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Hydrologic Investigations in Support of a Reservation of Water for Stariski Creek, Alaska

by

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and

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July 2014

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
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

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat or long
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	log_2, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

FISHERY DATA SERIES NO. 14-29

HYDROLOGIC INVESTIGATIONS IN SUPPORT OF A RESERVATION OF WATER FOR STARISKI CREEK, ALASKA

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ABSTRACT

Stariski Creek, located on the Kenai Peninsula near Homer, supports anadromous fish species important to local commercial and recreational fisheries. The Alaska Department of Fish and Game, Division of Sport Fish selected Stariski Creek, through a process of regional staff scoping in 2006, as a candidate water body for a reservation of water. To collect the data necessary to support a reservation of water application, a streamgage was operated from 15 June 2006 to 13 October 2011. The monthly mean discharge ranged from 15 ft^3/s for March to 176 ft^3/s for May. Stream discharge was lowest in winter prior to ice-out and increased from these lows in the spring. Flows decreased but were variable during the summer and then rose again during the fall and early winter. A preliminary reservation of water application was filed using the first 2 years of data collected during this study to reserve instream flows in one 6.1-mile reach of Stariski Creek. The application was accepted by the Alaska Department of Natural Resources and given a priority date of 6 July 2011. The data in this report will be used to support the pending reservation of water application.

Key words: Stariski Creek, streamgage, discharge, reservation of water, instream flow

INTRODUCTION

Stariski Creek, located near Anchor Point on the lower Kenai Peninsula (Figure 1), was nominated in 2006 as a high-priority stream for instream flow protection by means of a reservation of water. A reservation of water is a water right to retain a certain amount of water in a stream or lake. 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 [AS] 16.05.020). 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 as a reservation of water, under Alaskan law (AS 46.15.145) and regulation (11 AAC 93.970).

To reserve water, an application must be submitted to the Alaska Department of Natural Resources (DNR) that includes supporting data and analyses that substantiate the need for, and availability of, the amount of water being requested. An application that meets administrative and regulatory requirements is then ready for adjudication. Adjudication is the administrative determination of the validity and amount of a water right, including the settlement of conflicting claims among competing appropriators (11 AAC 93.970). After the adjudication process has been completed, a Certificate of Reservation is issued by DNR. For further information on reservations of water, see Klein (2014).

Ideally, 20 or more years of streamflow data are desired to statistically characterize a river’s flow regime; however, DNR considers 5 years of flow data to be sufficient for the purpose of quantifying flow or water levels for reservations of water. Modeling or correlations using appropriate longer-term gage records can be used to extend shorter-term flow records to meet this criterion. Record extension techniques are used by U.S. Geological Survey (USGS) and others to improve statistical measures (reduce error and bias) of streamflow at short-term gaging stations.

Stariski Creek and nearby Deep Creek were nominated in 2006 as streams warranting instream flow reservations by Region II Division of Sport Fish staff. Stariski Creek was selected because it was characterized as having (1) potential water extractions and other development pressures, (2) importance to local fisheries, (3) ease of access, and (4) wadeability throughout the open water season. In 2006, staff from the Statewide Aquatic Resources Coordination Unit (SARCU) of ADF&G installed a streamgage on Stariski Creek at river mile 3.9. Cook Inletkeeper (CIK), a community-based nonprofit organization with a mission to protect Alaska's Cook Inlet watershed, had been routinely collecting water quality information from Stariski Creek and other streams, which provided a convenient segue for a partnership to monitor streamflow in Stariski Creek. Cook Inletkeeper secured additional funding from the Alaska Sustainable Salmon Fund to support collection of streamflow and water quality data to complete 5 years of data collection. This is the final report from the 5-year effort to measure streamflow to support a reservation of water application for Stariski Creek.

OBJECTIVE

The objective of this project was to collect the hydrological data necessary to support a reservation of water application to protect instream flows within Stariski Creek. To accomplish this objective, a continuous streamgage was installed to monitor and record flow conditions representing a single reach on Stariski Creek.

STUDY AREA

The mainstem and several tributaries of Stariski Creek are catalogued as important to anadromous fish. Coho salmon (*Oncorhynchus kisutch*), chum salmon (*O. keta*), pink salmon (*O. gorbuscha*), and Dolly Varden (*Salvelinus malma*) utilize this creek for a portion of, or all of, their spawning, incubation, rearing, and passage life phases (Johnson and Blanche 2011). These species contribute to both sport and commercial fishing in the area.

Stariski Creek is a clear to tannin-stained stream that originates in the Caribou Hills from elevations less than 2,000 ft and drains a lowland area westward into Cook Inlet. The approximately 50 mi^2 dendritic drainage is mostly confined to a single meandering channel, with few secondary channels, off-channels, or braiding. Most of the few tributaries are first or second order, with no major higher-order tributary input. Streamflow is influenced by snowmelt during the spring, sporadic precipitation and interflow throughout summer, and periodic high flows caused by heavy precipitation during fall. Climate in the area, based on years 1981-2010, is maritime with an average temperature of 24.8 °F in January and 54.6 °F in July; average annual precipitation is 24.5 inches (WRCC 2013).

Surficial deposits are predominately undifferentiated till of the pre-late Wisconsin glaciation and complex glaciolacustrine deposits related to the early Moosehorn stade of the glaciations (Reger and Petrik 1993). The active lithographic layer ranges from mixed organics and loess, to sand, pebble-gravel, and cobbles (Reger and Petrik 1993). Trees in the drainage suffered from moderate to severe spruce-beetle kill in the 1990s, and many dead trees remain standing. A wide variety of small and large mammals, seabirds, shorebirds, raptors, waterfowl, and songbirds utilize the watershed.

METHODS

REACH DELINEATION

One of the requirements of a reservation of water application is to designate the particular reach or point on the subject water body to which the requested reservation flows will apply. Streams are typically segmented into reaches, such that the streamflow is not substantially different (plus or minus approximately 10%) between the upstream and downstream boundaries. The data collected at the measurement site are assumed to represent the entire reach. In cases when the data for a portion of a stream are unavailable or too costly to acquire, the downstream reach boundary is set further downstream than normal, with the understanding that the hydrological data at the collection point may be biased low for some of the reach. This practice is a trade-off for acquiring instream flow protection on a greater portion of the water body but with less data certainty or level of instream flow protection.

Funding, staffing, and accessibility limited selection to one reach located in the lower section of Stariski Creek, which included the Sterling Highway crossing (Figure 2). United States Geologic Survey (USGS) topographic maps and ground reconnaissance were used to aid in the selection of reach boundaries.

GAGING

Streamgage operation followed USGS protocols and procedures described in Rantz and others (1982).The collection of stage and direct measurements of discharge are essential components in the operation of a streamgage. A continuous record of stage is obtained by installing a pressure sensor that records water-surface elevation in the stream relative to an established data point (staff gages for this project). Direct measurements of discharge are taken at different times of year to record varying flows that are used to define the stage-discharge relationship (rating curve) and to detect the timing and magnitude of changes to this relationship over time (Kennedy 1984).

The Stariski Creek streamgage was located in a glide where stage was channel-controlled. Vented pressure transducers, +/-0.1% accuracy, were used to measure water level (stage). The transducer was housed within 1-1/4 inch perforated wellheads that were driven partially into the stream substrate, and supported by additional metal rods driven into the streambank. The transducer was programmed to record stage and water temperature at 15-minute intervals.

Three reference marks consisting of lag screws driven into cottonwood trees were established near each gage. The difference in the elevations of the reference marks in relation to the staff gage was measured using standard differential surveying techniques (Kennedy 1990). To save field time, beginning in the second year, a staff gage was installed to measure the water surface elevation (WSE) independent of the transducer, rather than surveying each visit. At each site visit, the staff gage WSE was compared to the transducer WSE reading to determine if it was being represented correctly by the transducer. Differential surveys were used at least once per year to monitor possible changes in the elevation of the staff gage or when other events occurred, such as floods and ice-out.

DISCHARGE MEASUREMENTS

Discharge is defined as the volume rate of flow of water and is reported in cubic feet per second (ft^3/s) rather than in metric terms as a universal convenience. Discharge is determined by measuring the average velocity, depth, and width of subsections across the discharge measurement transect. Ideally, each subsection should represent no more than 5% of the total flow.

