PROPOSAL FOR:

Habitat Analysis of Robe Lake

DEC 4, 2019

Brailey Hydrologic

inter·fluve

ARRI
Aquatic Restoration & Research Institute

Dec 4, 2019

Valdez Fisheries Development Association

Attn: Mike H. Wells
Mike.Wells@valdezfisheries.com
(907) 835-4874

Re: Proposal for Habitat Analysis of Robe Lake

Dear Mike,

Thank you for the opportunity to provide this proposal. Our team is excited by this important opportunity to develop an ecologically sound basis for the restoration of a natural resource with great regional economic importance. We believe that thriving economies and functioning ecosystems aren't necessarily mutually exclusive, and that this project has the potential to provide a proof of that concept. The Alaska Department of Fish and Game and Valdez Fisheries Development Association (VFDA) have a long history of work on Robe Lake, and it will be exciting to be part of crafting an ecologically sound solution.

Involving experts in multiple disciplines, we have put together a team that has incredible depth in stream restoration and aquatic ecology. Inter-Fluve is a nationally-recognized expert in habitat analysis and stream restoration with decades of experience on Alaskan streams. Jeff Davis' graduate work focused on the effects of light, temperature, and nutrients on aquatic plant ecology. Before forming ARRI, Jeff worked in the Habitat Division at ADF&G on projects including the development of streambank protection and revegetation guidance. Dave Brailey has worked with some of the country's foremost river scientists, engineers, and academics, including work with Inter-Fluve over 20 years ago. The focus on important questions and required data quality are part of what draws our team to these types of projects.

Represented by Dan Miller (Inter-Fluve) during the pre-proposal meeting, our project team is organized with Brailey Hydrologic as prime since we feel that proximity to VDFA and the project site will increase efficiency and best serve VFDA. Based on our combined lifetimes of experience, we have confidence that our team can provide a realistic assessment of the available enhancement alternatives, including the realistic steps for implementation. Although the streamflow measurement task will be challenging, we have confidence that we can capture the data needed for a thorough evaluation of enhancement alternatives. This represents no small task, requiring expert judgment to avoid many potential pitfalls, and we are up for the challenge.

The primary project contact will be Dave Brailey, but please do not hesitate to contact any of us with questions.

Sincere regards,

Dave Brailey
Project Manager
dbrailey@alaska.net
(907) 248-0058

Dan Miller, PE
Sr. Hydraulic Engineer
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(541) 399-0979

Jeff Davis
Aquatic Ecologist
ARRI
(907) 315-4631

Dec 4, 2019

Proposal for: Habitat Analysis of Robe Lake

SUBMITTED TO

Valdez Fisheries Development Association
1815 Mineral Creek Loop Road
P.O. Box 125
Valdez, AK 99686

Mike H. Wells
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(907) 835-4874

SUBMITTED BY

Brailey Hydrologic
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Project Manager: Dave Brailey
Hydrologist
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Colville River, AK

Organization & Qualifications

The project team is drawn together by a shared history and fascination with Alaskan aquatic and riverine systems. Over the past 20 years, the team members have collaborated on multiple projects aimed at protecting and enhancing Alaskan ecosystems. Our goal is to combine our specialized areas of expertise to evaluate Robe Lake improvement alternatives including a controlled diversion of Corbin Creek. Inter-Fluve and ARRI will provide the expert judgement needed for realistic assessment of this alternative, and Brailey Hydrologic will provide the hydrologic field data needed for quantitative temperature, turbidity, and macrophyte growth predictions.

Brailey Hydrologic

Brailey Hydrologic has provided hydrologic consulting services for Alaska clients since 1996. Surface water projects have included small and large scale hydropower, bridges and utility crossings, instream flow studies, stream restoration, and mining projects. Groundwater projects have included aquifer-lake interactions, groundwater cutoff walls, and geothermal investigations. Brailey has particular expertise in hydroacoustics, including shallow-water bathymetry and flow measurements using acoustic Doppler current profilers. Brailey uses both traditional and hydroacoustic methods for problems involving instream flow, hydroelectric power, and permitting of riverine impacts. Brailey's hydraulic modeling experience includes bridges, stream restoration projects, utility crossings, and instream flow studies. Groundwater modeling projects have included groundwater cutoff walls, mine excavations, and base flows in engineered stream channels. Brailey also performs stream gaging, water quality monitoring, and aquifer testing.

Inter-Fluve

Inter-Fluve was established in 1984 and is a pioneer in fisheries and river restoration design and construction. Our multidisciplinary team integrates biology, hydrology, and engineering to design environmentally-sound solutions for systems ranging from alpine to coastal and rural to urban. Our 35 years of experience building our own designs provides us an unparalleled ability to translate complex and innovative solutions into plans and specifications, and to provide efficient construction services. Our professional team of over 50 scientists and engineers maintain a focus on integrating science and engineering for complex water resources and aquatic habitat problems.

Aquatic Restoration and Research Institute

ARRI is located in Talkeetna, Alaska. ARRI conducts applied stream and lake research within Alaska. The objective of the organization is to provide the best available information to Government Agencies, NGOs, and the public to ensure that development within Alaska is conducted in a manner that avoids impacts to aquatic systems. Impacts to aquatic systems can only be avoided by understanding their complex ecology. ARRI research focuses on the evaluation and monitoring of aquatic systems to ensure that these systems remain healthy and to identify and address any impacts as soon as possible. ARRI specializes in the restoration of stream systems. ARRI assists private and public landowners to develop restoration plans, obtain the necessary resource permits, seek any available State or Federal funding, and construct or oversee project construction and post project monitoring.

Project Team

We propose an experienced team to complete this work, and have a deep bench of co-workers to draw from on an as-needed basis. The project team will be led by Dave Brailey, an Anchorage hydrologist with over 30 years of Alaska experience. Dave is familiar with the area and Robe Lake, and he is located in relatively close proximity to Valdez making him the ideal partner to manage the project and perform the hydrology fieldwork. Joining Dave is an interdisciplinary team of scientists and engineers with much experience in developing science bases that support appropriate restoration plans. Based in Talkeetna, Alaska ARRI's Jeff Davis (aquatic ecologist) has over 15 years of experience in Alaska. Based in Hood River, Oregon, Inter-Fluve brings over 50 years of collective Alaska experience and the perspective that comes from working on restoration projects across the country. Inter-Fluve team members include Luke Swan (fluvial geomorphologist), Dan Miller (engineer), Joe Parzych (fisheries biologist), and Greg Koonce (fisheries biologist, founding principal).

Dave Brailey

Role: Project manager, hydrologist, streamflow data collection

Dave is a hydrologist with over 30 years of experience working on Alaskan applied hydrology projects. Dave has managed large field efforts developing riverine hydrologic data, and has performed stream gaging on more than 75 Alaska streams.

Jeff Davis

Role: Aquatic ecologist, lake vegetation mapping, and alternatives analysis

Jeff is an aquatic ecologist with over 15 years working in Alaska stream and lake systems. He has lived in Alaska since 1989. Jeff's graduate work focused on algal and plant ecology, particularly the effects of light, temperature, and nutrients on primary and secondary production.

Luke Swan

Role: Project geomorphologist

Luke is a fluvial geomorphologist with 14 years of experience in applied geomorphology for watershed and river restoration projects. Luke's experience is diverse, having led river restoration projects across the American West.

Dan Miller, PE

Role: Project engineer & project feasibility

Dan is a hydraulic engineer with 28 years' experience specializing in hydraulic, sediment transport and fish passage analysis and design. Dan has worked extensively throughout Alaska over the past 20 years. He holds Alaska PE license number AELC 10,048.

Joe Parzych, AFP

Role: Fisheries biology & permitting

Joe is a fisheries biologist with extensive permiting, wetland delineations and revegetation planning experience. Joe will assist on an as-needed basis with analyses and fish habitat components of development of project concepts.

