Coquitlam/Buntzen Project Water Use Plan

Coquitlam Dam Flow Release Interim Ramping Rate Monitoring – Year 4 Report

Reference: COQMON#2

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Jason McNair
Living Resources Environmental Services

Coquitlam River Rampdown Summary
April 1, 2008 – April 1, 2009

Prepared by

J. Macnair, Living Resources Environmental Services

for

BC Hydro

Burnaby, BC.

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Executive Summary

This report summarizes rampdown events occurring on the Lower Coquitlam River for the water year April 1, 2008 to April 1, 2009. A total of 4 rampdown events were monitored during the annual survey period: May 7, 2008, November 1, 2008, January 15, 2009 and April 1, 2009.

The 2008-2009 water year ushered in a change in the flow regime on Coquitlam River. With the previous 7 years under treatment 1 giving way to treatment 2 on October 22, 2008. Under treatment 2 rampdowns will be more frequent, but of a much smaller scale, in addition to being predictable due to regularly scheduled flow reductions. The increase in the maximum allowable reservoir stage elevation will also reduce the need for large scale flow releases and subsequent full river rampdown surveys. 2008-2009 was the first year since surveys were initiated that an unscheduled spill did not occur. All rampdown surveys were under the new treatment 2 flow regime, with the exception of the May 7 survey which was under treatment 1.

Areas previously identified as susceptible to de-watering and fish stranding were visually inspected by survey crews during each rampdown event. Stranded fish were removed by dip netting, or were captured using gee-type minnow traps. A total of 138 fish were salvaged over the course of the 4 rampdown events, mortalities observed totaled 25. All of the fish salvaged or mortalities occurred during the May 7 rampdown. No fish or redds were noted to be stranded during the 3 other rampdown events.

Stranding sites examined under the previous flow regime will have to be continually reevaluated under the new flow conditions. All scheduled flow reductions under Treatment 2 should continue to be assessed until a low stranding risk is established for each reduction. Flow reductions scheduled for March 1, April 1, May 1, September 1 and November 1 may no longer require monitoring due to minimal river stage reduction. Minimizing impacts with careful adherence to rampdown schedules and consistent monitoring of potential stranding sites will continue to be the most appropriate means to reduce the fish stranding risk while being operationally feasible.

Acknowledgements

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1.0 Introduction and Site Description

The Coquitlam River watershed located in the Greater Vancouver area in southwestern British Columbia is a typical southwest pacific coastal watershed. Natural river flows are dominated by snowmelt during the spring months, with lower flows through dry summer months prior to elevated precipitation driven flows October through March. The Coquitlam Lake Reservoir portion of the watershed is utilized by two facilities. One facility, with origins dating back to 1892, provides an intake for domestic water supply by the Greater Vancouver Regional District (GVRD) for the Greater Vancouver area. The other facility, BC Hydro's, Coquitlam-Buntzen generation project dates to 1903 and diverts water out of Coquitlam Lake Reservoir via a 3.9 km tunnel to Buntzen Lake Reservoir, where dual penstocks lead to powerhouses, for electricity generation, located in Indian Arm, Burrard Inlet (Figure 1).

The Lower Coquitlam River watershed covers an area of approximately 60 km^2 and has its source at the Coquitlam Dam located within the GVRD watershed boundary. The Lower Coquitlam River flows though the municipality of Port Coquitlam before becoming confluent with the Fraser River. At present the lower watershed is impacted by gravel extraction, urbanization and the variable controlled discharges from the dam.

Controlled flow releases from the Coquitlam River Dam have potential impacts on downstream aquatic communities. Fish can be affected by the ramping rate (rate at which flow is released or decreased from the dam outlets) at all life-history stages. Impacts can include stranding of redds, fry, juveniles or adults depending on the time of year. Rampdown monitoring serves to minimize the potential impacts by identifying areas known to be susceptible to stranding during rampdown events.

Investigations into the impact of rampdowns on fish in Lower Coquitlam River have been ongoing since 2001. Field methods were developed and refined over the course of the treatment 1 flow regime (Table 1). Rampdown assessments undertaken since 2001 focused on developing survey methods that enabled BC Hydro to evaluate the performance of the interim ramping rate (Table 2), and its influence on mitigating fish stranding on the Coquitlam River.

The two questions given below drive the Lower Coquitlam River rampdown monitoring program. (Taken from COQMON#2 Terms of Reference).

a) *What is the most appropriate ramping rate protocol that should be developed for the Coquitlam Dam that best reduces fish stranding risk while being operationally feasible?*

b) *What are the ongoing fish stranding risks and/or impacts of the revised ramping rate protocol?*

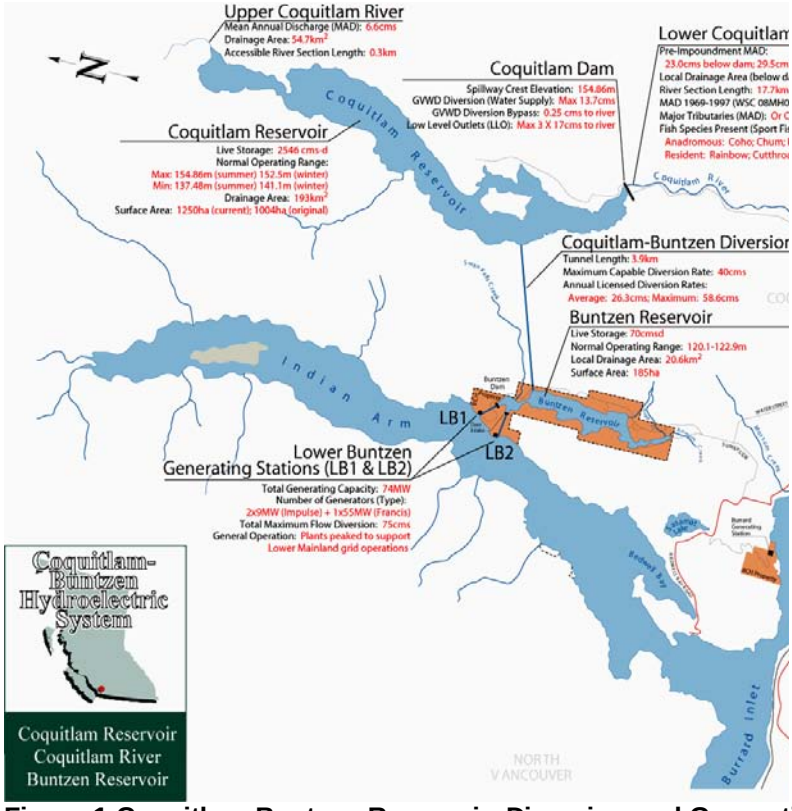

Figure 1 Coquitlam-Buntzen Reservoir, Diversion and Generating System

The ramping rate established under Treatment 1 had the goal of minimizing the impact of stranding during rampdowns, while maintaining operational feasibility (BC Hydro 2005). Following completion of the seismic upgrade on Coquitlam Dam in October 2008, a new flow release schedule (Treatment 2) was initiated. Under this new flow regime a series of scheduled rampdowns will occur at pre-determined times throughout the year. These rampdowns amount to small scale reductions (between 3.00cms and 0.60cms) in the flow release from Coquitlam Dam (Table 1). A new low level outlet (LLO) knife-gate installed at Coquitlam Dam in 2008 will control the flow adjustments at the same rate as the previous rampdown schedule (Table 2 for revised gate adjustment schedule). With the seismic upgrade to Coquitlam Dam complete, BC Hydro dam safety constraints no longer stipulate a maximum reservoir elevation of 149 metres, beyond which spill releases must be initiated to ensure dam integrity. The new maximum reservoir operating level is 155 metres. The increased reservoir capacity should greatly reduce the need for unscheduled spills from Coquitlam Dam.

