

Windfall Creek Streamgage, 2012–2018

by

Jarrold Sowa

March 2013

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)		General		Mathematics, statistics	
centimeter	cm	Alaska Administrative Code	AAC	<i>all standard mathematical signs, symbols and abbreviations</i>	
deciliter	dL	all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.	alternate hypothesis	H_A
gram	g	all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.	base of natural logarithm	e
hectare	ha	at	@	catch per unit effort	CPUE
kilogram	kg	compass directions:		coefficient of variation	CV
kilometer	km	east	E	common test statistics	(F, t, χ^2 , etc.)
liter	L	north	N	confidence interval	CI
meter	m	south	S	correlation coefficient	
milliliter	mL	west	W	(multiple)	R
millimeter	mm	copyright	©	correlation coefficient (simple)	r
		corporate suffixes:		covariance	cov
Weights and measures (English)		Company	Co.	degree (angular)	$^\circ$
cubic feet per second	ft ³ /s	Corporation	Corp.	degrees of freedom	df
foot	ft	Incorporated	Inc.	expected value	E
gallon	gal	Limited	Ltd.	greater than	>
inch	in	District of Columbia	D.C.	greater than or equal to	≥
mile	mi	et alii (and others)	et al.	harvest per unit effort	HPUE
nautical mile	nmi	et cetera (and so forth)	etc.	less than	<
ounce	oz	exempli gratia	e.g.	less than or equal to	≤
pound	lb	(for example)		logarithm (natural)	ln
quart	qt	Federal Information Code	FIC	logarithm (base 10)	log
yard	yd	id est (that is)	i.e.	logarithm (specify base)	log ₂ , etc.
		latitude or longitude	lat. or long.	minute (angular)	'
Time and temperature		monetary symbols (U.S.)	\$, ¢	not significant	NS
day	d	months (tables and figures): first three letters	Jan,...,Dec	null hypothesis	H_0
degrees Celsius	°C	registered trademark	®	percent	%
degrees Fahrenheit	°F	trademark	™	probability	P
degrees kelvin	K	United States (adjective)	U.S.	probability of a type I error (rejection of the null hypothesis when true)	α
hour	h	United States of America (noun)	USA	probability of a type II error (acceptance of the null hypothesis when false)	β
minute	min	U.S.C.	United States Code	second (angular)	"
second	s	U.S. state	use two-letter abbreviations (e.g., AK, WA)	standard deviation	SD
Physics and chemistry				standard error	SE
all atomic symbols				variance	
alternating current	AC			population sample	Var
ampere	A			sample	var
calorie	cal				
direct current	DC				
hertz	Hz				
horsepower	hp				
hydrogen ion activity (negative log of)	pH				
parts per million	ppm				
parts per thousand	ppt, ‰				
volts	V				
watts	W				

REGIONAL OPERATIONAL PLAN SF.4A.2013.05

WINDFALL CREEK STREAMGAGE, 2012–2018

by

Jarrod Sowa

Alaska Department of Fish and Game, Division of Sport Fish, Douglas

Alaska Department of Fish and Game
Sport Fish Division

March 2013

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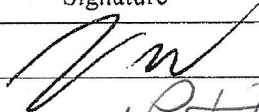
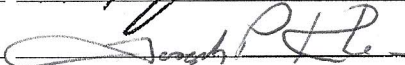
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PURPOSE

Alaska's rivers and lakes support some of North America's most viable and productive salmon fisheries. Over 17,000 streams, rivers, or lakes have been identified throughout the state as being important for spawning, rearing or migration of anadromous fish (Klein 2012). Fish migration, spawning, rearing, and ultimately production in these water bodies are dependent upon sufficient seasonal quantities of water. Demand for water to support hydroelectric power generation, petroleum production, mining, water supply (including out-of-state export), residential, forestry, agriculture, and other projects have the potential to modify the naturally occurring instream flows to which fish have adapted to and are dependent upon (Poff et al. 1997).