Greg Koonce, CFP

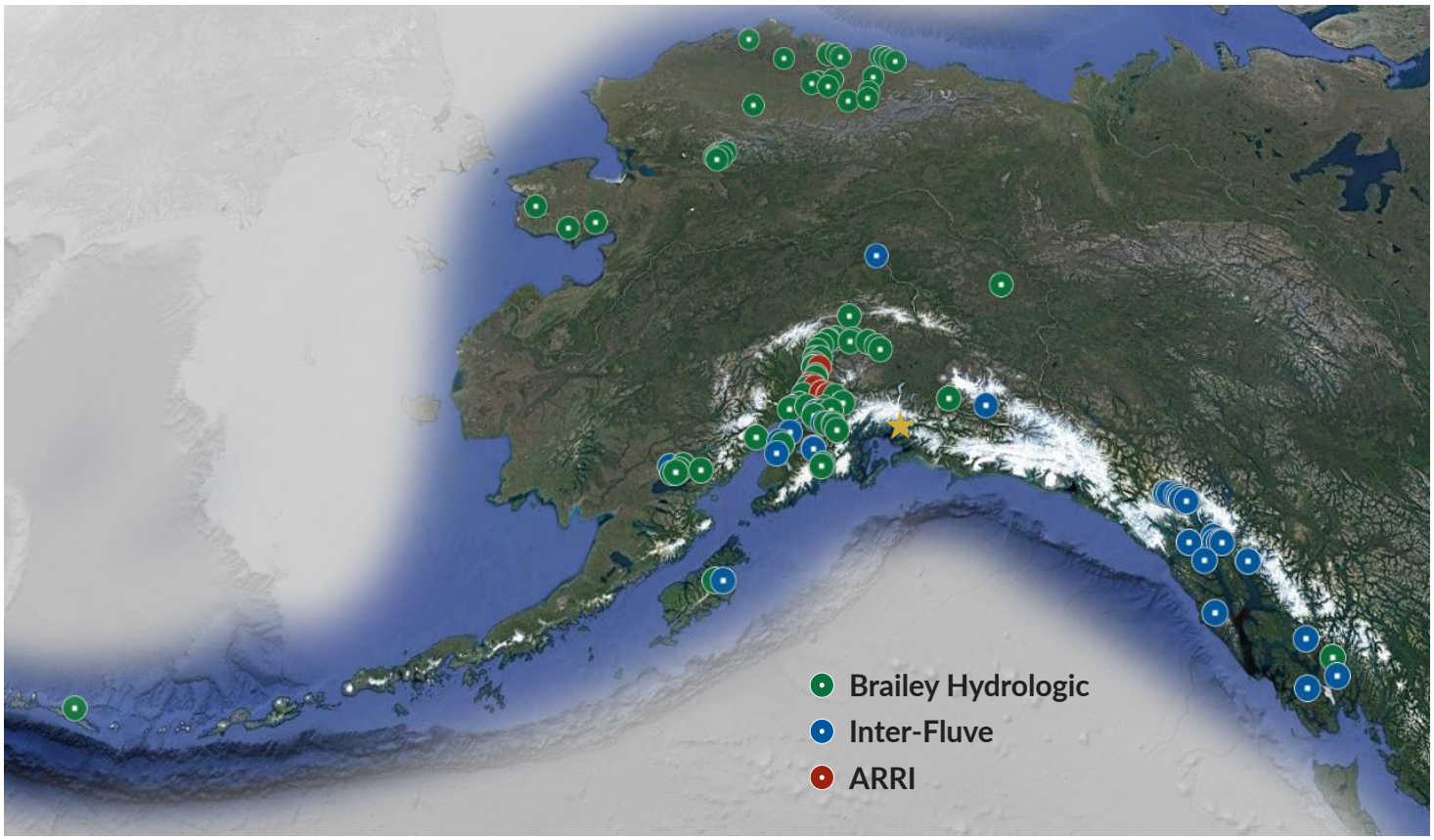
Role: QA/QC

Greg is a founding principal of Inter-Fluve and a true leader in the stream restoration industry. Trained as a fisheries biologist, Greg is also thoroughly knowledgeable in all phases of river project development.

Skookum Glacier, AK

Similar Experience

With decades of experience in aquatic habitat assessment and restoration, Inter-Fluve and ARRI have the experience needed for the Robe Lake Habitat Analysis. Including Brailey Hydrologic's stream gaging experience, the matrix on the following page summarizes similar projects completed on Alaskan systems. The project team has performed stream gaging and habitat analyses at over 100 Alaska sites, including several lake systems in southcentral Alaska. A list of completed ARRI projects can be found at http://arrialaska.org/completed-projects.html, and Inter-Fluve's experience is summarized at http://interfluve.com/our-work/.



The map above illustrates our project team's experience across Alaska. Each project represents one or more completed projects completed over the last 30 years.

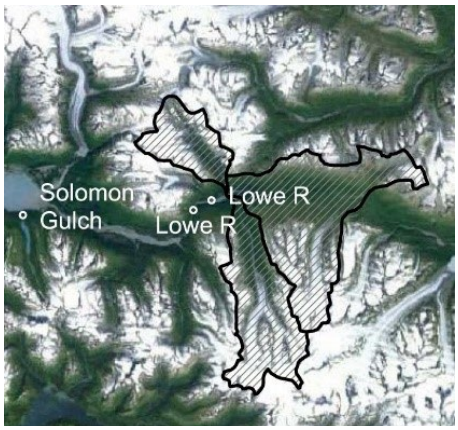
This table outlines the project team's experience in work throughout Alaska in relation to the project's specific tasks outlined in the RFP.

	Project	Location	Stream gaging/ Rating curves	Topo/Bathymetric Survey	Hydraulic Analysis	Geomorphic Assessment	Sediment Transport	Fish Passage	Salmon/Fish Habitat Assessment	Aquatic	Aquatic Productivity	Temperature and Turbidity	Infrastructure	Stakeholders
BRAILEY PROJECTS	Lowe River	Valdez, Alaska	•	•	•	•	•						•	
	Colville River	NPRA, Alaska	•	•								•	•	
	Savanirktok River	Alaska's north slope	•	•	•	•	•					•	•	•
	Susitna River	Southcentral Alaska	•	•		•	•		•			•	•	•
	Talkeetna River	Talkeetna, Alaska	•	•	•	•	•		•				•	•
	Chulitna River	Talkeetna, Alaska	•	•		•	•		•			•		•
	Kizhuyak River	Kodiak, Alaska	•	•	•	•	•						•	
	Kogoluktuk River	Brooks Range, Alaska	•	•	•								•	•
	Kobuk River	Kobuk & Kiana, Alaska	•	•										
	Newhalen River	Iliamna, Alaska	•	•								•	•	•
	Kenai River	Soldotna, Alaska	•	•										
	Eagle River	Eagle River, Alaska	•	•										
	Juniper Creek	Eagle River, Alaska	•	•	•	•	•					•	•	•
	Jack River	Cantwell, Alaska	•	•	•									
	Knutson Creek	Pedro Bay, Alaska	•	•	•									
INTER-FLUVE PROJECTS	Indian River	Sitka, AK		•	•	•	•	•	•				•	•
	Picnic Creek	Juneau, AK		•	•	•	•	•	•				•	•
	Lemon Creek	Juneau, AK		•	•	•	•		•				•	•
	McCarthy Creek	McCarthy, AK		•	•	•	•						•	•
	Pat Creek	Wrangell Island, AK		•	•	•	•		•				•	•
	Ship Creek - KAPP Dam	Anchorage, AK		•	•	•	•	•					•	•
	Ship Creek - Elmendorf Dam	Anchorage, AK		•	•	•	•	•					•	•
	Ship Creek - Fort Richardson Dam	Anchorage, AK		•	•	•	•	•					•	•
	Harris River	Prince of Wales Island, AK		•	•		•	•	•				•	•
	Naha River	Revillagigedo Island, AK		•	•	•	•						•	•
	Cooper Creek	Kenai Peninsula, AK		•	•	•	•		•				•	•
	Crooked Creek	Soldotna, AK			•		•	•	•				•	•
	Lake Orbin inlet Creek	Kodiak Island, AK		•	•		•	•	•	•			•	•
	Haines Highway 37-Mile	Haines, AK		•	•	•	•	•	•				•	•
	Haines Highway MP 3.5-25	Haines, AK		•	•		•	•	•				•	•
	Chester Creek	Anchorage, AK			•	•	•	•					•	•
	Chilkat River	Haines, AK		•	•	•	•		•				•	•
	Jordan Creek	Juneau, AK		•	•	•	•	•	•				•	•
	Bay Creek	Auke Bay, AK		•	•		•	•					•	•
	Rink Creek	Gustavus, AK		•	•	•	•	•	•				•	•
	Seward Highway MP 99-105	Anchorage, AK			•		•	•	•				•	•
	Tanana Lakes	Fairbanks, AK			•	•	•						•	•
	Geomorphic/channel study	Illiamna, AK		•	•	•	•		•				•	•
ARRI PROJECTS	Susitna River	Southcentral Alaska			•			•	•			•		
	Big Lake	Wasilla, Alaska		•							•	•		•
	Little Susitna River	Southcentral Alaska	•	•		•	•		•		•	•		•
	Lake Lucille	Wasilla, Alaska		•							•	•		
	Cottonwood Creek	Wasilla, Alaska	•	•			•	•	•	•	•	•	•	
	Wasilla Creek	Wasilla, Alaska	•	•			•	•	•	•	•	•	•	
	Montana Creek	Talkeetna, Alaska	•	•			•	•	•	•	•	•	•	
	Multiple Strems	Southcentral Alaska		•	•		•	•	•		•	•	•	
	Willow Creek	Willow, Alaska		•	•		•	•	•		•	•	•	

Erosion Hazard Assessment, Solomon Gulch Transmission Line

VALDEZ, ALASKA (2013-2014)

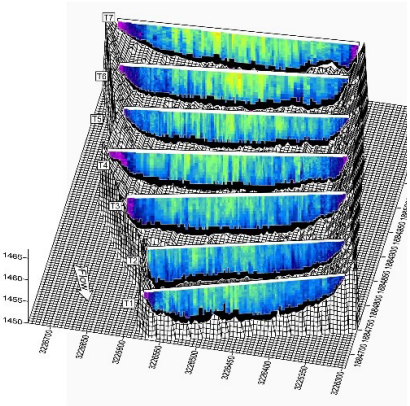
Brailey Hydrologic performed an erosion hazard evaluation of 13 transmission towers on Copper Valley Electric Association's Solomon Gulch transmission line, where bank migration required replacement of two transmission towers between 2011 and 2013. Brailey performed field surveys, bank migration analyses, hydraulic modeling, pier scour, and ice force calculations for a variety of transmission tower foundation alternatives. Field work included bankline and thalweg surveys throughout the 2-mile study reach, using snowmachine access via a 6-foot snowpack. Results were used to design single-leg pile foundations with riprap ice deflection structures. Brailey's bank migration predictions were confirmed when a third transmission tower failed in September 2014. The structure was replaced using the riprap-fortified pile design, eliminating further problems in this high-energy alluvial setting.



