REPORT

AQUATIC RESOURCES STUDY FOR THE KETCHIKAN LAKES HYDROELECTRIC PROJECT (FERC Project No. 420; State Review No. AK9608-09J)

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1.0 INTRODUCTION

This report presents the results of a fisheries study for the Ketchikan Lakes Hydroelectric Project (Project). The analyses in this report were conducted to describe the existing conditions for the fisheries in the Project area and to identify any effects that may occur with the continuation (relicensing) of the Project.

1.1 PROJECT BACKGROUND

The following brief project description focuses on fisheries-related information only. For a detailed description of the project, please refer to Scoping Document II (Greystone 1997a) or the Environmental Analysis (Greystone 1998). For a detailed description of hydrology, refer to a Hydrology Analysis under separate cover.

The first stage of development for the Ketchikan Lakes project was constructed in 1903, with eight distinct stages of development since that time. Licensing for the current facilities expires on June 30, 2000.

Water from both Ketchikan Lakes and the Granite Basin Creeks are conveyed to Fawn Lake by penstocks and aqueducts (**Figures 1 and 2 and Appendix A**). The water is then routed from Fawn Lake through an aqueduct to the powerhouse (with a small portion taken out for the municipal water supply just prior to entering the powerhouse). After passing through the powerhouse, some of the water is diverted to the Deer Mountain Hatchery via a 4-inch pipe and some is diverted directly to a stream flowing through the City Park. The balance is returned to Ketchikan Creek (the tailrace).

For the most part, all of the flow from Ketchikan Lakes and Granite Basin is routed to Fawn Lake. There are occasional spills from the system at Ketchikan Lake and at the Granite Basin diversion. (For example, during at least the past four decades, all flow out of Ketchikan Lakes, except approximately four spills, has been conveyed to Fawn Lake and the powerhouse.) Therefore, any flow occurring in the bypassed reaches of Ketchikan and Granite Basin creeks (bypassed reach) is seepage from the dams and direct runoff from water sources within the bypassed sections.

2.0 METHODS

2.1 BASELINE DATA COMPILATION METHODS

Information for the fisheries resource was acquired from three primary sources. First, information was obtained from resource management agencies. This information involved the status, occurrence and use of habitats for fish within the Project area.

The second source of information was published and unpublished literature that was used to corroborate and supplement information provided by the agencies. This literature included reports on site-specific surveys conducted in the Project area. General literature for the fish species under consideration also was reviewed.

The third source of information was the stream inventory conducted for the Ketchikan Lakes Project. The methods for this inventory are described in the section below.

2.2 STREAM INVENTORY METHODS

During August 1997, an aquatic habitat survey was conducted of the Ketchikan Creek system. During August 1997, September 1997, and April 1998 fish surveys were conducted. Significant aquatic habitats within this system consist of Ketchikan Creek, Granite Basin Creek, Schoenbar Creek, Scout Creek, and a tributary to Granite Basin Creek (**Figures 1 and 2**). These habitats were considered the analysis area for the fisheries resource.

Ketchikan and Granite Basin creeks were separated into approximately ½ mile long or less reaches. The reaches were delineated based primarily on significant hydrologic or physical aquatic habitat changes. A secondary factor in the determination of reach boundaries was field verification that within each reach was a relatively homogeneous section of stream having a repetitious sequence of physical characteristics and habitat types. After the reaches were identified, representative reaches were selected to be surveyed.

The stream inventory data were collected using the *Draft Fish Habitat Monitoring Protocol for the Tongass National Forest* (USFS 1997). This method was chosen because it is the method being used by the Tongass National Forest (TNF). Therefore, these data can be incorporated into TNF's stream database. Tier 3 was the level of effort undertaken for this study. A copy of this methodology is contained in **Appendix B**.

2.2.1 Aquatic Habitat Survey Methods

Attributes were recorded for each surveyed reach. These included average channel bed width, channel morphology, identification of side tributaries, and identification of migration barriers.

Figure 1 Aquatic Resources Map

Figure 2 Aquatic Resources Aerial Map

The surveyed reaches were divided into habitat types (e.g., pools, riffles, cascades). Within each habitat type, several aquatic habitat attributes were recorded. The attributes were: channel type, dominant substrate, length, riparian vegetation type and seral stage, large woody debris (split into 4 categories), length of undercut bank, and length and type of bank disturbance. Additional attributes for fastwater habitat types were average width and average depth. Additional attributes for slowwater (pool) habitat types were maximum depth, tailcrest depth, residual width, residual area, and residual depth.

All the aquatic habitat attributes were collected as described in the TNF Protocol. Therefore, detailed methodologies will not be described in this section. Refer to **Appendix B** for these specific methods.

The habitat survey was conducted at the TNF protocol's Tier 3 level of effort. However, it was determined that habitat type classifications would be increased to the Tier 4 level of effort to obtain a better description of the habitat in the Ketchikan Creek system (**Appendix B**).

All lengths were measured using a hip-chain and stream widths were measured using a SONIN electronic distance meter (accuracy ± 0.5 inches)

In addition to the TNF protocol surveys, KPU installed continuous HOBO temperature monitors (accuracy ± 0.5 °F) just above and just below the tailrace. The sample period was July 25 through October 5, 1997. These recorders monitored temperature every hour during the sample period. The recorders were reinstalled on April 18, 1998 and will be collecting hourly data for one year.

2.2.2 Aquatic Biota Survey Methods

Within each surveyed reach, snorkeling and trapping were conducted to determine presence/absence of fish species within the analysis area. As described in the TNF protocol, fish were grouped by size classes (<60, 60-100, 101-200, 201-300, and >300mm).

Snorkeling methods generally followed those described in the TNF Protocol and Hankin and Reeves (1998). Snorkeling observations were conducted at the TNF protocol's Tier 3 level of effort. However, due to the relatively few number of habitat types found per reach, sampling frequency was increased to more than the "every fifth pool and every 10th fast water" to obtain more information. For each snorkeled section, the length, average width, and habitat type identifier were recorded.

Trapping methods followed those used by the Alaska Department of Fish and Game (ADF&G 1997). Trapping was conducted using six Gee-style minnow traps per surveyed reach. Additional traps were put in non-selected reaches when it was deemed important information for the study. The traps were set for approximately 24-hour sampling periods. Traps were baited with disinfected salmon eggs.

3.0 AFFECTED ENVIRONMENT

3.1 GENERAL DESCRIPTION OF ANALYSIS AREA

The analysis area for the fisheries resource was determined to be the aquatic habitats within the Ketchikan Creek System. Significant aquatic habitats within this system consist of Ketchikan Creek, Granite Basin Creek, Schoenbar Creek, Scout Creek, and a tributary to Granite Basin Creek (**Figures 1 and 2**).