For this study, discharge was measured following the USGS midsection method (Rantz and others 1982), using either a Price AA or Pygmy (depending on depth and velocity) vertical-axis velocity meter attached to a top-setting wading rod. A JBS Energy, Inc., AquaCalc®[1] electronic digital counter was used to record the depths, count meter revolutions, and calculate discharge. All instruments were maintained, calibrated, and operated according to their respective manufacturer's instructions and USGS manuals and technical memos (Rantz and others 1982). For measurements through ice, a gas-powered auger was used to drill holes through the ice cover along a transect. Each hole then provided a subsection where depth was measured from bottom of ice in the water to the substrate and velocity was measured using a vertical-axis velocity meter. Discharge was calculated the same as the open-water measurement but multiplied by a standard ice roughness factor of 0.92 (Nolan and Jacobson 2000).

Site Visits

Site visits to the streamgage were made periodically during open water and once or twice during winter, to download data from the data loggers, measure discharge, and perform routine gage maintenance. Data were downloaded from the data loggers using a Palm PDA™ or laptop computer. Discharge measurement data, staff gage readings, and other site visit notes were recorded in waterproof field notebooks.

After a site visit, discharge measurement data was transcribed from the field notebooks to MS Excel® to calculate discharge, pictures were downloaded and labeled, and data were transferred to a desktop computer. Transducer-recorded stage and water temperature, staff gage readings, and discharge measurement data were imported into the Water Information System Kisters Incorporated© (WISKI©) hydrological software package database for storage and analysis.

Streamflow Records Computation

Streamflow records computation is a step-by-step process in which recorded stream stage is converted to discharge using the stage-discharge relationship (rating curve). Before being converted to discharge, the stage record was corrected for transducer movement and drift, or fill and scour of the hydraulic control. WISKI© was used to develop rating curves, make corrections to the stage record, apply rating curves to corrected stage values to calculate 15-minute discharges, and summarize these discharges to mean daily, mean monthly, and average annual flow values. Missing or suspect data caused by ice, operator error, or recorder malfunction were estimated by using the "hydrographic and climatic comparison" method (Rantz and others 1982; Melcher and Walker 1992). This included comparisons of streamflow records from the nearest USGS streamgage station (15266300, Kenai River near Soldotna), local weather records (Homer airport; NOAA[2], trends of the hydrograph before and after the missing data, and available instantaneous discharge measurements).

Computed daily discharge values[3] were summarized for each water year (WY; October 1-September 30). The procedures used to compute streamflow records follow methods described in Rantz and others (1982) and Kennedy (1983). Mean daily flow records were analyzed by a series of Statistical Analysis System® programs to estimate the annual, monthly, and mean daily summaries and flow duration values for specified biweekly and monthly time periods. Mean

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[1] Company and product names used in this publication are included for completeness but do not constitute an endorsement.

[2] National Oceanic and Atmospheric Administration Climate Data Online; http://www.ncdc.noaa.gov/cdo-web (accessed October 21, 2011).

[3] Values of daily mean discharge are shown following USGS guidelines (http://wdr.water.usgs.gov/current/documentation.html#sqw, accessed January 7, 2014) by rounding to the nearest hundredth of a cubic foot per second for discharges of less than 1 ft^3/s; to the nearest tenth between 1.0 and 10 ft3/s; to whole numbers between 10 and 1,000 ft3/s; and to 3 significant figures above 1,000 ft^3/s. The number of significant figures used is based solely on the magnitude of the discharge value.

annual flow was estimated as a mean of the annual mean daily flow values over all complete water years of record. Mean monthly flows were estimated as the mean of monthly mean daily flows for all complete months over the entire period of record. Duration estimates represent the expected frequency of occurrence of mean daily flows within the specified time periods. The durations of daily mean flows were calculated as the percentiles of the empirical distribution of observed values within the specified time periods over the period of record. This provided an estimate of the percentage of time a given mean daily flow was equaled or exceeded within the distribution of mean daily flows for each time period analyzed.

RESULTS

REACH DELINEATION

An upstream boundary was established where Tall Tree Road crosses Stariski Creek. This site was selected because it was easy to access and provided a readily identifiable boundary. Discharge was measured several times to determine the streamflow relative to the gage site. The downstream boundary of the reach was established at the mouth of Stariski Creek, at mean lower low water, providing a total reach length of 6.1 miles. No streamflow measurements were made downstream of the gage.

HYDROLOGIC DATA

The gage operated from 15 June to 25 October in 2006; 15 June to 25 October in 2007; 15 May to 9 October in 2008; and from 5 May 2009 to 13 October 2011. Due to funding issues and limited staff time, winter flows during WY2007 through WY2008 could not be measured. During these same winters the transducer was pulled out in the fall to protect it from becoming destroyed by freezing. It was reinstalled during the following spring as soon as the stream was clear of ice. It became evident that an adequate amount of flow remained to keep the transducer submerged, so it remained in place during the remaining years.

Forty-six measurements of instantaneous discharge, ranging from 13 to 107 ft^3/s, were taken at the site (Table 1). The highest flows could not be measured because personnel could not wade the stream and did not have alternative means to obtain the measurement. Summaries of mean daily (Figure 3 and Table 2) and mean monthly flows (Table 3) are provided and listed by water year (Appendix A). The durations of daily mean flows were calculated as the percentiles of the empirical distribution of observed values within monthly time periods (Table 4).

Two rating curves were developed to compute the mean daily flow records. The first rating was based on data collected from 15 June 2006 to 9 October 2007 and applied to the open water periods from the beginning of the project to 9 October 2007. During the following open water period the rating had changed, presumably from ice scouring or high spring runoff flows during breakup. Thus a new rating was developed based on data collected from 2008 through 2010. This second rating seemed consistent throughout 2011, so it was not revised and was used to calculate mean daily flows for the open water period from 5 May 2008 through the end of the project.

DISCUSSION

During this study, the Stariski Creek hydrograph exhibited an expected pattern characterized by stable base flows and influenced periodically by precipitation events occurring primarily during fall (Figure 3). Runoff from snowmelt during spring was recognizable in most years but was relatively mild in magnitude and brief, probably due to the relatively small size and low elevation relief of the drainage. The highest flow measured was 107 ft^3/s, and the highest mean daily flow based on stage records was 321 ft^3/s on 6 May 2008. The stream was typically not wadeable at the discharge transect at flows higher than the highest measured due to surface water velocity and depth. The bankfull stage was not identified nor witnessed during this study. Extrapolating the rating to greater than 300% beyond the highest measured amount was not problematic because the channel control and geometry at the site appeared consistent even at the highest stages recorded. Specialized equipment for measuring higher flows, such as an Acoustic Doppler Current Profiler (ADCP), was not available for use by CIK. The ability of project staff and any potential partners to obtain measurements at relatively high flows, and during winter, should be considered carefully when planning gaging projects at new sites.

Winter discharge measurements were difficult to obtain due to the varying ice conditions that occurred in this subarctic maritime climate. For example, sometimes ice holes had to be augured through multiple ice layers, laden with debris from previous overflow events. Winter trips had to be planned and scheduled weeks ahead of time, so ideal conditions could not be guaranteed. As a matter of policy, DNR requires 5 years of data analysis to support reservations of water. Despite the absence of winter records for WY2007 and WY2008, a cursory examination of winter records at the nearest concurrently operating USGS gage (15266300, Kenai River near Soldotna) indicated that flows during these 2 winters represent average or below average conditions, with some variability among months. Although the Kenai River is a larger, glacial- and lake-influenced system, winter flows in general are primarily influenced by regional hydrological and climatic conditions because water is stored as ice rather than precipitation and runoff (Melcher and Walker 1992). A more detailed analysis or a regression extension was beyond the scope of this study; nevertheless, the existing 3 years of winter records for Stariski Creek should be sufficient to support instream flow recommendations with the caveat that they may represent slightly drier than normal conditions during this time period. Therefore, a precautionary approach is recommended when final flows are adjudicated.

Flow records for the open water periods were based on discharge measurements rated as fair or better. Although the stage-discharge relationship changed substantially sometime during the ice-covered period between fall 2007 and spring 2008, this change probably occurred within a short time period. The control and rating was consistent throughout the open water period before and after this change; therefore, no temporal or stage-related rating shifts were ascertainable.

