Puntledge River (Reach C) Spawning Gravel Placements for Fish Habitat Restoration, 2005

by:

Scott Silvestri, B.Sc., Dip. Fisheries
BC Conservation Foundation
#3 – 1200 Princess Royal Avenue
Nanaimo, BC, V9S 3Z7

prepared for:

BC Hydro Bridge Coastal Fish and Wildlife Restoration Program
6911 Southpoint Drive (E14)
Burnaby, BC, V3N 4X8

and

Ministry of Environment
Fish and Wildlife Branch, Vancouver Island Region
2080-A Labieux Road
Nanaimo, BC, V9T 6J9

GREATER GEORGIA BASIN
STEELHEAD Recovery Plan
www.SteelheadRecoveryPlan.ca

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Executive Summary

Summer run stocks of Puntledge River steelhead trout and chinook salmon have been classified a conservation concern by provincial and federal fisheries managers. Declines in abundance have been caused by sharply reduced ocean survivals and impaired freshwater habitat capability related to Hydro and other development impacts. These stocks may not recover without significant improvements to their freshwater productivity.

This project addresses a limiting factor for fish production in Reach C of the Puntledge River by placing high quality spawning gravel in key locations to be used by summer steelhead and chinook. Approximately 590 m^3 of washed gravel was placed at two locations in late July, 2005 creating/enhancing 992 m^2 of spawning habitat. By increasing the availability of high quality spawning habitat, egg to fry survival will improve, an important step in the recovery of these valuable Puntledge stocks.

Funding for this project came from BC Hydro through the Bridge Coastal Fish and Wildlife Restoration Program (BCRP). Project costs including planning, materials, implementation, monitoring and reporting totalled $33,690.59.

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1.0 Introduction

1.1 Background

Hydro-electric development began in the Puntledge River watershed with the construction of the Comox Dam in 1912. Canadian Collieries Dunsmuir Limited initially built the structure to create a central hydroelectric facility that could supply power for its mining operations. In 1953 the dam was purchased by the BC Power Commission (a predecessor of BC Hydro), with a new modern powerhouse built shortly thereafter (BC Hydro 2003). The Comox Dam is located 16 km upstream from the City of Courtenay and provides flow regulation for facilities downstream, including the Diversion Dam which forms the headpond and is the location of the intake for the 5 km long woodstave and steel penstock feeding a 24 MW power generation facility. The river channel from the Diversion Dam to the powerhouse tailrace is known as Reach C or the "Diversion Reach".

In 2000, the strategic plan for the Bridge-Coastal Fish and Wildlife Restoration Program (BCRP) was released and provided the technical framework to guide restoration activities and priorities in the Bridge-Coastal Generation Area, including the Puntledge River watershed (BC Hydro 2000). Primary factors limiting fish diversity and production in the Puntledge River watershed were identified and included restricted access to historic habitats, loss of habitat, **reduced habitat capability**, and diversion of water. Reduced habitat capability, specifically the loss of spawning habitat, has been identified as the limiting factor to chinook production in the system. Restoration objectives aimed at addressing the limiting factors were prioritized in BCRP's strategic plan and included:

1. Restore historic wild salmon access to Comox Lake,
2. **Improve habitat conditions for fish stocks using the river channel between Comox Dam and the tailrace at the BC Hydro generation station,**
3. Conserve and improve habitats for resident wild and supplemented fish stocks in Comox Reservoir and its tributary systems.

In 2001, the Puntledge River water use planning (WUP) consultative process was initiated and consisted of 18 members representing a wide range of interest groups (i.e., power, fish, wildlife, culture, recreation, governments, etc.). The purpose of the planning process was to develop recommendations defining a preferred operating regime using a multi-stakeholder consultative process (BC Hydro 2003). When completed in 2003, the WUP process identified several issues regarding fish production in the Puntledge River, including optimal flow requirements for summer migration, rearing and spawning fish. In addition to recommendations defining a preferred operating regime, the consultative committee suggested that several monitoring studies be undertaken to answer key uncertainties, including spawning gravel monitoring and egg to fry survivals with different flow regimes. Several issues outside the scope of the WUP were also identified by the consultative committee including the recommendation that gravel placements be performed in lieu of operational changes (BC Hydro 2003).

Lough (2003) assessed steelhead and chinook spawning conditions in Reach C and found a total of 1,955 and 705 m^2 of functioning and non-functioning spawning habitat, respectively. Results noted that 90% of the functioning gravel was located in three specific areas: Barber's Pool, Bull Island side-channel, and the Gas Pipeline crossing. The remaining 10% were small patches 5-50 m^2 in size located along the channel's wetted margins. Insufficient depth and/or velocity were cited as the most common reasons why gravel was non-functional in terms of salmonid spawning use.

Over the past 50 years, many restoration projects have occurred in the Puntledge River watershed. Improvements for fish passability at Stotan and Nib Falls, located in Reach C, where completed between 1923 and 1977. Spawning and rearing channels where constructed adjacent to the upper hatchery site between 1965 and 1975 (BC Hydro 2003). Additional side-channel developments and spawning gravel placements include Bull Island, Jack Hames, Powerline, and Powerhouse side-channels. Using hatchery broodstock returns, a salmon carcass program has in recent years distributed marine derived nutrients to areas of the watershed where salmon returns are low compared to historic levels.

1.2 Need Statement

With the creation of storage and diversion dams in 1912, and the flooding of the headpond reach between the Comox Dam and the Diversion Dam (Reach B), it is estimated that approximately 90,000 m^2 of high quality spawning gravel was permanently lost (BC Hydro 2000). This area provided much of the spawning habitat for the river's summer run steelhead and chinook populations. Large spill events below Comox Dam have also scoured spawning gravel and diminished spawning habitat in Reach C. With the exception of small substrates from the Browns River (5 km downstream of the diversion dam), natural gravel recruitment to Reach C also ceased following construction of the storage and diversion dams.

Since the mid 1990s, winter and summer steelhead returns to the Puntledge River have been at or near record lows. Wightman et al. (1998) and Lill (2002) classified both stocks as an extreme conservation concern and at high risk of extinction. The river's unique summer run chinook stock is also severely depressed and would likely be quasi-extinct if not for the long standing federal hatchery program. Loss of habitat is cited as the reason for the summer run chinook decline as the stock dropped from an average of 3,000 fish annually, to less than 300 (http://www-heb.pac.dfo-mpo.gc.ca/facilities/puntledge/background_e.htm).

