

Fishery Data Series No. 15-42

Hydrologic Investigations in Support of Reservations of Water for Cowee Creek, Alaska

by

Jarrod J. Sowa

November 2015

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



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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

<i>all standard mathematical signs, symbols and abbreviations</i>	
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 ₀
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

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**HYDROLOGIC INVESTIGATIONS IN SUPPORT OF RESERVATIONS
OF WATER FOR COWEE CREEK, ALASKA**

by

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ABSTRACT

Cowee Creek watershed, located near Juneau in Southeast Alaska, supports a number of anadromous fish species. The Alaska Department of Fish and Game, Division of Sport Fish selected Cowee Creek as a candidate water body for a reservation of water. In order to collect the data necessary to file a reservation of water application, a streamgage was operated on Cowee Creek from May 23, 2007, to October 5, 2012. Streamflow data collected at the streamgage were used to prepare a reservation of water application to reserve instream flows in 1 reach of Cowee Creek. The application was filed using 2 years of preliminary data and was accepted by the Alaska Department of Natural Resources (DNR) and given a priority date of December 11, 2009. After 5 years of streamflow data were collected and analyzed, updated streamflow statistics and instream flow requests were submitted to and accepted by DNR on January 30, 2013. The application was adjudicated in 2015 and certificates of reservation were issued for 1 reach of Cowee Creek.

The mean annual discharge of the river measured at the streamgage averaged 283 ft³/s. The median monthly discharge ranged from 46 ft³/s in March to 450 ft³/s in September.

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

INTRODUCTION

Alaska's rivers and lakes support some of North America's most viable and productive salmon fisheries. Over 18,000 streams, rivers, or lakes have been identified throughout the state as being important for spawning, rearing, or migration of anadromous fish (Johnson and Coleman 2014). 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 has the potential to modify the naturally occurring instream flows to which fish have adapted 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 fish, game and aquatic plant resources of the state in the interest of the economy and general well-being of the state" (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 under Alaska 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 5 years of mean daily flow data is recommended by DNR to quantify instream flow requirements within an application.

Instream flows can be 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 4 types of uses:

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

Priority dates for reservation of water applications are based on the date they are accepted by 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 requested amount of water is first given to the appropriator who has the earliest priority date to beneficially

use the water. Senior water right holders have a legal standing to assert their right against conflicting uses of water from others who do not have a water right or who are junior in priority.

ADF&G began a project in 2001 that ranked Southeast Alaska watersheds by their importance for the protection of instream flows. From this study, Cowee Creek ranked 195th out of the 4,597 watersheds in Southeast (Klein 2011). In 2007, ADF&G began a multi-year project funded by the Alaska Sustainable Salmon Fund (AKSSF) to collect the hydrologic data necessary to file a reservation of water application for 1 reach of Cowee Creek. Before this study began, no hydrologic data existed that could be used to support a reservation of water application. This report summarizes the 5-year project.

OBJECTIVE

The objective of this project was to collect the hydrological data needed to file a reservation of water application to reserve instream flows within 1 reach (Reach A) of Cowee Creek. Two tasks were necessary to complete this objective:

1. Install and operate a streamgage on Cowee Creek for 5 years to quantify streamflows within Reach A.
2. Complete and file a reservation of water application for 1 reach of Cowee Creek to protect fish habitat, migration, and propagation.

STUDY AREA

Cowee Creek is located 40 miles north of Juneau in Southeast Alaska. The watershed has a drainage area of approximately 46 square miles and is bounded by snow- and glacier-covered mountains that reach up to 5,894 feet in elevation. Cowee Creek flows in a northwesterly direction approximately 6 miles before entering saltwater at Berners Bay. Two main tributaries named the South Fork of Cowee Creek and Davies Creek enter the mainstem from the south and north, respectively (Figure 1). The lower portion of the Cowee Creek watershed is comprised of low gradient meadows, meandering streams, and rocky beach fringe.

Land ownership within the drainage is fragmented between United States Forest Service (USFS), state, private, and corporate landowners. The USFS manages 88% of the land within the watershed as the Heen Latinee Experimental Forest (HLEF; USFS 2009). The HLEF is located mostly in the upper portions of the watershed while the lower portion of the watershed is managed by the State of Alaska as Point Bridget State Park. A popular public use cabin named Cowee Meadow is located within the park and is accessible from the Glacier Highway by a 2.5-mile long trail.

Cowee Creek has been specified as important to anadromous fish under the Anadromous Fish Act (AS 16.05.871), listed as AWC number 115-20-10620 (Johnson and Coleman 2014). The creek supports populations of coho salmon (*Oncorhynchus kisutch*), pink salmon (*O. gorbuscha*), chum salmon (*O. keta*), steelhead trout (*O. mykiss*), cutthroat trout (*O. clarki*), and Dolly Varden char (*Salvelinus malma*).

Cowee Creek is easily accessible by road and in 2013 composed the 4th largest freshwater sport fishery for salmon and Dolly Varden in Southeast Alaska¹. An ongoing project to determine Cowee Creek adult coho salmon marine fisheries harvest was initiated by the ADF&G in 2013.

METHODS

HYDROLOGIC DATA STUDY DESIGN

In May of 2007, a road-accessible streamgage site was selected on Cowee Creek just downstream of the Glacier Highway Bridge. It was decided not to operate an additional streamgage at the upper reaches of Cowee Creek or on Davies Creek due to the difficult access and the lack of suitable streamgage site locations.

The reach selected for instream flow protection began at the mouth of Cowee Creek at mean lower low water and extended upstream 2.6 miles to just below the confluence with Davies Creek (Reach A; Figure 2). No major tributaries enter Cowee Creek downstream of Davies Creek, and the difference in flows (from accretion and reduction) within the reach is minimal. To quantify streamflows within Reach A, Streamgage 11401 was installed just downstream of the bridge near the upstream end of the reach (Figure 2).

GAGING STATION

The objective of operating a streamgage is to obtain a continuous record of discharge at the site (Carter and Davidian 1968). 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 water-level data logger that measures and records water surface elevation (WSE) in the creek. Direct measurements of discharge are taken at different times of year and with varying flow rates in order to define the stage–discharge relationship (rating curve) and to detect the timing and magnitude of changes to this relationship over time. ADF&G followed USGS streamgage operation protocols and procedures described in Rantz and others (1982) and Klein (2013).

Rantz and others (1982) provides guidance for selection of a streamgage site. The ideal site includes a straight section of stream upstream and downstream of the site, has all the flow confined to one channel, and is far enough upstream from the confluence with another stream so as not to be affected by backwater. The streamgage was located in a pool, with a stable hydraulic control, and far enough upstream of confluences so as not to be affected by backwater.

To measure stage and water temperature at Streamgage 11401, one In-Situ Level TROLL 500² water level data logger was housed in 1¼-inch pipe driven through the streambank and secured to the streambed with custom pipe brackets and 5/8-inch rebar. The pressure transducer was programmed to measure stage and water temperature on the quarter hour.

A staff gage was installed within the streamgage pool to measure the WSE independent of the transducer. At installation, the transducer was programmed to read the corresponding staff gage WSE. At each site visit, the staff gage and transducer WSE were compared to ensure stage was

¹ Alaska Sport Fishing Survey database [Intranet]. 1996– . Anchorage, AK: Alaska Department of Fish and Game, Division of Sport Fish (cited September 1, 2015). Available from: https://intra.sf.adfg.state.ak.us/swhs_est/.

