Campbell River (Elk Falls) Canyon Spawning Gravel Delivery Yr. 1.

FWCP Project # COA-F17-F-1218

Prepared for

Fish and Wildlife Compensation Program
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Executive Summary

Following construction of the John Hart dam on the upper Campbell River in 1953, natural recruitment of spawning substrates in the Elk Falls Canyon and the lower river was significantly reduced, leading to "gravel poor" habitat in those reaches. Increasing spawning habitat and egg to fry survival for the remnant population steelhead and Chinook are important steps in the recovery of these stocks in the Campbell River watershed.

Completed in March 2016 funded through FWCP, RFCPP, CRSF and Living Rivers, a gravel delivery system was built in Elk Falls Provincial Park to deliver washed spawning gravel into the first pool tail-out, below Elk Falls. The infrastructure, as built, allows for approximately 0.5 m^3 of spawning gravel to be dumped at a time using an overhead skyline spanning the canyon. A gravel staging area was selected, located adjacent to the existing footbridge that crosses the wood stave penstocks on BC Hydro property, and accessible using tandem axle gravel trucks. Tracked skidsteers (aka Bobcats) were used to transport the gravel from the staging area through the park, using both existing pedestrian and new trails, to the skyline and bucket. The skyline bucket is loaded directly by the skidsteer and then lowered out over the canyon and released.

Between August 8, and 12, 2016 approximately 200 m3 of graded and washed spawning gravel was delivered into the Elk Falls Canyon, the largest single gravel project at this site since construction of the John Hart Dam in 1952. Costs per unit to deliver the gravel was approximately 60% less than the previously used helicopter method. The gravel pad produced was used by dozens of adult Chinook, Pink, Chum and Coho salmon in the fall of 2016.

This project addressed directly two items in the 2011 FWCP Salmonid Action Plan: 'Continue augmentation of gravels in Elk Falls Canyon' (Priority 1), and 'Maintenance and monitoring of existing gravel pads in Elk Falls canyon and the lower Campbell River' (Priority 1). The primary target species for this project is Chinook and Steelhead, both cited in FWCP 2011 as the "highest priority species in the Lower Campbell"

Total cost of this project was about $68,000 and was funded largely by the Fish and Wildlife Compensation Program (FWCP).

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1.0 INTRODUCTION

The Campbell River flows east from Strathcona Provincial Park, entering Johnstone Strait at the City of Campbell River. Draining an area of 1,744 km^2, the Campbell River is Vancouver Island's second largest watershed, having a mean annual reservoir discharge of 87 cubic meters per second (cms) at John Hart Dam, and 103 cms downstream near the river's mouth.

The 1.8 km of Elk Falls Canyon (Map 1), located immediately upstream of the John Hart powerhouse tailrace (JHT), remains accessible to anadromous salmonids. The reach is characterized by incised bedrock geology with relatively narrow channel widths and a distinct rapid-pool hydraulic character. Substrates are typically very large as a result of historically high flows, usually related to winter rain-on-snow events and spills from John Hart Dam.

Prior to 1999, spawning gravel in the Elk Falls canyon was extremely limited, with only a few small, isolated patches. In July 1999, BC Hydro, Ministry of Environment, Lands and Parks and DFO contracted LGL Ltd. and the BC Conservation Foundation (BCCF) to install 75 cubic meters of washed 6 inch minus gravel in the tail-out of the Elk Falls plunge pool.

Since 2002, spawning gravel has been introduced to Elk Falls canyon five times using heavy lift helicopters (Pellett 2012). Although each project achieved target loading rates, cost per unit was high (~$650/cubic meter), compared to more conventional means of delivery. Bulk loading concepts were previously explored under a FWCP funded project entitled, "Campbell River (Elk Falls) canyon spawning gravel placement - feasibility of a land based conveyance system" (McCulloch and Silvestri 2006). Two delivery options were subsequently identified, but based on cost and potential impacts to the provincial park neither was seriously considered at the time.

In 2015, construction of a new suspension bridge just downstream of Elk Falls has preempted the future ability to replenish gravel using helicopters, as the proposed bridge is directly under required flight paths. Given the new proposal, an opportunity to re-visit a bulk gravel loading strategy was presented. The initial project concept and layout was developed in 2014/15 by

Herold Engineering and used as a base for more detailed construction plans included in this fiscal year accomplishments.