On 6 July 2011, ADF&G filed a reservation of water application for the identified 6.1-mile reach of Stariski Creek with DNR. To expedite a priority date, a preliminary analysis and incomplete data set (approximately 2 years) was used to quantify the requested instream flows. To comply with regulations, either the completed analysis from all data collected during this study (contained herein) will need to be submitted to DNR by 6 July 2014 or a request for a 2-year extension can be made.

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Most of the funding for this project was secured through an Alaska Sustainable Salmon Fund grant submitted by Cook Inletkeeper, who also provided supporting staff and volunteers for the field data collection essential to the success of this project. Travis Elison, ADF&G Fisheries Biologist, enthusiastically and skillfully provided technical support and assisted with the field work.

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TABLES AND FIGURES

Table 1.–Summary of discharge measurements (ft^3/s) and water surface elevation (WSE) made at the Stariski Creek gage, 15 June 2006 to 13 October 2011.

Date	Start time	End time	Discharge (ft^3/s)	Quality rating	WSE[1]
6/15/2006	16:03	16:45	54	Fair	95.65
8/18/2006	12:25	12:50	65	Fair	95.87
9/1/2006	12:35	13:08	97	Fair	96.14
9/14/2006	16:24	17:02	49	Fair	95.69
10/12/2006	16:45	17:22	103	Fair	96.17
6/15/2007	13:20	13:50	32	Fair	95.38
6/20/2007	16:10	17:20	29	Fair	95.33
6/28/2007	12:32	13:06	28	Fair	95.34
7/3/2007	14:00	15:30	24	Fair	95.28
7/12/2007	11:59	12:40	60	Fair	95.68
7/19/007	12:10	12:47	33	Fair	95.38
7/24/2007	14:55	15:43	40	Fair	95.50
7/31/2007	12:59	13:39	23	Fair	95.26
8/9/2007	15:30	16:15	20	Poor	95.19
8/15/2007	15:07	15:40	20	Fair	95.16
8/23/2007	13:20	14:45	39	Fair	95.49
8/30/2007	12:05	12:35	22	Fair	95.22
9/6/2007	12:15	12:45	16	Poor	95.20
9/12/2007	14:45	15:15	82	Fair	95.90
9/18/2007	15:30	16:01	40	Fair	95.50
9/27/2007	14:20	15:05	61	Fair	95.74
10/3/2007	11:00	13:12	37	Poor	95.54
10/9/2007	10:50	11:20	35	Fair	95.42
6/23/2008	15:43	16:35	42	Fair	95.48
7/2/2008	16:35	16:59	31	Fair	95.36
8/14/2008	14:38	15:13	42	Fair	95.50

-continued-

Table 1.–Page 2 of 2.

Date	Start time	End time	Discharge (ft^3/s)	Quality rating	WSE[1]
12/17/2008	15:00	15:30	39	Poor	ice
2/26/2009	13:50	14:12	34	Poor	ice
6/9/2009	12:35	13:10	73	Poor	95.45
6/18/2009	14:30	16:00	31	Fair	95.35
8/5/2009	14:25	14:46	46	Fair	95.55
9/9/2009	13:29	14:12	28	Fair	95.33
10/14/2009	13:50	14:19	66	Fair	95.75
11/27/2009	16:15	17:20	25	Poor	ice
12/29/2009	12:30	13:05	23	Poor	ice
5/21/2010	12:25	1:03	107	Fair	95.97
6/16/2010	10:57	11:43	85	Fair	95.87
7/22/2010	12:55	13:50	54	Fair	95.63
8/20/2010	12:15	12:55	45	Fair	95.50
9/24/2010	12:30	13:10	28	Fair	95.31
10/8/2010	12:55	13:35	57	Fair	95.63
3/3/2011	16:20	17:20	15	Poor	ice
3/21/2011	15:15	15:55	13	Poor	ice
6/17/2011	13:50	14:40	51	Fair	95.60
6/23/2011	13:15	14:05	33	Fair	95.39
10/13/2011	12:20	12:58	39	Fair	95.48

[1] Water surface elevation as determined from either level survey, if done, or staff gage reading.

Table 2.–Daily flow summaries (in ft^3/s) for the Stariski Creek gage. The period of record is from 15 June to 25 October in 2006; 15 June to 25 October in 2007; 15 May to 9 October in 2008; and 5 May 2009 to 13 October in 2011.

Julian day	Day of year	# of days of record	Minimum-mean daily flow (ft^3/s)	Mean-mean daily flow (ft^3/s)	Maximum-mean daily flow (ft^3/s)
1	January 1	3	23	29	39
2	January 2	3	22	30	39
3	January 3	3	22	30	39
4	January 4	3	22	30	38
5	January 5	3	22	30	38
6	January 6	3	22	31	38
7	January 7	3	22	32	38
8	January 8	3	22	32	38
9	January 9	3	22	32	38
10	January 10	3	22	32	38
11	January 11	3	22	32	37
12	January 12	3	22	32	38
13	January 13	3	22	33	41
14	January 14	3	22	34	44
15	January 15	3	22	33	42
16	January 16	3	22	33	42
17	January 17	3	22	34	43
18	January 18	3	22	34	44
19	January 19	3	22	34	44
20	January 20	3	22	35	48
21	January 21	3	22	34	46
22	January 22	3	22	35	49
23	January 23	3	22	35	49
24	January 24	3	22	35	49
25	January 25	3	22	35	49
26	January 26	3	22	35	47
27	January 27	3	22	34	44
28	January 28	3	22	33	43
29	January 29	3	22	33	43
30	January 30	3	22	33	43
31	January 31	3	22	33	43

-continued-

Table 2.–Page 2 of 12.

Julian day	Day of year	# of days of record	Minimum-mean daily flow (ft^3/s)	Mean-mean daily flow (ft^3/s)	Maximum-mean daily flow (ft^3/s)
32	February 1	3	22	33	43
33	February 2	3	22	33	43
34	February 3	3	22	33	43
35	February 4	3	22	32	42
36	February 5	3	22	32	42
37	February 6	3	22	32	42
38	February 7	3	22	32	41
39	February 8	3	22	32	40
40	February 9	3	22	32	40
41	February 10	3	22	32	40
42	February 11	3	22	31	39
43	February 12	3	22	31	39
44	February 13	3	22	31	38
45	February 14	3	22	30	37
46	February 15	3	22	30	36
47	February 16	3	22	30	35
48	February 17	3	22	29	34
49	February 18	3	22	29	34
50	February 19	3	22	29	34
51	February 20	3	22	29	33
52	February 21	3	23	29	33
53	February 22	3	23	29	32
54	February 23	3	23	29	32
55	February 24	3	23	29	32
56	February 25	3	23	29	32
57	February 26	3	23	29	32
58	February 27	3	23	28	31
59	February 28 *or* 29	3	23	28	31

-continued-

Table 2.–Page 3 of 12.

Julian day	Day of year	# of days of record	Minimum-mean daily flow (ft^3/s)	Mean-mean daily flow (ft^3/s)	Maximum-mean daily flow (ft^3/s)
60	March 1	3	22	28	31
61	March 2	3	22	28	31
62	March 3	3	22	28	31
63	March 4	3	22	28	31
64	March 5	3	22	27	31
65	March 6	3	22	27	31
66	March 7	3	22	27	31
67	March 8	3	22	27	31
68	March 9	3	22	27	31
69	March 10	3	22	27	31
70	March 11	3	22	27	31
71	March 12	3	22	27	31
72	March 13	3	22	27	31
73	March 14	3	22	27	31
74	March 15	3	22	28	31
75	March 16	3	23	28	31
76	March 17	3	23	28	31
77	March 18	3	23	28	31
78	March 19	3	23	28	31
79	March 20	3	23	28	31
80	March 21	3	23	28	31
81	March 22	3	23	28	31
82	March 23	3	23	28	31
83	March 24	3	23	28	31
84	March 25	3	23	28	31
85	March 26	3	23	28	31
86	March 27	3	23	28	31
87	March 28	3	23	28	31
88	March 29	3	23	28	31
89	March 30	3	23	29	32
90	March 31	3	23	29	34