Since 2001, stranding risk has been assessed on the Coquitlam River at several locations from the face of the dam to the confluence with Maple Creek. The total survey area incorporates approximately 14 river kilometers. Appendix B identifies all stranding index sites and classifies areas within the sites identified as high (A - red), medium (B - blue), or low (C - green) risk. New areas of potential stranding risk under Treatment 2 have also been identified. These areas have yet to produce any stranding and are therefore marked in yellow on the maps in Appendix B. These areas will be subject to risk classification in the future as monitoring continues.

Due to the size of the study area and the infrequent occurrence of ramping events, some sections of the river have received little investigation. Areas that are not highlighted on the map are generally free of any characteristics that would indicate susceptibility to stranding. All areas not highlighted have been surveyed at least once over the past 7 years and have been determined by survey crews to have minimal or no stranding risk, therefore, they are not included in any rampdown assessments.

Stranding is identified by three categories:

1. Adult stranding of spawning salmon, which is confined to the active spawning period (Oct.- Jan. depending on species).
2. Redd stranding during active Pacific salmon spawning period (Oct.-Jan.).
3. Juvenile stranding (fry, parr and smolt), potential risk exists year round.

Mortalities of adults and juveniles during rampdown events can result from fish being caught in pools or ephemeral channels which dewater during release reductions, leaving fish isolated in pools that eventually completely drain. In addition, fry are vulnerable to increased predation risk and oxygen depletion when trapped in highly visible, shallow pools. Dam releases during the fall may temporarily give access to spawning areas which dewater following release reduction. This can impact redds by leaving them stranded, and rendering incubated eggs unviable.

Table 1 Coquitlam River flow release schedule under Treatment 1 and 2

	Reservoir diversion schedule (m^3/s)					
	Domestic water		Coquitlam Dam releases			
			Treatment 1	Treatment 2		
Period	Target	Min		Target	Min	Target species and life stage
Jan 1-15	11.9	10.7	1.0	5.9	3.6	Chinook spawning
Jan 15-31	11.9	10.7	1.0	2.9	2.9	Chinook incubation
Feb	11.9	10.7	1.0	2.9	1.8	Chinook incubation
Mar	11.9	10.7	0.8	4.3	1.1	Steelhead spawning
Apr	12.0	10.8	0.8	3.5	1.1	Steelhead spawning
May	12.0	11.0	1.1	2.9	1.1	Steelhead spawning
Jun	12.0	10.9	1.4	1.1	1.1	Steelhead parr
Jul	18.0	15.8	1.4	1.2	1.1	Steelhead parr
Aug	23.0	20.2	1.1	2.7	1.1	Steelhead parr
Sep	23.0	20.9	0.8	2.2	1.1	Steelhead parr
Oct	12.0	10.8	0.8	6.1	3.6	Chinook spawning
Nov	12.0	10.8	1.1	4.0	1.5	Chinook spawning
Dec	11.9	10.7	1.1	5.0	2.5	Chinook spawning

2.0 Methods

During spill reductions, locations susceptible to stranding risk are assessed during daylight hours by crews of between two and four people. Due to the short duration of most rampdown events and the large amount of habitat potentially affected, only locations that have been identified as most susceptible are assessed. Susceptible areas are visually surveyed several times over the course of the rampdown event to determine at what point stranding becomes evident. All isolated pools are assessed for fish and initial attempts at salvaging are conducted with dip nets. Areas that are difficult to net by

hand or are known to strand large numbers of fish are fished overnight with baited minnow traps or dragged with seine nets.

These methods enable constant monitoring of sites susceptible to stranding risk, which ensures that crews can be on hand in a timely fashion should stranding be observed. Stranding data gathered by survey crews can be compared to gate and river stage elevation in order to identify which operational stages are most hazardous to fish. Fish life stage and operational stage risk can also be determined by comparing river stage and gate stage data.

Site assessments are also linked to dam operations through the three LLO gates and their stage; sites are assessed with respect to which LLO gate is being shut as well the specific gate elevation. LLO gates are classed A-C; A= first gate to close, B= second gate to close, C= third and last gate to close (Table 2). Survey crews keep in constant contact with gate operators during rampdown events to ensure proper survey timing during dewatering.

Table 2 Revised gate adjustment schedule for Coquitlam Dam Low level outlets gates during release reductions

Gate	Step	Gate Change		Action	
		From	*To*		
Starting Gate	1	60"	0"	Continous gate change until closed	
Second Gate	2	60"	46"	0.5hr change	
Second Gate	3	46"	36"	0.5hr change	
Second Gate	4	36"	24"	0.5hr change	
Second Gate	5	24"	16"	0.5hr change	
Second Gate	6	16"	9"	0.5hr change	
Second Gate	7	9"	3"	0.5hr change	
Second Gate	8	3"	0	0.25hr change	
LLO3 (Knife Gate Valve)	9	100%	85%	0.5hr change	
LLO3 (Knife Gate Valve)	10	85%	83%	0.5hr change	
LLO3 (Knife Gate Valve)	11	83%	81%	0.5hr change	
LLO3 (Knife Gate Valve)	12	81%	79%	0.5hr change	
LLO3 (Knife Gate Valve)	13	79%	76%	0.5hr change	
LLO3 (Knife Gate Valve)	14	76%	71%	0.5hr change	
LLO3 (Knife Gate Valve)	15	71%	66%	0.5hr change	
LLO3 (Knife Gate Valve)	16	66%	62%	0.5hr change	
LLO3 (Knife Gate Valve)	17	62%	60%	0.5hr change	
LLO3 (Knife Gate Valve)	18	60%	56%	0.5hr change	
LLO3 (Knife Gate Valve)	19	56%	53%	0.5hr change	
LLO3 (Knife Gate Valve)	20	53%	48%	0.5hr change	
LLO3 (Knife Gate Valve)	21	48%	45%	0.5hr change	
LLO3 (Knife Gate Valve)	22	45%	41%	0.5hr change	
LLO3 (Knife Gate Valve)	23	41%	34%	0.5hr change	
LLO3 (Knife Gate Valve)	24	34%	31%	0.25hr change	
LLO3 (Knife Gate Valve)	25	31%	28%	0.25hr change	For special
LLO3 (Knife Gate Valve)	26	28%	22%	0.5hr change	circumstances only
LLO3 (Knife Gate Valve)	27	22%	15%	0.5hr change	(where minimum flows
LLO3 (Knife Gate Valve)	28	15%	8%	0.5hr change	are provided outside of
LLO3 (Knife Gate Valve)	29	8%	0%	0.5hr change	the Knife Gate Valve)

