

FINAL BLUE LAKE RAINBOW TROUT SPAWNING SURVEY

STUDY PLAN FOR 2008

Blue Lake Hydroelectric Project FERC No. 2230 Expansion

City and Borough of Sitka, AK Electric Department

May, 2008

INTRODUCTION

This study plan describes proposals for monitoring rainbow trout spawning and other factors in Blue Lake near Sitka, Alaska, during 2008. The plan describes both field and office studies aimed at determining effects of a proposed raise in height of the Blue Lake Project dam.

This final plan incorporates Participant comment and changes made by the City on the draft version distributed in February, 2008. Changes related to Participant comments are highlighted in red and are documented in Table 1 in the final section. Changes made by the City independent of comments, are in red, underlined.

BACKGROUND

The City and Borough of Sitka Electric Department (City) recently received a new license for the Blue Lake hydroelectric Project (FERC No. 2230, "Project") from the Federal Energy Regulatory Commission (FERC). During the relicensing process, the City's ongoing energy forecasts indicated that, in order to assure continued delivery of low cost electrical power in the face of rising energy needs in Sitka, it must expand its electrical generating base.

Among other alternatives, the City is examining 1) installing a third generating turbine next to the existing Blue Lake Project powerhouse; and 2) raising the height of Project dam. Study planning for the potential dam raise is prioritized in this document to assure that the final study plan will be available prior to the time period when Blue Lake rainbow trout are expected to begin their spawning migration in Spring, 2008.

As part of the early study planning process, the City distributed a draft of this study plan on Feb. 7, 2008, with a request for comment. As of May 15, 2008, the City received comments requesting change only from the US Forest Service (USFS) Sitka Ranger District, dated May 8, 2008. These comments were addressed as described in the "Consultation and Comment" section, below.

Also part of this study planning process was the City's proposal to address rainbow trout spawning and rearing habitat in Blue Lake Creek, the primacy inflow tributary to Blue Lake, as described in point 4 of the following section. The City proposed to prepare a

draft Habitat Study Plan and to convene a “Habitat Work Group” to address studies in Blue Lake Creek and other tributaries in more detail. Further consultation and comment in that area are also described in the “Consultation and Comment” Section, below. The Habitat Study Plan remains separate from this plan and will be finalized after the Habitat Work Group completes early field work and methods development for those studies.

ELEMENTS OF PROPOSED 2008 BLUE LAKE STUDIES

To evaluate effects of dam raising, the City proposes studies in four different areas: 1) Literature Review; 2) Temperature Monitoring; 3) Spawning, Incubation, Emergence and Life History Observations; and 4) Habitat Analysis, as described in the following:

1. LITERATURE REVIEW

The City will compile and make available in reports, all Blue Lake data gathered during the Project relicensing. These data will be from finished and reviewed reports, as well as from the City’s and contractor’s files. The City will also review and include, as appropriate, other relevant information on rainbow trout spawning from Southeast Alaska and the lower 48 states.

2. TEMPERATURE MONITORING

To better determine associations between rainbow trout spawning and temperatures in both Blue Lake and its tributary streams, the City will continuously monitor water and air temperature in locations selected to best represent conditions associated with spawning and incubation.

3. SPAWNING, INCUBATION and EMERGENCE OBSERVATIONS

To build on spawning surveys conducted in 2005, the City will intensively monitor rainbow trout spawning, incubation and fry emergence in Blue Lake Creek and other Blue Lake tributaries known to offer spawning habitat.

4. HABITAT ANALYSIS

Because the proposed dam raise would increase Blue Lake elevation during the spawning period, rainbow trout would be able to ascend further up Blue Lake Creek after a dam raise. This is because there is a barrier falls near the mouth of Blue Lake Creek which blocks upstream migration when the reservoir level is below about El 337 (Figure 1). Because of this barrier, only a short segment of Blue Lake Creek is currently available for spawning during the May-June spawning period because reservoir levels are usually below the barrier’s elevation during that period. Water rises above the barrier elevation in the fall as the reservoir fills, but spawning is normally complete by the time the stream’s upper reaches become accessible. This barrier is called the “lower barrier”; a second impassable falls, the “upper barrier” is located about 1.9 miles upstream on Blue Lake Creek (See Figure 1).