2.0 Goals and Objectives

Functioning mainstem spawning habitat, as identified during a recent assessment of steelhead and chinook spawning habitat in Reach C, totalled 1,099 m^2, with 777 m^2 in the traditional summer run area upstream of Stotan Falls (Lough 2003). As adult summer and winter steelhead are primarily mainstem spawners, the lack of suitable mainstem spawning habitat, coupled with a lack of natural gravel recruitment to this reach, greatly reduced the system's productivity, particularly for steelhead.

The overall goal of the 2005 restoration project was to create approximately 1,000 m^2 of spawning habitat by placing 600 m^3 of gravel at three locations in Reach C. The work was done to immediately increase the available spawning habitat for all species present in Reach C but would specifically target threatened steelhead and chinook stocks. Gravel additions over several years should also aid downstream recruitment to other spawning locations. This directly addresses limiting factors of fish production as described in BCRP's Strategic Plan and conforms to Objective 2 of improving habitat conditions for fish stocks using the river channel between Comox Dam and the tailrace (BC Hydro 2000).

A secondary objective of the project involves post construction monitoring of gravel pad use by spawning salmonids and downstream displacement of gravel to other spawning locations. Detailed

monitoring should help in future site selection and in developing techniques to improve site effectiveness.

3.0 Study Area

The Puntledge River is an important salmon and steelhead producing stream on the central east coast of Vancouver Island (Figure 1). The river historically supported diverse and abundant fish stocks of salmon and trout that sustained local First Nations, while more recently contributing significantly to economically viable commercial and recreational fisheries (Guimond and Norgen 2003). From its headwaters in Strathcona Provincial Park, the Puntledge River flows northeast from the Vancouver Island Range and joins the Tsolum River to form the Courtenay River before entering the Strait of Georgia at the City of Courtenay (Figure 1). Two headwater lakes, Forbush and Willimar, feed the upper Puntledge River above Comox Lake Reservoir. Major tributaries to the Puntledge system include the Cruickshank River, entering on the west side of Comox Lake, and the Browns River, which enters approximately five kilometres downstream of the Diversion Dam.

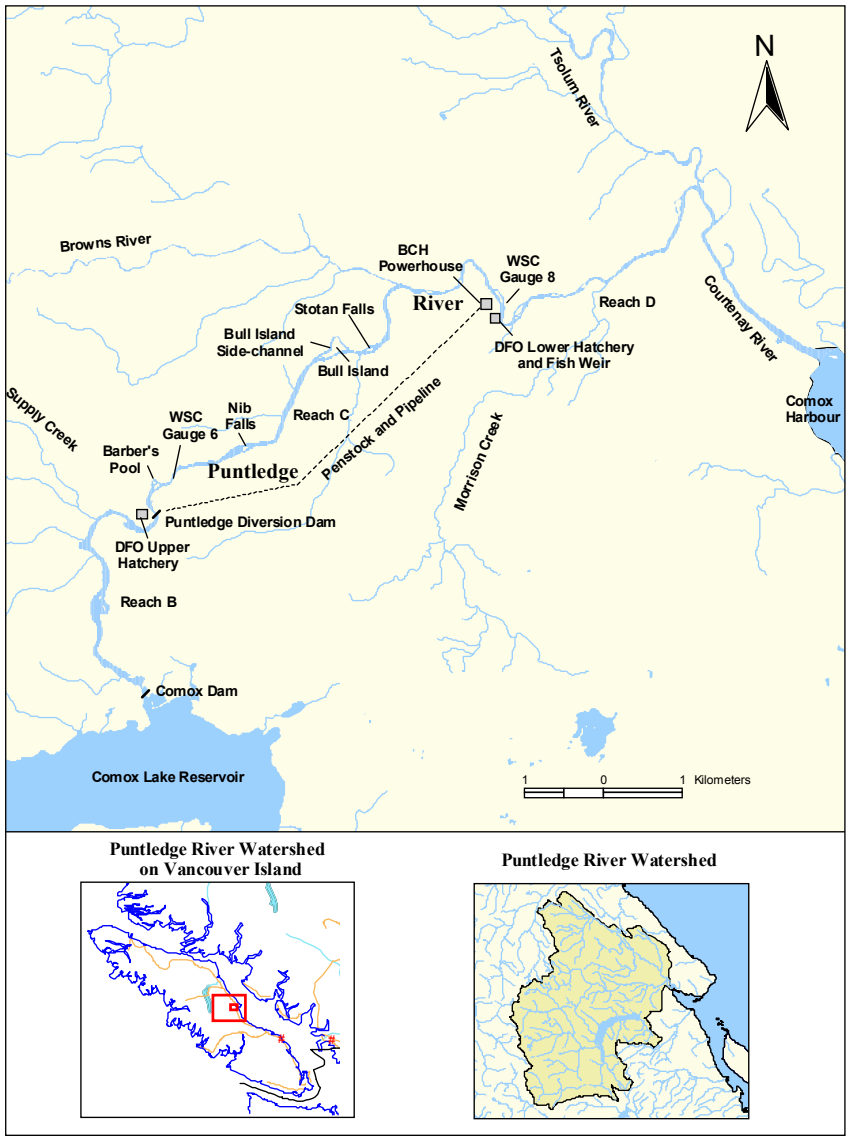

Figure 1. Puntledge River watershed on the east coast of Vancouver Island.

The lower Puntledge River (below the Comox Dam) can be divided into three distinct reaches (Bengeyfield and McLaren 1994). Reach B extends from the impoundment dam at the outlet of Comox Lake to the BCH Diversion Dam approximately 3.7 km downstream and has a gradient of 0.01% (BC Hydro 2003). Reach C is the section of natural river channel that is bypassed by BCH's

penstock diversion and is the focus area for the restoration works completed during this project. This reach extends approximately 6.4 km from the Diversion Dam downstream to BC Hydro's powerhouse. Reach C contains a high proportion of bedrock and shale formations, and has a gradient of 1.5%. Two significant falls (Stotan and Nib) located in Reach C have been altered to improve fish passage. Reach D, which lies between the powerhouse and the Tsolum River, is 5.7 km long and has a gradient of 0.05% (BC Hydro 2003).