Dewatered areas are classified according to index sites lettered A-E, including two to three specific rampdown sub-areas in each index site (Appendix A). Rampdown survey

areas within each index site are not always contiguous, and may represent a large area of discontinuous but comparable fluvial and river edge characteristics (see Appendix A for site maps and descriptions). All sites surveyed typically contain many small depressions and areas where fish and spawning habitat are susceptible to stranding. Isolated pools are examined and their location recorded so that they can be returned to during future rampdown assessments if they are determined to pose a stranding risk. All salvaged fish, both live and dead are enumerated, identified to species and live fish returned to areas of the river not affected by the flow reduction.

River stage elevation changes are monitored at several sites during the course of rampdown events to compare the dam operations ramp-rates with observed stage reduction at each index site. Stage reductions are recorded by survey crews during periodic visual inspections of staff gauges located in reach 1, reach 2a and reach 2b (Appendix B) These gauges are monitored from the onset of flow reductions to the end of daily salvage operations (which are called off at the onset darkness for safety and visibility reasons). River stage elevation is also monitored using hourly flow data from the Water Survey of Canada (WSC) gauge located in Port Coquitlam (08MH002). Analysis of the rate of change in river stage is related to stranding risk to determine if the rate observed is sufficient to minimize stranding.

The area of each site is calculated by estimating the extent of inundation during a full 3 LLO gate release. This is done on a yearly basis by survey crews in all areas, regardless of whether stranding has occurred at a site. The full extent of each site is included, meaning areas within the ramp site that do not necessarily pose a stranding risk are represented in the area calculation. The total extent of each stranding site is represented as dewatered area in square metres (see Appendix A for ramp site descriptions and area). The number of fish stranded in each site are divided by the total area to determine the number of fish stranded per square metre.

3.0 Results

3.1 Coquitlam Rampdown Summary May 7, 2008

Operational changes on 7 May 2008 resulted in the sole rampdown that occurred under Treatment 1 for the 2008-2009 water year. Spilling from one LLO at Coquitlam Dam had been ongoing for ten days at a controlled discharge of 8.0 cms. This release was part of the Coquitlam River Sockeye program designed to allow smolts to migrate out of Coquitlam Lake Reservoir. A rampdown of the one gate was scheduled for May 7, 2008. Commencing at 0730hrs on May 7, one gate was ramped down at the prescribed ramping rate. The flow reduction was complete at approximately 1630hrs on the same day. This rampdown occurred at a particularly vulnerable time for fry populations in Coquitlam River, which had completed full emergence, and were very active out-migrating, foraging and feeding along the margins of Coquitlam River, increasing their risk of stranding. Smolt populations were also at peak out-migration increasing the risk of stranding.

Due to the fact that only one gate had been opened, some areas normally impacted by flow reductions did not require monitoring because they had not been inundated by the release flow (for example sites, E1, D3, A3, A2, see maps in Appendix B). Net salvage and minnow trap salvage were carried out by crews to assess the extent of stranding. A total of 138 fish were salvaged and 25 mortalities were observed over the two day period (see Table 3 for site totals). Total fish stranded per metre of dewatered area (including only those areas that were inundated by the spill) was 0.0274 (Table 3).

Index Site A

Sites A2 and A3 were not inundated during the flow release, therefore no stranding was observed in these areas. Five minnow traps were set in site A1 on May 7 at 1400hrs, and were recovered the following morning at 08:00. One chinook Fry was recovered in the traps with 21 coho fry and 9 chum fry salvaged by net. Mortalities observed in site A1 included 5 coho fry, (Table 3). Not all of site A1 was inundated during the spill, but the most problematic areas were. No new stranding areas were discovered. Table 4 shows the total fish stranded and mortalities per square metre. The total surface area of dewatered substrate in site A1 was 1450 m^2 resulting in 0.025 fish stranded per square metre

Index Site B

Both side channels in site B1 remained wetted following full gate closure. Fry were salvaged from small pools adjacent to the side channels. Fifteen coho fry and 8 chum were net salvaged, 1 chum fry mortality was observed. The upper portion of the site B1 side channel became desiccated following the rampdown, however, the lower two-thirds of this channel is fed by a visible groundwater source, and therefore, remained wetted. The Lower section of B2 was not inundated, however, the upper section of B2 was monitored regularly throughout the day with 4 coho fry and 6 chum fry netted. The following day 2 coho fry and 5 chum fry mortalities were found.

Site B2 experienced the highest rate of stranding at 0.1417 fish stranded per square metre (Table 4). During two or more gate openings the total dewatered area of B2 is approximately 3000m^2. However, in a spill consisting of one LLO gate, only the upper portion of the site is inundated. This resulted in a dewatered area of approximately 120m^2 in Site B2 (Table 3).

Index Site C

Site C1, was monitored continuously for several hours during the rampdown due to severe stranding problems. One survey crew spent over six hours at this spot salvaging fry and parr from a cobble/boulder side channel that drains rapidly. Twenty coho fry, 16 chum fry, 8 chinook fry, 1 trout smolt, 3 coho smolts and 1 lamprey, were salvaged. Mortalities observed the following day included 5 coho fry, 3 chum fry and 3 chinook fry (Table 3). Total fish stranded per square metre was 0.0870 with a total dewatered substrate area of 690 square metres (Table 3)

At site C2 survey crews observed 1 chum fry mortality. This area was minimally inundated (perhaps 10m^2 of a potential 550m^2) during the spill, releases using all three LLO gates are required to completely inundate this area. Total fish stranded per square metre was 0.1, using a total area of dewatered substrate estimate of 10 square metres (Table 3).

Index Site D

Site D1 was minimally inundated during the spill, two traps were set in one pool, but no fish were recovered. Visual observations yielded no results in this same area. A new stranding pool was found in this area during the rampdown and 12 coho fry net salvaged it. No stranding was observed in site D2.

Index Site E

Four traps were set in site E2 and were checked twice during the course of the day, 8 threespine sticklebacks were salvaged from the traps. These traps were also left overnight and rechecked on the morning of May 8, no fish were recovered in the traps. Five coho fry were also net salvaged in Site E2.