-continued-

Julian day	Day of year	# of days of record	Minimum-mean daily flow (ft^3/s)	Mean-mean daily flow (ft^3/s)	Maximum-mean daily flow (ft^3/s)
91	April 1	3	23	29	34
92	April 2	3	23	29	34
93	April 3	3	23	30	37
94	April 4	3	23	30	37
95	April 5	3	24	31	37
96	April 6	3	24	31	39
97	April 7	3	25	32	41
98	April 8	3	25	33	44
99	April 9	3	25	34	47
100	April 10	3	25	35	48
101	April 11	3	25	35	50
102	April 12	3	25	36	52
103	April 13	3	25	36	53
104	April 14	3	26	37	54
105	April 15	3	26	37	55
106	April 16	3	26	37	56
107	April 17	3	26	37	56
108	April 18	3	27	38	57
109	April 19	3	27	38	58
110	April 20	3	28	39	58
111	April 21	3	28	39	59
112	April 22	3	29	41	63
113	April 23	3	30	41	62
114	April 24	3	30	42	67
115	April 25	3	30	44	73
116	April 26	3	30	47	79
117	April 27	3	30	49	86
118	April 28	3	30	54	99
119	April 29	3	30	61	118
120	April 30	3	30	83	184

-continued-

Julian day	Day of year	# of days of record	Minimum-mean daily flow (ft^3/s)	Mean-mean daily flow (ft^3/s)	Maximum-mean daily flow (ft^3/s)
121	May 1	3	30	92	209
122	May 2	3	30	83	181
123	May 3	3	30	75	156
124	May 4	3	30	75	154
125	May 5	4	30	120	244
126	May 6	4	30	135	321
127	May 7	4	30	130	289
128	May 8	4	30	122	279
129	May 9	4	30	110	212
130	May 10	4	30	124	256
131	May 11	4	30	120	268
132	May 12	4	30	119	292
133	May 13	4	30	112	269
134	May 14	4	30	94	201
135	May 15	4	30	85	173
136	May 16	4	30	101	237
137	May 17	4	30	87	186
138	May 18	4	30	83	164
139	May 19	4	30	80	153
140	May 20	4	30	76	136
141	May 21	4	30	79	138
142	May 22	4	33	75	125
143	May 23	4	35	69	119
144	May 24	4	33	68	125
145	May 25	4	31	63	109
146	May 26	4	30	57	91
147	May 27	4	30	53	81
148	May 28	4	41	57	74
149	May 29	4	40	69	115
150	May 30	4	37	57	73
151	May 31	4	37	56	75

-continued-

Julian day	Day of year	# of days of record	Minimum-mean daily flow (ft^3/s)	Mean-mean daily flow (ft^3/s)	Maximum-mean daily flow (ft^3/s)
152	June 1	4	39	57	75
153	June 2	4	38	53	65
154	June 3	4	37	50	63
155	June 4	4	42	53	66
156	June 5	4	53	61	77
157	June 6	4	48	55	72
158	June 7	4	43	49	61
159	June 8	4	38	45	55
160	June 9	4	35	42	51
161	June 10	4	34	40	47
162	June 11	4	33	43	48
163	June 12	4	34	44	52
164	June 13	4	33	40	50
165	June 14	4	31	40	52
166	June 15	5	29	38	49
167	June 16	5	29	49	77
168	June 17	5	30	45	72
169	June 18	5	30	41	62
170	June 19	5	32	44	71
171	June 20	5	30	44	79
172	June 21	5	28	40	64
173	June 22	5	27	38	50
174	June 23	5	29	43	69
175	June 24	5	31	42	58
176	June 25	5	36	44	62
177	June 26	5	35	49	90
178	June 27	5	33	49	100
179	June 28	5	29	46	70
180	June 29	5	27	38	50
181	June 30	5	26	34	42

-continued-

Julian day	Day of year	# of days of record	Minimum-mean daily flow (ft^3/s)	Mean-mean daily flow (ft^3/s)	Maximum-mean daily flow (ft^3/s)
182	July 1	5	26	32	37
183	July 2	5	28	31	34
184	July 3	5	26	32	41
185	July 4	5	25	30	33
186	July 5	5	26	32	42
187	July 6	5	24	31	35
188	July 7	5	22	30	37
189	July 8	5	21	34	59
190	July 9	5	20	31	44
191	July 10	5	19	29	36
192	July 11	5	19	29	34
193	July 12	5	20	33	55
194	July 13	5	19	40	79
195	July 14	5	19	47	88
196	July 15	5	19	36	59
197	July 16	5	18	30	42
198	July 17	5	18	40	93
199	July 18	5	20	47	127
200	July 19	5	22	40	70
201	July 20	5	21	38	57
202	July 21	5	21	40	72
203	July 22	5	22	38	58
204	July 23	5	21	42	73
205	July 24	5	25	66	188
206	July 25	5	25	81	260
207	July 26	5	23	64	144
208	July 27	5	26	85	202
209	July 28	5	28	80	189
210	July 29	5	29	54	108
211	July 30	5	23	43	71
212	July 31	5	21	46	91

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Julian day	Day of year	# of days of record	Minimum-mean daily flow (ft^3/s)	Mean-mean daily flow (ft^3/s)	Maximum-mean daily flow (ft^3/s)
213	August 1	5	21	42	82
214	August 2	5	28	38	64
215	August 3	5	26	40	54
216	August 4	5	29	44	78
217	August 5	5	32	56	122
218	August 6	5	31	50	96
219	August 7	5	27	52	109
220	August 8	5	24	43	81
221	August 9	5	23	38	75
222	August 10	5	22	34	65
223	August 11	5	21	31	54
224	August 12	5	20	28	47
225	August 13	5	19	29	44
226	August 14	5	19	35	63
227	August 15	5	20	44	66
228	August 16	5	20	51	95
229	August 17	5	19	51	94
230	August 18	5	19	44	69
231	August 19	5	24	40	57
232	August 20	5	22	47	92
233	August 21	5	26	47	101
234	August 22	5	24	58	131
235	August 23	5	25	50	80
236	August 24	5	35	49	65
237	August 25	5	32	41	52
238	August 26	5	30	37	45
239	August 27	5	29	35	46
240	August 28	5	26	33	43
241	August 29	5	24	32	39
242	August 30	5	23	30	36
243	August 31	5	24	34	44

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Table 2.–Page 9 of 12.

Julian day	Day of year	# of days of record	Minimum-mean daily flow (ft^3/s)	Mean-mean daily flow (ft^3/s)	Maximum-mean daily flow (ft^3/s)
244	September 1	5	24	49	96
245	September 2	5	23	40	62
246	September 3	5	23	38	48
247	September 4	5	24	36	45
248	September 5	5	23	38	54
249	September 6	5	22	40	67
250	September 7	5	21	42	65
251	September 8	5	27	52	77
252	September 9	5	28	76	142
253	September 10	5	28	56	100
254	September 11	5	33	48	79
255	September 12	5	33	51	83
256	September 13	5	33	68	162
257	September 14	5	31	56	101
258	September 15	5	29	51	91
259	September 16	5	27	51	109
260	September 17	5	26	90	317
261	September 18	5	26	69	209
262	September 19	5	26	76	147
263	September 20	5	25	72	141
264	September 21	5	24	60	89
265	September 22	5	24	55	90
266	September 23	5	25	53	77
267	September 24	5	25	61	117
268	September 25	5	26	81	190
269	September 26	5	27	72	152
270	September 27	5	27	57	109
271	September 28	5	27	51	85
272	September 29	5	28	47	73
273	September 30	5	35	49	66

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Julian day	Day of year	# of days of record	Minimum-mean daily flow (ft^3/s)	Mean-mean daily flow (ft^3/s)	Maximum-mean daily flow (ft^3/s)
274	October 1	5	53	64	83
275	October 2	5	42	87	182
276	October 3	5	42	85	188
277	October 4	5	43	88	214
278	October 5	5	40	75	128
279	October 6	5	42	75	106
280	October 7	5	64	73	93
281	October 8	5	56	79	110
282	October 9	5	50	89	142
283	October 10	4	46	138	213
284	October 11	4	42	123	200
285	October 12	4	41	141	306
286	October 13	4	39	120	260
287	October 14	4	37	92	177
288	October 15	4	39	89	179
289	October 16	4	35	88	174
290	October 17	4	38	98	167
291	October 18	4	36	76	114
292	October 19	4	40	68	95
293	October 20	4	39	63	88
294	October 21	4	37	60	81
295	October 22	4	40	57	74
296	October 23	4	41	56	69
297	October 24	4	39	56	66
298	October 25	4	40	55	65
299	October 26	3	45	52	62
300	October 27	3	40	49	62
301	October 28	3	42	50	63
302	October 29	3	38	50	61
303	October 30	3	35	48	61
304	October 31	3	35	45	61

