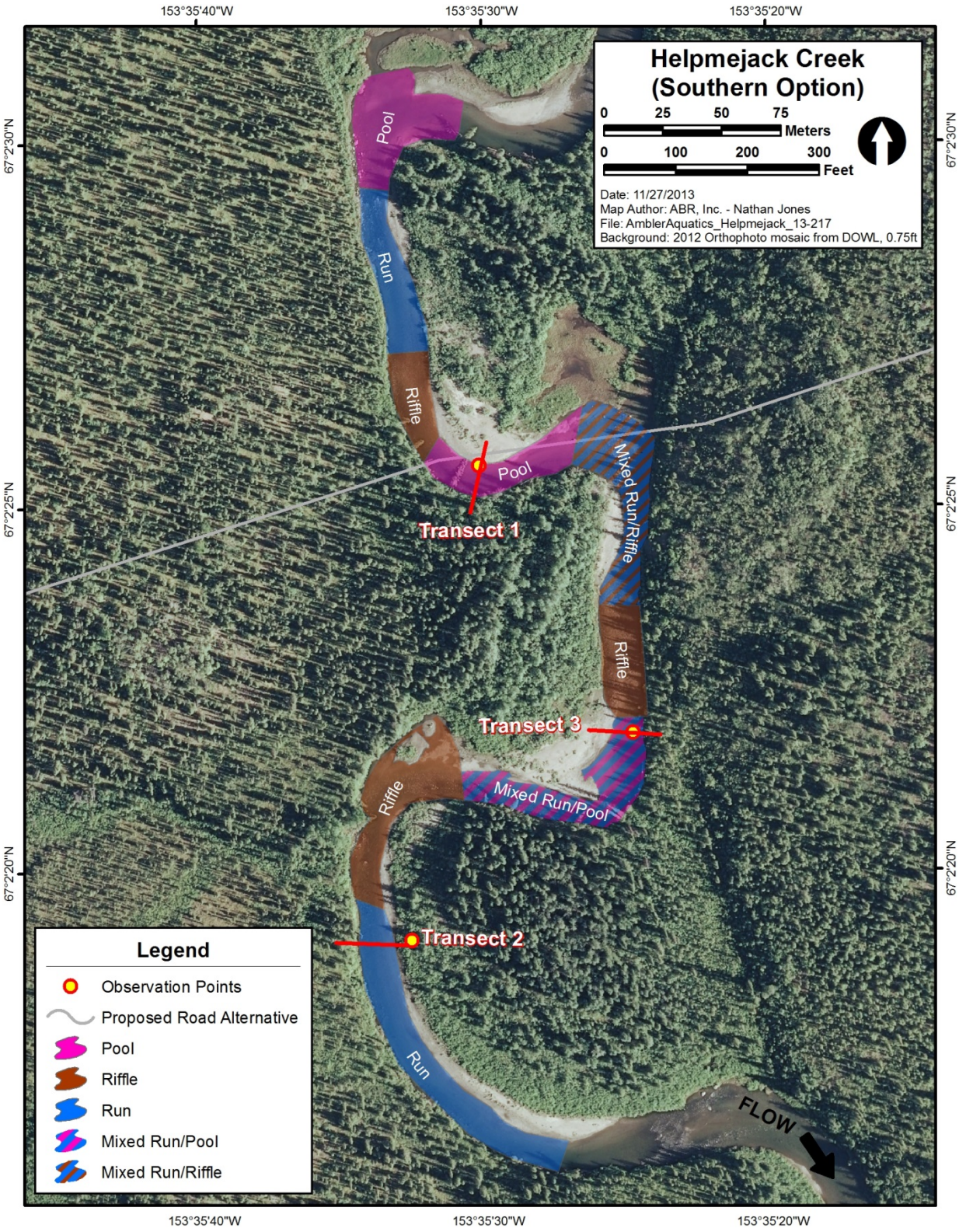



Figure 20. Stream habitat survey locations and flow characteristics at the proposed Brooks East Corridor crossing of Helpmejack Creek on the southern road option, Alaska, August 2013.

Appendix A. Anadromous Waters Catalog (AWC) nomination forms for Pacific salmon observed by ABR during 2012 fish surveys in waterbodies traversed by the Brooks East Corridor, Alaska. Forms were submitted to the Alaska Department of Fish and Game (ADFG) in September 2013.

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): AMBLER RIVER A-2

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Kogoluktuk River (331-00-10490-2307)

Name of Waterway: CANYON CREEK ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

| | | |
|---|---|---|
| Nomination # _____ | _____ Fisheries Scientist | _____ Date |
| Revision Year: _____ | _____ Habitat Operations Manager | _____ Date |
| Revision to: Atlas _____ Catalog _____ Both _____ | _____ AWC Project Biologist | _____ Date |
| Revision Code: _____ | _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| DOLLY VARDEN | 07/13/2013 | | ✓ | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT:** Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**
Two juvenile Dolly Varden (111 and 114 mm) caught in minnow traps by Jena Lemke and Matthew Apling of ABR. Minnow traps were set at N67.02888, W156.66255. Minnow traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for full methods and maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): SURVEY PASS A-2

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Alatna River (334-40-11000-2125-3661)

Name of Waterway: HELPMEJACK CREEK ☑ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

| | | |
|---|---|---|
| Nomination # _____ | _____ Fisheries Scientist | _____ Date |
| Revision Year: _____ | _____ Habitat Operations Manager | _____ Date |
| Revision to: Atlas _____ Catalog _____ Both _____ | _____ AWC Project Biologist | _____ Date |
| Revision Code: _____ | _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| DOLLY VARDEN | 07/16/2013 | | ✓ | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**
Two juvenile dolly varden caught at N 67.05835, W153.79528. one individual (FL=86mm) was caught using baited minnow traps. The other individual was caught by electrofishing (FL=122 mm). Fishers were Jena Lemke and Matthew Apling of ABR. See attached report for sampling methods and maps.


Name of Observer (please print): SABRINA GARCIA
Signature: Sabrina Garcia Date: 09/12/2013
Agency: ABR, Inc.
Address: 1225 E. International Airport Rd. Suite 101
Anchorage, AK 99518


This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): HUGHES D-2

Anadromous Waters Catalog Number of Waterway: 334-40-11000-2125-3355

Name of Waterway: HOGATZA RIVER ☑ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

| | | |
|---|---|---|
| Nomination # _____ | _____ Fisheries Scientist | _____ Date |
| Revision Year: _____ | _____ Habitat Operations Manager | _____ Date |
| Revision to: Atlas _____ Catalog _____ Both _____ | _____ AWC Project Biologist | _____ Date |
| Revision Code: _____ | _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| CHUM SALMON | 07/21/2012 | ✓ | | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**
Visual observation of two adult spawning chum salmon by Jena Lemke and Matthew Apling of ABR, Inc. Observations occurred at N 66.82131, W153.99037. Please see Figure 4 and plate 6 in the attached report for maps and photos.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/11/2013

Agency: ABR, INC.

Address: 1225 E. International Airport Dr. Ste. 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): SURVEY PASS A-3

Anadromous Waters Catalog Number of Waterway: 331-00-10490

Name of Waterway: KOBUK RIVER ☑ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

| | | |
|---|---|---|
| Nomination # _____ | _____ Fisheries Scientist | _____ Date |
| Revision Year: _____ | _____ Habitat Operations Manager | _____ Date |
| Revision to: Atlas _____ Catalog _____ Both _____ | _____ AWC Project Biologist | _____ Date |
| Revision Code: _____ | _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| CHUM SALMON | 09/04/2012 | ✓ | | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT:** Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**
Visual observation of spawning adult chum salmon by Jena Lemke and Matthew Appling of ABR. Observation occurred at N 67.02165, W 154.35763. Please see attached report for sampling methods and maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/11/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): AMBLER RIVER A-1

Anadromous Waters Catalog Number of Waterway: Mauneluk River (331-00-10490-2335)

Name of Waterway: Mauneluk River

☑ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

| | | |
|---|---|---|
| Nomination # _____ | _____ Fisheries Scientist | _____ Date |
| Revision Year: _____ | _____ Habitat Operations Manager | _____ Date |
| Revision to: Atlas _____ Catalog _____ Both _____ | _____ AWC Project Biologist | _____ Date |
| Revision Code: _____ | _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| CHUM SALMON | 07/25/2012 | | ✓ | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**
Three juvenile Chum Salmon caught via electrofishing by Jena Lemke and Matthew Apling of ABR, Inc. The three individuals measured 41, 55, and 57 mm. Capture occurred at N 67.00295, W 156.09182. Please see attached report for sampling methods and maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/11/2013

Agency: ABR, INC.

Address: 1225 E. International Airport Dr. suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): HUGHES D-4

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Kobuk River (331-00-10490)

Name of Waterway: REED RIVER

☑ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____

Revision Year: _____

Revision to: Atlas _____ Catalog _____ Both _____

Revision Code: _____

| | |
|---|---|
| Fisheries Scientist | Date |
| Habitat Operations Manager | Date |
| AWC Project Biologist | Date |
| Cartographer | Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| CHUM SALMON | 07/21/2012 | | ✓ | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Two juvenile chum salmon captured via electrofishing by Jena Lemke and Matthew Apling of ABR, Inc. The individuals were 36 and 38mm long. Please see attached report for sampling methods and maps. Juveniles observed at N 66.96365, W 154.81606.

Name of Observer (please print): SABRINA GARCIA

Signature: [signature]

Date: 09/11/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. Ste. 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): HUGHES D-4

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Kobuk River (331-00-10490)

Name of Waterway: REED RIVER ☑ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____

Revision Year: _____

Revision to: Atlas _____ Catalog _____ Both _____

Revision Code: _____

| | |
|---|---|
| Fisheries Scientist | Date |
| Habitat Operations Manager | Date |
| AWC Project Biologist | Date |
| Cartographer | Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| CHUM SALMON | 09 \| 04 \| 2012 | ✓ | | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Visual observation of adult chum salmon spawning area by Jena Lemke and Matthew Apling of ABR, Inc.
Adult observed at N 66.88630, W 154.83643.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/11/2013

Agency: ABR, INC.

Address: 1225 E. International Airport Dr. Ste. 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): AMBLER RIVER A-2

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Kogoluktuk River (331-00-10490-2307

Name of Waterway: RILEY CREEK

☑ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

| | | |
|---|---|---|
| Nomination # _____ | _____ Fisheries Scientist | _____ Date |
| Revision Year: _____ | _____ Habitat Operations Manager | _____ Date |
| Revision to: Atlas _____ Catalog _____ Both _____ | _____ AWC Project Biologist | _____ Date |
| Revision Code: _____ | _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| DOLLY VARDEN | 07/13/2013 | | ✓ | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**
Three juvenile Dolly Varden (102, 108, 128 mm) were captured in minnow traps by Jena Lemke and Matthew Apling. Minnow traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for sampling methods and maps. Traps were set at N67.05552, W156.70256.

Name of Observer (please print): SABRINA GARCIA

Signature: [signature] Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): SURVEY PASS A-1

Anadromous Waters Catalog Number of Waterway: N/A, closest is AWC 334-40-11000-2125

Name of Waterway: TOBUK CREEK ☑ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

| | | |
|---|---|---|
| Nomination # _____ | _____ Fisheries Scientist | _____ Date |
| Revision Year: _____ | _____ Habitat Operations Manager | _____ Date |
| Revision to: Atlas _____ Catalog _____ Both _____ | _____ AWC Project Biologist | _____ Date |
| Revision Code: _____ | _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| COHO SALMON | 07/16/2012 | | ✓ | ✓ | ✓ |
| CHINOOK SALMON | 07/16/2012 | | ✓ | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Fishing was conducted via electrofishing. Matthew Apling and Jena Lemke with ABR, Inc. were the observers/fishers. Fishing took place at N 67.07944, W 153.18635. The Coho salmon was a juvenile measured at 69mm, Chinook was 74mm. Only one individual from each species was found. Please see attached report for sampling methods and maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia

Date: 09/11/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): AMBLER RIVER B-2

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Ambler River (331-00-10490-2205)

Name of Waterway: ULANEAK CREEK ☑ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

| | | |
|---|---|---|
| Nomination # _____ | _____ Fisheries Scientist | _____ Date |
| Revision Year: _____ | _____ Habitat Operations Manager | _____ Date |
| Revision to: Atlas _____ Catalog _____ Both _____ | _____ AWC Project Biologist | _____ Date |
| Revision Code: _____ | _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| DOLLY VARDEN | 07/13/2013 | | ✓ | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**
8 juvenile Dolly Varden caught in minnow traps by Lena Lemke and Matthew Apling of ABR. Minnow traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for sampling methods and maps. Traps were set at N 67.39883, W 156.81866.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia

Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____

Revision 02/08

Comments (cont.):

Dolly Varden FL (mm) were:

112
109
108
109
124
87
83
98

See Appendix C in attached report

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): SURVEY PASS A-2

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Alatna River (334-40-11000-2125-3661)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

| | | |
|---|---|---|
| Nomination # _____ | _____ Fisheries Scientist | _____ Date |
| Revision Year: _____ | _____ Habitat Operations Manager | _____ Date |
| Revision to: Atlas _____ Catalog _____ Both _____ | _____ AWC Project Biologist | _____ Date |
| Revision Code: _____ | _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| CHUM SALMON | 07/23/2012 | ✓ | | ✓ | ✓ |
| CHINOOK SALMON | 07/23/2012 | ✓ | | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT:** Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**
Visual observation by Jena Lemke and Matthew Apling of an adult chum salmon (67.22524, -153.55644) and an adult chinook salmon (67.22868, -153.59320). Both observations were made during aerial surveys. The chum salmon spawning area was located less than 1 km upstream of the confluence of the unnamed tributary with the mainstem Alatna River and extended (see back)

Name of Observer (please print): SABRINA GARCIA

Signature: Gabrielgarcia Date: 09/11/2013

Agency: ABR, Inc.

Address: 1225 E International Airport Dr. Suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

Comments (cont.):
Approximately 100m upstream (see Figure 4; Plates 7 and 8 of the Report). The Chinook Salmon spawning area was documented approximately 1.8 km upstream (see Figure 6; Plates 9 and 10 of the attached report).

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): SURVEY PASS A-5

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Beaver Creek (331-00-10490-2437)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

| | | |
|---|---|---|
| Nomination # _____ | _____ Fisheries Scientist | _____ Date |
| Revision Year: _____ | _____ Habitat Operations Manager | _____ Date |
| Revision to: Atlas _____ Catalog _____ Both _____ | _____ AWC Project Biologist | _____ Date |
| Revision Code: _____ | _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| DOLLY VARDEN | 07/15/2013 | | ✓ | ✓ | ☑ |
| | | | | | ☐ |
| | | | | | ☐ |
| | | | | | ☐ |
| | | | | | ☐ |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**
Three juvenile dolly varden (75, 83, 144mm) caught in minnow traps by Jena Lemke and Matthew Appling. Traps were set at N 67.01060, W 155.08077. Traps were baited with disinfected salmon eggs and soaked overnight. See attached report for maps and sampling methods.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Rd. Suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): HUGHES D-5

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Beaver Creek (331-00-10490-2437)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

| | | |
|---|---|---|
| Nomination # _____ | _____ Fisheries Scientist | _____ Date |
| Revision Year: _____ | _____ Habitat Operations Manager | _____ Date |
| Revision to: Atlas _____ Catalog _____ Both _____ | _____ AWC Project Biologist | _____ Date |
| Revision Code: _____ | _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| DOLLY VARDEN | 07/24/2012 | | ✓ | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**
Two juvenile Dolly Varden (88 and 98mm) were caught via electrofishing by Jena Lemke and Matthew Apling. Fishing occurred at N 66.98333, W155.02530. Please see attached report for sampling methods and maps.

Name of Observer (please print): SABRINA GARCIA
Signature: Gabrielgarcia Date: 09/12/2013
Agency: ABR, Inc
Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): BETTLES D-2

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Jim River (334-40-11000-2125-3740-4080)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____

Revision Year: _____

Revision to: Atlas _____ Catalog _____ Both _____

Revision Code: _____

| | |
|---|---|
| Fisheries Scientist | Date |
| Habitat Operations Manager | Date |
| AWC Project Biologist | Date |
| Cartographer | Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| COHO SALMON | 07/20/2012 | | ✓ | ✓ | ✓ |
| CHINOOK SALMON | 07/20/2012 | | ✓ | ✓ | ✓ |
| | | | | | ☐ |
| | | | | | ☐ |
| | | | | | ☐ |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**
Nine coho salmon (55, 62, 49, 55, 66, 55, 52, 61, 55 mm) and one chinook salmon (48 mm) were caught during electrofishing surveys by Jena Lemke and Matthew Apling. Fishing occurred at N66.78089, W150.85132. Please see attached report for sampling methods and maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, INC.

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): BETTLES D-2

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Jim River (334-40-11000-2125-3740-4080)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____

Revision Year: _____

Revision to: Atlas _____ Catalog _____ Both _____

Revision Code: _____

| | |
|---|---|
| Fisheries Scientist | Date |
| Habitat Operations Manager | Date |
| AWC Project Biologist | Date |
| Cartographer | Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| COHO SALMON | 07/23/2012 | | ✓ | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Two coho salmon (FL = 61 and 62 mm) were caught during electrofishing surveys by Jena Lemke and Matthew Apling. Fishing occurred at N 66.83560, W150.64531. Please see attached report for sampling methods and maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): SURVEY PASS A-3

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Kichaiakaleq Creek

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

| | | |
|---|---|---|
| Nomination # _____ | _____ Fisheries Scientist | _____ Date |
| Revision Year: _____ | _____ Habitat Operations Manager | _____ Date |
| Revision to: Atlas _____ Catalog _____ Both _____ | _____ AWC Project Biologist | _____ Date |
| Revision Code: _____ | _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| DOLLY VARDEN | 09/07/2012 | | ✓ | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**
2 juvenile Dolly Varden (128 and 147 mm) caught in minnow traps by Jena Lemke and Matthew Apling. Minnow traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for sampling methods and maps. Traps were set at N67.02964, W154.01124.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): SURVEY PASS A-3

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Kobuk River (331-00-10490)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

| | | |
|---|---|---|
| Nomination # _____ | _____ Fisheries Scientist | _____ Date |
| Revision Year: _____ | _____ Habitat Operations Manager | _____ Date |
| Revision to: Atlas _____ Catalog _____ Both _____ | _____ AWC Project Biologist | _____ Date |
| Revision Code: _____ | _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| DOLLY VARDEN | 09/04/12 | | ✓ | ✓ | ✓ |
| | | | | | ☐ |
| | | | | | ☐ |
| | | | | | ☐ |
| | | | | | ☐ |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**
Two juvenile Dolly varden (128 and 130 mm) caught in minnow traps by Jena Lemke and Matthew Apling. Minnow traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for full sampling methods and maps. Traps were set at N 67.01901, W 154.44464.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): SURVEY PASS A-4

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Kobuk River (331-00-10490)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination #: _____

Revision Year: _____

Revision to: Atlas _____ Catalog _____ Both _____

Revision Code: _____

| | |
|---|---|
| _____ Fisheries Scientist | _____ Date |
| _____ Habitat Operations Manager | _____ Date |
| _____ AWC Project Biologist | _____ Date |
| _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| DOLLY VARDEN | 09/04/2012 | | ✓ | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**
3 juvenile Dolly Varden (116, 131, 146mm) caught in minnow traps by Jena Lemke and Matthew Apling. Minnow traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for full sampling methods and maps. Traps were set at N67.00066, W154.55439.

Name of Observer (please print): SABRINA GARCIA

Signature: Gabrielgarcia Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): WISEMAN A-6

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Malamute Fork Alatna River (334-40-11000-2125-3661-4100)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

| | | |
|---|---|---|
| Nomination # _____ | _____ Fisheries Scientist | _____ Date |
| Revision Year: _____ | _____ Habitat Operations Manager | _____ Date |
| Revision to: Atlas _____ Catalog _____ Both _____ | _____ AWC Project Biologist | _____ Date |
| Revision Code: _____ | _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| COHO SALMON | 07/16/2013 | | ✓ | ✓ | ✓ |
| CHUM SALMON | 07/16/2013 | | ✓ | ✓ | ✓ |
| | | | | | ☐ |
| | | | | | ☐ |
| | | | | | ☐ |

**IMPORTANT:** Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**
Four coho salmon (FL = 46, 48, 47, and 47 mm) and two chum salmon (FL = 38 and 44 mm) were caught using dipnets by Jena Lemke and Matthew Apling of ABR. Capture occurred at N 67.11074, W152.93070. See attached report for sampling methods and maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): WISEMAN A-6

Anadromous Waters Catalog Number of Waterway: 334-40-11000-2125-3661-4100

Name of Waterway: UNNAMED TRIB. TO MALAMUTE FORK ALATNA RIVER ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

| | | |
|---|---|---|
| Nomination # _____ | _____ Fisheries Scientist | _____ Date |
| Revision Year: _____ | _____ Habitat Operations Manager | _____ Date |
| Revision to: Atlas _____ Catalog _____ Both _____ | _____ AWC Project Biologist | _____ Date |
| Revision Code: _____ | _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| COHO SALMON | 07/16/2013 | | ✓ | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**

Two juvenile Coho Salmon (57 and 58mm) were captured in minnow traps by Jena Lemke and Matthew Apling. Minnow traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for methods and maps. Traps were set at N 67.10036, W 152.74847

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99501

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): AMBLER RIVER A-1

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Maunelu K River (331-00-10490-2335

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

| | | |
|---|---|---|
| Nomination # _____ | _____ Fisheries Scientist | _____ Date |
| Revision Year: _____ | _____ Habitat Operations Manager | _____ Date |
| Revision to: Atlas _____ Catalog _____ Both _____ | _____ AWC Project Biologist | _____ Date |
| Revision Code: _____ | _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| CHUM SALMON | 07/25/2012 | | ✓ | ✓ | ☑ |
| | | | | | ☐ |
| | | | | | ☐ |
| | | | | | ☐ |
| | | | | | ☐ |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
Two juvenile chum salmon (52 and 55mm) caught via electrofishing by Jena Lemke and Matthew Apling. Fish were captured at N67.02696, W156.04826. Please see attached report for sampling methods and maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Gabriela Garcia Date: 09/11/2013

Agency: ABR, INC.

Address: 1225 E. International Airport Rd. suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): AMBLER RIVER A-1

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Maunelu River (331-00-10490-2335)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

| | | |
|---|---|---|
| Nomination # _____ | _____ Fisheries Scientist | _____ Date |
| Revision Year: _____ | _____ Habitat Operations Manager | _____ Date |
| Revision to: Atlas _____ Catalog _____ Both _____ | _____ AWC Project Biologist | _____ Date |
| Revision Code: _____ | _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| DOLLY VARDEN | 07/13/2013 | | ✓ | ✓ | ✓ |
| | | | | | ☐ |
| | | | | | ☐ |
| | | | | | ☐ |
| | | | | | ☐ |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**
Four juvenile Dolly Varden (115, 115, 122, 139 mm) caught in minnowtraps by Jena Lemke and Matthew Apling. Minnow traps were set at N 67.04256, W 156.13206. Minnow traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for full methods and maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, INC

Address: 1225 E. International Airport Dr. suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): SURVEY PASS A-6

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Mauneluk River (331-00-10490-2335)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

| | | |
|---|---|---|
| Nomination # _____ | _____ Fisheries Scientist | _____ Date |
| Revision Year: _____ | _____ Habitat Operations Manager | _____ Date |
| Revision to: Atlas _____ Catalog _____ Both _____ | _____ AWC Project Biologist | _____ Date |
| Revision Code: _____ | _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| DOLLY VARDEN | 07/14/2013 | | ✓ | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including number of fish and life stages observed, sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**
20 juvenile Dolly Varden caught in minnow traps by Jena Lemke and Matthew Apling of ABR. Minnow traps were set at N67.02217, W155.84178. Traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for full sampling methods and maps. See back.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc

Address: 1225 E. International Airport Dr. suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

Comments (cont.):

Dolly Varden lengths were (for K length, mm):

| | | |
|---|---|---|
| 110 | 100 | 123 |
| 129 | 123 | 114 |
| 118 | 117 | 168 |
| 111 | 97 | 128 |
| 135 | 99 | 122 |
| 102 | 125 | 78 |
| 100 | 113 | |

see Appendix C in attached report.