Observations in April, August, and September 1997, indicated that a falls at the upstream end of the canyon area of Ketchikan Creek creates a migration barrier to anadromous species. Therefore, for discussion purposes, the analysis area has been divided into four areas: 1) the anadromous section of Ketchikan Creek (K1, K2, K3); 2) the nonanadromous section of Ketchikan Creek (K4, K5, K6); 3) Granite Basin Creek (G1, G2, GT1); and, 4) Ketchikan Lakes. **Figures 1 and 2** illustrate the stream reach locations and photographs of the system are presented in **Appendix A**.

3.2 ANADROMOUS SECTION OF KETCHIKAN CREEK

3.2.1 Information for All Reaches of the Anadromous Section

The anadromous section of Ketchikan Creek supports a variety of salmonid fish species. Coho salmon, chinook salmon, sockeye salmon, pink salmon, chum salmon, Dolly Varden char, cutthroat trout, steelhead trout, rainbow trout, and brook trout all use portions of Ketchikan Creek for spawning and rearing (ADF&G 1987; Greystone 1997b). The anadromous section (K1, K2, and K3) is 5,321 feet long.

Chinook salmon and the summer coho run are not native to the system, but are maintained by the Deer Mountain Hatchery. Brook trout are also not native to the system. The remaining species (including the fall run coho) are native, with supplemental stocking of some species. None of the species of fish occurring in Ketchikan Creek System are on the state or federal threatened or endangered species lists. Refer to **Table 1** for scientific names, synonyms, and codes for fish species.

3.2.1.1 Escapement

ADF&G's escapement surveys conducted from 1978 to 1995 document significant salmon uses of Ketchikan Creek (**Table 2**). These surveys were timed to detect peak pink salmon escapement. Other species were noted and counted; however, their run timing differs and the numbers presented in the table are for general information only.

ADF&G foot and snorkel surveys have been conducted from the mouth of Ketchikan Creek to the project's tailrace (K1 and K2) from 1995 to present (**Table 3**). This table also includes steelhead surveys conducted by Greystone in reaches K2 and K3 on April 19, 1998.

The escapement surveys document that there is a substantial amount of wild pink salmon production in Ketchikan Creek, with maximum yearly counts ranging from 850 to 40,000. Additionally, there are relatively small amounts of chinook, sockeye, chum, and coho salmon production (**Table 2**). Numbers of salmon produced in Ketchikan Creek are large enough to make Ketchikan Creek a regionally important base for commercial and sport salmon fisheries.

Table 1
Species List and Codes For Fish
Occurring Within the Ketchikan Creek Watershed

Common Name	Species Code	Scientific Name
Chinook salmon (= king salmon)	KS	*Oncorhynchus tshawytscha*
Coho salmon (= silver salmon)	CO	*Oncorhynchus kisutch*
Sockeye salmon (= red salmon)	RS	*Oncorhynchus nerka*
Pink salmon (= humpback salmon)	PK	*Oncorhynchus gorbuscha*
Chum salmon (= dog salmon)	CH	*Oncorhynchus keta*
Steelhead, rainbow trout	SH	*Oncorhynchus mykiss*
Dolly Varden char	DV	*Salvelinus malma*
Cutthroat trout	CT	*Oncorhynchus clarki*
Eastern brook trout	BT	*Salvelinus fontinalis*
Stickleback	SB	*Gasterosteus aculatus*
Sculpin	SC	*Cottus* spp.

In addition to the salmon in Ketchikan Creek, there are wild populations of steelhead, rainbow, cutthroat, brook trout, and Dolly Varden char. This is documented in ADF&G's steelhead surveys (**Table 3**), sport fish harvest data (**Table 4**), and the 1997 survey described later. Additionally, the average of 541 anglers recorded for the years 1990 to 1994 documents Ketchikan Creek's importance as a recreational fishery.

Because of this stream's importance as a fishery, the ADF&G has specified it for protection under AS16.05.870(a) as important to anadromous fish and is an ADF&G cataloged anadromous fish stream (stream # 101-47-10250) (ADF&G, 1987).

Table 2
Salmon Escapement Surveys

Year	Date	Chinook	Coho	Sockeye	Pink	Chum
1978	9/15/97			21	850	
1979	8/10/97			9	9200	
	8/20/97			15	13300	

	8/29/97				13000	
	10/4/97		60			
	11/5/97		130			
1980	9/10/97	1	10	23	4267	
1982	8/17/97			15	936	
1982	8/13/97	80				
	9/23/97		2	6	9272	1
1983	9/2/97	1353				
	9/23/97		1400			
	9/28/97	1	494	2	13230	1
1984	7/25/97	500				
	9/11/97	5				
	9/27/97				11187	1
	10/30/97				6880	6
1985	9/20/97		58			
1985	8/27/97				2076	3
	9/12/97	130			7830	
1989	8/5/97	300				
	9/7/97	7		1	27600	
1990	8/21/97	160	1000		11500	
1992	8/27/97	16	20		40000	1
1994	9/8/97		40		22960	
1995	9/6/97	7	25	2	19250	
Total*		2560	3239	94	216410	13
Average*		213	294	10	11390	2
Maxiumum		1353	1400	23	40000	6

Source:ADF&G 1996

Notes:

The ADF&G times these escapement surveys to detect peak pink salmon escapement and, while other species are noted and counted, their run timing differs and the numbers seen here should not be used in any other format.

* Because of the note above and that dates and frequency of surveys varied from year to year, the totals and averages per species are only given for general information.

Table 3
Adult Steelhead Survey Data for Ketchikan Creek, 1995 to 1998

Date	Reach #	Adult Steelhead Observed	Redds	Distance Surveyed (miles)	Survey Method	Source
04/06/95	K1 & K2	5	0	1.00	Foot	ADF&G
04/15/95	K1 & K2	4	0	1.00	Foot	ADF&G
04/21/95	K1 & K2	5	-	1.00	Foot	ADF&G
04/28/95	K1 & K2	16	0	1.00	Foot	ADF&G
05/05/95	K1 & K2	15	0	1.00	Foot	ADF&G
04/08/96	K1 & K2	0	0	1.50	Foot	ADF&G
04/16/96	K1 & K2	9	0	1.50	Foot	ADF&G
04/22/96	K1 & K2	9	0	1.50	Foot	ADF&G
05/03/96	K1 & K2	42	0	1.50	Foot	ADF&G
04/22/97	K1 & K2	1	1	0.76	Snorkel	ADF&G
04/29/97	K1 & K2	8	5	0.76	Snorkel	ADF&G
05/06/97	K1 & K2	7	-	0.76	Snorkel	ADF&G
05/14/97	K1 & K2	11	7	0.76	Snorkel	ADF&G
05/20/97	K1 & K2	27	15	0.76	Snorkel	ADF&G
05/30/97	K1 & K2	48	14	0.76	Snorkel	ADF&G
04/10/98	K1 & K2	13	0	0.76	Snorkel	ADF&G
04/23/98	K1 & K2	6	1	0.76	Snorkel	ADF&G
04/30/98	K1 & K2	17	1	0.76	Snorkel	ADF&G
05/07/98	K1 & K2	32	3	0.76	Snorkel	ADF&G
05/21/98	K1 & K2	32	13	0.76	Snorkel	ADF&G
05/29/98	K1 & K2	47	21	0.76	Snorkel	ADF&G
06/05/98	K1 & K2	20	28	0.76	Snorkel	ADF&G
04/19/98	*K3**	*0*	*0*	*0.26*	*Snorkel*	*Greystone*