² Product names used in this publication are included for completeness but do not constitute product endorsement.

being accurately measured by the transducer. If a discrepancy was identified, protocols described in Klein (2013) or manufacturer guidelines were followed to correct the problem.

To monitor possible changes in the elevation of the staff gage, 3 reference marks (RMs) were established near the streamgage. RM1 and RM3 were located at the corner of concrete pads that the bridge piling are secured to, while RM2 is a large galvanized bolt head secured to the bridge. The difference in the elevations of the RMs in relation to the staff gage was measured using standard differential surveying techniques (Kennedy 1990). The RM and staff gage elevations were surveyed at a minimum once a year and also when the streamgage was removed.

DISCHARGE MEASUREMENTS

Streamflow, or discharge, is defined as the volume rate of flow of water and is typically reported in cubic feet per second (ft^3/s ; Buchanan and Somers 1969). Discharge is determined by measuring the average velocity, depth, and width of subsections across the stream and summing the discharge of each subsection. Discharge measurements were taken periodically throughout the year and during periods of extreme low and high flows following USGS protocols (Rantz and others 1982).

Discharge measurements were taken just downstream of the bridge that crosses Cowee Creek. Discharge measurements were collected by wading across the creek and using a Pygmy or Price AA velocity meter attached to a top-set wading rod. A JBS Energy, Inc. AquaCalc electronic digital counter was used to record transect parameters, count meter revolutions, and calculate discharge. When the creek was too deep or unsafe to wade across, a StreamPro Acoustic Doppler Current Profiler (ADCP) was used to measure discharge. One person with a rope would cross the bridge near the discharge transect, and the StreamPro was attached to this rope. The tethered StreamPro was then towed back and forth across the creek to take a discharge measurement. Using a Bluetooth connection, data collected by the ADCP were recorded on a ruggedized laptop computer.

SITE VISITS

Site visits to the streamgage were made 7 to 12 times each year during the period of operation of the streamgage. During snowy periods in the winter, Glacier Highway was not plowed to Cowee Creek, making it impossible to drive to the streamgage site. During all other times of the year, the road was open and the streamgage site could be driven to. During a typical site visit, stage and water temperature data were downloaded from the transducer data logger using an In-Situ RuggedReader Handheld PC, stream discharge was measured, and routine gage maintenance was performed. Differential survey notes and other site visit notes were recorded in waterproof field notebooks. Photographs of the streamgage pool, discharge measurement transect, and the stream hydraulic control were typically taken.

After each site visit, discharge measurement data were downloaded from the AquaCalc counter or ADCP laptop to Microsoft Excel, pictures were downloaded and labeled, and transducer data were downloaded from the RuggedReader to a desktop computer. Transducer stage, water surface elevations, air temperature, and discharge measurement data were imported into the Water Information System Kisters Incorporated (WISKI) hydrological database for storage and analysis.

STREAMFLOW RECORDS COMPUTATION

Streamflow records computation is a step-by-step process in which stream stage measured at the streamgage is converted to discharge using a rating curve. Before being converted to discharge, the stage record was corrected for movement of the staff gage, 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 mean 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). This included comparison of water temperatures measured by the transducer, nearby weather records, trends of the hydrograph, and instantaneous discharge measurements that were made.

Computed discharge values were typically summarized as mean daily, mean monthly, and mean annual flow values for the water year (October 1–September 30). The procedures used to compute streamflow records coincide with those described in Rantz and others (1982), Kennedy (1983), and Klein (2013).

Mean daily flow records computed for each gage were analyzed by a series of SAS programs to estimate the annual, monthly, and mean daily summaries and flow duration values for specified time periods. Mean 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.

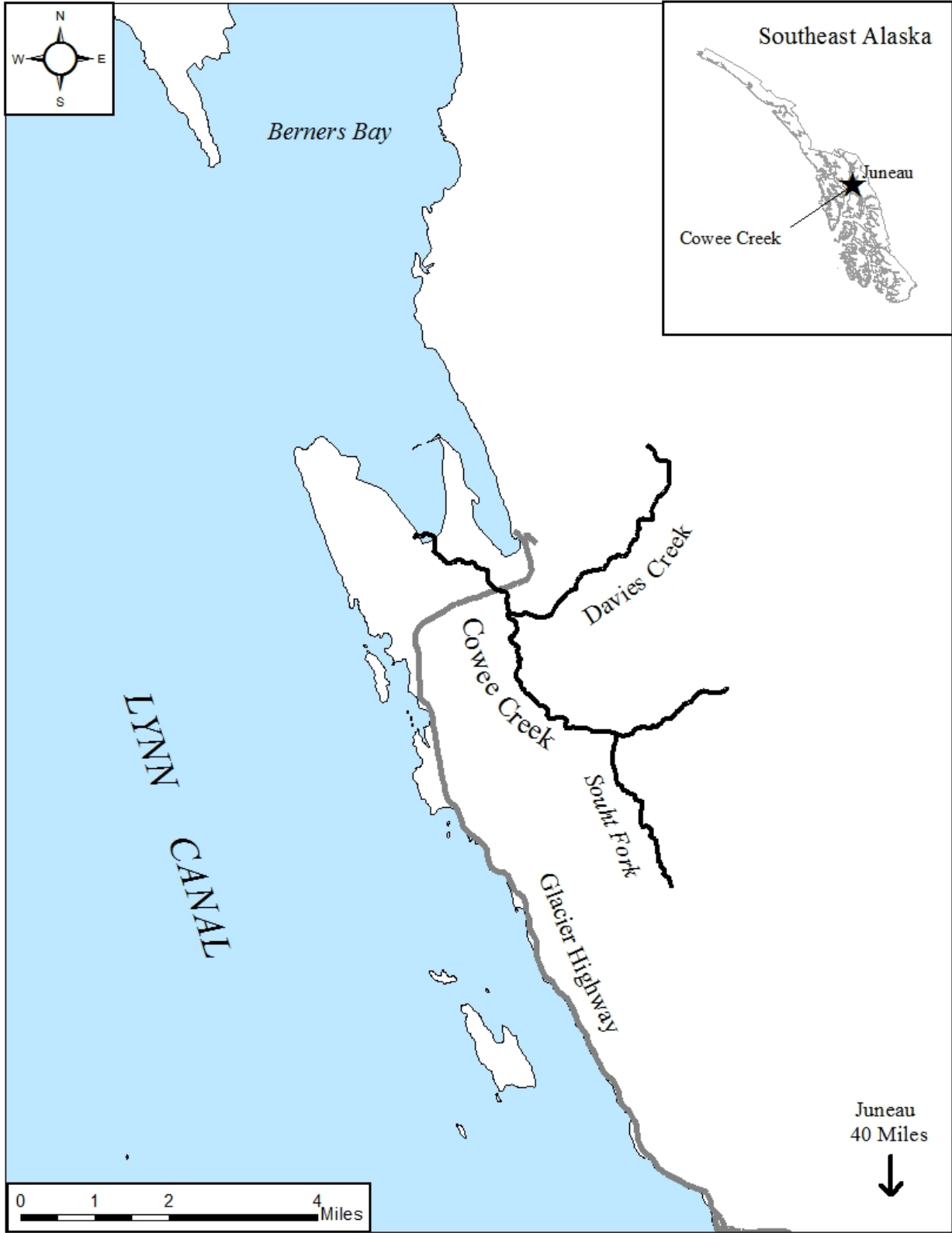


Figure 1.—Area map of the Cowee Creek watershed in Southeast Alaska.