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): AMBLER RIVER A-1

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Mauneluk River (331-00-10490-2335)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

Nomination # _____

Revision Year: _____

Revision to: Atlas _____ Catalog _____ Both _____

Revision Code: _____

| | |
|---|---|
| _____ Fisheries Scientist | _____ Date |
| _____ Habitat Operations Manager | _____ Date |
| _____ AWC Project Biologist | _____ Date |
| _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| DOLLY VARDEN | 07/14/2013 | | ✓ | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT:** Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**
19 juvenile Dolly Varden caught in minnow traps by Jena Lemke and Matthew Apling of ABR. Minnow traps were set at N67.12383, W156.00801. Traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for full sampling methods and maps. See back.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

Comments (cont.):

Dolly Varden lengths were (fork length, mm):

| | | |
|---|---|---|
| 87 | 150 | 80 |
| 107 | 99 | 95 |
| 129 | 97 | 96 |
| 112 | 98 | 69 |
| 119 | 102 | |
| 94 | 73 | |
| 101 | 88 | |
| | 87 | |

See Appendix C in attached report.

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): SURVEY PASS_A-6

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Mauneluk River (331-00-10490-2335)

Name of Waterway: UNNAMED TRIBUTARY  USGS Name  Local Name

✓ Addition  Deletion  Correction  Backup Information

For Office Use

| | |
|---|---|
| Nomination # | Fisheries Scientist / Date |
| Revision Year: | Habitat Operations Manager / Date |
| Revision to: Atlas ____ Catalog ____ Both ____ | AWC Project Biologist / Date |
| Revision Code: | Cartographer / Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| DOLLY VARDEN | 07/14/2013 | | ✓ | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

Comments:
6 juvenile Dolly Varden caught in minnow traps by Jena Lemke and Matthew Apling of ABR. Minnow traps were set at N67.05437, W155.81388. Traps were baited with disinfected salmon eggs and left to soak overnight. See attached report for full sampling methods and maps. See back.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia  Date: 09/12/2013

Agency: ABR, Inc

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

Comments (cont.):

Dolly Varden fork lengths (mm) were:

95

104

114

117

118

126

See Appendix C in attached report.

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: INTERIOR

USGS Quad(s): SURVEY PASS A-6

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Mauneluk River (331-00-10490-2335)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

| | |
|---|---|
| Nomination # _____ | _____ Fisheries Scientist _____ Date |
| Revision Year: _____ | _____ Habitat Operations Manager _____ Date |
| Revision to: Atlas _____ Catalog _____ Both _____ | _____ AWC Project Biologist _____ Date |
| Revision Code: _____ | _____ Cartographer _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| DOLLY VARDEN | 07/26/2012 | | ✓ | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**
Two juvenile Dolly Varden (85 and 127 mm FL) caught via electrofishing by Jena Lemke and Matthew Apling. Fishing occurred at N67.12433, W155.63481. Please see attached report for sampling methods and maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/12/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Dr. Suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

State of Alaska
Department of Fish and Game
Division of Sport Fish

Nomination Form
Anadromous Waters Catalog

Region: ARCTIC

USGS Quad(s): AMBLER RIVER A-1

Anadromous Waters Catalog Number of Waterway: N/A, tributary to Mauneluk River (331-00-10490-2335)

Name of Waterway: UNNAMED TRIBUTARY ☐ USGS Name ☐ Local Name

☑ Addition ☐ Deletion ☐ Correction ☐ Backup Information

For Office Use

| | | |
|---|---|---|
| Nomination # _____ | _____ Fisheries Scientist | _____ Date |
| Revision Year: _____ | _____ Habitat Operations Manager | _____ Date |
| Revision to: Atlas _____ Catalog _____ Both _____ | _____ AWC Project Biologist | _____ Date |
| Revision Code: _____ | _____ Cartographer | _____ Date |

OBSERVATION INFORMATION

| Species | Date(s) Observed | Spawning | Rearing | Present | Anadromous |
|---|---|---|---|---|---|
| CHUM SALMON | 07/25/2012 | ✓ | | ✓ | ✓ |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**IMPORTANT**: Provide all supporting documentation that this water body is important for the spawning, rearing or migration of anadromous fish, including: number of fish and life stages observed; sampling methods, sampling duration and area sampled; copies of field notes; etc. Attach a copy of a map showing location of mouth and observed upper extent of each species, as well as other information such as: specific stream reaches observed as spawning or rearing habitat; locations, types, and heights of any barriers; etc.

**Comments:**
Visual observation of adult chum salmon spawning area by Jena Lemke and Matthew Apling. Observation occurred at N 67.03453, W156.03934. Please see attached report for sampling methods and area maps.

Name of Observer (please print): SABRINA GARCIA

Signature: Sabrina Garcia Date: 09/11/2013

Agency: ABR, Inc.

Address: 1225 E. International Airport Rd. suite 101
Anchorage, AK 99518

This certifies that in my best professional judgment and belief the above information is evidence that this waterbody should be included in or deleted from the Anadromous Waters Catalog.

Signature of Area Biologist: _____ Date: _____ Revision

02/08

Appendix B. Raw stream habitat data collected at survey transects on waterbodies traversed by the Brooks East Corridor, Alaska, August 2013.

| | | | |
|---|---|---|---|
| **Site Name** | SH-T1-13 | **Event Code** | |
| **Date** | 12 August 2013 | **Time** | 10:43 |
| **Latitude N** | 67.120893 | **Longitude W** | 156.985129 |
| **Observers** | JCS, MMA, SDG | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 9.5 °C | Bankfull Width | 59 m |
| Dissolved Oxygen | 100% | Wetted Width | 52 m |
| Dissolved Oxygen | 11.32 mg/L | Thalweg Depth | not measured (unwadeable) |
| Conductivity | 115.3 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.164 mS/cm | Stream Gradient | < 1 % |
| pH | 6.58 | Stream Stage | Low |
| Turbidity | 1.92 NTU | Water Color | Mostly clear/Humic |

## Bank Angle Sketches

LB Angle- Not measured (unwadeable)

RB Angle- 115°

## Substrate (inorganic) = 100%

| Type | Diameter | % Composition |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 5 |
| Cobble | 64-256mm (2.5-10in) | 5 |
| Gravel | 2-64mm (0.1-2.5in) | 5 |
| Sand | 0.06-2mm | 5 |
| Silt | 0.06-2mm | 40 |
| Clay | 0.004-0.06 mm | 40 |

## Flow

Crew was unable to take flow measurements because transect was unwadeable

**Comments:**

Flowing at 0.33 m/s at the surface, generally it is slow flowing.

Visual observation of approximately 5 inch juvenile fish

Photos:

US-0665

DS-0666

LB-0667

RB-0668

Substrate photos taken 15 August 2013-0823,0824

| | | | |
|---|---|---|---|
| **Site Name** | SH-T1-13 | **Event Code** | |
| **Date** | 12 August 2013 | **Time** | 11:34 |
| **Latitude N** | 67.120893 | **Longitude W** | 156.985129 |
| **Observers** | JCS, MMA, SDG | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 1 |
| Macrophytes | 2 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 0 |
| Overhanging Vegetation | 1 |
| Undercut Bank | 0 |
| Boulders | 1 |
| Artificial Structures | 0 |

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

**Comments:**

Stream was unwadeable due to fines. Slack to slow flow. Low water level, potential rearing fish habitat.
Bacterial foam flowing at the surface.
Islands present now due to low flow- likely submerged at high water.

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| 30% cover by black spruce, the only tree greater than 5 m.<br>More dense upstream, less dense downstream. | No canopy 10+ m from the bank. |
| Understory (0.5 - 5 m) | |
| Mixed coniferous and deciduous (higher willow density).<br>75-80% willow cover, grasses next highest density | Dominated by willow and tall grasses. |
| Ground (< 0.5 m) | |
| Low percentage of open, bare ground.<br>Mostly grasses. Low percentage of down wood, mostly within bankfull width. | Not much barren ground, less than 5%.<br>Mostly grasses. |

| | | | |
|---|---|---|---|
| **Site Name** | SH-T2-13 | **Event Code** | |
| **Date** | 12 August 2013 | **Time** | 12:20 |
| **Latitude N** | 67.120226 | **Longitude W** | 156.979087 |
| **Observers** | JCS, SDG, MMA | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 9.9°C | Bankfull Width | 37 m |
| Dissolved Oxygen | 102.10% | Wetted Width | 49 m |
| Dissolved Oxygen | 11.51 mg/L | Thalweg Depth | 0.85 m |
| Conductivity | 115.7 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.162 mS/cm | Stream Gradient | 1% |
| pH | 7.95 | Stream Stage | Low |
| Turbidity | 1.71 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle - 175°

RB Angle-165°

## Substrate (inorganic) = 100%

| **Type** | **Diameter** | **% Composition** |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 5 |
| Cobble | 64-256mm (2.5-10in) | 30 |
| Gravel | 2-64mm (0.1-2.5in) | 40 |
| Sand | 0.06-2mm | 25 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| RB | 1 | 1.85 | 36 | 0.25 |
| | 2 | 5.55 | 58 | 0.85 |
| | 3 | 9.25 | 83 | 0.79 |
| | 4 | 12.95 | 65 | 1.07 |
| | 5 | 16.65 | 27 | 0.98 |
| | 6 | 20.35 | 47 | 0.65 |
| | 7 | 24.05 | 29 | 0.47 |
| | 8 | 27.75 | 20 | 0.31 |
| | 9 | 31.45 | 17 | 0.19 |
| LB | 10 | 35.15 | 13 | 0.09 |

**Comments:**

Right bank is higher than left. Area of transect is typical of most of 2,000 ft corridor, a shallow (< 2 ft) long run composed of cobble, boulder, gravel, sand. Returned to get flow measurements on 13 Aug.

Substrate photos taken 15 August 2013- 0819,0820,0821,0822

Photos: 0669 (US), 0671 (DS), 0670 (LB), 0672 (RB)

| | | | |
|---|---|---|---|
| **Site Name** | SH-T2-13 | **Event Code** | |
| **Date** | 12 August 2013 | **Time** | 12:20 |
| **Latitude N** | 67.120226 | **Longitude W** | 156.979087 |
| **Observers** | JCS, SDG, MMA | | |

Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 0 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 0 |
| Overhanging Vegetation | 1 |
| Undercut Bank | 0 |
| Boulders | 1 |
| Artificial Structures | 0 |

| |
|---|
| 0 = Absent |
| 1 = Sparse (<10%) |
| 2=Moderate (10-40%) |
| 3=Heavy (40-75%) |
| 4=Very Heavy (>75%) |

**Comments:**

Mostly cobble and gravel with a few boulders on right bank, lots of sand on left bank. Figured out flowmeter had dead batteries (returned Aug 13).

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| None. | 5% Black Spruce. |
| Understory (0.5 - 5 m) | |
| Grasses, 5-10%<br>Willow, 10-20% | Grasses, 10%<br>Small spruce, 10%<br>Willow, 50%<br>Berries/shrubs, 30%<br>(High/Low Cran, Blueberry, Salmonberry) |
| Ground (< 0.5 m) | |
| Short grass, 25%<br>Small willow, 5%<br>Bare ground, 50% minimum | Fireweed, 5%<br>Bare ground, 20%<br>Grass, 50%<br>Willow, 25% |

| | | | |
|---|---|---|---|
| **Site Name** | SH-T3-13 | **Event Code** | |
| **Date** | 12 August 2013 | **Time** | 15:19 |
| **Latitude N** | 67.117791 | **Longitude W** | 156.968715 |
| **Observers** | JCS, SDG, MMA | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 10.5 °C | Bankfull Width | 49 m |
| Dissolved Oxygen | 106.90% | Wetted Width | 40 m |
| Dissolved Oxygen | 11.92 mg/L | Thalweg Depth | 0.82 m |
| Conductivity | 116.7 uS/cm | 48 hr. Precipita | Low |
| Sp. Cond. | 0.161 mS/cm | Stream Gradier | 0.50% |
| pH | 7.57 | Stream Stage | Low |
| Turbidity | 1.79 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle- 115°

RB Angle- 175°

## Substrate (inorganic) = 100%

| **Type** | **Diameter** | **% Composition** |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 5 |
| Cobble | 64-256mm (2.5-10in) | 35 |
| Gravel | 2-64mm (0.1-2.5in) | 40 |
| Sand | 0.06-2mm | 20 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| RB | 1 | 2 | 2 | 0.1 |
| | 2 | 6 | 33 | 0.44 |
| | 3 | 10 | 34 | 0.73 |
| | 4 | 14 | 45 | 0.9 |
| | 5 | 18 | 65 | 0.78 |
| | 6 | 22 | 62 | 0.87 |
| | 7 | 26 | 60 | 0.86 |
| | 8 | 30 | 35 | 0.38 |
| | 9 | 34 | 55 | 0.38 |
| LB | 10 | 38 | 39 | 0.16 |

**Comments:**

Flow was measured 8/13 because of dead batteries 8/12.

Photos: 0677 (US), 0678 (DS), 0680 (LB), 0681 (RB)

8 inch Arctic Grayling caught by Brett using rod and reel

Substrate photos taken 15 August 2013-0815,0816,0817

| | | | |
|---|---|---|---|
| **Site Name** | SH-T3-13 | **Event Code** | |
| **Date** | 12 August 2013 | **Time** | 15:19 |
| **Latitude N** | 67.117791 | **Longitude W** | 156.968715 |
| **Observers** | JCS, SDG, MMA | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 2 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 1 |
| Overhanging Vegetation | 2 |
| Undercut Bank | 2 |
| Boulders | 1 |
| Artificial Structures | 0 |

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

**Comments:**
Left bank angles variable (low angles, up to 90 degrees, and undercut in some places)

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| Canopy dominated by black spruce-<br>10% cover. | No canopy 10 m from bank. |
| Understory (0.5 - 5 m) | |
| Mostly willow, other woody shrubs,<br>possibly alder (up to 50% cover).<br>Tall grasses (up to 25%) | 5-10% mostly willow<br><5% grasses |
| Ground (< 0.5 m) | |
| Bare, 25%<br>Small saplings and grasses | 80% bare with gravel and sand<br>10% saplings<br>10% grasses |

| | | | |
|---|---|---|---|
| **Site Name** | KG-T1-13 | **Event Code** | |
| **Date** | 13 August 2013 | **Time** | 12:16 |
| **Latitude N** | 67.016932 | **Longitude W** | 156.694493 |
| **Observers** | JCS, SDG, MMA | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 11.3 °C | Bankfull Width | 120 m |
| Dissolved Oxygen | 103.90% | Wetted Width | 102 m |
| Dissolved Oxygen | 11.35 mg/L | Thalweg Depth | 1.02 m |
| Conductivity | 195.2 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.264 mS/cm | Stream Gradient | <1 % |
| pH | 7.83 | Stream Stage | Low |
| Turbidity | 0.99 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle- 175°

RB Angle- 160°

## Substrate (inorganic) = 100%

| **Type** | **Diameter** | **% Composition** | |
|---|---|---|---|
| | | **Main Channel** | **Side Channel** |
| Bedrock | | 0 | 0 |
| Boulder | >256mm (10in) | 0 | 5 |
| Cobble | 64-256mm (2.5-10in) | 5 | 20 |
| Gravel | 2-64mm (0.1-2.5in) | 5 | 25 |
| Sand | 0.06-2mm | 90 | 50 |
| Silt | 0.06-2mm | 0 | 0 |
| Clay | 0.004-0.06 mm | 0 | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) | Channel |
|---|---|---|---|---|---|
| LB | 1 | 5 | 40 | 0.27 | Main |
| | 2 | 15 | 81 | 0.53 | Main |
| | 3 | 25 | 79 | 0.54 | Main |
| | 4 | 35 | 63 | 0.45 | Main |
| | 5 | 45 | 65 | 0.48 | Main |
| | 6 | 55 | 86 | 0.39 | Main |
| RB | 7 | 60 | 43 | 0.3 | Main |
| LB | 8 | 81 | 20 | 0.03 | Side |
| | 9 | 85 | 38 | 0.11 | Side |
| | 10 | 89 | 63 | 0.25 | Side |
| | 11 | 93 | 75 | 0.27 | Side |
| | 12 | 97 | 112 | 0.24 | Side |
| RB | 13 | 99 | 101 | 0.07 | Side |

**Comments:** Photos: 0690 (Side channel RB), 0691(SC US), 0692(SC LB), 0693(SC DS), 0694(Main Channel RB), 0695(MC US), 0696(MC DS), 069 (MC LB). Last MC flow was taken 5 m from the sandbar. Sandbar was 14.05 m across at the transect. The thalweg was at 53.9 m from LB. Main channel 10 m from sandbar 50% SA, 50% GR and CO. Visual observation of approximately 50 cm Arctic Grayling. Substrate photos taken 15 August 2013: 0795-0799

| | | | |
|---|---|---|---|
| **Site Name** | KG-T1-13 | **Event Code** | |
| **Date** | 13 August 2013 | **Time** | 12:16 |
| **Latitude N** | 67.016932 | **Longitude W** | 156.694493 |
| **Observers** | JCS, SDG, MMA | | |

Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 0 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 0 |
| Overhanging Vegetation | 0 |
| Boulders | 1 |
| Artificial Structures | 0 |

| |
|---|
| 0 = Absent |
| 1 = Sparse (<10%) |
| 2=Moderate (10-40%) |
| 3=Heavy (40-75%) |
| 4=Very Heavy (>75%) |

**Comments:**

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| No canopy | 50% Spruce/Alder |
| Understory (0.5 - 5 m) | |
| Willow, fireweed, grass all combined- 10% cover | Willow-15%<br>Alder-25%<br>Tall grass/shrubs-15% |
| Ground (< 0.5 m) | |
| Willow/grass- 25% cover<br>Bare- 75% | Bare-10%<br>Grass/shrubs-90% |

| | | | |
|---|---|---|---|
| **Site Name** | KG-T2-13 | **Event Code** | |
| **Date** | 13 August 2013 | **Time** | 14:05 |
| **Latitude N** | 67.018092 | **Longitude W** | 156.687062 |
| **Observers** | JCS, SDG, MMA | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 12.3 °C | Bankfull Width | 131 m |
| Dissolved Oxygen | 106.10% | Wetted Width | 124 m |
| Dissolved Oxygen | 11.35 mg/L | Thalweg Depth | 0.89 m |
| Conductivity | 200.7 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.265 mS/cm | Stream Gradient | <1 % |
| pH | 8.11 | Stream Stage | Low |
| Turbidity | 0.89 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle- 155°

RB Angle- 160°

## Substrate (inorganic) = 100%

| Type | Diameter | % Composition |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 0 |
| Cobble | 64-256mm (2.5-10in) | 30 |
| Gravel | 2-64mm (0.1-2.5in) | 30 |
| Sand | 0.06-2mm | 40 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| LB | 1 | 2 | 59 | 0.47 |
| | 2 | 14 | 75 | 0.57 |
| | 3 | 26 | 26 | 0.54 |
| | 4 | 38 | 33 | 0.48 |
| | 5 | 50 | 34 | 0.73 |
| | 6 | 62 | 43 | 0.61 |
| | 7 | 74 | 49 | 0.53 |
| | 8 | 86 | 25 | 0.65 |
| | 9 | 98 | 20 | 0.62 |
| | 10 | 110 | 13 | 0.57 |
| RB | 11 | 122 | 8 | 0.15 |

**Comments:**

Photos: 0703 (US), 0704 (DS), 0705 (LB), 0706 (RB)

More photos of substrate taken 15 August 2013-0804-0810

| | | | |
|---|---|---|---|
| **Site Name** | KG-T2-13 | **Event Code** | |
| **Date** | 13 August 2013 | **Time** | 14:05 |
| **Latitude N** | 67.018092 | **Longitude W** | 156.687062 |
| **Observers** | JCS, SDG, MMA | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 2 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 0 |
| Overhanging Vegetation | 1 |
| Undercut Bank | 0 |
| Boulders | 0 |
| Artificial Structures | 0 |

| |
|---|
| 0 = Absent |
| 1 = Sparse (<10%) |
| 2=Moderate (10-40%) |
| 3=Heavy (40-75%) |
| 4=Very Heavy (>75%) |

**Comments:**

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| Spruce-10% cover | Spruce less than 10% |
| Understory (0.5 - 5 m) | |
| Alder and willow close to 100% cover | Willow/Alder- 20% cover<br>Grass- 50% cover |
| Ground (< 0.5 m) | |
| Bare-10%<br>Grass/shrub close to 100% | Grass-75% cover<br>Rose-5% cover<br>Alder-5% cover |

| | | | |
|---|---|---|---|
| **Site Name** | MN-T1-13 | **Event Code** | |
| **Date** | 13 August 2013 | **Time** | 15:50 |
| **Latitude N** | 67.008356 | **Longitude W** | 156.074302 |
| **Observers** | JCS, SDG, MMA | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 11.1 °C | Bankfull Width | 97 m |
| Dissolved Oxygen | 110.30% | Wetted Width | 58 m |
| Dissolved Oxygen | 12.07 mg/L | Thalweg Depth | not measured-unwadeable |
| Conductivity | 151.6 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.206 mS/cm | Stream Gradient | <1 % |
| pH | 7.73 | Stream Stage | Low |
| Turbidity | 1.14 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle- unmeasurable RB Angle- 175°

## Substrate (inorganic) = 100%

| Type | Diameter | % Composition |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 0 |
| Cobble | 64-256mm (2.5-10in) | 35 |
| Gravel | 2-64mm (0.1-2.5in) | 50 |
| Sand | 0.06-2mm | 15 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

Crew was unable to take flow measurements because transect was unwadeable

**Comments:**

Photos:

0707- US

0708-DS

0709-LB

0710-RB

0711-Substrate

Lots of fine gravel

Brett (helicopter pilot) caught numerous Arctic Grayling

Corridor section from lower end to bridge is consistent in terms of substrate

**Site Name** MN-T1-13 **Event Code**

**Date** 13 August 2013 **Time** 15:50

**Latitude N** 67.008356 **Longitude W** 156.074302

**Observers** JCS, SDG, MMA

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 2 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 1 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 1 |
| Overhanging Vegetation | 1 |
| Undercut Bank | 0 |
| Boulders | 0 |
| Artificial Structures | 0 |

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

**Comments:**

Woody debris on left bank

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| Black spruce/Alder-30% cover | No canopy |
| Understory (0.5 - 5 m) | |
| Dominated by willow, alder, spruce (total cover) | No understory |
| Ground (< 0.5 m) | |
| Bare-5%<br>Small grasses, fireweed,saplings | Bare-90%<br>Fireweed and small grasses-10% |

| | | | |
|---|---|---|---|
| **Site Name** | MN-T2-13 | **Event Code** | |
| **Date** | 13 August 2013 | **Time** | 17:29 |
| **Latitude N** | 67.016628 | **Longitude W** | 156.054698 |
| **Observers** | JCS, SDG, MMA | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 11.9 °C | Bankfull Width | nm |
| Dissolved Oxygen | 110.40% | Wetted Width | 70 m |
| Dissolved Oxygen | 11.90 mg/L | Thalweg Depth | not measured-unwadeable |
| Conductivity | 155.9 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.208 mS/cm | Stream Gradient | nm |
| pH | 7.71 | Stream Stage | Low |
| Turbidity | 0.95 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle- unmeasurable

RB Angle- 160°

## Substrate (inorganic) = 100%

| Type | Diameter | % Composition |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 0 |
| Cobble | 64-256mm (2.5-10in) | 40 |
| Gravel | 2-64mm (0.1-2.5in) | 20 |
| Sand | 0.06-2mm | 40 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| RB | 1 | 3.5 | 34 | 0.24 |
| | 2 | 8.5 | 52 | 0.25 |
| | 3 | 13.5 | 62 | 0.43 |
| | 4 | 18.5 | 82 | 0.52 |
| | 5 | 23.5 | 82 | 0.53 |
| | 6 | 28.5 | 95 | 0.65 |
| LB | 7 | 33.5 | 103 | 0.65 |

**Comments:**

Half of stream unwadeable

Visual observation of 5 salmon

JCS saw Chum Salmon

Turbidity sample taken near helicopter LZ, approximately 100 m downstream from transect

| | | | |
|---|---|---|---|
| **Site Name** | MN-T2-13 | **Event Code** | |
| **Date** | 13 August 2013 | **Time** | 17:29 |
| **Latitude N** | 67.016628 | **Longitude W** | 156.054698 |
| **Observers** | JCS, SDG, MMA | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 2 |
| Macrophytes | 1 |
| Woody Debris (Big) >0.3m | 1 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 0 |
| Overhanging Vegetation | 2 |
| Undercut Bank | 0 |
| Boulders | 0 |
| Artificial Structures | 0 |

| |
|---|
| 0 = Absent |
| 1 = Sparse (<10%) |
| 2=Moderate (10-40%) |
| 3=Heavy (40-75%) |
| 4=Very Heavy (>75%) |

