

2016 Vedder River Sediment Removal

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Environmental Monitors Report

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Prepared for:

The Vedder River Management Area Committee

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Nova Pacific
Environmental

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Introduction

Sediment removal is a key part of the floodway protection plan implemented by the Vedder River Management Area Committee (VRMAC). Typically, several excavations are conducted at strategic locations every two years to correspond with non-pink salmon years.

In the summer of 2016, gravel and other sediment was removed from selected locations along the Vedder River as part of the ongoing floodway management program. The volume proposed was approximately equal to the long term biennial net accumulation of sediments of 100,000 m³. Sediment removal locations within the Upper, Middle, Lower, and Canal reaches were selected to effectively lower water levels where dyke freeboard is limited, trap gravel upstream of freeboard limited areas, reduce excessive excavation requirements downstream, and provide optimum habitat outcomes while meeting flood protection objectives for sediment removal. The program was administered under the guidance of VRMAC. Based on the target quantity and general areas for sediment removal defined by the committee, Nova Pacific Environmental (NPE) was responsible for selecting specific sites and providing site design and proposed layouts to the committee. Subsequently, NPE was contracted to provide environmental monitoring services. This included on the ground site layout, environmental monitoring and providing directions as needed to ensure that the excavations were completed in accordance with the design and program objectives. The purpose of this report is to describe the implementation and environmental outcomes of the 2016 sediment removal program.

To ensure that the best possible suite of sediment removal sites was selected, a preliminary overview of 14 sites was conducted. Through consultation with the VRMAC committee members, a total of seven sites (Giesbrecht, Lickman, Bergman, Railway, D/S Rail Bridge, Yarrow, and Keith Wilson bars) were selected for the sediment removal program in 2016 (Figure 1). Giesbrecht site was recommended to be a provisional site in case access concerns at D/S Rail Bridge Bar were found to be insurmountable. As this was the case, the Giesbrecht site was included and D/S Rail Bridge Bar was not completed. Four of the sites approved for excavation in 2016 were located on Provincial Crown lands and two sites were located on City of Chilliwack lands.

The sites selected were those that best met the VRMAC mandates to reduce flood risk and protect fish habitat. Surveys and hydraulic modeling of the river at high flows were used to identify areas of limited freeboard and assist in determining the site selection and target removal volumes. The selection and design of individual sediment removal projects also relies on a variety of environmental and other factors including presence of vegetation, proximity to sensitive and valuable habitats, access for machinery, and potential effects on existing channel features and configurations.

Excavations began on August 9th, 2016 and extended to September 29th, 2016, 14 days beyond the September 15th closing of the in-stream work window. The extension of work was authorized by The Department of Fisheries and Oceans (DFO) on September 13th, 2016 and the period during which the work can be carried was from July 22nd, 2016 to September 30th, 2016. Authorization by The Ministry of Forests Lands and Natural Resource Operations (FLNRO) was originally granted up to September 30, 2016.

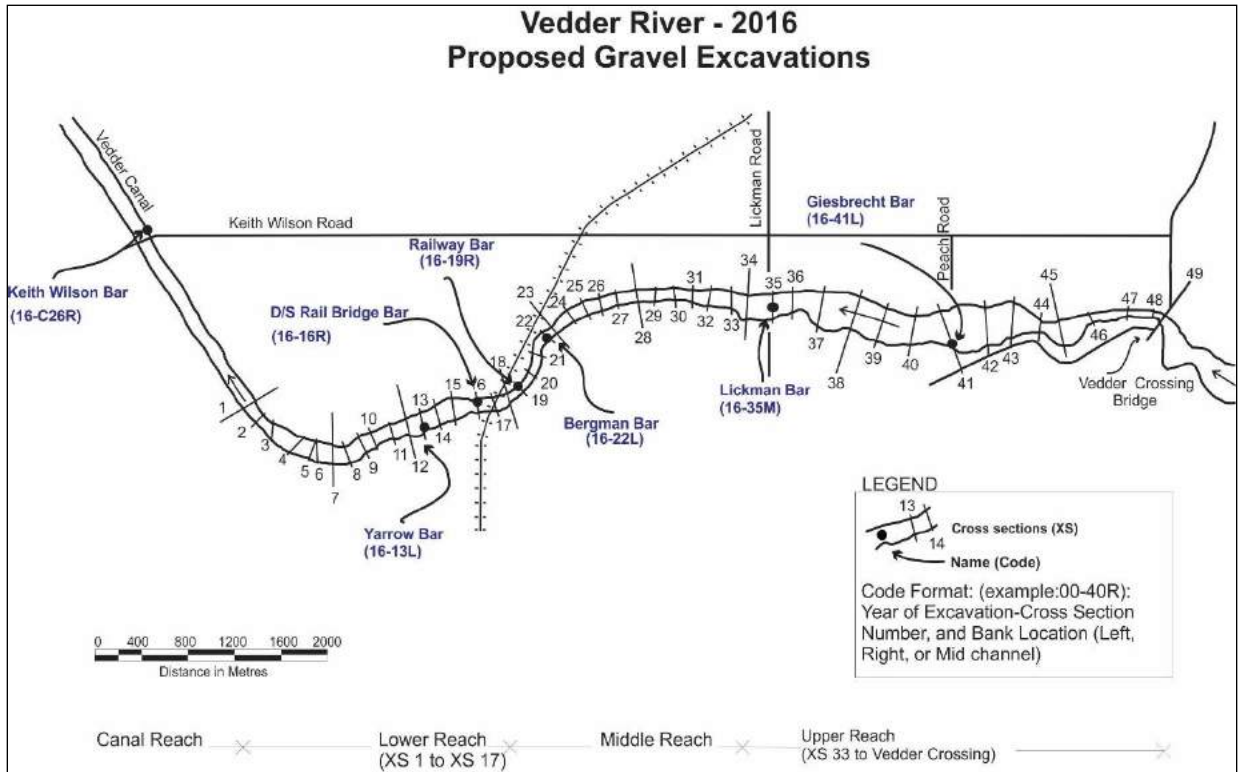


Figure 1 – Overview of sediment removal locations on the Vedder River in 2016

Sediment Removal Practice and Procedures

Design

Prior to designing each set of excavations, the Vedder River and Canal are thoroughly surveyed along previously determined cross-sectional transects. These transects are used to provide data for river hydraulic modelling and determining areas where dyke freeboard may be limited. In subsequent parts of the biannual planning, the model is used to test the efficacy of each excavation in lowering the flood water level profile.

The surveyed transects also provide a unique identification code for each excavation site. For example, 16-23L, describes the year (2016), the transect number (23) and the location within the channel (L). An “L” indicates a site close to the left bank, an “R” indicates a site close to the right bank and an “M” represents mid-channel bars. A “C” is used to designate transect numbers in the Canal (for example, 16-C26R).

Individual excavation site plans are generally developed during lower flow periods prior to the spring freshet. This allows on-the-ground design and provides an opportunity to see expected conditions, predict geomorphic changes that could arise and to consider various means to protect habitat features on and around the proposed excavation site. These plans are submitted for approval and for contract tendering purposes. If necessary, they are modified to a limited degree, to accommodate changes that occur during the freshet. With water levels dropping from the tail end of the freshet as excavation begins, the final plan is generally in place only just in time for excavation.

Site designs are intended to protect and enhance fish habitat attributes wherever possible. Pit design and site selection guidelines were developed to help avoid or mitigate potentially negative impacts. A detailed discussion of the design principles is available in the guidelines document prepared in 1999.¹ These guidelines have been updated and the most up to date version can be found in the assessment report for 2012².

The typical maximum depth proposed for each excavation is 3 meters but where additional material is available above the water level, an excavation depth of up to 4 meters is allowed. Proposed and actual volumes for each of the seven (7) excavations are shown in Table 1.

¹ Wright, Bruce F. “Gravel Removal Constraints, Guidelines, and Planning Procedures for the Protection of Fish Habitat: The Vedder River Floodway Protection Program 1994 to 1998”. Vedder River Management Area Committee. October 1999.

² Wright, B., Kozlova, T., and C. Hegele. 2012 Vedder River Gravel Excavation – Habitat Changes and Environmental Impacts. Vedder River Management Area Committee. January 2014.

Table 1: Expected and Actual Pit Volumes for 2016 Excavations

Site	Code	Expected Yield (m ³)	Actual Volume (m ³)	Percent obtained (%)
Giesbrecht Bar	16-41L	12,700	11,714	92
Lickman Bar	16-35M	21,500	28,668	133
Bergman Bar	16-23L	9,600	14,433	150
Railway Bar	16-19R	3,200	4,160	130
FLNRO Total		47,000	58,975	125
Yarrow Bar	16-13L	14,300	16,566	116
D/S Rail Bridge Bar		26,850	0	0
Keith Wilson Bar	16-C26R	17,200	16,944	99
City Total		58,350	33,510	57
TOTAL		105,350	92,485	88

Authorizations and Monitoring

A Paragraph 35(2)(b) Fisheries Act Authorization and a Notification of Modifications to Dates in Conditions of Paragraph 35(2)(b) Fisheries Act authorization 16-HPAC -00518 were issued by DFO (File 16-HPAC-00518). A Water Sustainability Act Approval Subsection 11(1) and 11(2) - Changes in and About a Stream - was issued by FLNRO (File 2004412). Copies of the DFO authorization and notification and FLNRO approval are included in Appendix A.

Five of the 2016 excavation sites were awarded to Jakes Construction Ltd. (Giesbrecht, Lickman, Bergman, Railway, and Yarrow Bars) and one site to Walter's Bulldozing Ltd (Keith Wilson Bar).

An environmental monitor (EM) was present as required to ensure the work was completed in accordance with excavation designs, authorization conditions and other relevant best management practices. The EM was also responsible for site layout and minor design modifications as required to ensure that excavations best met program objectives and fit post freshet conditions. A site meeting was held at each site prior to the start of work to ensure onsite personnel understood the project requirements, and were aware of the standards and requirements for working near a sensitive fish-bearing stream. Copies of the relevant permits were provided to the contractors and were available on-site at all times. All work which could not be completed in isolation of flow, including site access, construction and excavation of openings, was supervised by the EM.

Conditions Encountered During the Excavation Window

Figure 2 shows the flow hydrograph from Water Survey of Canada gauge 08MH001 Chilliwack River at Vedder Crossing during the excavation window (August 1 to September 30, 2016).

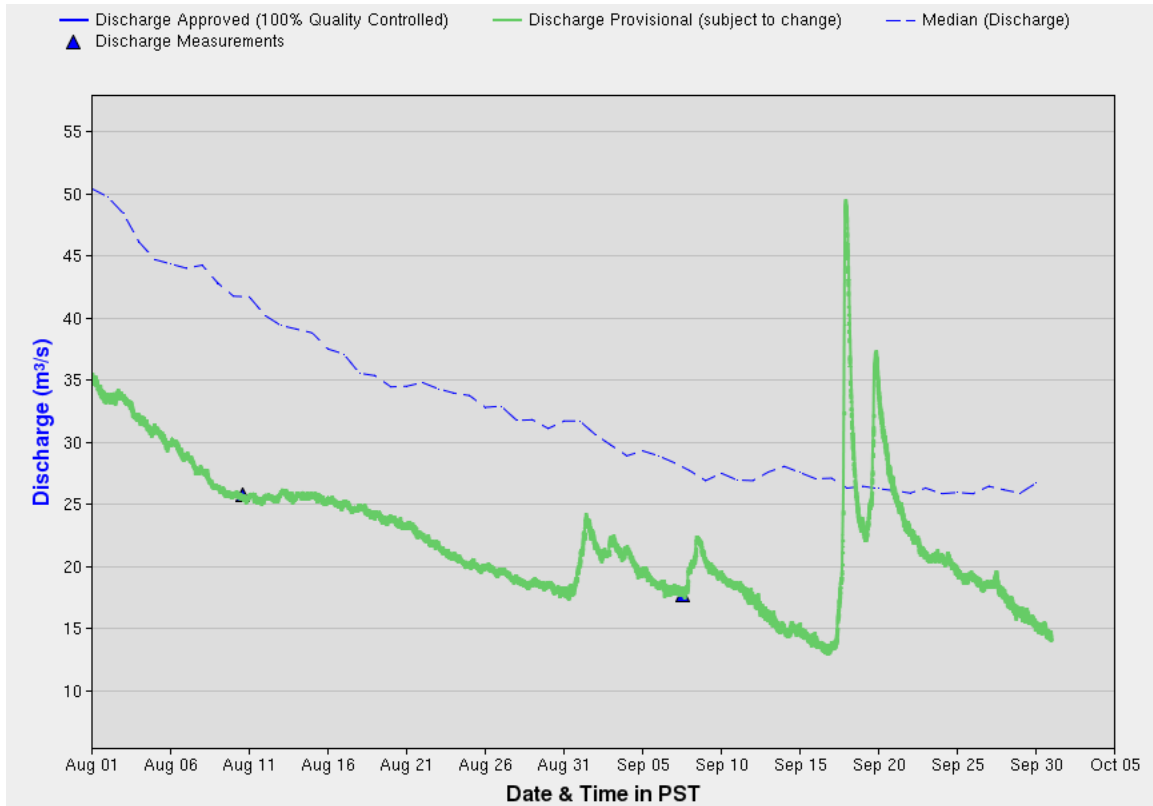


Figure 2: Water discharge at ‘Chilliwack River at Vedder Crossing’ station (08MH001), August 1 to September 30, 2016.