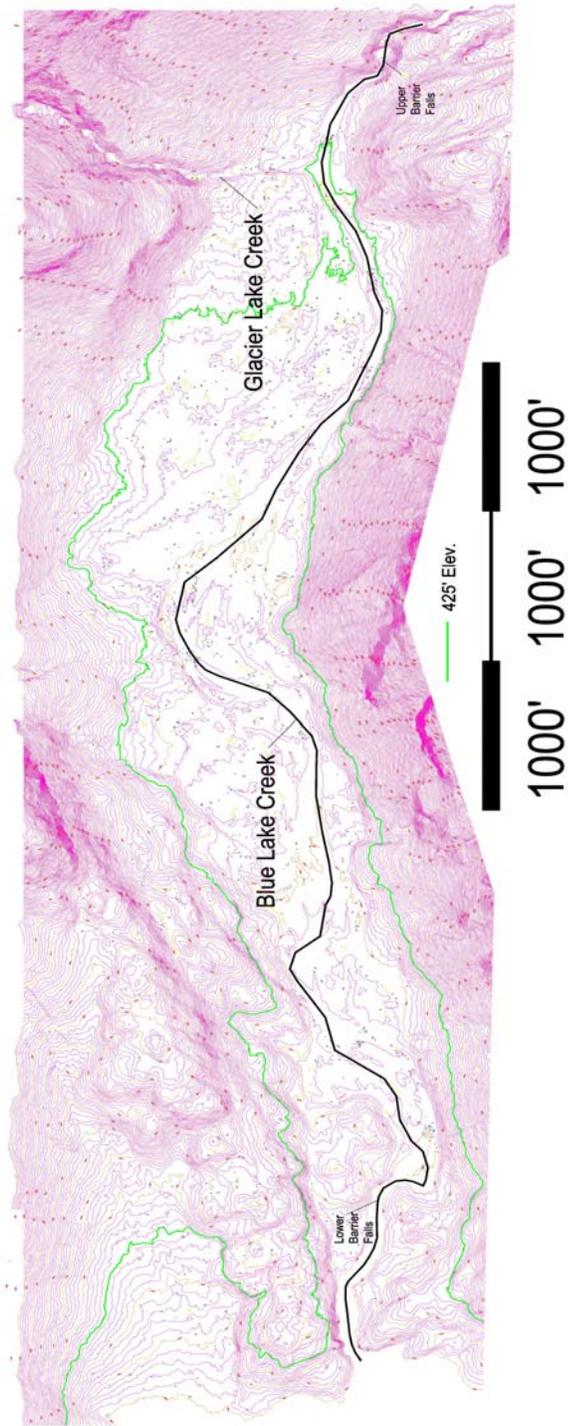


Figure 1. Blue Lake Creek Lower and Upper Migration Barriers

Access into the stream reaches between the two barriers could provide extensive spawning, depending on the spawning habitat quality in the newly-accessible reaches. To determine the potential for additional spawning in these potentially-available stream reaches, the City proposes, in association with resource agency specialists, to develop and apply a method for evaluating spawning habitat in Blue Lake Creek's potentially-accessible reaches.

The City proposes to convene a Habitat Work Group in late winter and early spring, 2008. This Work Group, composed of resource agency specialists and City representatives, will develop field measurement and office analysis protocols to be applied on Blue Lake Creek. In addition to the detailed analysis of Blue Lake Creek, the Habitat Work Group will also address ways to evaluate available habitat in other Blue Lake tributaries, and the extent to which higher water elevations might affect spawning rainbow trout there.

MATERIALS AND METHODS

LITERATURE REVIEW

The City and its contractors will review existing literature on both Blue Lake and on other comparable rainbow trout populations in Southeast Alaska and elsewhere. Available documents include, but will not be limited to:

Chadwick, Robert. 2004. Electronic Database of Historical Blue Lake Drainage Letters. ADF&G Sport Fish Division, Sitka.

City and Borough of Sitka Electric Department, 2005. Population Estimation of Adult Rainbow Trout in Blue Lake Near Sitka Alaska. Blue Lake Hydroelectric Project (FERC No. 2230) Relicensing. 23 pp.

City and Borough of Sitka Electric Department, 2005. Saw Mill Creek and Blue Lake Water Temperature Studies. Blue Lake Hydroelectric Project (FERC No. 2230) Relicensing. 16 pp.