**Comments:**

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| Spruce, alder, and birch provide about 80% cover | No canopy |
| Understory (0.5 - 5 m) | |
| Almost 100% cover by willow, alder, and other shrubs<br>Not much grasss | Willow and alder-75% cover<br>Grasses |
| Ground (< 0.5 m) | |
| Grass and other herbaceous vegetation up to 75% cover<br>Very little bare ground | Bare-10%<br>Small grasses-50% cover |

| | | | |
|---|---|---|---|
| **Site Name** | BV-T1-13 | **Event Code** | |
| **Date** | 14 August 2013 | **Time** | 12:40 |
| **Latitude N** | 67.021206 | **Longitude W** | 155.150792 |
| **Observers** | JCS, SDG, MMA | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 8.7 °C | Bankfull Width | 34.2 m |
| Dissolved Oxygen | 100.50% | Wetted Width | 31.5 m |
| Dissolved Oxygen | 11.66 mg/L | Thalweg Depth | 0.66 m |
| Conductivity | 126.9 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.184 mS/cm | Stream Gradient | <1 % |
| pH | 7.86 | Stream Stage | Low |
| Turbidity | 0.86 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle- 163°

RB Angle- 160°

## Substrate (inorganic) = 100%

| **Type** | **Diameter** | **% Composition** |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 15 |
| Cobble | 64-256mm (2.5-10in) | 50 |
| Gravel | 2-64mm (0.1-2.5in) | 25 |
| Sand | 0.06-2mm | 5 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 5 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| LB | 1 | 1.6 | 9 | 0.06 |
| | 2 | 4.8 | 21 | 0.19 |
| | 3 | 8 | 39 | 0.53 |
| | 4 | 11.2 | 53 | 0.79 |
| | 5 | 14.4 | 66 | 0.56 |
| | 6 | 17.6 | 62 | 0.75 |
| | 7 | 20.8 | 57 | 0.55 |
| | 8 | 24 | 48 | 0.71 |
| | 9 | 27.2 | 34 | 0.53 |
| RB | 10 | 30.4 | 20 | 0.34 |

**Comments:**

Photos: 0728-US, 0719-DS, 0730-LB, 0731-RB, 0732-Substrate at thalweg

0733- Substrate at thalweg

Thalweg at 14.4 meters from left bank

| | | | |
|---|---|---|---|
| **Site Name** | BV-T1-13 | **Event Code** | |
| **Date** | 14 August 2013 | **Time** | 12:40 |
| **Latitude N** | 67.021206 | **Longitude W** | 155.150792 |
| **Observers** | JCS, SDG, MMA | | |

Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 4 |
| Macrophytes | 1 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 0 |
| Overhanging Vegetation | 2 |
| Undercut Bank | 1 |
| Boulders | 2 |
| Artificial Structures | 0 |

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

**Comments:**
Periphyton-very heavy cover

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| Spruce-10% cover | Spruce-20% |
| Understory (0.5 - 5 m) | |
| Willow, tall grass, spruce combined is 90% coverage | Willow, tall grass, and herbaceous vegetation is 65% coverage |
| Ground (< 0.5 m) | |
| Grass, herbaceous vegetation-100% cover | Bare ground-15%<br>Grass and herbaceous vegetation-85% |

| | | | |
|---|---|---|---|
| **Site Name** | BV-T2-13 | **Event Code** | |
| **Date** | 14 August 2013 | **Time** | 14:10 |
| **Latitude N** | 67.023342 | **Longitude W** | 155.158002 |
| **Observers** | JCS, SDG, MMA | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 9.1 °C | Bankfull Width | 29.05 m |
| Dissolved Oxygen | 102.70% | Wetted Width | 28 m |
| Dissolved Oxygen | 11.78 mg/L | Thalweg Depth | 0.88 m |
| Conductivity | 128.6 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.184 mS/cm | Stream Gradient | <1% |
| pH | 7.79 | Stream Stage | Low |
| Turbidity | 0.74 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle- 73°

RB Angle- 115°

## Substrate (inorganic) = 100%

| Type | Diameter | % Composition |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 20 |
| Cobble | 64-256mm (2.5-10in) | 30 |
| Gravel | 2-64mm (0.1-2.5in) | 20 |
| Sand | 0.06-2mm | 30 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| LB | 1 | 1.4 | 30 | 0.13 |
| | 2 | 4.2 | 24 | 0.22 |
| | 3 | 7 | 35 | 0.39 |
| | 4 | 9.8 | 49 | 0.49 |
| | 5 | 12.6 | 65 | 0.59 |
| | 6 | 15.4 | 88 | 0.78 |
| | 7 | 18.2 | 85 | 0.56 |
| | 8 | 21 | 74 | 0.73 |
| | 9 | 23.8 | 72 | 0.36 |
| RB | 10 | 26.6 | 39 | 0.03 |

**Comments:**

0735-Right bank substrate, 0736-RB moving towards left bank substrate, 0737- RB moving towards LB substrate with JCS foot for scale, 0739- Center channel substrate, ski pole for scale, 0740-US 0741- DS, 0742-LB, 0743-RB, 0744-LB substrate

| | | | |
|---|---|---|---|
| **Site Name** | BV-T2-13 | **Event Code** | |
| **Date** | 14 August 2013 | **Time** | 14:10 |
| **Latitude N** | 67.023342 | **Longitude W** | 155.158002 |
| **Observers** | JCS, SDG, MMA | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 4 |
| Macrophytes | 1 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 1 |
| Overhanging Vegetation | 2 |
| Undercut Bank | 1 |
| Boulders | 2 |
| Artificial Structures | 0 |

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

**Comments:**

Periphyon very heavy on all substrate

LB heavy sand, center heavy cobble, right bank heavy boudler

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| Spruce-10% cover | No canopy |
| Understory (0.5 - 5 m) | |
| Willow, alder, berries, spruce- 30% cover | Willow, alder, herbaceous vegetation, and spruce- 30% cover |
| Ground (< 0.5 m) | |
| Moss, lichen, small herb, and grass- 90% cover<br>Bare due to game trail -10% cover | Moss, lichen, small herb, grass- almost 100% cover |

| | | | |
|---|---|---|---|
| **Site Name** | RD-T1-13 | **Event Code** | |
| **Date** | 15 August 2013 | **Time** | 9:57 |
| **Latitude N** | 67.035785 | **Longitude W** | 154.835141 |
| **Observers** | SDG, MMA | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 8.1 °C | Bankfull Width | 79 m |
| Dissolved Oxygen | 103.0% | Wetted Width | 56 m |
| Dissolved Oxygen | 12.13 mg/L | Thalweg Depth | 0.98 m |
| Conductivity | 81.1 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.120 mS/cm | Stream Gradient | <1 % |
| pH | 6.72 | Stream Stage | Low |
| Turbidity | 1.13 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle- 169°

RB Angle- 170°

## Substrate (inorganic) = 100%

| **Type** | **Diameter** | **% Composition** |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 10 |
| Cobble | 64-256mm (2.5-10in) | 20 |
| Gravel | 2-64mm (0.1-2.5in) | 35 |
| Sand | 0.06-2mm | 35 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| LB | 1 | 2.8 | 37 | 0.48 |
| | 2 | 8.4 | 45 | 0.62 |
| | 3 | 14 | 59 | 0.58 |
| | 4 | 19.6 | 89 | 0.67 |
| | 5 | 25.2 | 92 | 0.81 |
| | 6 | 30.8 | 87 | 0.77 |
| | 7 | 36.4 | 86 | 0.8 |
| | 8 | 42 | 67 | 0.65 |
| | 9 | 47.6 | 81 | 0.61 |
| RB | 10 | 53.2 | 61 | 0.64 |

**Comments:**

Thalweg 18.5 m from left bank. RB has cut bank at bankfull (photo taken). Periphyton cover heavy from RB to center of transect. Photos: 0763- JCS in pack raft, 0764- Cut bank at bankfull, right bank 0765- Substrate at RB, 0766-US, 0767-DS, 0768-LB, 0769-RB, 0771-Substrate at LB

| | | | |
|---|---|---|---|
| **Site Name** | RD-T1-13 | **Event Code** | |
| **Date** | 15 August 2013 | **Time** | 9:57 |
| **Latitude N** | 67.035785 | **Longitude W** | 154.835141 |
| **Observers** | SDG, MMA | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 2 |
| Macrophytes | 1 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 1 |
| Overhanging Vegetation | 1 |
| Undercut Bank | 0 |
| Boulders | 1 |
| Artificial Structures | 0 |

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

**Comments:**

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| No canopy | Spruce-less than 10% |
| Understory (0.5 - 5 m) | |
| No understory | Willow, small spruce, alder-60% cover |
| Ground (< 0.5 m) | |
| 100% sand and gravel cover | Bare (fine sediment)-30%<br>Small grasses, saplings, berries, moss, and lichen-50% |

**Site Name** KB-T1-13 **Event Code**

**Date** 15 August 2013 **Time** 13:18

**Latitude N** 67.012346 **Longitude W** 154.367417

**Observers** JCS, SDG, MMA

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 10.6 °C | Bankfull Width | 90 m |
| Dissolved Oxygen | 106.50% | Wetted Width | 89 m |
| Dissolved Oxygen | 11.84 mg/L | Thalweg Depth | 0.97 m |
| Conductivity | 142.2 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.196 mS/cm | Stream Gradient | <1 % |
| pH | 7.45 | Stream Stage | Low |
| Turbidity | 0.68 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle- 95° RB Angle- 160°

## Substrate (inorganic) = 100%

| **Type** | **Diameter** | **% Composition** |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 5 |
| Cobble | 64-256mm (2.5-10in) | 35 |
| Gravel | 2-64mm (0.1-2.5in) | 35 |
| Sand | 0.06-2mm | 25 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| # | Width (m) | Depth (cm) | Flow (m/s) | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|---|---|---|
| LB-1 | 2.3 | 42 | 0.64 | 11 | 46.8 | 36 | 0.52 |
| 2 | 6.75 | 47 | 0.67 | 12 | 51.25 | 50 | 0.73 |
| 3 | 11.2 | 41 | 0.66 | 13 | 55.7 | 50 | 0.63 |
| 4 | 15.65 | 32 | 0.62 | 14 | 60.15 | 72 | 0.65 |
| 5 | 20.1 | 25 | 0.42 | 15 | 64.6 | 97 | 0.82 |
| 6 | 24.55 | 12 | 0.13 | 16 | 69.05 | 92 | 1.02 |
| 7 | 29 | 11 | 0.23 | 17 | 73.5 | 82 | 0.93 |
| 8 | 33.45 | 14 | 0.31 | 18 | 77.95 | 65 | 0.98 |
| 9 | 37.9 | 19 | 0.47 | 19 | 82.4 | 71 | 0.84 |
| 10 | 42.35 | 24 | 0.53 | RB-20 | 86.85 | 44 | 0.62 |

**Comments:**

Brett caught an Arctic Grayling 100 m downstream of transect

| | | | |
|---|---|---|---|
| **Site Name** | KB-T1-13 | **Event Code** | |
| **Date** | 15 August 2013 | **Time** | 13:18 |
| **Latitude N** | 67.012346 | **Longitude W** | 154.367417 |
| **Observers** | JCS, SDG, MMA | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 2 |
| Macrophytes | 1 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 1 |
| Overhanging Vegetation | 2 |
| Undercut Bank | 1 |
| Boulders | 1 |
| Artificial Structures | 0 |

| |
|---|
| 0 = Absent |
| 1 = Sparse (<10%) |
| 2=Moderate (10-40%) |
| 3=Heavy (40-75%) |
| 4=Very Heavy (>75%) |

**Comments:**

Periphyton cover heavy at banks only

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| Willow, alder-25% | Spruce, birch, alder-70% |
| Understory (0.5 - 5 m) | |
| Tall grass, willow, berries-50% | Spruce, alder (dominant), willow-almost 100% cover |
| Ground (< 0.5 m) | |
| Grass, willow, herb-100% | Moss, herb, grass, and willow-90%<br>Bare-10% |

| | | | |
|---|---|---|---|
| **Site Name** | AL-T2-13 | **Event Code** | |
| **Date** | 17 August 2013 | **Time** | 16:25 |
| **Latitude N** | 67.077422 | **Longitude W** | 153.327899 |
| **Observers** | JCS,SDG | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 12.5 °C | Bankfull Width | 98.5 m |
| Dissolved Oxygen | 103.10% | Wetted Width | 75.5 m |
| Dissolved Oxygen | 10.97 mg/L | Thalweg Depth | not measurable |
| Conductivity | 355.8 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.467 mS/cm | Stream Gradient | <1% |
| pH | 7.83 | Stream Stage | Low |
| Turbidity | 5.47 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle- not measured

RB Angle- 175°

## Substrate (inorganic) = 100%

| Type | Diameter | % Composition |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 10 |
| Cobble | 64-256mm (2.5-10in) | 25 |
| Gravel | 2-64mm (0.1-2.5in) | 10 |
| Sand | 0.06-2mm | 35 |
| Silt | 0.06-2mm | 20 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

Crew was unable to take flow measurements because transect was unwadeable

**Comments:**

Flow was unmeasurable because river was unwadeable

Photos:

0867-US

0868-DS

0869-LB

0870-RB

0871- Substrate at RB

0872- Substrate at RB

Transect 1 doesn't have a full habitat assessment (photos taken)

Associated sonar saved as chart 1, sonar completed 8/18

| | | | |
|---|---|---|---|
| **Site Name** | AL-T2-13 | **Event Code** | |
| **Date** | 17 August 2013 | **Time** | 16:25 |
| **Latitude N** | 67.077422 | **Longitude W** | 153.327899 |
| **Observers** | JCS,SDG | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 0 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 0 |
| Overhanging Vegetation | 0 |
| Undercut Bank | 0 |
| Boulders | 2 |
| Artificial Structures | 0 |

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

**Comments:**
Cover based on what was visible from the bank
Very heavy periphyton cover mixed with silt
Boulders on exposed banks

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| No canopy | No canopy |
| Understory (0.5 - 5 m) | |
| Alder-10%<br>Grasses-50% | Alder-10% cover |
| Ground (< 0.5 m) | |
| Bare-60%<br>Small grass-10% | Bare ground-80%<br>Herbaceous grasses-10% |

Above bankfull on both banks heavy black spruce cover

| | | | |
|---|---|---|---|
| **Site Name** | MF-T1-13 | **Event Code** | |
| **Date** | 17 August 2013 | **Time** | 14:20 |
| **Latitude N** | 67.064310 | **Longitude W** | 153.176053 |
| **Observers** | JCS,SDG | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 12.6 °C | Bankfull Width | 91 m |
| Dissolved Oxygen | 108.10% | Wetted Width | 53.5 m |
| Dissolved Oxygen | 11.4 mg/L | Thalweg Depth | 0.75 m |
| Conductivity | 273.2 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.357 mS/cm | Stream Gradient | <1% |
| pH | 8.3 | Stream Stage | Low |
| Turbidity | 0.98 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle- 100° RB Angle- 115°

## Substrate (inorganic) = 100%

| **Type** | **Diameter** | **% Composition** |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 5 |
| Cobble | 64-256mm (2.5-10in) | 25 |
| Gravel | 2-64mm (0.1-2.5in) | 35 |
| Sand | 0.06-2mm | 35 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| | # | **Width (m)** | **Depth (cm)** | **Flow (m/s)** |
|---|---|---|---|---|
| LB | *1 | 2.7 | 3 | n/a |
| | 2 | 8.05 | 9 | 0.14 |
| | 3 | 13.4 | 14 | 0.22 |
| | 4 | 18.75 | 41 | 0.47 |
| | 5 | 24.1 | 52 | 0.64 |
| | 6 | 29.45 | 52 | 0.61 |
| | 7 | 34.8 | 62 | 0.69 |
| | 8 | 40.15 | 69 | 0.73 |
| | 9 | 45.5 | 55 | 0.67 |
| RB | 10 | 50.85 | 42 | 0.26 |

**Comments:**

* too shallow to measure flow. Thalweg was between flow measurements 7 and 8. Increment for flow was 5.35 m. Malamute Fork previously named UN15. Transect cut across gravel/cobble island and side channel. Side channel not flowing-mostly isolated pools.

Wetted width taken along main channel (side channel included in bankfull width)

Visual observation of spawning chum salmon upstream of transect (at top of corridor)

Photos: 0853-Substrate at RB, 0854-Center substrate, 0855 (US), 0856 (DS), 0857 (RB), 0858 (LB)

| | | | |
|---|---|---|---|
| **Site Name** | MF-T1-13 | **Event Code** | |
| **Date** | 17 August 2013 | **Time** | 14:20 |
| **Latitude N** | 67.064310 | **Longitude W** | 153.176053 |

Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 1 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 0 |
| Overhanging Vegetation | 1 |
| Undercut Bank | 1 |
| Boulders | 1 |
| Artificial Structures | 0 |

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

**Comments:**

Filamentous Algae on left and right bank
Heavy periphyton cover
Small woody debris on right bank
Transect is indicative of corridor reach

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| Alder-25% cover<br>Spruce behind the 10 meter mark | No canopy |
| Understory (0.5 - 5 m) | |
| Willow, alder, tall grasses along bank-75% cover | Willow, alder, and grasses-70% |
| Ground (< 0.5 m) | |
| Bare ground-20%<br>Small grass, herbaceous vegetation-80% | Bare ground-25%<br>Small grasses and saplings-75% |

| | | | |
|---|---|---|---|
| **Site Name** | UN18-T1-13 | **Event Code** | |
| **Date** | 16 August 2013 | **Time** | 16:37 |
| **Latitude N** | 67.091882 | **Longitude W** | 152.730167 |
| **Observers** | JCS,SDG, MMA | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 12.2 °C | Bankfull Width | 15.5 m |
| Dissolved Oxygen | 102.30% | Wetted Width | 9.6 m |
| Dissolved Oxygen | 10.96 mg/L | Thalweg Depth | 0.39 m |
| Conductivity | 116.5 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.154 mS/cm | Stream Gradient | 1% |
| pH | 7.33 | Stream Stage | Low |
| Turbidity | 1.63 NTU | Water Color | Mostly Clear |

## Bank Angle Sketches

LB Angle- 145°

RB Angle- 170°

## Substrate (inorganic) = 100%

| Type | Diameter | % Composition |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 50 |
| Cobble | 64-256mm (2.5-10in) | 30 |
| Gravel | 2-64mm (0.1-2.5in) | 15 |
| Sand | 0.06-2mm | 5 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| RB | 1 | 0.48 | 2 | 0 |
| | *2 | 1.44 | 10 | 0.02 |
| | 3 | 2.4 | 23 | 0.6 |
| | 4 | 3.36 | 21 | 0.21 |
| | 5 | 4.32 | 23 | 0.53 |
| | *6 | 5.28 | 30 | 0.07 |
| | 7 | 6.24 | 20 | 0.46 |
| | 8 | 7.2 | 22 | 0.07 |
| | 9 | 8.16 | 24 | 0.35 |
| LB | 10 | 9.12 | 34 | 0.3 |

**Comments:**

* Flow measurements number 2 and 6 were behind a boulder

JCS took approximately 20 minute long video upstream of transect 1 on GoPro

Photos: 0838-Right bank substrate, 0839-Center substrate, 0840-Left bank substrate, 0841 (US), 0842 (DS), 0843 (LB), 0844 (RB). Corridor map needs to be drawn from GPS (too sinuous).

Visual observation of Northern Pike

| | | | |
|---|---|---|---|
| **Site Name** | UN18-T1-13 | **Event Code** | |
| **Date** | 16 August 2013 | **Time** | 16:37 |
| **Latitude N** | 67.091882 | **Longitude W** | 152.730167 |
| **Observers** | JCS,SDG, MMA | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 2 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 1 |
| Overhanging Vegetation | 2 |
| Undercut Bank | 1 |
| Boulders | 3 |

| |
|---|
| 0 = Absent |
| 1 = Sparse (<10%) |
| 2=Moderate (10-40%) |
| 3=Heavy (40-75%) |
| 4=Very Heavy (>75%) |

**Comments:**

Small woody debris along left bank

Filamentous algae is zero, measurement of 2 accounts for periphyton cover

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| Alder, spruce, birch - 75% cover | Spruce, alder, willow-10% |
| Understory (0.5 - 5 m) | |
| Almost 100% cover<br>Mainly alder, some spruce, some willow | Willow and alder-50% cover |
| Ground (< 0.5 m) | |
| Bare-15%<br>Grass and moss-85% | Herb, grass, moss-50%<br>Bare ground (cobble, gravel, boulder)-50% |

| | | | |
|---|---|---|---|
| **Site Name** | UN18-T2-13 | **Event Code** | |
| **Date** | 16 August 2013 | **Time** | 17:30 |
| **Latitude N** | 67.090632 | **Longitude W** | 152.728927 |
| **Observers** | JCS,SDG, MMA | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 12.5 °C | Bankfull Width | 19.5 m |
| Dissolved Oxygen | 100.60% | Wetted Width | 7.3 m |
| Dissolved Oxygen | 10.76 mg/L | Thalweg Depth | 1.08 m |
| Conductivity | 117.1 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.154 mS/cm | Stream Gradient | 1% |
| pH | 7.47 | Stream Stage | Low |
| Turbidity | 1.92 NTU | Water Color | Mostly Clear |

## Bank Angle Sketches

LB Angle- 165°

RB Angle- 150°

## Substrate (inorganic) = 100%

| Type | Diameter | % Composition |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 25 |
| Cobble | 64-256mm (2.5-10in) | 25 |
| Gravel | 2-64mm (0.1-2.5in) | 25 |
| Sand | 0.06-2mm | 25 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| LB | 1 | 0.36 | 6 | 0.01 |
| | 2 | 1.10 | 35 | 0.05 |
| | 3 | 1.83 | 52 | 0.1 |
| | 4 | 2.56 | 61 | 0.13 |
| | 5 | 3.29 | 72 | 0.12 |
| | 6 | 4.02 | 78 | 0.06 |
| | 7 | 4.75 | 96 | 0.08 |
| | 8 | 5.48 | 94 | 0.05 |
| RB | 9 | 6.21 | 50 | 0.03 |

**Comments:**

Photos:

0845-Right bank substrate, 0846- Center substrate, 0847- Left bank substrate,

0848 (US), 0849 (DS), 0850 (LB), 0851 (RB), 0852 (US)

Not mapped, needs to be mapped with GPS due to sinuousity

| | | | |
|---|---|---|---|
| **Site Name** | UN18-T2-13 | **Event Code** | |
| **Date** | 16 August 2013 | **Time** | 17:30 |
| **Latitude N** | 67.090632 | **Longitude W** | 152.728927 |
| **Observers** | JCS, SDG, MMA | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 3 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 2 |
| Live Trees Root | 1 |
| Overhanging Vegetation | 2 |
| Undercut Bank | 2 |
| Boulders | 1 |
| Artificial Structures | 0 |

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

**Comments:**
Lots of dead tree roots on right bank
Heavy periphyton cover all along transect

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| No canopy | Spruce-10% cover |
| Understory (0.5 - 5 m) | |
| Dominated by willow-15% cover | Dominated by willow, some alder, some spruce-35% cover |
| Ground (< 0.5 m) | |
| 85% bare ground (cobble, gravel) | Herbaceous vegetation, berries, labrador tea-almost total cover<br>No bare ground |

| | | | |
|---|---|---|---|
| **Site Name** | SF-T1-13 | **Event Code** | |
| **Date** | 22 August 2013 | **Time** | 15:33 |
| **Latitude N** | 66.846855 | **Longitude W** | 151.097338 |
| **Observers** | SDG,LIM | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 10.5 °C | Bankfull Width | 85 m |
| Dissolved Oxygen | 102.70% | Wetted Width | 56 m |
| Dissolved Oxygen | 11.42 mg/L | Thalweg Depth | 1.04 m |
| Conductivity | 180.8 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.250 mS/cm | Stream Gradient | <1% |
| pH | 7.89 | Stream Stage | Low |
| Turbidity | 1.14 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle- 178°

RB Angle- 173°

## Substrate (inorganic) = 100%

| Type | Diameter | % Composition |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 15 |
| Cobble | 64-256mm (2.5-10in) | 40 |
| Gravel | 2-64mm (0.1-2.5in) | 30 |
| Sand | 0.06-2mm | 15 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| LB | 1 | 2.8 | 9 | 0.06 |
| | 2 | 8.4 | 23 | 0.34 |
| | 3 | 14 | 44 | 0.33 |
| | 4 | 19.6 | 51 | 0.34 |
| | 5 | 25.2 | 63 | 0.54 |
| | 6 | 30.8 | 72 | 0.78 |
| | 7 | 36.4 | 93 | 0.51 |
| | 8 | 42 | 87 | 0.5 |
| | 9 | 47.6 | 55 | 0.41 |
| RB | 10 | 53.2 | 19 | 0.1 |

**Comments:**

Sluffed bank above right bank angle measurement. Increment=5.6 m. We ended 1.55 meters from right bank instead of 2.8 m (used range finder for wetted width). Wetted width and bankfull measured with rangefinder. A meter from WW left bank angle decreases to 169°. Visual observation of dead burbot (LIM touched it). Thalweg was 2.3 meters towards right bank from flow measurement 7. Photos: 0066 (Winter trail at RB), 0067 (US), 0068 (DS), 0069 (LB), 0070 (LB), 0071 (RB), 0072 (Center substrate), 0073 (LB substrate), 0074 (LB substrate)

| | | | |
|---|---|---|---|
| **Site Name** | SF-T1-13 | **Event Code** | |
| **Date** | 22 August 2013 | **Time** | 15:33 |
| **Latitude N** | 66.846855 | **Longitude W** | 151.097338 |
| **Observers** | SDG,LIM | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 0 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 0 |
| Overhanging Vegetation | 0 |
| Undercut Bank | 0 |
| Artificial Structures | 2 |

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

**Comments:**

Periphyton cover is moderate to heavy
Beyond our 10 meter zone there is overhanging vegetation due to sluffed bank
Artificial structure was the winter trail which took up almost half of our 10 meter buffer downstream of transect. Cabin and mailbox were within sight of transect.