The hydrograph provides a good representation of the flow conditions encountered during of the excavations in 2016. However, concerns about the accuracy of this gauge for flows below 50 m³/s remain. Table 2 provides a comparison of the Vedder Crossing (08MH001) station with the water flow recorded at the two upstream WSC gauges “Chilliwack River above Slesse Creek” (08MH103) and “Slesse Creek near Vedder Crossing” (06MH056) stations, with a scaling factor of 1.5 applied (L. Flint-Petersen, MFLNRO, personal communication, January 2014).

Table 2: Discharge for 2016 Excavations

Site	Discharge (m ³ /s) at 08MH001		Discharge (m ³ /s) at (08MH103+08MH056) x 1.5	
	Excavation start	Excavation end	Excavation start	Excavation end
Giesbrecht Bar	25.7	24.3	28.9	26.4
Lickman Bar	19.3	18.1	17.3	17.9
Bergman Bar	23.9	19.4	25.7	19.8
Railway Bar	19.3	15.1	17.3	14.1
Yarrow Bar	19.0	20.6	19.2	19.1
Keith Wilson Bar	18.1	15.6	No data	15.5

Because water levels on the river are still falling from the spring freshet during the work window, excavations are laid out “just in time” to meet the start-up requirements for the next site. Typically, the upstream excavations are completed first, mainly because the downstream excavations are flatter and the area of exposed bar increases as water levels drop. The upstream bars often have steeper slopes around their edges as well as greater depth of gravel to be removed. The actual sequence of excavation of sites was: Giesbrecht, Bergman, Yarrow, Keith Wilson, Railway, and

Lickman Bars. The discussion of the individual sites, in keeping with past reporting, is presented in an upstream to downstream sequence.

Implementation of the Excavations

All machinery was found to be clean and free from oil leaks. The contractor ensured that machinery used to complete the work carried a spill kit and used a biodegradable hydraulic fluid.

On October 26th and 31st, the excavations were inspected to check for fish stranding in accordance with MFLNRO Water Sustainability Act Approval (File 2004412, clause dd.) which requires three stranding check in the year following the excavations. All excavations and habitat excavations were open and flowing as planned. No evidence of fish stranding or likelihood of stranding was apparent.

Site Reports – Upper Reach

The Upper Reach of the river is bounded by Vedder Crossing at the upstream end and by cross section (XS) 33 at the downstream end. The Upper Reach is characterized by coarser sediment, and is less confined by dykes and armour. As this area is not typically freeboard limited, sediment removal in this reach is intended to lessen the requirement to remove sediment downstream. Both sites selected for sediment removal in Upper Reach in 2016, Giesbrecht Bar and Lickman Bar, were located within lands administered by the Provincial Crown. The total planned yield from the Upper Reach was 34,200 m³; however, the actual volume of excavated material was 40,641 m³, or 119% of plan.

Giesbrecht Bar (16-41L)

Plan

The Giesbrecht Bar excavation was located on the left side of the main channel, approximately 200 m downstream from Peach Road. The footprint of the excavation was between XS41 upstream and XS40 downstream (Figure G1). The site was accessed from Giesbrecht Road via the setback dyke to the stockpile site and then along an existing access road adjacent to recently cleared spurs. Material was to be stored at the Giesbrecht stockpile located approximately 500 m from the excavation site.

The excavation was designed to be 150 m long, 50 m wide and 3.5 m deep from the surface of the bar with an anticipated removal volume of 12,700 m³.

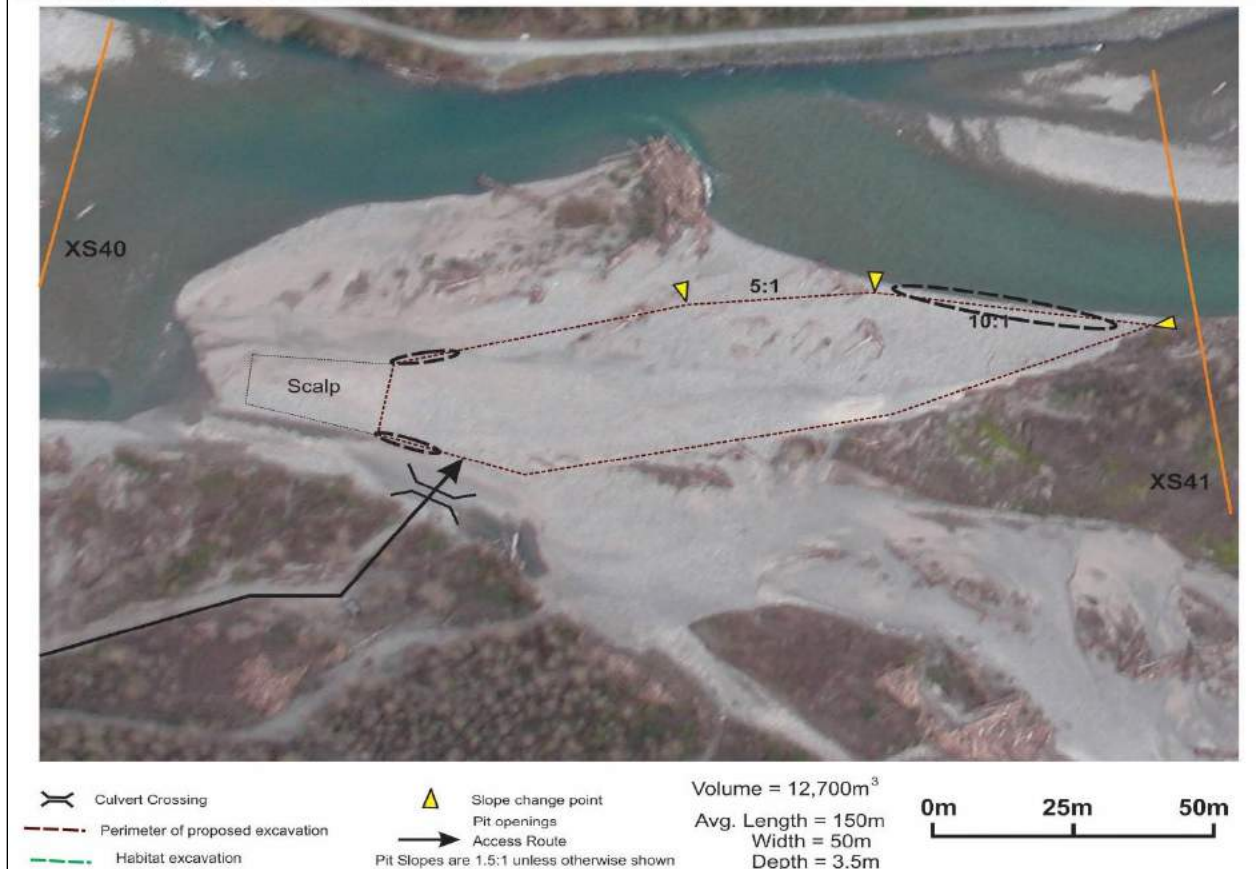


Figure G1: Layout of 2016 Giesbrecht Bar (16-41L) sediment removal project. Photo taken March 19, 2016, draft plan – April 5, 2016.

The main purpose of this project was to intercept gravel upstream of the area of freeboard limitation. It was anticipated that the pit would refill quickly with a low flow channel to be retained at this location. The layout of the 2016 excavation was positioned parallel to the main channel and consisted of one deep pit with a small shallow excavation or scalp located at the downstream end. A 10:1 slope riffle type entry was proposed at the upstream end to provide habitat value, limit amount of flow diverted into the excavation and retain habitats downstream. It was planned that the inlet be field designed to ensure that the river does not enter the pit where the slope changes from 10:1 to 5:1. This could include extending the 10:1 slope or gradual transitioning from the flatter to the steeper slope. Two downstream openings, approximately 20 m wide, were prescribed to permit flow and to allow fish to move freely through the site.

Plan Modifications

Conditions around the Giesbrecht Bar presented additional challenges for the excavation in 2016, primarily due to the river configuration changes and slope of the riverbed at this location. This included bank cutting on the left bank upstream of the excavation and along the upstream edge of the pit. This led to a concern that the riffle flow into the excavation would be too steep creating a potential risk of fry stranding and possibly, excess flow directed into the excavation. To mitigate these concerns, the excavation design was converted to a scalp, the upstream point of the excavation was modified and a flat section was added within the 10:1 slope (Figure G2). Despite this change, the reduction in expected volume was small (12,700 to 12,000). This was mainly due to the higher proportion of the volume initially above the water level and the slope which reduces

the footprint as depth increases. As an above water level scalp, no openings were planned and there were no changes to the bank at the upstream or downstream ends.

Implementation

Site conditions were reviewed and the excavation layout was completed on August 9th. The existing access road between the bar and the stockpile was upgraded and a few swales were temporarily filled. A small ramp was built to access the excavation site from the end of the access road. The temporary channel at the foot of the bank was dry, so no culverts were required.

A site meeting was held prior to the start of excavation on the morning of August 10th. Plans for the implementation of the project were discussed and the safety and environmental standards were reviewed.

The work on the bar started with clearing the site and moving woody debris aside. Excavation continued until August 17th and ended with placement of LWD structures and a small amount of grading to prevent possible stranding in minor depressions.

Site level control was included as the excavation had been changed from deep pit type to scalp type. The contractor provided a laser level (Leica Rugby 810 Laser Level) and a technician as required to maintain a very slight slope from the upstream end to the downstream end of the footprint. The presence of the water table within the excavation area also served as a guide to the excavation depth.

LWD was placed at three strategic locations and in two of these, a platform of boulders was included to provide an additional habitat feature. This year, we have initiated improved tracking of installed LWD features. Details and photos can be found in Appendix B.