Summary

The timing of this rampdown event, at a critical period for fry emergence and out-migration, resulted in a predominance of fry among stranded fish observed. Of a total 163 fish stranded, 150 were fry, and of this total, over half (89) were coho fry (Table 3). Observations of stranded smolt/parr were very low (4 in total), and no mortalities were observed. This, despite the fact that smolts were actively out-migrating at the time of the rampdown.

Stranding areas that are persistently problematic were targeted by survey crews. These sites also held the majority of stranded fish (particularly sites A1 and C1 which had 97 of 163 stranded fish, equivalent to 60% of the total). One new stranding area was discovered in site D1. This was a single small pool, (approximately 3m^2**)** that held 12 stranded coho fry. This site will be added to the stranding area maps and surveyed during future rampdowns. River stage elevation changes at all 3 stations monitored were under 3.0cm per hour (2.7cm-2.3cm, Table 4).

Table 3 Total of salvaged fish and mortalities per metre of dewatered area for rampdown event May 7, 2008.

Index Site Code	A1	A2	A3	B1	B2	C1	C2	D1	D2	D3	E1	E2	E3	Total
Salvaged														
Coho fry	21			15	4	20		12				5		77
Chum Fry	9			8	6	16								39
Chinook Fry	1					8								9
Rt Parr						1								1
Coho parr/smolt						3								3
Lamprey						1								1
TSS												8		8
Total	**31**			**23**	**10**	**49**		**12**				**13**		**138**
Mortalities														
Coho fry	5				2	5								12
Chum Fry				1	5	3	1							10
Chinook Fry						3								3
Total	**5**			**1**	**7**	**11**	**1**							**25**
Dewatered Area/m^2	**1450**			**270**	**120**	**690**	**10**	**1000**				**1800**		
Stranded/m2	**0.025**			**0.089**	**0.14**	**0.087**	**0.1**	**0.012**				**0.007**		**0.03**
Mortalities/m2	**0.003**			**0.004**	**0.058**	**0.016**	**0.1**							**0.004**
Risk Class	**A/B**	**A/B**	**A**	**B**	**A**	**A**	**A**	**A**	**A/B**	**A**	**A/B**	**A**	**A/B**	
Gate Class	B/C	B/C	B	C	C	C	B	B/C	B/C	C	B/C	C	B/C	

Table 4 River stage elevation change during rampdown event. Data from R2B and R2A is gathered on site by survey crews, R1 data is from the Water Survey of Canada gauge (WSC 08MH002) in Port Coquitlam

R2B (at Galette)		R2A at Hockaday		R1 WSC Gauge	
Time	Stage	Time	Stage	Time	Stage
0800	0.90	0800	38.52	0800	8.13
0915	0.87	1000	38.48	0900	8.09
1015	0.79	1030	38.45	1000	8.04
1115	0.76	1130	38.44	1100	8.00
1215	0.71	1230	38.43	1200	7.96
1330	0.69	1340	38.42	1300	7.95
1535	0.65	1530	38.41	1400	7.92
1645	0.63	1700	38.39	1500	7.91
1830	0.61	1800	38.38	1600	7.90
				1700	7.88
				1800	7.87
				1900	7.86
				2000	7.85
10.5hrs	0.29m	10hrs	0.24m	12hrs	0.28m
2.7cm per hour		**2.4cm per hour**		**2.3cm per hour**	

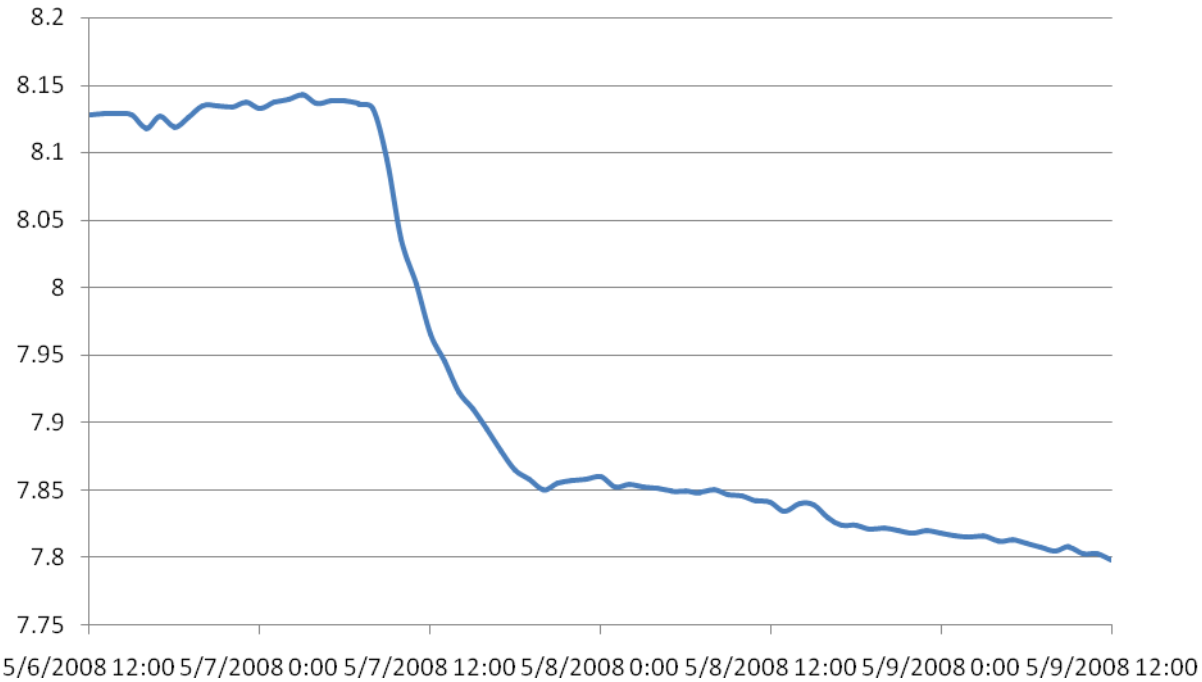

Figure 2 Coquitlam River stage elevation decrease during rampdown May 7, 2008.

3.2 Coquitlam Rampdown November 1, 2008

On November 1, 2008 in accordance with the treatment 2, flow regime, LLO releases from Coquitlam Dam were scheduled to be reduced from 6.1cms to 4.0cms. The scheduled rampdown began at approximately 1130hr and was completed at 1400hr. Due to rainfall, downstream river stage elevation changes were barely detectable (Table 5). No stranding was observed due to the minimal change in river stage elevation (Table 5, Figure 3). Stage elevation actually rose later in the evening as heavy rain continued over the next 24 hours and flow continued to increase in Coquitlam River.