Figure 2.—Location of reservation of water Reach A boundaries and ADF&G streamgage 11401 at Cowee Creek, Alaska.

RESULTS

HYDROLOGIC DATA

Streamgage 11401 was operated from May 23, 2007, to October 5, 2012. Sixty-one measurements of instantaneous discharge, ranging from 24 to 1,520 ft³/s, were taken at the site (Table 1). Mean annual flow at the site ranged from 238 to 314 ft³/s and averaged 283 ft³/s for water years 2008 to 2012 (Table 2). The highest flow recorded at the gage was 2,227 ft³/s on August 20, 2011, and the lowest flow recorded at the gage was 17 ft³/s on January 31, 2009.

The lowest flows of the years were in the winter during dry cold spells (Figure 3). Due to snowmelt, flows increased from April to May. Flows typically peaked sometime in August due to glacial melt then receded throughout fall and winter. Appendix A contains mean daily summarized for the period of record. The durations of mean daily flows are also presented in this appendix.

RESERVATION OF WATER APPLICATION

Preliminary streamflow data were used to prepare a reservation of water application for Reach A of Cowee Creek. The application was based on 2 years of data and included the following components: 1) maps and legal descriptions describing the reach boundaries and streamgage location, 2) hydrologic data collected within the reach, 3) description and justification of the method used to quantify instream flow needs, 4) fish species periodicity chart, and 5) the water quantities requested by time period for the reach. The application was accepted by DNR (Land Administration System [LAS] number 27485) and given a priority date of December 11, 2009. In 2014, following 5 years of data collection, updated flow statistics and modified instream flow requests were submitted to and accepted by DNR (LAS number 30036) with a priority date of January 30, 2013.

In 2015, the accepted reservation of water application was adjudicated by DNR. Adjudication is the legal process that determines the amount of water to be reserved (Klein 2012). The adjudicated flows were in the 65–70% exceedance flow range and generally above the minimum–mean daily flow and below the mean–mean daily flow for their respective time period (Figure 3). Klein (2014) provides further information on DNR’s water right process.

Table 1.–Summary of instantaneous discharge measurements taken on Cowee Creek, Alaska.

Data record number	Date	Start time	End time	Made by	Width (ft)	Area (ft ²)	Mean vel (ft/s)	Q (ft ³ /s)	Staff gage stage start	Staff gage stage end	No. sections	Quality
1	05/22/2007	15:00	15:40	TCS	110	227	1.7	385	–	1.73	22	fair
2	06/08/2007	14:10	15:08	JJS	118	240	2.0	451	1.70	1.71	34	fair
3	06/19/2007	11:43	12:35	JJS	111	197	1.9	368	1.47	1.47	33	fair
4	07/16/2007	13:29	14:05	ACB/TCS	89	437	3.5	1,520	3.62	3.63	134	poor
5	08/07/2007	9:30	10:10	JJS	113	212	1.7	363	1.52	1.51	32	fair
6	08/07/2007	10:57	11:15	JJS/JTH	103	164	2.1	327	1.49	1.48	224	fair
7	08/28/2007	11:47	12:32	JJS	110	166	1.2	200	0.99	0.98	36	fair
8	09/12/2007	12:36	13:08	JJS	112	200	1.7	335	1.39	1.39	29	good
9	10/04/2007	12:30	13:30	JJS	109	159	1.2	196	0.91	0.90	31	fair
10	11/23/2007	13:30	14:15	JJS	108	89	0.81	72	0.31	0.31	27	fair
11	12/27/2007	11:30	13:00	JJS	64	131	0.27	36	0.08	0.08	24	poor
12	03/20/2008	12:42	13:30	JJS	103	83	0.78	64	1.05	1.05	24	fair
13	04/22/2008	10:15	10:51	JJS	108	117	0.97	114	1.33	1.33	29	fair
14	05/19/2008	12:26	13:15	JJS	109	231	1.8	415	2.40	2.40	29	fair
15	05/29/2008	12:23	13:30	JJS	109	273	2.2	605	2.82	2.78	29	fair
16	07/30/2008	12:40	13:30	JJS	110	237	1.9	447	2.48	2.43	29	fair
17	09/05/2008	12:05	12:45	JJS	108	152	1.6	240	1.90	1.90	32	fair
18	10/03/2008	10:16	10:24	JJS/JTH	85	277	3.1	851	3.40	3.40	131	poor
19	12/12/2008	11:00	11:36	JJS/JTH	100	106	1.1	121	1.40	1.40	30	fair
20	04/20/2009	10:45	11:25	JJS/JTH	110	98	1.1	112	1.40	1.40	30	fair
21	04/29/2009	12:00	12:45	JJS/JTH	110	192	1.8	343	2.18	2.17	31	fair
22	07/27/2009	12:00	12:55	JJS	111	241	2.2	521	2.79	2.79	29	fair
23	08/04/2009	10:28	11:05	JJS/JTH	108	199	1.8	365	2.39	2.39	31	fair
24	08/19/2009	9:44	10:40	JJS/JTH	107	228	2.2	491	2.66	2.65	28	fair
25	10/01/2009	9:45	10:40	JJS/TCS	113	264	2.2	574	2.92	2.84	30	fair
26	12/15/2009	12:45	13:15	JJS/TCS	111	105	0.26	28	1.78	1.75	28	poor
27	02/05/2010	12:15	13:00	JJS/TCS	110	75	0.66	50	1.20	1.20	50	fair
28	02/09/2010	14:00	14:45	JJS/TCS	11	95	0.88	84	1.36	1.38	32	fair
29	03/25/2010	10:45	11:16	JJS/JTH	111	111	1.1	117	1.54	1.53	28	good
30	04/23/2010	12:55	13:05	JJS/JTH	112	144	1.3	199	1.84	1.84	25	fair

-continued-

Table 1.–Page 2 of 2.