City and Borough of Sitka Electric Department, 2005. Blue Lake Water Temperature and Rainbow Trout Spawning Studies. Blue Lake Hydroelectric Project (FERC No. 2230) Relicensing. 26 pp.

Der Hovanisian, J. A. 1994. Stock assessment of rainbow trout in a southeast Alaska impoundment. Juneau: University of Alaska. Thesis

Much of the available literature was reviewed during production of the City's temperature and spawning studies used in the Project relicensing. However, more emphasis will be placed on studies documenting spawning and rearing habitat analysis, to assist in the analyses described under "Habitat Analysis", below.

In addition, the City will further research 1) documented rainbow trout spawning in other southeast Alaska lakes and reservoirs; and 2) analyses of rainbow trout spawning in streams in southeast Alaska and the Pacific Northwest, with emphasis on habitat utilization and quantification methods.

TEMPERATURE MONITORING

Because water temperature is an important factor in the timing of rainbow trout spawning, the City will continue to measure water temperature in Blue Lake and its tributaries. Both continuous and instantaneous temperature monitoring will be conducted, as described in the following:

Continuous Temperature Measurement

Monitoring Equipment

All continuous water temperature measurements in Blue Lake and its tributaries will be monitored using Onset Computer “Hobo Pro V2 Water Temperature Data Logger” model U22-001 loggers with 64K bytes memory. Specifications for these loggers may be reviewed at Onsetcomputer.com.

Loggers will be set to record temperature every two hours. Data will be downloaded onsite in order to minimize gaps in the data set.

Data from each logger will be transferred in the field to an Hobo Waterproof Shuttle, model U-DTW-1. The Shuttle utilizes an Optic Coupler which holds the shuttle and logger with their optic communications windows aligned. This optical connection is immune to weather conditions and functions well underwater. Data will be downloaded to a computer in the office by connecting the Waterproof Shuttle to an Optic USB Base Station, again using the Optic Coupler.

Data Processing and Operational Software

Computer processing of logger data will be done using Hoboware Pro for Windows. We have used the predecessor of this system extensively and found it to be very reliable under all weather conditions. This software allows data export to an Excel format file or delimited text file, allowing analysis by almost any data processing program.

Continuous Temperature Monitoring Elements and Locations

Blue Lake continuous temperature monitoring in 2008 will consist of the following three elements:

- Blue Lake Creek and other Tributary Stream Monitoring.
- Surface Water Temperature Monitoring; and
- Lake Stratification Monitoring.

Temperature loggers will be placed at various locations in Blue Lake, Blue Lake Creek and other tributaries as described below. Locations of loggers in the earlier Blue Lake studies are shown in Figure 2 [in this Draft Study Plan for reference](#). These locations may be changed based on agency review. Final locations will include additional loggers in various reaches of Blue Lake Creek along its entire potentially-accessible length. Current logger locations are shown in Figure 3.

Blue Lake Tributary Stream Temperature Monitoring

Blue Lake tributary loggers will continuously monitor temperatures leading up to, during and immediately after the expected rainbow trout spawning period. These loggers will be placed in their respective tributaries during late March early April, 2008.

Loggers will be placed in Blue Lake Creek and other Blue Lake tributaries in which either rainbow trout or their fry were observed in earlier years of the study. Blue Lake Creek loggers will be placed along the Blue Lake Creek's entire accessible length to measure temperatures which might be available if trout were allowed to ascend higher in the stream at higher water levels. Also, loggers will be placed higher in other tributaries than during earlier studies, to evaluate temperatures in reaches available at higher water levels. Exact logger placement will be agreed upon between City researchers and reviewing agencies prior to [May](#), 2008.

Loggers will be checked for operation every time researchers visit the tributaries to observe spawning, as described below. After researchers conclude that spawning is complete in 2008, we will visit the logger locations less frequently.

Surface Water Temperature Monitoring

To monitor "surface" water temperature, two single loggers will be installed: one on the "log boom" near the dam, and another in the [east](#) end of the reservoir near the Blue Lake Creek inlet. Both of these loggers will remain about 18 inches underwater at all reservoir levels. The [east end](#) logger will document surface temperatures associated with effects from Blue Lake Creek and Becky Creek.