Upon reviewing the McCulloch and Silvestri 2006 report and discussing possible options with engineers, it was decided that the most effective way to bulk load gravel into this location was to use an overhead skyline and trolley bucket design. The trolley system was constructed in the early spring of 2016. The trolley can hold just under 0.5 m^3 of gravel and is loaded with the use of a tracked skid steer (bobcat) from a gravel stockpile located about 100 m away, near the penstock footbridge. The trolley is lowered out over the canyon using a hydraulic winch and dumped remotely, retrieved and reloaded. Using this method gravel amounts of up to 8 m^3 per hour can be achieved.

Annual monitoring since 2002 has shown significant use of introduced spawning gravel by all salmon and trout species occurring in Campbell River. As expected, large rain events and subsequent water releases down the Elk Falls Canyon continually displace gravel through the canyon. As a result, annual additions of spawning gravel, via bulk loading, will likely be part of a long term rehabilitation and maintenance plan for the Campbell River John Hart Facility.

2.0 GOALS AND OBJECTIVES

The primary goals and objectives of this project were to increase the quantity/quality of spawning gravel in the Elk Falls Canyon reach toward levels identified by Burt (2003) with the addition of 200 m^3 of pre-washed and graded spawning gravel to the upper Elk Falls Canyon. The increase in gravel would ultimately increase the freshwater productivity of the system's remnant populations of summer and winter steelhead stocks (*Oncorhynchus mykiss*) as well as Chinook (*O. tshawytscha*), Coho (*O. kisutch*), and Chum (*O. keta*) salmon. Increasing spawning habitat and egg to fry survival for the remnant population of summer and winter steelhead are important steps in the recovery of these stocks in the Campbell River watershed (Lill 2002). General equipment maintenance and project efficiencies are also being refined through the use of the infrastructure.

A second main objective was to have trained hydrologists review the natural gravel recruitment through the system and help to determine long term target loading rates for the Canyon and downstream. Using appropriate background information the hydrologists can provide recommendations for future gravel additions.

These objectives will help the FWCP and others to achieve a long term to increase the abundance of gravel in Elk Falls Canyon to levels capable of supporting all salmonids species occurring in this reach.

4.0 METHODS/RESULTS

4.1 Engineering, Permitting and Planning

Gravel Trolley upgrades

Matt Seyd (P. Eng, Herold Engineering) continued as primary structural engineer for the project. He was responsible for the design to upgrade the trolley bucket which failed in the initial test-run in March 2016. With consulting with the fabricators, BCCF and PGH Consulting Staff, some modifications to the trolley bucket were completed before project commencement in August 2016. These modifications included the addition of remotely releasing actuators to allow for FOB control of the trolley bucket release mechanism. Two actuators (Progressive Automations Model PA-14 – 150) were mounted on either side of the bucket (Figure 1). The remote release switch (Gama Electronics Model: LRF12V-1PR-ASL Long Range RF Remote Control) powered by a 12V Microstart XP-1 lithium ion battery.