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| No canopy | Mainly birch, willow, and spruce-10%<br>Lack of more canopy may be due to presence of winter trail |
| Understory (0.5 - 5 m) | |
| Willow, rose, fireweed-15% | Poplar, fireweed, rose, tall grasses, and willow-70% |
| Ground (< 0.5 m) | |
| Bare ground-90% (cobble, gravel, and sand)<br>Herbaceous vegeation, fireweed, and small willow-10% | Bare ground-25%<br>(Less than 10% of bare ground is natural, most of the 25% can be attributed to the winter trail)<br><br>Herbaceous vegetation, moss, poplar saplings-75% |

| | | | |
|---|---|---|---|
| **Site Name** | JM-T1-13 | **Event Code** | |
| **Date** | 22 August 2013 | **Time** | 12:50 |
| **Latitude N** | 66.793188 | **Longitude W** | 150.732181 |
| **Observers** | SDG,LIM | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 6.4 °C | Bankfull Width | 65.0 m |
| Dissolved Oxygen | 105.50% | Wetted Width | 23.5 m |
| Dissolved Oxygen | 13.00 mg/L | Thalweg Depth | 0.71 m |
| Conductivity | 53.6 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.083 mS/cm | Stream Gradient | <1% |
| pH | 7.04 | Stream Stage | Low |
| Turbidity | 1.35 NTU | Water Color | Mostly Clear |

## Bank Angle Sketches

LB Angle- 158°

RB Angle- 175°

## Substrate (inorganic) = 100%

| Type | Diameter | % Composition |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 5 |
| Cobble | 64-256mm (2.5-10in) | 35 |
| Gravel | 2-64mm (0.1-2.5in) | 45 |
| Sand | 0.06-2mm | 15 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| RB | 1 | 1.17 | 6 | 0.03 |
| | 2 | 3.52 | 23 | 0.13 |
| | 3 | 5.87 | 47 | 0.29 |
| | 4 | 8.22 | 65 | 0.37 |
| | 5 | 10.57 | 68 | 0.43 |
| | 6 | 12.92 | 71 | 0.44 |
| | 7 | 15.27 | 60 | 0.52 |
| | 8 | 17.62 | 67 | 0.44 |
| | 9 | 19.98 | 64 | 0.43 |
| LB | 10 | 22.33 | 64 | 0.41 |

**Comments:**

Thalweg is 51 cm towards right bank from flow measurement 5. Increment=2.35 m

Crew was going to do a second transect downstream of first transect but didn't because of visual observation of grizzly bear sow and two cubs in proximity to the transect site. Photos:

0051 (Vegetation above bankfull width onLB), 0052 (RB from LB BFW), 0053 (US), 0054 (DS), 0055 (RB), 0056 (LB), 0057 (Substrate), 0058 (Substrate), 0059 (Substrate)

| | | | |
|---|---|---|---|
| **Site Name** | JM-T1-13 | **Event Code** | |
| **Date** | 22 August 2013 | **Time** | 12:50 |
| **Latitude N** | 66.793188 | **Longitude W** | 150.732181 |
| **Observers** | SDG,LIM | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 1 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 1 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 0 |
| Overhanging Vegetation | 0 |
| Undercut Bank | 0 |
| Boulders | 1 |
| Artificial Structures | 0 |

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

**Comments:**

Periphyton cover is heavy along transect

No undercut at wetted width, moderate undercut at bankfull due to sluffing

Sluffed bank with live vegetation 2 meters from wetted width

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| No canopy | No canopy |
| Understory (0.5 - 5 m) | |
| Willow, alder, birch (predominately birch), some fireweed- 60% | Willow and fireweed-15% |
| Ground (< 0.5 m) | |
| Bare ground-50%<br>Moss, herbaceous vegetation, fireweed, and small birch-50% | Bare ground-90%<br>Small fireweed and willow-10% |

| | | | |
|---|---|---|---|
| **Site Name** | UN30-T1-13n | **Event Code** | |
| **Date** | 21 August 2013 | **Time** | 12:48 |
| **Latitude N** | 67.060008 | **Longitude W** | 156.030637 |
| **Observers** | JCS,SDG,LIM | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 5.8 °C | Bankfull Width | 46 m |
| Dissolved Oxygen | 103.20% | Wetted Width | 19.5 m |
| Dissolved Oxygen | 12.79 mg/L | Thalweg Depth | 0.97 m |
| Conductivity | 140.0 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.221 mS/cm | Stream Gradient | 1% |
| pH | 7.95 | Stream Stage | Low |
| Turbidity | 0.72 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle- 170° (estimated)

RB Angle- 165°

## Substrate (inorganic) = 100%

| Type | Diameter | % Composition |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 50 |
| Cobble | 64-256mm (2.5-10in) | 30 |
| Gravel | 2-64mm (0.1-2.5in) | 15 |
| Sand | 0.06-2mm | 5 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| LB | 1 | 0.97 | 10 | 0.04 |
| | 2 | 2.92 | 16 | 0.29 |
| | 3 | 4.87 | 38 | 0.35 |
| | 4 | 6.82 | 15 | 0.63 |
| | 5 | 8.77 | 59 | 0.79 |
| | 6 | 10.72 | 71 | 0.76 |
| | 7 | 12.67 | 80 | 0.49 |
| | 8 | 14.62 | 54 | 0.36 |
| | 9 | 16.57 | 44 | 0.14 |
| RB | 10 | 18.52 | 24 | 0.18 |

**Comments:**

Thalweg is 50 cm towards left bank from flow measurement 7. More sand on exposed banks and on bends with slower flow (as compared to our transect). Above where right bank angle was measured, bank angle increases towards 90 degrees. Increment=1.95 m. Photos: 0005 (US), 0006 (DS), 0007 (LB), 0008 (RB), 0009 (Substrate), 0010 (Substrate)

| | | | |
|---|---|---|---|
| **Site Name** | UN30-T1-13n | **Event Code** | |
| **Date** | 21 August 2013 | **Time** | 12:48 |
| **Latitude N** | 67.060008 | **Longitude W** | 156.030637 |
| **Observers** | JCS,SDG,LIM | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 1 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 2 |
| Live Trees Root | 0 |
| Overhanging Vegetation | 1 |
| Undercut Bank | 0 |
| Boulders | 3 |
| Artificial Structures | 0 |

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

**Comments:**

Periphyton cover from center to right bank was moderate

If water was higher, overhanging vegetation would be moderate

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| No canopy | Paper birch, willow, spruce, alder-30% |
| Understory (0.5 - 5 m) | |
| Willow-30% | Herbaceous vegetation, willow, alder, and spruce-50% |
| Ground (< 0.5 m) | |
| Bare ground-50%<br>Small willow, grasses, and fireweed-50% | Bare ground-20%<br>Moss, lichen, small grasses, cranberry, blueberry, and woody shrubs-80% |

| | | | |
|---|---|---|---|
| **Site Name** | MN-T1-13n | **Event Code** | |
| **Date** | 21 August 2013 | **Time** | 16:16 |
| **Latitude N** | 67.051217 | **Longitude W** | 155.765139 |
| **Observers** | JCS,SDG,LIM | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 8.3 °C | Bankfull Width | 60 m |
| Dissolved Oxygen | 106.40% | Wetted Width | 33.7 m |
| Dissolved Oxygen | 12.47 mg/L | Thalweg Depth | 0.99 m |
| Conductivity | 171.3 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.251 mS/cm | Stream Gradient | <1% |
| pH | 7.67 | Stream Stage | Low |
| Turbidity | 0.63 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle- 170° (estimated) RB Angle- 115°

## Substrate (inorganic) = 100%

| Type | Diameter | % Composition |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 5 |
| Cobble | 64-256mm (2.5-10in) | 15 |
| Gravel | 2-64mm (0.1-2.5in) | 65 |
| Sand | 0.06-2mm | 15 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| LB | 1 | 1.69 | 6 | 0.12 |
| | 2 | 5.06 | 20 | 0.37 |
| | 3 | 8.43 | 36 | 0.5 |
| | 4 | 11.8 | 54 | 0.58 |
| | 5 | 15.17 | 68 | 0.7 |
| | 6 | 18.54 | 81 | 0.7 |
| | 7 | 21.91 | 91 | 0.89 |
| | 8 | 25.28 | 99 | 0.92 |
| | 9 | 28.65 | 95 | 0.9 |
| RB | 10 | 32.02 | 62 | 0.64 |

**Comments:**

Flow measurement 8 marks the thalweg. Increment=3.37 m

Photos: 0015(US), 0016 (DS), 0017 (LB), 0018 (RB), 0019 (Substrate), 0020 (Substrate), 0021 (LB from LB)

| | | | |
|---|---|---|---|
| **Site Name** | MN-T1-13n | **Event Code** | |
| **Date** | 21 August 2013 | **Time** | 16:16 |
| **Latitude N** | 67.051217 | **Longitude W** | 155.765139 |
| **Observers** | JCS,SDG,LIM | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 2 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 0 |
| Overhanging Vegetation | 1 |
| Undercut Bank | 1 |
| Boulders | 1 |
| Artificial Structures | 0 |

| |
|---|
| 0 = Absent |
| 1 = Sparse (<10%) |
| 2=Moderate (10-40%) |
| 3=Heavy (40-75%) |
| 4=Very Heavy (>75%) |

**Comments:**
Filamentous algae is low-moderate
Periphyton is moderately high

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| No canopy | No canopy |
| Understory (0.5 - 5 m) | |
| No understory | Willow and tall grass-40% |
| Ground (< 0.5 m) | |
| Bare ground is > 95% composed of cobble, gravel, sand<br><br>Remainder is horsetail<br><br>Also some standing water at outskirts of 10 meter buffer, shows signs of redox | Fireweed, herbaceous vegetation, and willow-50%<br>Bare ground-50% (sand and silt) |

| | | | |
|---|---|---|---|
| **Site Name** | RD-T1-13s | **Event Code** | |
| **Date** | 19 August 2013 | **Time** | 13:35 |
| **Latitude N** | 66.886494 | **Longitude W** | 154.837675 |
| **Observers** | JCS,SDG,LIM | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 9.1 °C | Bankfull Width | 65.5 m |
| Dissolved Oxygen | 106.70% | Wetted Width | 57 m |
| Dissolved Oxygen | 12.24 mg/L | Thalweg Depth | 0.93 m |
| Conductivity | 94.1 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.135 mS/cm | Stream Gradient | <1% |
| pH | 7.56 | Stream Stage | Low |
| Turbidity | 3.11 NTU | Water Color | Mostly Clear |

## Bank Angle Sketches

LB Angle- 170°

RB Angle- 165°

## Substrate (inorganic) = 100%

| Type | Diameter | % Composition |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 10 |
| Cobble | 64-256mm (2.5-10in) | 40 |
| Gravel | 2-64mm (0.1-2.5in) | 20 |
| Sand | 0.06-2mm | 30 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| LB | 1 | 2.85 | 36 | 0.29 |
| | 2 | 8.55 | 81 | 0.45 |
| | 3 | 14.25 | 92 | 0.58 |
| | 4 | 19.95 | 72 | 0.67 |
| | 5 | 25.65 | 73 | 0.66 |
| | 6 | 31.35 | 84 | 0.73 |
| | 7 | 37.05 | 86 | 0.71 |
| | 8 | 42.75 | 61 | 0.63 |
| | 9 | 48.45 | 40 | 0.54 |
| RB | 10 | 54.15 | 18 | 0.19 |

**Comments:**

Increment= 5.7 m. Thalweg was 93cm deep and very close to flow measurement #3.
Photos: 0941 (US), 0942 (DS), 0943 (LB), 0944 (RB), 0945-Right bank substrate,
0946-Righ bank substrate, 0947-Center substrate, 0948-Center substrate, 0949-Left bank substrate.

| | | | |
|---|---|---|---|
| **Site Name** | RD-T1-13s | **Event Code** | |
| **Date** | 19 August 2013 | **Time** | 13:35 |
| **Latitude N** | 66.886494 | **Longitude W** | 154.837075 |
| **Observers** | JCS,SDG,LIM | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 1 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 0 |
| Overhanging Vegetation | 0 |
| Undercut Bank | 0 |
| Boulders | 1 |
| Artificial Structures | 0 |

| |
|---|
| 0 = Absent |
| 1 = Sparse (<10%) |
| 2=Moderate (10-40%) |
| 3=Heavy (40-75%) |
| 4=Very Heavy (>75%) |

**Comments:**

Periphyton cover is heavy

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| Birch and spruce-40% | No canopy |
| Understory (0.5 - 5 m) | |
| Alder, grasses, willow, herbaceous vegetation-40% cover | Willow, alder, grasses-70% |
| Ground (< 0.5 m) | |
| Bare ground-50%<br>Grasses, willow, fireweed, herbaceous vegetation. Woody shrubs, moss-50% cover | Bare ground-20%<br>Herbaceous-80% |

| | | | |
|---|---|---|---|
| **Site Name** | RD-T2-13s | **Event Code** | |
| **Date** | 19 August 2013 | **Time** | 12:16 |
| **Latitude N** | 66.887137 | **Longitude W** | 154.834857 |
| **Observers** | JCS,SDG,LIM | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 8.7 °C | Bankfull Width | 80 m |
| Dissolved Oxygen | 102.80% | Wetted Width | 46.5 m |
| Dissolved Oxygen | 11.93 mg/L | Thalweg Depth | 0.81 m |
| Conductivity | 91.4 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.133 mS/cm | Stream Gradient | <1% |
| pH | 7.55 | Stream Stage | Low |
| Turbidity | 2.27 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle- 82°

RB Angle- 175°

## Substrate (inorganic) = 100%

| **Type** | **Diameter** | **% Composition** | |
|---|---|---|---|
| | | **Main Channel** | **Side Channel** |
| Bedrock | | 0 | 0 |
| Boulder | >256mm (10in) | 5 | 0 |
| Cobble | 64-256mm (2.5-10in) | 35 | 10 |
| Gravel | 2-64mm (0.1-2.5in) | 30 | 30 |
| Sand | 0.06-2mm | 30 | 60 |
| Silt | 0.06-2mm | 0 | 0 |
| Clay | 0.004-0.06 mm | 0 | 0 |

## Flow

Main Channel

| | # | **Width (m)** | **Depth (cm)** | **Flow (m/s)** |
|---|---|---|---|---|
| LB | 1 | 2.33 | 12 | 0.33 |
| | 2 | 6.98 | 58 | 0.54 |
| | 3 | 11.63 | 72 | 0.7 |
| | 4 | 16.28 | 57 | 0.76 |
| | 5 | 20.93 | 65 | 0.8 |
| | 6 | 25.58 | 81 | 0.85 |
| | 7 | 30.23 | 77 | 0.99 |
| | 8 | 34.88 | 71 | 0.85 |
| | 9 | 39.53 | 57 | 0.84 |
| RB | 10 | 44.18 | 36 | 0.57 |

Side Channel

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| RB | 1 | 0.64 | 19 | 0.08 |
| | 2 | 1.92 | 44 | 0.13 |
| | 3 | 3.2 | 58 | 0.18 |
| | 4 | 4.48 | 58 | 0.19 |
| | 5 | 5.76 | 70 | 0.25 |
| | 6 | 7.04 | 76 | 0.35 |
| | 7 | 8.32 | 92 | 0.34 |
| | *8 | 9.6 | 88 | 0.05 |
| | 9 | 10.88 | 66 | 0.26 |
| LB | 10 | 12.16 | 52 | 0.38 |

**Comments:**

Wetted width of main channel is 46.5 m. Island is 15 m across. Wetted width of side channel is 12.8 m

Main channel thalweg is 25.5 m from left bank.

Side channel thalweg is 0.76 m before flow measurement #7, depth is 1.03 m.

Main channel increment= 4.65 m, Side channel increment= 1.28 m

* flow measurement taken behind mound of sand

Main Channel Photos-

0929-US

0930-DS

0931-LB

0932-RB

0933-Center substrate

0934/0935- Right bank substrate

Side Channel Photos-

0936-US

0937-DS

0938-RB

0939-LB

0940-Substrate

| | | | |
|---|---|---|---|
| **Site Name** | RD-T2-13s | **Event Code** | |
| **Date** | 19 August 2013 | **Time** | 12:16 |
| **Latitude N** | 66.887137 | **Longitude W** | 154.834857 |
| **Observers** | JCS,SDG,LIM | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 1 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 0 |
| Overhanging Vegetation | 1 |
| Undercut Bank | 1 |
| Boulders | 1 |
| Artificial Structures | 0 |

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

**Comments:**

Undercut bank is on left bank by side channel

Periphyton is heavy (mostly on banks)

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| No canopy | Mainly spruce-30% |
| Understory (0.5 - 5 m) | |
| Dominated by willow, some grasses-65% cover | Alder, spruce saplings, willow, grasses, berries, roses-80% |
| Ground (< 0.5 m) | |
| Bare ground-30%<br>Small grasses, herbaceous vegetation-70% | Bare ground-40%<br>Small grasses, moss, berries-60% |

| | | | |
|---|---|---|---|
| **Site Name** | KB-T1-13s | **Event Code** | |
| **Date** | 19 August 2013 | **Time** | 15:45 |
| **Latitude N** | 66.889348 | **Longitude W** | 154.635693 |
| **Observers** | JCS,SDG,LIM | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 12.4 °C | Bankfull Width | 113 m |
| Dissolved Oxygen | 109.40% | Wetted Width | 77 m |
| Dissolved Oxygen | 11.67 mg/L | Thalweg Depth | 1.03 m |
| Conductivity | 140.1 uS/cm | 48 hr. Precipitatio | Low |
| Sp. Cond. | 0.184 mS/cm | Stream Gradient | < 1% (estimated) |
| pH | 8.31 | Stream Stage | Low |
| Turbidity | 1.21 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle- 177°

RB Angle- 172°

## Substrate (inorganic) = 100%

| Type | Diameter | % Composition |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 5 |
| Cobble | 64-256mm (2.5-10in) | 35 |
| Gravel | 2-64mm (0.1-2.5in) | 50 |
| Sand | 0.06-2mm | 10 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| LB | 1 | 3.85 | 17 | 0.12 |
| | 2 | 11.55 | 57 | 0.72 |
| | 3 | 19.25 | 86 | 0.77 |
| | 4 | 26.95 | 93 | 0.83 |
| | 5 | 34.65 | 96 | 0.63 |
| | 6 | 42.35 | 77 | 0.57 |
| | 7 | 50.05 | 38 | 0.55 |
| | 8 | 57.75 | 40 | 0.65 |
| | 9 | 65.45 | 24 | 0.79 |
| | 10 | 73.15 | 18 | 0.6 |
| RB | 11 | 80.85 | 14 | 0.63 |

**Comments:**

Wetted width measured with range finder, may be a few meters off from actual wetted width (as shown by flow measurements). Increment= 7.7 m. Thalweg was 41 meters from left bank. Photos: 0950 (US), 0951 (DS), 0952 (LB), 0953 (RB), 0955 (Substrate between LB and center), 0956 (LB substrate), 0958 (Center sand substrate)

| | | | |
|---|---|---|---|
| **Site Name** | KB-T1-13s | **Event Code** | |
| **Date** | 19 August 2013 | **Time** | 15:35 |
| **Latitude N** | 66.889348 | **Longitude W** | 154.635693 |
| **Observers** | JCS,SDG,LIM | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 2 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 0 |
| Overhanging Vegetation | 0 |
| Undercut Bank | 0 |
| Boulders | 1 |
| Artificial Structures | 0 |

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

**Comments:**

Beaver activity on right bank

Outisde of transect overhanging vegetation is moderate on right bank only

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| No canopy | One black spruce on high bank- 5% |
| Understory (0.5 - 5 m) | |
| No understory | Willow, spruce, fireweed, blueberry-50% |
| Ground (< 0.5 m) | |
| Bare ground-95%<br>Woody saplings, moss, and small grasses-5% | Bare ground-60%<br>Woody and herbaceous vegetation, blueberry, fireweed-40% |

| | | | |
|---|---|---|---|
| **Site Name** | HG-T1-13s | **Event Code** | |
| **Date** | 20 August 2013 | **Time** | 12:31 |
| **Latitude N** | 66.822889 | **Longitude W** | 153.989294 |
| **Observers** | JCS,SDG,LIM | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 6.8 °C | Bankfull Width | 27.5 m |
| Dissolved Oxygen | 98.70% | Wetted Width | 9.2 m |
| Dissolved Oxygen | 12.0 mg/L | Thalweg Depth | 0.42 m |
| Conductivity | 71.3 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.109 mS/cm | Stream Gradient | 0% |
| pH | 6.69 | Stream Stage | Low |
| Turbidity | 0.82 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle- 80°

RB Angle- 174°

## Substrate (inorganic) = 100%

| Type | Diameter | % Composition |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 10 |
| Cobble | 64-256mm (2.5-10in) | 40 |
| Gravel | 2-64mm (0.1-2.5in) | 35 |
| Sand | 0.06-2mm | 15 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| RB | 1 | 0.46 | 3 | 0 |
| | 2 | 1.38 | 4 | 0.01 |
| | 3 | 2.3 | 9 | 0.15 |
| | 4 | 3.22 | 16 | 0.32 |
| | 5 | 4.14 | 27 | 0.36 |
| | 6 | 5.06 | 34 | 0.25 |
| | 7 | 5.98 | 30 | 0.43 |
| | 8 | 6.9 | 30 | 0.47 |
| | 9 | 7.82 | 32 | 0.37 |
| LB | 10 | 8.74 | 14 | 0.31 |

**Comments:**

Thalweg about 3 meters from left bank. Visual observation of Arctic Grayling 25 meters downstream of transect. Depth variable due to substrate. Increment-0.92 m

Photos: 0963 (US), 0964 (DS), 0965 (LB), 0966 (RB), 0967 (Center substrate), 0968 (Center substrate), 0969 (Center substrate)

| | | | |
|---|---|---|---|
| **Site Name** | HG-T1-13s | **Event Code** | |
| **Date** | 20 August 2013 | **Time** | 12:31 |
| **Latitude N** | 66.822889 | **Longitude W** | 153.989294 |
| **Observers** | JCS,SDG,LIM | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 2 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 1 |
| Brush/Woody Debris (Small) <0.3m | 2 |
| Live Trees Root | 1 |
| Overhanging Vegetation | 2 |
| Undercut Bank | 1 |
| Boulders | 1 |
| Artificial Structures | 0 |

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

**Comments:**
Heavy periphyton cover all along transect

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| Spruce-20%<br>Outside 10 meter zone spruce density is heavier | No canopy |
| Understory (0.5 - 5 m) | |
| Willow, alder, berries, tall grass-80% cover | Willow-15% |
| Ground (< 0.5 m) | |
| Bare ground-10%<br>Moss, small grass, saplings, berries-90% | Bare ground-90%<br>Small grass, willow, and fireweed-10% |

| | | | |
|---|---|---|---|
| **Site Name** | HG-T2-13MCs | **Event Code** | |
| **Date** | 20 August 2013 | **Time** | 13:39 |
| **Latitude N** | 66.820099 | **Longitude W** | 153.990330 |
| **Observers** | JCS,SDG,LIM | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 7.3 °C | Bankfull Width | 12.5 m |
| Dissolved Oxygen | 100.60% | Wetted Width | 5.6 m |
| Dissolved Oxygen | 12.13 mg/L | Thalweg Depth | 0.84 m |
| Conductivity | 72.2 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.109 mS/cm | Stream Gradient | < 1% |
| pH | 6.87 | Stream Stage | Low |
| Turbidity | 1.42 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle- 160°