Lake Stratification Monitoring

To continuously monitor Blue Lake water temperature from bottom to surface, an array of [15](#) loggers will be attached to a line suspended near a vertical rock face (Figure 3). Vertical positioning (elevation relative to fixed datum) of the loggers will not change regardless of reservoir surface elevation. The array will be positioned far enough from the Project intake to minimize effects of water being drawn from the lake either over the spillway or through the intake.

In our earlier temperature stratification study, we measured temperature to a depth of about 120 feet below existing spillway level (El [342](#)) because the exposed loggers had a

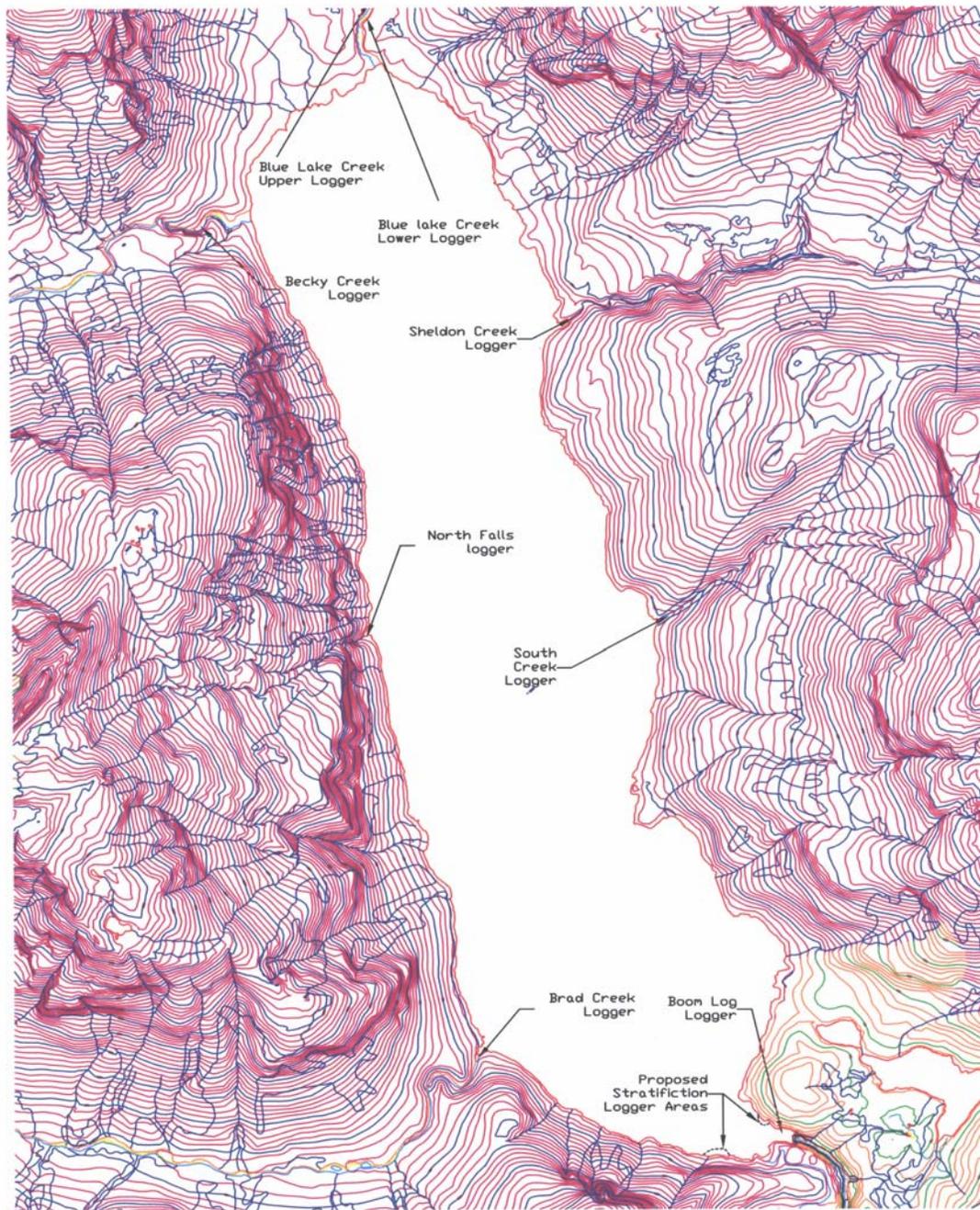


Figure 2. Blue Lake Temperature Logger Locations from Earlier Studies

	Description	Name Used in Loggers	Location Acronym	State Plane NAD 83 EAST	State Plane NAD 83 NORTH
Upper Lake Tributaries					
1	Brad Creek	Brad Crk	BRAD	2381964	1917337
2	Falls North Side of Lake	Falls North Side of Lake	FALL	2388268	1918905
3	Becky Creek	Becky Crk	BECK	2394208	1921255
4	Sheldon Creek	Sheldon Crk	SHEL	2393077	1915820
5	Drainage Valley on South Side of Lake	Southside Drainage	BLSD	2388466	1914775
6	Blue Lake Creek - Upper	Blue Lake Crk - Upper	BLCU	2397322	1918786
7	Blue Lake Creek - Lower	Blue Lake Crk - Lower	BLCL	2397187	1918874
8	Blue Lake Creek - Upper Barrier Falls	Blue Lake Crk - Upper Barrier Falls	UBF	2405406	1918717
9	Blue Lake Creek - Glacier Creek	Glacier Crk	GC	2404736	1919148
10	Blue Lake Creek - Stream Mile 1	Blue Lake Creek - Stream Mile 1	SM1		
11	Lake Surface Temp east end	Lake Surface East	LSE	2394250	1918289
Near Dam and Intake					
12	Log Boom measuring lake surface temperature	Log Boom	BOOM	2380800	1913156
13	Thermocline String -15 ft	Thermocline -15	TS15	2380773	1914976
14	Thermocline String -30 ft	Thermocline -30	TS30	2380773	1914976
15	Thermocline String -45 ft	Thermocline -45	TS45	2380773	1914976
16	Thermocline String -60 ft	Thermocline -60	TS60	2380773	1914976