* One adult steelhead (> 36 inches) was incidentally observed in reach K1 by Greystone on 4/19/98.

Table 4
Sport Fish Harvest and Effort by Species
Ketchikan Creek, 1990 to 1994

Year	Anglers	Trips	Days Fished	Fish Species: Chinook	Coho	Sockeye	Pink	Chum	Dolly Varden	Steelhead	Rainbow	Cutthroat	Brook
1990	926	2187	1978	197	292	10	470	11	479	96	80	16	16
1991	239	529	579	0	13	28	0	32	139	135	84	0	0
1992	436	835	1014	0	16	8	82	0	0	93	0	0	0
1993	352	1091	1212	0	82	9	9	0	214	0	0	0	0
1994	751	1936	2625	57	831	52	74	0	134	0	28	0	26
Avg	541	1316	1482	51	247	21	127	9	193	65	38	3	8
Min	239	529	579	0	13	8	0	0	0	0	0	0	0
Max	926	2187	2625	197	831	52	470	32	479	135	84	16	26

Source: (ADF&G 1996)

Table 5
Ketchikan Creek Fish Species Periodicity Chart

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chinook Salmon												
Passage					XXX	XXXX	XXXX	XXXX	XX			
Spawning							XXXX	XXXX	XXXX			
Incubation	XXXX	XXXX	XXXX	XXXX			XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Coho Salmon												
Passage								XXXX	XXXX	XXXX	XXXX	
Spawning	XX							XX	XXXX	XXXX	XXXX	XXXX
Incubation	XXXX	XXXX	XXXX	XXXX				XX	XXXX	XXXX	XXXX	XXXX
Rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Pink Salmon												
Passage							XXXX	XXXX	XXXX			
Spawning							XX	XXXX	XXXX			
Incubation	XXXX	XXXX	XXXX	XXXX			XX	XXXX	XXXX	XXXX	XXXX	XXXX
Rearing			XX	XXXX	XXX							
Sockeye Salmon												
Passage						XX	XXXX	XXXX	XXXX			
Spawning							XXXX	XXXX	XXXX	XXXX		
Incubation	XXXX	XXXX	XXXX				XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Rearing			XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Chum Salmon												
Passage							XX	XXXX	XXXX			
Spawning								XXXX	XXXX			
Incubation	XXXX	XXXX	XXXX	XXX				XXXX	XXXX	XXXX	XXXX	XXXX
Rearing		XX	XXXX	XXXX	XXXX							
Dolly Varden												
Passage												
Spawning						XXXX	XXXX	XXXX	XXXX			
Incubation	XXXX	XXXX	XXXX	XXXX		XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Rainbow Trout												
Passage												
Spawning		XX	XXXX	XXXX	XXXX							
Incubation		XX	XXXX	XXXX	XXXX	XXXX	XXX					
Rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
Steelhead Trout												
Passage	XX	XXXX	XXXX	XXXX	XXXX	XXXX						
Spawning		XX	XXXX	XXXX	XXXX							
Incubation		XX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX				
Rearing	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX

Source:(ADF&G 1988)
Notes:
Each 'X' represents a quarter of the month
Periodicity based upon professional judgment of ADF&G biologists
Incubation life phase includes period from egg deposition to fry emergence

3.2.1.2 Periodicity

Chinook, coho, and sockeye salmon rear year-round in this segment of Ketchikan Creek and the other species of salmon rear for short durations of the year following emergence (**Table 5**). Steelhead/rainbow trout and Dolly Varden char also use this stream segment for spawning, incubation and rearing year round (**Table 5**).

3.2.1.3 Deer Mountain Hatchery

A fish hatchery is located next to Ketchikan Creek (**Figure 1**). ADF&G began operation of the Deer Mountain Hatchery in the mid-1970's and the Ketchikan Indian Corporation is the current operator (Denton, 1996). Chinook salmon culture (Unuk River ancestral stock) began with the 1977 brood. Annual smolt releases into Ketchikan Creek have been around 100,000 for most of the years (**Appendix C**). Native-strain Ketchikan Creek coho stock was cultured until 1982. However, from 1986 to present, nonnative strain Reflection Lake summer coho stock has been cultured and released into Ketchikan Creek. Enhancement of the Ketchikan Creek steelhead stock has been intermittent, with small numbers released in some years (**Appendix C**).

The hatchery has a water appropriation of approximately 4.5 cfs from KPU's diversion water. It is withdrawn just after being released through the turbines but before the tailrace and routed directly to the hatchery via a 4-inch pipeline. The hatchery receives all of its water from this source.

3.2.1.4 Temperature

Because the hatchery's water supply comes directly from KPU's diversion waters just prior to the tailrace outlet, the hatchery's water temperature records provide data on tailrace water temperatures. Monthly averages at the hatchery ranged from 1.1°C (34°F) to 16.1°C (61.0°F), with maximum temperatures sometimes reaching 18.0°C (64.4°F), especially in August (Denton 1996). This is the upper limit for chinook salmon culture (Denton 1996) and the upper limit for 50% egg mortality (Alderdice and Velsen 1978; Groot and Margolis 1991). Detrimental effects have been seen in gamete viability, resulting in lowered survival of fertilized eggs (Denton 1996).

Although the hatchery and 1997 temperature data indicate temperature occasionally reaches higher than preferable for salmonids, lack of suitable rearing habitat is the most likely limiting factor to natural fish production (Denton 1996; Greystone 1997b).

In conversations with KPU employees, hatchery staff have learned that the occasionally high water temperature is a consequence of the intake pipe being on the bottom of Lower Ketchikan Lake, which is shallow. It would not be possible to access cooler water in the summer from the lower Ketchikan Lake where the outlet is located. Therefore, the hatchery staff has learned to work around the high temperatures by using refrigeration techniques (Denton 1996). Because the hatchery was constructed after the hydro-project, it has designed its operation with KPU's operation requirements as an existing condition.