2016 Construction Drawing: Giesbrecht Bar (16-41L)

Draft Plan: August 11, 2016 Photo: March 19, 2016

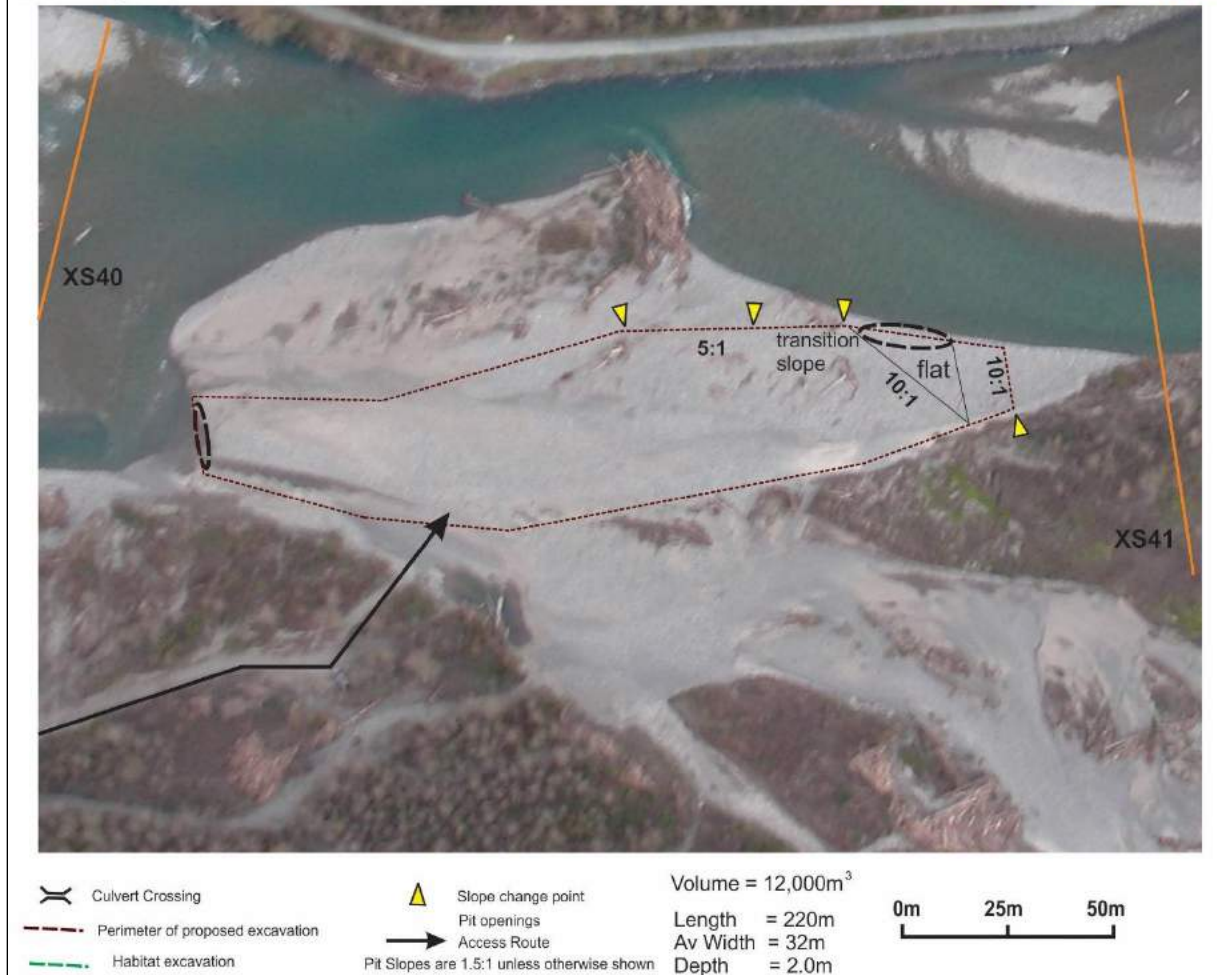


Figure G2: 2016 Giesbrecht Bar (16-41L) construction drawing, August 11, 2016. Photo March 19, 2016.

Summary

The Giesbrecht Bar excavation continued from August 10th to August 17th, 2016. Despite changes to the excavation design, the contractor was able to obtain 92% of the originally proposed volume. The modified excavation as completed substantially met the objectives for the work.

During the first post excavation check for stranding, there was a substantial amount of flow through the pit. The modifications at the upstream end provided a stable entrance and the three LWD complexes were functioning within the channel as planned.

Giesbrecht Bar Photos



G1: Giesbrecht sediment removal site prior to work facing upstream. August 9, 2016.



G2: Giesbrecht sediment removal site prior to work facing downstream. August 9, 2016.



G3: Access ramp constructed. August 9, 2016.



G4: Emergency spill kit container. August 9, 2016.



G5: Existing trail road used as an access road from the site to the stockpile. August 9, 2016.



G6: Beginning of excavation at upstream end with 10:1 slope. August 10, 2016.



G7: Gradual slope transition at upstream end of excavation. August 11, 2016.



G8: View of work activities from upstream end of site. August 11, 2016.



G9: Work near completion at downstream end of excavation. August 16, 2016.



G10: LWD placing along the river side of the pit. August 17, 2016.



G11: View of the completed excavation from downstream of the work. August 17, 2016.



G12: Restored access to the bar after access ramp decommission. August 17, 2016.

Lickman Bar (16-35M)

Plan

The Lickman Bar sediment removal site was located mid-channel at XS-35 (Figure L1). The site was accessible via Lickman Road and the Lickman Road parking lot to the top of bank at the Vedder River. A ramp and culverts were required to access the excavation site from the bank. The Hooge stockpile was proposed for storage of material removed from this location unless arrangements were made to haul off site. Material was to be hauled back along the access route to the dyke and then west along the dyke road for 1.6 km to the Hooge Stockpile site.

The excavation was designed to be 105 m long, 70 m wide and 3.5 m deep from the surface of the bar with an anticipated removal volume of 21,500 m³.



Figure L1: Layout of 2016 Lickman Bar (16-35M) sediment removal project. Photo taken March 19, 2016, draft plan – April 12, 2016.

The purpose of this excavation was to trap gravel at the downstream end of the Upper Reach before it enters the narrower Middle Reach. The excavation was designed to maintain the basic bar configuration but also to direct some of the flow towards secondary channels on the right and to reduce the growing point bar that is directing flow to the left. The left bank across from the site is a steep cut bank that was contributing LWD to the river, however, as it was eroding rapidly, the loss of riparian habitat and contribution of sediment to the river negatively offsets any habitat value contribution.

The layout of the 2016 excavation was parallel to the main channel and consisted of one deep pit. A 5:1 slope at the upstream edge of the excavation was prescribed to provide stability during higher flows. The outer berm of the pit was designed with a 1:1 slope with the expectation that it

would collapse into excavation at higher flows. The remaining slopes were the standard 1.5:1. Two openings to the main channel, 20m wide, were prescribed to permit flow and to allow fish to move freely through the site. The third opening, at downstream right corner of the pit, was prescribed to allow some flow to the right channel. Abundant LWD on site were planned to be keyed in around the excavation site.

Access to the bar required the crossing of a side channel near the right bank. Use of two small culverts was expected to accommodate the flow.

Implementation

The site was laid out as originally planned with no significant modifications between the initial and construction layout drawings (Figure L2). Minor field fit changes included increase of the pit length and decrease of the width which resulted in slight decrease to the proposed volume.

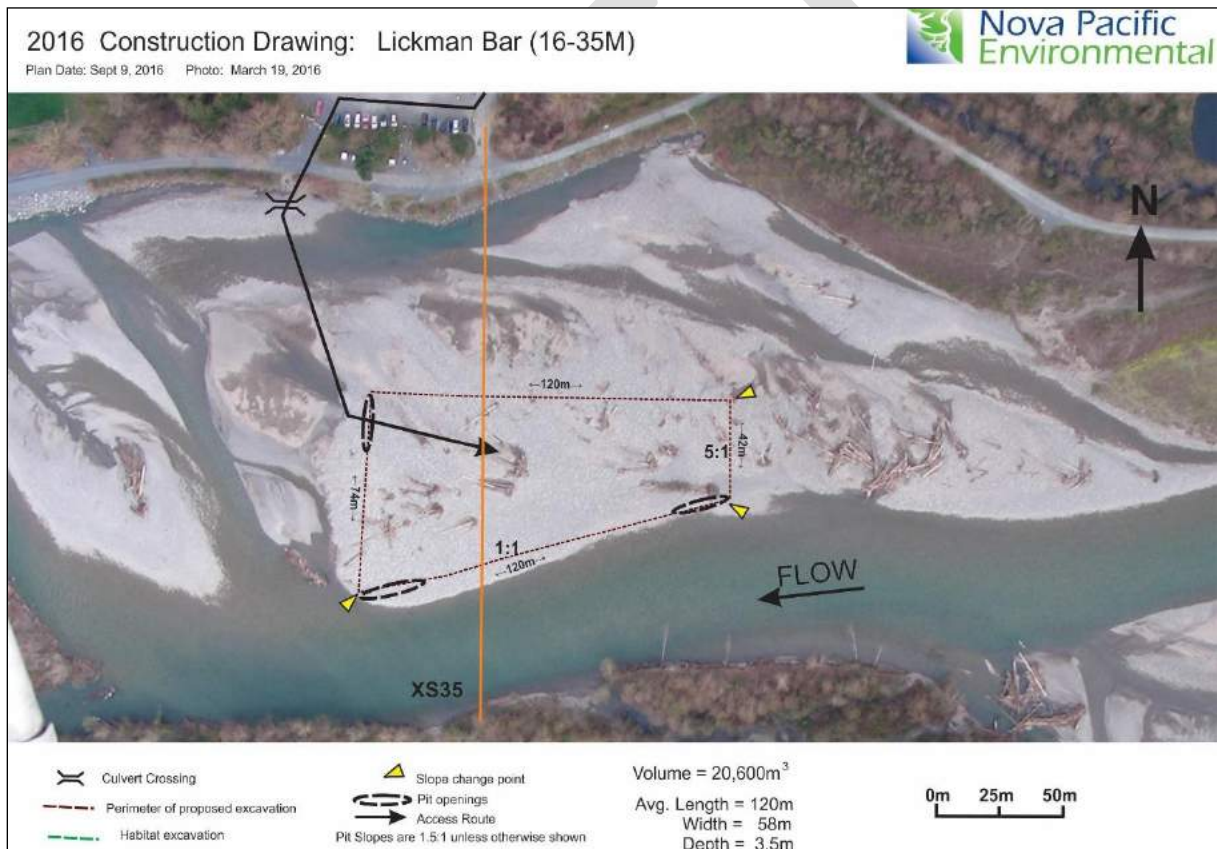


Figure L2: 2016 Lickman Bar (16-3R) construction drawing. Photo taken March 19, 2016, drawing – September 9, 2016.

Excavation start-up activities began on September 9th, 2016 and included the installation of a ramp down from the right bank and a side channel crossing with two 16 inch culverts. Prior to installing the ramp, the City of Chilliwack was notified about a patch of invasive Japanese Knotweed that could have been fragmented and spread as a result of the ramp construction and trucking activity. City crew were dispatched to remove and isolate the plant material.

Two tandem trucks were used to deliver material from the Railway Bar excavation to construct the main ramp. An excavator and a loader were used to move LWD from the excavation footprint and to place them on adjacent areas of unvegetated gravel bar for later use in habitat works.

Two flag persons were employed to regulate public safety. One was stationed at the Rotary Trail where the access road crossed the trail, and the other was stationed at the setback dyke crossing to regulate interactions between trucks hauling gravel and public cars using the parking lot.

Initially, the work was limited to excavation with material temporarily stockpiled on site. On September 13th, approximately 12-15 trucks arrived on site to start hauling material. Two rock trucks were used to take gravel to the Hooge stockpile, while road trucks were used to haul material directly to a project outside the Vedder River Management area. Deep pit excavation started at the upstream end with a 5:1 slope. Most of the excavation area was first excavated to near the water table prior to starting the pit excavation. The practice of excavating to the bar surface continued, allowing water to drain from the gravel before it was loaded into the trucks. The loader was equipped with technology that measured and tallied the weight of gravel being hauled away.

Heavy rain on Saturday September 17th, caused the river to rise, by September 19th, so that it was approximately level with the outer berm of the excavation. The berm was still holding the water inside the pit except for one small section at the upstream end. To prevent silty water seeping to the river, an excavator walked on the berm to upgrade that small section.

On September 27th, site decommissioning was completed. The downstream opening was completed first followed by the upstream opening. A habitat channel was constructed downstream of excavation to connect flow from the pit to the secondary channel to maintain it flowing to the right. Several LWD structures were installed along the bank side of the pit and in the constructed habitat channel. Photos of these LWD structures and its GPS coordinates as well as habitat channel details are presented in Appendix B.

Summary

The Lickman Bar excavation continued from September 9th to September 27th, 2016. The volume of material removed was 28,668 m³ of the 21,500 m³ proposed which was 133% of the expected volume from the site. The abundant supply of LWD was well utilized being incorporated into the microchannel immediately downstream from the southwest pit outlet, in the northeast corner of the excavation, along the bank upstream of the secondary pit outlet in the northwest corner and in that outlet.

Despite the higher flows after the September 17th rainfall and the fact that the work was into the window extension period, there were no apparent conflicts with spawning or spawning behaviour.

Following the excavation during a post exaction check for fish stranding it was noted that substantial flow had been directed through this opening and has likely washed the LWD out of the channel.

Lickman Bar Photos



L1: Lickman sediment removal site prior to work facing upstream. September 9, 2016.



L2: Lickman sediment removal site prior to work facing downstream. September 9, 2016.



L3: Installation of site access ramp. September 9, 2016.



L4: View from the bar towards installed ramp. September 10, 2016.