17	Thermocline String -75 ft	Thermocline -75	TS75	2380773	1914976
18	Thermocline String -90 ft	Thermocline -90	TS90	2380773	1914976
19	Thermocline String -105 ft	Thermocline -105	T105	2380773	1914976
20	Thermocline String -120 ft	Thermocline -120	T120	2380773	1914976
21	Thermocline String -135 ft	Thermocline -135	T135	2380773	1914976
22	Thermocline String -150 ft	Thermocline -150	T150	2380773	1914976
23	Thermocline String -165 ft	Thermocline -165	T165	2380773	1914976
24	Thermocline String -180 ft	Thermocline -180	T180	2380773	1914976
25	Thermocline String -195 ft	Thermocline -195	T195	2380773	1914976
26	Thermocline String -210 ft	Thermocline -210	T210	2380773	1914976
27	Thermocline String -225 ft	Thermocline -225	T225	2380773	1914976
Sawmill Creek					
28	Dewatered Reach	Dewatered Reach	DWR	2379602	1912320
29	Sawmill Creek Penstock Crossing	Penstock Crossing	PENX	2379152	1912320
30	Fish Valve Hydro Tailrace & Bypass Valve	Fish Valve - Tailrace	FVHT	2379152	1912545
31	Campground Bridge Across Sawmill Creek	Campground Bridge	CGB	2378848	1912545
32	Lower Staff Gauge	Lower Staff Gauge	LSG	2374758	1909213
33	Blue Lake Hydro Tailrace	Blue Lake Hydro Tailrace	BLHT	2374871	1909043
34	Sawmill Creek Road Highway Bridge	SMC Road Bridge	SCRB		
				R. Dryden/Orbison	8-Feb-08

Figure 3. 2008 locations of temperature loggers in Blue Lake and Sawmill Creek.

depth limitation at about that depth. In 2008, the City intends to measure temperature to a depth of 225 feet to better simulate stratification conditions under increased dam height(s). From El 342 to a depth of about 225 feet, loggers will be deployed every 15 feet.

Continuous Temperature Monitoring Timeframe

All continuous temperature loggers will be emplaced by May, 2008, depending on access to various lake and tributary areas, and will remain active and in place through late fall, 2008, at a minimum. Experience has shown that leaving tributary loggers in place through the winter can cause damage or loss due to burial. It is expected that the tributary loggers will be removed in late fall-early winter, 2008.