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Julian day	Day of year	# of days of record	Minimum-mean daily flow (ft^3/s)	Mean-mean daily flow (ft^3/s)	Maximum-mean daily flow (ft^3/s)
305	November 1	3	34	45	61
306	November 2	3	34	45	60
307	November 3	3	34	44	59
308	November 4	3	33	48	59
309	November 5	3	33	49	58
310	November 6	3	32	47	57
311	November 7	3	32	49	60
312	November 8	3	32	49	59
313	November 9	3	31	46	55
314	November 10	3	31	44	54
315	November 11	3	31	45	53
316	November 12	3	30	44	53
317	November 13	3	30	44	52
318	November 14	3	29	44	52
319	November 15	3	29	43	51
320	November 16	3	29	42	50
321	November 17	3	28	41	50
322	November 18	3	28	40	49
323	November 19	3	28	40	49
324	November 20	3	27	39	48
325	November 21	3	27	38	48
326	November 22	3	26	37	48
327	November 23	3	26	37	47
328	November 24	3	26	36	47
329	November 25	3	25	35	47
330	November 26	3	25	34	46
331	November 27	3	25	34	46
332	November 28	3	25	33	45
333	November 29	3	24	33	45
334	November 30	3	24	32	45

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Julian day	Day of year	# of days of record	Minimum-mean daily flow (ft^3/s)	Mean-mean daily flow (ft^3/s)	Maximum-mean daily flow (ft^3/s)
335	December 1	3	24	32	44
336	December 2	3	24	32	44
337	December 3	3	24	32	44
338	December 4	3	24	32	44
339	December 5	3	24	32	44
340	December 6	3	24	31	43
341	December 7	3	24	31	43
342	December 8	3	24	31	43
343	December 9	3	24	31	43
344	December 10	3	24	31	43
345	December 11	3	24	31	43
346	December 12	3	24	31	43
347	December 13	3	24	31	43
348	December 14	3	24	30	43
349	December 15	3	23	30	44
350	December 16	3	23	31	45
351	December 17	3	23	31	45
352	December 18	3	23	30	44
353	December 19	3	23	30	44
354	December 20	3	23	30	44
355	December 21	3	23	30	43
356	December 22	3	23	30	43
357	December 23	3	22	29	43
358	December 24	3	22	29	42
359	December 25	3	22	29	42
360	December 26	3	22	29	42
361	December 27	3	23	29	41
362	December 28	3	23	29	41
363	December 29	3	23	29	41
364	December 30	3	23	30	40
365	December 31	3	23	30	40

Table 3.– Minimum, mean, and maximum monthly flows (in ft3/s) for the Stariski Creek gage, based on complete months of record from 15 June to 25 October in 2006; 15 June to 25 October in 2007; 15 May to 9 October in 2008; and 5 May 2009 to 13 October in 2011.

Month	# of Months	Minimum monthly flow	Mean monthly flow	Maximum monthly flow
January	3	19	25	37
February	3	16	22	35
March	3	15	21	34
April	3	21	29	33
May	4	39	91	176
June	5	32	44	49
July	6	27	42	71
August	6	27	47	73
September	6	31	60	95
October	5	59	78	101
November	3	27	38	43
December	3	24	29	39

Table 4.–Monthly exceedance flows (in ft3/s) for Stariski Creek gage based on complete months of record from 15 June to 25 October in 2006; 15 June to 25 October in 2007; 15 May to 9 October in 2008; and 5 May 2009 to 13 October in 2011.

% Time exceeded	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	49	43	34	184	321	100	260	197	317	306	61	45
5	48	42	31	79	262	72	93	101	142	182	59	44
10	44	40	31	61	194	65	70	82	108	152	56	44
15	43	38	31	56	155	61	53	70	96	110	53	43
20	41	34	31	53	141	53	45	64	79	95	52	43
25	38	34	31	44	121	51	42	54	75	88	51	42
30	38	33	31	37	86	48	40	49	67	82	49	41
35	37	33	31	34	75	45	37	45	63	78	48	27
40	36	32	31	31	71	44	35	43	56	69	47	26
45	36	32	30	31	66	42	34	39	52	65	45	26
50	35	32	30	31	63	41	33	38	48	63	43	24
55	35	32	30	30	58	40	32	36	43	61	40	24
60	34	31	29	30	54	39	31	34	40	57	35	24
65	28	31	29	30	48	38	30	32	37	54	33	24
70	22	23	23	30	43	37	29	30	35	49	32	23
75	22	23	23	30	37	36	28	29	32	45	30	23
80	22	22	23	27	32	34	26	28	29	42	29	23
85	22	22	22	26	30	33	25	24	28	41	28	23
90	22	22	22	25	30	31	22	23	27	40	27	23
95	22	22	22	24	30	29	20	21	25	38	25	23
100	22	22	22	23	30	26	18	19	21	35	24	22

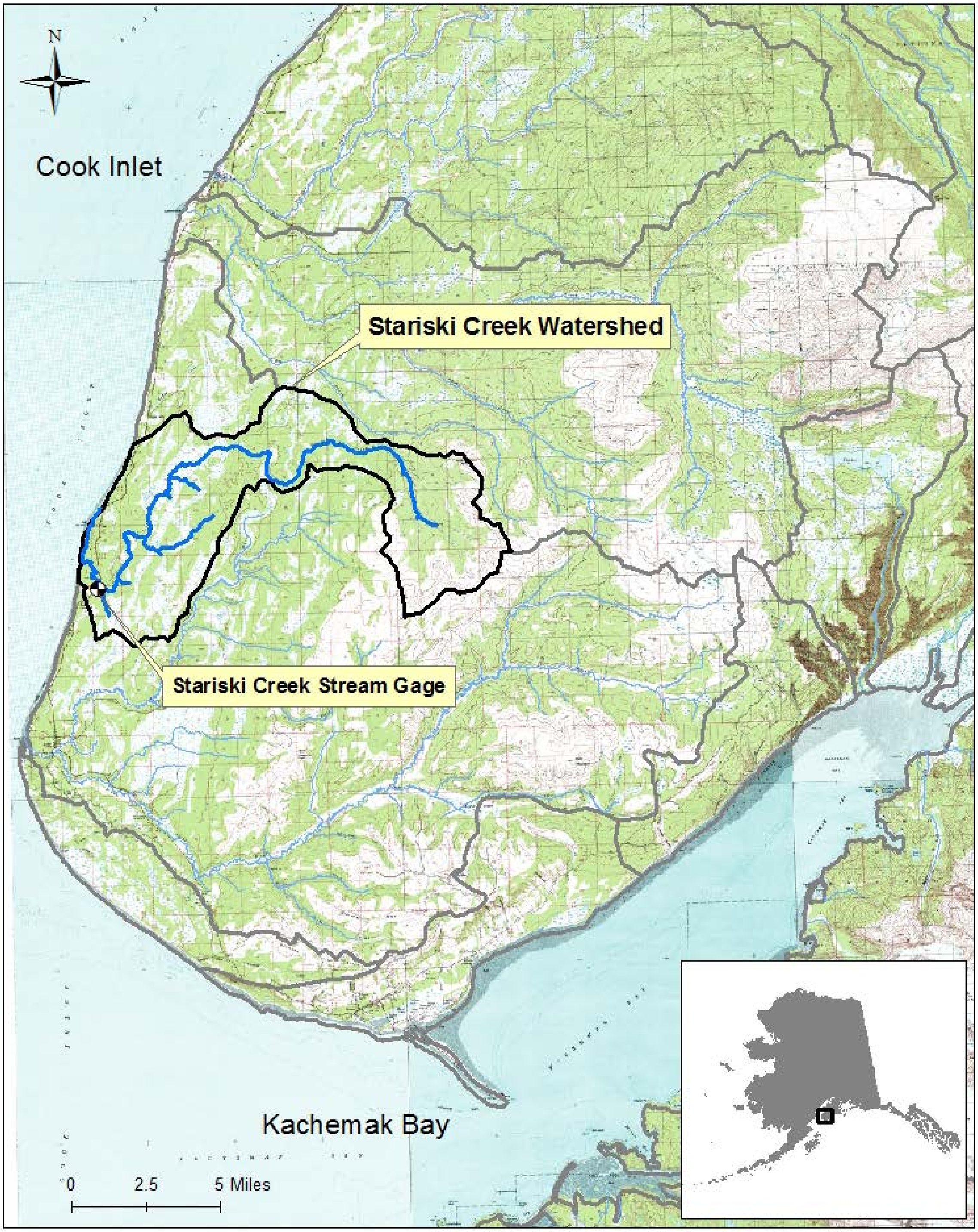

Figure 1.–Location of the Stariski Creek watershed, Alaska.