During the November 1, 2008 rampdown it was assumed that some chum redds were created in new permanently wetted side channels inundated during the increased October flow and subsequently dewatered during the rampdown. Survey crews performed a series of pre-rampdown assessments in order to determine if redds were being made in areas that may dewater following flow reductions. The rampdown survey found that due to the small decrease in flow release (6.1cms to 4.0cms) combined with natural inflows, all areas where redds were created remained wetted for the duration of the spawning run.

Table 5 Coquitlam River stage elevation changes November 1, 2008

Saturday, November 01, 2008

R2B (at Galette)		R1 Staff Gauge	
Time	Stage	Time	Stage
1025	0.76	1055	1.25
1130	0.75	1200	1.25
1255	0.75	1315	1.24
1400	0.75	1415	1.24
1500	0.75	1530	1.24
1630	0.76	1645	1.25
6.0hrs	**0.00m**	**5.75hrs**	**0.00m**

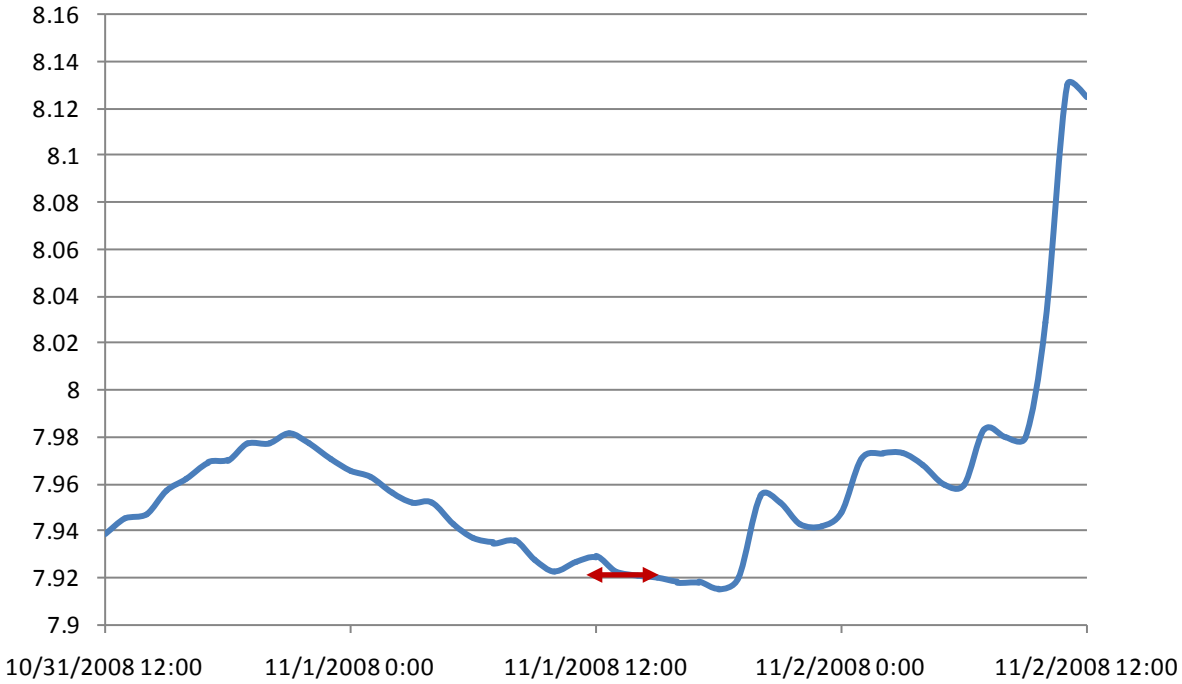

Figure 3 Coquitlam River stage elevation (m) change during rampdown event November 1, 2008, WSC data. Red arrow indicates rampdown period.

3.3 Coquitlam Rampdown January 15-16, 22, 2009

On January 15, 2009 in response to the recently initiated flow regime (Treatment 2), LLO releases from Coquitlam Dam were scheduled to be reduced from 5.9cms to 2.9cms. The scheduled rampdown began at approximately 1030hr and was completed at 1430hr. Likely due to rainfall and snowmelt, downstream river stage elevation changes were virtually nil (Table 6). No stranding was observed, as there was no detectable change in river stage elevation. Due to an increase in the reservoir level, a second minor reduction in flow involving a reduction of one step from the LLO was completed on, January 21, 2009. This reduction also produced no change in river stage elevation. Weather conditions during the rampdown period were wet and also influenced by continual snow melt. These conditions likely augmented flow in Coquitlam River to a degree that minimal river stage reductions were evident.

A total of six traps were set overnight on January 15; 2 traps in Site A2, 2 traps in Site A3 and two traps in site E3. None of the trap set areas became dewatered overnight, nor did they produce any captures.

The main concern during this rampdown was the potential for dewatering at several locations where adult salmon had spawned in the fall. The increase in flow during the months of October through December opened up side channels and river margin areas not continuously accessible for spawning under the previous flow regime. Field observations confirmed all of these areas remained fully wetted following flow reductions.

Table 6 Coquitlam River stage elevation changes January 15, 2009

Thursday January 15 2009

R2B (at Galette)		R2A at Hockaday		R1 Staff Gauge		R1 WSC Gauge	
Time	Stage	Time	Stage	Time	Stage	Time	Stage
1000	0.75	1030	38.44	1130	1.24	1100	0.795
1130	0.75	1130	38.44	1245	1.24	1200	0.795
1300	0.75	1230	38.44	1330	1.24	1300	0.795
1530	0.745	1340	38.44	1445	1.25	1400	0.795
		1530	38.44			1500	0.795
5.5hrs	0.005m	5.0hrs	0.00m	3.25hrs	+0.01m	4.0hrs	0.00m