KPU installed hourly continuous temperature monitors just above and just below the tailrace on July 25, 1997. A heavy flow event, occurring sometime between August 20 and October 4, washed out the loggers. They were both retrieved downstream of the tailrace on October 5, 1997. For this reason, only limited temperature data above and below the tailrace has been obtained. However, information from the limited data set is as follows.

Ketchikan Creek reached a maximum temperature of 19.4°C (67.0°F) below the tailrace during the sample period (with an average of 13.1°C (55.6°F). Additionally, the data indicate that the average stream temperature was at least 1.3°C (2.2°F) higher downstream of the tailrace than upstream of the tailrace during the sample period. Furthermore, the maximum temperature was at least 3.4°C (6.1°F) higher downstream than upstream of the tailrace. It is not known how much of this is project-related as described in Section 4.0.

3.2.1.5 Instream Flows

KPU has been operating at a required minimum flow (35 cfs) below the powerhouse since 1982. Prior to this 35 cfs requirement, the project was operated to maximize power production with no attempt to maintain instream flows below the tailrace. This minimum flow is required by FERC. Review of historical data indicates that 35 cfs is about the highest minimum flow that could be sustained over the summer months during a low rainfall summer. KPU's operating personnel have achieved a high degree of reliability in providing this minimum flow by installing a bypass gate that assures the 35 cfs flow even if a power failure occurs. This 35 cfs flow includes flows provided to the hatchery (maximum 4.5 cfs) and to a stream in the City Park.

There is no required instream flow above the tailrace in the bypassed reaches. Any flow in this reach is provided by seepage from the dams and direct runoff into these reaches. Flows have been documented to be as low as 3.6 cfs in the bypass reach just above the tailrace.

In 1988, the ADF&G filed an instream flow reservation to protect and maintain fish production within Ketchikan Creek from its mouth (river mile 0.0) upstream to approximately river mile 2.1 (ADF&G 1988). River mile 2.1 is approximately at the Ketchikan Lakes outlet (**Figures 1 and 2**). The rational for the instream flow request was an instream flow analysis conducted by the ADF&G using the Tennant Method. This analysis determined the hydrological characteristics of Ketchikan Creek and evaluated the effects that changes in those characteristics had on the fish species that depend on them (Tennant 1976; ADF&G 1988).

The ADF&G requested reservation of 74 cubic feet per second (cfs) in January, 70 cfs in February, 67 cfs in March, 122 cfs in April, 200 cfs in May and June, 70 cfs in July, 134 cfs in August and September, 219 cfs in October, 200 cfs in November, and 105 cfs in December. (Refer to the EA and hydrology technical report for more detailed discussion of this request.) KPU's operation of the project is not consistent with these requests. They currently run operations to maximize power output while maintaining the guaranteed minimum flow requirement of 35 cfs below the powerhouse and the water quality and quantity demands of the municipal water supply and hatchery water supply. The hydrology data indicates that these flow requests could not be maintained during the summer months where flows are often continuously at 35 cfs for weeks and even months.

These ADF&G states that these requested flows are not a request for water from KPU's operation, but is requested as the desired water in Ketchikan Creek if KPU's project is ever abandoned or modified which would allow additional instream flow water rights (ADF&G 1997).

3.2.2 Reach-Specific Information for the Anadromous Section

3.2.2.1 K1

This reach extends from the mouth of Ketchikan Creek (the Stedman street bridge) upstream to the confluence with Schoenbar Creek (**Figures 1 and 2 and Appendix A**). K1 is 2,659 feet long.

This reach was not surveyed for fish during the 1997 and 1998 field effort. However, ADF&G surveys (**Tables 2 and 3**) document the presence of all five species of salmon and adult steelhead throughout this reach. Additionally, Greystone incidentally observed one adult steelhead in this reach on April 19, 1998.

This reach was not surveyed for habitat during the 1997 field effort. However, general observations of spawning activities and substrate composition indicate that a portion of this reach is an important salmon spawning area for the Ketchikan Creek fishery. Additionally, the spawning and migration activities in this reach are important for the city of Ketchikan's tourism; providing an important part of the city's tours.

Historically, there was a substantial pink salmon fishery that spawned in the estuarian gravels at the mouth of Ketchikan Creek. Numbers probably exceeded 100,000 adults. However, removal of these gravels for roads and to deepen the harbor has eliminated this fishery (ADF&G 1998). Additionally, the Ketchikan Creek fishery was subjected to extensive overharvesting in the early 1900s from the now illegal fish trapping in the mouth of Ketchikan Creek.

A fishway was built in 1957 near the upper end of this reach to assist salmon escapement past a falls/cascade (**Figures 1 and 2**) for hatchery purposes. It is maintained by both the ADF&G and Ketchikan Indian Corporation, (the current operators of the Deer Mountain Hatchery). Although no documentation exists, it is thought that the fishway has greatly improved the pink salmon fishery above the fishway. The ADF&G has filed for a 5 cfs instream flow reservation at the fishway to maintain fish migration ability through the fishway. The top of the fishway is 1,355 feet downstream of Schoenbar Creek.

This reach ends at the confluence with Schoenbar Creek, historically an important salmon spawning area. However, communications with local residents indicate that alteration of habitat in upper areas of the creek have reduced its capabilities. Additionally, the 1997 survey crew observed a significant pooling of salmon at the mouth of Schoenbar Creek, unable to migrate past a poorly installed culvert at its mouth. Although heavy rains later made this passable, the poor culvert installation may significantly delay and disrupt migrations and, if low flows persist, may block migration. During worst-case conditions the culvert is perched, but even during best case conditions the length of the culvert creates difficult passage.

3.2.2.2 K2

This reach extends from Ketchikan Creek at the confluence with Schoenbar Creek to KPU's powerhouse tailrace (**Figures 1 and 2 and Appendix A**).

Dominant substrates in the reach were generally comprised of small cobbles (**Table 6** and **Appendix D**) suggesting this reach is an important salmon spawning area for the system. However, the reach was extremely homogenous with only fastwater habitat types present. The lack of pools in this reach equates to a lack of suitable rearing habitat and is the most likely limiting factor to natural fish production. Additionally, abundance of large woody debris (LWD) was the lowest of all the survey reaches, with only 23 per mile (**Table 6**), further contributing to the poor habitat diversity of the reach. The gradient is a relatively low 1 percent.