The Fish and Game Act requires the Alaska Department of Fish and Game (ADF&G), to "...manage, protect, maintain, improve, and extend the fishery resources of the state in the interest of the economy and general well-being of the state" (Alaska Statute 16.05.020; AS). One mechanism ADF&G uses to fulfill its mandate is to reserve water in rivers and lakes for fish and wildlife. An appropriation of water that remains within a river is legally defined under Alaskan law (AS 46.15.145) and regulations (11 AAC 93.970) as a reservation of water. To reserve water, an application with supporting data and analyses must be submitted to the Alaska Department of Natural Resources (DNR). A minimum of five years of mean daily flow data is recommended by DNR to quantify instream flow requirements within an application. A reservation of water application must contain supporting data and analyses that demonstrate the need for the amount of water being requested.

The State of Alaska Legislature amended the Alaska Water Use Act in 1980 to allow instream flows to be legally reserved by a private individual, group, or government agency in order to maintain specific flow rates in a river or volumes and water levels in a lake during specified time periods for one or a combination of four types of uses:

- protection of fish and wildlife habitat, migration, and propagation;
- recreation and parks purposes;
- navigation and transportation purposes; and
- sanitary and water quality purposes.

Priority dates for reservation of water applications are based on the date that they are accepted by the DNR. Alaska water law is based on the doctrine of prior appropriation also known as "first in time first in right". According to the rules of prior appropriation, the right to the full volume of water is first given to the appropriator who has the earliest priority date to beneficially use the water. This senior water right holder has a legal standing to assert that right against conflicting uses of water from others who do not have water rights or who are junior in priority.

In 2004, Windfall Creek was selected through a process of regional staff scoping by Region 1 ADF&G Division of Sport Fish staff as a candidate for a reservation of water. A review for any historical streamflow data for Windfall Creek concluded that no records exist. Based on importance of the resources to be protected, regional staff scoping process, consideration of other water bodies in the area with less than 5 years of streamflow records, site access, and comments from local biologists, Windfall Creek was selected for streamgaging. The purpose of this project is to collect the streamflow data necessary to file and adjudicate a reservation of water application with the Alaska Department of Natural Resources (DNR) for one reach of Windfall Creek to protect fish habitat, migration, and propagation.

This operational plan serves to provide project-specific information and rationale to supplement the Surface-water data manual for the Statewide Aquatic Resources Coordination Unit (SARCU; Klein 2013).

OBJECTIVE

The objective of this project is to collect the streamflow data necessary to file a reservation of water application to reserve instream flows within one reach of Windfall Creek. Two tasks are necessary to complete this objective and include:

Tasks

1. Install and operate a streamgage for five years within one reach of Windfall Creek.
2. Complete and file a reservation of water application for one reach of Windfall Creek.

METHODS

STUDY AREA

Windfall Creek is located 18 miles northwest of Juneau (Figure 1) and has been catalogued by the Alaska Department of Fish and Game (ADF&G) as Anadromous Waters Catalog (AWC) stream number 111-50-10700-2004-3006 (Johnson and Blanche 2012). The creek supports populations of coho salmon (*Oncorhynchus kisutch*), pink salmon (*O. gorbuscha*), chum salmon (*O. keta*), sockeye salmon (*O. nerka*), steelhead (*O. mykiss*), cutthroat trout (*O. clarki*), and Dolly Varden char (*Salvelinus malma*).

Windfall Creek drains out of Windfall Lake and flows downstream 0.5 miles to a side channel of the Herbert River (Figure 2). Two tributaries flow into Windfall Lake; Windfall Creek which enters into the southwest corner of the lake and an unnamed creek which enters from the southeast. The watershed has a drainage area of approximately 12 square miles.

Windfall Creek is located within the temperate coastal rainforest of Southeast Alaska. The climate of this area is characterized by cold, snowy winters and cool wet summers. The entire watershed is located within the Tongass National Forest.

The creek is a popular fishery for Juneau area anglers since it is the only Juneau area stream where anglers can catch and retain sockeye. There also is a United States Forest Service public use cabin located on the northeast shore of the lake that can be accessed by a 3.2 mile long trail.

An ADF&G fish weir operated in the spring of 1997 and counted 616 cutthroat trout, 34,074 Dolly Varden, and nine steelhead outmigrating trout from Windfall Creek (Jones and Harding 1998). Immigrating sockeye salmon were counted at ADF&G fish weirs in 1989 and 1997 and the total return was estimated to be 4,667 in 1989 and 4,228 in 1997 (Bethers and Glynn 1990, Yanusz 1998). ADF&G has also conducted foot surveys of spawning sockeye salmon in Slate Creek, a tributary to Windfall Creek above Windfall Lake (Figure 2), since 1990.