L5: Beginning of excavation at upstream end with 5:1 slope. September 10, 2016.



L6: Ongoing work activities: view from upstream part of excavation. September 13, 2016.



L7: Machinery on site. September 19, 2016.



L8: Inflow of completed site. September 27, 2016.



L9: Outflow of completed site. September 27, 2016.



L10: View of the completed excavation from downstream of the work, near second outflow to the constructed channel. September 27, 2016.



L11: Constructed channel, view downstream. September 27, 2016.



L12: Restored channel after access ramp decommission. September 28, 2016.

Site Reports – Middle Reach

The Middle Reach of the river extends from cross section (XS) 33 at the upstream end to the BC Southern Railway Crossing (XS-17) at the downstream end. Material was removed from the Middle Reach both to maintain design flood capacity in the floodway and to decrease the volume of sediment moving into the Lower Reach. Both sites selected for sediment removal in Middle Reach in 2016, Bergman Bar and Railway Bar, were located within lands administered by the Provincial Crown. These two locations were selected as they presented accessible, feasible options that showed a comparatively low environmental impact. The total planned yield from the Middle Reach was 12,800 m³; however, the actual volume of excavated material was 18,593 m³, or 145% of plan.

Bergman Bar (16-23L)

Plan

The Bergman Bar sediment removal site was located on the left side of the main channel at XS-23 (Figure B1). The site was accessible via Bergman Road by crossing over the Vedder River setback dyke and continuing approximately 200 m to the bank. Material was to be stored at Bergman stockpile site located adjacent to the excavation site.

The excavation was designed to be 135 m long, 25 m wide and 4 m deep from the surface of the bar with an anticipated removal volume of 9,600 m³.



Figure B1: Layout of 2016 Bergman Bar (16-23L) sediment removal project. Photo taken March 19, 2016, draft plan – April 5, 2016.

The intent of the design was to prevent sediment from moving downstream into the freeboard limited section of the river. The design of the site was similar to previous excavations at this location. This site was selected because it tends to refill in approximately the same configuration each time it is excavated and can be accessed with minimal difficulty and does not appear to cause impacts outside the footprint when excavated in accordance with the established guidelines.

The excavation was designed to maintain the bar's configuration and refill over time. The upstream boundary of the excavation was established downstream from the bar head in accordance with the guidelines. The pit was designed with a 5:1 slope at the upstream end to ensure stability of the bar during higher flows and protection of riffle, glide tail and eddy pool habitats located near the upstream end of the excavation. A buffer was left at the downstream end of the bar to help retain the alignment of the main and secondary channels. The river edge of the pit was designed with a 1:1 slope with the expectation that the berm would collapse into the pit during higher flows. The remaining edges were designed to have a 1.5:1 slope. An inflow opening was located at the upstream end of the excavation and an outflow was located at the downstream end. Each opening was approximately 20m wide allowing sufficient capacity for fish movement through the site. The third opening at the downstream end of the excavation was designed to direct flow to the left bank side channel.

A habitat channel excavation was proposed along the left bank upstream and downstream of the main pit. This work was intended to provide habitat that is independent of the surface flow at the upstream end of the bar by deepening the left bank side channel to maintain sub-gravel flow. The upstream surface connection tends to be in a zone of aggradation so the design was intended to assure flow even if the inlet flow was cut off. The purpose was to improve rearing capacity, provide additional Chum Salmon spawning habitat and reduce the potential for fry stranding. A small scalp has been appended to the habitat excavation to improve gravel yield.

The channel along the left bank was expected to be dry at the time of excavation so a wetted channel crossing was not required.

Implementation

A site meeting was held on August 18 to discuss access construction, site layout and excavation strategies as well as safety and environmental concerns. Conditions at the site provided for a wider excavation (Figure B2) than originally planned which contributed to the volume increase for this site.

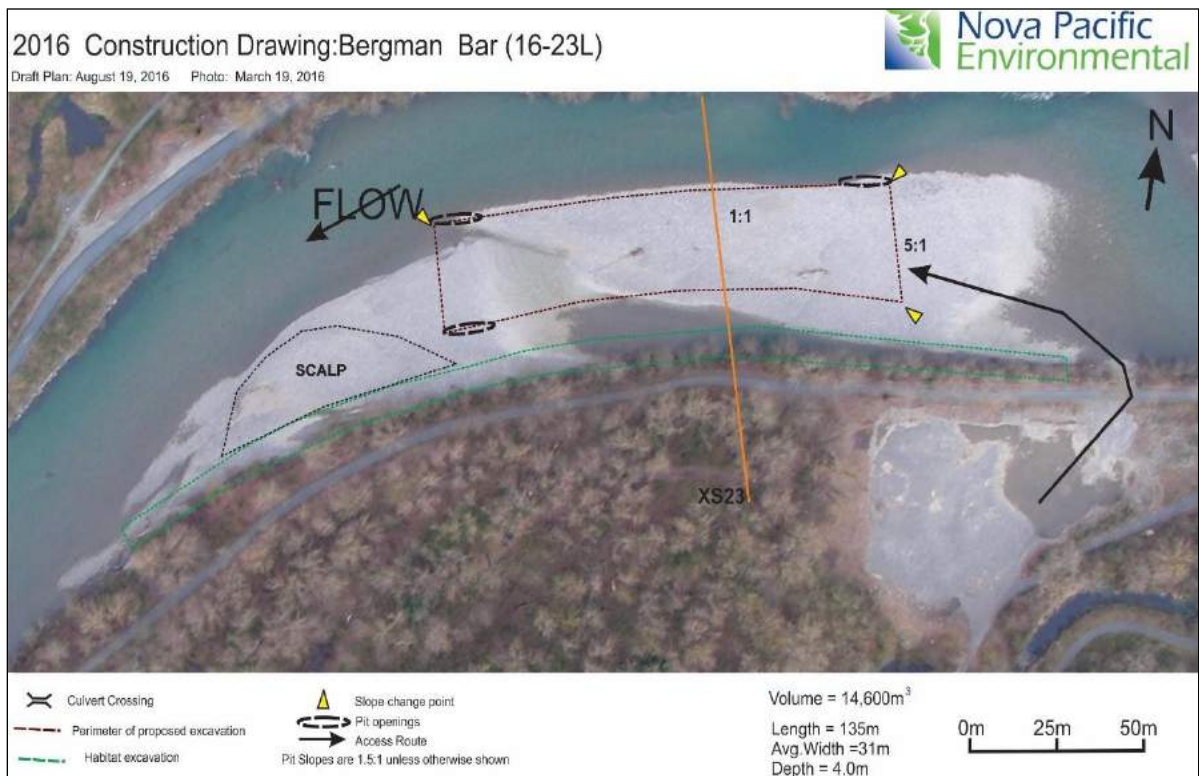


Figure B2: 2016 Bergman Bar (16-23L) construction drawing. Photo taken March 19, 2016, drawing – August 19, 2016.

Activities at this site began on August 18th with construction of an access ramp from the left bank. Material to build the ramp was taken from the scalp area at the downstream end of the excavation. One excavator, one loader and three or two rock trucks were present on site throughout the period of the excavation.

On August 19th, fry salvage and gee trapping were conducted within an isolated pond that was to be part of the left bank habitat channel enhancement. The results are presented in Table B1 and Table B2.

Table B1: Fish salvaged at Bergman Bar side channel

Date	Fish species	Number of fish
August 19, 2016	Coho Salmon (<i>Oncorhynchus kisutch</i>)	7
1 st pass	Cutthroat Trout (<i>O. clarki clarki</i>)	1
	Sculpin (<i>Cottus spp.</i>)	12
	Large Scale Sucker (<i>Catostomus macrocheilus</i>)	1
2 nd pass	Coho Salmon (<i>Oncorhynchus kisutch</i>)	3
	Cutthroat Trout (<i>O. clarki clarki</i>)	3
	Sculpin (<i>Cottus spp.</i>)	4
	Leopard Dace (<i>Rhinichthys falcatus</i>)	1
3 rd pass	Sculpin (<i>Cottus spp.</i>)	4
	Total number	36

Once the area was cleared of salmonids, the downstream part of the excavation was initiated.

This included the area of bar downstream of main pit identified as “scalp” in Figure B2 as well as the footprint of the habitat channel. The channel was pre-excavated to near the water table with a 12m width with final excavation of the wetted channel deferred to the end of the excavation.

Table B2: Gee traps at Bergman Bar side channel

Date	Number of Gee traps	Set time	Fish species	Number of fish
August 19, 2016	15	9:45 – 15:30	Coho Salmon/ Chinook Salmon	53

Excavation of the deep pit started at the downstream end with a 1.5:1 slope and continued upstream towards the access road. The pit excavation was completed on August 25th. Habitat channel construction and opening of the excavation was completed on August 26th. The downstream opening was completed first followed by the upstream opening.

The habitat channel was constructed along the left bank and connected to the river at upstream and downstream ends. The excavation of habitat channel was intended to provide habitat that would be independent of the surface flow at the upstream end of the bar. Initial excavation was fitted to sub-gravel flow availability so that habitat value would be maintained in the event that the upstream opening was blocked by gravel. The section of the channel upstream of the ramp was excavated just prior to removing the ramp which was then excavated to deliver the desired surface flow. Several LWD structures were installed along the constructed habitat channel. Photos of these LWD structures and their GPS coordinates as well as habitat channel details are presented in Appendix B.

The excavated habitat channel was 427m long by 12m wide providing a habitat improved area of 5,124 m².

Summary

The Bergman Bar excavation continued from August 18 to August 26, 2016. The volume of material removed was 14,433 m³ of the 9,600 m³ proposed which was 150% of the originally proposed volume from the site. Approximately 30% can be explained by the increased width with the balance coming from the material removed for the habitat excavation.

Originally, it was planned to excavate a second pit outflow and connect it to the excavated habitat channel, however it was determined that this would direct too much flow to the habitat channel. Instead, a swale was excavated across the buffer strip between the excavation to replicate the pre-excavation condition.

Bergman Bar Photos



B1: Bergman sediment removal site prior to work facing upstream. August 17, 2016.



B2: Bergman sediment removal site prior to work facing downstream. August 17, 2016.



B3: Access road constructed. August 18, 2016.



B4: Scalping pit area along the river side. August 18, 2016.



B5: E-fishing prior to channel construction. August 19, 2016.



B6: Habitat channel construction. August 23, 2016.



B7: View of work activities from downstream end of site. August 24, 2016.



B8: Upstream end completion with 5:1 slope. August 25, 2016.



B9: Outflow of completed site. August 31, 2016.



B10: Inflow of completed site. August 31, 2016.



B11: View of the completed excavation from downstream of the work. August 31, 2016.



B12: Restored channel after access road decommission. August 31, 2016.

Railway Bar (16-19R)

Plan

Railway Bar is a narrow point bar located on the right bank on an inside bend of the river, upstream of the BC Southern Railway Bridge. The Railway Bar sediment removal footprint in 2016 extended from about 20 m downstream to about 70m upstream of XS-19 (Figure R1). The site was accessible via Keith Wilson and Sinclair Roads and then along the setback dyke to the access road that runs west along the top of the armoured bank. Material was to be stored at the Hooge stockpile that is located just east of the access road between the armoured bank and the setback dyke.

The excavation was designed to be 90 m long, 20 m wide and 3 m deep from the surface of the bar with an anticipated removal volume of 3,200 m³.