Snorkel observations in August and September of 1997 recorded adults of all five salmon species. Pink salmon was by far the most abundant adult salmon, while coho was the most abundant juvenile salmon (**Table 7**). The trapping and snorkeling surveys documented the presence of juvenile chinook, coho, Dolly Varden, steelhead/rainbow, and cutthroat in the reach (**Table 7**). Snorkel observations in April of 1998 found no adult steelhead; however, ADF&G Snorkel surveys in April and May of 1997/1998 document the occurrence of adult steelhead in this reach (**Table 3**).

The Deer Mountain Hatchery is located 663 feet upstream from the start of this reach (**Figures 1 and 2**). This hatchery diverts migrating salmon into the hatchery by installing a diversion (bar screen) across Ketchikan Creek during the Coho and Chinook spawning period in the fall. While installed, this barrier appears to almost completely restrict all but smaller-bodied pink salmon from

Table 6
Summary of Key Aquatic Habitat Parameters in the Ketchikan Creek System
August and September 1997

Reach ID	Reach Channel Type	Reach Length (ft)	Approx. Gradient (%)	Pool/FW Number Ratio	Pool/FW Lengths Ratio	Dominant Substrate	Fastwater			Pool		Dominant Vegetation Type	LWD (#/mile)
							Avg Length (ft)	Avg Width (ft)	Avg Depth (ft)	Avg Length (ft)	Avg Res. Depth (ft)		
K2	LC1	1378	1	0.0	0.0	SC	689	73	2.2	--	--	NFA/NHO	23
K3*	MC3	1284	5	0.8	0.5	BR	172	20	0.9	71	1.2	CFC	350
K4*	MC2	1855	2	1.0	0.5	LC	183	36	0.6	82	1.2	NFA	413
G1*	MC1	2400	2	1.1	0.3	BR	170	17	0.5	53	1.4	NFA	290
Avg	--	1729	3	0.7	0.3	--	303	36	1.0	69	1.3	--	269
Min	--	1284	1	0.0	0.0	--	170	17	0.5	53	1.2	--	23
Max	--	2400	5	1.1	0.5	--	689	73	2.2	82	1.4	--	413

Notes:
Reach Channel Type determinations were made using (Paustian 1992); MC1 = Moderate gradient, narrow shallow contained channel; MC2=Moderate gradient, moderate width and incision, contained channel; MC3=Moderate gradient, deeply incised, contained channel; LC1=Low gradient, contained channel.
2,659 feet total length of K1 (from Stedman Street bridge to Schoenbar Creek); upstream end of fishway to end of K1 (Schoenbar Creek) is 1,355 feet; 1,980 feet from start of estuarian influence to Schoenbar Creek.
* Flows in the bypassed reaches were higher than typical because no water was being diverted at Granite Basin Diversion so flow-related parameters should be viewed accordingly.

Table 7
Summary of Snorkeling and Fish Trapping Results
in the Ketchikan Creek System
August and September 1997 and April 1998

Reach ID	Species	Snorkel Data (fish/acre) Fastwater <300 mm	Fastwater >300 mm	Pool <300 mm	Pool >300 mm	Fish Trapping Data (Total for 6 Traps) <300 mm
K2	Chinook Salmon	66	18	--	--	6
	Coho salmon	931	30	--	--	14
	Sockeye salmon	0	18	--	--	0
	Pink salmon	0	2283	--	--	0
	Chum salmon	0	24	--	--	0
	Dolly Varden	48	12	--	--	0
	Steelhead/rainbow	240	0	--	--	24
	Cutthroat trout	12	0	--	--	1
	TOTAL	1298	2385	--	--	46
K3	Chinook salmon	0	0	42 (0)[1]	0	6 (1)[1]
	Coho salmon	114	0	354 (0)	71	28 (1)
	Sockeye salmon	0	0	0 (0)	35	0 (0)
	Pink salmon	0	2083	0 (0)	4243	0 (0)
	Chum salmon	0	0	0 (0)	71	0 (0)
	Dolly Varden	152	0	389 (35)	71	0 (0)
	Steelhead/rainbow	417	0	636 (813)	0	34 (5)
	Cutthroat trout	0	0	0 (0)	0	6 (0)
	Brook trout	0	0	24 (0)	0	0 (0)
	TOTAL	682	2083	1445 (848)	4490	74 (7)
K4	Steelhead/rainbow[2]	0	0	82	0	19
	Cutthroat trout[2]	0	0	37	0	22
	Brook trout	0	0	74	0	1
	TOTAL	0	0	193	0	42
G1a[3]	Brook trout	34	0	453	0	46
G1b[3]	Brook trout	0	0	0	0	0
GT1[4]	*Brook trout*	--	--	--	--	*48*
G2[4]	*no fish*	--	--	*0*	*0*	*0*
K5[4]	*Brook Trout*	--	--	*67*	*0*	--
K6[4]	*Brook trout*	--	--	*3*	*0*	*2*

Notes:

[1] Numbers in parentheses indicate snorkel and trap data collected on April 19, 1998. Additionally, a snorkel survey for adult steelhead was conducted in K2 and K4. No adult steelhead were found during the survey; however, one >36-inch steelhead was incidentally observed in reach K1.

[2] Because most, if not all, of these two species showed evidence of hybridization, identification was based on dominant phenotype.

[3] To more accurately describe the fisheries in this reach, the reach was split into two sections, G1a is the section below the migration barrier and G1b is upstream.

[4] Although not part of the survey, data was obtained to provide additional information. K5 was sampled just below confluence with G1, and K6 was sampled just above G1. This was qualitative data only, no estimate of fish/acre or fish/trap should be assumed.

migrating further upstream to spawn. It is not known what affect this passage restriction has on the anadromous fishery above the hatchery.

The hatchery supplements the native and wild steelhead and coho fishery occurring in Ketchikan Creek. It is not known what effect the hatchery has had on the genetic vigor of the native stocks of these two species, but it likely has had a negative effect on them. However, current thought in fisheries science is that any time you introduce genetically inferior hatchery-reared fish to a system that already has the same species natively occurring, it reduces the genetic fitness of the stock (unless the planted fish are sterile).

This reach ends at KPU's powerhouse tailrace. Field observations indicate that the tailrace is a false fish attraction for the migrating salmon (dominated by pink salmon). However, as described below, the spawning habitat upstream of the tailrace is extremely limited because of the bedrock-dominated substrate in K3 and the migration barrier at the end of K3.

3.2.2.3 K3

This reach extends from the tailrace to an anadromous fish migration barrier located 1284 feet upstream of the tailrace (**Figures 1 and 2 and Appendix A**).