4.0 Methods

DFO, MoE and Homalco FN staff[1] approved gravel restoration sites prior to proposal submission during an on-site meeting in October 2004. Sites also received approval from the local Watershed Enhancement Manager[2]. DFO engineering staff later confirmed mean stable rock sizes at 25, 50, and 70 mm for sites 1, 2 and 3, respectively.

Prior to construction, additional meetings on-site with DFO, MoE, BCCF and BCH occurred on June 20 and 29, 2005. Staff reviewed project logistics, potential gravel placement options, access routes, environmental management and safety plans. Concerns about gravel additions at the Water Survey of Canada (WSC) gauging station 6 (i.e., implications for discharge metering) were expressed by A. McLean[3] and M. Sheng[4]. As a result, the WSC site (Site 2 in the original proposal) was cancelled, and spawning gravel for this site was re-directed to Site 1 (upper hatchery pool).

A notification under Section 9 of the Water Act for "works in or about a stream" was received by MoE on July 4, 2005. Detailed safety and environmental management plans were submitted and approved by BCH on July 23, 2005.

Landowners (BCH and Hancock Forest Management) were contacted prior to construction to obtain access and ensure gravel delivery/installation schedules did not conflict with commercial operations or recreational activities.

On July 20, 2005, a back-hoe[5] cleared and prepared a ramp near the upper hatchery site for gravel stockpiling and excavator access (to Site 1). Also on July 20, a commercial tow truck[6] removed lock blocks from the lower Bull Island Side-channel access road (Site 2).

Suitably sized washed spawning gravel[7] was purchased and stockpiled at Hyland Precast Inc. On July 21, approximately 294 metric tonnes (166 m^3) of gravel were stockpiled on the lower Bull Island Side-channel access road, adjacent to the side-channel. On July 22, approximately 477 metric tonnes (271 m^3) were stockpiled on the prepared ramp adjacent to the upper hatchery site. An additional 266 metric tonnes (151 m^3) of gravel were delivered to Site 1 on July 26, during construction.

[1] Russ Doucet, Senior Engineer, Department of Fisheries and Oceans, Nanaimo; Craig Wightman, A/Manager Salmon and Steelhead Recovery, Ministry of Environment, Nanaimo; Kathy Campbell, Biologist, Homalco First Nation, Campbell River.
[2] Chris Beggs, Watershed Enhancement Manager, Department of Fisheries and Oceans, Courtenay.
[3] Natural Resource Specialist, Vancouver Island Region, BC Hydro, Campbell River.
[4] Biologist, Habitat Enhancement Branch, Resource Restoration, Fisheries and Oceans Canada, Nanaimo.
[5] John Deere 310 back-hoe, Gord Corrigall Trucking & Backhoe Ltd., Courtenay.
[6] Commercial tow-truck from Georgia Strait Collision, Courtenay.
[7] Gravel specifications were requested as follows: 10% small gravel (0.63-2.5 cm), 20% medium gravel (2.5-5.0 cm), 60% gravel/cobble (5.0-7.5 cm) and 10% cobble (7.5-10.0 cm).

On the day of construction, a safety meeting was first held to identify all hazards associated with the project. The prepared safety and environmental management plans were thoroughly discussed to ensure the safety of all personnel on-site and to identify protocols to ensure appropriate environmental protection.

Prior to construction at Site 2, crews isolated a small wetted channel (~2 m in width) crossing the access road and removed fish using a Smith-Root LR 24 electrofisher. With fish salvage completed and a fuel containment boom installed downstream, the channel was then filled in with gravel to enable machine crossings.

To construct pads, a back-hoe forwarded gravel from the stockpile to the river's edge. From this location, an excavator[8] hoe-chucked gravel into position under direction of the project manager.

To monitor stability and fish use of the installed gravel, crews surveyed stream bed profiles and completed swims in the fall of 2005 (prior to high water) and the spring of 2006 (post high water). Two benchmarked transects were completed at each site, using a Pentax AP-120 level, to document the movement of gravel following high water. Snorkellers looked for redds and performed minor excavation to confirm if eggs were present. Habitats immediately downstream of pads were examined to document gravel presence/abundance and enable future comparisons.

5.0 Results

Construction at Site 2, consisting of mainstem pads above and below the Bull Island Side-channel outlet, occurred on July 25 (Figure 2). The upstream pad received the bulk of the gravel (~60%), creating approximately 274 m^2 of spawning habitat. Mean gravel depth at this location was 0.5 m.

The downstream pad received the balance of the gravel, creating approximately 264 m^2 of spawning habitat. Mean gravel depth at this location was 0.4 m.

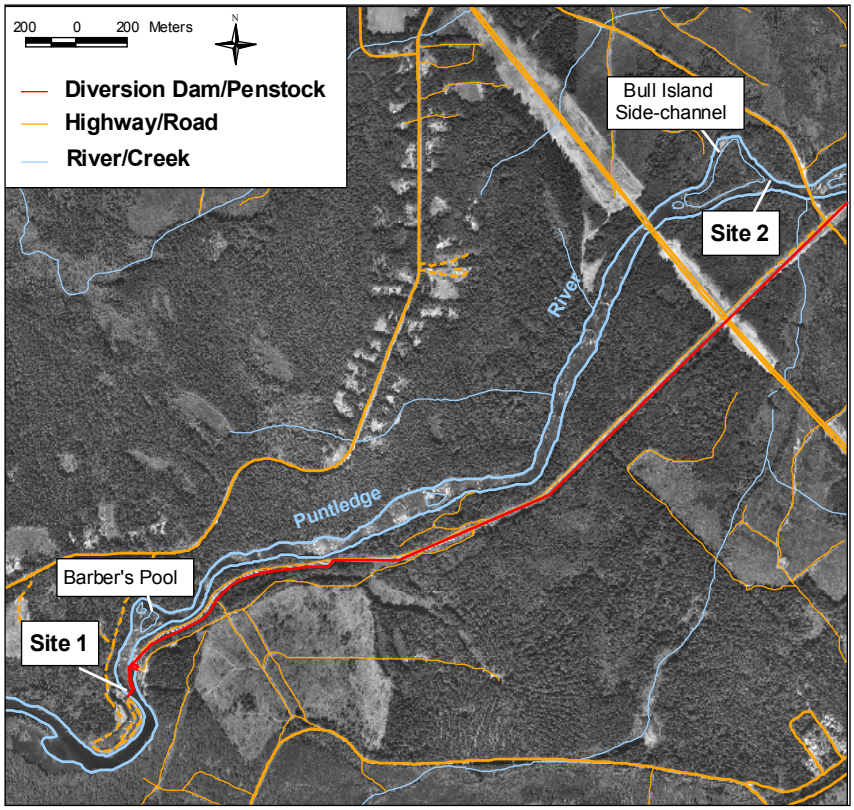

Figure 2. Location of gravel placement sites in Reach C of the Puntledge River.