Instream Flow Studies, Susitna-Watana Hydroelectric Project

TALKEETNA, ALASKA (2012-2016)

Brailey Hydrologic was the study lead for four years of hydrologic data collection, including surveys of over 200 cross sections, 800 acoustic Doppler discharge measurements, and bathymetric mapping of more than 10 miles of Susitna River corridor. Brailey provided flow and bathymetric data for a 1-dimensional hydraulic model of the 200-mile river corridor, and for 2-dimensional hydraulic models of 9 intensive study areas. Brailey also performed acoustic velocity mapping and 2 years of under-ice discharge measurements on the mainstem Susitna and tributaries. Brailey installed, maintained, and decommissioned over 50 hydrologic measurement and radio telemetry stations. Brailey quantified groundwater/surface water exchange rates using seepage meters and reach-scale seepage runs. Brailey worked with project stakeholders, managers, and modeling experts to develop cost-effective solutions to challenging logistic and scientific problems. Brailey's scope was completed on-time, within budget, and with a perfect safety record despite over 500 man-days of swiftwater hazard exposure.



Juniper Creek Hydroelectric Prjoject

EAGLE RIVER, ALASKA (2014-PRESENT)

Together with a team of civil, geotechnical, electrical, and construction contractors, Brailey Hydrologic collected all of the necessary hydrologic, geotechnical, and topographic data required for permitting, design, and construction of a 300 kW run-of-river hydroelectric system on an alpine tributary of Eagle River. Brailey used a fluorescent tracer method to measure supercritical flows on steep creeks and springs, resulting in water rights acceptance with only 3 years of data collection. Brailey secured 12 federal, state, and municipal permits in just 9 months, including four variances to Municipal code, 3 public hearings, and several public comment periods. Brailey performed streamflow record extension, flood frequency analyses, and hydraulic modeling of stream crossings, diversion pipelines, an intake structure, and an armored creek outfall. Brailey used geotextile-lined gabion baskets and landscaping block to construct an access trail crossing 700 feet of 40-degree slope, including 5 stream crossings. Brailey used track vehicles, helicopter sling-loads, and manual labor to construct over 4000 feet of access trails and pipeway, including an 18 inch-diameter penstock that descends over a 50-degree cliff. The project is scheduled for completion in July 2020, meeting the annual power requirements for 200 homes and displacing 2 million pounds of carbon dioxide annually.

Indian River Geomorphic Assessment & Sheldon Jackson Hatchery Diversion Evaluation

SITKA, AK 2019

Inter-Fluve is working with Sitka Sound Science Center (SSSC) in partnership with U.S. Fish and Wildlife Service (USFWS) on a geomorphic assessment and alternatives analysis of the Indian River in the vicinity of a boulder dam. The dam is used to divert flow to the SSSC fish hatchery, and project stakeholders are interested in identifying alternatives for improved sediment transport, fish passage, and maintenance reduction through the Sheldon Jackson Hatchery diversion reach of the Indian River. To date, Inter-fluve has completed the site and sediment transport analyses and is working with project stakeholders to apply the analyses to the development of feasible alternatives that meet the project objectives. The project will conclude during the first quarter of 2020 with the identification of, and concept level design for, the preferred alternative.

Picnic Creek Passage & Habitat Enhancement

JUNEAU, AK (2018)

Inter-Fluve was commissioned by Southeast Alaska Watershed Coalition (SAWC) and US Fish & Wildlife Service (USFWS) to provide survey and engineering design services to improve fish passage and spawning habitat at two stream crossings on Picnic Creek in Juneau, Alaska. Picnic Creek is a second order anadromous fish stream that flows into Lena Cove approximately 3.5 miles northwest of Auke Bay and provides spawning and rearing habitat for coastal cutthroat trout, Dolly Varden char, and pink and coho salmon. We completed alternatives, worked with stakeholders to identify a preferred alternative and prepared final designs and construction documents. The lower culvert was replaced with a pre-fabricated bridge, while the upper culvert was retrofitted to raise the culvert tailwater to provide passable hydraulic conditions.

Kenai River Restoration Project Assessment

KENAI, AK 2010

Inter-Fluve led this applied research and monitoring effort that evaluated the extent and effectiveness of streambank restoration projects on the lower Kenai River and provided recommendations for future restoration work to achieve fish habitat as well as erosion control objectives. This study involved two parts: 1) Project Status Assessment – an inventory of the extent and type of restoration work that has been conducted between the mouth and Skilak Lake (river mile 50), and 2) Project Effectiveness Assessment – an evaluation of a sub-sample of projects with respect to their effectiveness in enhancing fish habitat.

The Project Effectiveness Assessment demonstrated that cabled spruce tree (CSTs) were effective at creating near-bank velocity conditions that were similar to natural sites and lower than untreated disturbed sites, thus providing more suitable near-bank habitat for juvenile salmon rearing. CSTs, however, lacked several habitat attributes that were present at natural sites, including emergent vegetation, overhanging vegetation, undercut banks, and natural woody debris inputs.

The results of this study provide information on the scale and effectiveness of streambank restoration on the Kenai River. This information helps identify the degree to which streambank restoration addresses habitat impairment along the river. The recommendations help guide the development of future efforts that will have the greatest habitat benefit while also accomplishing erosion control objectives.

McCarthy Creek, AK

Project Understanding

Together with Inter-Fluve and the Aquatic Restoration Research Institute (ARRI), Brailey Hydrologic has prepared this proposal to assess the current state of macrophyte proliferation in Robe Lake and to evaluate habitat improvement alternatives including those recommended by the Alaska Department of Fish and Game (ADF&G). ADF&G's 1987 evaluation concludes that although the water quality of Robe Lake is good, macrophyte proliferation poses a threat to salmonid rearing and renders the lake "unfit for recreational use". ADF&G's water quality data indicate seasonal nitrogen exhaustion and changes in nutrient ratios that could reduce algae, phytoplankton and zooplankton production. Together with non-optimal water temperatures, these changes could retard juvenile salmonid growth. In addition, decaying vegetation could pose a risk of winter fish kills. In summary, ADF&G concludes that much of what is physically, chemically, and biologically undesirable about Robe Lake can be reversed by controlling the growth of aquatic macrophytes.

In accordance with ADF&G's recommendations, VFDA implemented a mechanical weed harvesting program that maintains adult migration pathways to important Sockeye and Coho spawning areas. Although VFDA plans to continue this program, VFDA would like to evaluate other alternatives for maintaining or improving the lake. One of the alternatives identified by ADF&G (1987) involves the removal of a 1956 flood control dike diverting Corbin Creek away from the Robe Lake basin. Although complete dike removal could pose a risk of flooding, culverts or other control structures could be used to limit the maximum flow. Important questions regarding this alternative include the quantity of water available in Corbin Creek, the geomorphic and biologic impacts of flow diversion, and the effectiveness of the diversion for controlling macrophyte proliferation. Through the use of existing data and the targeted collection and analysis of new data, (detailed in the Scope of work, below), a baseline will be established from which the feasibility and effectiveness of this alternative can be evaluated.

Sourced from a glacial watershed between Port Valdez and Thompson Pass, Corbin Creek lies on the flank of an outwash braided alluvial plain emanating from the Valdez Glacier. Sediment aggradation has elevated the center of the braided alluvial plain relative to its eastern flank. Together with the lateral slope of the braided alluvial plain, relic channels east of Corbin Creek indicate that glacial outflows formerly drained into Robe Lake (Figure 1). Although the 1956 dike effectively blocked surface flow, winter photographs indicate that subsurface flow feeds Brownie Creek, Old Corbin Creek, and other small streams entering Robe Lake (Figure 2). The volume of subsurface flow may be significant, as the 1982 discharge from Robe Lake was 40% greater than annual precipitation at the Valdez airport (ADF&G 1987).