RB Angle- 155°

## Substrate (inorganic) = 100%

| Type | Diameter | % Composition |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 5 |
| Cobble | 64-256mm (2.5-10in) | 40 |
| Gravel | 2-64mm (0.1-2.5in) | 40 |
| Sand | 0.06-2mm | 15 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| LB | 1 | 0.28 | 14 | 0.01 |
| | 2 | 0.84 | 31 | 0.12 |
| | 3 | 1.4 | 44 | 0.18 |
| | 4 | 1.96 | 60 | 0.2 |
| | 5 | 2.52 | 72 | 0.22 |
| | 6 | 3.08 | 72 | 0.29 |
| | 7 | 3.64 | 77 | 0.3 |
| | 8 | 4.2 | 62 | 0.24 |
| | 9 | 4.76 | 42 | 0.12 |
| RB | 10 | 5.32 | 22 | 0.06 |

**Comments:**

Transect is side channel-island-side channel. 16 Arctic Grayling on right bank of first side channel (GoPro video). Thalweg is 2.65 meters from left bank. Side channel 2-see separate data sheet. Photos: 0970 (US), 0971 (DS), 0972 (LB), 0973 (RB), 0974 (Center substrate), 0975 (RB substrate) 0976 (LB substrate). Increment=0.56 m

| | | | |
|---|---|---|---|
| **Site Name** | HG-T2-13MCs | **Event Code** | |
| **Date** | 20 August 2013 | **Time** | 13:39 |
| **Latitude N** | 66.820099 | **Longitude W** | 153.990330 |
| **Observers** | JCS,SDG,LIM | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 1 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 1 |
| Overhanging Vegetation | 2 |
| Undercut Bank | 1 |
| Boulders | 1 |
| Artificial Structures | 0 |

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

**Comments:**
Periphyton cover is moderate to heavy

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| No canopy | Willow-40% |
| Understory (0.5 - 5 m) | |
| Willow, tall grasses-50% | Tall grasses and willow-50% |
| Ground (< 0.5 m) | |
| Bare ground-30%<br>Small grasses, willow, fireweed, moss-70% | Bare ground-10%<br>Herbaceous vegetation, small grasses-90% |

| | | | |
|---|---|---|---|
| **Site Name** | HG-T2-13SCs | **Event Code** | |
| **Date** | 20 August 2013 | **Time** | 14:27 |
| **Latitude N** | 66.820099 | **Longitude W** | 153.990330 |
| **Observers** | JCS,SDG,LIM | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 7.6 °C | Bankfull Width | 11.2 m |
| Dissolved Oxygen | 95.30% | Wetted Width | 9.4 m |
| Dissolved Oxygen | 11.29 mg/L | Thalweg Depth | 0.53 m |
| Conductivity | 72.7 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.109 mS/cm | Stream Gradient | <1% |
| pH | 6.53 | Stream Stage | Low |
| Turbidity | 1.45 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle- 120°

RB Angle- 70°

## Substrate (inorganic) = 100%

| Type | Diameter | % Composition |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 5 |
| Cobble | 64-256mm (2.5-10in) | 20 |
| Gravel | 2-64mm (0.1-2.5in) | 50 |
| Sand | 0.06-2mm | 25 |
| Silt | 0.06-2mm | 0 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| LB | 1 | 0.47 | 4 | 0 |
| | 2 | 1.41 | 6 | 0 |
| | 3 | 2.35 | 6 | 0 |
| | 4 | 3.29 | 26 | 0.05 |
| | 5 | 4.23 | 22 | 0.07 |
| | 6 | 5.17 | 29 | 0.07 |
| | 7 | 6.11 | 30 | 0.05 |
| | 8 | 7.05 | 27 | 0.07 |
| | 9 | 7.99 | 33 | 0.06 |
| RB | 10 | 8.93 | 48 | 0.05 |

**Comments:**

Flow measurement 3 was on top of gravel mound. Flow measurement 5 was on top of rock. Thalweg is 41 cm from right bank. Photos: 0977 (US), 0978 (DS), 0979 (LB), 0980 (RB), 0981 (Left substrate), 0982 (Left substrate), 0983 (Left substrate)

| | | | |
|---|---|---|---|
| **Site Name** | HG-T2-13SCs | **Event Code** | |
| **Date** | 20 August 2013 | **Time** | 14:27 |
| **Latitude N** | 66.820099 | **Longitude W** | 153.990330 |
| **Observers** | JCS,SDG,LIM | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 2 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 2 |
| Live Trees Root | 1 |
| Overhanging Vegetation | 2 |
| Undercut Bank | 2 |
| Boulders | 1 |
| Artificial Structures | 0 |

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

**Comments:**
Periphyton moderate cover

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| Spruce, alder-60% | Spruce, alder-50% |
| Understory (0.5 - 5 m) | |
| Alder, willow, tall grasses-30% | Willow, tall grasses, alder-50% |
| Ground (< 0.5 m) | |
| Bare ground-25%<br>Moss, herbaceous vegetation, woody shrubs (small alder and willow)- 75% | Bare ground-20%<br>Moss, small grasses, herbaceous vegetation, woody shrubs (willow and rose)- 80% |

| | | | |
|---|---|---|---|
| **Site Name** | HJ-T1-13s | **Event Code** | |
| **Date** | 18 August 2013 | **Time** | 15:05 |
| **Latitude N** | 67.040438 | **Longitude W** | 153.591748 |
| **Observers** | JCS,SDG,LIM | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 9.2 °C | Bankfull Width | 39.2 m |
| Dissolved Oxygen | 103.30% | Wetted Width | 11.15 m |
| Dissolved Oxygen | 11.74 mg/L | Thalweg Depth | 0.92 m |
| Conductivity | 156.5 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.224 mS/cm | Stream Gradient | <1% |
| pH | 7.67 | Stream Stage | Low |
| Turbidity | 5.6 NTU | Water Color | Clear/Glacial Low Turbidity |

## Bank Angle Sketches

LB Angle- 177°

RB Angle- 80°

## Substrate (inorganic) = 100%

| Type | Diameter | % Composition |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 5 |
| Cobble | 64-256mm (2.5-10in) | 30 |
| Gravel | 2-64mm (0.1-2.5in) | 0 |
| Sand | 0.06-2mm | 40 |
| Silt | 0.06-2mm | 25 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| LB | 1 | 0.55 | 10 | 0 |
| | 2 | 1.65 | 17 | 0.02 |
| | 3 | 2.75 | 32 | 0.03 |
| | 4 | 3.85 | 52 | 0.13 |
| | 5 | 4.95 | 72 | 0.26 |
| | 6 | 6.05 | 82 | 0.36 |
| | 7 | 7.15 | 88 | 0.27 |
| | *8 | 8.25 | 88 | 0.27 |
| | 9 | 9.35 | 88 | 0.24 |
| RB | 10 | 10.45 | 68 | 0.5 |

**Comments:**

Sinusodal river. Thalweg is 7.7 meters from right bank.

Photos: 0910 (US), 0911 (DS), 0912 (LB), 0913 (RB), 0914 (Left bank substrate)

| | | | |
|---|---|---|---|
| **Site Name** | HJ-T1-13s | **Event Code** | |
| **Date** | 18 August 2013 | **Time** | 15:05 |
| **Latitude N** | 67.040438 | **Longitude W** | 153.591748 |
| **Observers** | JCS,SDG,LIM | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 1 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 1 |
| Brush/Woody Debris (Small) <0.3m | 2 |
| Live Trees Root | 0 |
| Overhanging Vegetation | 1 |
| Undercut Bank | 1 |
| Boulders | 1 |
| Artificial Structures | 0 |

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

**Comments:**
Periphyton mixed with silt = Heavy (greater than 40%)

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| No canopy | Spruce and alder-20% (more alder than spruce) |
| Understory (0.5 - 5 m) | |
| Willow-25% | Alder,some willow, tall grass-75% |
| Ground (< 0.5 m) | |
| Small willow-20%<br>Bare gravel and cobble-80% | Bare ground-10%<br>Herbaceous vegetation, small grasses, moss, blueberries, and roses-90% |

| | | | |
|---|---|---|---|
| **Site Name** | HJ-T2-13s | **Event Code** | |
| **Date** | 18 August 2013 | **Time** | 16:18 |
| **Latitude N** | 67.038627 | **Longitude W** | 153.592427 |
| **Observers** | JCS,SDG,LIM | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 10.3 °C | Bankfull Width | 19.3 m |
| Dissolved Oxygen | 106.10% | Wetted Width | 10.5 m |
| Dissolved Oxygen | 11.74 mg/L | Thalweg Depth | 0.81 m |
| Conductivity | 161.7 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.224 mS/cm | Stream Gradient | <1% |
| pH | 7.84 | Stream Stage | Low |
| Turbidity | 4.55 NTU | Water Color | Mostly Clear |

## Bank Angle Sketches

LB Angle- 175°

RB Angle- 105°

## Substrate (inorganic) = 100%

| Type | Diameter | % Composition |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 30 |
| Cobble | 64-256mm (2.5-10in) | 40 |
| Gravel | 2-64mm (0.1-2.5in) | 20 |
| Sand | 0.06-2mm | 5 |
| Silt | 0.06-2mm | 5 |
| Clay | 0.004-0.06 mm | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| LB | 1 | 0.52 | 8 | 0.16 |
| | 2 | 1.57 | 26 | 0.4 |
| | 3 | 2.62 | 39 | 0.46 |
| | 4 | 3.67 | 59 | 0.29 |
| | 5 | 4.72 | 63 | 0.38 |
| | 6 | 5.77 | 78 | 0.36 |
| | 7 | 6.82 | 68 | 0.44 |
| | *8 | 7.87 | 30 | 0.56 |
| | 9 | 8.92 | 20 | 0.35 |
| RB | 10 | 9.97 | 32 | 0.07 |

**Comments:**

Thalweg is 5.57 meters from left bank, shortly before flow measurement number 6. Increment= 1.05 m

* Measurement taken on top of boulder. Photos: 0915 (US), 0916 (DS), 0917 (LB), 0918 (RB), 0919 (Substrate at LB with JCS boot), 0920 (Substrate in center-boulders), 0921 (Substrate in center)

| | | | |
|---|---|---|---|
| **Site Name** | HJ-T2-13s | **Event Code** | |
| **Date** | 18 August 2013 | **Time** | 16:18 |
| **Latitude N** | 67.038627 | **Longitude W** | 153.592427 |
| **Observers** | JCS,SDG,LIM | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 1 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 0 |
| Overhanging Vegetation | 1 |
| Undercut Bank | 1 |
| Boulders | 2 |
| Artificial Structures | 0 |

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

**Comments:**
Boulders highly moderate
Heavy periphyton mixed with silt cover

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| No canopy | All spruce-35% cover |
| Understory (0.5 - 5 m) | |
| Mostly willow and some spruce-20% cover | Dense with willow, herbaceous vegetation, spruce saplings, blueberry, and rose-almost total cover |
| Ground (< 0.5 m) | |
| Bare ground (gravel and cobble)-65%<br>Small grass-35% | Bare ground-5%<br>Moss, small grass, berries, and rose-95% |

| | | | |
|---|---|---|---|
| **Site Name** | HJ-T3-13s | **Event Code** | |
| **Date** | 18 August 2013 | **Time** | 17:05 |
| **Latitude N** | 67.039417 | **Longitude W** | 153.590255 |
| **Observers** | JCS,SDG,LIM | | |

## Aquatics Data

| **Ambient Water Quality** | | **Channel Characteristics** | |
|---|---|---|---|
| Temperature | 11.0 °C | Bankfull Width | 24.2 m |
| Dissolved Oxygen | 106.40% | Wetted Width | 10.9 m |
| Dissolved Oxygen | 11.64 mg/L | Thalweg Depth | 0.69 m |
| Conductivity | 164.6 uS/cm | 48 hr. Precipitation | Low |
| Sp. Cond. | 0.225 mS/cm | Stream Gradient | 1% |
| pH | 7.75 | Stream Stage | Low |
| Turbidity | 3.71 NTU | Water Color | Clear |

## Bank Angle Sketches

LB Angle- 175°

RB Angle- 90°

## Substrate (inorganic) = 100%

| Type | Diameter | % Composition |
|---|---|---|
| Bedrock | | 0 |
| Boulder | >256mm (10in) | 10 |
| Cobble | 64-256mm (2.5-10in) | 50 |
| Gravel | 2-64mm (0.1-2.5in) | 20 |
| Sand | 0.06-2mm | 0 |
| Silt | 0.06-2mm | 20 |
| Clay | 0.004-0.06mm | 0 |

## Flow

| | # | Width (m) | Depth (cm) | Flow (m/s) |
|---|---|---|---|---|
| RB | 1 | 0.55 | 3 | 0 |
| | 2 | 1.64 | 19 | 0.01 |
| | 3 | 2.73 | 31 | -0.01 |
| | 4 | 3.82 | 52 | -0.01 |
| | 5 | 4.91 | 52 | 0.11 |
| | 6 | 6 | 60 | 0.36 |
| | 7 | 7.09 | 68 | 0.61 |
| | 8 | 8.18 | 68 | 0.83 |
| | 9 | 9.27 | 68 | 1.03 |
| LB | 10 | 10.36 | 58 | 0.2 |

**Comments:**

Increment=1.09 m. Thalweg was 3.22 meters from left bank

Photos: 0922 (US), 0923 (DS), 0924 (LB), 0925 (RB)

| | | | |
|---|---|---|---|
| **Site Name** | HJ-T3-13s | **Event Code** | |
| **Date** | 18 August 2013 | **Time** | 17:05 |
| **Latitude N** | 67.039417 | **Longitude W** | 153.590255 |
| **Observers** | JCS,SDG,LIM | | |

## Channel Cover in Stream Transect

| Cover in Transect | |
|---|---|
| Filamentous Algae | 0 |
| Macrophytes | 0 |
| Woody Debris (Big) >0.3m | 0 |
| Brush/Woody Debris (Small) <0.3m | 1 |
| Live Trees Root | 0 |
| Overhanging Vegetation | 1 |
| Undercut Bank | 0 |
| Boulders | 1 |
| Artificial Structures | 0 |

0 = Absent
1 = Sparse (<10%)
2=Moderate (10-40%)
3=Heavy (40-75%)
4=Very Heavy (>75%)

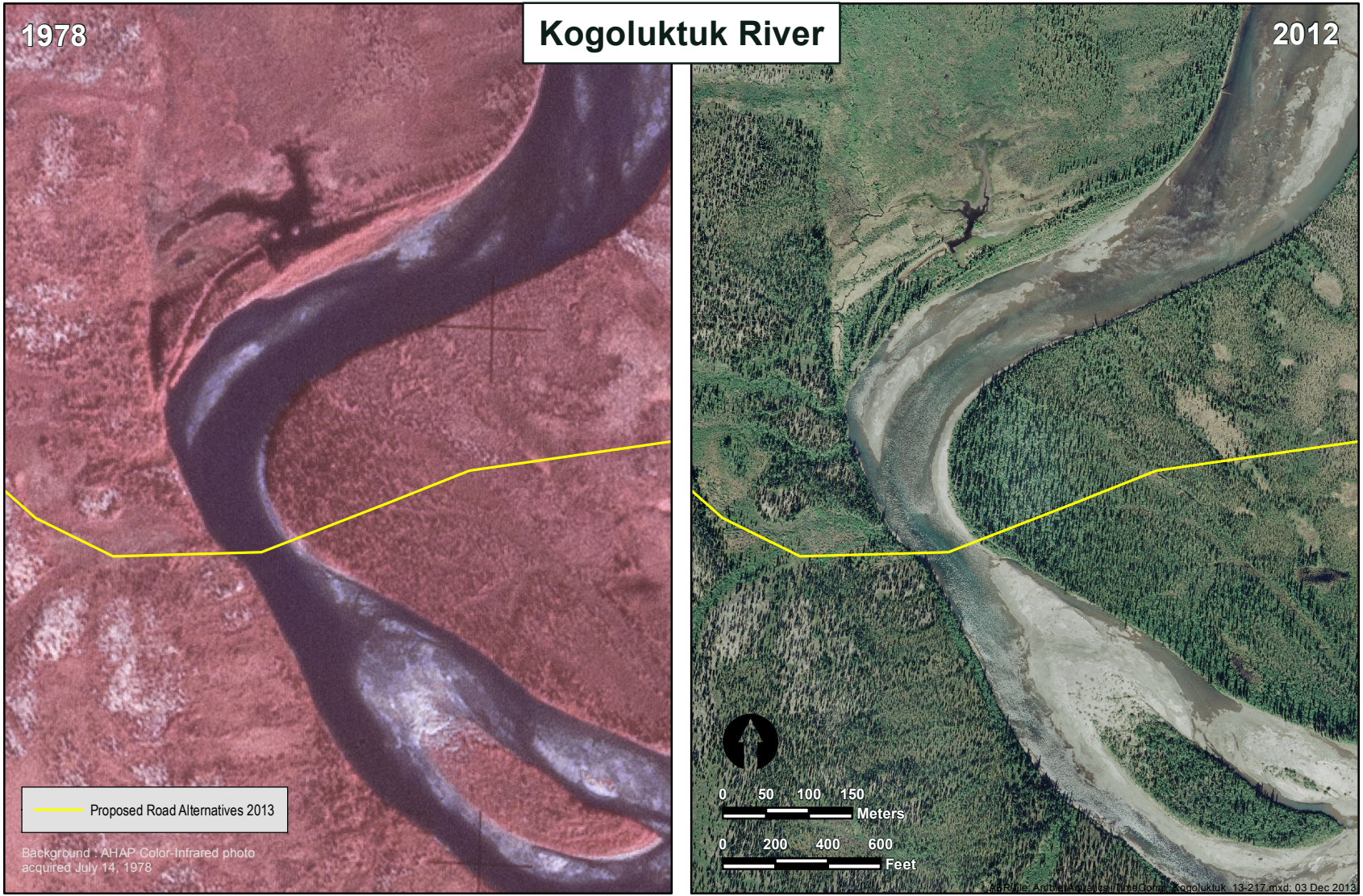
**Comments:**
Periphyton = heavy (mixed with silt)

| Riparian Vegetation (percentage and type 10 meters from bank) | |
|---|---|
| Left Bank | Right Bank |
| Canopy (> 5 m) | |
| Spruce-40% | No canopy |
| Understory (0.5 - 5 m) | |
| Willow, alder, blueberry, and spruce-70% | Willow and tall grass-10% |
| Ground (< 0.5 m) | |
| Bare ground-0%<br>Grasses, herbs, and willow-100% | Bare ground-95%<br>Small grasses-5% |

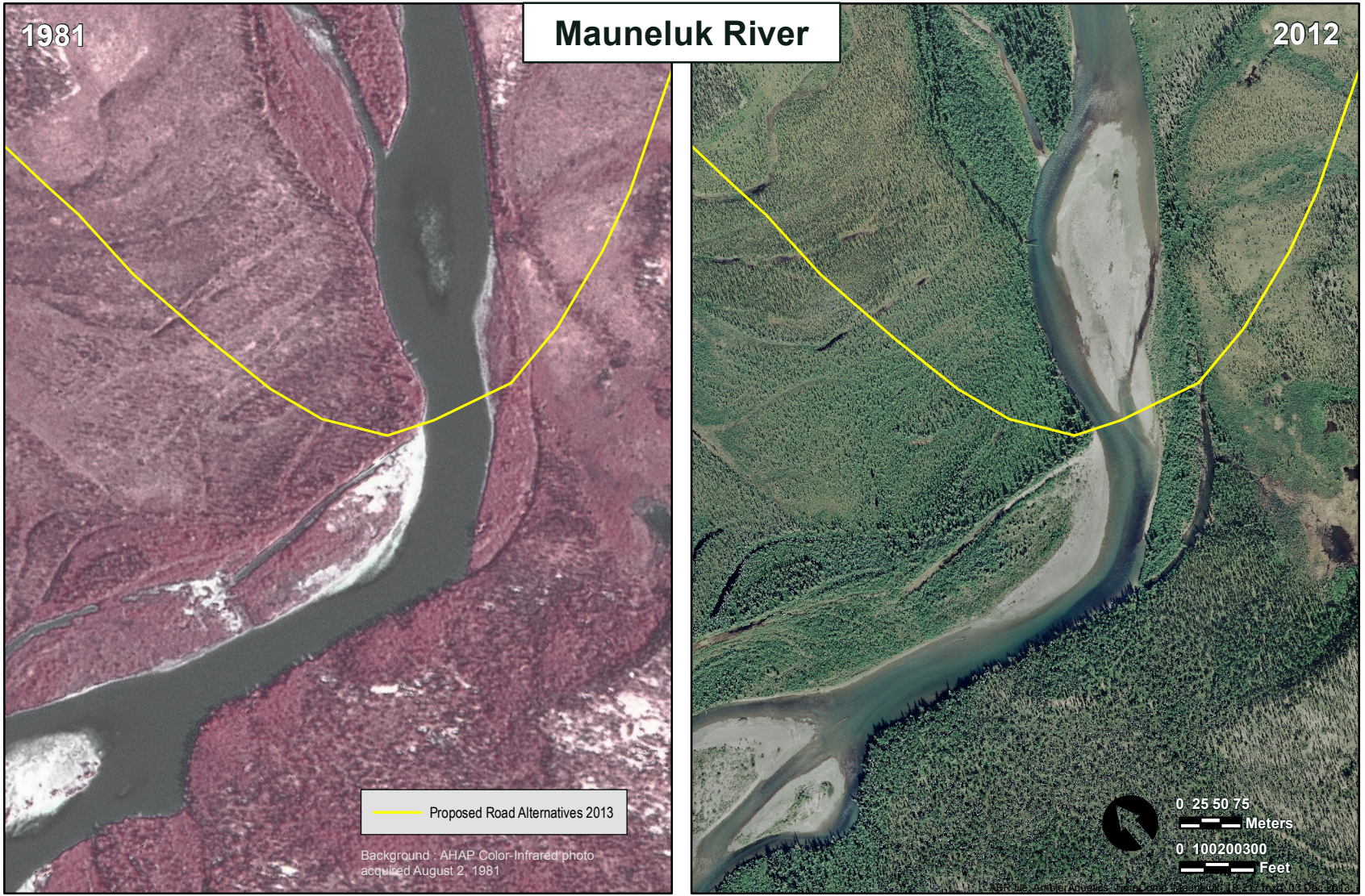
Appendix C. A comparison of stream corridor aerial imagery from 1978–1982 versus imagery from 2012 of waterbodies traversed by the Brooks East Corridor, Alaska.