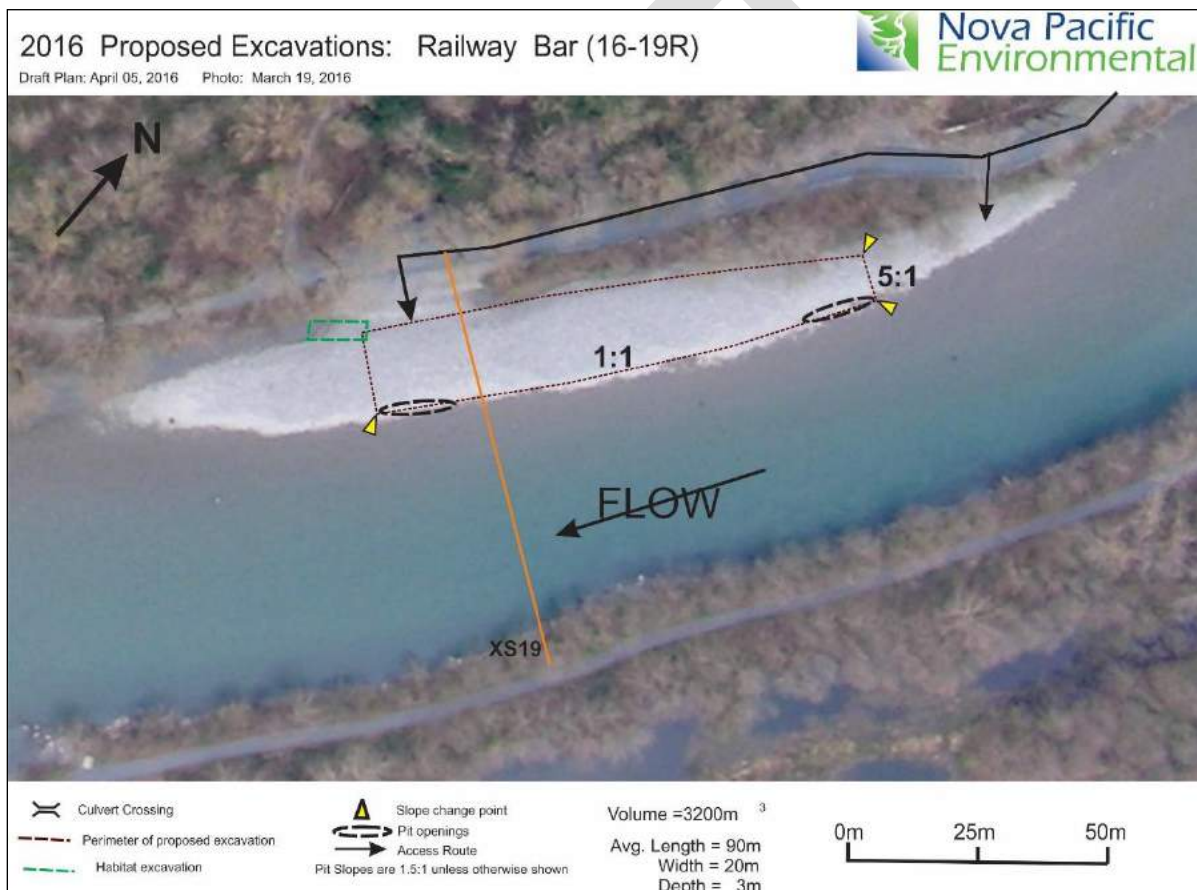


Figure R1: Layout of 2016 Railway Bar (16-19R) sediment removal project. Photo taken March 19, 2016, draft plan – April 5, 2016.

The site layout was similar to previous excavations at this location. The upstream boundary was located approximately 40 m downstream from the head of the bar and a 5:1 slope was prescribed for the upstream edge to ensure slope stability. The outer berm was designed with a 1:1 slope so that it would collapse into the excavation at higher flows. The inner edge, against the right bank, and the downstream edge were designed with 1.5:1 slopes. A 20m wide inflow was located at the upstream end to permit flow into the excavated area, and a corresponding 20m outflow opening was located at the downstream end.

The intent of the design was to trap gravel upstream of Railway Bridge and reduce the amount of gravel moving downstream into the reach of the river that is most freeboard limited. A secondary purpose was to increase channel capacity upstream of the Railway Bridge.

The access route from the Hooge stockpile site to the Railway Bar location followed an existing road along the top of the armoured bank. In 2015, vehicle access to the bar was closed off and the old haul road was redeveloped as a trail. Access to the site did not require a crossing over a wetted channel.

Implementation

Site conditions were reviewed and the excavation layout was completed on September 8th. The excavation was laid out as originally planned; the modification was only the length increase which resulted in volume increase (Figure R2). Marking stakes were employed at all inflection points in the site layout and a flagging tape was used to confirm dimensions.

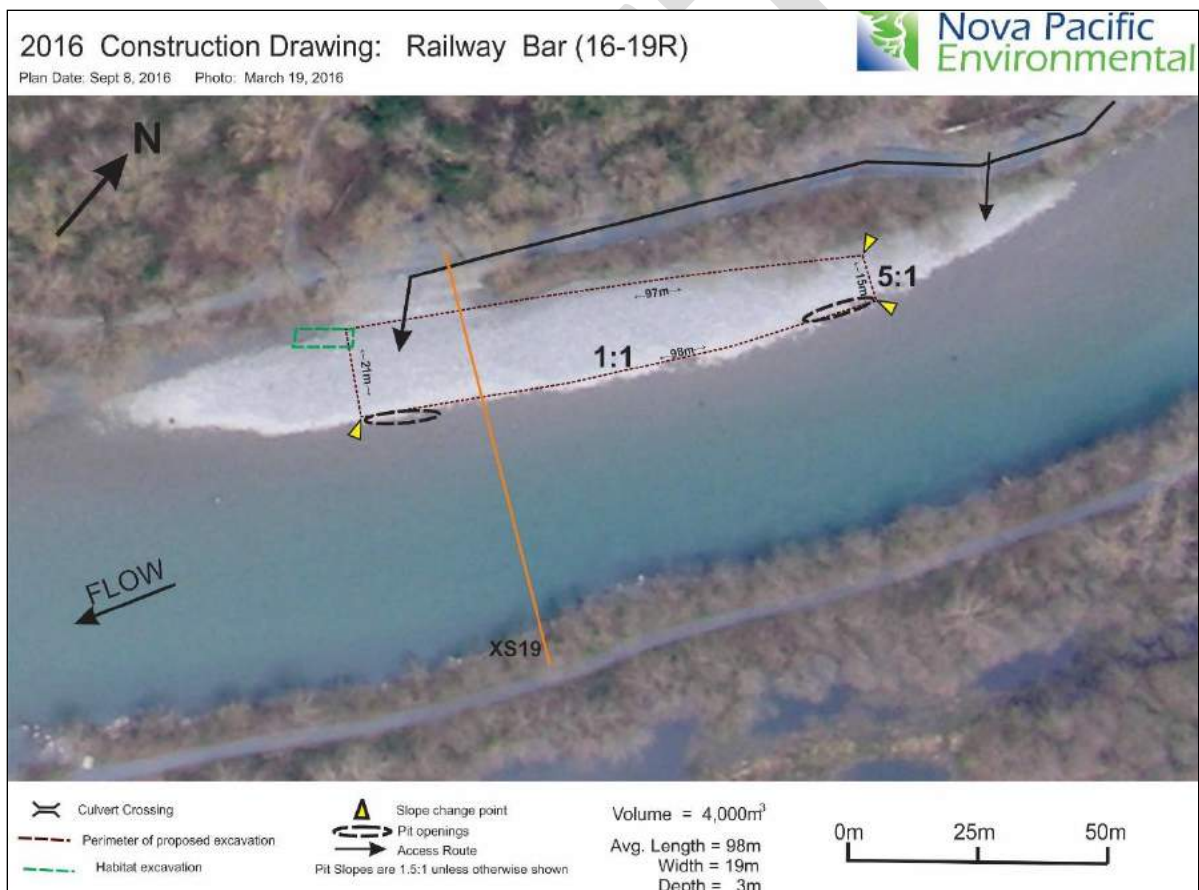


Figure R2: 2016 Railway Bar (16-19R) construction drawing. Photo taken March 19, 2016, drawing – September 8, 2016.

Excavation started at the upstream end on September 9th, after construction of a small access ramp and a site meeting to review environmental requirements and safety. The upstream end was excavated to a 5:1 slope and then excavation continued downstream towards the access road. The machinery used on the site included an excavator and a loader. Initially two to three dump trucks were employed but these were later replaced with rock trucks.

The work continued for four days and was completed on September 13th. Although a provision had been included in the plan to access the upstream opening from the bank, this was

determined not to be necessary as the profile along the bar was flat. The upstream end opening (inflow) was accessed first by walking the excavator along the outer berm. Next, the habitat channel along the right bank was enhanced with the shallow excavation of a series riffles. The downstream pit opening was then completed.

Summary

The Railway Bar excavation continued from September 9th to September 13th, 2016. The volume of material removed was 4,160 m³ of the 3,200m³ proposed which was 130% of the expected volume from the site.

The completed excavation had sufficient flow through the pit and the habitat channel, and directing flow to the right bank provided a modest but effective increment to the habitat value in this area. The bank downstream of this site has high quality overhanging vegetation and channel complexity which supports chum spawning. No LWD was available at this site.

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Railway Bar Photos



R1: Railway sediment removal site prior to work facing upstream from bar access point. September 8, 2016.



R2: Railway sediment removal site prior to work facing downstream from bar access point. September 8, 2016.



R3: View of from the downstream end of the bar showing the access road at left. September 10, 2016.



R4: Beginning of excavation at upstream end with 5:1 slope. September 10, 2016.



R5: View of work activities from upstream end of site. September 10, 2016.



R6: Ongoing work activities, at downstream end. Excavation is near completion. September 12, 2016.



R7: Downstream end completion with 1.5:1 slope. September 13, 2016.



R8: Inflow of the completed site. September 16, 2016.



R9: Outflow of the completed site. September 16, 2016.



R10: View of the completed excavation from the downstream end. September 16, 2016.



R11: Habitat channel enhanced at the right bank. September 13, 2016.



R14: Restored access road. September 13, 2016.

Site Reports – Lower Reach

The Lower Reach of the river extends from the BC Southern Railway Crossing (XS-17) to the upstream end of the Vedder Canal (XS-1). Hydraulic modelling of the river has indicated that the freeboard capacity of the right dyke is limited in the Lower Reach. One site, Yarrow Bar, was determined to be feasible for sediment removal in this reach with a planned volume of 14,300 m³. The site was located on lands administered by the City of Chilliwack. The volume removed from the Lower Reach in 2016 was 16,566 m³ which accounts for 116% of the estimated removal volume.

Yarrow Bar (16-13L)

Plan

The Yarrow Bar excavation was positioned on the left side of the main channel between XS-13 at the upstream end and XS-12 at the downstream end (Figure Y1). The site was accessible from the north end of Wilson Road. Removed sediment was to be stored at the Wilson Road stockpile site immediately adjacent to the excavation. Wilson Road stockpile is limited by presence of Yarrow Water Works wells which require a 30m setback, however, with the smaller volume proposed in 2016, compared to 2014 which fit only marginally within the acceptable use area, the usable area of the stockpile was expected to be sufficient.

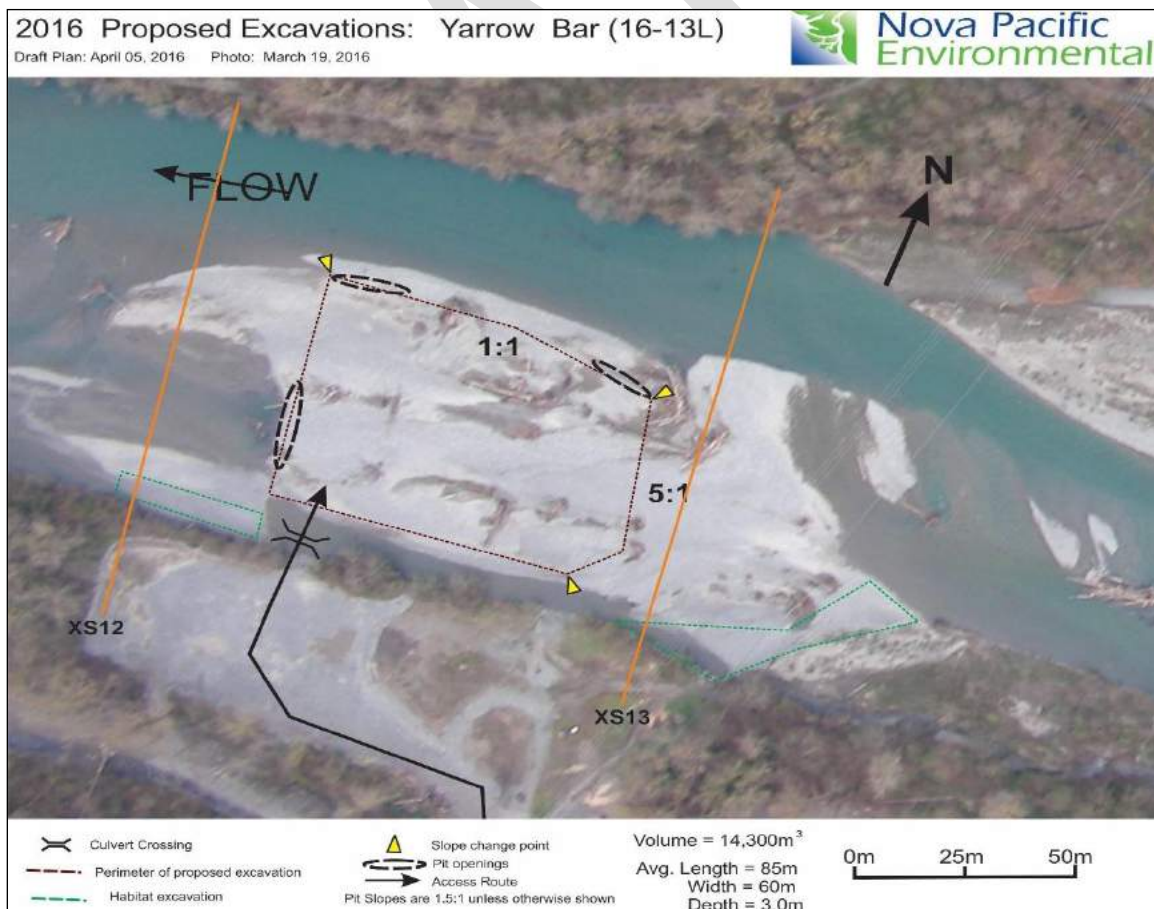


Figure Y1: Layout of 2016 Yarrow Bar (16-13L) sediment removal project. Photo taken March 19, 2016, draft plan – April 5, 2016.