Outwash sediments in braided river valleys are often sufficiently transmissive to support year-round streams in adjacent channels with limited surface connectivity (e.g.

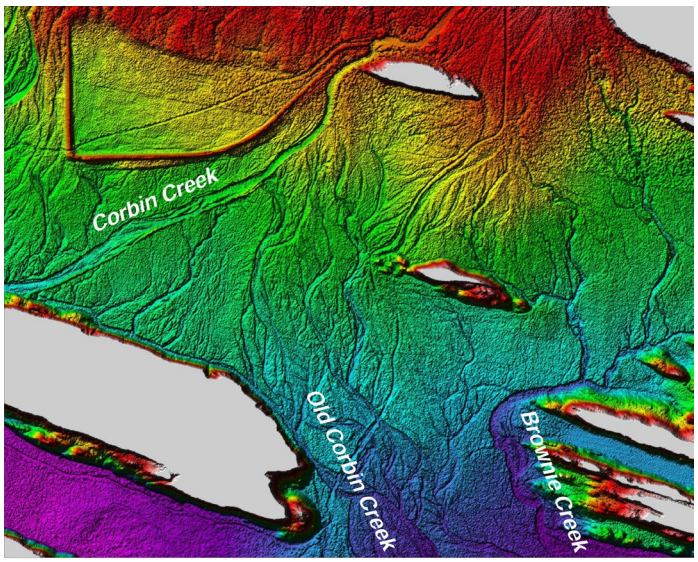


Figure 1. 2011 LiDAR Relief Map, Upper Braidplain

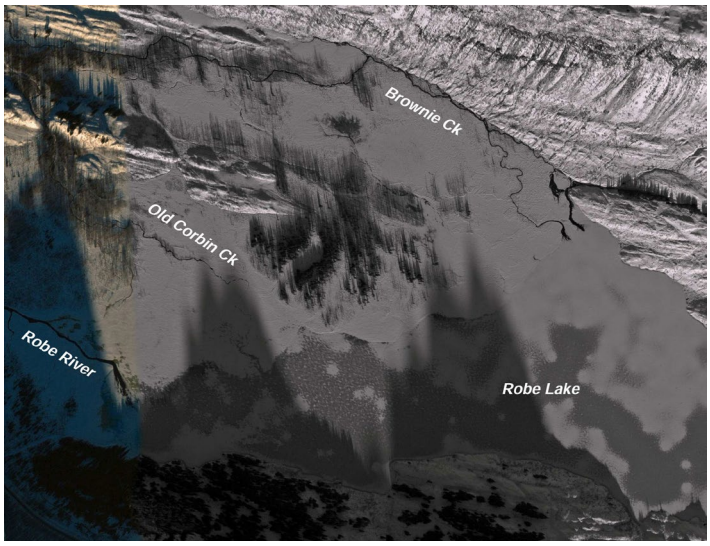


Figure 2. January 28, 2014 Open-Water Flows

Brailey 2017, Inter-Fluve 1999). Considering that the bedrock ridge south of the lake constitutes a barrier to subsurface flow, it is reasonable to expect that subsurface flow discharges into Robe Lake. Winter lake temperature profiles support this concept, with consistently warm temperatures near the lakebed (ADF&G 1987). As a result, some of the difference between Robe Lake outflow and 1982 annual precipitation could reflect groundwater inflow into Robe Lake.

Although streamflows on Brownie and Old Corbin Creeks are important, predicting the effects of diversion on Robe Lake macrophyte growth will require a water balance including all major lake inflows and outflows. Similarly, measurements of temperature, turbidity, and discharge are needed to evaluate potential effects of diversions from Corbin Creek. As a result, we propose two additional gages besides those requested in the RFP. A gage on Corbin Creek would include a logging turbidimeter to provide a continuous turbidity record, and a gage on the Robe River would measure the total outflow from Robe Lake.

The RFP requests annual streamflows, facilitating comparison against trends at nearby long-term gaging stations. Based on March 2013 and January 2014 aerial images (Figure 2), it appears that open-water conditions prevail at the Richardson Highway crossing of the Robe River. If this is the case, then winter flows could be computed using an open-water rating curve. Corrections would be required for periods of snow and ice accumulation, that could be confirmed using time-lapse camera images.

Depending on their location, the upstream gages might have longer periods of snow and ice effect. However, it is likely that the correlation between daily and hourly flows on the Robe River vs. the upstream gages is good. If so, the Robe River gage could be used as an index gage to estimate periods of missing streamflow data at upstream gages. One year of hourly or daily data should be adequate to establish correlations between the Robe River and upstream gages.

The bathymetry of Robe Lake suggests that Brownie Creek would provide better mixing of diverted water than Old Corbin Creek (Figure 3). LiDAR topography also indicates that a Brownie Creek diversion would pose less risk of flooding in adjacent subdivisions, and would avoid the potential for lake bypassing.

Although accurate discharge measurements can be performed at the mouths of Brownie and Old Corbin Creeks, these areas are poor locations for rating curve development. Better locations probably exist upstream, where narrows or pool/riffle complexes could provide better gage sensitivity. Although upstream flows may be smaller than streamflows measured at the creek outlets, the Robe River gage would provide a complete summation of Robe Lake flows. Upstream gage locations would be useful for understanding the feasibility of structural habitat improvements in Old Corbin and Brownie Creeks, as these areas may be prone to channel instability due to greater channel slopes and the influences of snow and ice melt in the spring.

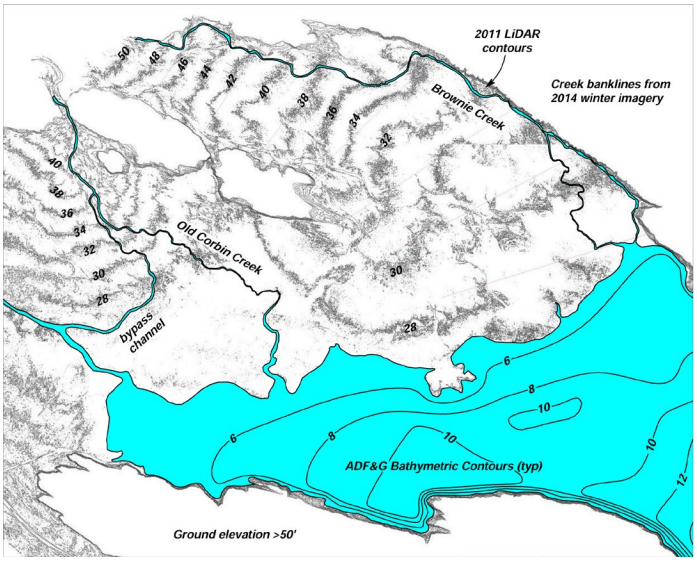


Figure 3. Topographic map of the lower project area

Accurate rating curves, particularly those with limited rating measurements, require extreme care regarding site selection, elevation control, and discharge measurements. Professional standards advocated by the Alaska Department of Natural Resources require at least 5 valid discharge measurements for rating curve development. Based on the mean annual hydrograph of estimated natural flows for Solomon Gulch (USGS Gage no. 15226000), we've selected 5 measurement events between March and December 2020 (Figure 4). A final data download would occur in March or April 2021, providing one complete year of streamflow data. A complete year would minimize seasonal bias in streamflow record extensions necessary to compute design flows including annual and extreme floods.

Alternating sources and amounts of tributary flows into Robe Lake will change water physical characteristics. Water temperature and light attenuation are a key parameters affecting both salmonid and macrophyte growth. Considering that 2019 brought record temperatures to Alaska streams, current continuous temperature measurements will provide an important comparison against the 1987 ADF&G study, allow us to evaluate changes in lake temperature response to changing air temperatures, and estimate changes in lake temperature with the introduction of cold glacial water. We propose to log water temperatures throughout the growing season in Robe Lake at the four sampling stations established by ADF&G, using dataloggers deployed at multiple depths.

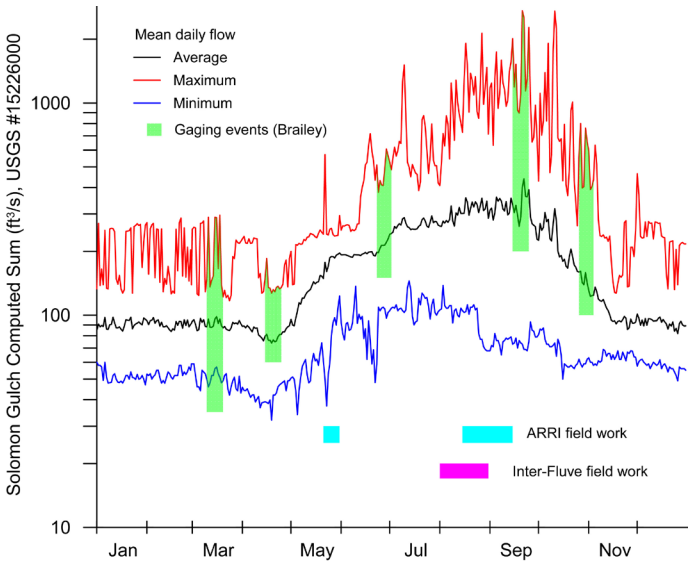


Figure 4. Discharge measurement and other fieldwork dates were identified using streamflow data from Salomon Gulch.