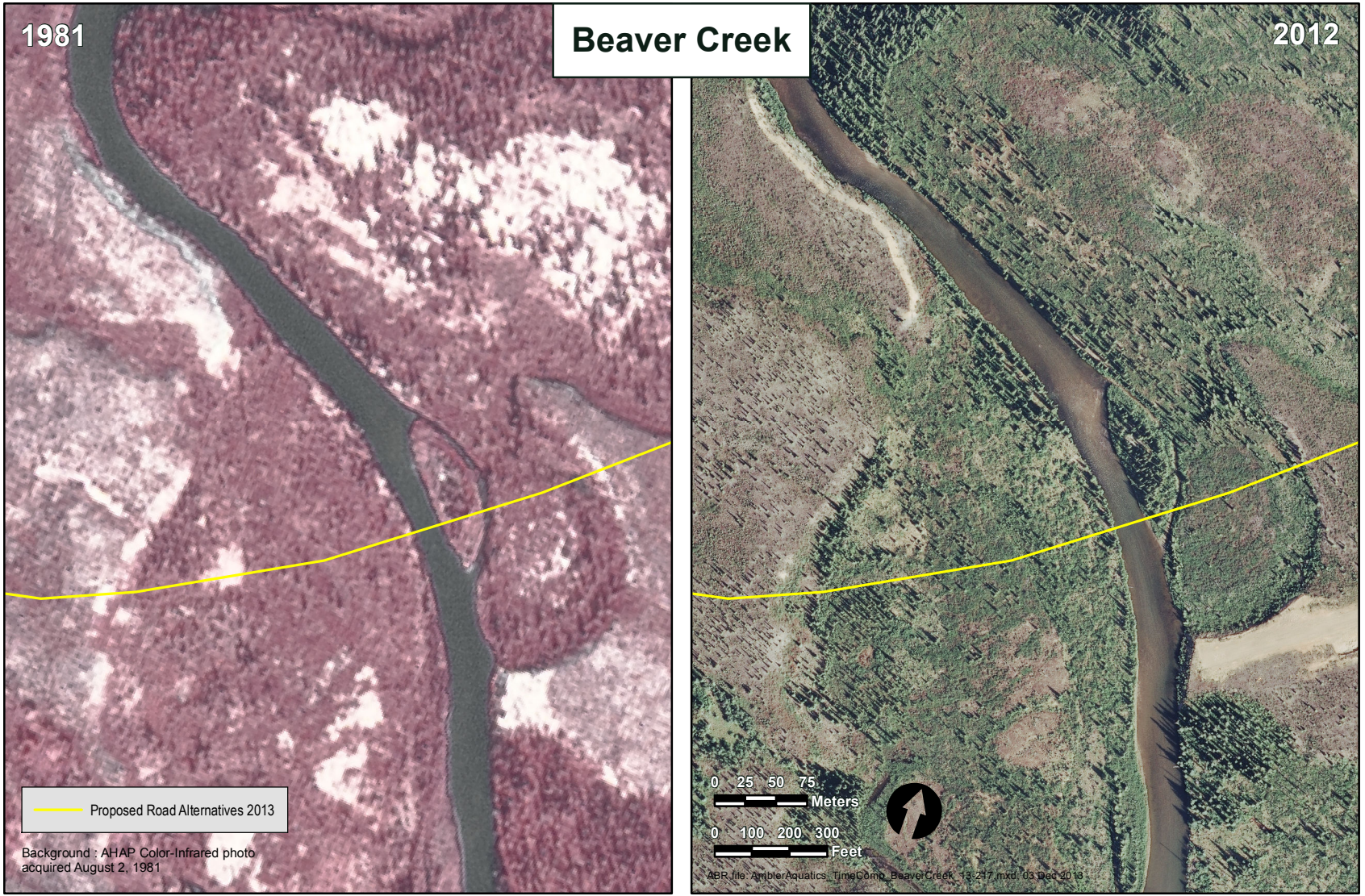
# Shungnak River

# Kogoluktuk River

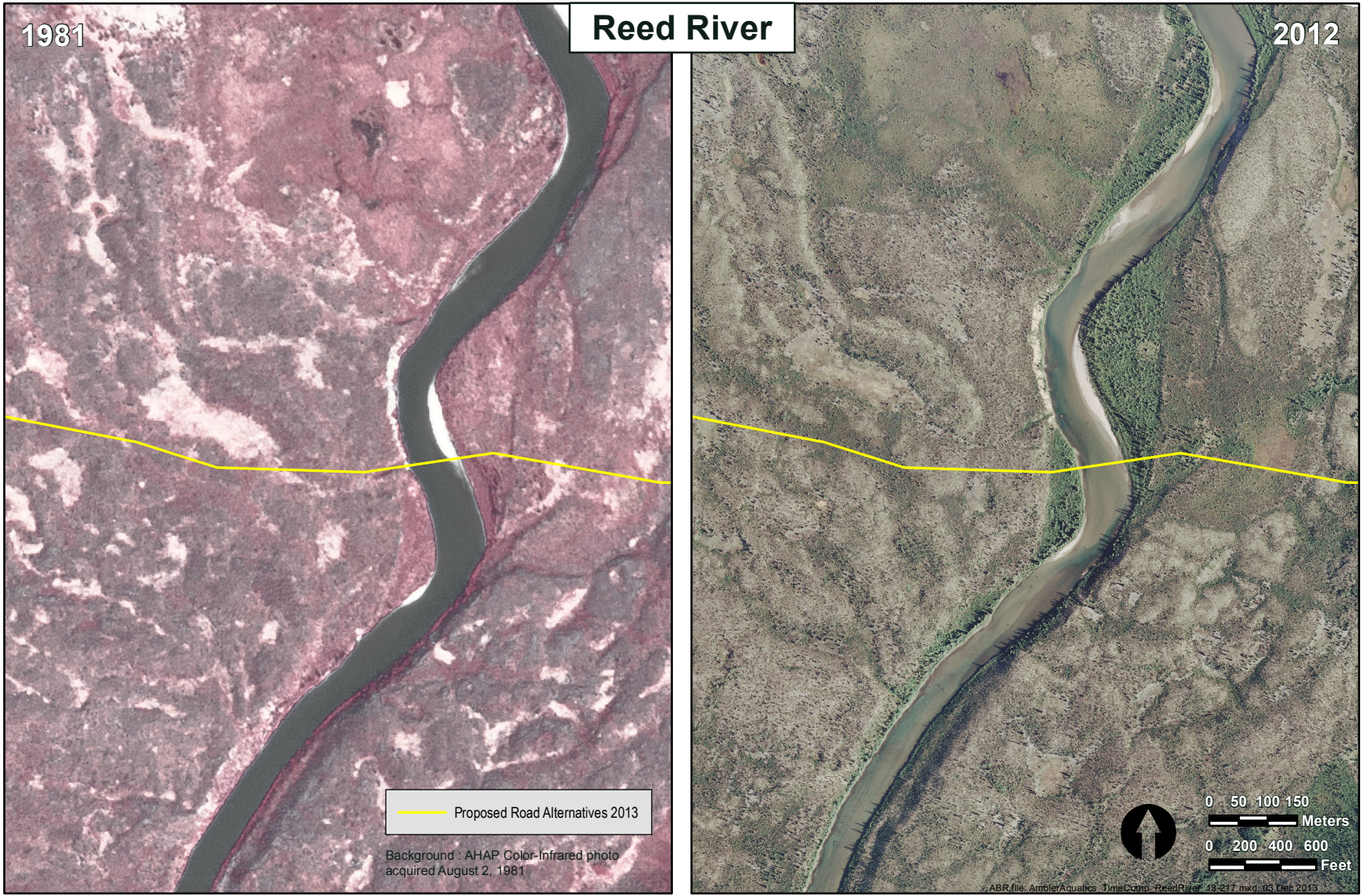


# Mauneluk River

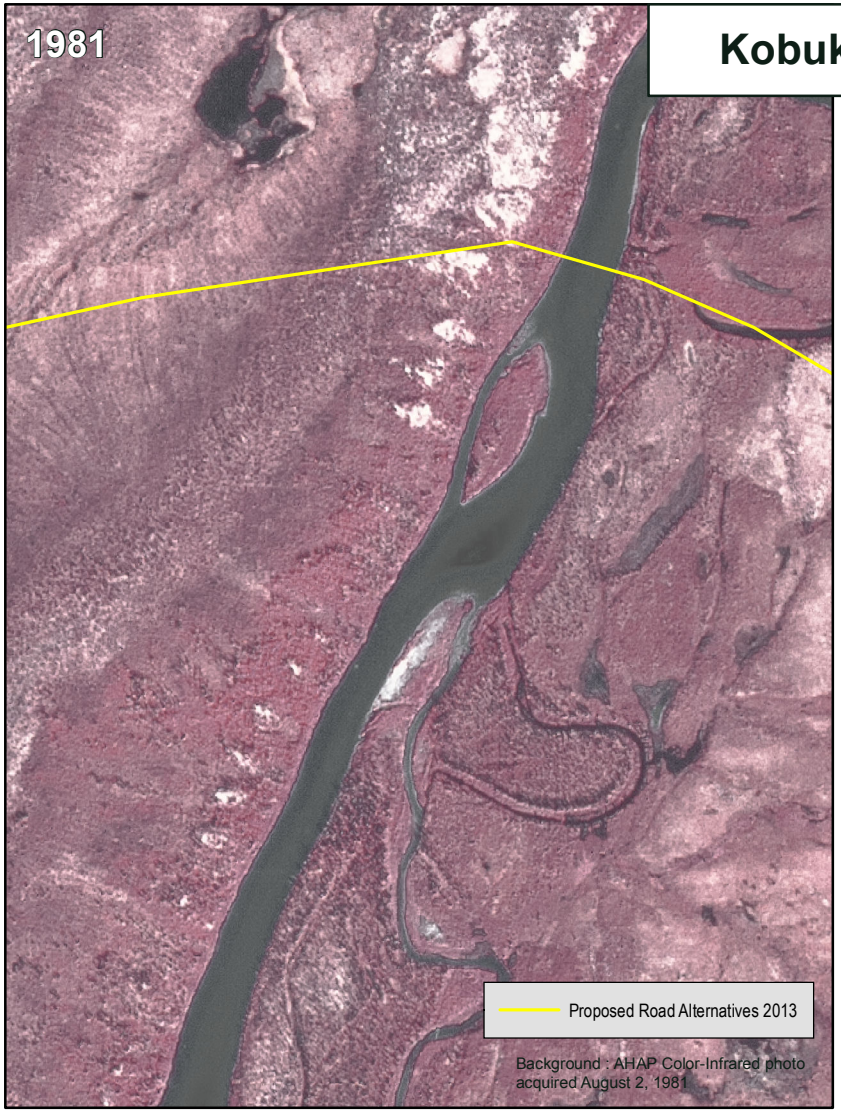


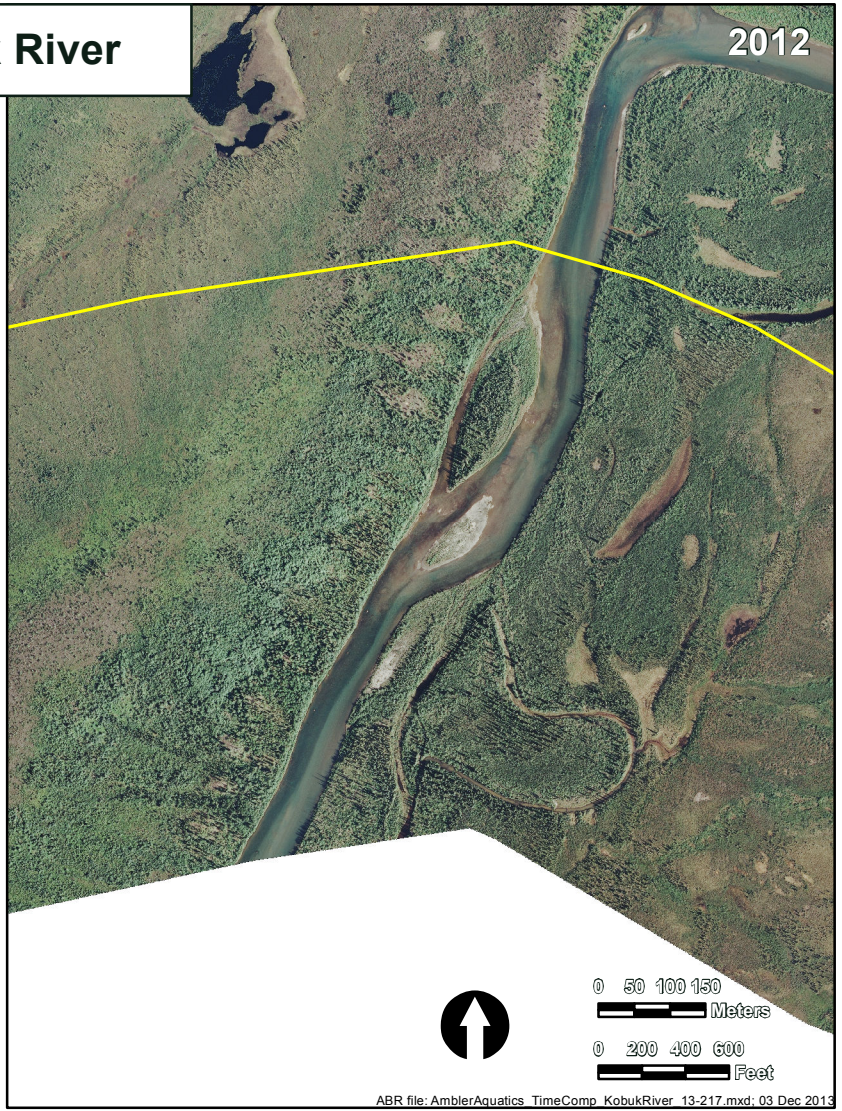

1981
Beaver Creek
2012
Proposed Road Alternatives 2013
Background : AHAP Color-Infrared photo
acquired August 2, 1981
0 25 50 75
Meters
0 100 200 300
Feet
ABR file: AmblerAquatics_TimeComp_BeaverCreek_13-217.mxd 03 Dec 2013

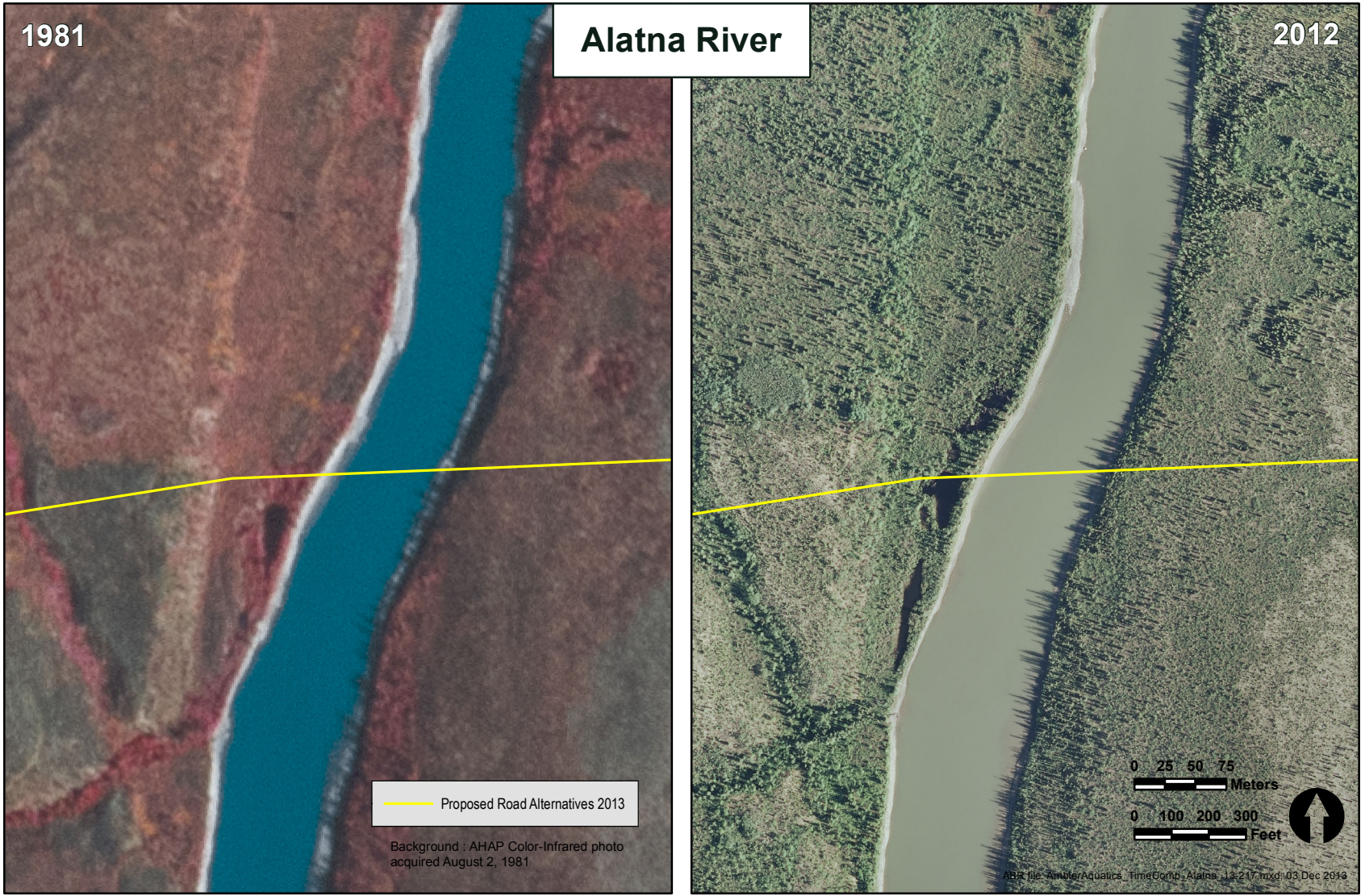
# Reed River


1981
2012
Proposed Road Alternatives 2013
Background : AHAP Color-Infrared photo
acquired August 2, 1981
0 50 100 150
Meters
0 200 400 600
Feet
ABR file: AmblerAquatics_TimeComp_ReedRiver_13-217.mxd 03 Dec 2013

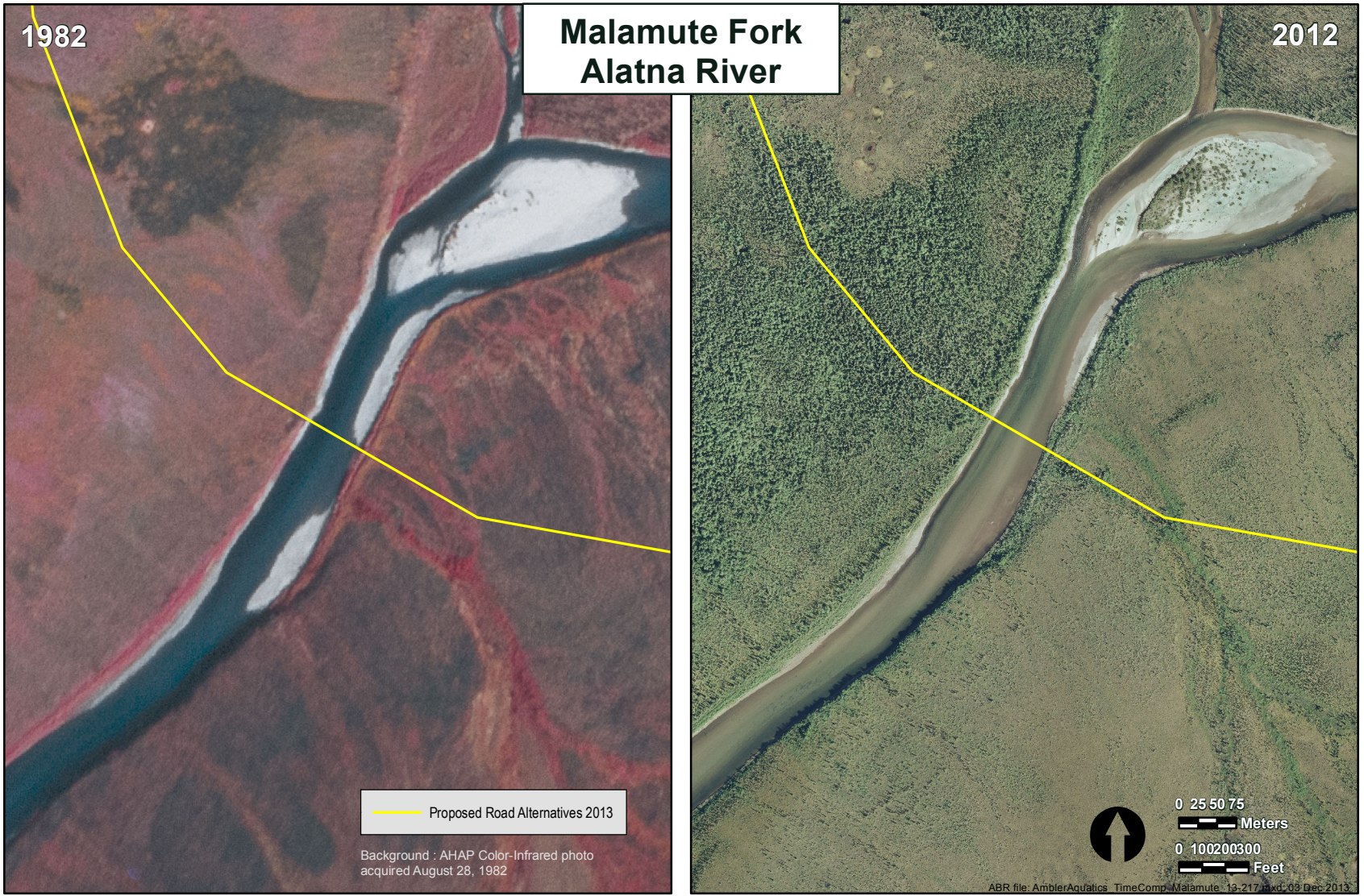
# Kobuk River

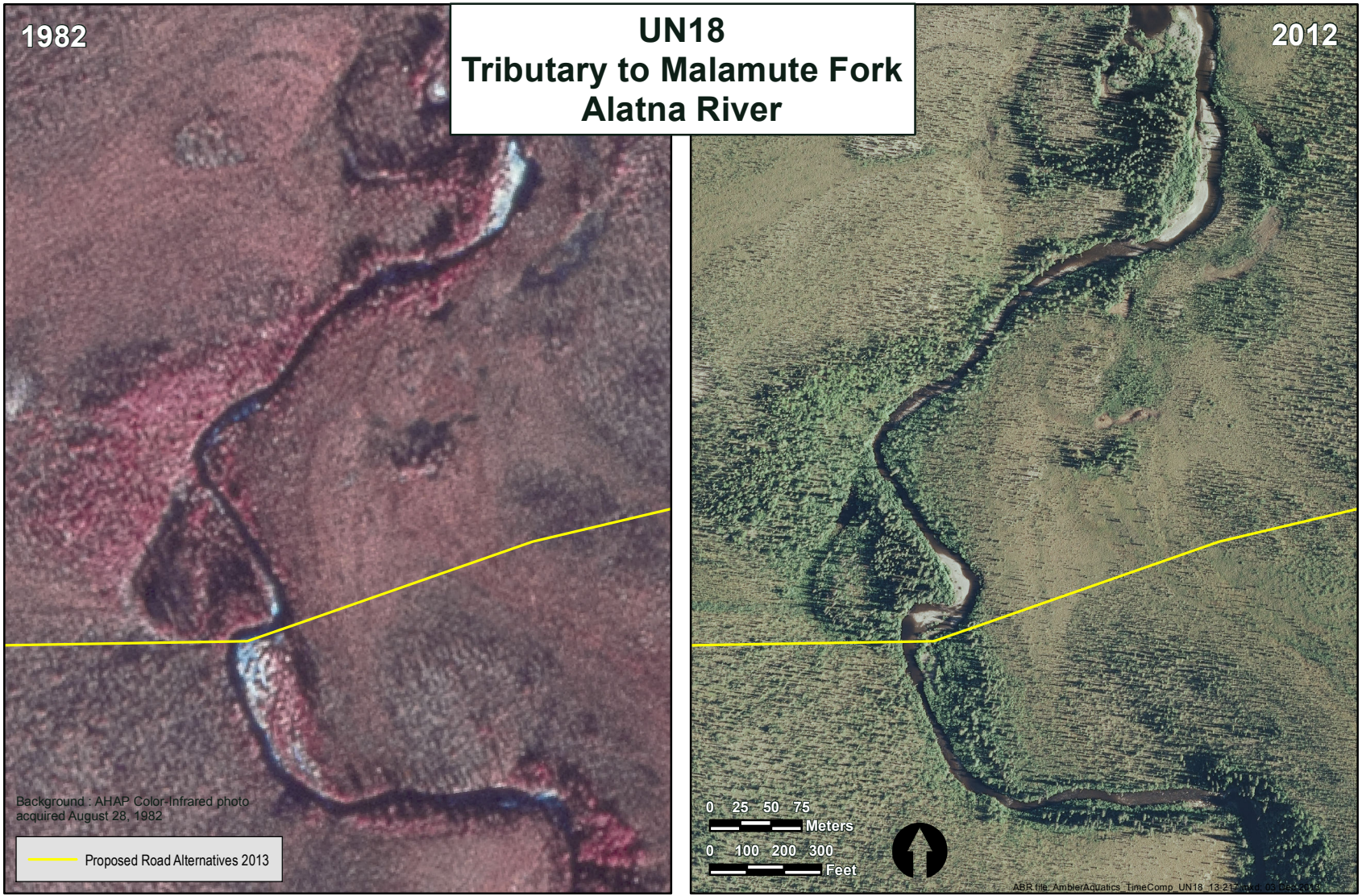

1981
Proposed Road Alternatives 2013
Background : AHAP Color-Infrared photo
acquired August 2, 1981


2012
0 50 100 150
Meters
0 200 400 600
Feet
ABR file: AmblerAquatics_TimeComp_KobukRiver_13-217.mxd; 03 Dec 2013