[8] Hitachi ZX 200 excavator provided by Dennis Phye Bulldozing Ltd., Courtenay.

Construction at Site 1, located adjacent to the BCH Diversion Dam (Figure 2), occurred on July 26. Additional gravel was delivered to the staging area as previously stockpiled gravel was moved instream by the excavator. In total, 421 m^3 of gravel were placed at Site 1, creating approximately 454 m^2 of spawning habitat. Mean gravel depth at this location was approximately 0.9 m.

Large native boulders present were placed on gravel pads to increase habitat complexity. At Site 1, additional boulders were also placed at the back of the pad to increase its stability.

Following gravel pad construction, the channel was re-established on the lower access, and both roads were deactivated to prevent public access. Alders cleared from the ramp at Site 1 were randomly strewn across the road, and lock blocks at Site 2 were re-installed.

6.0 Site Monitoring

6.1 Fall Surveys

During surveys on October 25-27, use of gravel by spawning chinook salmon was noted at both locations (Q= 12 m^3/s). Site 1 had four chinook (two adults, two jacks) holding over the pad, however, no active digging was observed. Approximately 12-14 redds/test redds were located on the pad, as were two post-spawn chinook carcasses. Hand excavation revealed viable eggs in a site near the downstream end of the pad. DFO hatchery staff had previously removed 12-15 pairs of chinook carcasses from Site 1 during dead pitch operations (D. Fetzner[9], pers. comm.)

At Site 2, eight chinook (including two jacks) were observed holding over the lower portion of the upstream pad. One female was observed excavating a redd close to the bank. In total, eight redds/test redds were noted on the upstream pad (no eggs found during brief inspection). One obvious redd/test redd was noted on the downstream pad, as were three post-spawn chinook carcasses.

For 50 m downstream of Site 1, substrates were dominated by bedrock and boulders, with moderate amounts of large gravel (round and angular). Most of this gravel had collected in interstitial spaces around the larger boulders and offered limited spawning potential. The remaining stream bed down to Barber's Pool was bedrock dominated with little to no gravel. Any material displaced from Site 1 will likely pass through this area and deposit in Barber's Pool.

On right bank, the head of Barbers Pool contained moderate amounts of mostly angular medium to small gravel (5 to 10 cm). Some fine material was also present at the head of the pool on the left bank (right hand channel). Barber's Pool proper was dominated by larger gravels, cobbles and some boulders. Towards the tailout, a moderate amount of poor quality gravel was noted on right bank. This location may be hydraulically suitable for gravel additions in future years. The left hand channel entering Barber's Pool contained low quantities of small angular gravel near the riffle entry point.

Substrates downstream of Site 2 were dominated by boulders and large cobbles. Small amounts of gravel and cobble fill the interstitial spaces around the larger material. Bedrock dominates the substrate immediately upstream and downstream of the Comox Logging Road Bridge.

[9] Enhancement Technician, Puntledge River Hatchery, Department of Fisheries and Oceans, Courtenay.

Water depths and velocities were measured along transect lines to assess spawning conditions. Data gathered on October 27 (Q=12 m^3/s) indicated good hydraulic conditions for spawning at Site 2 as water depths at the upper (Transect 1) and lower (Transect 2) pads averaged 0.46 and 0.58 m, respectively. Water velocities at the upstream and downstream pads were also highly suitable with mean velocities of 0.41 and 0.61 m/s, respectively.

At Site 1 spawning conditions appeared less suitable (October 25, Q=7.3 m^3/s) as water depth and velocity measured at Transect 1 averaged 0.63 m and 0.08 m/s, respectively. Spawning conditions improved when discharge was increased to 12 m^3/s (October 26). Mean depths along Transects 1 and 2 were 0.74 and 0.84 m, respectively, while velocities along the two transects averaged 0.17 and 0.20 m/s, respectively.

As evident from fish use and flows prior to the monitoring session on October 25-27, discharges of 20 m^3/s or greater in the diversion reach likely provide suitable spawning conditions (depths and velocities) at Site 1.

6.2 Spring Surveys

Spring surveys took place on March 23, 2006 at a discharge of 12 m^3/s. The largest mean daily discharge following gravel pad construction occurred on December 26, 2005 with 162 m^3/s recorded in Reach C. At Site 1, minor displacement of gravel (5-10 m^3) occurred near the pad's downstream perimeter and from its right hand edge near the thalweg. Displaced gravel was noted in interstitial spaces around larger boulders for 20 m downstream of the pad. Gravel near the thalweg appeared to be flattened, reducing the overall slope of the edge of the pad.

One small but recent redd/test redd was noted at Site 1, indicating digging by a resident trout or captive brood steelhead (released in October of 2005). In addition, most of the gravel pad and complexing boulders were covered by a layer of green filamentous algae and D*idymosphenia geminata* (diatom species). The abundance of both decreased significantly downstream of the first series of riffles leading into Barber's Pool and was not present at all at Site 2 (~ 3.5 km downstream).

At Site 2, approximately 60% of the upstream pad was displaced up to 50 m downstream, fanning out across the channel, settling around large cobbles and adding to gravel already present. Remaining gravel appeared highly usable, with good depths and velocities for spawning. About 25% of the displaced gravel appeared usable at the time of survey.

Approximately 25% of Site 2's downstream pad was displaced, though losses appeared to have been partially replaced by the upstream pad. Material displaced downstream has settled into interstitial spaces around the large boulders. No recent use of the downstream pad by fish was noted. Displaced material from both sites was apparent in the bedrock pool upstream of the Comox Logging Road Bridge.

At Site 1, streambed profiles confirmed snorkel survey findings that noted little gravel movement following high water (Figure 3). Minor changes in gravel pad height can likely be attributed to rod positioning error. Gravel placed at the outside edge of the pad, near the thalweg, appeared to have been flattened during high water. In addition, gravel displaced from the outside edge of the pad near the upstream end (i.e., Transect 2) appeared to have settled along the outside of the pad at the downstream end (Transect 1).