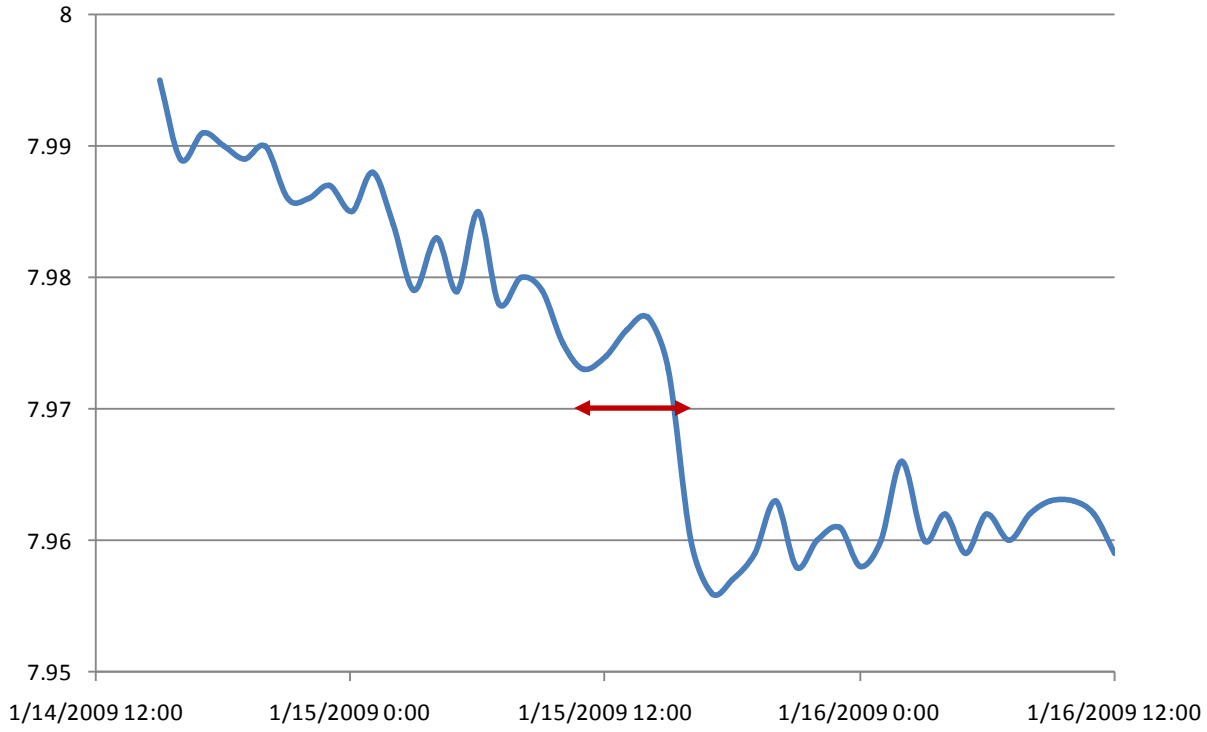

Figure 4 Coquitlam River stage elevation (m) change during rampdown event January 15, 2009 WSC data. Red arrow indicates rampdown period.

3.4 Coquitlam Rampdown Summary April 1, 2009

On April 1, 2009 in response to the recently initiated flow regime (Treatment 2), LLO releases from Coquitlam Dam were scheduled to be reduced from 4.3cms to 3.5cms. The scheduled rampdown began at approximately 1330hr and was completed at 1530hr. Due to rainfall and snowmelt the downstream river stage elevation changes were virtually nil (Table 7). No stranding was observed, as there was no detectable change in river stage elevation. Stage elevation actually rose in Reach 1 and Reach 2B according to the installed staff gauge (Table 7). Heavy rain continued over the next 24 hours and flow continued to increase in Coquitlam River (Figure 5).

Table 7 Coquitlam River stage elevation change April 1, 2009.

Wednesday April 1, 2009

R2B (at Galette)		R2A at Hockaday		R1 Staff Gauge	
Time	Stage	Time	Stage	Time	Stage
1000	0.74	1030	38.42	1015	1.24
1200	0.74	1130	38.42	1230	1.24
1400	0.74	1215	38.42	1320	1.24
1530	0.74	1600	38.42	1445	1.25
1800	0.75	1800	38.42	1815	1.26
8.5hrs	+0.01m	7.5hrs	0.00m	8.0hrs	+0.01m

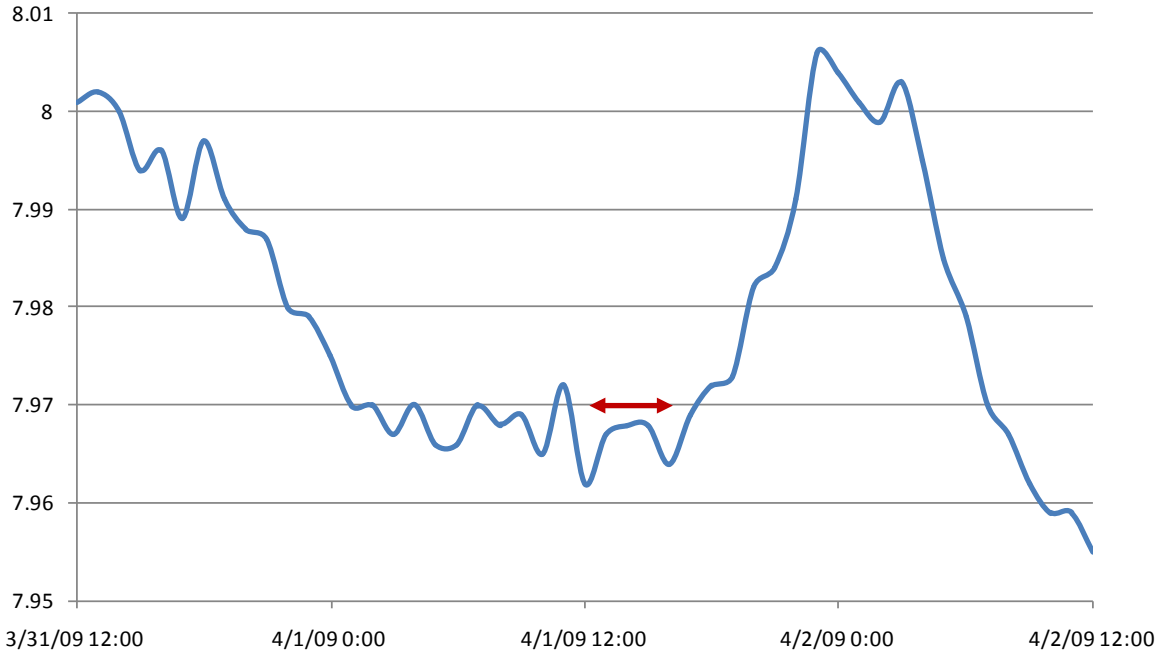

Figure 5 Coquitlam River stage elevation (m) change during rampdown event April 1, 2009, WSC data. Red arrow indicates rampdown period.

4.0 Discussion

The results of the May 7, 2008 rampdown, the final rampdown under Treatment 1, were consistent with results from preceding years (2002-2008). The discovery of a new stranding area in Site D1 was all that differentiated it, however, this stranding area is now permanently inundated under the Treatment 2 flow regime and no longer poses a risk. As per Table 8, impacts on fish populations in the river due to stranding were fairly typical of what has been witnessed during previous rampdown assessments conducted during 2001-2008 (Macnair, 2008).

The May 7 rampdown occurred at a critical period for fry/smolt emergence and out-migration, resulting in a large number of stranded fish that were predominantly fry. Coho and chum fry at this time are commonly found in the shallowest areas of the river immediately adjacent to the river bank making them particularly susceptible to stranding. Table 9 gives a breakdown of seasonal stranding totals for the 2004-2008 period (the table gives totals for salmonids only). The results demonstrate that the average number of fish stranding is highest in the spring and summer when fry and smolts are at the height of migration and emergence. This illustrates the strong influence that seasonal rampdown timing has on stranding fish.