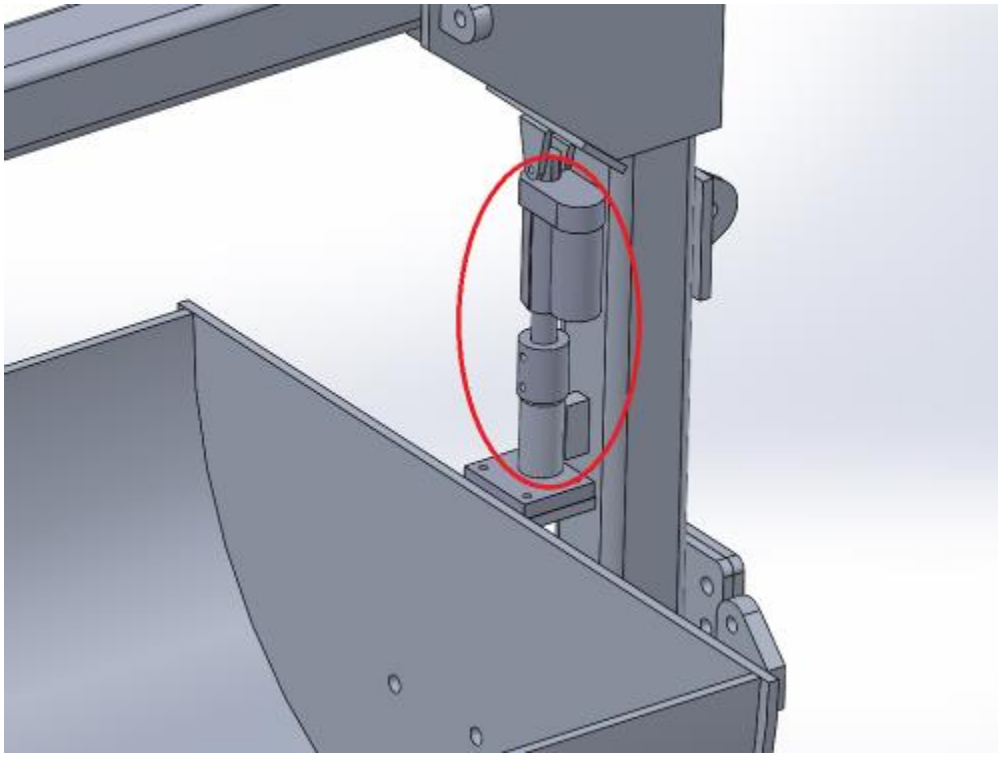

Figure 1. Schematic image of the linear actuators (circled in red) used to remotely release the trolley bucket allowing for gravel deployment.

To prevent full bucket rotation, 'snubber' cables were also added, these included 3/8" wire robe fastened to welded cleats on the frame and bucket. Repairs include a new bearing assembly and a design modification securing the pivot shaft through the side of the bucket to prevent any frame flex.

Park Use Permit

Given the work site was located within a Provincial Park (Elk Falls), a Parks Use Permit (PUP) was required and an amendment was submitted in May, 2015. This PUP is valid until 2021 and included the provisions for BCCF to use the Elk Falls Provincial Park for gravel delivery. BCCF worked closely with Parks Staff, Brent Blackmun, to ensure parks features and aspects were maintained and impacts were kept to a minimum.

Section 11 and DFO notifications.

A Section 11 Notification (previously Section 9) (File # 100173012) was submitted on July 22, 2016, and approval was given July 26, 2016 via e-mail. Though under new Fisheries Act Legislation, DFO has no formal method for application for habitat restoration projects, BCCF staff did go through the Self-Assessment Review for Projects Near Water process as outlined on the DFO website (http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html). Please note that the gravel delivery timing occurred within the specified "fisheries Timing Window" for the Campbell River watershed. Both Federal and Provincial fisheries enforcement staff were notified of the project before commencement.

Parks Closure Notices

Prior to commencement of construction, BCCF was required as part of the PUP agreement to give advance notice to potential park users of any trail closures or impacts the project may have on the trial system. Similar notifications were included on the BC Parks website, and the FWCP website. Signs were was also erected approximately two weeks prior to construction to inform regular park users of potential disruptions. During construction, trained/certified flagging personnel were hired to control pedestrian traffic through the Park.

In addition, the local radio stations, The Eagle 97.3 FM and The Goat 98.9 FM, included brief public advisories and project background on August 8, 2016. The radio stations also included corresponding stories on their respective websites.

Safety and BC Hydro Permitting

All pertinent safety processes were followed and necessary permits obtained, these include, but are not limited to, the following:

1. BCCF supplied BC Hydro with a Safety Plan to conform to general FWCP safety requirements
2. BCCF obtained and signed a Permission to Enter Agreement extension between BCCF and BC Hydro and Power Authority File # 502-1506.0(2) Pt IV
3. BCCF supplied a completed Permit to Work Procedure (#16-054) to access/pass through SNC Lavalin (BC Hydro Prime Contractor) controlled areas.
4. BCCF. provided a detailed Safety Management Plan to BC Hydro for review and acceptance.
5. BCCF provided a detailed Environmental Management Plan to BC Hydro for review and acceptance

6. BCCF Staff, informed BC Hydro/SNC Lavalin of plans for each week and access requirements through SNC Lavalin controlled areas.
7. Three BCCF staff obtained WPP CAT A & B safety courses provided by BC Hydro in case of any requirements for staff to work in the canyon floor.