Measures of light availability with depth will be collected at all sampling locations and we will experimentally determine how changes in turbidity will affect lake light levels.

Stream surveys will be conducted to determine how changes in sources and amounts of stream discharge may affect current salmon tributary spawning. Potential increases or decrease in spawning habitat will be estimated using combined remote imagery, measures of channel slopes and substrate size distribution, and field surveys of existing and potential spawning habitats.

Results from stream gauge data, lake plant surveys and water quality investigations, and tributary spawning analyses will be combined to evaluate multiple different restoration alternatives. Upon completion of the fisheries habitat and limnologic evaluations, results will be shared with VFDA to discuss alternatives for improving salmon habitat in Robe Lake and its tributaries. Based on these discussions, a draft report will be prepared for review by VFDA. The final report will provide a narrative and compilation of all field work, analysis and results for distribution to permitting and funding agencies.

Chilkat River, AK

Scope of Work

Our scope of work follows the tasks as outlined in the RFP. In some cases we've refined the RFP's text to better reflect our approach:

Task 1) Field work for the hydrology, fisheries habitat and Robe Lake limnology efforts

With the exception of the vegetation mapping described in Task 2, Task 1 includes all of the fieldwork required to support the remaining project tasks. Additions to the scope are noted for the hydrology, limnology, and fisheries habitat efforts.

HYDROLOGY:

In February 2020, we will contact VFDA and Robe Lake Lodge regarding ice conditions on the Robe River. If open water is present at the Richardson Highway crossing, a gaging trip will be scheduled for early March. The March trip will be used to select stream gage locations, install Solinst Levelogger transducers, install survey control, and perform streamflow measurements. In addition to stream gages on Brownie and Old Corbin Creeks, two additional stream gages will be installed on Corbin Creek and the Robe River. If ice cover is present on Corbin Creek, equipment installation may be delayed until April. Each stream gage will include a game camera programmed for daily time-lapse photographs.

Access for the March gaging event will be by snowmachine, allowing transportation of survey and flow measurement equipment. Snowmachine access will also facilitate the selection of stream gage locations, allowing rapid inspection of flow conditions, icing, and gage pool hydraulic controls. Before the trip, we will consult with Robe Lake Lodge regarding local snowpack conditions.

Streamflow data for the nearby Solomon Gulch gage suggest an annual minimum in late April (Figure 4). Accordingly, a second gaging event is scheduled for this timeframe, when open-water conditions are expected. Survey control will be re-established, and a Seametrics turbidity logger will be installed at the Corbin Creek gage. Water level measurements will be recorded from at least one surveyed reference point, and at least three elevation control points will be installed at each gage.

Streamflows will be measured using techniques dependent on flow conditions. Low flows will be measured using an acoustic Doppler velocimeter (ADV) that accounts for horizontal variations in flow (unlike traditional current meters). If measurements on Corbin Creek are compromised by ice, under-ice measurements may be performed using fluorescent dye dilution. Depending on flow conditions, this technique can allow rapid, repeatable measurements with precision less than 2 percent (Brailey 2017).

At high flows, a motorized cataraft will be used if Corbin Creek or the Robe River are too deep for wading. Equipped with a RiverPro acoustic Doppler current profiler (ADCP), the cataraft can provide repeated ADCP measurements in the same timeframe as a single current meter measurement. The ADCP also provides spatial data that can be used for hydraulic model calibration.

Three additional gaging events are planned for June, September, and November 2011 (Figure 4). Using real-time data for the Solomon Gulch gage, these events will be timed to capture intermediate and peak flows needed to define rating curves for each gage. The gaging events will include data downloads and battery replacement for the Seametrics turbidity logger. Turbidity data will be reviewed in the field and the sensor will be recalibrated if necessary.

DELIVERABLES: Deliverables for this task include electronic temperature, turbidity, and water level data, and discharge results using various flow measurement systems.

Proposed additions to the scope include annual streamflow measurements for Corbin Creek and the Robe River, turbidity measurements on Corbin Creek, and game camera images of the stream gage installations.

FISHERIES HABITAT AND CHANNEL ALIGNMENTS:

Based on the desktop findings discussed under Task 3 below, fisheries habitat and channel mapping field efforts will entail ground proofing portions of various channel alignments that have the most potential to provide spawning habitat for salmonids. We will also evaluate portions of former channel alignments that may provide opportunities for enhancement under flow augmentation, those areas where aquatic vegetation may restrict migrating salmonids and areas where significant upwelling of groundwater may be observable.

The availability of a 1-meter digital terrain model based on 2011 Light Detection and Ranging (LiDAR) data eliminates the need for extensive topographic surveying at this point. Supplemental surveys (as needed) will be limited to portions of Old Corbin, Brownie and other segments identified as having the highest potential for habitat enhancements. Detail of channel segments observed to have high quality habitat will be collected using handheld GPS, tape, and a hand level. Weather permitting, a drone will be used to identify existing channel conditions, locations of other high-quality habitats, and existing creek alignments. This will be preceded by a desktop evaluation of the 2011 LiDAR data, to identify the locations for potential spawning and enhancement efforts. This effort will concentrate on identifying portions of the mapped channels (delineated as part of Task 3) with channel slopes between 0.25 and 1 percent slope. These slope ranges commonly exhibit geomorphic processes that provide substrates and habitat conditions suitable for spawning. This information, along with aerial photography, LiDAR, and other site observations will be used to determine the feasibility of habitat improvements.

Surface pebble surveys from select sites and observations of bank stratigraphy where visible will be conducted to document existing substrate conditions, confirm suitability as spawning substrates, and to understand the impacts of increased flow streamflow.

DELIVERABLES: Deliverables for this task will be included as a chapter in the Draft and Final Report (Task 7).

ROBE LAKE LIMNOLOGY:

Prior to the growing season, multilevel temperature loggers will be deployed at the four sampling stations established by ADF&G. To model plant growth under different treatment conditions, water quality and physical parameters will be recorded at each station. At a minimum, we will measure lake temperature, dissolved oxygen, photosynthetically active radiation, pH, specific conductivity, and depth. Measurement methods will be comparable with the ADF&G study. The measurements will be repeated during vegetation mapping (Task 2) and upon datalogger removal in November.

DELIVERABLES: Field measures of lake water quality characteristics and light penetration.

EXISTING PROJECT EVALUATION:

With location information supplied by VFDA, the condition and effectiveness of previously implemented habitat improvement projects will be documented with photographs and GPS points. This information will be used in Task 5 to evaluate and recommend feasible habitat improvement projects.

DELIVERABLES: Deliverables for this task will be included as a chapter in the Draft and Final Report (Task 7).

Inter-Fluve maintains six FAA licensed UAV (drone) operators and three UAVs. We utilize Pix4D software that assists us in creating 2D georeferenced orthomosaics and 3D SFM (Structure from Motion) models.

Task 2) Measure Robe Lake surface area and the extent and density of vegetation

Together with 1998 or older orthophotographs, six dates of publicly available imagery will be georeferenced with 2011 LiDAR acquired by the Federal Emergency Management Agency (Figure 1). We will use this data set to map the shorelines and surface area Robe Lake over time. Unfortunately, most of the images do not show vegetation coverage. As a result, the extent and density of vegetation will be mapped using field surveys.

During the peak growing season, we will conduct vegetation surveys to determine the extent and density of aquatic plants on multiple transects similar to the methods used by ADF&G (1987). The peak growing season will be identified based on 1982 biomass measurements and in consultation with the VFDA and Robe Lake Lodge. We will use boat and aerial surveys (drone or fixed wing charter) to determine if there are any major plant colonies between transects. The available literature will be reviewed prior to conducting plant surveys to select the most applicable and repeatable survey methods.

We will collect aquatic plant samples from the major plant colonies for species identification. In particular we will work with the Alaska Department of Natural Resources to survey for invasive Elodea. Elodea is an invasive plant species that has been found in a number of lakes in Alaska used by float planes. The presence of Elodea may alter treatment options potentially allowing for use of specific herbicides.

DELIVERABLES: maps and tables quantifying changes in lake surface area and aquatic vegetation coverage over time.

Task 3) Map Old Corbin Creek, Brownie Creek and other former stream alignments

Using the time-series aerial imagery developed under Task 2 and other data as made available by VFDA, we will map current channel alignments and compare those to observable channel changes over time. This effort will concentrate on the main channels of Old Corbin and Brownie Creeks. Other former channel alignments may also be identified and mapped as well. Field data collected as part of Task 1 will be used to ground truth the channel alignments.

Alignments produced as part of this task will be made available as GIS shapefiles. Deliverables: Deliverables for this task will be included as a chapter in the Draft and Final Report (Task 7).