The planned excavation was 85m long, 60m wide and 3m deep from the surface of the bar with an anticipated removal volume of 14,300 m³.

This general area is excavated regularly and is usually at or near the freeboard limited zone. Thus, this excavation served a dual purpose of trapping sediments and contributing to increased floodway capacity in freeboard-limited zone. In addition, it was also expected to continue mitigating the bank erosion concern downstream by directing flow more centrally within the channel instead of towards the left bank.

The layout of the 2016 excavation consisted of one deep pit. A 5:1 slope at the upstream edge of the excavation was prescribed to provide stability during higher flows and to prevent erosion of the head of the bar. The right side of the pit was designed with a 1:1 slope to allow the berm to collapse into the excavation at higher flows, and the remaining slopes were 1.5:1. Two openings, 20 m wide, were prescribed to permit flow in and out of the excavation and to allow fish to move freely through the site. A third opening, at the downstream end of the excavation was designed to direct flow into the downstream end of the secondary channel and was expected to be a shallow riffle type opening.

A 4m buffer zone between the left bank side channel and the pit was prescribed. Habitat excavation upstream and downstream of the site designed to improve flows along the left bank. Abundant LWD on site was available to be used on site and to be provided to DFO for an enhancement project adjacent to the stockpile site.

Use of one or more culverts was anticipated for crossing the wetted channel at the right bank where the ramp down to the bar was proposed.

Implementation

The excavation site was laid out on August 22nd using flagging, stakes and survey paint. An adjustment of the perimeter was made during the layout of the site in order to field fit the key bar features identified in the original plan. A slight increase of width and depth resulted in volume increase from 14,300 m³ to 17,750 m³. Figure Y2 shows the revised plan.

Prior to beginning work on August 27, a site meeting was held to discuss environmental requirements and the implementation of the project design. It had been arranged to use the part of the Wilson Road Stockpile area that was outside the 30m setback. The setback area was marked off prior to the start of hauling and logs that had been stored within the stockpile area were moved to provide a perimeter for the foot of the stockpile.

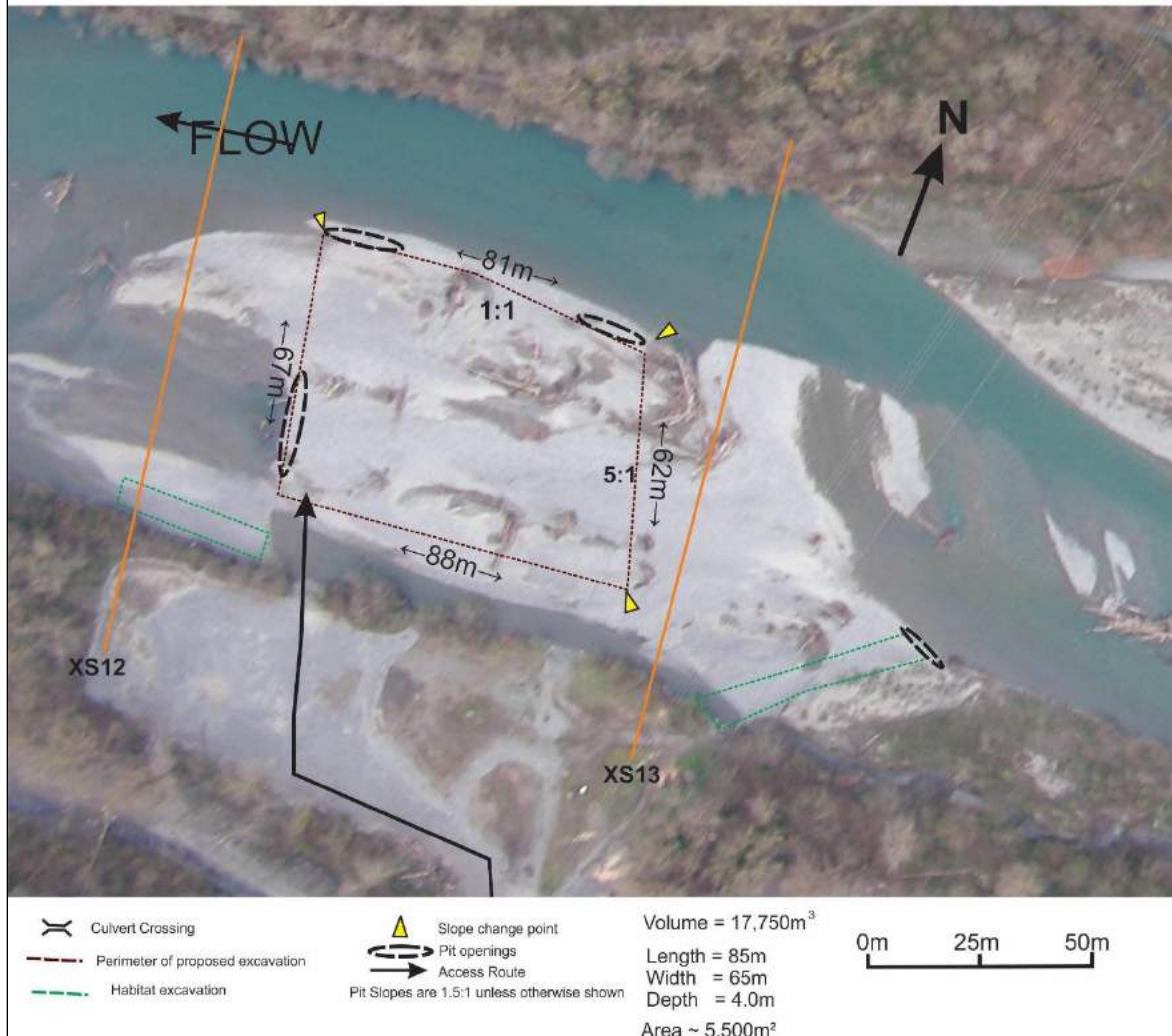


Figure Y2: 2016 Yarrow Bar (16-13L) construction drawing. Photo taken March 19, 2016, drawing – August 24, 2016.

The work on the bar started with building the access ramp, clearing the site and moving woody debris aside until for habitat use at the end of the excavation. Excavation began on August 29th, 2016 starting with scalping the area. This continued to the next day, August 30th, when the excavation of the deep pit was also started with a 5:1 slope at the upstream end. The excavated material was initially piled on site, and then loaded into trucks the next day to be hauled to the stockpile site. One excavator, one loader, and 2 rock trucks were regularly present on site. As the work continued, the excavator removed material from the pit to a temporary pile and the loader was used to load the trucks. This allowed the material to drain before being transported to the stockpile. On September 2nd, the operator constructed berms at upstream outside edge to mitigate risk of water breaching the pit from the main channel in the event of rising water levels.

As the excavated pit extended closer to its downstream end, water percolating from the ground into the small pool remaining from the 2014 excavation and located immediately downstream of the 2016 excavation was noted to contain silt. Turbidity was measured and the results are presented in the table below.

Table Y1: Turbidity measurements taken at Yarrow Bar excavation site on September 1st, 2016

Sampling location	Turbidity (NTU)
1. At location of silty water percolation	327
2. Mid-pool	48.8
3. Prior to outflow from secondary channel to main channel	28.1
4. Main channel (for baseline comparison)	1.7

The value for sampling station 1 was very high, and likely representative of water within the excavation that was close to the direct action of the excavator. The mid-pool excavation was less than 10m away from the point where percolation entered the pool. This rapid decrease would be due to a combination of immediate settling of suspended sediment and dilution. The area was checked and no evidence of fish or other species in distress was observed. Fish, mostly Longnose Dace, were seen throughout the pool and downstream sub-gravel fed microchannel.

It seems likely that, as excavation proceeded, the turbid water of the pool intersected a zone of sub-gravel percolation and thereafter delivered some turbid water from the pit. As the turbidity discharge was minor in its effects and did not have a detrimental effect beyond the work zone, the work continued. The turbidity in the pit work zone cleared quickly once the excavation was complete and opened to the flowing water of the main channel. The secondary channel also received a significant portion of the flow. This is a good example of the environmental site monitoring which includes turbidity measurement to ensure that the contractor receives good direction to prevent any harmful habitat effect.

Work continued until September 7th when the deep pit was completed and excavation of two habitat channel sections began. The downstream section, which was dry, was enhanced by providing some deeper pools, separated by areas of riffle. The upstream section was excavated to restore surface flow to the left bank channel. As with the Bergman Bar habitat channel, this work was intended to increase the groundwater fed habitat value to provide reliable habitat for spawning and rearing salmonids and to supplement this with surface flow that while beneficial, was at risk of being cut off due to infilling. The middle section that was already wetted and contained salmonids was left in its original condition except that flow was restored. Three LWD structures were installed along the left bank side channel downstream of the access ramp and two more were installed along the wetted portion of the left bank channel upstream of the access ramp. A few remaining high quality LWD pieces were donated to the DFO LWD stockpile adjacent to the City of Chilliwack's gravel stockpile. Photos and more detail about the habitat works are contained in Appendix B.

Site decommissioning was completed on September 8th, 2016. A 20m wide outflow opening was constructed first, followed by the excavation of a 20m inflow opening. A third riffle type opening at the downstream end of the excavation was constructed to improve fish habitat downstream by directing flow through the remnant of the 2014 excavation. LWD structures were placed immediately upstream (in the pit) and downstream of the third opening. The access ramp was removed allowing flow to the channel to be restored as a riffle. The upstream channel which had been previously excavated was opened last to admit surface flow to the whole channel. Photos of the LWD structures and their GPS coordinates are presented in Appendix B.

Summary

The Yarrow Bar excavation continued from August 27th to September 8th, 2016. The volume of material removed was 16,566 m³ of the 14,300 m³ proposed which was 116% of the expected volume from the site.

The abundance of LWD presented a good opportunity for habitat enhancement. Seven LWD structures were placed at Yarrow Bar. Two sections of habitat channel excavation have improved

side channel flow and fish spawning rearing habitat. The upstream excavated channel was approximately 10m wide and 67m in length while the downstream channel was approximately 89m by 10m providing a total of 1,560m² of constructed habitat. The middle section, enhanced by placing LWD and increasing flow was approximately 120m x15m for an additional 1,800m² of enhanced habitat.

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Yarrow Bar Photos



Y1: Yarrow sediment removal site prior to work looking upstream. August 26, 2016.



Y2: Yarrow sediment removal site prior to work looking downstream. August 26, 2016.



Y3: Bar access ramp constructed. August 29, 2016.



Y4: Scalping of deep pit area. August 29, 2016.



Y5: Yarrow Water Wells area protected with tape demarcation. August 29, 2016.



Y6: Start of excavation at upstream end with 5:1 slope. August 30, 2016.



Y7: View of machinery and work activities on site. August 31, 2016.



Y8: Work in progress. View from upstream end of site. September 7, 2016.