All rampdown assessments during the period April 1, 2008 to March 31, 2009, under Treatment 2 flow regime were free of stranded fish. This was due to a combination of two factors: the very moderate adjustments to the required flow release under Treatment 2, and, rainfall and snowmelt during rampdown events. Tables 5-7 show that at no time during the three rampdowns was a river stage elevation decrease of more than 1 cm evident throughout the course of the day.

Potential modifications to rampdown monitoring could be introduced during scheduled flow reductions that have minimal change in river stage elevations. Flow reductions scheduled for March 1, April 1, May 1, September 1 and possibly November 1 may demonstrate such a small change in river stage that stranding will not be an issue throughout treatment 2.

Along with potential new areas of stranding discovered in the 2008-2009 survey period, changes to the flow regime have influenced perennially problematic stranding areas at sites A1, A2, B1, C1 and D1 (Appendix B). The increased flow has transformed some sections from stranding sites to potential year round available rearing habitat. New areas identified as potential stranding sites will be monitored closely in the future to determine their risk factor.

Table 8 Yearly site by site comparison of stranded fish during all rampdown events, 2004-2009. [a] All stranding comes from 1 (May 7, 2008), of the 4 rampdown events.

	Site A		Site B		Site C		Site D		Site E		Total	Total	Total	Ramp
Year	Salv	Mort	Salv	Mort	Salv	Mort	Salv	Mort	Salv	Mort	Salvaged	Mortalities	Stranded	Events
2008-2009	31	5	33	9	49	12	12	0	13	0	138	25	163	4[a]
2007-2008	67	6	32	11	199	17	20	1	65	1	383	36	419	3
2006-2007	39	14	3	4	47	80	36	4	0	0	125	103	228	2
2005-2006	95	0	0	0	1	9	0	7	85	6	181	22	203	2
2004-2005	75	2	10	0	13	9	0	0	48	0	146	11	157	3
Total	**307**	**27**	**78**	**24**	**309**	**127**	**68**	**12**	**211**	**7**	**973**	**197**	**1170**	

Table 9 Showing the relationship between seasonal timing and stranding risk 2004-2008.

		Life Stage When Stranded					
Season	# Rampdowns	Adult	Fry	Smolt/Parr	Total	Avg/rampdown	Stranding/m^2
Spring (Mar 23-June 22)	3	0	364	60	424	141	0.015
Summer (June 23-Sept 22)	2	0	199	64	263	132	0.015
Fall (Sept 23 - Dec 22)	3	11	124	96	231	77	0.005
Winter (Dec 23 - Mar 22)	3	0	36	61	97	32	0.002

Table 9 shows the steady increase each year in the amount of fish stranded on Coquitlam River under Treatment 1. This increase was influenced by a number of factors, including: the number of rampdown events, timing of rampdown events, survey crews finding more stranding areas and increased efficiency in fish salvage. Results of stranding due to scheduled rampdowns under treatment 2 and unscheduled spills are not comparable. In order to understand what influence the new flow regime may have on stranding comparable rampdown events need to be compared through the entire Treatment 2 schedule (Table 2). With the maximum allowable reservoir elevation returning to 155 metres, the likelihood of 2-3 yearly spill events per year is greatly reduced.

Stranding influence on fish production in Coquitlam River is likely to be minimal based on the results of the past 7 years. For pink and chum fry the influence is negligible. Decker et. al. 2007 reports the estimated average annual outmigrating population for chum and pink fry for the 2003-2008 period is 2,616,800 and 340,000 respectively. Contrast this with a total of 66 chum mortalities and zero pink mortalities observed during rampdowns for the same period. Coho and steelhead smolt population estimates for the same period average 14,972 and 6,867 per year respectively (Decker et. al. 2007). The average number of coho and steelhead smolt mortalities per year due to rampdowns is 3 and 7 respectively.

5.0 Conclusions and Recommendations

Due to the fact that the scheduled releases under Treatment 2 do not inundate large areas of habitat, that flow releases are maintained at a relatively constant rate throughout the year, and flow reductions are small, the risk of stranding appears to be minimal during scheduled rampdowns. However, because initiation of Treatment 2 was not realized until October, 2008, all scheduled flow reductions under Treatment 2 should continue to be assessed until a low stranding risk is established for each reduction.

Stranding sites examined under the previous flow regime will have to be continually reevaluated under the new conditions. The likelihood of some stranding site risk factors being altered in the future is high. Already it appears as if some formerly susceptible areas may now be considered low risk for stranding. Additionally, new areas may still appear and those new areas already identified will have to be categorized. The fluvial morphological structure of Coquitlam River will continue to transform as it adapts to the increased annual flow, and so areas of stranding will shift.

Operational changes to the timing of the commencement of gate closures was recommended in the 2006-2007 report, based on the negative impacts which occurred as a result of critical stranding occurring after dark, when crews are unable to survey (Macnair 2007). The operational practice of implementing early start times for gate closures, particularly during the winter months, was effectively used during 2007-2008 and 2008-2009 rampdown period.

The possibility of reducing rampdown likelihood during sensitive fall and spring fisheries periods should be explored with options such as diversion of pre-spills to Buntzen Lake Reservoir to reduce spill frequency and magnitude. Ongoing upgrades of the Bunzten Lake spillway are underway to pass Coquiltam Reservoir flows in the case of the Buntzen Generating station being out of service. It is expected that a reduction in spill frequency will occur now that the Coquitlam Dam seismic upgrade is complete and the maximum operating level of 155 metres has been reinstated. As evidence of this benefit, there were no unscheduled spill events during the 2008-2009 monitoring period. The Coquitlam River rampdown monitoring program is entering a new phase with the introduction of the treatment 2 flow regime. The previous years under treatment 1 have been useful in identifying high risk areas of the river and developing surveys techniques designed to reduce stranding impact.

Flow reductions scheduled for March 1, April 1, May 1, September 1 and possibly November 1 may require reduced or no field surveys in the future. This first year of monitoring under treatment 2 has revealed no stranding risk during these scheduled flow reductions. If a second year of monitoring has the same result, then it may be feasible to phase out rampdown surveys for these flow reductions for the remainder of treatment 2.

The revised ramping rate established under Treatment 2 (modified to match the rate established under treatment 1) appears to be effective. Survey crews have adapted to the ramp rate and are continually increasing their efficiency at salvaging fish. Comparison of rampdown mortalities to fish productivity clearly shows the negligible impact that rampdowns appear to have on fish productivity in Coquitlam River. Minimizing impacts with careful adherence to rampdown schedules and consistent

monitoring of potential stranding sites will continue to be the most appropriate means to reduce the fish stranding risk while being operationally feasible. Observations have shown no visible increase in stranding risk during the first months of introducing the Treatment 2 flow regime. Future rampdown events will provide further insight into the impact of the new flow regime on stranding in Coquitlam River.