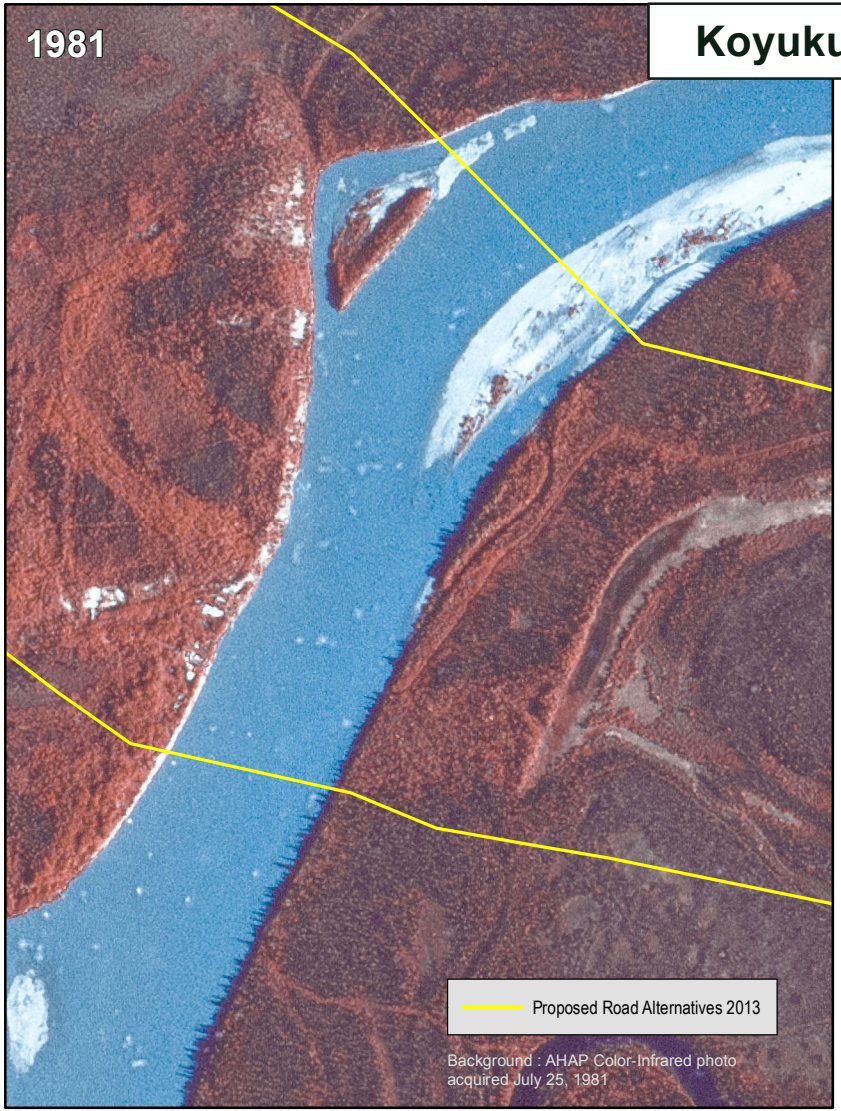

1981
Alatna River
2012
Proposed Road Alternatives 2013
Background : AHAP Color-Infrared photo
acquired August 2, 1981
0 25 50 75
Meters
0 100 200 300
Feet
ABR file: AmbierAquatics_TimeComp_Alatna_13-217.mxd 03 Dec 2013

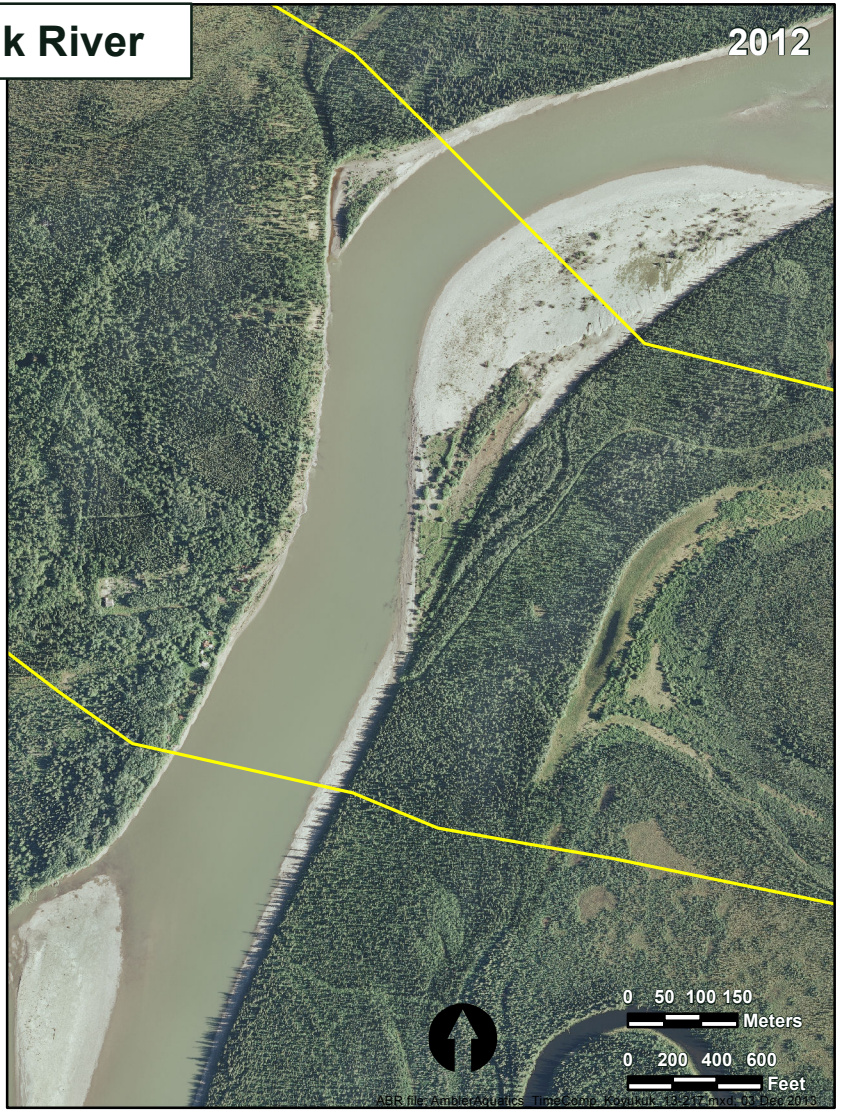
# Malamute Fork Alatna River



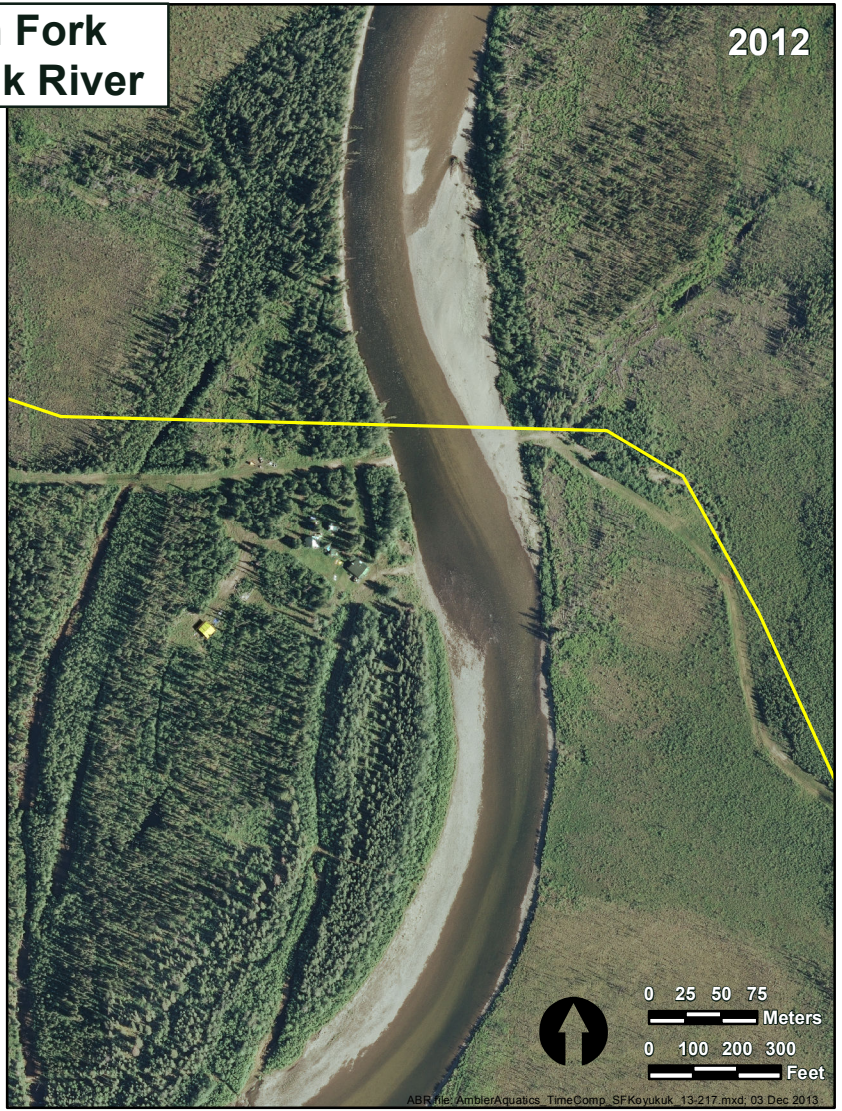

1982
UN18
Tributary to Malamute Fork
Alatna River
2012
Background : AHAP Color-Infrared photo
acquired August 28, 1982
Proposed Road Alternatives 2013
0 25 50 75
Meters
0 100 200 300
Feet

# Koyukuk River

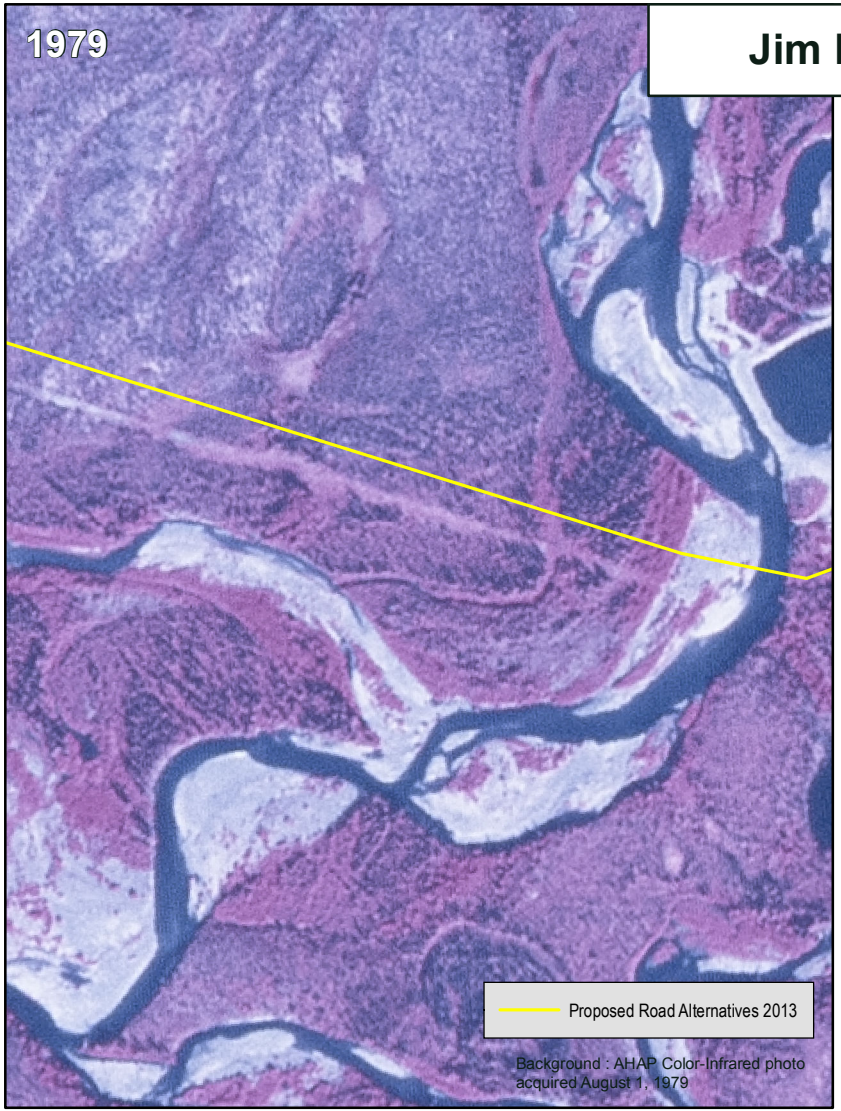


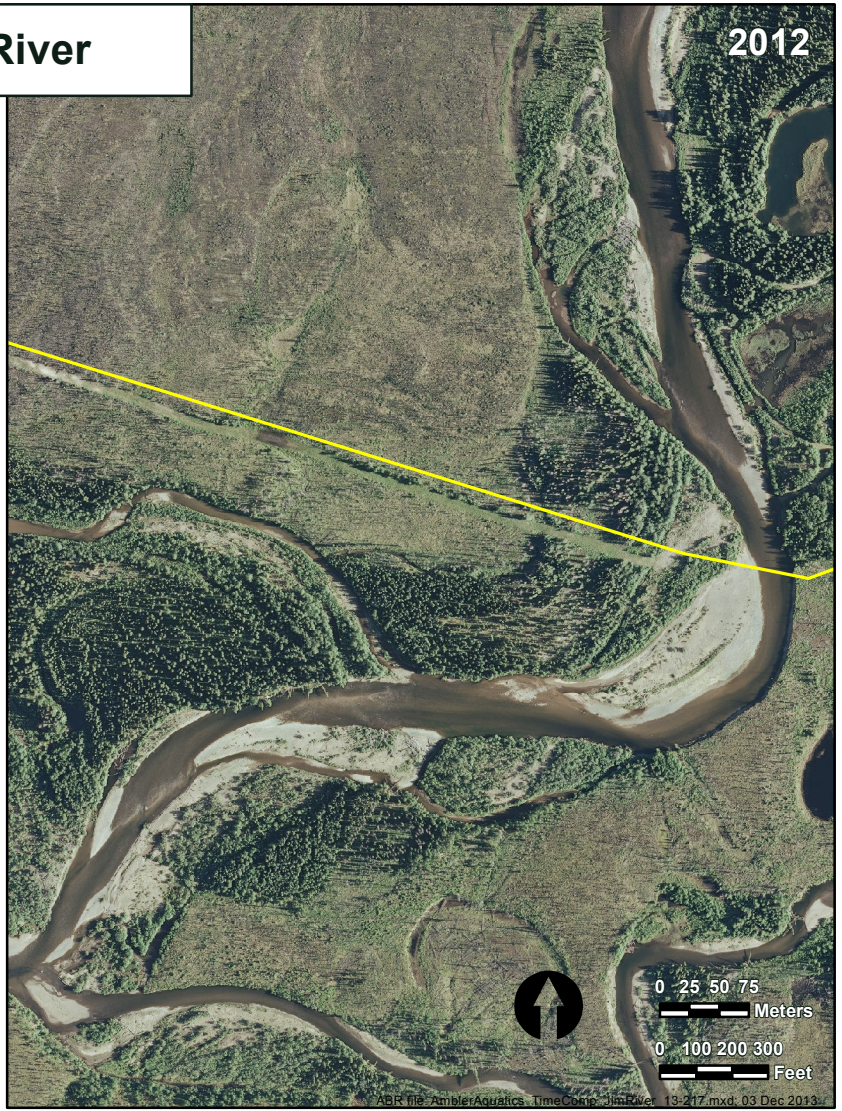



# South Fork Koyukuk River

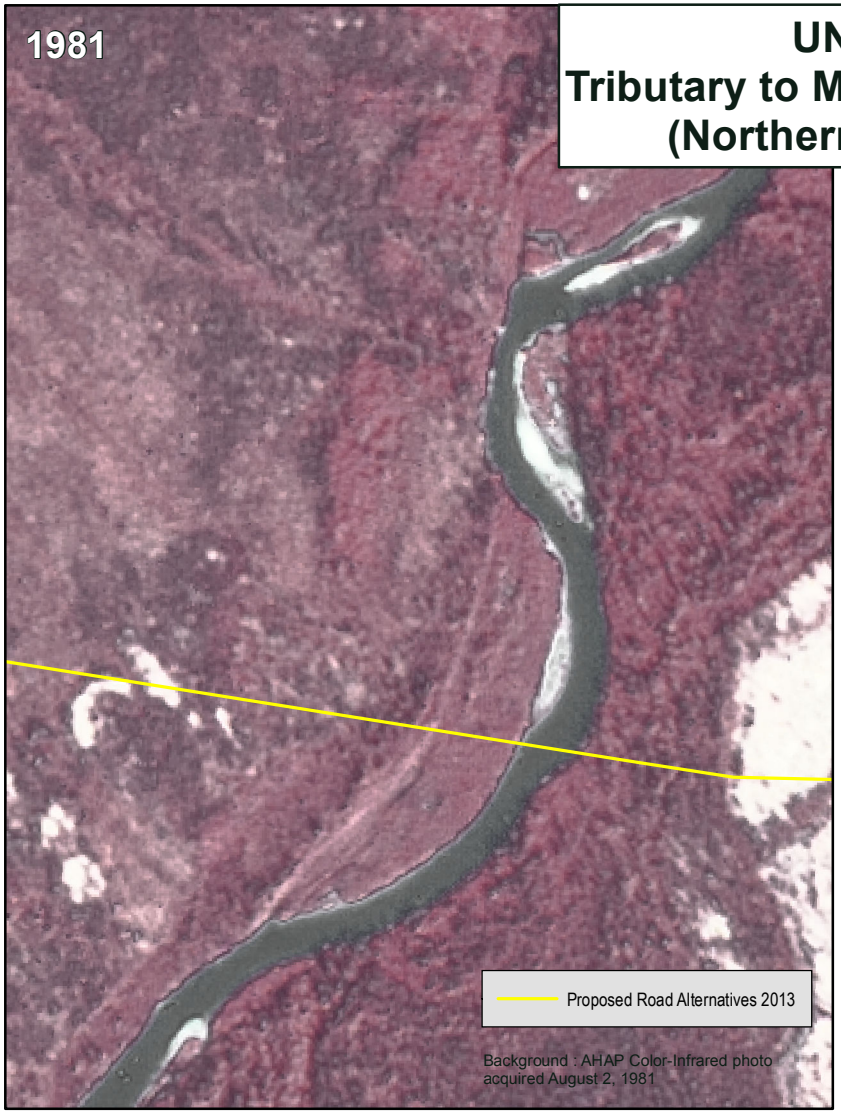



# Jim River

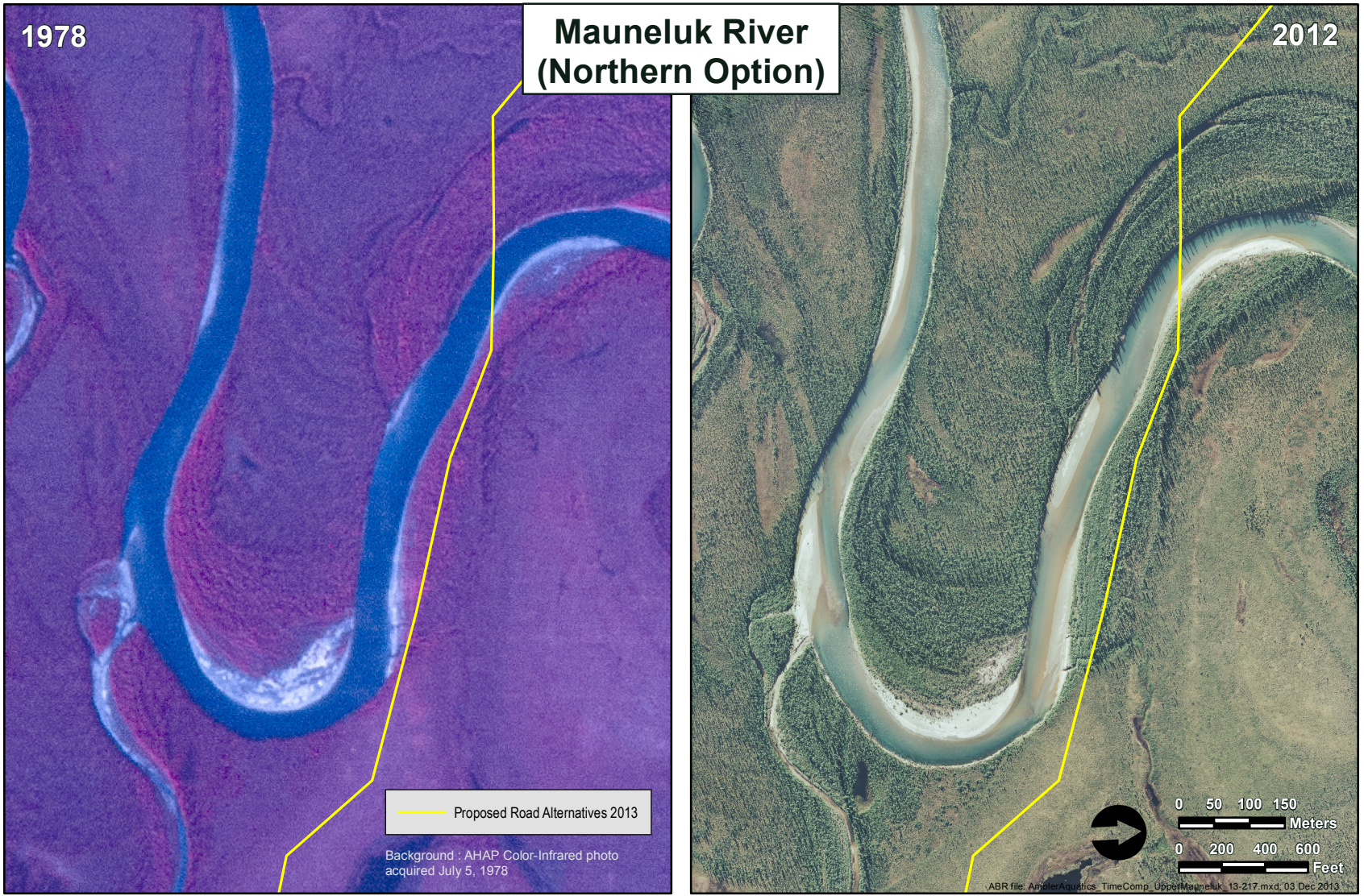

1979
Proposed Road Alternatives 2013
Background : AHAP Color-Infrared photo
acquired August 1, 1979


2012
0 25 50 75
Meters
0 100 200 300
Feet
ABR file: AmblerAquatics_TimeComp_JimRiver_13-217.mxd; 03 Dec 2013

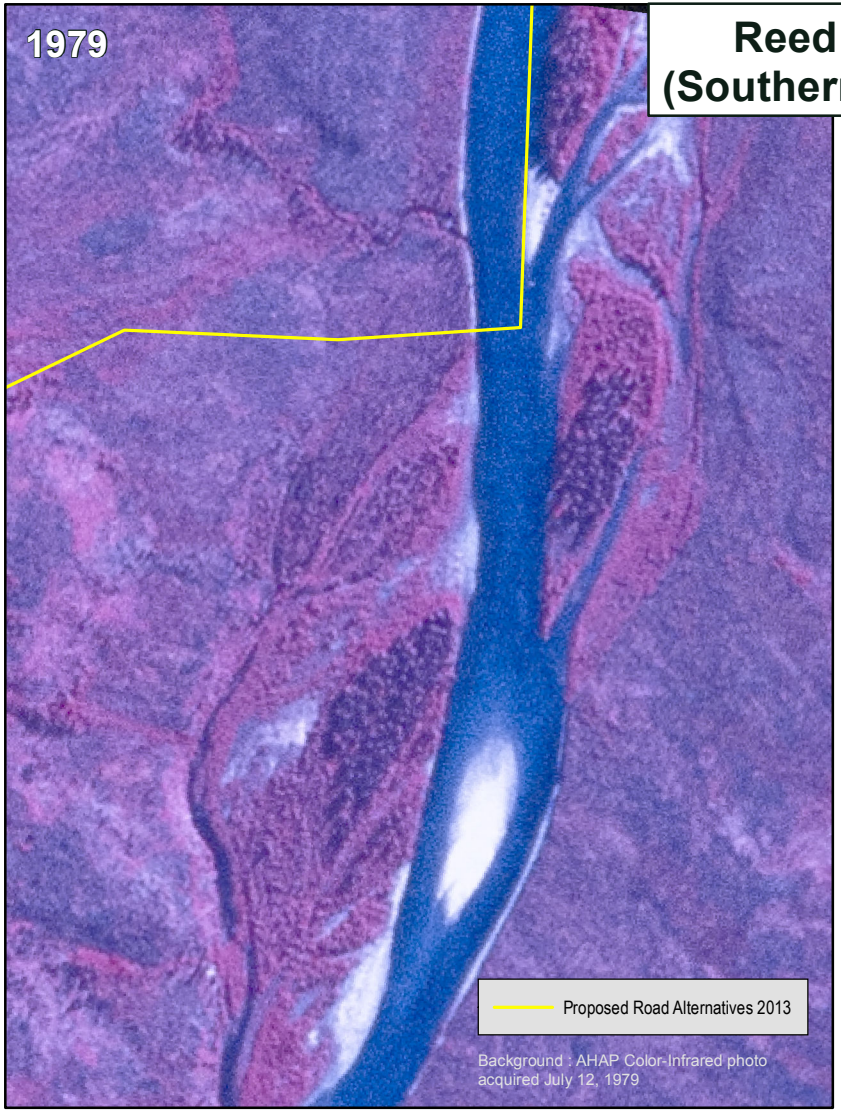
# UN30
# Tributary to Mauneluk River
# (Northern Option)