Observations in April, August, and September 1997 and April 1998, indicate that a falls at the upstream end of the canyon area of Ketchikan Creek creates a migration barrier to anadromous species. This barrier consists of a cascade that hits bedrock wall, angles 90 degrees, and then drops approximately 5 feet. Additionally, there is not an adequate takeoff pool to allow salmon to maneuver the falls. The barrier may best be described as semi-permanent. It is not quite permanent because it is partially created by an old growth timber that will, after many years, deteriorate. However, it is essentially permanent because it does not appear to be a typical large woody debris barrier that could be washed out by a high flow event. As described in Section 3.3.1, there is anecdotal evidence that steelhead migrated past this point many years ago.

This section is significantly different from the rest of Ketchikan Creek for several reasons. First, this reach has extremely steep bedrock walls.

Accordingly, it has a relatively narrow channel (20 ft compared with 73 ft for K2 and 36 ft for K4) and complete lack of floodplain. It has relatively steep gradient (approximately 5%) with primarily bedrock substrates (**Table 5**). Also, because this section is above the tailrace, flows taken from Ketchikan Lakes and Granite Basin Diversion bypasses this reach. Therefore, it has significantly less flow than the downstream reaches.

Unlike K1, K2, and K4, spawning habitat in this reach is extremely limited, primarily due to the bedrock-dominated substrate. The lower instream flows may also reduce available spawning habitat in this reach, but increasing flows in this reach would only slightly increase its spawning habitat. The bedrock substrate in this reach limits its spawning habitat potential to such a degree that even historic flow levels would not appreciably increase habitat. Furthermore, the narrow channel width, complete lack of floodplain, and field observations indicate that high flows (e.g., ADF&G requested flows) in this reach would actually reduce available habitat, not increase it.

Adult pink, sockeye, chum, and coho salmon were all found up to the migration barrier at the end of this reach with pink salmon most abundant (**Table 7**). Additionally, juvenile chinook and coho were recorded, although almost exclusively near the downstream end of the reach (**Appendix D**).

During a reconnaissance survey in April 1997, an adult steelhead trout was observed trying to jump the migration barrier falls, documenting its presence up to the migration barrier. Accordingly, steelhead/rainbow juveniles were found throughout reach K3 during the snorkeling and trapping surveys in August and September 1997 and April 1998. No steelhead were seen past the migration barrier at the end of K3 during ocular observations in April of 1997 or during the adult steelhead survey conducted in April 1998.

Resident species recorded during the survey included rainbow, brook trout, and Dolly Varden. This was the farthest upstream reach where Dolly Varden char were found.

3.3 NONANADROMOUS SECTION OF KETCHIKAN CREEK

3.3.1 K4

This reach extends from the 5-foot falls at the upstream end of the canyon to a 35-foot falls (Rainbow Falls) (**Figures 1 and 2**).

This reach is much different from K3. This reach has a much broader flood plain and wider stream channel than K3. The 2 percent gradient is much more gradual than the 5 percent found within K3. Additionally, the substrates are comprised primarily of large cobbles instead of bedrock (**Table 6 and Appendix D**). Because of these differences, this reach has much better spawning and rearing habitat.

The bypass of flows in this reach appears to reduce its available aquatic habitat. More flow in this reach would increase the aquatic habitat, especially spawning habitat. However, field surveys in 1997 indicate that this reach cannot be accessed by anadromous fish. As a result, it is only inhabited by a small population of resident trout. This reach likely had much more aquatic habitat available for these resident fish species (and possibly anadromous prior to the barrier) when natural instream flows were present.

The snorkel and trapping surveys indicate that resident rainbow, cutthroat, and brook trout are the only fish species occurring in this reach (**Table 6**). The data collected indicate that the fish populations within reach K4, while not abundant, are reproducing successfully.

Snorkel observations and trapping in the reach document that fish sizes are very small. This could be caused by: 1) slow growth caused by marginal food availability due to the extremely unproductive, oligotrophic water; 2) fishing pressure; or, 3) a combination of the two. Fishing pressure on the small fish population found here could easily remove the larger fish. Survey crews during 1997 observed active fishing and camping within this reach of Ketchikan Creek.

Most rainbow and cutthroat showed evidence of hybridization with each other. This is not surprising given the limited population sizes in this reach and the tendency of these two species to readily hybridize.

Three hundred and thirty-four feet upstream from the start of the reach is where Scout Creek enters Ketchikan Creek (**Figure 1**). This creek is important because it contributes more than half of the flows to the bypass reach during low-flow periods (i.e., the flow in K4 above this point is half of the flow below). A qualitative fish snorkel survey in April 1998 found cutthroat/rainbow hybrids in Scout Creek and what appeared to be pure cutthroat in Scout Lake and upper portions of the stream. This finding suggests that this is the recruitment source for the cutthroat remaining in Ketchikan Creek.

There are unconfirmed reports from local fisherman that historically (possibly 35 years ago or more) steelhead made it upstream to Rainbow Falls. This was likely before the old growth timber created the migration barrier at the top of the canyon.

Three thousand and one hundred thirty-nine feet upstream from the tailrace is Rainbow Falls, and is the end of reach K4. Rainbow Falls has a vertical drop of approximately 35 feet. As its height suggests, it definitely is (and historically was) a migration barrier to all fish species. Refer to **Appendix A** for photographs of the falls.

3.3.2 K5

This reach extends from Rainbow Falls to the confluence with Granite Basin Creek (**Figures 1 and 2**.)

A second 35-foot falls occurs near the upper end of this reach (**Figures 1 and 2**). It is very similar to Rainbow Falls. As its height suggests, this falls is a definite permanent migration barrier, and was so historically.

No aquatic habitat and no formal fisheries data were collected in this reach during the 1997 survey. However, qualitative fisheries data were collected at the upper end of the reach (between the second 35-foot falls and Granite Basin Creek). The data were obtained by snorkeling and trapping optimum habitats. Both snorkeling and trapping found only eastern brook trout (**Table 7**). Although not sampled, the section of the reach between Rainbow Falls and the second 35-foot falls likely contains brook trout as were found above the second 35-foot falls. Additionally, because rainbow and cutthroat were found in K4, these species may also be found in this segment.

3.3.3 K6

This reach extends from Granite Basin Creek to the outlet of Ketchikan Lakes (**Figures 1 and 2**).

This reach was not formally surveyed; however, qualitative snorkeling and trapping were conducted in optimum habitats to determine species occurrence (**Table 7**). As in upper K5, only brook trout were found.

3.4 GRANITE BASIN CREEK

3.4.1 G1

This reach starts at the mouth of Granite Basin Creek and ends at KPU's Granite Basin Diversion. This is the reach where flows from upstream are bypassed to Fawn Lake (**Figures 1 and 2**).

This reach has relatively good aquatic habitat with the exception of its reduced flows as explained below. It had the best pool-to-fastwater ratio of any of the reaches and, although dominated by bedrock, had several sections with suitable spawning substrates (**Table 6**). It also has a relatively low (2%) gradient.