Y9: Constructing of inflow opening to the main river followed by outflow opening completion. September 8, 2016.



Y10: Third opening to the secondary channel at downstream end of the pit constructed as a riffle feature. September 10, 2016.



Y11: View of the completed excavation, looking towards outflow opening. September 10, 2016.



Y12: Restored channel after access road decommission. September 8, 2016.

Site Reports – Canal Reach

The Canal Reach extends from XS-1 downstream to Keith Wilson Bridge. One site, Keith Wilson Bar, was selected for sediment removal in this reach with a planned volume of 17,200 m³. The site was located on lands administered by the City of Chilliwack. The volume removed from the Canal Reach in 2016 was 16,944 m³ which accounts for 99% of the estimated removal volume.

Keith Wilson Bar (16-C26R)

Plan

The Keith Wilson Bar sediment removal site was located on the right side of the Vedder Canal, approximately 150m downstream of Keith Wilson Bridge. The excavation footprint extended downstream of XSC25 and upstream of XSC26 (Figure KW1). The site was accessible from the east end of Keith Wilson Bridge. Material was to be stored at Greendale stockpile.

The excavation was designed to be 190m long, 35m wide and 3m deep from the surface of the bar with anticipated removal volume of 17,200 m³.

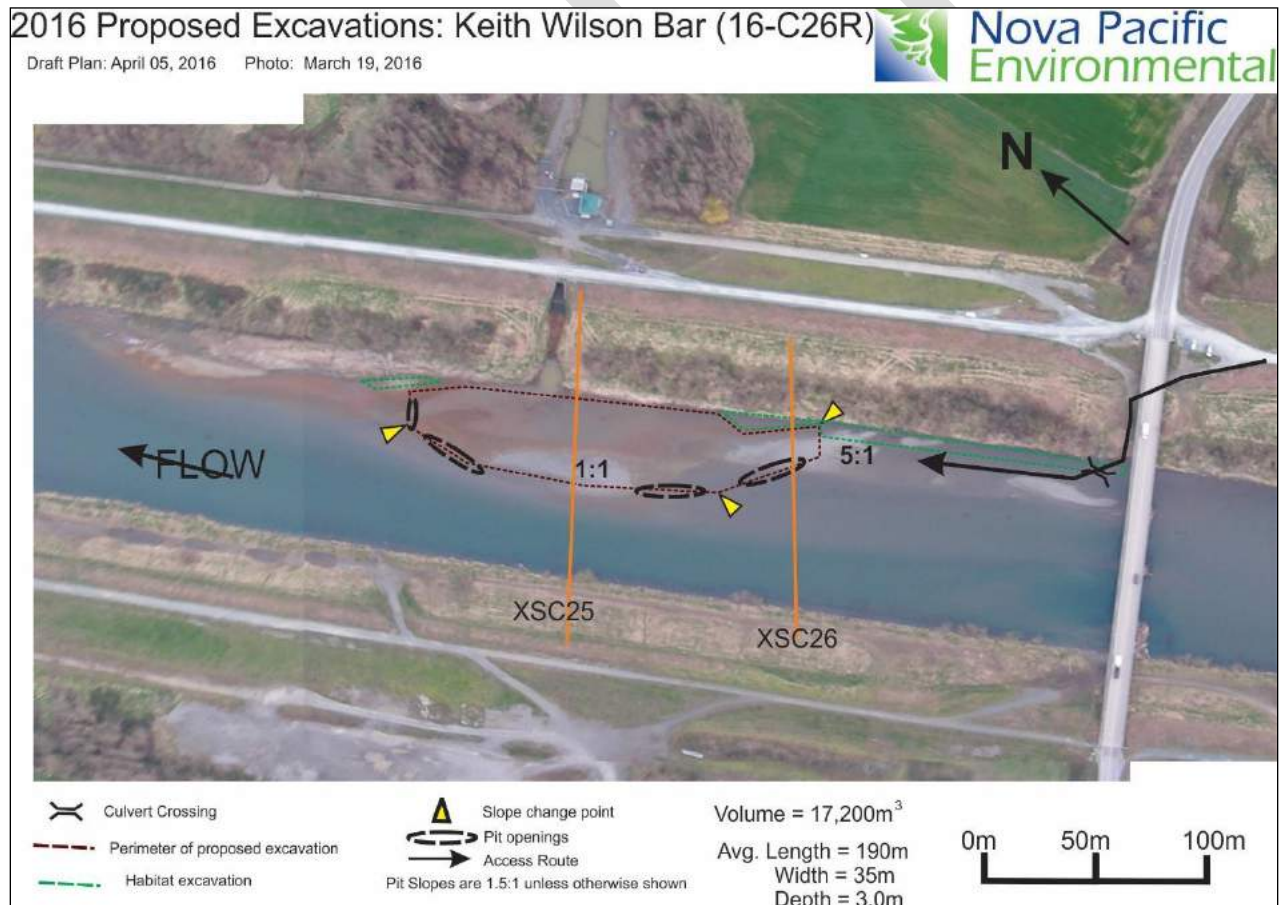


Figure KW1: Layout of 2016 Keith Wilson Bar (16-C26R) sediment removal project. Photo taken March 19, 2016, draft plan – April 5, 2016.

The main objective of the excavation project was to reduce the risk of dyke overtopping upstream by improving the backwater profile. Habitat benefits were expected from an improved outflow channel for the pump station and from the right bank habitat channel excavation.

The layout of the Keith Wilson Bar excavation consisted of one deep pit. A standard 5:1 slope along the upstream edge of the excavation was prescribed to provide a stable feature during higher flows and to limit erosion at the head of the bar. All the remaining slopes were 1.5:1. Two standard openings, 20m wide, were prescribed to permit flow and to allow fish to move freely through the site. A third opening at the upstream end of the pit was designed as a wide riffle to add habitat complexity and permit additional flow through the pit. The fourth opening at the downstream end of the excavation was designed to connect pit outflow to the constructed pump station outflow channel.

Use of one or more culverts was anticipated for crossing the wetted channel at the right bank where the ramp down to the bar was proposed.

Implementation

A site meeting was held prior to the start of the project on the morning of September 6. Plans for the implementation of the work were discussed and the safety and environmental standards were reviewed. The site was laid out as originally planned except that the measured length was approximately 30m longer resulting in a projected construction volume of 18,500 m³ (Figure KW2).

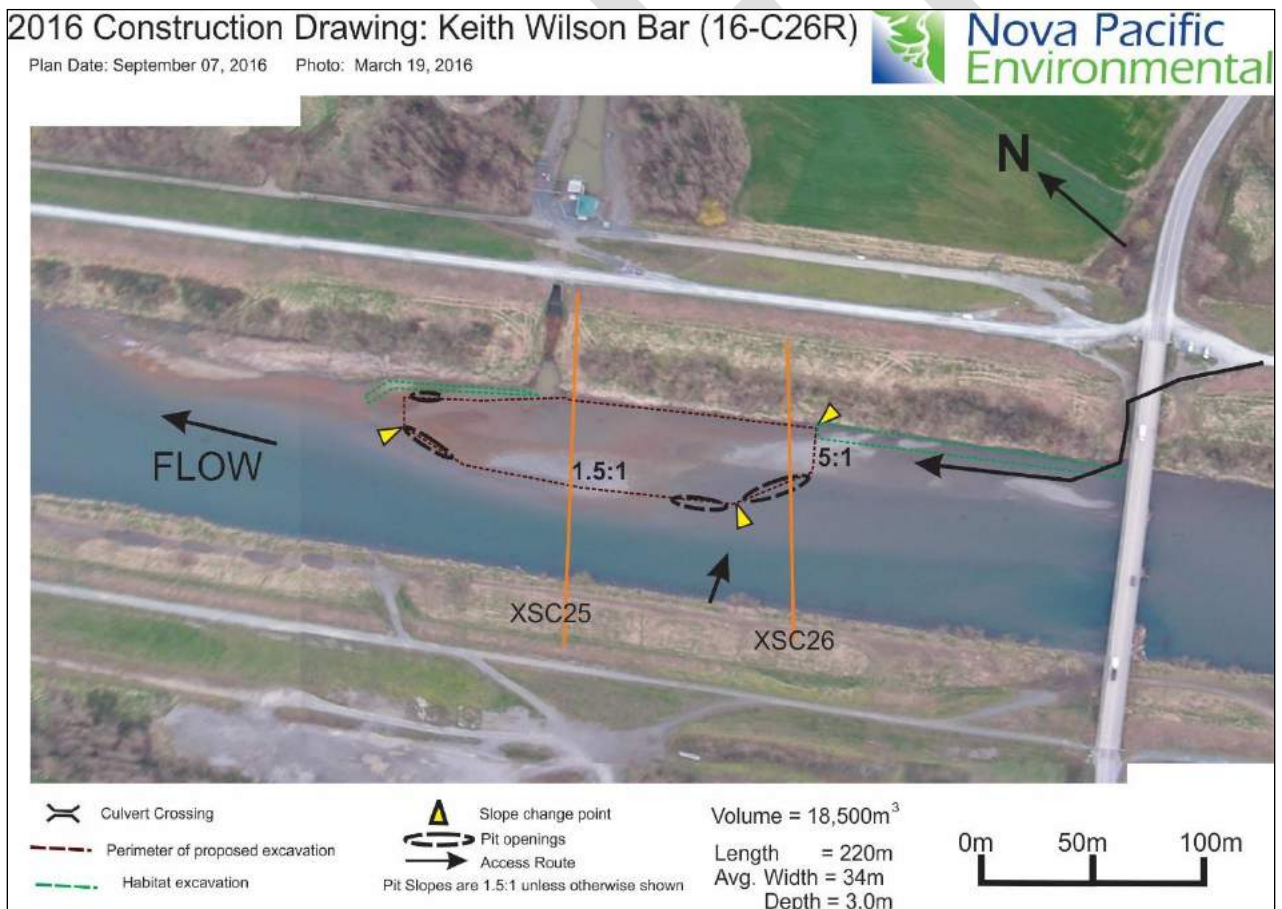


Figure KW2: 2016 Keith Wilson Bar (16-C26R) construction drawing. Photo taken March 19, 2016, drawing – September 7, 2016.

Activities at this site began on September 6th with the excavation of a new outflow channel at the pump station and the installation of an access ramp down from the right bank under the bridge.

The ramp was completed using gravel from within the excavation footprint. The outflow channel was tested and found to be slightly inadequate to carry the full outflow of the pump station with bank erosion noted at the upstream end of the excavation. The channel was deepened and a berm was constructed on the left side of the channel to ensure that the outflow did not breach the excavation pit when the pump station was running (6 times per day). Prior to work, the existing channel near the pump station was salvaged by seining. No salmonids were observed but other species were pushed by the net into areas not to be disturbed by the work. The species salvaged included 2 sculpins (*Cottus spp.*), 1 large-scale sucker (*Catostomus macrocheilus*), 2 crayfish, 2 bullfrog tadpoles, and abundant stickleback (*Gasterosteus aculeatus*) and Northern pikeminnow (*Ptychocheilus oregonensis*).

Excavation of the first two thirds of the pit proceeded from downstream to upstream until September 17th when heavy rains resulted in inundation of the excavation site. Work was held up until the site was again dry enough on September 23rd, 2016. The completed portion of the excavation remained slightly open to flowing water and having been fully inundated could have contained salmonids that were not salvageable. To restart the excavation safely, a strip was left and a small berm across the bar was created. A berm was also constructed across the upstream end of the riffle opening to ensure that section of the pit was not breached. Excavation then continued in an upstream direction to completion on September 28th.

To decommission this site, the downstream opening was excavated first. It was decided not to excavate to the power station outflow channel as this would have flowed into the pit rather than out of the pit. Next, a section of the berm isolating the two parts of the excavation, to the limit of the excavator's reach was removed. As a considerable amount of work remained to fully decommission the site the upstream and riffle openings were left for the following day. Turbidity data was collected during the main inlet opening at the upstream end and is provided in the table below.