STUDY DESIGN

Following the approach and guidelines set forth in Klein (2013) and the DNR Handbook (DNR 1985), one reach (Figure 2) of Windfall Creek was selected for instream flow protection. The reach begins just upstream of the confluence with the Herbert River and extends approximately 0.5 miles to the outlet of Windfall Lake (Figure 2). No major tributaries enter the creek between

the bottom and top of the reach. Therefore, streamflows within the reach are assumed to be relatively uniform. This reach provides important habitat for fish spawning, incubation, rearing, and passage life phases (Johnson and Blanche 2012; B. Glynn, ADF&G, Fishery Biologist, Douglas, Alaska, 2007, personal communication).

In order to collect the streamflow data necessary to file a reservation of water application, ADF&G will operate a streamgage for five years within the reach. After one year of data have been collected and analyzed, a reservation of water application will be completed and submitted to DNR. This application will be updated and an amendment filed with DNR after five years of data have been collected. Instream flow requests for the reach will be determined using the flow duration method (Annear et al. 2004).

The feasibility, cost, and staff requirements of collecting the streamflow data needed to support reservation of water applications upstream of Windfall Lake for Windfall Creek and or Slate Creek will also be assessed. If this additional data collection proves feasible an update to this operational plan would be completed detailing how this data will be collected and analyzed.

ADF&G employees Jarrod Sowa and Jason Hass will perform all field duties with funding provided by the Alaska Sustainable Salmon Fund.

DATA COMPILATION AND COLLECTION

Biologic Data Compilation

Fish distribution and periodicity data will be compiled and summarized from scientific literature, local ADF&G biologists, the *Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes*, its associated Atlas (Johnson and Blanche 2012), and the Division of Sport Fish Statewide Harvest Survey publication. Professional interviews and literature reviews of other relevant fish periodicity data will be performed and documented to ensure all available data on the distributions of fish are compiled and consensus reached and documented when variations in literature and experts occur. With the help of Juneau area fishery biologists, a fish periodicity chart (Table 1) that includes all fish species present in Windfall Creek and details the timing of life history phases, will be finalized and included in the reservation of water application.

Hydrologic Data Collection

Site Selection

Hydrologic data collection for Windfall Creek will follow U.S. Geological Survey (USGS) standards as described in Klein (2013). The gage will be located within the reach at a location where the creek is confined to one channel, far enough upstream of the confluence with the Herbert River to avoid backwater affects, within reasonable proximity of a satisfactory reach to measure stream discharge, and where it can be reached during high water events. A field reconnaissance trip to determine the exact location of the streamgage will occur in the spring of 2013.

Access

The site will be accessed by a combination of biking and hiking the 3.2 mile trail to Windfall Lake. There is a 100 yard long trail off the main trail that can be used to access the creek. Backpack style rafts may also be used to access the site from the lake then float back down the

creek and eventually the Herbert River to the trailhead. During the winter when the trail is covered in snow Nordic skis will be used access the site. A floatplane will be used to fly in the necessary gear and equipment for the installation of the streamgage.

Streamgage Operation

Prior to installation of the streamgage, an ADF&G Habitat Division fish habitat permit and a USFS special use permit will be acquired. The streamgage will be installed during the summer of 2013.

Stage and water temperature will be measured at the streamgage using an Insitu[®] Level Troll 500 pressure transducer housed in a 1-1/4" pipe that is secured to the stream bank with custom pipe brackets and 5/8" rebar. The pressure transducer will be programmed at the time of installation to measure stage and water temperature every fifteen minutes on the quarter hour.

Typically, ADF&G installs a staff gage in the gage pool and the pressure transducer is programmed to read the same as the staff gage at the time of installation. In lieu of installing a staff gage, water surface elevations (WSE) may be surveyed using an auto level every field visit. Three survey reference marks (RMs) will be established near the streamgage to establish the gage datum. At the time of the installation, the WSE in relation to RM 1 will be measured by differential surveying techniques. At this time the transducer will be set to read the surveyed water surface elevation. Two additional RMs (named RM2 and RM3) will be established near the gage site to monitor possible changes in the elevation of RM1. The differences in the elevations of these RM's in relation to RM1 will be measured using standard differential surveying techniques following USGS protocols (Kenney 2010). The RM elevations will be surveyed at least once a year and also at the time of gage removal. The transducer and surveyed WSE are compared at each site visit to determine if the surveyed WSE is being represented correctly by the transducer. If a deficiency is identified, protocols described in Klein (2013) or manufacturer guidelines will be followed to correct the problem.