The only species of fish found in Granite Basin Creek was the nonnative eastern brook trout. Furthermore, they were only found up to a migration barrier in reach G1 (1352 feet upstream). Therefore, for fisheries discussions, reach G1 is divided into two sections. G1a is the fish-bearing section (below the migration barrier) and G1b in the remaining section (**Table 7**).

During low flow periods, reach G1 (the bypassed reach of Granite Basin) has some sections of stream flowing subsurface (i.e., beneath the substrate) (see photo in **Appendix A**). These sections have a few permanent pools that provide some habitat to support the limited brook trout population.

3.4.2 GT1

This reach consists of a small tributary stream just upstream of where the penstocks cross Granite Basin Creek (**Figures 1 and 2**).

This reach was not surveyed for aquatic habitat. However, fish traps were set to document the large numbers of brook trout fry observed. Its size is limited (< 0.5 cfs flow, < 0.1 ft avg depth, and < 3 ft avg width during the 1997 survey). Despite its limited size, hundreds of fry were seen throughout this tributary, indicating its importance as a spawning tributary and probable recruitment source for lower Granite Basin Creek (G1a). Two fish older than a year were recorded in this reach (**Table 7 and Appendix D**).

3.4.3 G2

This reach extends from KPU's Granite Basin Diversion to the first lake on Granite Basin Creek (**Figures 1 and 2**).

This was not a formally surveyed stream reach. However, trapping and qualitative snorkeling of optimum habitat was conducted to provide information on presence/absence of fish species above the diversion. No fish were found in this reach.

3.5 KETCHIKAN LAKES

According to an ADF&G survey of Ketchikan Lakes, fish species within Ketchikan Lakes include cutthroat trout, sticklebacks, cottids, and nonnative eastern brook trout (ADF&G 1995). ADF&G records show that the brook trout population originated from a U.S. Forest Service stocking of 5,000 fingerlings in 1931 from Yes Bay Hatchery.

The ADF&G survey reports that the Lakes substrates generally consist of bedrock and talus, with some muck in the depths. However, there are good spawning grounds at the primary inlet to the Lakes. The Lakes are approximately 640 acres in size with an estimated maximum depth of 200+ feet in the upper lake. The Lakes are oligotrophic, probably resulting in a fishery with slow growth rates.

All of Ketchikan Lakes water, except infrequent spills, is diverted from its historic course of Ketchikan Creek (**Figures 1 and 2**). The intake pipe for this diversion is located in the lower levels of Lower Ketchikan Lake. Because this is a shallow lake, water temperatures are strongly influenced by seasonal air temperatures.

Fish were observed rising in Fawn Lake during the 1997 survey. Conversations with KPU staff indicated that the fish migrate to and from Ketchikan Lakes via the penstock. Fawn Lake is a manmade lake created for this project to route water to the powerhouse.

4.0 PROJECT-RELATED EFFECTS

This section evaluates the potential consequences of continued operation of the hydroelectric project on the fisheries resource. No changes to the current operation are proposed in the relicense application.

Potential effects on the fishery in Ketchikan Creek was identified as an issue during scoping for the Ketchikan Lakes Project. Specifically, fishery issues and concerns for the project were:

- Potential effects of the project's flow modifications on aquatic habitat in the bypassed reaches of Ketchikan and Granite Creeks. Specifically, there is concern regarding the potential elimination of instream flows throughout the Ketchikan Creek bypassed reach (there is concern about the lack of a project flow regime for the bypassed reach).

- Potential effects of project facilities and operations on aquatic habitat and fish migration below the powerhouse. There is concern that the current flow regime (volume, variability and timing) is inadequate and is affecting fish resources and spawning habitat of Ketchikan Creek below the powerhouse. There is specific concern about the potential for stranding of fry due to flow being reduced during critical times.

- Potential project-related modification of stream temperatures and effects on the fishery in Ketchikan Creek and adjacent fish hatchery.

- Potential effects of flow and lake level fluctuations on the fishery in Ketchikan Lakes, particularly the effects on brook trout spawning.

Because no changes to the current operation are proposed, effects on the fisheries due to continuation of the project would be the same as those occurring at present. These effects or potential effects are described below.

4.1 REDUCTION OF FLOWS IN BYPASSED REACHES

Flows in the bypassed reaches (K3-K6, G1) will continue to be bypassed. Accordingly, this will result in continuation of reduced aquatic habitat in the bypassed section (except potentially for K3 as discussed above). This reduces available resident fish spawning and rearing habitat and reduces habitat for periphyton and macroinvertebrates, lowering productivity and the fishery's food supply.

Reduction of flows will primarily affect resident fish species. This is because anadromous fish only occur in the lower 1284 feet of the bypassed section (reach K3) and this reach has very poor spawning habitat. Good potential spawning habitat only occurs upstream of a falls impassible by anadromous fish.

Upper parts of the bypassed section (K5, K6, G1) were documented to be dry (except subsurface flow) during low rain periods, leaving only residual pools to sustain fish. This likely reduces the fish populations by increasing stress, competition, and predation.

KPU will continue to restrict fishing in the Project Area. Because the bypassed section appears to be unproductive and may not be able to support fishing pressure, these restrictions will help maintain current population levels.

4.2 MODIFICATION OF INSTREAM FLOW BELOW THE TAILRACE

4.2.1 Ramping Rates

The ADF&G reports that abrupt decreases in water discharge into the creek from the project have, in the past, resulted in high mortality to rearing juveniles (Denton 1996). This and other ADF&G information on fry strandings suggests that some level of impact occurs. The effect on the fishery resulting from potentially abrupt decreases in flow is currently unquantified.

KPU's ramping rates are conducted to maximize power production (taking into account the project's other operational needs) and protect's the fishery below the tailrace by maintenance of 35 cfs flow. Accurate ramping rate information is currently not known. Therefore KPU is currently conducting studies to collect the necessary streamflow data to enable the calculation of ramping rates.

4.2.2 Minimum Flows

The data set found that minimum flow below the tailrace was at or near 35 cfs in more than half the months. Flows at or very near 35 cfs occurred every day of the month during 9 of the 66 months recorded (and at least 90 continuous days during the summer of 1992). This confirms that constant minimum flows occur for relatively long periods.

While the effect of the minimum flow level on the fishery has not been quantified, the current flow regime supports a significant wild pink salmon fishery with spawning occurring throughout the reaches of Ketchikan Creek below the tailrace. Furthermore, KPU’s ability to store water and guarantee at least 35 cfs below the tailrace may benefit the fishery during no-rain periods compared to pre-project flows. This is because it is likely that pre-project (unregulated) flows were less than 35 cfs during some of these no-rain periods. Additionally, the 35 cfs minimum flow requirement has increased minimum instream flows substantially with flows recorded as low as 3.6 cfs prior to the requirement.