Instantaneous Blue Lake Temperature Measurement

During the rainbow trout spawning period, water temperature in the east end of Blue Lake and selected tributaries will be measured using hand-held thermometers during each visit scheduled to service tributary loggers or observe rainbow trout spawning. These temperatures will be measured in multiple areas whether or not spawning fish are observed, to correlate tributary temperatures (from the loggers) with those in adjacent Blue Lake areas. Temperature loggers will be checked for operation and instantaneous temperature measurements, using hand-held thermometers, will be made at the logger locations to verify and, if necessary, calibrate, logger measurements.

SPAWNING, INCUBATION, EMERGENCE and LIFE HISTORY OBSERVATIONS

The objectives of these observations will be to determine the extent and timing of rainbow trout life history stages in Blue Lake Creek and other Blue Lake tributaries, with a focus on habitat utilization for spawning, incubation and rearing. In Blue Lake Creek, observations will extend in duration to better document whether rainbow trout use the stream as juveniles and adults.

Observation Methods

Foot and snorkel surveys will be conducted to observe rainbow trout activity in Blue Lake tributaries in spring and summer, 2008. Observations will be conducted throughout Blue Lake Creek to its confluence with Glacier Creek, as permitted by safety and access considerations. As rainbow trout are observed ascending tributaries to spawn, researchers will visit the suspected tributaries more frequently, and may even remain on the lake overnight during periods of peak activity.

Snorkel methods will be used wherever water depth and velocity do not preclude their use. A detailed habitat map of Blue Lake Creek has been developed, upon which trout spawning locations will be noted by date, temperature, and time. Similar maps have been developed for other tributaries, as data become available. Researchers will record lake

level, air temperature, cloud cover, precipitation, time of day at beginning and end of survey, and other factors, on a standardized field form.

Surveys will initially be done twice per week, until spawning in-migration is noted to peak. After actual spawning is observed, surveys may be conducted daily, to assure observation of peak spawning period and location. **For the remainder of the year, observations will be conducted roughly monthly to observe juvenile and adult fish and better described overall life history.**

Observation Time Period

Earlier studies have shown that spawning occurs between mid May and July. Spawning observations have **begun in May on a weekly basis** and will increase in frequency through June and July. Because some spawning in Blue Lake Creek has been observed as late as July, the observations will continue until it is determined by researchers to have ceased entirely. At that time, surveys will continue in order to document fry emergence, thought to begin by early July and continue through September.

Monitoring Data Collection And Recording

For all types of temperature and fish monitoring, dates and locations of each measurement or observation will be noted as data is collected. When possible, Global Positioning System (GPS) equipment will be used to verify locations. Where GPS will not receive satellite signals due to the terrain, the latitude and longitude of the locations will be determined from a geo-referenced orthophoto or LIDAR-developed topography.

HABITAT ANALYSIS

Blue Lake Creek

The City will conduct a habitat analysis to determine the potential for rainbow trout spawning in all accessible reaches of Blue Lake Creek. **The “accessible” reaches of Blue Lake Creek are thought to lie between two barriers, the “Lower Barrier” just upstream of the outlet to the lake S.M. 0.1 and the “UpperBarrier” at S.M. 2.0.** Generally, the analytic method will involve measurement, quantification and analysis of both macro- and micro-habitat conditions. Macrohabitat factors might include: pool-riffle ratio; gradient; width to depth ratio; large woody debris; and other factors, as deemed relevant by the Habitat Work Group. Micro-habitat factors might include: substrate particle size distribution and proportion in the various stream reaches; water depth and velocity and instream or overhanging cover, all at various discharges. Stream discharge will be measured or approximated on each day when the habitat survey is conducted, to determine relationships between stream flow and certain habitat conditions.

Other Tributaries

As determined during Habitat Work Group consultation, we will also measure available habitats in other Blue Lake tributaries. The objective of these measurements will be to determine the quality and quantity of stream habitat which would be used under the reservoir's elevation regime after dam raising.

Exact measurement and recording protocols for all habitat measurements will be approved by the Habitat Work Group.

REPORTING

A draft Blue Lake Dam Raise Survey Report will be submitted prior to January, 2009. This report will describe monitoring methods and locations, and present results for all data available at the time of the report. The Report will present Introduction, Materials and Methods, Results and Discussion sections. The Report's primary objective, beyond documentation of the location, timing and physical factors affecting Blue Lake rainbow trout populations, will be to provide a basis for impact analysis of various water levels which might result from dam raising. These impact analyses will be used to support environmental analysis sections of the Application for Capacity-Related Amendment to be submitted by the City to the FERC.