To define the stage-discharge relationship, discharge measurements will be taken near the streamgage at least six times a year over a range of low to high flows and during different seasons for the period that the gage is operational. When the creek is wadeable a Price AA, Pygmy, or acoustic Doppler velocity meter along with a tagline will be used to measure discharge. During high water conditions when the creek cannot be waded, a Teledyne-RDI Steampro[®] Acoustic Doppler Current Profiler (ADCP) will be used to measure discharge. A backpack style raft would be used by one person to access the other streambank while the other stayed on opposite streambank. The Steampro would be tethered and towed back and forth across the creek to take the discharge measurement. During winter when the creek is frozen over the ice will be removed by spud bar or an ice auger will be used to drill holes in the ice. All scientific equipment will be calibrated and maintained according to manufacturer specifications and USGS standards.

Biologic Data Collection

At this time, biological data will not be collected at the creek. If it is determined that biological data are lacking or needs further refinement protocols will be developed to collect the necessary data.

DATA REDUCTION

Stage and water temperature data will be transferred from the transducer to a Rugged Reader[®] Pocket PC then uploaded to a personal desktop computer. The stage data will then be converted to Excel or comma delimited text files and entered into the Water Information System Kisters Inc. (WISKI) hydrologic software package. Discharge measurements and observed staff gage readings will be entered into the BIBER component of WISKI. Electronic copies of field notes, photographs, and level summary records will be stored in folders associated with the gaging station name and number on the WISKI dedicated server. Further data reduction details are provided in Klein (2013).

DATA ANALYSIS

Analyses for the streamgage data will be performed following USGS standards and protocols and will include: development of a stage-discharge rating, discharge measurement summaries, associated shift analysis if applicable, a table of applied datum and gage-height corrections, mean daily flow computations for each day of record, mean monthly flow for each month of record, and a station description and manuscript (a synopsis that describes the gage site, mechanics and other pertinent information regarding the gage station operation).

SCHEDULES AND DELIVERABLES

Activity	Completion Date
Site Scoping	Spring 2013
Gage installation	Summer 2013
Site Visits (download stage data, perform discharge measurement)	At least six times a year at range of low to high flows, during different seasons, and when repairs and maintenance are required
Complete Surface Water Records for Water Year	February 28, following end of water year
Reservation of water application for Reach A completed	06/01/2015
Field data collection completed	10/01/2018
Amended reservation of water if needed.	06/01/2019
FDS Report	10/01/2019

RESPONSIBILITIES

Jarrold Sowa, Fishery Biologist III

Duties: Project manager. Responsible for study design, data collection, reduction, and administration of project responsibilities. Responsible for preparation and review of operational plan, reservation of water application, and FDS report.

Jason Hass, Fishery Biologist II

Duties: Assist with data collection, reduction, and administration of project responsibilities. Provides biologic and hydrologic technical assistance. Assist with preparation and review of operational plan, reservation of water application, and FDS report.

Shawn Johnson, Fishery Biologist III

Duties: Assist with management, coordination, and administration of project responsibilities. Provides biologic and hydrologic technical assistance. Assist with preparation and review of operational plan, reservation of water application, and FDS report.

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TABLES AND FIGURES

Table 1.–Fish periodicity tables for Windfall Creek.

Coho Salmon

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Smolt Passage			XX	XXXX	XXXX	XX						
Adult Passage								XXXX	XXXX	XXXX	XX	
Spawning								XX	XXXX	XXXX	XXXX	XX
Incubation	XXXX	XXXX	XXXX	XXXX				XX	XXXX	XXXX	XXXX	XXXX
Rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX

Pink Salmon

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fry Passage			XX	XXXX	XXXX	XX						
Adult Passage							XXXX	XXXX	XXXX			
Spawning							XX	XXXX	XXXX	XX		
Incubation	XXXX	XXXX	XXXX	XXXX	XX		XX	XXXX	XXXX	XXXX	XXXX	XXXX
Rearing				XXXX	XX							