Data record number	Date	Start time	End time	Made by	Width (ft)	Area (ft ²)	Mean vel (ft/s)	Q (ft ³ /s)	Staff gage stage start	Staff gage stage end	No. sections	Quality
31	05/21/2010	10:10	10:45	JTH/TCS	110	203	2.0	409	2.38	2.37	30	fair
32	06/03/2010	11:06	11:45	JJS/JTH	110	215	2.0	429	2.50	2.46	28	fair
33	07/01/2010	10:45	11:40	JJS, BT	111	215	2.2	471	2.63	2.58	33	fair
34	08/20/2010	14:07	14:14	JJS, TCS	111	224	2.5	564	2.70	–	105	fair
35	09/16/2010	10:30	11:15	JJS	111	123	1.4	174	1.75	1.75	32	fair
36	09/22/2010	9:35	10:25	JJS/JTH	112	95	1.1	99	1.48	1.48	32	fair
37	10/28/2010	14:00	15:00	JJS	102	113	0.83	93	1.40	1.40	29	fair
38	01/05/2011	10:51	11:30	JJS/JW	93	90	1.5	139	ice	ice	28	fair
39	03/25/2011	9:50	10:22	JJS/SLJ	72	31	0.75	24	ice	ice	32	fair
40	04/07/2011	10:45	11:35	JJS/JTH	110	81	0.74	60	1.26	1.26	32	good
41	04/20/2011	11:00	12:00	JJS/JTH/TCS	108	88	0.77	68	1.30	1.30	32	good
42	05/31/2011	11:25	12:13	JJS/JTH	111	250	2.2	551	2.69	2.68	33	fair
43	06/27/2011	11:15	12:15	JJS/DJS/JTH	112	186	1.7	316	2.16	2.18	29	fair
44	08/24/2011	11:44	12:16	JJS/JTH/TCS	132	476	2.9	1,380	4.45	4.34	479	fair
45	09/16/2011	10:00	11:15	JJS/DJS	113	224	1.4	310	2.30	2.28	33	fair
46	09/23/2011	10:00	11:15	JJS	105	257	1.7	439	2.68	2.67	34	fair
47	10/11/2011	9:52	10:26	JJS/JTH/TCS	110	154	0.80	124	1.69	1.69	33	good
48	11/30/2011	10:19	10:57	JJS/JTH	98	134	0.44	59	1.18	1.18	30	fair
49	12/09/2012	9:31	10:04	JJS/JTH	110	209	1.4	293	2.21	2.19	30	good
50	01/05/2012	9:58	10:41	JJS/JTH	110	109	0.72	79	1.30	1.30	33	fair
51	02/24/2012	11:00	11:35	JJS/SLJ	110	87	0.71	62	1.12	1.12	31	good
52	03/01/2012	12:23	12:58	JJS/TCS	106	94	0.42	40	0.97	0.97	29	fair
53	03/08/2012	10:29	11:05	JJS/JTH	106	125	0.55	68	1.20	1.20	28	fair
54	03/22/2012	9:29	10:05	JJS/JTH	84	50	0.74	36	1.26	1.26	32	fair
55	04/09/2012	11:21	12:06	JJS/JTH	110	102	0.75	77	1.24	1.24	31	fair
56	05/03/2012	10:24	11:01	JJS/JTH	112	201	1.4	288	2.09	2.08	33	fair
57	06/01/2012	10:45	11:45	JJS/JTH	110	269	2.0	541	2.76	2.77	31	fair
58	07/12/2012	11:15	12:23	JJS/JTH	115	283	1.4	408	2.49	2.47	28	fair
59	08/21/2012	11:28	12:30	JJS/JTH	113	236	1.4	332	2.35	2.35	33	fair
60	09/21/2012	9:58	10:36	JJS/JTH	110	238	1.6	389	2.39	2.38	31	fair
61	10/05/2012	11:42	12:29	JJS/JTH	112	186	1.3	232	1.92	1.91	35	fair

Note: En dashes indicate no staff gage reading taken before or after discharge measurement; “ice” indicates no staff gage reading due to ice across channel.

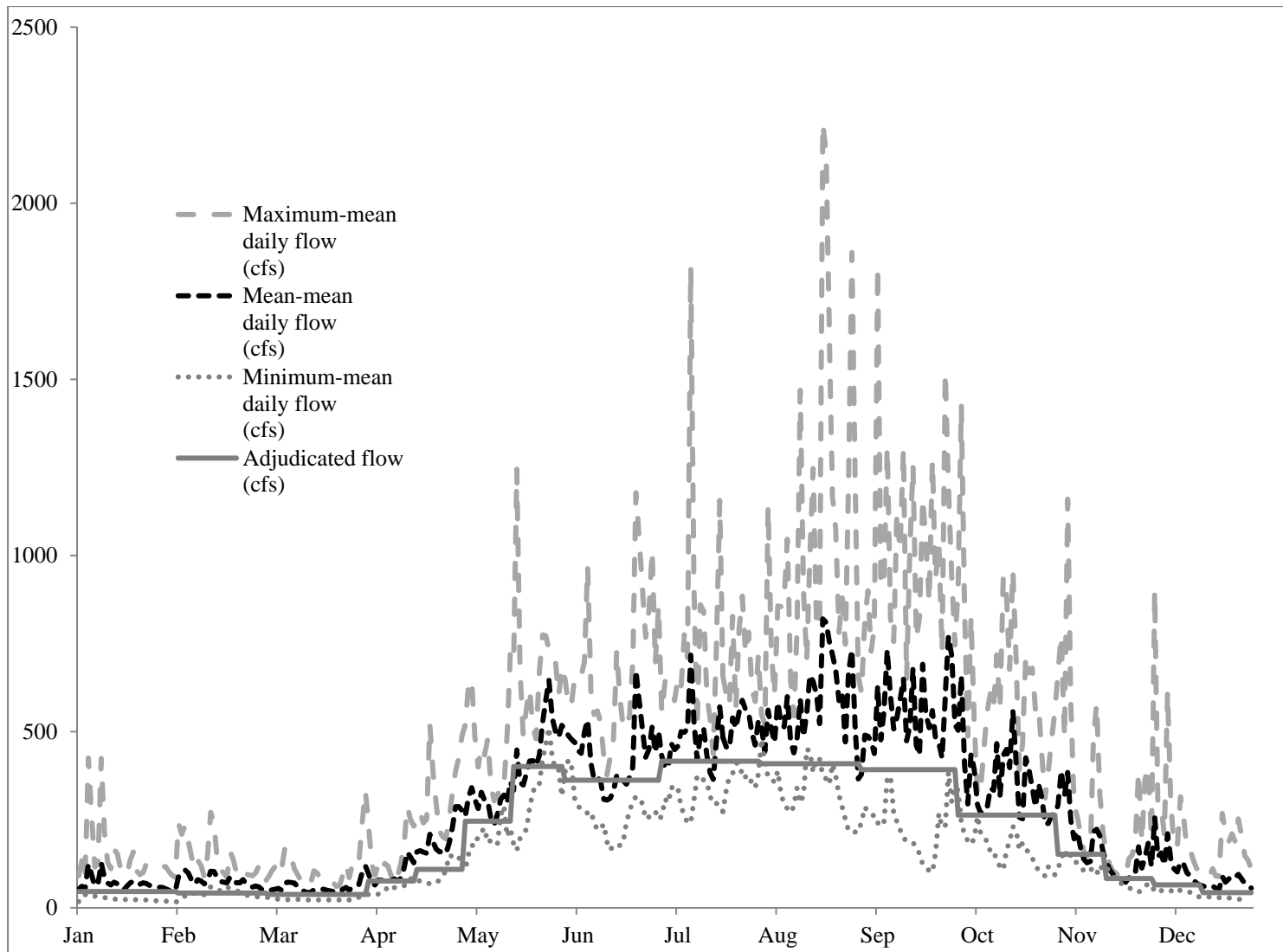


Figure 3.—Annual hydrograph of minimum, mean, maximum mean daily, and adjudicated flows (in ft^3/s) for Cowee Creek, Alaska. Based on data from ADF&G streamgage 11401 (October 1, 2007, to September 30, 2012) located on Cowee Creek downstream of Glacier Highway Bridge.