CONSULTATION and COMMENT

Comments from the USFS letter of May 8, 2008 (Attachment I) were numbered and addressed as described in Table 1.

Table 1. USFS Comments from May 8, 2008 Letter, and City Responses

Comment No.	Comment Summary	City Response	City Comment
FS 1	Requests modeling to determine rise and fall of lake levels	No change to study plan	The City will use the operations model from relicensing to predict these factors
FS 2	Request to determine rainbow trout life history in Blue Lake Creek.	Page 2, wording added under Spawning, Incubation....; Page 6, sentence added under Spawning, Incubation....; Page 7, first paragraph, last sentence.	

FS 3a	Document fry emergence	No change to study plan	Fry emergence methods are included in the snorkel surveys; fry are known to be quite difficult to see and/or capture.
FS 3b	Need for method to determine relative recruitment for each tributary	No change to study plan.	Method for this will be part of the overall analysis of observations.
FS 4	Need to conduct observations from SM 1.0 to SM 2.0.	Sentence added, under “Observation Methods”, second sentence	
FS 5	Priority of lakeshore observations	No change to study plan	Suggestion noted.
FS 6	Use USFS Region method for pools and riffles	No change to study plan	Exact measurement methods will be described in Habitat Study Plan. Suggestion noted.

ATTACHMENT I

Copy Of USFS Comment Letter of May 8, 2008, with Comments Numbered



United States
Department of
Agriculture

Forest
Service

Alaska Region
Tongass National Forest
Sitka Ranger District

204 Siginaka Way
Sitka, AK 99835
Phone: (907) 747-6671
Fax: (907) 747-4253

File Code: 2770

Date: May 8, 2008

Charlie Walls
Utility Director
City & Borough of Sitka - Electric Department
105 Jarvis Street
Sitka, AK 99835

RE: Blue Lake Hydroelectric Project (FERC No. 2230) License Amendment, Comments on Draft Blue Lake Creek and Tributaries Habitat Quantification AND Blue Lake Rainbow Trout Spawning Survey Study Plans

Dear Mr. Walls: *Charlie*

We have reviewed the above referenced study plans and offer the following comments:

General Comments

FS1

Modeling the incremental rise and fall of lake levels and the timing of these events in relation to Blue Lake Creek and other tributaries would help to evaluate the effects on spawning rainbow trout.

FS2

Based on spawning data collected previously it appears that most Blue Lake tributaries primarily function as spawning and rearing habitat with adult fish returning to the main lake for the remainder of the year. However, this relationship is unclear for Blue Lake Creek. An effort to describe the life history of rainbow trout utilizing Blue Lake Creek should be undertaken.

FS3a
FS3b

We would like the City to provide more detail on the proposal to document fry emergence. The City also needs to develop a methodology for determining the relative level of rainbow trout recruitment from each tributary to the overall Blue Lake population.

FS4

Spawning, Incubation and Emergence/Rearing Observations

Spawning, incubation and emergence/rearing observations on Blue Lake Creek should include stream reaches from SM 0.1 to SM 2.0. Although we believe this to be City's intent it is not clear how much of Blue Lake Creek the City will include in its surveys.

FS5

Lakeshore Observations

The methods for observing lakeshore spawning are adequate. However, based on data collected by the City during the recent re-licensing effort, lakeshore spawning probably contributes very little to the overall Blue Lake rainbow trout population. Therefore, we suggest that lakeshore observations should be a lower priority in comparison to tributary observations and habitat work.



Caring for the Land and Serving People



FS-6 Measure Existing and Potential Habitat in Blue Lake Creek
Pool and riffles could be defined utilizing USFS Region 10 methodology based on channel bed width and residual pool depths and channel type info.

Thank you for the opportunity to comment. Please address all inquires and comments regarding the Project to me, by mail at the address listed above; by phone 747-4218; by fax 747-4253; or by email at cgoularte@fs.fed.us. Please copy (cc) Melissa Dinsmore, by email at mdinsmore@fs.fed.us; by phone at 747-4201.

Sincerely,



CAROL A. GOULARTE
District Ranger