4.2 Implementation

BCCF staff installed the main cable, winch, and hydraulic power-pack (Photo 1.) and gravel trolley (Photo 2.) during the week of August 1st. A 'strawline' (50lb dacron cord) was launched across the canyon using a three man slingshot. This was then used to pull across ¼" nylon ropes. Using the hydraulic winch and a basic pulley system, the main cable (7/8" wire rope) was pulled across the canyon and fastened to the bridle anchor on the north side (Photo 3.). The cable was pulled taught up to the South Tower (Photo 4.) using a 11/2 ton Grip Puller (a.k.a. Tirfor) and tensioned further with the use of a 60 t, 36" turnbuckle.

Gravel was delivered to the staging area (Photo 5), selected near the north side of the pedestrian walking bridge that spans the wooden penstocks, using tandem axel gravel trucks. Gravel was delivered starting August 4, 2016 and continued periodically through to August 11, 2016. In total 318 tons of gavel was delivered to the staging area.

A large tracked Skidsteer (JohnDeere 232D) equipped with a 2.5 m^3 mechanical wheelbarrow (Photo 6.) was used to transport the gravel from the staging area, through the park (approximately 100m) to the trolley loading area. At this point the gravel was dumped and loaded into the trolley bucket with another skidsteer (Bobcat T180) with a standard 0.5 m^3 'cleanup' bucket (Photo 7.). This method of using two machines was used to help reduce the impact to Park users. The wheelbarrow allowed for far fewer trips up and down though the park trails and therefore less disruptions.

Gravel placement commenced August 8, 2018 and continued until August 12 2016. Over this period the trolley was in operation for approximately 35 hours and nearly 500 trolley loads were dropped into the canyon (Photo 8.), a total of approximately 320 ton (200 m^3).
The trolley system was de mobilized on August 12, 2016. This included the removal of the overhead skyline, hydraulic winch and powerpack. The trails used by the bobcats were repaired and topped with ½" minus 'blue crush' which was compacted and raked (as requested by BC parks, Photo 9.). All related items were removed and the fence panel replaced.

Northwest Hydraulic Consultants Ltd. (NHC) were retained to perform the hydrology study portion of this project. A geomorphic study to assess the pre-regulation sediment transport regime of the river in order to improve planning for future channel restoration efforts was completed and submitted to BCCF (NHC 2016, Appendix 1). Using a comprehensive analysis of the project site, water shed area and geomorphologic characteristics and comparing the Campbell system to other river systems to estimate an annual sediment yield for the Lowe Campbell River. This report can be used to help determine realistic gravel targets for the Canyon and lower river.

5.0 CONCLUSION/RECOMMENDATIONS

This first year of major gravel additions using the new gravel trolley system was a great test of the system and its capabilities. In total nearly 500 drops were made placing approximately 320 t or over 200 m^3 of washed and graded spawning gravel into the first pool tailout below Elk Falls. The gravel, as it falls, spreads out approximately 8 m by the time it reaches the canyon floor with the resulting gravel pad nicely contoured and immediately useable to spawning Salmonid (Photo 10,11.). Habitat benefits for this project creation/improvement of approximately 400 m^2 of salmon spawning habitat. On October 17, 2016, 22 active Chinook redds were recorded on the new gravel, Sockeye and Pink salmon were also observed actively spawning on the new gravel in earlier surveys (Kyle Milburn, Eco fish research Pers. Comm.). Unfortunately due to increased flow released at JHT dam through the canyon most of this gravel was re distributed downstream (Photo 12.). At extreme flows like the ones seen in 2016 there is little that can be done prevent loss of productivity through destruction of redds.

It is hoped in future years the reservoirs can be managed in such a way that will result in less extreme flows through the canyon, and some gravel will remain at the drop location. Based on previous gravel movement monitoring at this location typically displaced gravel will settle out in various location within the canyon and is available and functional for spawning in future years at some locations (M. McCulloch, FLNRO Anad. Fish Specialist, Pers, Comm.). Gravel movement is a natural process which can only be mitigated by the continual addition of gravel to the upper canyon. If flows can be managed and sustained at under 150 m^3/s gravel distribution should happen at a letter rate, and the resulting location of the distributed gravel will be more functional. At extreme flows a higher proportion of the gravel gets moved to locations that are not wetted at base flows making them unusable to spawning salmonid.