DISCUSSION

According to ADF&G's Anadromous Waters Catalog, over 18,000 streams, rivers, and lakes have been specified as supporting anadromous fish populations in Alaska (Johnson and Coleman 2014). These waterbodies are all potentially subject to water withdrawals and modification of their natural streamflows. Although most water bodies in the state are currently not subject to flow modifications, it is important to protect these unallocated streamflows before competition over the water arises. In 2005, total freshwater surface withdrawals in Alaska were only 393 million gallons per day (MGD), compared to 4,190 MGD in Washington and 22,200 MGD in California (Kenney 2009).

ADF&G has filed applications for reservation of water for 250 river reaches and 4 lakes since 1980 and has been granted certificates for 105 river reaches and 1 lake (Klein 2015). There are potentially tens of thousands more stream reaches where instream flows can still be protected within the state. One major challenge to filing more applications is the lack of available streamflow data that can be used to file applications. Only 107 continuous streamgages were operated by the USGS in federal Water Year 2014 (October 1, 2013 through September 30, 2014; Klein 2015). Recognizing this data limitation, ADF&G began a program in 2001 to collect streamflow data at important fisheries throughout the state.

Cowee Creek is an important freshwater fishery that provides habitat for many fish species at various life stages. Prior to this project, no known streamflow data had been collected within the creek. This project collected the 5 years (water years 2008 to 2012) of streamflow data needed to support a reservation of water application for Cowee Creek.

Instream flows were requested to attempt to mimic the natural seasonal patterns of streamflows observed within Cowee Creek. All requested flows were near the mean daily flow for the requested time periods. Although not requested, research has shown that flows near bankfull are needed to maintain the channel's sediment, riparian vegetation, and floodplain habitat (Leopold et al. 1964; Reiser et al. 1985; Schmidt and Potyondy 2004). Changes in the magnitude, frequency, timing, and duration of these flows could directly lead to biological and geomorphic changes (Whiting 2002).

Certificates of Reservation were granted by DNR on April 24th, 2015 for protection of instream flows within 2.6 miles of Cowee Creek (Appendix D). At this time, no major water withdrawals or impoundments occur within the Cowee Creek watershed.

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APPENDIX A
ADF&G STREAMGAGE 11401 DATA SUMMARY

Appendix A1.—ADF&G streamgage 11401 daily flow summary reported in cubic feet per second (ft³/s). Period of record for the gage is May 23, 2007 to October 5, 2012.

Day of year	# of days of record	Minimum-mean daily flow (cfs)	Mean-mean daily flow (cfs)	Maximum-mean daily flow (cfs)
01/01	5	18	53	91
01/02	5	22	61	134
01/03	5	38	54	89
01/04	5	32	124	425
01/05	5	34	94	263
01/06	5	33	63	116
01/07	5	32	67	125
01/08	5	31	127	424
01/09	5	29	86	216
01/10	5	28	70	129
01/11	5	28	65	111
01/12	5	25	73	166
01/13	5	24	68	153
01/14	5	24	56	112
01/15	5	23	51	98
01/16	5	24	62	94
01/17	5	23	71	136
01/18	5	23	76	159
01/19	5	23	68	105
01/20	5	22	67	94
01/21	5	23	71	100
01/22	5	22	69	125
01/23	5	21	64	123
01/24	5	21	63	121
01/25	5	20	61	117
01/26	5	20	58	116
01/27	5	20	58	117
01/28	5	19	54	117
01/29	5	18	50	103
01/30	5	18	48	92
01/31	5	17	48	87

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Day of year	# of days of record	Minimum-mean daily flow (cfs)	Mean-mean daily flow (cfs)	Maximum-mean daily flow (cfs)
02/01	5	18	89	239
02/02	5	25	100	209
02/03	5	34	108	233
02/04	5	41	99	190
02/05	5	42	79	146
02/06	5	41	67	111
02/07	5	40	80	134
02/08	5	40	76	120
02/09	5	37	68	87
02/10	5	47	78	148
02/11	5	60	104	271
02/12	5	54	103	239
02/13	5	50	86	138
02/14	5	49	75	110
02/15	5	59	73	99
02/16	5	58	71	87
02/17	5	56	88	160
02/18	5	53	83	137
02/19	5	49	71	100
02/20	5	45	71	108
02/21	5	42	80	114
02/22	5	37	69	96
02/23	5	33	62	93
02/24	5	33	59	91
02/25	5	32	62	100
02/26	5	31	59	120
02/27	5	31	51	91
02/28	7	30	49	76

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Day of year	# of days of record	Minimum-mean daily flow (cfs)	Mean-mean daily flow (cfs)	Maximum-mean daily flow (cfs)
03/01	5	29	48	89
03/02	5	29	51	105
03/03	5	26	53	117
03/04	5	24	55	134
03/05	5	24	50	111
03/06	5	24	70	168
03/07	5	23	73	140
03/08	5	23	72	141
03/09	5	24	70	110
03/10	5	24	60	94
03/11	5	23	51	77
03/12	5	22	47	67
03/13	5	22	43	60
03/14	5	22	44	68
03/15	5	22	51	105
03/16	5	22	49	99
03/17	5	22	50	83
03/18	5	22	53	86
03/19	5	22	50	81
03/20	5	22	48	77
03/21	5	22	46	72
03/22	5	22	43	61
03/23	5	22	45	64
03/24	5	23	53	94
03/25	5	24	58	124
03/26	5	22	50	86
03/27	5	28	59	125
03/28	5	29	65	141
03/29	5	30	66	131
03/30	5	33	100	240
03/31	5	39	119	332

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Day of year	# of days of record	Minimum-mean daily flow (cfs)	Mean-mean daily flow (cfs)	Maximum-mean daily flow (cfs)
04/01	5	38	96	233
04/02	5	36	71	125
04/03	5	35	65	92
04/04	5	39	79	124
04/05	5	49	78	104
04/06	5	54	81	126
04/07	5	54	78	119
04/08	5	64	78	91
04/09	5	57	82	113
04/10	5	57	76	90
04/11	5	61	84	126
04/12	5	63	113	179
04/13	5	65	158	286
04/14	5	82	144	252
04/15	5	88	128	232
04/16	5	81	159	246
04/17	5	75	162	272
04/18	5	74	158	241
04/19	5	69	155	251
04/20	5	69	209	521
04/21	5	69	187	385
04/22	5	70	167	294
04/23	5	80	159	218
04/24	5	91	159	202
04/25	5	106	154	196
04/26	5	149	183	252
04/27	5	146	228	326
04/28	5	140	287	389
04/29	5	145	287	425
04/30	5	110	277	488