Chum Salmon

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fry Passage			XX	XXXX	XXXX	XX						
Adult Passage							X	XXXX	XXXX	XX		
Spawning								XXXX	XXXX	XXX		
Incubation	XXXX	XXXX	XXXX	XXXX				XXXX	XXXX	XXXX	XXXX	XXXX
Rearing				XXXX	XX							

Sockeye Salmon

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Smolt Passage					XX	XXXX	XXXX					
Adult Passage					X	XXXX	XXXX	XXXX	XXXX	X		
Spawning							XXXX	XXXX	XXXX	X		
Incubation	XXXX	XXXX	XXXX	XXXX	XXXX		XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX

* DV and CT smolt defined as those fish undergoing initial emigration

Based upon professional judgment of ADF&G biologists

Smolt passage is for juvenile emigration to estuarine/marine environment

Adult passage: for salmon is immigration: for trout, char, and other species, immigration and emigration.

Incubation life phase includes time of egg deposition to fry emergence

? = Data not available or timing is incomplete

Table 1.–Page 2 of 2.

Cutthroat Trout

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Smolt passage *			XXXX	XXXX	XXXX							
Adult passage			XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	
Spawning				XXX	XXXX	XX						
Incubation				XXX	XXXX	XXXX	XXXX	XX				
Rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX

Steelhead Trout

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Smolt Passage				XX	XXXX	XXXX						
Adult Passage Up				XXXX	XXXX	XXXX						
Adult Passage Down					XXXX	XXXX	XX					
Spawning				XX	XXXX	XXXX						
Incubation				XX	XXXX	XXXX	XXXX	XXXX				

Dolly Varden

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Smolt passage *			XXXX	XXXX	XXXX							
Adult passage			XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	
Spawning									XX	XXXX	XX	
Incubation	XXXX	XXXX	XXXX	XXXX	XX				XX	XXXX	XXXX	XXXX
Rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX

* DV and CT smolt defined as those fish undergoing initial emigration
 Based upon professional judgment of ADF&G biologists
 Smolt passage is for juvenile emigration to estuarine/marine environment

Figure 1.—Windfall Creek area map.