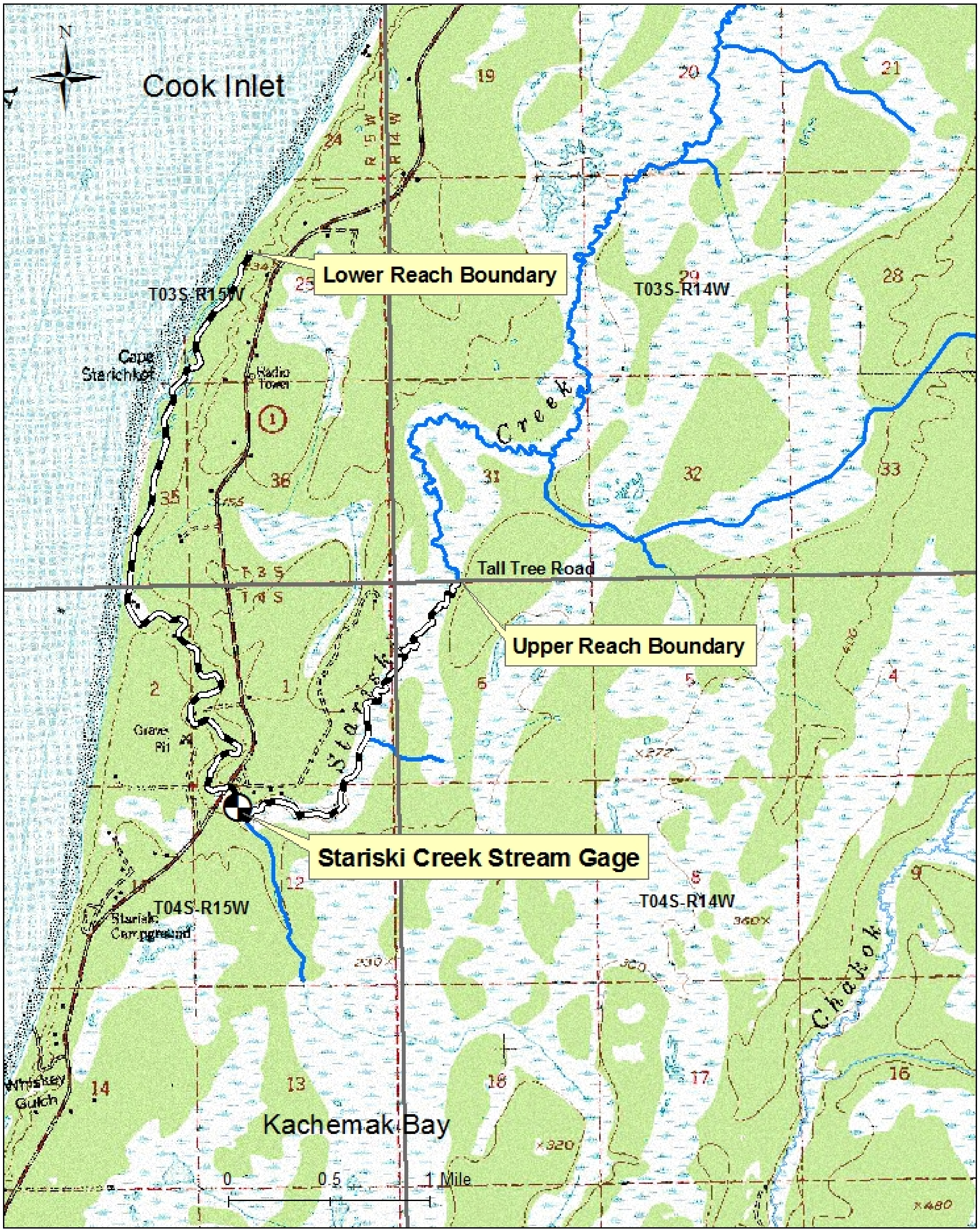

Figure 2.–Location of reservation of water reach boundary for Stariski Creek, Alaska.

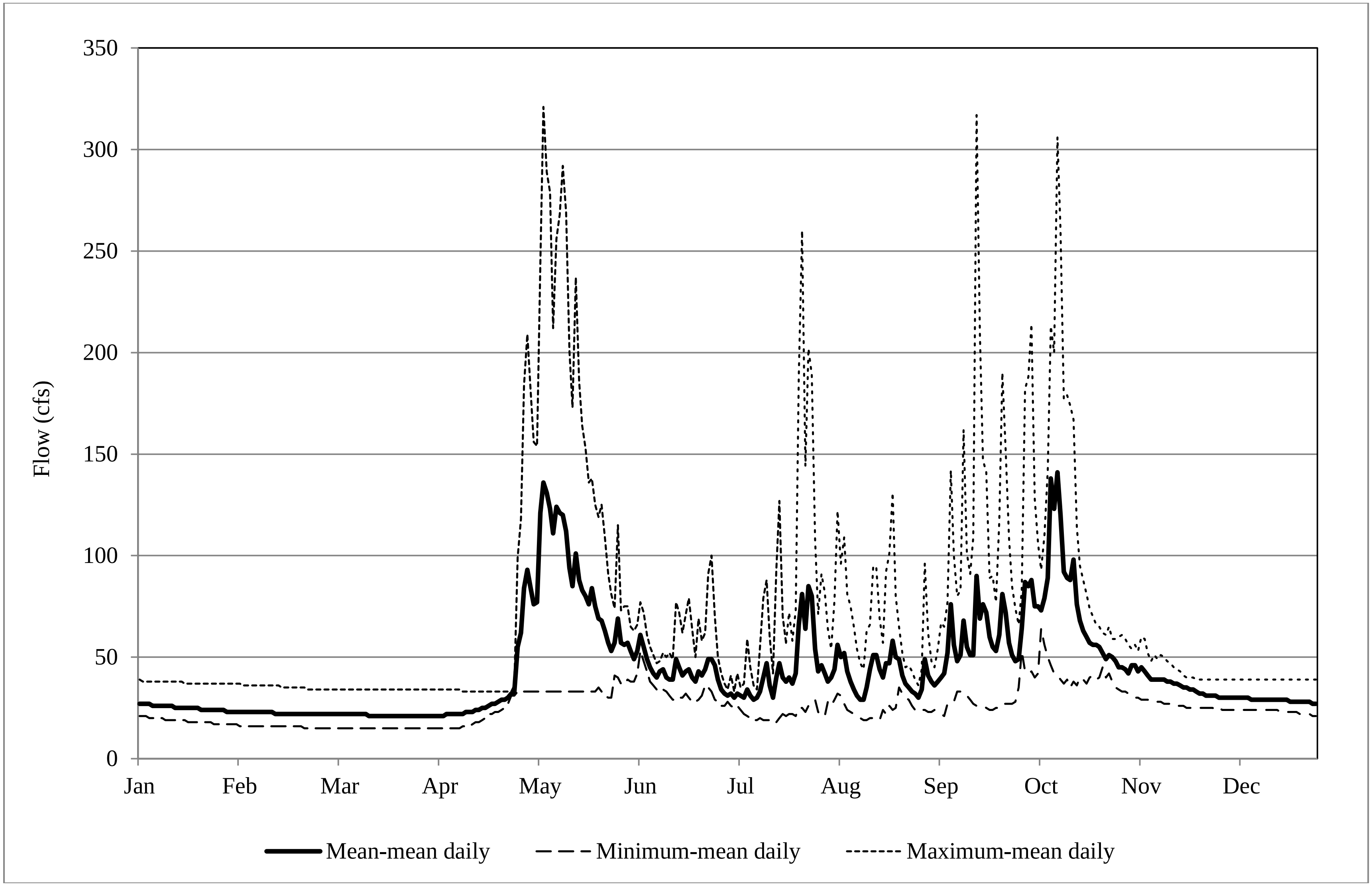

Figure 3.–Hydrograph of mean of mean, maximum-mean, and minimum-mean daily flows for Stariski Creek based on all computed daily records from 15 June 2006 to 13 October 2011.