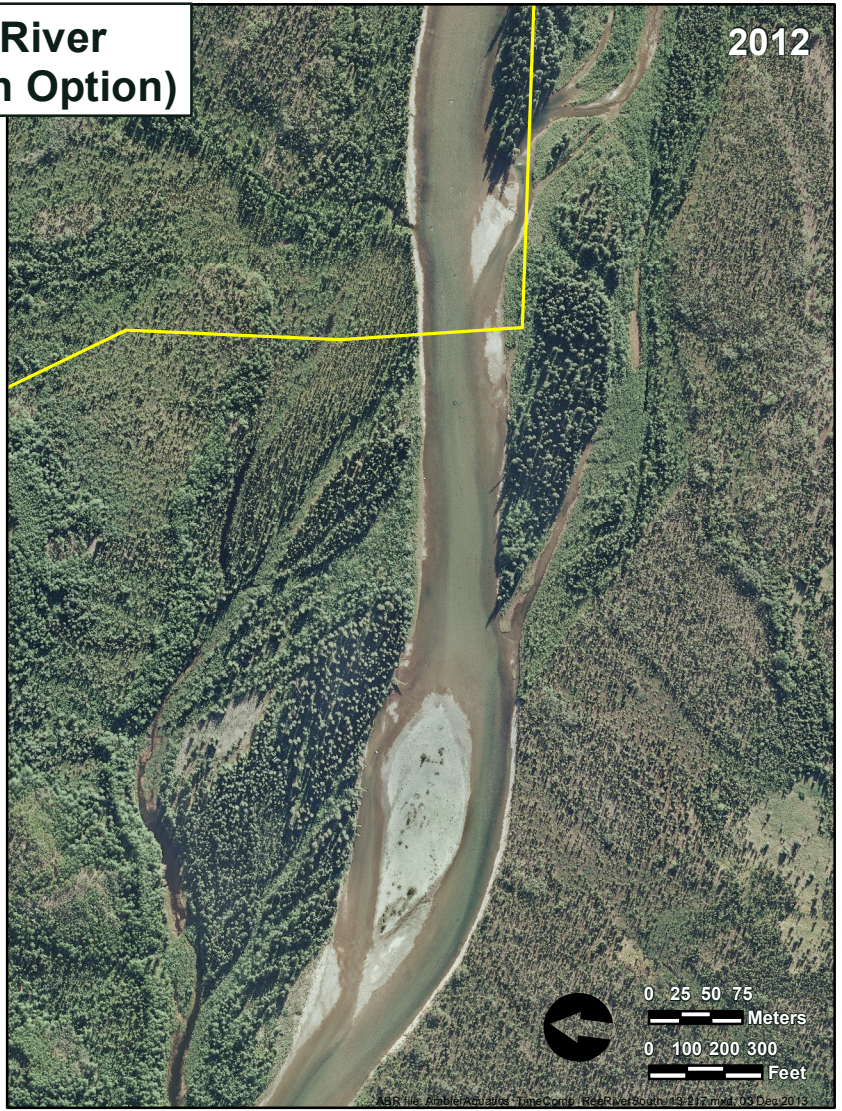



# Mauneluk River (Northern Option)

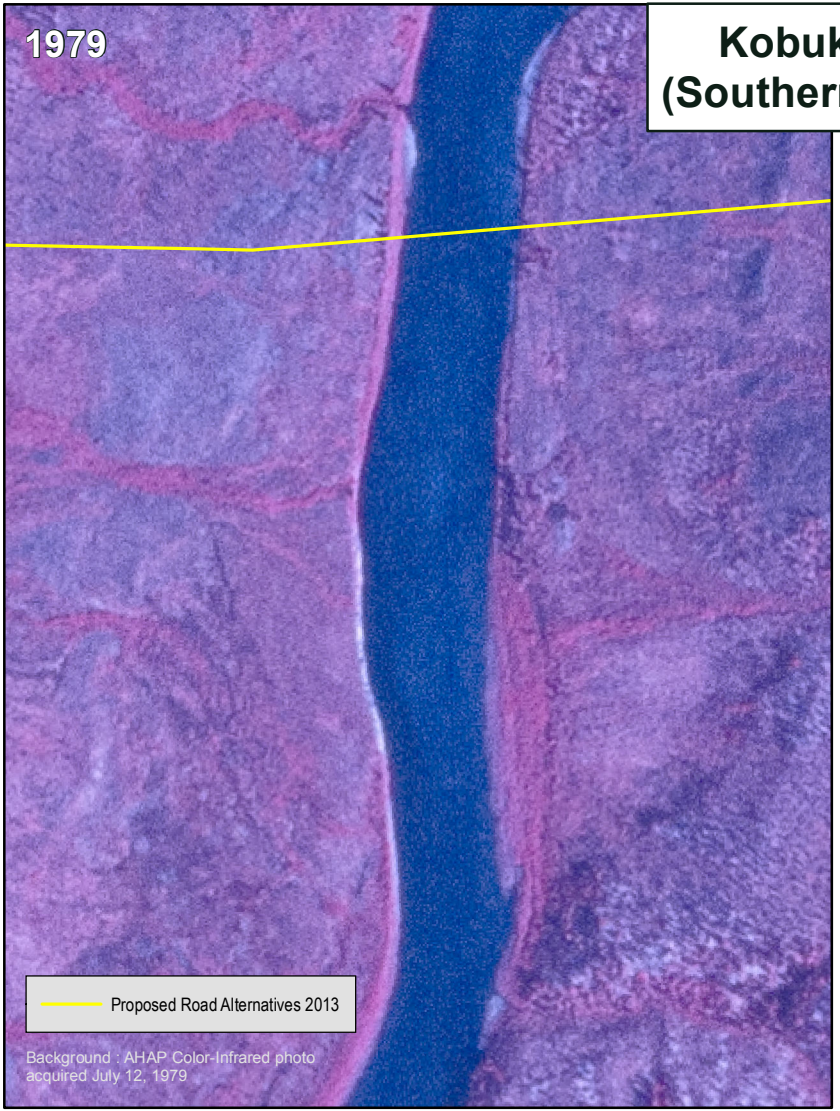


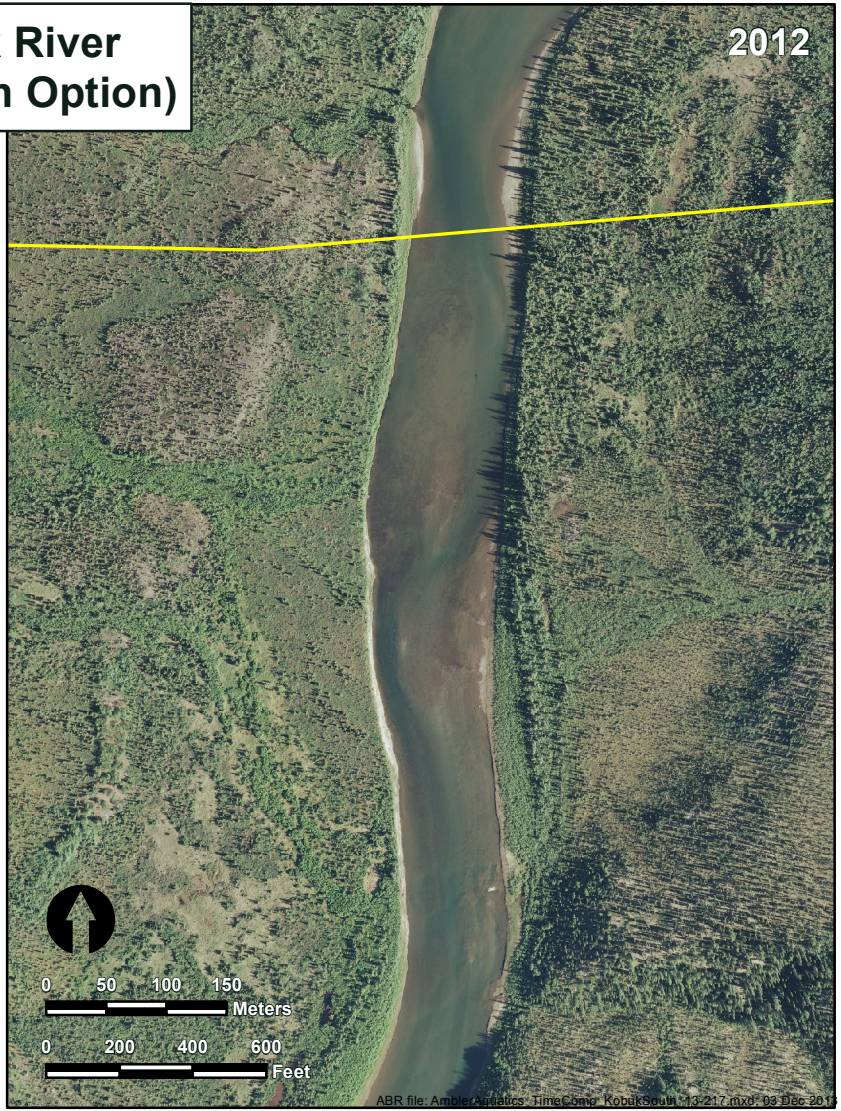
# Reed River (Southern Option)

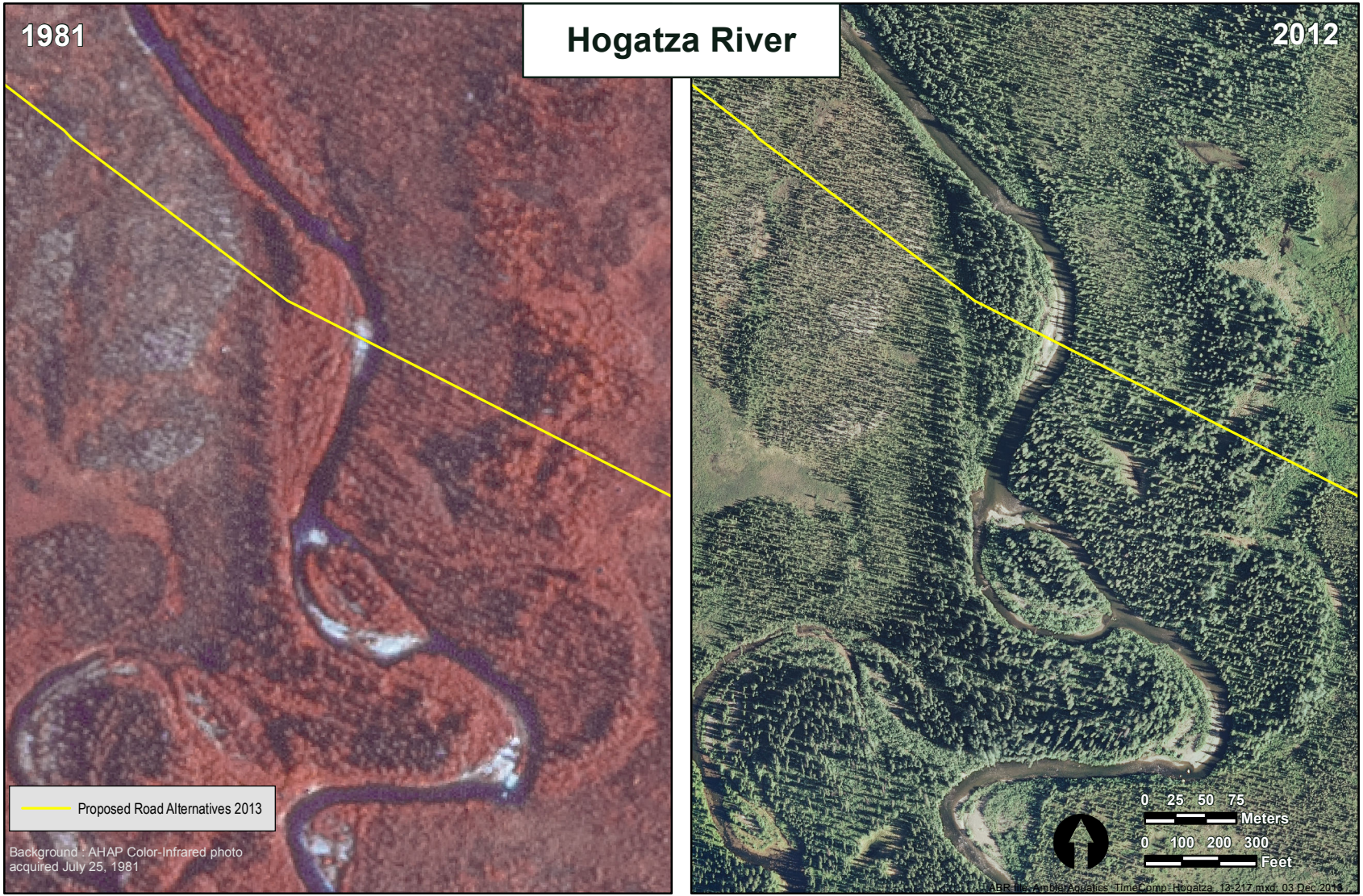


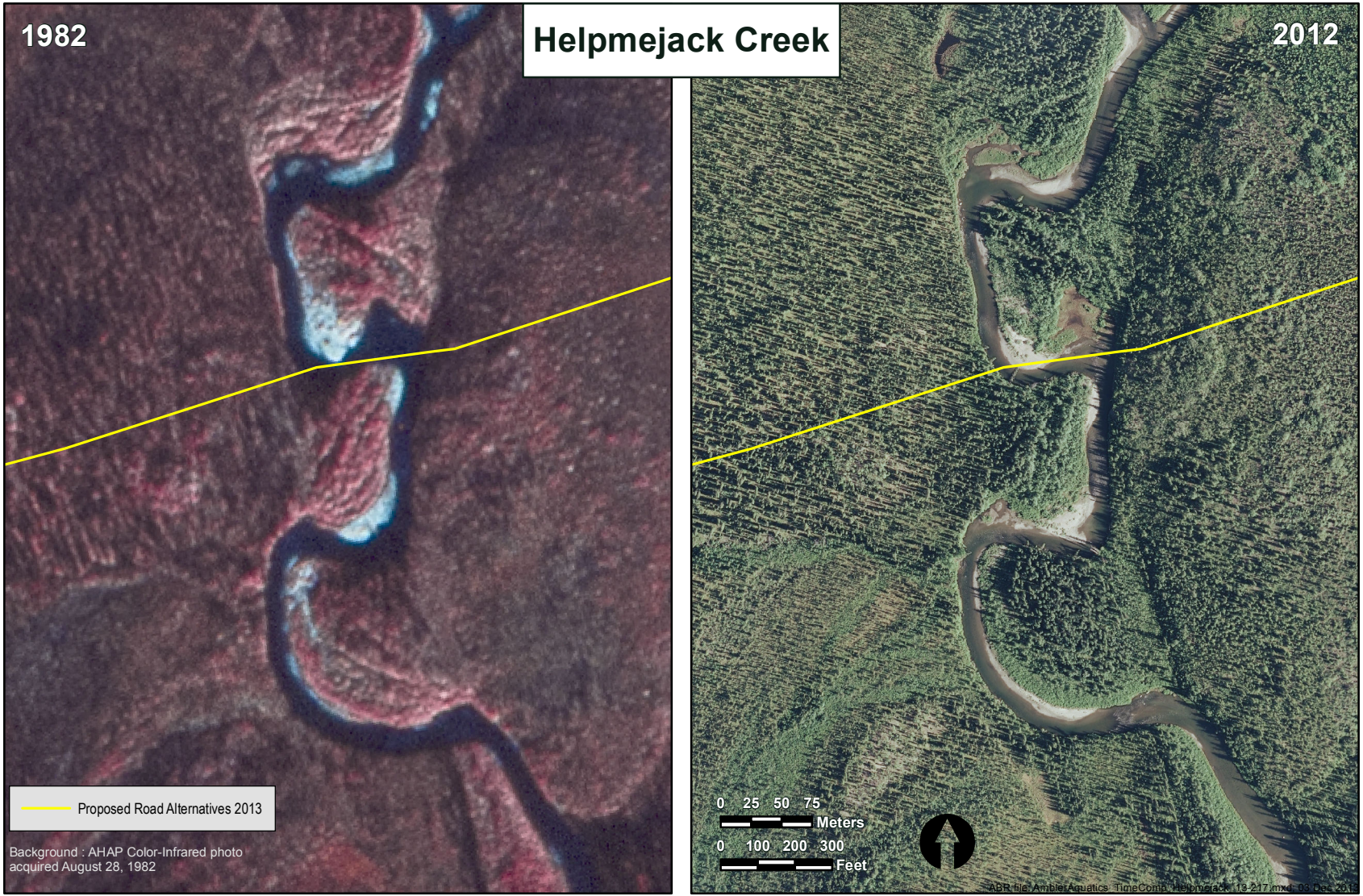



# Kobuk River (Southern Option)




1981
Hogatza River
2012
Proposed Road Alternatives 2013
Background : AHAP Color-Infrared photo acquired July 25, 1981
0 25 50 75
Meters
0 100 200 300
Feet
ABR file: AmblerAquatics\TimeComp\Hogatza_13-217.mxd; 03 Dec 2013


1982
Helpmejack Creek
2012
Proposed Road Alternatives 2013
Background : AHAP Color-Infrared photo
acquired August 28, 1982
0 25 50 75
Meters
0 100 200 300
Feet
ABR file: Ambler Aquatics_TimeComp_Helpmejack_13-217.mxd 03 Dec 2015

Appendix D. Ambient water chemistry collected at habitat survey transects located on waterbodies traversed by the Brooks East Corridor, Alaska, August 2013.

| Transect | Waterbody | Latitude (°N) | Longitude (°W) | Date | Temperature (°C) | DO (%) | DO (mg/L) | Conductivity (µS/cm) | Specific Conductance (mS/cm) | pH | Turbidity (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SH-T1-13 | Shungnak River | 67.120893 | -156.98513 | 8/12/2013 | 9.5 | 100 | 11.32 | 115.3 | 0.164 | 6.58 | 1.92 |
| SH-T2-13 | Shungnak River | 67.120226 | -156.97909 | 8/12/2013 | 9.9 | 102.1 | 11.51 | 115.7 | 0.162 | 7.95 | 1.71 |
| SH-T3-13 | Shungnak River | 67.117791 | -156.96872 | 8/12/2013 | 10.5 | 106.9 | 11.92 | 116.7 | 0.161 | 7.57 | 1.79 |
| KG-T1-13 | Kogoluktuk River | 67.016932 | -156.69449 | 8/13/2013 | 11.3 | 103.9 | 11.35 | 195.2 | 0.264 | 7.83 | 0.99 |
| KG-T2-13 | Kogoluktuk River | 67.018092 | -156.68706 | 8/13/2013 | 12.3 | 106.1 | 11.35 | 200.7 | 0.265 | 8.11 | 0.89 |
| MN-T1-13 | Mauneluk River | 67.008356 | -156.0743 | 8/13/2013 | 11.1 | 110.3 | 12.07 | 151.6 | 0.206 | 7.73 | 1.14 |
| MN-T2-13 | Mauneluk River | 67.016628 | -156.0547 | 8/13/2013 | 11.9 | 110.4 | 11.9 | 155.9 | 0.208 | 7.71 | 0.95 |
| BV-T1-13 | Beaver Creek | 67.021206 | -155.15079 | 8/14/2013 | 8.7 | 100.5 | 11.66 | 126.9 | 0.184 | 7.86 | 0.86 |
| BV-T2-13 | Beaver Creek | 67.023342 | -155.158 | 8/14/2013 | 9.1 | 102.7 | 11.78 | 128.6 | 0.184 | 7.79 | 0.74 |
| RD-T1-13 | Reed River | 67.035785 | -154.83514 | 8/15/2013 | 8.1 | 103 | 12.13 | 81.1 | 0.12 | 6.72 | 1.13 |
| KB-T1-13 | Kobuk River | 67.012346 | -154.36742 | 8/15/2013 | 10.6 | 106.5 | 11.84 | 142.2 | 0.196 | 7.45 | 0.68 |
| AL-T2-13 | Alatna River | 67.077422 | -153.3279 | 8/17/2013 | 12.5 | 103.1 | 10.97 | 355.8 | 0.467 | 7.83 | 5.47 |
| MF-T1-13 | Malamute Fork Alatna River | 67.06431 | -153.17605 | 8/17/2013 | 12.6 | 108.1 | 11.4 | 273.2 | 0.357 | 8.3 | 0.98 |
| UN18-T1-13 | Unnamed tributary to Malamute Fork Alatna River | 67.091882 | -152.73017 | 8/16/2013 | 12.2 | 102.3 | 10.96 | 116.5 | 0.154 | 7.33 | 1.63 |
| UN18-T2-13 | Unnamed tributary to Malamute Fork Alatna River | 67.090632 | -152.72893 | 8/16/2013 | 12.5 | 100.6 | 10.76 | 117.1 | 0.154 | 7.47 | 1.92 |
| SF-T1-13 | South Fork Koyukuk River | 66.846855 | -151.09734 | 8/22/2013 | 10.5 | 102.7 | 11.42 | 180.8 | 0.25 | 7.89 | 1.14 |
| JM-T1-13 | Jim River | 66.793188 | -150.73218 | 8/22/2013 | 6.4 | 105.5 | 13 | 53.6 | 0.083 | 7.04 | 1.35 |
| UN30-T1-13n | Unnamed tributary to Mauneluk River | 67.060008 | -156.03064 | 8/21/2013 | 5.8 | 103.2 | 12.79 | 140 | 0.221 | 7.95 | 0.72 |
| MN-T1-13n | Mauneluk River | 67.051217 | -155.76514 | 8/21/2013 | 8.3 | 106.4 | 12.47 | 171.3 | 0.251 | 7.67 | 0.63 |
| RD-T1-13s | Reed River | 66.886494 | -154.83768 | 8/19/2013 | 9.1 | 106.7 | 12.24 | 94.1 | 0.135 | 7.56 | 3.11 |
| RD-T2-13s | Reed River | 66.887137 | -154.83486 | 8/19/2013 | 8.7 | 102.8 | 11.93 | 91.4 | 0.133 | 7.55 | 2.27 |
| KB-T1-13s | Kobuk River | 66.889348 | -154.63569 | 8/19/2013 | 12.4 | 109.4 | 11.67 | 140.1 | 0.184 | 8.31 | 1.21 |
| HG-T1-13s | Hogatza River | 66.822889 | -153.98929 | 8/20/2013 | 6.8 | 98.7 | 12 | 71.3 | 0.109 | 6.69 | 0.82 |

| Transect | Waterbody | Latitude (°N) | Longitude (°W) | Date | Temperature (°C) | DO (%) | DO (mg/L) | Conductivity (µS/cm) | Specific Conductance (mS/cm) | pH | Turbidity (NTU) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HG-T2-13MCs | Hogatza River | 66.820099 | -153.99033 | 8/20/2013 | 7.3 | 100.6 | 12.13 | 72.2 | 0.109 | 6.87 | 1.42 |
| HG-T2-13SCs | Hogatza River | 66.820099 | -153.99033 | 8/20/2013 | 7.6 | 95.3 | 11.29 | 72.7 | 0.109 | 6.53 | 1.45 |
| HJ-T1-13s | Helpmejack Creek | 67.040438 | -153.59175 | 8/18/2013 | 9.2 | 103.3 | 11.74 | 156.5 | 0.224 | 7.67 | 5.6 |
| HJ-T2-13s | Helpmejack Creek | 67.038627 | -153.59243 | 8/18/2013 | 10.3 | 106.1 | 11.74 | 161.7 | 0.224 | 7.84 | 4.55 |
| HJ-T3-13s | Helpmejack Creek | 67.039417 | -153.59026 | 8/18/2013 | 11 | 106.4 | 11.64 | 164.6 | 0.225 | 7.75 | 3.71 |