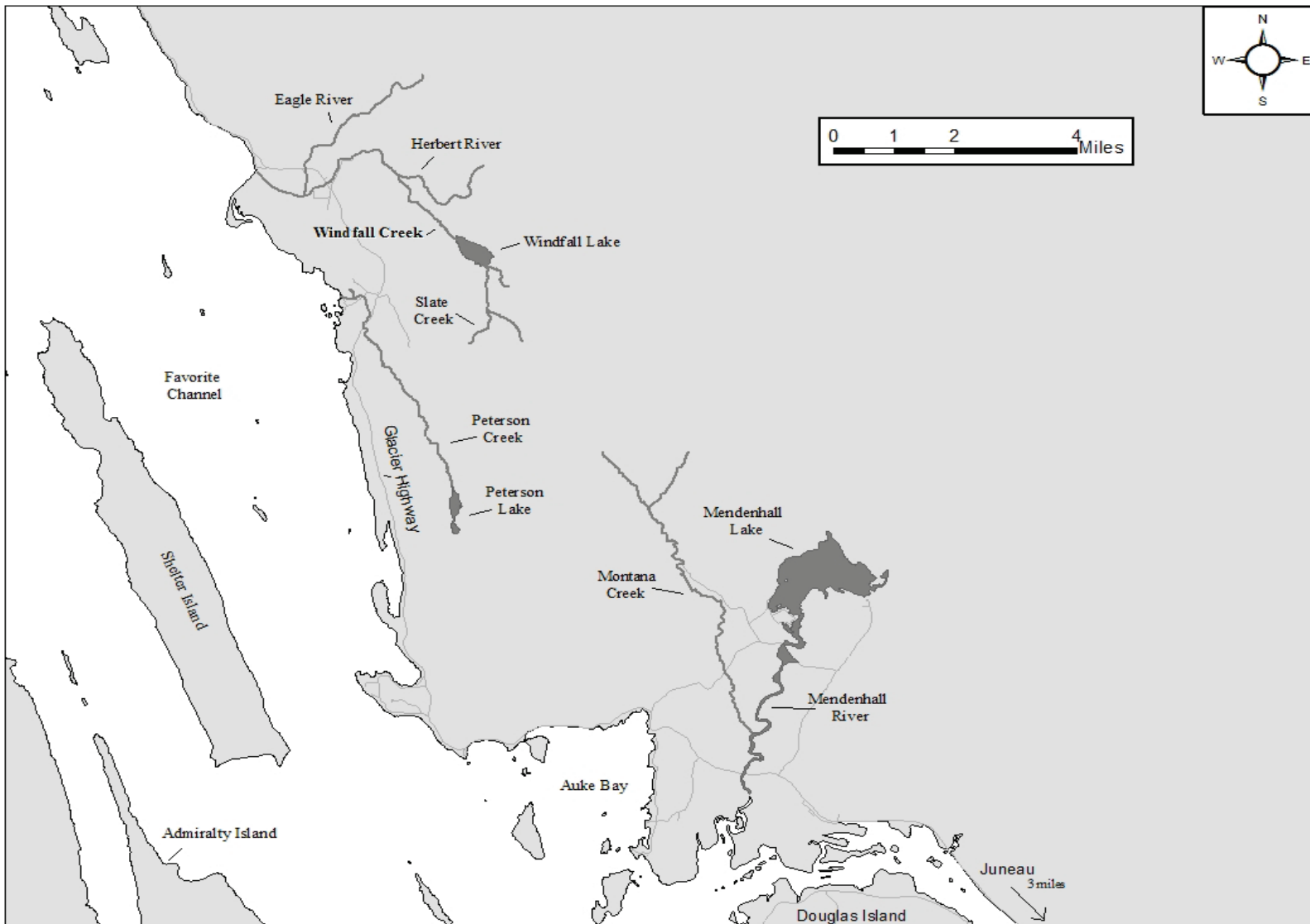
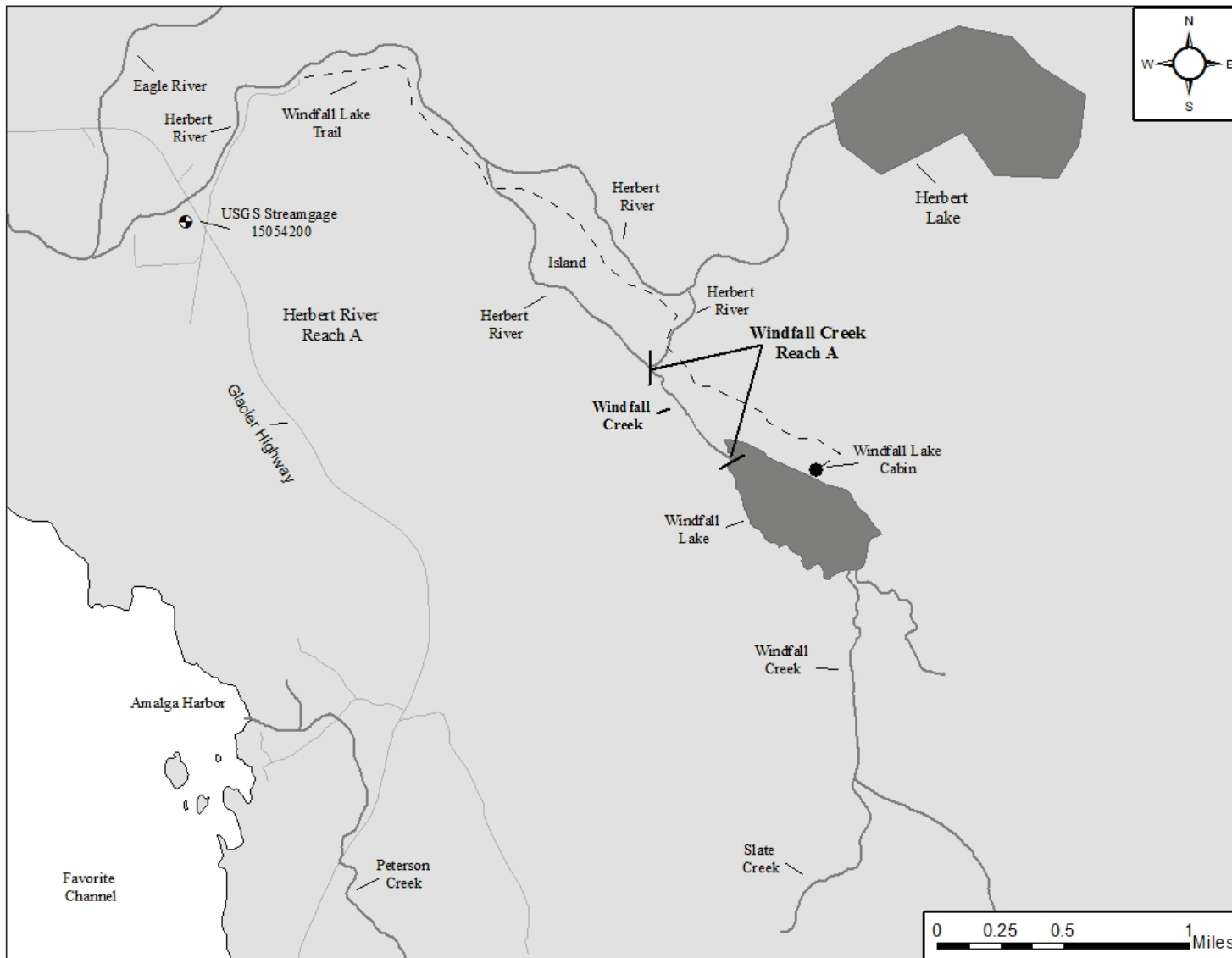