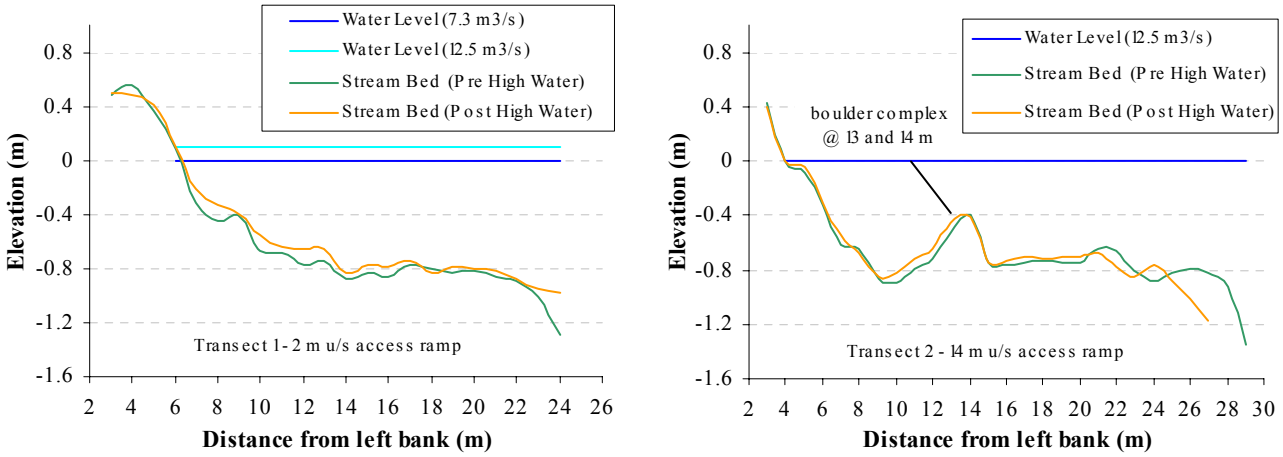

Figure 3. Gravel pad profiles at Site 1 before (October 25, 2005) and after (March 23, 2006) high water events. Elevations adjusted for water height.

At Site 2, significant gravel movement was noted at Transect 1, while less gravel movement was observed at Transect 2 (Figure 4). Similar to Site 1, displaced gravel from the upstream ends of both pads at Site 2 appears to have settled out along the outside edge of each pad near mid-channel. Significant gravel displacement was noted between 5 and 13 m along Transect 1.

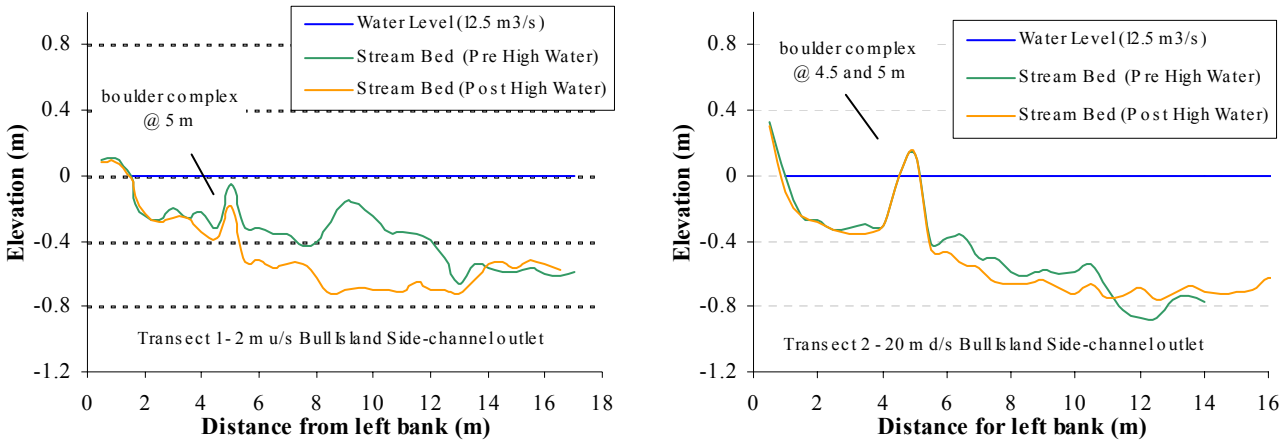

Figure 4. Gravel pad profiles at Site 2 before (October 25,2005) and after (March 23, 2006) high water events. Elevations adjusted for water height.

7.0 Recommendations

To continue to address "identified" limiting factors including loss of habitat and reduced habitat capability, we recommend:

1) Continued placement of gravel in the mainstem Puntledge River below the diversion dam (Reach C) in stable and usable locations to immediately increase the available spawning habitat for salmon and trout.
2) Determining the feasibility and effectiveness of bulk loading gravel at the diversion dam for recruitment into usable areas downstream. This concept was recommended by Bengyfield and McLaren (1994) and has been recommended for the Elk Falls Canyon in the Campbell River (another Hydro-regulated watershed) by Burt (2004).
3) Continued monitoring of gravel placed at both sites to determine its effectiveness and stability. If gravel placed at Site 1 (Diversion Dam) is deemed stable at higher spills (i.e., > 200 m^3/s), additional gravel could be placed at this site to increase velocities over the gravel pad during spawning pulse flows (~ 12 m^3/s). Alternatively, a low-water deflection structure could be placed above the pad to narrow the channel and focus flow over the pad at Site 1. Such a structure would require engineering design to ensure stability and functionality.

8.0 Acknowledgements

Thanks are extended to Craig Wightman, who developed the project and acted as scientific authority. Mike McCulloch[10] initiated the project and completed most of the pre-planning and gravel acquisition work. Hancock Forest Management, BC Hydro and DFO allowed access to lands to complete this project; their support was appreciated. Kevin Pellett[11] helped implement post-construction monitoring. Appreciation is extended to James Craig[12] for editing this report. Mike Savoie[13] helped during project construction and his hard work was greatly appreciated. Funding for this project was provided by BC Hydro's Bridge Coastal Fish and Wildlife Restoration Program. Their continued support of steelhead and salmon recovery initiatives in the Puntledge River watershed is greatly appreciated.