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Day of year	# of days of record	Minimum-mean daily flow (cfs)	Mean-mean daily flow (cfs)	Maximum-mean daily flow (cfs)
05/01	5	108	260	520
05/02	5	152	314	632
05/03	5	178	341	648
05/04	5	175	309	487
05/05	5	204	282	400
05/06	5	216	328	458
05/07	5	226	305	434
05/08	5	185	303	479
05/09	5	192	250	343
05/10	5	189	237	304
05/11	5	180	265	317
05/12	5	262	307	346
05/13	5	289	320	344
05/14	5	203	298	493
05/15	5	226	358	720
05/16	5	181	334	698
05/17	5	163	448	1245
05/18	5	197	356	678
05/19	5	208	349	489
05/20	5	224	382	569
05/21	5	286	417	621
05/22	5	328	418	513
05/23	5	352	403	480
05/24	5	353	434	671
05/25	5	422	526	775
05/26	5	463	590	772
05/27	5	511	646	734
05/28	5	427	538	719
05/29	5	392	501	699
05/30	5	392	484	603
05/31	5	317	518	684

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Day of year	# of days of record	Minimum-mean daily flow (cfs)	Mean-mean daily flow (cfs)	Maximum-mean daily flow (cfs)
06/01	5	387	506	647
06/02	5	420	489	573
06/03	5	402	478	580
06/04	5	310	470	654
06/05	5	287	446	662
06/06	5	283	439	658
06/07	5	280	499	699
06/08	5	268	533	969
06/09	5	273	411	615
06/10	5	243	364	549
06/11	5	221	370	559
06/12	5	225	361	528
06/13	5	237	308	431
06/14	5	187	306	378
06/15	5	164	311	427
06/16	5	178	331	478
06/17	5	180	375	731
06/18	5	177	370	596
06/19	5	185	361	516
06/20	5	241	351	511
06/21	5	276	371	547
06/22	5	300	399	699
06/23	5	316	673	1,178
06/24	5	308	587	1,045
06/25	5	296	506	907
06/26	5	252	428	768
06/27	5	258	449	842
06/28	5	266	514	1,015
06/29	5	274	441	692
06/30	5	251	501	858

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Day of year	# of days of record	Minimum-mean daily flow (cfs)	Mean-mean daily flow (cfs)	Maximum-mean daily flow (cfs)
07/01	5	260	431	554
07/02	5	309	397	643
07/03	5	298	399	632
07/04	5	343	466	625
07/05	5	335	449	588
07/06	5	341	459	652
07/07	5	286	500	626
07/08	5	264	498	775
07/09	5	240	508	711
07/10	5	244	717	1,818
07/11	5	306	528	907
07/12	5	375	420	513
07/13	5	373	491	860
07/14	5	362	509	843
07/15	5	357	432	603
07/16	5	317	384	538
07/17	5	294	365	438
07/18	5	296	479	760
07/19	5	292	570	1,156
07/20	5	273	484	657
07/21	5	335	457	605
07/22	5	373	452	574
07/23	5	382	539	827
07/24	5	404	510	565
07/25	5	427	556	793
07/26	5	368	589	885
07/27	5	372	563	722
07/28	5	377	553	782
07/29	5	352	495	620
07/30	5	341	462	586
07/31	5	380	532	718

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Day of year	# of days of record	Minimum-mean daily flow (cfs)	Mean-mean daily flow (cfs)	Maximum-mean daily flow (cfs)
08/01	5	479	512	549
08/02	5	414	444	521
08/03	5	371	561	1,141
08/04	5	366	510	736
08/05	5	357	469	602
08/06	5	388	583	857
08/07	5	325	525	855
08/08	5	293	514	881
08/09	5	282	599	1,046
08/10	5	271	472	645
08/11	5	289	440	545
08/12	5	340	481	793
08/13	5	298	593	1,469
08/14	5	321	486	898
08/15	5	451	553	700
08/16	5	443	660	999
08/17	5	385	643	1,247
08/18	5	424	607	808
08/19	5	422	523	795
08/20	5	376	820	2,227
08/21	5	366	810	2,139
08/22	5	351	756	1,634
08/23	5	408	718	1,167
08/24	5	376	676	1,076
08/25	5	320	588	782
08/26	5	286	611	881
08/27	5	251	471	748
08/28	5	219	672	1,218
08/29	5	220	732	1,860
08/30	5	215	517	1,226
08/31	5	215	366	658

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Day of year	# of days of record	Minimum-mean daily flow (cfs)	Mean-mean daily flow (cfs)	Maximum-mean daily flow (cfs)
09/01	5	244	379	611
09/02	5	286	490	815
09/03	5	274	487	900
09/04	5	265	473	729
09/05	5	261	438	796
09/06	5	239	630	1,821
09/07	5	253	477	912
09/08	5	244	559	931
09/09	5	368	732	1,308
09/10	5	373	600	821
09/11	5	267	508	756
09/12	5	245	540	1,124
09/13	5	222	591	1,014
09/14	5	197	650	1,303
09/15	5	191	474	650
09/16	5	190	516	1,012
09/17	5	185	680	1,256
09/18	5	173	462	764
09/19	5	153	434	823
09/20	5	124	691	1,164
09/21	5	113	551	1,037
09/22	5	106	511	869
09/23	5	101	560	1,270
09/24	5	155	481	934
09/25	5	268	468	1,034
09/26	5	229	425	726
09/27	5	232	600	1,521
09/28	5	385	771	1,199
09/29	5	301	715	937
09/30	5	344	521	746

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Day of year	# of days of record	Minimum-mean daily flow (cfs)	Mean-mean daily flow (cfs)	Maximum-mean daily flow (cfs)
10/01	5	333	504	911
10/02	5	243	658	1,426
10/03	5	207	404	832
10/04	5	190	295	487
10/05	5	180	436	828
10/06	5	198	393	530
10/07	5	260	292	319
10/08	5	211	269	337
10/09	5	201	270	452
10/10	5	188	283	555
10/11	5	159	340	610
10/12	5	161	334	570
10/13	5	134	466	718
10/14	5	117	316	565
10/15	5	108	433	940
10/16	5	164	450	888
10/17	5	189	398	677
10/18	5	231	559	959
10/19	5	219	411	705
10/20	5	165	257	392
10/21	5	184	253	465
10/22	5	169	426	717
10/23	5	154	391	667
10/24	5	142	341	680
10/25	5	120	287	563
10/26	5	106	352	576
10/27	5	98	312	430
10/28	5	90	237	312
10/29	5	116	240	388
10/30	5	109	263	480
10/31	5	94	267	557

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Day of year	# of days of record	Minimum-mean daily flow (cfs)	Mean-mean daily flow (cfs)	Maximum-mean daily flow (cfs)
11/01	5	112	292	668
11/02	5	136	389	774
11/03	5	165	320	483
11/04	5	139	384	1,160
11/05	5	151	247	574
11/06	5	137	196	295
11/07	5	125	216	258
11/08	5	114	170	208
11/09	5	106	138	161
11/10	5	108	128	147
11/11	5	114	132	157
11/12	5	99	216	483
11/13	5	94	223	579
11/14	5	121	204	322
11/15	5	107	158	208
11/16	5	116	130	158
11/17	5	102	109	123
11/18	5	88	96	105
11/19	5	83	90	98
11/20	5	70	82	90
11/21	5	68	78	87
11/22	5	61	73	89
11/23	5	57	85	140
11/24	5	53	97	149
11/25	5	46	99	187
11/26	5	45	173	387
11/27	5	49	113	189
11/28	5	59	143	364
11/29	5	70	183	400
11/30	5	63	118	200