APPENDIX A.
MEAN DAILY FLOWS BY WATER YEAR

Appendix A1.–Mean daily discharge (ft^3/s) for water year 2006, Stariski Creek gage (*e* indicates estimated flow).

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	---	---	---	---	---	---	---	---	---	53	47	98
2	---	---	---	---	---	---	---	---	---	49	40	74
3	---	---	---	---	---	---	---	---	---	44	37	105
4	---	---	---	---	---	---	---	---	---	42	36	99
5	---	---	---	---	---	---	---	---	---	41	45	107
6	---	---	---	---	---	---	---	---	---	40	51	95
7	---	---	---	---	---	---	---	---	---	49	40	78
8	---	---	---	---	---	---	---	---	---	52	34	74
9	---	---	---	---	---	---	---	---	---	45	31	71
10	---	---	---	---	---	---	---	---	---	42	31	64
11	---	---	---	---	---	---	---	---	---	39	39	67
12	---	---	---	---	---	---	---	---	---	38	50	59
13	---	---	---	---	---	---	---	---	---	36	46	53
14	---	---	---	---	---	---	---	---	---	34	40	52
15	---	---	---	---	---	---	---	---	50e	34	51	64
16	---	---	---	---	---	---	---	---	62	33	87	60
17	---	---	---	---	---	---	---	---	81	33	96	55
18	---	---	---	---	---	---	---	---	71	33	74	52
19	---	---	---	---	---	---	---	---	64	32	154	50
20	---	---	---	---	---	---	---	---	57	31	121	53
21	---	---	---	---	---	---	---	---	53	31	87	51
22	---	---	---	---	---	---	---	---	65	33	73	56
23	---	---	---	---	---	---	---	---	132	34	113	65
24	---	---	---	---	---	---	---	---	100	33	89	55
25	---	---	---	---	---	---	---	---	80	36	197	51
26	---	---	---	---	---	---	---	---	84	49	146	49
27	---	---	---	---	---	---	---	---	95	40	112	98
28	---	---	---	---	---	---	---	---	71	34	81	181
29	---	---	---	---	---	---	---	---	59	32	66	191
30	---	---	---	---	---	---	---	---	55	31	63	110
31	---	---	---	---	---	---	---	---	---	43	76	---

Appendix A2.–Mean daily discharge (ft^3/s) for water year 2007, Stariski Creek gage (*e* indicates an estimated flow).

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	83	---	---	---	---	---	---	---	---	26	27	24
2	94	---	---	---	---	---	---	---	---	28	28	23
3	90	---	---	---	---	---	---	---	---	26	29	23
4	80	---	---	---	---	---	---	---	---	25	29	24
5	82	---	---	---	---	---	---	---	---	26	32	23
6	79	---	---	---	---	---	---	---	---	28	31	22
7	79	---	---	---	---	---	---	---	---	27	26	21
8	85	---	---	---	---	---	---	---	---	25	24	43
9	142	---	---	---	---	---	---	---	---	25	23	142
10	213	---	---	---	---	---	---	---	---	26	22	72
11	152	---	---	---	---	---	---	---	---	34	21	50
12	109	---	---	---	---	---	---	---	---	55	20	83
13	95	---	---	---	---	---	---	---	---	79	19	162
14	82	---	---	---	---	---	---	---	---	69	19	101
15	73	---	---	---	---	---	---	---	32	47	20	76
16	85	---	---	---	---	---	---	---	32	36	22	59
17	167	---	---	---	---	---	---	---	31	30	23	49
18	114	---	---	---	---	---	---	---	32	29	23	47
19	95	---	---	---	---	---	---	---	32	31	24	147
20	88	---	---	---	---	---	---	---	30	28	22	141
21	81	---	---	---	---	---	---	---	28	25	28	89
22	74	---	---	---	---	---	---	---	27	26	29	68
23	69	---	---	---	---	---	---	---	29	36	42	77
24	64	---	---	---	---	---	---	---	42	45	46	77
25	63	---	---	---	---	---	---	---	47	45	35	109
26	---	---	---	---	---	---	---	---	40	41	32	103
27	---	---	---	---	---	---	---	---	33	38	30	76
28	---	---	---	---	---	---	---	---	29	33	26	67
29	---	---	---	---	---	---	---	---	27	29	24	64
30	---	---	---	---	---	---	---	---	26	26	23	56
31	---	---	---	---	---	---	---	---	---	26	24	---

Appendix A3.–Mean daily discharge (ft^3/s) for water year 2008, Stariski Creek gage (*e* indicates an estimated flow).

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	60	---	---	---	---	---	---	---	67	35	45	35
2	60	---	---	---	---	---	---	---	65	32	41	34
3	52	---	---	---	---	---	---	---	63	31	39	37
4	49	---	---	---	---	---	---	---	66	32	39	38
5	68	---	---	---	---	---	---	244	77	32	43	35
6	106	---	---	---	---	---	---	321	72	31	46	41
7	93	---	---	---	---	---	---	289	61	37	38	59
8	74	---	---	---	---	---	---	279	55	59	34	70
9	64	---	---	---	---	---	---	212	51	44	31	110
10	---	---	---	---	---	---	---	256	47	36	30	100
11	---	---	---	---	---	---	---	268	47	33	30	79
12	---	---	---	---	---	---	---	292	52	31	30	63
13	---	---	---	---	---	---	---	269	50	31	38	76
14	---	---	---	---	---	---	---	201	52	31	42	81
15	---	---	---	---	---	---	---	173	49	29	54	91
16	---	---	---	---	---	---	---	237	44	32	95	109
17	---	---	---	---	---	---	---	186	40	93	94	317
18	---	---	---	---	---	---	---	164	38	127	69	209
19	---	---	---	---	---	---	---	153	38	70	57	138
20	---	---	---	---	---	---	---	136	37	49	49	110
21	---	---	---	---	---	---	---	138	36	42	44	84
22	---	---	---	---	---	---	---	125	37	45	131	68
23	---	---	---	---	---	---	---	119	42	73	80	63
24	---	---	---	---	---	---	---	125	39	188	63	117
25	---	---	---	---	---	---	---	109	37	260	50	190
26	---	---	---	---	---	---	---	91	35	144	45	152
27	---	---	---	---	---	---	---	81	36	133	46	109
28	---	---	---	---	---	---	---	74	58	189	43	85
29	---	---	---	---	---	---	---	71	47	108	39	73
30	---	---	---	---	---	---	---	68	39	71	36	66
31	---	---	---	---	---	---	---	66	---	54	35	---

Appendix A4.–Mean daily discharge (ft^3/s) for water year 2009, Stariski Creek gage (*e* indicates an estimated flow).