Task 4) Evaluate annual streamflows for Brownie and Old Corbin Creeks

In addition to streamflows on Brownie and Old Corbin Creeks, annual streamflow data will be developed for Corbin Creek and the Robe River. Stage data will be collected at 15-minute intervals for a period of at least 1 year. Upon completion, the stage data will be downloaded and corrected for transducer offsets and drift using the Aquarius Workstation software. As recommended by USGS, rating curves will be developed in Aquarius, ensuring that rating coefficients are consistent with observed channel characteristics and flow conditions. Daily streamflows will be computed together with monthly and annual flows for each station.

To evaluate the measured streamflows in the context of historical flows, daily streamflows for Corbin Creek and the Robe River will be correlated against nearby active USGS gages including Solomon Gulch (USGS #15226000). Using the summation procedure developed for USGS #15226000, we will work with USGS and VFDA to complete the USGS#15226000 record through March 2021 (data for this gage is normally processed after the end of each water year). As a glacial watershed within 5 miles of Robe Lake, USGS #15226000 should show a good correlation with Corbin Creek, allowing estimation of Corbin Creek flows from 1986 through the present. The extended flow record will allow flood frequency analyses and evaluation of measured flows in the context of nearby long-term trends.

DELIVERABLES: Rating curves, daily and 15-minute streamflow data, and correlations of each gage with nearby active USGS gages.

Additions to the scope include daily and 15-minute streamflow data for the Corbin Creek and Robe River gages, and correlations of each gage with nearby active USGS gages.

Task 5) Evaluate prior enhancement efforts in Old Corbin Creek and document current conditions

Habitat improvements in Old Corbin Creek will be visited during the field work (discussed in Task 1) and reviewed using available as-built or monitoring information provided by VFDA. The goal for this effort will be to determine how these efforts have performed over time and to document current

habitat conditions. The performance of these efforts will be used as information to guide further enhancement efforts.

Deliverables for this task will be used to guide decisions made under task 6 and findings will be included as a chapter in the Draft and Final Report (Task 7).

Task 6) Identify enhancement opportunities for improving salmonid habitat

Based on the team's findings after completion of tasks 1-5, a list of possible enhancement actions will be formulated. Options for Robe Lake, Brownie, and Old Corbin Creek will be identified and discussed at a conceptual level including graphics and an implementation timeline to fully describe each effort. Implementation/construction and or maintenance costs will be estimated for each action as well as predictions of habitat benefits. In addition, any compounding benefits that may occur if more than one effort is implemented as well as suggested project sequencing will be discussed. Implementation permitting requirements and or constraints will be identified for each action and a list of permit requirements from the various agencies will be provided.

Provided that stream gaging results indicate that there is sufficient flow, one of the enhancement actions to be considered will be a controlled diversion of flow from Corbin Creek into Robe Lake. The effects of diversion will be evaluated using a simple mixing-cell model to predict lake temperature and turbidity levels resulting from seasonal flow diversions. These results will be linked to effects on macrophyte growth, salmonid habitat, and existing infrastructure that could be affected by the diversions. The physical and biological limitations of the analysis will be emphasized, and the permitting ramifications of this approach will be vetted with relevant state, federal and local agencies.

The goal for each of the proposed enhancement action items will be to provide sufficient information for use in the completion of an implementation grant. Sources of grant funding will be suggested and a list options provided.

DELIVERABLES for this task will be included as a chapter in the Draft and Final Report (Task 7).

Task 7) Summarize tasks 1-6 in a final report

A final draft will be compiled for discussion and revision. Upon review and comment a final report will be compiled.

Rink Creek, Gustavus, AK

Timeline of Each Deliverable

The team proposes the following schedule and budget. The schedule is based on project mileposts that often encompasses multiple work tasks. At notice to proceed, the team will review the schedule with VFDA in a teleconference to refine the schedule if necessary to best meet project needs.

Cooper Creek, AK

Assumptions & Exclusions

1. Drone flights are dependent upon the weather conditions.

2. VFDA will provide existing, relevant data sets including historical aerial photographs, data associated with the 1987 Robe Lake Diagnostic/Feasibility Study, and reports, as-builts, photographs, and locations of previous projects to be evaluated as part of this project.

3. Data generated as part of this scope will be provided to VFDA via ftp or other electronic file transfer system.

Indian River, Sitka, AK

Budget

The project budget is broken down by task in the table below. Direct costs are included. Lodging and meals were calculated using 2020 Federal Per Diem rates for Valdez, AK. To illustrate our teaming arrangement, fees per task are additionally broken down by firm.

	Inter-Fluve	ARRI	Brailey	Total
Task 1 - Fieldwork	$17,146	$7,000	$34,903	$59,049
Task 2 - Aquatic vegetation mapping	$332	$5,800	$1,895	$8,027
Task 3 - Stream channel mapping	$2,928		$193	$3,121
Task 4 - Streamflow data processing	$332		$5,222	$5,554
Task 5 - Habitat improvement evaluation	$1,872		$124	$1,996
Task 6 - Alternatives analysis	$10,776	$4,700	$4,141	$19,617
Task 7 - Draft and final reports	$8,872		$2,666	$11,538
Total	**$42,258**	**$17,500**	**$49,144**	**$108,902**

Talarik Creek, AK

Resumes

Dave Brailey

Dave Brailey has 32 years of experience working on applied hydrology projects in Alaska. Surface water projects have included small and large scale hydropower, bridges and utility crossings, instream flow studies, stream restoration, and mining projects. Groundwater projects have included aquifer-lake interactions, groundwater cutoff walls, seepage measurements, and geothermal investigations. Brailey has managed large field efforts in remote Alaska wilderness with aggressive data acquisition schedules and rigorous quality control requirements. Brailey is adept at developing innovative approaches for solving Alaskan logistic and data acquisition problems, ranging from measuring turbulent flows under ice to acquiring real-time hydrologic data through radio, satellite, and cellular telemetry.

Expertise

Stream Gaging

Bathymetric Surveying

Acoustic Doppler Discharge Measurements

Tracer Dilution Discharge Measurements

Hydroelectric Evaluations

Groundwater Modeling,

RTK Topographic Surveys

Radio & Satellite Telemetry

Education

MS Geology 1986, University of Wisconsin-Madison

BS Geology 1938, University of Wisconsin-Madison

Graduate Study, Colorado State University 1987

JUNIPER CREEK HYDROELECTRIC PROJECT

Eagle River, Alaska (2014-present)

Brailey Hydrologic collected all of the necessary hydrologic, geotechnical, and topographic data required for permitting, design, and construction of a 300 kW run-of-river hydroelectric system on an alpine tributary of Eagle River. Brailey secured 12 federal, state, and municipal permits in just 9 months, including four variances to Municipal code, 3 public hearings, and several public comment periods. Brailey performed streamflow record extension, flood frequency analyses, and hydraulic modeling of stream crossings, diversion pipelines, an intake structure, and an armored creek outfall. The project is scheduled for completion in July 2020, meeting the annual power requirements for 200 homes and displacing 2 million pounds of carbon dioxide annually.

INSTREAM FLOW STUDIES, SUSITNA-WATANA HYDROELECTRIC PROJECT

Talkeetna, Alaska (2012-2016)

Brailey Hydrologic was the study lead for four years of hydrologic data collection, including surveys of over 200 cross sections, 800 acoustic Doppler discharge measurements, and bathymetric mapping of more than 10 miles of Susitna River corridor. Brailey performed acoustic velocity mapping and 2 years of under-ice discharge measurements on the mainstem Susitna and tributaries. Brailey installed, maintained, and decommissioned over 50 hydrologic measurement and radio telemetry stations. Brailey's scope was completed on-time, within budget, and with a perfect safety record despite over 500 man-days of swiftwater hazard exposure.

EROSION HAZARD ASSESSMENT, SOLOMON GULCH TRANSMISSION LINE

Valdez, Alaska (2013-2014)

Brailey Hydrologic performed an erosion hazard evaluation of 13 transmission towers on Copper Valley Electric Association's Solomon Gulch transmission line, where bank migration required replacement of two transmission towers between 2011 and 2013. Brailey performed field surveys, bank migration analyses, hydraulic modeling, pier scour, and ice force calculations for a variety of transmission tower foundation alternatives. Field work included bankline and thalweg surveys throughout the 2-mile study reach, using snowmachine access via a 6-foot snowpack. Results were used to design single-leg pile foundations with riprap ice deflection structures.

SEDIMENT TRANSPORT STUDIES, SAGAVANIRKTOK RIVER

Brooks Range, Alaska (2016-2018)

Following the May and June 2015 Dalton Highway closures, Brailey Hydrologic performed three years of spring breakup flood measurements on the Sagavanirktok River. This work was done as a contractor for long-term sediment transport studies conducted by the University of Alaska – Fairbanks. Brailey used a motorized cataraft to conduct daily discharge measurements at three gaging stations located up to 50 miles apart, measuring flood flows ranging up to 30,000 ft3/s. Brailey reported daily flows and breakup observations to a group of government, university, and industry stakeholders, and performed field sediment transport measurements throughout each three-week breakup event.