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Day of year	# of days of record	Minimum-mean daily flow (cfs)	Mean-mean daily flow (cfs)	Maximum-mean daily flow (cfs)
12/01	5	53	256	902
12/02	5	47	145	294
12/03	5	43	156	291
12/04	5	49	122	205
12/05	5	48	210	615
12/06	5	45	137	300
12/07	5	47	111	180
12/08	5	56	102	172
12/09	5	53	131	315
12/10	5	49	124	255
12/11	5	48	100	170
12/12	5	44	91	166
12/13	5	44	79	135
12/14	5	41	70	112
12/15	5	36	65	103
12/16	5	30	62	95
12/17	5	31	59	88
12/18	5	31	60	89
12/19	5	31	62	111
12/20	5	32	55	90
12/21	5	30	52	89
12/22	5	29	89	268
12/23	5	27	73	213
12/24	5	29	82	188
12/25	5	28	91	210
12/26	5	27	87	188
12/27	5	26	95	252
12/28	5	25	82	202
12/29	5	23	69	148
12/30	5	20	63	135
12/31	5	19	56	110

Note: Streamflow values in this report are based on USGS guidelines for daily mean discharge (<http://wdr.water.usgs.gov/current/documentation.html#sqw>, accessed January 7, 2014): “Values of daily mean discharge are shown to the nearest hundredth of a cubic foot per second for discharges of less than 1 ft³/s; to the nearest tenths between 1.0 and 10 ft³/s; to whole numbers between 10 and 1,000 ft³/s; and to three significant figures above 1,000 ft³/s. The number of significant figures used is based solely on the magnitude of the discharge value. The same rounding rules apply to discharge values listed for partial-record stations.”

Appendix A2.–ADF&G streamgage 11401 monthly exceedance flows reported in cubic feet per second.

% Time exceeded	Discharge (ft ³ /s)											
	January	February	March	April	May	June	July	August	September	October	November	December
0	425	271	332	521	1,245	1,178	2,099	2,227	1,821	1,426	1,160	902
5	136	169	134	326	699	850	843	1,141	1,081	828	475	268
10	117	134	110	269	621	691	726	855	933	647	311	188
15	101	107	94	248	543	643	646	782	833	556	245	166
20	90	94	81	233	496	584	603	700	767	512	210	138
25	82	89	72	196	482	543	576	628	692	465	186	113
30	76	85	64	181	444	509	556	545	636	413	168	106
35	71	80	60	146	409	479	528	503	574	379	157	94
40	62	76	56	133	393	446	489	484	519	340	145	87
45	57	70	50	125	364	427	463	464	477	316	137	76
50	52	63	46	109	343	410	448	441	450	307	125	60
55	48	59	41	100	321	388	435	424	418	279	119	54
60	46	56	38	91	309	362	416	409	392	263	111	52
65	44	54	35	87	287	342	399	388	369	246	102	48
70	40	52	31	81	276	323	380	366	349	232	96	46
75	39	49	30	76	249	306	372	336	332	208	89	44
80	35	45	28	70	234	292	359	318	288	198	83	41
85	28	41	24	64	224	282	343	302	266	184	78	38
90	23	37	23	61	205	262	328	286	241	161	69	31
95	20	33	22	51	183	230	298	265	190	117	61	28
100	17	18	22	35	108	164	240	215	101	90	45	19

Note: Streamflow values in this report are based on USGS guidelines for daily mean discharge (<http://wdr.water.usgs.gov/current/documentation.html#sqw>, accessed January 7, 2014): “Values of daily mean discharge are shown to the nearest hundredth of a cubic foot per second for discharges of less than 1 ft³/s; to the nearest tenths between 1.0 and 10 ft³/s; to whole numbers between 10 and 1,000 ft³/s; and to three significant figures above 1,000 ft³/s. The number of significant figures used is based solely on the magnitude of the discharge value. The same rounding rules apply to discharge values listed for partial-record stations.”

APPENDIX B
ADF&G STREAMGAGE 11401 AVAILABLE DATA

Appendix B1.–ADF&G Streamgage 11401 available data. The following data used for this report are stored in the WISKI database and are available upon request.

Station	Station location	Data available	WISKI database reference
11401	Cowee Cr at Glacier Highway Bridge	Mean daily flow from 5/23/2007 to 10/5/2012	Cowee Cr at Glac.Q.DayMean.E
11401	Cowee Cr at Glacier Highway Bridge	Instantaneous discharge measurements from 5/22/2007 to 10/5/2012	Cowee Cr at Glac.Q.Obs.Q

Note: Contact SARCU Surface Water Data Coordinator, ADF&G Division of Sport Fish, Research and Technical Services, 802 3rd St. Douglas, AK 99824.

**APPENDIX C
PHOTOGRAPHS**

Appendix C1.–View of Cowee Creek looking downstream from Glacier Highway Bridge on April 20, 2009 at a discharge of 112 ft³/s. The streamgage (ADF&G 11401) was located on the left bank just downstream of the bridge.



Appendix C2.– View of Cowee Creek looking downstream from Glacier Highway Bridge on February 05, 2010 at a discharge of 50 ft³/s.





APPENDIX D
COWEE CREEK CERTIFICATES OF RESERVATION
LAS 27485 AND LAS 30036

State of Alaska



Water Rights

Certificate of Reservation
LAS 27485

The State of Alaska, acting by and through the Department of Natural Resources, Division of Mining, Land and Water, 550 West 7th Avenue, Suite 1020, Anchorage, AK 99501-3562, hereinafter referred to as the grantor, under AS 46.15, the Alaska Water Use Act, and the regulations adopted under it, grants to:

Alaska Department of Fish and Game
333 Raspberry Road
Anchorage, AK 99518-1599

A reservation of water flows as follows:

SOURCE: Cowee Creek, from the Ordinary High Water Mark (OHWM) of the outer bank (of the outside braid, where braided) of the left bank up to the OHWM of the outer bank (of the outside braid, where braided) of the right bank, including any sloughs, braids, or channels which carry water and are an integral part of the creek from the downstream end of Cowee Creek at river mile 0.0 (at the closing line) and extending upstream to just below the confluence with Davies Creek at river mile 2.0. This description does not limit the quantities of water (flow rate) reserved by this decision and certificate to quantities (flow rates) within said OHWM boundaries. Descriptions of time periods and flows are listed below:

QUANTITY:

Time Period	Granted Reservation Flows (cfs)
JANUARY	36
FEBRUARY	42
MARCH	38

Certificate of Reservation – LAS 27485

APRIL 1-15	76
APRIL 16-30	109
MAY 1-15	246
MAY 16-31	401
JUNE	361
JULY	416
AUGUST	409
SEPTEMBER	392
OCTOBER	263
NOVEMBER 1-15	136
NOVEMBER 16-30	83
DECEMBER 1-15	65
DECEMBER 16-31	43

cfs = cubic feet per second

PURPOSE: To protect fish and wildlife habitat, migration, and propagation.