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	61	60e	39e	39e	36e	34e	34e	33e	75	37	36	27
2	57	59e	39e	38e	36e	34e	34e	33e	62	34	29	35
3	54	56e	39e	38e	36e	34e	34e	33e	53	31	26	44
4	54	54e	39e	38e	36e	34e	34e	33e	49	28	29	36
5	57	52e	39e	38e	36e	34e	34e	33e	56	26	44	31
6	63	48	39e	38e	36e	34e	34e	33e	50	24	39	28
7	64	44e	39e	38e	36e	34e	34e	33e	43	22	32	27
8	69	43e	39e	38e	36e	34e	33e	33e	38	21	28	27
9	65	41e	39e	38e	36e	34e	33e	33e	35	20	25	28
10	179	39e	39e	38e	36e	34e	33e	33e	33	19	24	28
11	200e	40e	39e	38e	36e	34e	33e	33e	33	19	22	40
12	306	40e	39e	38e	36e	34e	33e	33e	34	20	21	41
13	260	40e	39e	38e	35e	34e	33e	33e	33	19	22	36
14	177	40e	39e	38e	35e	34e	33e	33e	31	19	28	34
15	179	40e	39e	37e	35e	34e	33e	33e	29	19	66	30
16	174	40e	39e	37e	35e	34e	33e	33e	29	18	64	27
17	132	40e	39e	37e	35e	34e	33e	33e	30	18	48	26
18	104	40e	39e	37e	35e	34e	33e	33e	30	20	38	26
19	91	40e	39e	37e	35e	34e	33e	33e	37	25	31	26
20	81	40e	39e	37e	35e	34e	33e	33e	34	33	28	25
21	78e	39e	39e	37e	35e	34e	33e	33e	36	42	26	24
22	72e	39e	39e	37e	34e	34e	33e	33	40	37	24	24
23	69e	39e	39e	37e	34e	34e	33e	35	69	32	25	25
24	66e	39e	39e	37e	34e	34e	33e	33	58	29	35	25
25	65e	39e	39e	37e	34e	34e	33e	31	62	27	37	33
26	62e	39e	39e	37e	34e	34e	33e	30	90	28	33	37
27	61e	39e	39e	37e	34e	34e	33e	30	100	27	32	32
28	65e	39e	39e	37e	34e	34e	33e	56	70	28	32	33
29	59e	39e	39e	37e	---	34e	33e	115	50	31	34	32
30	59e	39e	39e	37e	---	34e	33e	73	42	30	33	45
31	60e	---	39e	36e	---	34e	---	75	---	40	29	---

Appendix A5.–Mean daily discharge (ft^3/s) for water year 2010, Stariski Creek gage (*e* indicates an estimated flow).

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	53	61e	44e	39e	34e	31e	31e	30e	46	31	82	63
2	42	60e	44e	39e	34e	31e	31e	30e	45	31	64	48
3	42	59e	44e	39e	34e	31e	31e	30e	45	32	54	38
4	43	59e	44e	38e	33e	31e	31e	30e	56	32	78	35
5	40	58e	44e	38e	33e	31e	31e	30e	58	34	122	54
6	42	57	43e	38e	33e	31e	31e	30e	51	35	96	67
7	65	56e	43e	38e	33e	31e	31e	30e	45	34	109	65
8	110	55e	43e	38e	33e	31e	31e	30e	42	37	81	77
9	122	55e	43e	38e	33e	31e	31e	30e	39	35	75	56
10	114	54e	43e	37e	33e	31e	31e	30e	37	36	65	45
11	97	53e	43e	37e	32e	31e	31e	30e	48	34	54	39
12	109	53e	43e	37e	32e	31e	31e	30e	44	29	47	35
13	85	52e	43e	37e	32e	31e	31e	30e	37	39	44	33
14	70	52e	43e	36e	32e	31e	30e	30e	35	88	63	31
15	64	51e	44e	36e	32e	31e	30e	30e	41	59	61	30
16	58	50e	45e	36e	32e	31e	30e	30e	77	42	52	30
17	54	50e	45e	36e	32e	31e	30e	30e	72	35	70	29
18	49	49e	44e	36e	32e	31e	30e	30e	62	36	69	28
19	45	49e	44e	36e	32e	31e	30e	30e	71	50	52	28
20	43	48e	44e	36e	32e	31e	30e	30e	79	57	42	28
21	42	48e	43e	35e	32e	31e	30e	30e	64	72	38	27
22	42	48e	43e	35e	32e	31e	30e	33	50	58	37	26
23	45	47e	43e	35e	32e	31e	30e	35	43	47	39	26
24	55	47e	42e	35e	32e	31e	30e	33	38	42	36	27
25	51	47e	42e	35e	31e	31e	30e	31	36	47	32	26
26	48	46e	42e	35e	31e	31e	30e	30	38	86	30	27
27	44	46e	41e	35e	31e	31e	30e	30	39	202	29	27
28	42	45e	41e	34e	31e	31e	30e	56	38	111	30	27
29	38	45e	41e	34e	---	31e	30e	115	35	75	31	28
30	35e	45e	40e	34e	---	31e	30e	73	34	63	29	35
31	35e	---	40e	34e	---	31e	---	75	---	91	36	---

Appendix A6.–Mean daily discharge (ft^3/s) for water year 2011, Stariski Creek gage (*e* indicates an estimated flow).

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	53	61e	44e	39e	34e	31e	31e	30e	39	29	21	96
2	42	60e	44e	39e	34e	31e	31e	30e	38	30	30	62
3	42	59e	44e	39e	34e	31e	31e	30e	37	41	50	48
4	43	59e	44e	38e	33e	31e	31e	30e	42	33	45	45
5	40	58e	44e	38e	33e	31e	31e	30e	53	42	40	49
6	42	57	43e	38e	33e	31e	31e	30e	48	35	37	42
7	65	56e	43e	38e	33e	31e	31e	30e	45	31	54	37
8	110	55e	43e	38e	33e	31e	31e	30e	45	29	48	41
9	122	55e	43e	38e	33e	31e	31e	30e	42	29	37	44
10	114	54e	43e	37e	33e	31e	31e	30e	41	28	31	37
11	97	53e	43e	37e	32e	31e	31e	30e	43	27	27	33
12	109	53e	43e	37e	32e	31e	31e	30e	45	30	24	33
13	85	52e	43e	37e	32e	31e	31e	30e	41	31	23	33
14	70	52e	43e	36e	32e	31e	30e	30e	40	27	22	31
15	64	51e	44e	36e	32e	31e	30e	30e	41	24	21	29
16	58	50e	45e	36e	32e	31e	30e	30e	62	22	20	28
17	54	50e	45e	36e	32e	31e	30e	30e	53	22	19	28
18	49	49e	44e	36e	32e	31e	30e	30e	44	24	19	37
19	45	49e	44e	36e	32e	31e	30e	30e	40	22	35	40
20	43	48e	44e	36e	32e	31e	30e	30e	39	21	92	54
21	42	48e	43e	35e	32e	31e	30e	30e	37	21	101	78
22	42	48e	43e	35e	32e	31e	30e	33	35	22	70	90
23	45	47e	43e	35e	32e	31e	30e	35	33	21	66	75
24	55	47e	42e	35e	32e	31e	30e	33	31	25	65	57
25	51	47e	42e	35e	31e	31e	30e	31	36	25	52	48
26	48	46e	42e	35e	31e	31e	30e	30	43	23	45	43
27	44	46e	41e	35e	31e	31e	30e	30	39	26	39	41
28	42	45e	41e	34e	31e	31e	30e	56	36	37	36	41
29	38	45e	41e	34e	---	31e	30e	115	33	29	32	40
30	35	45e	40e	34e	---	31e	30e	73	31	23	29	41
31	35	---	40e	34e	---	31e	---	75	---	21	44	---

APPENDIX B. DATA FILES

Appendix B1.–Data files used for this report.

Database Reference	Description
Stariski.Q.DayMean.E	Available mean daily flows from 15 June 2006 to 13 October 2011
Stariski.Q.Obs.Q	Instantaneous measured discharge collected from 15 June 2006 to 8 October 2011
Stariski.WT.Water Temp.1	Water temperature at 15-minute intervals from 15 June 2006 to 13 October 2011 (data gaps during winter)
Station Description	Summary of gage location, equipment, benchmarks, access, and other interesting details
Station Analysis	Summary gage operation and stream flow computations, ratings, etc.

Note: These files are stored in the WISKI© database. Contact ADF&G Division of Sport Fish, Research and Technical Services, 333 Raspberry Rd, Anchorage, AK 99518.

APPENDIX C. PHOTOGRAPHS OF STARISKI GAGE DISCHARGE MEASUREMENT TRANSECT

Appendix C1.–The Stariski Creek gage setup, showing a laptop computer being used to access sensor and download data.

Appendix C2.–Discharge transect at Stariski Creek on 9 October 2007 when discharge was measured at 35 ft^3/s.

Appendix C3.–Winter discharge transect, showing mixed open and ice-covered channel on 29 December 2009; discharge was measured at 23 ft^3/s.