Based on NHC 2016 report (Appendix 1), approximate natural recruitment through the canyon was estimated at 2200 m^3 per year, an order of magnitude higher than this projects realistic capacity. Limits to gravel placement volume at this location is governed by the capacity of the canyon floor/pool to hold gravel. (i.e. we need to stop gravel additions before the point where gravel is causing subsurface flows (through the new gravel) at $3m^3/s$ discharge rate).

Given this, it is recommended that gravel placement at this location continue into the future. Frequency of the gravel additions will be based on wintertime flow releases from JHT. If high flows occur in a given winter resulting in gravel emigration from the site, the gravel should be replaced during the following fisheries work window. This poses a challenge for continued FWCP support/proposal writing as the proposal window closed before the need for gravel additions is certain. One solution is to apply preemptively every fall for the following summer, assuming the gravel will be washed away – by the time the FWCP board meet in the late winter a decision can be made on whether or not to fund the project for the upcoming year.

The use of two bobcats increases efficiency to some extent but more importantly keeps the disturbance to the park much less just running one unit. Generally the system functioned as expected. Some minor issues to address for future projects include upgrading the hydraulic power pack in order to keep the fluid at a lower operating temperature. As well, changing the

cable on the hydraulic from 5/16” to ¼” will help increase line speed and consequently quicken turnaround times.

6.0 ACKNOWLEDGEMENTS

Thanks are extended to Brent Blackmun of BC Parks who facilitated the Parks Use Permit and helped to develop a safe, low impact strategy for securing trails and facilities in Elk Falls Provincial Park. Thanks to all the project partners and funders including, but not limited to: Fish and Wildlife Compensation Program, and Living Rivers – Georgia Basin/Vancouver Island. Local DFO staff Shannon Anderson, FLNRO staff Mike McCulloch and Kevin Telfor. BC Hydro staff, Trevor Oussoren, Eva Wichmann, Amy Stevenson and Stephen Watson among others. BCCF administration/support staff and the rest of the project team.

7.0 REFERENCES

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8.0 CONFIRMATION OF FWCP RECOGNITION

On August 11, 2016, a news story was published in the CR Mirror (Appendix 2), it included a brief project background, benefits. The project was also printed on the FWCP website and BC Parks websites. Two local radio stations, *The Eagle 97.3 FM* and *The Goat 98.9 FM*, included brief public advisories and project background on August 8, 2016, this also included corresponding stories on their respective websites. During project implementation a temporary interpretive sign was set up on the public trail leading to the suspension bridge. Public response was very good to this project, given the location of the skyline the public was fascinated with the dropping gravel as it is a spectacular view (Photo 14.). It is estimated that 2500-3000 visitors used the park during the five days of implementation in August 2016

A 24”x40” interpretative sign (Appendix 3) was installed along the Millennium Trail in Elk Falls Provincial Park (Photo 13.). The sign mentions FWCP as a primary funding source for the project.

9.0 PHOTOGRAPHIC RECORD

Photo 1. Installed hydraulic winch used to deploy and retrieve gravel trolley.

Photo 2. Gravel trolley installed on overhead cable, ready for loading

Photo 3. North anchor bridle system.

Photo 4. South tower.

Photo 5. Gravel staging area.

Photo 6. Tracked Skidsteer with wheelbarrow attachment to move gravel to trolley loading location.

Photo 7. Loading trolley bucket with skidsteer.

Photo 8. Gravel soon after release, falling to canyon floor.

Photo 9. Repaired millenium trail at the end of the project.

Photo 10. Adult Chinook use on gravel pad in falls pool tail-out, October 17, 2016.

Photo 11. Falls pool tailout gravel pad, taken from suspension bridge, August 12, 2016.

Photo 12. Falls Pool tail out after flows through canyon exceeding 480 m3/s, all gravel distributed downstream.

Photo 13. Information Signboard installed along Millenuim trail in Elk Falls Provincial Park.

Photo 14. Park visitors on the suspension bridge look onward viewing the gravel as it drops to the canyon floor.

APPENDIX 1

NHC REPORT

APPENDIX 2

MEDIA COVERAGE

APPENDIX 3

INTERPRETATIVE SIGNAGE