SR. WATER RESOURCES ENGINEER

Dan Miller, PE

Dan has 29 years of experience in applied open channel stream hydraulics, fish passage and sediment transport engineering analysis, and design along wild and urban stream systems. Dan's projects include analysis and design; preparation of construction documents; construction oversight for stream creation, relocation and restoration; streambank stabilization; fish passage; dam removal; aquatic habitat enhancement; prediction of sediment transport loads/budgets; and assessment of stream process. He has managed many large-scale water resources projects located throughout the Pacific Northwest and Alaska.

EXPERTISE

Channel Hydraulic Analysis & Modeling

Sediment Transport Analysis & Modeling

Fish Passage & Screening Design

Dam Removal

Watershed Hydrologic Analysis & Modeling

Wetland Mitigation Design

Groundwater Hydrologic Analysis & Well Design

Construction & Project Management

PROFESSIONAL AFFILIATIONS & REGISTRATIONS

Professional Engineer:
AK, CO, FL, ID, OR, VT, WA

River Restoration Northwest

FAA UAV Licensed Pilot

EDUCATION

MS, Civil Engineering (Water Resources)Colorado State University, 1991

BS, Civil Engineering (Structures) Cornell University, 1987

SELECTED PROJECT EXPERIENCE

Indian River Geomorphic Assessment and Sheldon Jackson Hatchery Diversion Evaluation

Sitka, AK (2019-present)

Inter-Fluve is working with Sitka Sound Science Center (SSSC) in partnership with U.S. Fish and Wildlife Service (USFWS) on a geomorphic assessment and alternatives analysis of the Indian River in the vicinity of a boulder dam. Inter-fluve has completed the site and sediment transport analyses and is working with project stakeholders to apply the analyses to the development of feasible alternatives that meet the project objectives. The project will conclude during the first quarter of 2020 with the identification of, and concept level design for, the preferred alternative. Dan is the project manager.

Picnic Creek

Juneau, AK (2015)

Inter-Fluve was commissioned by Southeast Alaska Watershed Coalition (SAWC) and US Fish & Wildlife Service (USFWS) to provide survey and engineering design services to improve fish passage and spawning habitat at two stream crossings on Picnic Creek in Juneau, Alaska. Picnic Creek is a second order anadromous fish stream that flows into Lena Cove approximately 3.5 miles northwest of Auke Bay and provides spawning and rearing habitat for coastal cutthroat trout, Dolly Varden char, and pink and coho salmon. Dan was project manager and lead engineer.

McCarthy Creek Fluvial Geomorphic Assessment

McCarthy, Alaska (2005)

In 1995, the Kennicot River altered its course, threatening McCarthy's historic structures, its water supply, and its tourism-based economy. Dan conducted a baseline geomorphic assessment to determine the exact causes of fluvial changes over the years and make recommendations for how to best-manage potential future fluvial changes. Our assessment combined field observations and local anecdotal information with existing data, historic air photos, and LIDAR topographic surveys. We also developed hydrologic and hydraulic models to access sediment transport, channel stability, and geomorphic trends.

37-Mile Creek Spawning Channel & Wetlands

Haines, AK (1999-2000)

Under contract with ADOT&PF, Inter-Fluve prepared designs and construction plans for creation of 7,000 feet of geomorphically stable channel for Coho and Chum salmon spawning and rearing habitat, relocation and enhancement of about 2,700 feet of existing channel and creation of 15.5 acres of adjacent emergent wetlands. As project manager and lead project engineer, Dan performed an analysis of sediment replenishment by natural river processes and evaluated river stability in assessing the impacts of 580,000-cy of gravel mined from the active braided river floodplain adjacent to the project site. He also managed the field investigations, development of designs, construction, and monitoring plans for the channel and wetlands.

SR. GEOMORPHOLOGIST

Luke Swan

Luke is a fluvial geomorphologist with over 14 years of experience in the application of analytical and quantitative tools to watershed and stream restoration projects. In addition to leading a number of projects across the Western United States, he has also been an instructor in the areas of applied fluvial geomorphology, sediment transport, and stream simulation crossing design. Luke relies on a balanced mix of field and analytical skills to apply a science- and evidence-based approach to restoration that seeks to understand the linkages between physical processes at the watershed, reach, and site scales. He believes that this approach is key to building resiliency in our projects and communities. For this project, Luke brings extensive experience in geomorphic, habitat, and project feasibility assessments, sediment transport and budgeting, hydraulic analysis, and field data collection.

EXPERTISE

Applied Fluvial Geomorphology

Geomorphic Assessments

Analytical Channel Design

Channel Stability Calculations

Hydraulic Modeling (1D & 2D)

Magnitude-Frequency Analysis

Sediment Transport Modeling

Geomorphic Risk Assessment

Terrain Modeling & Analysis

Sediment Sampling

Spatial Data Modeling & GIScience

Hydrologic Modeling

Construction Oversight

Stakeholder Engagement

Topographic Surveying

EDUCATION

MS, Natural Resource Management (Fluvial Geomorphology and GIScience), Central Washington University, 2006

BS, Geography, Ohio University, 2003

SELECTED PROJECT EXPERIENCE

Indian River Geomorphic Assessment and Sheldon Jackson Hatchery Diversion Evaluation

Sitka, AK (2019-present)

Inter-Fluve is working with Sitka Sound Science Center (SSSC) in partnership with U.S. Fish and Wildlife Service (USFWS) on a geomorphic assessment and alternatives analysis of the Indian River in the vicinity of a boulder dam. Inter-fluve has completed the site and sediment transport analyses and is working with project stakeholders to apply the analyses to the development of feasible alternatives that meet the project objectives. The project will conclude during the first quarter of 2020 with the identification of, and concept level design for, the preferred alternative. Luke performed the geomorphic assessment, built the sediment transport model, and is applying it to the development of project alternatives.

Vincent to Vinegar

Middle Fork John Day, OR (2019-present)

The project involves restoration of 1.2 miles of the Middle Fork John Day River. Through removal of a historical railroad grade with disconnects the river, roughly 5000 feet of the mainstem channel will be realigned. Existing relic channel scars will be re-activated as part of this comprehensive floodplain and channel restoration project. Luke served as geomorphologist on this project, contributing to the site assessment and design, developed a conceptual geomorphic model of reach trajectory, and worked with the project team to design a vegetation-controlled, multi-channel network that would reconnect the channel to its historical floodplain.

Leavenworth Area Reach 9 Fish Enhancement

Leavenworth, WA (2018-now)

Inter-Fluve was contracted by the Yakama Nation to develop a suite of conceptual restoration actions to improve spawning and rearing habitat for salmonids along mile 24.35 to 25.6 of the Lower Wenatchee River, including development of a side channel, log wood installation and groundwater fed habitats. Luke led the field data collection and processing, and constructed a 2D hydraulic model that was used to assess project alternatives.

Chehalis Basin Aquatic Species Restoration Plan

Newaukum, WA (2018-Present)

Inter-Fluve was contracted by the Washington State Recreation and Conservation Office to produce reach-scale restoration designs for two sub-basins to the Chehalis River: Newaukum River and Chehalis River South Fork. These designs will advance goals of the Aquatic Species Restoration Plan, support habitat function and populations of aquatic and semi-aquatic species - while also creating flood and climate-resilient systems that support the human needs in the Basin. Luke served as geomorphologist on this project, contributing to the site assessment and design, developed a conceptual geomorphic model of reach trajectory, and applied it to the development of conceptual designs.

PRINCIPAL EMERITUS / SR. FISHERIES BIOLOGIST

Greg Koonce, CFP

As Inter-Fluve's founding partner, Greg has 39 years of continuous experience in the recovery of degraded streams and rivers, specializing in fisheries and fluvial geomorphology. His career began at state and federal agencies where he was exposed to the genesis of modern stream restoration science. Greg is passionate about developing standards of practice for the river restoration industry. A dynamic communicator, he brings three decades of experience to facilitate interactions between agencies, municipalities, and citizen groups concerned with complex aquatic challenges. He has advised on topics ranging from establishing national stream restoration design standards to assisting local non-profits with programmatic strategies. He has also served in numerous technical roles promoting stream restoration science and has provided expert testimony.

EXPERTISE

Fisheries Habitat Rehabilitation Design

Fish Population & Habitat Assessments

Project Management & Construction Oversight

EDUCATION

Graduate-level work in Watershed Management
Humboldt State University, 1984

BS, Fisheries Biology
Humboldt State University, 1980

PROFESSIONAL AFFILIATIONS & REGISTRATIONS

Certified Fisheries Professional
American Fisheries Society

River Restoration Northwest
Former Board Member

SELECTED PROJECT EXPERIENCE

37-Mile Creek, Spawning Channel & Wetlands Mitigation

Haines, AK (1999-2000)

Under contract with ADOT&PF, Inter-Fluve prepared designs and construction plans for creation of 7,000 feet of geomorphically stable channel for Coho and Chum salmon spawning and rearing habitat, relocation and enhancement of about 2,700 feet of existing channel and creation of 15.5 acres of adjacent emergent wetlands. The scope included analysis of sediment replenishment by natural river processes and evaluation of river stability. Greg was senior fish biologist and fluvial geomorphologist.