4.2.3 Seasonal Flow Requirements of Fish

Because the project started modifying flows in 1903, no true data on the unregulated flows exist. However, estimates of unregulated flows have been synthesized and indicate that the current regulated flows more closely approximate the ADF&G’s requested flows than would unregulated flows. This indicates that the project has improved the instream flows over natural unregulated flows. Furthermore, the hydrological analysis indicates that operation of the project has significantly reduced peak flows compared to unregulated flows.

The ADF&G’s instream flow study (ADF&G 1988) indicates that their seasonal flow requests would improve the fishery over the current regulated flows. However, further manipulation of flows to achieve the ADF&G’s requests would reduce power production and disrupt how KPU operates their entire hydroelectric system on the island.

4.3 TEMPERATURES BELOW THE TAILRACE AND AT THE HATCHERY

Stream temperatures in Ketchikan Creek below the tailrace (during the limited data set of the fall temperature monitoring) was found to reach a maximum of 19.4°C, and that the tailrace waters average at least 1.3°C higher than the water upstream (with a maximum of 3.4°C higher). Additionally, the hatchery's temperature data recorded a maximum average monthly temperature of 16.1°C (in August) and an instantaneous maximum of 18.0°C.

While the limited data collected last fall indicate that the tailrace water is warmer than the bypass reach, it is not known if it is project-related. This is because there is no pre-project temperature data and it is very likely that temperatures in the bypass reach were warmer than what occurs now. For example, during pre-project conditions, the warmer Ketchikan Lakes water was a major portion of the water in the bypass reach. This likely resulted in warmer water at the above tailrace sample location than occurs currently.

Any project-created water temperature increases would likely be relatively insignificant compared to the temperature increases resulting from water retention time/solar radiation in Ketchikan Lakes. However, possible project-related temperature increases could be the result of heat transfer from the turbines, heat friction from water passing through the penstocks, and solar warming of water in above ground penstocks and Fawn Lake. (The latter is unlikely due to the lack of retention time in the penstocks and Fawn Lake.)

Regardless of whether the warm water temperature is natural or project-induced, these data indicate temperature could be affecting the survival rates of salmon during incubation. Alderdice and Velsen (1978) determined that the upper limit for 50% egg mortality of Chinook salmon was 16°C when incubation temperature was constant. However, the data indicate that temperatures probably do not stay at or above 16°C throughout the incubation period. Additionally, temperatures typically are lower during September and much lower during October, potentially reducing the adverse effects to the eggs.

Continuation of the project has not adversely affect temperature problems at the Deer Mountain hatchery for the following reasons. The hatchery was built when the project's operations were already in place. Therefore, any temperature problems experienced at the hatchery were present from the beginning of hatchery operations. Furthermore, the hatchery uses refrigeration techniques to remedy the temperature problem.

4.4 LAKE LEVEL FLUCTUATION IN KETCHIKAN LAKES

Eastern brook trout is an exotic species that historically did not occur in Alaska. Typically, maintenance of a nonnative fish species only occurs when the fishery is managed for recreation fishing. Since recreational fishing is restricted in Ketchikan Lakes, maintenance of nonnative brook trout should not be an issue.

KPU will continue to restrict fishing within Ketchikan Lakes. Because the lakes appear to be unproductive and may not be able to support fishing pressure, these restrictions will help maintain current population levels. Furthermore, KPU has committed to conducting a lake fishery study if the lakes are opened to fishing in the future.

It is unlikely that the project's fluctuations of lake levels adversely affect brook trout populations within Ketchikan Lakes. This is because the brook trout population was not established until after the projects operation was already in place; therefore, the population has developed under any operational flow fluctuations. Furthermore, there is protection afforded to the Ketchikan Lakes fish habitat due to KPU's filtration avoidance program (required for the City's water supply which also comes from this project). Under this program, KPU is restricted by the EPA from drawing down the water levels in Ketchikan

Lakes to a great extent. This restriction would not likely allow the reduction of brook trout spawning habitat to the level where it would affect the existing population. Based on water-level drawdown restrictions at Ketchikan Lakes, continuation of existing operations would probably have negligible effects on the lakes' current fish populations.

4.5 FALSE FISH ATTRACTION AND ENTRAINMENT POTENTIAL

Adult salmonids were observed to be falsely attracted to the project's higher-velocity tailrace during their upstream spawning migrations. This false attraction can result in delaying the upstream migration of these fish (FERC 1995). Although this delay is occurring, true impacts from this are most likely minimal. This is because the spawning habitat (accessible to salmon) above the tailrace is limited.

Because the Ketchikan Lakes intake is located away from shoreline fisheries habitat and the water supply requirements limit water-level drawdowns, entrainment affects on the fishery is expected to be low. Additionally, there is no entrainment potential at the intake tunnel entrance on Granite Basin Creek because surveys conducted in 1997 document the absence of fish populations in this segment of Granite Basin Creek.

4.6 SPAWNING GRAVEL RECRUITMENT

Installation of the dam at the outlet of Ketchikan Lakes and installation of the Granite Basin Creek diversion have most likely resulted in some loss of alluvial material recruitment to Ketchikan Creek and lower Granite Creek. However, aquatic habitat surveys conducted in 1997 indicate good quality and quantity of spawning substrates in the system, especially in reaches K2, K4, and G1.

4.7 CUMULATIVE IMPACTS

No cumulative impacts to the aquatic resources of Ketchikan are expected for the following reasons. The project is already in operation and, as a result, no project-related construction activities (other than routine maintenance) will be completed. Additionally, because this project is located within a restricted-use watershed to maintain drinking water quality, no projects that could affect the aquatic habitat would be allowed in the watershed. An exception to this is a proposed "scenic old-growth forest tram" project within the Granite Creek Basin drainage. This project is under consideration by the U.S. Forest Service. However, if implemented, this project, by its very nature, is intended to be installed using very environmentally sensitive procedures. As a consequence, this project would not be expected to cumulatively affect the aquatic resources.

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APPENDIX A
REPRESENTATIVE PHOTOGRAPHS OF THE KETCHIKAN CREEK SYSTEM, 1997

APPENDIX B
FISH HABITAT MONITORING PROTOCOL FOR THE TONGASS NATIONAL FOREST SUMMARY

APPENDIX C
DEER MOUNTAIN HATCHERY RELEASE HISTORY, 1977 TO 1995

APPENDIX D
AQUATIC SURVEY, AUGUST AND SEPTEMBER 1997

D-1

Aquatic Habitat Data

D-2
Snorkel Data

D-3

Fish Trapping Data