6.0 Literature cited

BC Hydro 2006, Coquitlam-Buntzen Water Use Plan Monitoring Terms of Reference, January 2006, Burnaby BC

Macnair, J., P. Troffe. 2006 Assessment of fish stranding on the Lower Coquitlam River, Prepared for BC Hydro Generation Sustainability, Burnaby B.C. pp. 20

Macnair, J., P. Troffe. 2007 Assessment of fish stranding on the Lower Coquitlam River, Prepared for BC Hydro Generation Sustainability, Burnaby B.C. pp. 29

Decker, Scott, G. Lewis, J. Macnair, 2009, Coquitlam River Fish monitoring Program Results 2000-2006, Prepared for BC Hydro Coastal Generation, Burnaby B.C., pp. 116

Appendix A Site descriptions and photographs

Site A1: This area is characterized by densely treed and shrubby river margins that contain many depressions that form isolated pools. The substrate is mainly soil and vegetated cover, along with some areas of exposed gravel and cobble.
Total Area: 3800m^2

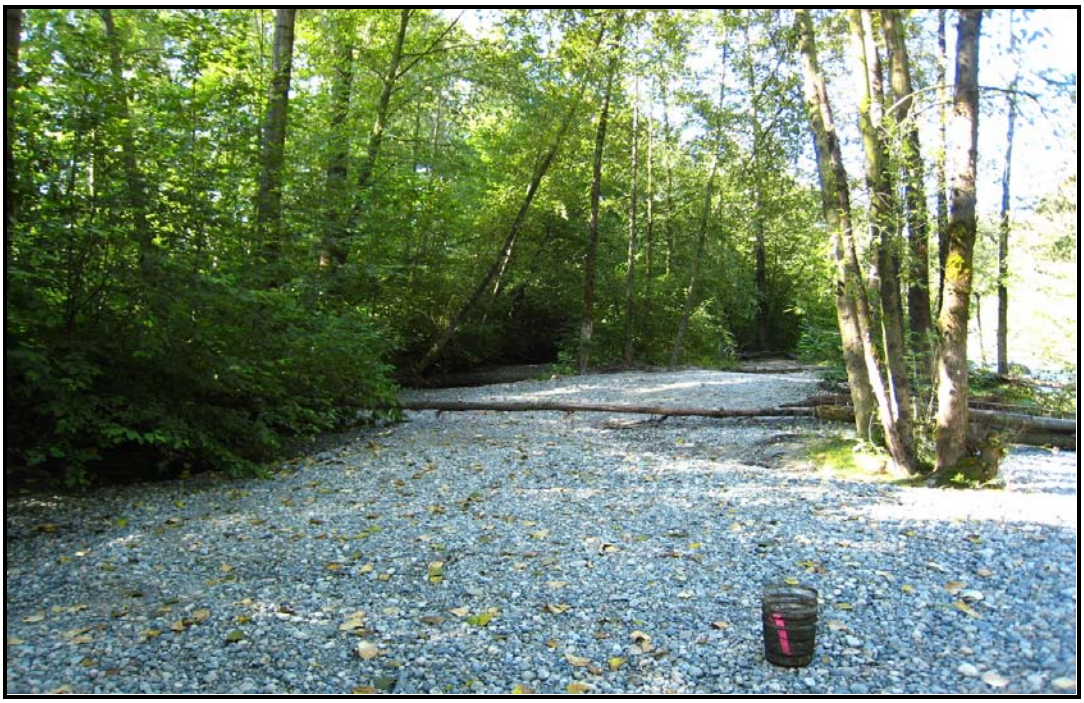

Figure 6 Site A1 showing gravel area on fluvial island where fish are regularly stranded

Site A2: These areas are characterized by large expanses of exposed gravel and cobble suitable for spawning adjacent to the river, accompanied by moderately treed areas with numerous depressions that form isolated pools when dewatering. These areas represent a hazard for stranding of both adults, juveniles and redds due to the combination of off channel habitat and spawning gravel that is wetted during flow releases.
Total Area: 19000m^2

Site A3: This area is primarily a large gravel and cobble fan with gently sloping topography. There are several areas where large isolated pools form during rampdowns.
Total Area: 4800m^2

Site B1: This area is a side channel that is normally wetted except at very low flows (below 3.00cms WSC gauge Port Coquitlam). It is a gravel and cobble substrate, that drains quickly and leaves behind many isolated pools. It rarely completely dewaters, so is only a stranding risks when flow in the river is very low.
Total Area: 270m^2

Site B2: This area is a long narrow partially treed platform with a combined soil, gravel and vegetated substrate. It strands adults, juveniles and redds. This site only becomes inundated during a full three LLO release, and is one of the earliest sites to begin dewatering.
Total Area: 3000m^2

Figure 7 Site B2, showing isolated pool formed during flow reduction, this site strands juveniles, adults and redds. Substrate is primarily mud and soil.

Site C1: This site is a long side channel composed of gravel and cobble substrate. It drains rapidly and forms many isolated pools that do not retain water well. This site experienced the highest number of stranding during the past two years
Total Area: 690m^2

Figure 8 View of site C1 side channel that is wetted during single gate openings. This site typically has the highest incidence of stranding on Coquitlam River.

Site C2: The area is densely covered in shrubs. The substrate is very muddy with vegetated ground cover. Juveniles were regularly stranded in this area until the 2007/2008 rampdown period, which often requires the use of minnow traps for salvage. Morphological changes may have reduced the risk of stranding at this site.
Total Area: 550m^2

Site D1: This area is densely vegetated with trees and shrubs. It is primarily a narrow river margin, with mud and soil substrate.
Total Area: 1000m^2

Site D2: This area is densely vegetated with trees and shrubs. It is primarily a narrow river margin with cobble and boulder substrate and relatively steep banks.
Total Area: 600m^2

Site D3: This area is a short, narrow platform densely grown in with trees and shrubs, it has a combined soil, gravel and vegetated substrate. Isolated pools form during flow reductions, stranding juveniles which are best removed using minnow traps due to the dense concentration of roots within the pools.
Total Area: 665m^2

Site E1: This area is adjacent to a rearing pond that overflows during dam releases. Juveniles spill over the pond and can become stranded. Substrate is mainly cobble and gravel intermixed with moderately treed areas.
Total Area: 1200m^2

Site E2: This area consists of narrow river margins that are densely treed and shrub covered. Many isolated pools form close to the river mainstem during gate closure. Observations over the past 3 years indicate that many of these pools remain wetted year round due to their proximity to the river channel.
Total Area: 1800m^2

Site E3: This area, situated near the dam face, is densely covered in trees and shrubs. Isolated pools are minimal, but juveniles are often caught in the area of dense vegetation during dewatering.
Total Area: 6000m^2

Appendix B Coquitlam River Rampdown Site Maps

All areas marked in yellow on the site location maps reflect new stranding risk areas identified under treatment 2. No fish have been observed stranded in these areas since the initiation of treatment 2.