[10] Fisheries Technician, BC Conservation Foundation, Nanaimo.
[11] Fisheries Technician, BC Conservation Foundation, Nanaimo.
[12] Fisheries Technician, BC Conservation Foundation, Nanaimo.
[13] Band member, Comox First Nation, Comox.

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Appendix A.

BCRP Financial Statement

Financial Statement Form

Project # 05.Pu.04

	BUDGET		ACTUAL	
INCOME	BCRP	Other	BCRP	Other
Total Income by Source	40,288.49	5,700.00	40,288.00	2,200.00
Grand Total Income (BCRP + other)	**45,988.49**		**42,488.00**	
EXPENSES *Project Personnel*				
Wages (BCCF)	9,070.00		9,590.20	
Sub Contracts (Comox FN)	n/a	n/a	290.32	
Fisheries Flow Specialist		500.00		
Senior Biologist (MoE)		1,500.00		1,500.00
Subtotal	**9,070.00**	**2,000.00**	**9,880.52**	**1,500.00**
Materials and Equipment				
Spawning Gravel	9,000.00	3,000.00	9,266.68	
Gravel Hauling	4,500.00		2,875.35	
Excavator + Mobilization	7,649.00		3,067.50	
Skid Steer/Back-hoe + Mobilization	1,451.90		1,260.00	
Volvo Articulated Dump Truck	2,140.00			
Volvo Articulated Dump Truck Mobilization	660.00			
Travel (Per Diems)	660.00		236.25	
Truck Rental	585.00		910.00	
Vehicle Expense (Fuel)	360.00		520.94	
Communications	100.00			
Safety/Survey Equipment		500.00	84.13	450.00
Work Site Equipment		200.00	45.00	250.00
Riparian Planting	450.00			
GST	n/a	n/a	569.83	
Subtotal	**27,555.90**	**3,700.00**	**18,835.68**	**700.00**
Administration				
Telephone Charges	50.00			
Photocopies and printing	250.00		250.00	
BCCF admin @ 10%	3,362.59		2,524.39	
Subtotal	**3,662.59**		**2,774.39**	
Total Expenses	**40,288.49**	**5,700.00**	**31,490.59**	**2,200.00**
Grand Total Expenses (BCRP+other)	**45,988.49**		**33,690.59**	
BALANCE (Grand Total Income - Grand Total Expenses)	**0.00**		**8797.41 (amount of unused BCRP funds)**	

Appendix B.

BCRP Performance Measures

Performance Measures

Project # 05.Pu.04

Using the performance measures applicable to your project, please identify the amount of habitat actually restored/enhanced for each of the specificied areas (e.g. riparian, tributary, mainstem).

Performance Measures - Target Outcomes													
Project Type	**Primary Habitat Benefit Targeted of Project (m^2)**	**Primary Target Species**	**Habitat (m^2)**										
			Estuarine	In-Stream Habitat - Mainstream	In-Stream Habitat - Tributary	Riparian	Reservoir Shoreline Complexes	Riverine	Lowland Deciduous	Lowland Coniferous	Upland	Wetland
Impact Mitigation												
Fish passage technologies	Area of habitat made available to target species											
Drawdown zone revegetation / stabilization	Area turned into productive habitat											
Wildlife migration improvement	Area of habitat made available to target species											
Prevention of drowning of nests, nestlings	Area of wetland habitat created outside expected flood level (1:10 year)											
Habitat Conservation												
Habitat conserved – general	Functional habitat conserved/replaced through acquisition and mgmt											
	Functional habitat conserved by other measures (e.g. riprapping)											
Designated rare/special habitat	Rare/special habitat protected											
Maintain or Restore Habitat forming process												
Artificial gravel recruitment	Area of stream habitat improved by gravel plcmt	Steelhead and Chinook		992								
Artificial wood debris recruitment	Area of stream habitat improved by LWD plcmt											
Small-scale complexing in existing habitats	Area increase in functional habitat through complexing											
Prescribed burns or other upland habitat enhancement for wildlife	Functional area of habitat improved											
Habitat Development												
New habitat created	Functional area created											

Appendix C.

Confirmation of BCRP Recognition

A FISH-SAFE EXCAVATOR placed gravel above Stotan Falls and below the diversion dam. The $37,000 enhancement will provide about a 25 per cent increase in spawning habitat. *PHOTO BY PAUL JACOBS*

Fish-safe excavator adds spawning gravel to river

Paul Jacobs
Record Staff Writer

PUNTLEDGE

The BC Conservation Foundation (BCCF) oversaw the installation of 560 cubic metres of spawning gravel in the Puntledge River last month. Funded by BC Hydro's Bridge Coastal Fish and Wildlife Restoration Program, crews used a fish-safe excavator to place gravel above Stotan Falls and below the diversion dam. The $37,000 enhancement will provide about a 25 per cent increase in spawning habitat for summer steelhead and chinook salmon to deposit eggs between the falls and the dam.

A recent inventory in the Puntledge found a lack of spawning gravel in the river. Spill events from the dams wash the gravel downstream and the dams impede gravel from moving down the system naturally, according to Scott Silvestri, fisheries technician for the Greater Georgia Basin Steelhead Recovery Plan.

"Our plan is to add gravel over the next three years at key locations where we know it will stay," says Silvestri.

As well, the Department of Fisheries and Oceans will be adding gravel in other areas of the river.

BCCF will monitor the results from this year's enhancement before installing more gravel at adjacent sites or other new sites.

Appendix D.

Photo Documentation

1. Gravel placement by excavator at Site 1 (Diversion Dam).

2. Completed spawning platform at Site 1 (Diversion Dam).

3. Gravel placement by excavator at Site 2 (Bull Island Side-channel).

4. Completed spawning platform at Site 2 (upstream Bull Island Side-channel outlet).

5. Possible chinook redd/test redd at Site 2.

6. Confirmed chinook redd at Site 1.

7. Viable chinook eggs from redd at Site 1.

8. Spawning activity (likely chinook) at Site 1.

Appendix E.