Ship Creek Fish Passage Alternatives

Anchorage, AK (2004-2006)

The Kapp Dam is located .80 miles upstream from the mouth of Ship Creek in Anchorage, Alaska. Inter-Fluve was contracted to develop design alternatives to improve fish passage past the Kapp Dam for the Anchorage Waterways Council and the Alaska Department of Fish & Game. The project goal was to allow important species to return to the hatchery, while maintaining sport-fishing opportunities vital to the economic health of the City of Anchorage. Greg was Principal-in-Charge and responsible for QA/QC.

Haines Highway MP 3-25

Haines, AK (2006)

ADOT&PF was addressing upgrades to the Haines Highway from Milepost 3 to 25. As part of the design team, Inter-Fluve was responsible for conducting a stream and habitat inventory, and Hydrologic and Hydraulic (H&H) study for stream crossings and encroachments into the Chilkat River. Inter-Fluve identified mitigation opportunities including stream relocations and improved fish passage conditions. Greg was senior fish biologist and fluvial geomorphologist.

Lemon Creek Reconnaissance Level Sediment Transport Study

Juneau, AK (2003)

Using a HEC-RAS model of the study reach prepared by the USGS, Inter-Fluve performed a reach-based analysis of sediment transport conditions using the USACE SAM sediment transport model to quantify event-based sediment deposition potential. Results of the reconnaissance-level study confirmed the degree of sediment deposition potential for all flows and highlighted that management action by the CBJ should be given priority. Greg was responsible for fish habitat.

McCarthy Creek Fluvial Geomorphic Assessment & Prelim Flood Mitigation Plan

McCarthy, AK (2005)

Inter-Fluve conducted a baseline geomorphic assessment and make recommendations for how to best-manage potential future fluvial changes. The assessment combined field observations and local anecdotal information with existing data, historic air photos, and LIDAR topographic surveys. We also developed hydrologic and hydraulic models to access sediment transport, channel stability, and geomorphic trends. Greg was Principal-in-Charge and responsible for QA/QC.

FISHERIES BIOLOGIST

Joe Parzych, AFP

Joe has four years of experience as a fisheries biologist and is an American Fisheries Society-endorsed certified Associate Fisheries Professional. His experience includes database management, technical writing, hydrological analyses, evaluating food web interactions, GIS analysis, topographic surveying, project permitting, construction oversight, and project management. Joe's interests include using a combination of site-specific field data and broader scientific literature to inform design strategies that enhance fish habitat and river processes. Joe continues to be involved in ongoing research with Washington State University investigating the impacts of channel complexity on environmental DNA transport.

EXPERTISE

Total Station, RTK & GPS survey

Natural Resource Permitting

Fish Habitat Requirements & Modeling

Wetland Delineations

Piezometer Installation and Measurement

Fish Sampling (various methods)

Fish Stomach & Tissue Sampling

Construction Oversight

Project Management

COMPUTER APPLICATIONS

ArcGIS

HEC-RAS

Onset HOBO Software

Survey Software – Topcon & Magnet

EDUCATION

MS Environmental Science
Washington State University, 2015

BS Fisheries and Wildlife
Michigan State University, 2013

SELECTED PROJECT EXPERIENCE

Boardman River Dam Removals

Traverse City, MI (2011-Present)

Joe performed construction oversight for various construction activities, including channel bed construction, habitat boulder placement, riffle construction, floodplain grading, revegetation activities, and directed the placement of over 350 pieces of large wood in several log structures within the former Sabin Pond impoundment. These structures were designed by Joe in the field to arrest bank erosion and sloughing as river flows worked through fine sediments in the former impoundment.

Toppenish Creek, Three Way Levee Designs

Yakima, WA (2016-Present)

Inter-Fluve was contracted by Yakama Nation to design options for the removal of a 3-way diversion levee built in 1974 in Toppenish Creek. The levee has created a highly incised and channelized river which lacks instream habitat complexity and connection to it's historic floodplain. Joe assisted with site survey, data collection, and alternatives analysis.

Yakima River Rm 89.5 Floodplain Restoration

Zillah, WA (2017-present)

The Yakima River RM 89.5 Floodplain Restoration includes around 900 acres of historical floodplain, over 2 miles of side channels and 3 miles of mainstem Yakima River. Inter-Fluve was contracted by the Yakama Nation to assess existing geomorphic conditions, develop concept and alternative designs for restoration of the entire area and final construction design plans for priority restoration treatment. Joe assisted with site survey and report writing.

Upper Cowlitz & Cispus Subbasins Community Based Habitat Strategy Development

Eastern Lewis County, WA (2018-present)

Inter-Fluve was contracted by LCFRB to facilitate a community work group to gather existing technical information, receive input from community stakeholders, and conduct additional field survey data to assess the habitat factors limiting salmon and steelhead recovery. The project area includes the Upper Cowlitz and Cispus subbasins and selected tributaries, totaling roughly 85 miles of analysis. The habitat strategy, list of prioritized projects and preliminary design that are outcomes of this project will guide project sponsors' future work in the basin toward the highest benefit projects. Joe assisted with the technical memorandum, spatial data processing and compiling the project concepts and list.

Upper Wenatchee River, Deadhorse Tunnel Habitat Restoration

Wenatchee, WA (2018-Present)

Inter-Fluve was contracted by the Yakama Nation to develop a restoration strategy through concept design for five project opportunities including Deadhorse Island site-channel enhancement, Tunnel alcove enhancement,

Jeffrey Davis

Jeff has been President of the Aquatic Restoration and Research Institute (ARRI) for 9 years. During that time, ARRI has completed over 40 research and water quality projects and conducted a majority of the field work, data analyses and report writing. Previously, Jeff worked for the State of Alaska for nearly 10 years within the Governor's Office implementing the Coastal Management Program and for the Alaska Department of Fish and Game and Department of Natural Resources, Habitat and Restoration Division where he was the supervisor of the Matanuska-Susitna Area Office of Habitat Management and Permitting.

Education

M.S. Biology, Idaho State University (1995)

Bachelor of Science, University of Alaska Anchorage, Anchorage, Alaska (1993)

Aquatic Restoration and Research Institute

Talkeetna, Alaska (2003-present)

Developed and operate a non-profit stream research corporation. Apply for research grants from state, federal and municipal agencies. Implement research projects including writing Quality Assurance Project Plans and Investigation Plans; hire and supervise professional staff and field technicians; work with analytical laboratories; conduct field sampling; analyze and report project results; and present research at local and national conferences. I have served on committees to develop protocols for monitoring stream temperatures; the prioritization of fish passage restoration projects. I am currently a steering committee member with the Mat-Su Basin Salmon Habitat Partnership.

Alaska Department of Natural Resources March 2003 to April 2005 Area Manager

Talkeetna, Alaska (2012-2016)

Supervisor of the Matanuska-Susitna Area office. Conduct permitting review of all proposed projects that require state authorization for work in specified streams supporting anadromous fish or that could cause migration barriers. Evaluate all projects that require federal authorization for potential fish and wildlife impacts under the Fish and Wildlife Coordination Act. Review all Forest Land Use Plans and inspect all timber harvest activities for compliance with the Forest Resources and Practices Act and regulations. Was part of a committee that developed riparian management standards for Region II.

Alaska Department of Fish and Game Habitat Biologist, Habitat and Restoration Division

Oversee construction of the Power Creek Hydroelectric Project near Cordova, Alaska. Ensure that construction practices complied with FERC license conditions, and conditions and stipulations of other state and federal resource permits and the Coastal Zone Management Act. Made on-site permit modification decisions for Fish Habitat Permits. Review all Forest Land Use Plans and inspect timber harvest operations near Cordova, on the Kenai Peninsula, Kodiak and Afognak Islands and the Matanuska-Susitna Borough for compliance with state statutes and regulations. Conduct literature review and summary comparing and contrasting the effects of beetle-killed spruce forest and timber harvest on the vegetative community and fish and wildlife resources. Conduct research comparing the plant communities and moose use of beetle-killed spruce forests and timber harvest units. Conduct surveys of ATV stream crossings on the southern Kenai Peninsula and northern Susitna River drainage.

Division of Governmental Coordination Project Review Coordinator

Anchorage, Alaska (2016-2018)

Implement the Alaska Coastal Management Program under the Coastal Zone Management Act. Coordinate state resource agency review of development projects for consistency with the state standards and Coastal District policies. Work with resource agencies, applicants, and consultants to address potential project-related impacts