Figure 2.—Windfall Creek reservation of water reach map.



APPENDIX A: FIELD CHECKLIST

Appendix A1.–Field Checklist

Pre Site Visit Checklist

- Obtain approval to travel from supervisor via email
- Contact Watershed Councils or other partners
- Reserve cabin, air charter, ferry (use STO unless < 4hr notice, or Wings of Alaska)
- Charge Batteries: camera, Rugged Reader, VHF, Aquacalc
- Spin test velocity meters
- Check weather
- Read last Field Trip Report
- Review stage data, rating curves, rating table, discharge summary sheet
- Print rating table, rating curve, benchmark locations, survey notes

Equipment Checklist

- Velocity meters (Pryce and/or Pygmy)
- Wading rod
- Tape measure
- Aquacalc
- Headphones
- Stopwatch
- Cables to connect Aquacalc to velocity meters
- Pencils
- Notebook/Discharge Measurement Sheets
- Camera
- Rating Table
- Stadia Rod, Auto Level, Tripod, Survey Notes
- Rugged Reader and cable to download data
- Dessicant
- Pipe wrenches, pipe goop, misc tools
- First Aid Kit
- Watch
- Extra 9V batteries for Aquacalc
- 12 gage w/ slugs/bear spray (if needed)
- Spare parts and oil for velocity meters
- Calculator

-continued-

Site Visit Checklist

- Take staff gage reading and photos
- Inspect site for changes to control, staff gage, channel, etc
- Take discharge measurement and record exact start/end time on discharge measurement notes sheet
- Take photos upstream/downstream, across discharge measurement
- Take staff gage reading after discharge measurement
- Take picture of control
- Download datalogger data. Check battery level and memory. View data.
- Take instantaneous probe reading and compare to staff gage
- Make sure probe test is running (Running Man)
- Record all pertinent information on discharge measurement sheet i.e.; weather, site conditions, equipment problems, changes to channel, changes to control, differences between staff gage and probe, work that needs to be completed at next visit, wildlife seen (especially fish activity), etc.
- Survey benchmarks/staff gage/control/WSE at installation, yearly, at decommission, and if staff gage is suspected to have moved. Make sure to move level and survey all stations again. Check data in the field before leaving and compare with old survey data.

Post Visit Checklist

- Download data from Aquacalc
- Download data from Rugged Reader
- Compare discharge data from Aquacalc to discharge measurement sheet.
- Make sure all pertinent information is posted to discharge measurements notes sheet.
- Post discharge measurement data to Shift Analysis sheet.
- Plot discharge measurement to rating curve.
- Post discharge measurement data to Flow Summary sheet.
- Convert stage, water temperature, observed staff gage, discharge measurement data into WISKI compatible format. Import data into WISKI.
- Review stage data to make sure probe is operating correctly.
- Post observed staff gage readings and probe readings to Gage Height Corrections Sheet. Difference between the two should be less than or equal to .03ft.
- Complete Field Trip Report
- Download and label pictures.