PRIORITY DATE: December 11, 2009

LOCATION: The location to which this reservation of water pertains is within Cowee Creek, from the Ordinary High Water Mark (OHWM) of the outer bank (of the outside braid, where braided) of the left bank up to the OHWM of the outer bank (of the outside braid, where braided) of the right bank, including any sloughs, braids, or channels which carry water and are an integral part of the creek from the downstream end of Cowee Creek at river mile 0.0 (at the closing line) and extending upstream to just below the confluence with Davies Creek at river mile 2.0. This description does not limit the quantities of water (flow rate) reserved by this decision and certificate to quantities (flow rates) within said OHWM boundaries. Said portion of the Cowee River is located within:

Township	Range	Sections
37 South	63 East	13
37 South	64 East	18, 19

All within the Copper River Meridian, Juneau Recording District, First Judicial District, State of Alaska.

Certificate of Reservation – LAS 27485

This Certificate of Reservation is granted subject to the conditions listed below.

1. This certificate shall be subject to review under AS 46.15.145 (f).
2. Pursuant to AS 46.15.145(f) this reservation may be modified to reduce the flows reserved under this reservation but cannot be modified to increase the reserved flows.
3. The certificate of reservation does not authorize the certificate holder or any other person to prevent access to, on, or through the water reserved by the certificate, or to prohibit the use of the reserved water for other compatible purposes set out in AS 46.15.145(a).
4. The holder of this certificate shall comply with all the applicable requirements of AS 46.15.010 – 46.15.270 and 11 AAC 93.010 – 11 AAC 93.970, now effective or as they might in the future be amended.
5. The certificate of reservation may not be voluntarily abandoned, conveyed, transferred, assigned, or converted to another use, in whole or in part, unless required as a result of review under 11 AAC 93.147.
6. The holder of this certificate shall notify the grantor of any change of address, or change of water use.
7. Except for claims or losses arising from negligence of the State, the holder of this certificate shall defend and indemnify the state against and hold it harmless from any and all claims, demands, legal actions, loss, liability and expense from injury to or death of persons and damages to or loss of property arising out of or connected with the exercise of the water right granted by this certificate.

Certificate of Reservation – LAS 27485

This Certificate of Reservation becomes effective on April 24, 2015

APPROVED *David W. Schade*
David W. Schade

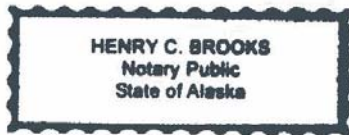
Title Chief, Water Resources Section

STATE OF ALASKA)
3rd JUDICIAL DISTRICT) ss.
)

This is to certify that on April 24, 2015 before me appeared David W. Schade known by me to be the authorized representative of the Division of Mining, Land and Water, Department of Natural Resources, and acknowledged to me that this Certificate of Reservation was voluntarily executed on behalf of the State of Alaska.

Henry C. Brooks
Notary Public in and for the State of Alaska

with office
My Commission expires



After recording return to Grantor
Department of Natural Resources
Division of Mining, Land and Water
550 West 7th Ave. Suite 1020
Anchorage, Alaska 99501
State Business – No Charge

State of Alaska

Water Rights

Certificate of Reservation
LAS 30036

The State of Alaska, acting by and through the Department of Natural Resources, Division of Mining, Land and Water, 550 West 7th Avenue, Suite 1020, Anchorage, AK 99501-3562, hereinafter referred to as the grantor, under AS 46.15, the Alaska Water Use Act, and the regulations adopted under it, grants to:

Alaska Department of Fish and Game
333 Raspberry Road
Anchorage, AK 99518-1599

A reservation of water flows as follows:

SOURCE: Cowee Creek – Additional Flows, from the Ordinary High Water Mark (OHWM) of the outer bank (of the outside braid, where braided) of the left bank up to the OHWM of the outer bank (of the outside braid, where braided) of the right bank, including any sloughs, braids, or channels which carry water and are an integral part of the creek from the downstream end of Cowee Creek at river mile 0.0 (at the closing line) and extending upstream to just below the confluence with Davies Creek at river mile 2.0. This description does not limit the quantities of water (flow rate) reserved by this decision and certificate to quantities (flow rates) within said OHWM boundaries. Descriptions of time periods and flows are listed below:

QUANTITY:

Time Period	Granted Reservation Flows (cfs)
JANUARY	10
APRIL 16-30	37
JUNE	1
NOVEMBER 1-15	16

cfs = cubic feet per second

Certificate of Reservation – LAS 30036

PURPOSE: To protect fish and wildlife habitat, migration, and propagation.

PRIORITY DATE: January 30, 2013

LOCATION: The location to which this reservation of water pertains is within Cowee Creek – Additional Flows, from the Ordinary High Water Mark (OHWM) of the outer bank (of the outside braid, where braided) of the left bank up to the OHWM of the outer bank (of the outside braid, where braided) of the right bank, including any sloughs, braids, or channels which carry water and are an integral part of the creek from the downstream end of Cowee Creek at river mile 0.0 (at the closing line) and extending upstream to just below the confluence with Davies Creek at river mile 2.0. This description does not limit the quantities of water (flow rate) reserved by this decision and certificate to quantities (flow rates) within said OHWM boundaries. Said portion of the Cowee River is located within:

Township	Range	Sections
37 South	63 East	13
37 South	64 East	18, 19

All within the Copper River Meridian, Juneau Recording District, First Judicial District, State of Alaska.

Certificate of Reservation – LAS 30036

This Certificate of Reservation is granted subject to the conditions listed below.

1. This certificate shall be subject to review under AS 46.15.145 (f).
2. Pursuant to AS 46.15.145(f) this reservation may be modified to reduce the flows reserved under this reservation but cannot be modified to increase the reserved flows.
3. The certificate of reservation does not authorize the certificate holder or any other person to prevent access to, on, or through the water reserved by the certificate, or to prohibit the use of the reserved water for other compatible purposes set out in AS 46.15.145(a).
4. The holder of this certificate shall comply with all the applicable requirements of AS 46.15.010 – 46.15.270 and 11 AAC 93.010 – 11 AAC 93.970, now effective or as they might in the future be amended.
5. The certificate of reservation may not be voluntarily abandoned, conveyed, transferred, assigned, or converted to another use, in whole or in part, unless required as a result of review under 11 AAC 93.147.
6. The holder of this certificate shall notify the grantor of any change of address, or change of water use.
7. Except for claims or losses arising from negligence of the State, the holder of this certificate shall defend and indemnify the state against and hold it harmless from any and all claims, demands, legal actions, loss, liability and expense from injury to or death of persons and damages to or loss of property arising out of or connected with the exercise of the water right granted by this certificate.

Certificate of Reservation – LAS 30036

This Certificate of Reservation becomes effective on April 24, 2015

APPROVED *David W. Schade*
David W. Schade

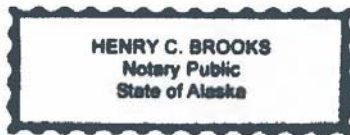
Title Chief, Water Resources Section

STATE OF ALASKA)
3rd JUDICIAL DISTRICT) ss.

This is to certify that on April 24, 2015 before me appeared David W. Schade known by me to be the authorized representative of the Division of Mining, Land and Water, Department of Natural Resources, and acknowledged to me that this Certificate of Reservation was voluntarily executed on behalf of the State of Alaska.

Henry C. Brooks
Notary Public in and for the State of Alaska

with office
My Commission expires



After recording return to Grantor
Department of Natural Resources
Division of Mining, Land and Water
550 West 7th Ave. Suite 1020
Anchorage, Alaska 99501
State Business – No Charge