Snorkel Survey Report

GREATER GEORGIA BASIN
STEELHEAD Recovery Plan
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FILE NOTE

Date: November 16, 2005
File: 34560-20/SNORK
xf: 34560-27/*PUNTLEDGE*

SNORKEL SURVEY REPORT
Puntledge River

DATE: October 25 & 26, 2005
WEATHER: Mainly OC, light rain, air temp 10°C
WATER TEMP.(°C): 12 at 1100 hours (October 25) @ diversion
DISCHARGE (m^3/s): October 25 -7.2, October 26-12.6 (per WSC gauge 6, waiting for WSC data)
VISIBILITY (m): 7+
PERSONNEL: S. Silvestri, K. Pellett
AREA: Spot swim from the BC Hydro Diversion Dam to Barber's Pool tailout (~350 m) and 40 m u/s Bull Island S/C outlet to Comox Logging Road Bridge (~250 m)
Total distance: approx. 0.6 km

1. **Fish Observed**:

Adults

0 steelhead. No steelhead were observed during the two spot swims.

Distribution of fish observed:

Location	# of Chinook	# of Coho	# of Residualized Hatchery Steelhead Smolts (10-20 cm)	# of Captive Brood Released Steelhead (25-45+ cm)*
Diversion Pool	6 (2 jacks)	15	30	1
Diversion Gravel Pad	4 (2 jacks)			
Gravel Pad – Top of Barber's Pool	2		150	3
Top of Barber's Pool – Barber's Pool Tailout	10	5	50	75
Upstream of Bull Island S/C Outlet	10	1	10	
Bull Island S/C Outlet to Bridge	17 (4 jacks)	8	40	18

* Note: Size of captive brood steelhead varied from 25 – 45+ cm. It appears that some of these fish were Floy tagged and some were not.

Juveniles

Steelhead parr abundance was low to moderate overall. A high density of residualized steelhead smolts (hatchery origin) were observed in both sections. A few coho juveniles were noted in margin habitat.

2. Notes

- This swim was completed to monitor salmon use of gravel pads constructed in July 2005 at two sites: Site 1 - across from the BC Hydro Diversion Dam and Site 2 - immediately upstream and downstream of the Bull Island Side-Channel outlet (on left bank). In 2003, MJL Environmental Consultants documented a total of 1, 955 m^2 and 705 m^2 of naturally occurring functioning and non-functioning spawning gravel in Reach C of the Puntledge River. In 2005, a total of 610 m^3 of washed spawning gravel was placed at the two sites, creating approximately 992 m^2 of spawning habitat (an increase of 51%).
- At site 1, approximately 420 m^3 of gravel was installed, creating approximately 453 m^2 of new spawning habitat. Gravel on the pad averaged approximately 1.0 m in depth, while water depth over the pad averaged 0.76 m at the observed discharge of 12.6 m^3/s. At site 2, approximately 190 m^3 of spawning gravel was placed, creating/enhancing approximately 539 m^2 of spawning habitat. Average gravel and water depths at this location were approximately 0.35 m and 0.45 m, respectively.
- No movement of gravel has occurred since construction of the two pads on July 27, 2005. The highest discharge observed in Reach C since this date was 20.7 m^3/s (Oct. 18, WSC data).
- Site 2 appeared to provide excellent hydraulic diversity and spawning conditions for all species of salmon and steelhead at the observed discharge. Hydraulic conditions at Site 1 were less suitable (measured velocities averaged 0.17 m/s) at the observed flows, however spawning conditions would likely improve with spawning pulse flows and water releases from the dam (i.e., releases of 20 m^3/s or higher). At both locations, spawning gravel size appeared to be a reasonable compromise between stability and usability. Site 2, located where the channel has higher than average widths, appears to have some inherent stability during extreme events, as gravel has persisted at this location over time. The channel also has characteristics that facilitate spawning during periods of base flows.
- Use of the gravel by spawning chinook salmon was noted at both locations. Site 1 had four chinook salmon (two adults, two jacks) actively holding over parts of the gravel pad (no active digging was observed). Approximately 12-14 redds/test redds were located on the pad, as were two post spawn chinook carcasses. Hand excavation revealed viable eggs in a site near the downstream end of the pad. DFO hatchery staff had previously removed 12-15 pairs of chinook carcasses from the pad during their dead pitch operations (D. Fetzner, Enhancement Technician, Puntledge Hatchery, pers. comm.).
- At site 2, eight chinook salmon (including two jacks) were noted holding over the lower portion of the upstream pad. One female was observed digging near the left bank portion of the pad, just upstream of the Bull Island S/C outlet. In total, eight redds/test redds were noted on the gravel pad upstream of the side-channel outlet. No eggs were observed during limited excavation of several redds/test redds at this location. Only one obvious redd/test redd was noted on the gravel placed downstream of the side-channel outlet. Three dead post spawn chinook carcasses were observed on the gravel placed at this location.
- Substrates downstream of gravel placement sites were examined to document current conditions and improve gravel pad displacement assessments in future surveys. The area immediately downstream (~50 m) of Site 1 was dominated by bedrock and boulders, but has a low-moderate abundance of large (round and angular) gravel. Most of this gravel has collected in interstitial

spaces around the larger boulders and offered very limited spawning potential. The remaining stream bed down to Barber's Pool was bedrock dominated with little to no gravel. Any gravel displaced from Site 1 will likely pass through this area and deposit in Barber's Pool. Barber's Pool contained moderate amounts of mostly angular medium and small size gravels (5 to 10 cm) in the head of the right bank run leading into the pool. Some fine material was also present on the left side of the right bank channel. Barber's Pool proper was dominated by larger gravels, cobbles and some boulders. A moderate amount of poor quality spawning gravel was noted on the right bank portion of the thalweg leading into the tail-out. This location may have sufficient hydraulic stability to support the addition of gravel in future years. The left bank channel that enters Barber's Pool was dominated by bedrock, but did have some small angular gravel near the riffle entry point. The area on the far left bank (near the small island) also had moderate amounts of spawning sized gravels.

- The substrate downstream of Site 2 was dominated by boulders and large cobbles. Small amounts of gravel/smaller cobble fill the interstitial spaces around the larger material. Bedrock dominates the substrate immediately upstream and downstream of the Comox Logging Road Bridge.

Scott Silvestri
Fisheries Technician
Greater Georgia Basin Steelhead Recovery Plan

Photos attached

cc: All Fisheries staff
Steelhead Crew
A. McLean, Biologist, BCH, Campbell River
C. Beggs, Watershed Enhancement Manager, Puntledge River Hatchery, Courtenay
L. Petersen, Co-chairman, Puntledge River Restoration Committee, Courtenay

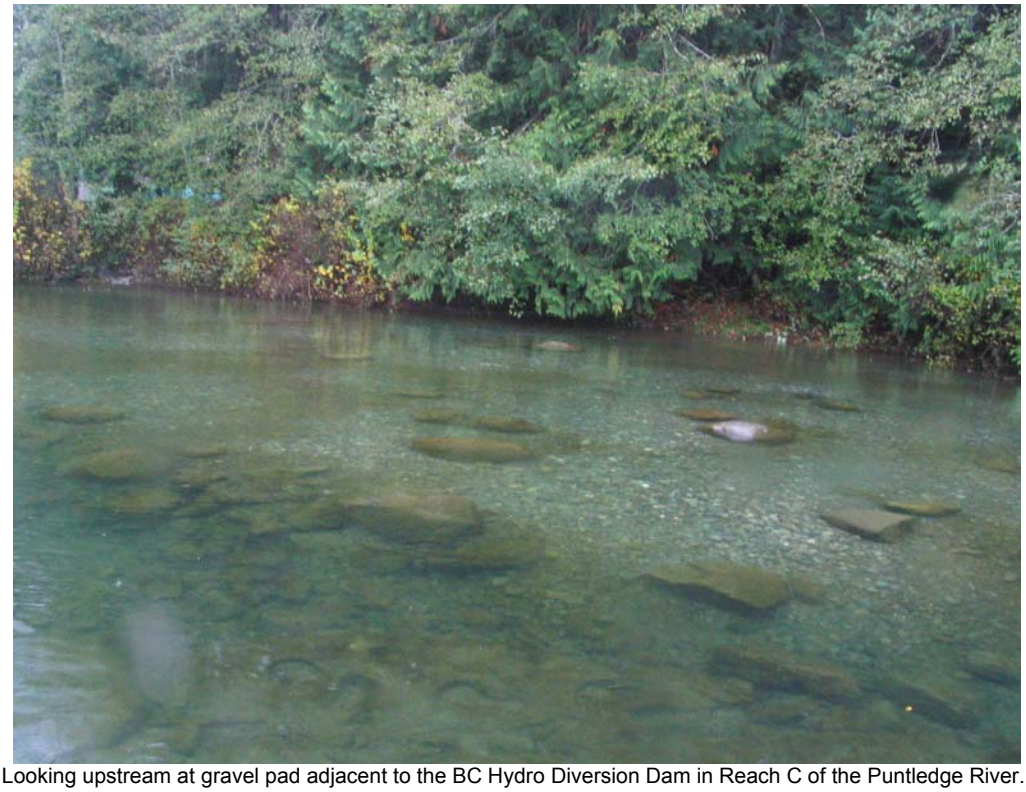

Photo 1. Looking upstream at gravel pad adjacent to the BC Hydro Diversion Dam in Reach C of the Puntledge River. The lighter gravel areas generally indicate redd/test redd locations.

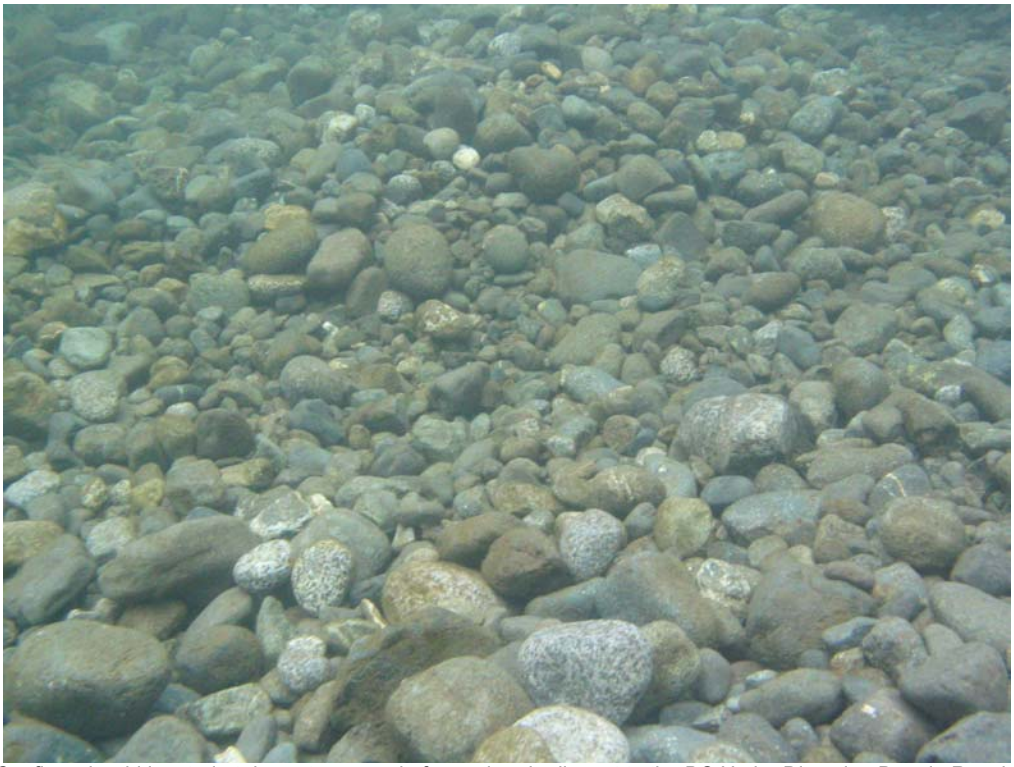

Photo 2. Confirmed redd located at downstream end of gravel pad adjacent to the BC Hydro Diversion Dam in Reach C of the Puntledge River. This redd was partially excavated to determine egg presence. Three large viable eggs (likely chinook) were found at this location.

Photo 3. Viable eggs excavated from a redd near the downstream end of the spawning gravel pad adjacent to the BC Hydro Diversion Dam in Reach C of the Puntledge River.

Photo 4. Looking upstream at gravel pad immediately upstream of the Bull Island Side-channel outlet (Left bank) in Reach C of the Puntledge River.

Photo 5. Possible redd/test redd located at downstream end of gravel pad immediately upstream of the Bull Island Side-channel outlet in Reach C of the Puntledge River. A few redd/test redds were partially excavated, however no eggs were found. A pair of actively spawning chinook salmon were observed at the downstream end of this gravel pad.