Table KW1: September 29th turbidity readings during pit opening

Station	Location	Pre-opening	Mid-opening	Post-opening
Time		~9:00 am	~10:00 am	~11:30 am
Immediately D/S of opening	River	0.5	12.0	0.3
	Pit	48.4	58.7	48.8
Midway along the pit	River	0.3	7.2	0.9
	Pit	45.3	47.1	40.2
Immediately below outlet	River	2.2	23.9	27.3
Pump station channel	Channel	6.7	7.5	7.3
50m D/S of outlet	River	5.0	13.8	19.9
100m D/S of outlet	River	not sampled	14.1	18.5
150m D/S of outlet	Along bank	not sampled	not sampled	18.5
	~20m off bank	not sampled	not sampled	0.9

The turbidity data at this site illustrates the typical effects of opening an excavation to flowing water. Turbidity increases on the river side, outside of the excavation were minor and short lived

because the flow is generally directed into the excavation. The excavation had been left overnight so the pit area would have cleared however, turbidity was higher in the upper half of the pit because of the disturbance of the opening. The flushing of the excavation with clear water is usually complete within a few hours but this is dependent on flow rates that varies mainly with the elevation difference between the inlet and outlet. The plume of turbidity at the exit is slowly diluted but is often confined to the bank as evidenced by the low reading 20m off the bank. The turbid plume can be seen downstream of the excavation usually until a river feature such as a riffle induces more aggressive mixing. Due to the relatively low values, short duration, and confinement of the turbid water to the bank (allowing fish to avoid the turbid water), this turbidity event is not considered to be significantly detrimental.

Once the openings were complete, work continued on the habitat channel along the right bank. This was opened to flow upon removal of the ramp. A plan to use excess LWD from the bridge pier was scrapped because the LWD present at the pier already provided a scoured opening to the upstream end of the channel. The habitat channel was 145m in length and approximately 5m in width, providing a new habitat feature of approximately 725m².

Decommissioning of this site included grooming of the bar surface where truck activity had created an accumulation of finer sediments, removal of fines collected in a settling pond adjacent to the right bank concurrently with constructing the habitat channel, removing the ramp and removing accumulated material around the haul road under the bridge. Due to the finer material at this excavation site as well as the practice of loading directly from the excavation to the trucks, rather than to a temporary pile as was more common at the upstream sites, there was an accumulation of mud churned up by the truck tires as well as some ponded silty water. Despite this, the site was well managed by the contractor and there was no release of sediment or sediment laden water to the flowing river. The contractor and monitors were diligent about ensuring that the spillage from the trucks flowed back into the pit or to the temporary pond near the foot of the ramp.

To improve public perception and help further reduce risk of silt entry into the river, it is recommended that more regular removal of mud from the access road section under the bridge be incorporated into future removals at this site. The contractor could also rely more on a temporary pile of drained material to partially fill trucks in a manner that would allow a drier site.

Summary

The Keith Wilson Bar excavation continued from September 6th to September 29th, 2016. The volume of material removed was 16,944 m³ of the 17,200m³ proposed which was 99% of the expected volume from the site.

A temporary breach of the excavation as well as the need to deal with outflows from the pump station delayed the project and required that the full-time frame of the extension was needed to complete the project.

Keith Wilson Bar Photos



KW1: Keith Wilson sediment removal site prior to work looking upstream. September 6, 2016.



KW2: Keith Wilson sediment removal site prior to work looking downstream. September 6, 2016.



KW3: Bar access ramp constructed. September 6, 2016.



KW4: Channel at pump station salvaged by seine net. September 6, 2016.



KW5: Pump station outflow channel constructed. September 7, 2016.



KW6: Pump station water release. September 7, 2016.



KW7: Work in progress. View from downstream end of site. September 14, 2016.



KW8: Berm constructed at upstream end and along the river to continue excavation after heavy rain. September 23, 2016.



KW9: Constructed outflow opening to the main river. September 28, 2016.



KW10: Constructed inflow opening to the main river. September 28, 2016.



KW11: View of the completed excavation from upstream of the work. September 29, 2016.



KW12: Access road decommissioning. September 29, 2016.

Date and Signature Page

The effective date of this report titled “2016 Vedder River Sediment Removal – Environmental Monitors Report” is December 7, 2016.

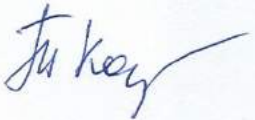
Signed,



Bruce F. Wright, BSc, MBA, RPBio

Dated: December 7, 2016

Signed,



Tatiana Kozlova, PhD, RPBio

Dated: December 7, 2016

Appendix A: Permits and Authorizations

- 1) Fisheries and Oceans Canada Authorization – Paragraph 35(2)(b) Fisheries Act Authorization issued by the Department of Fisheries and Oceans (DFO) on July 22, 2016. File: 16-HPAC-00518. Issued to the City of Chilliwack.
- 2) Fisheries and Oceans Canada Authorization – Notification of modifications to dates in conditions of Paragraph 35(2)(b) Fisheries Act Authorization 16-HPAC-00518. Issued to the City of Chilliwack.
- 3) Water Sustainability Act Approval – Subsection 11(1) and 11(2) (Changes in and about a stream). File: 2004412. Issued to the City of Chilliwack.

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Authorization No. : 16-HPAC-00518

PARAGRAPH 35(2)(b) FISHERIES ACT AUTHORIZATION

Authorization issued to:

City of Chilliwack and Ministry of Forests, Lands and Natural Resource Operations (*hereafter referred to as the "Proponent"*)

Attention to:

Mr. Frank Van Nynatten
Environmental Services and Engineering
City of Chilliwack
8550 Young Road
Chilliwack, BC
V2P 8A4

Mr. John Pattle
Head, Flood Safety Section
Ministry of Forests, Lands and Natural
Resource Operations
Unit 200 - 10428 153rd Street
Surrey, BC
V3R 1E1

Location of Proposed Project:

Nearest community (city, town, village): Chilliwack
Municipality, district, township, county: City of Chilliwack
Province: British Columbia

Name of watercourse, waterbody: Vedder River

UTM Coordinates: 121°59'16.95" West and 49° 5'49.18" North ("Geisbrecht Bar")
 122° 4'45.71" West and 49° 6'18.69" North ("Keith Wilson Bar")

Description of Proposed Project:

The proposed project of which the work(s), undertaking(s) or activity(ies) authorized is a part involves:

- The excavation and removal of sediment from 7 sites on the Vedder River for flow conveyance and flood protection.

The project is more specifically described in the authorization application package prepared by Nova Pacific Environmental, dated May, 2016, including "Proposed 2016 Vedder River Sediment Removal Project", "2014 Vedder River Gravel Excavation – Habitat Changes and Environmental Impacts", "2014 Vedder River Sediment Removal – Environmental Monitors Report", memo dated June 27, 2016 to Teri Ridley, DFO "RE: 16-HPAC-00518 Vedder River gravel removal" (**Schedule 1**) and "Vedder River Management Area Plan Update", prepared by Tetra Tech EBA Inc. dated December 11th, 2015 (**Schedule 2**).

Description of Authorized work(s), undertaking(s) or activity(ies) likely to result in serious harm to fish:

The work(s), undertaking(s), or activity(ies) associated with the proposed project described above that are likely to result in serious harm to fish are:

- The removal of sediment from Giesbrecht, Lickman, Bergman, Railway, Downstream Rail Bridge, Yarrow and Keith Wilson Bars on the Vedder River, Chilliwack, BC.

The serious harm to fish likely to result from the proposed work(s), undertaking(s), or activity(ies), and covered by this authorization includes:

- The permanent alteration of up to 7500 m² (approximately 150 m long by 50 m wide by 3.5 m maximum depth) of instream habitat resulting from the excavation of sediment from Giesbrecht Bar in the Vedder River.
- The permanent alteration of up to 7350 m² (approximately 105 m long by 70 m wide by 3.5 m maximum depth) of instream habitat resulting from the excavation of sediment from Lickman Bar in the Vedder River.
- The permanent alteration of up to 3375 m² (approximately 135 m long by 25 m wide by 4 m maximum depth) of instream habitat resulting from the excavation of sediment from Bergman Bar in the Vedder River.
- The permanent alteration of up to 1800 m² (approximately 90 m long by 20 m wide by 3 m maximum depth) of instream habitat resulting from the excavation of sediment from Railway Bar in the Vedder River.
- The permanent alteration of up to 6460 m² (approximately 190 m long by 34 m wide by 3.75 m maximum depth) of instream habitat resulting from the excavation of sediment from Downstream Rail Bridge Bar in the Vedder River.
- The permanent alteration of up to 5100 m² (approximately 85 m long by 60 m wide by 3 m maximum depth) of instream habitat resulting from the excavation of sediment from Yarrow Bar in the Vedder River.
- The permanent alteration of up to 6650 m² (approximately 190 m long by 35 m wide by 3 m maximum depth) of instream habitat resulting from the excavation of sediment from Keith Wilson Bar in the Vedder River.

Conditions of Authorization

The above described work(s), undertaking(s) or activity(ies) that is likely to result in serious harm to fish must be carried on in accordance with the following conditions.

1. Conditions that relate to the period during which the work(s), undertaking(s) or activity(ies) that will result in serious harm to fish can be carried on:

The work(s), undertaking(s) or activity(ies) that results in serious harm to fish is authorized to be carried on during the following period:

From: Date of Issuance

To: September 15th, 2016

If the Proponent cannot complete the work(s), undertaking(s) or activity(ies) during this period, Fisheries and Oceans Canada (DFO) must be notified in advance of the expiration of the above time period. DFO may, where appropriate, provide written notice that the period to carry on the work, undertaking or activity has been extended.

The periods during which other conditions of this authorization must be complied with are provided in their respective sections below. DFO may, where appropriate, provide written notice that these periods have been extended, in order to correspond to the extension of the period to carry on a work, undertaking, or activity.

2. Conditions that relate to measures and standards to avoid and mitigate serious harm to fish:

- 2.1. Sediment and erosion control measures must be in place and shall be maintained, such that release of sediment is avoided at the location of the authorized work(s), undertaking(s), or activity(ies).
- 2.2. Works shall be conducted in a manner that prevents the death of fish (refer to section 2 of the *Fisheries Act* for the full definition of fish).
- 2.3. All works shall be conducted in isolation of flowing water.
- 2.4. Fish salvage(s) at the Project site shall be conducted and any necessary permits to conduct the salvage(s) shall be obtained.
- 2.5. All works shall be conducted to minimize fish stranding to the greatest extent possible.
- 2.6. Guidelines and constraints identified in Table 3 of **Schedule 1** (page 7 of "Proposed 2016 Vedder River Sediment Removal Project") shall be followed.
- 2.7. Mitigation plans for each of the seven bars identified in Schedule 1 ("Proposed 2016 Vedder River Sediment Removal Project") shall be implemented.
- 2.8. Existing access and haul routes identified in **Schedule 1** ("Proposed 2016 Vedder River Sediment Removal Project") shall be used.
- 2.9. Any disturbed riparian vegetation shall be replaced with equal or greater number of native plant species.
- 2.10. A Qualified Environmental Professional (QEP) must monitor the implementation of avoidance and mitigation measures to prevent serious harm to fish beyond that covered by this Authorization.
- 2.11. Contingency measures shall be put in place if monitoring required in condition 3 below indicates that the measures and standards to avoid and mitigate serious harm to fish are not successful.

3. Conditions that relate to monitoring and reporting of measures and standards to avoid and mitigate serious harm to fish

- 3.1. The Proponent shall monitor the implementation of avoidance and mitigation measures referred to in section 2 of this authorization and report to DFO, by December 15th, 2016, and indicate whether the measures and standards to avoid and mitigate serious harm to fish were conducted according to the conditions of this Authorization. This shall be done, by:

- 3.1.1. Providing dated photographs and inspection reports to demonstrate effective implementation and functioning of mitigation measures and standards described above to limit the serious harm to fish to what is covered by this Authorization.
 - 3.1.2. Providing details of any contingency measures that were followed, to prevent impacts greater than those covered by this Authorization in the event that mitigation measures did not function as described.
 - 3.2. If monitoring indicates that the measures and standards to avoid and mitigate serious harm to fish are not successful, the proponent will report any potential issues of non-compliance to DFO's Observe, Record and Report line (1-800-465-4336) and implement appropriate contingency mitigation measures.
4. **Conditions that relate to the offsetting of the serious harm to fish likely to result from the authorized work, undertaking or activity:**
 - 4.1. Offsetting measures will follow the design plans and parameters outlined in: "Proposed 2016 Vedder River Sediment Removal Project", dated May 2016, prepared by Nova Pacific Environmental (**Schedule 1**).
 - 4.2. As per the offsetting objective outlined in **Schedule 1** ("Proposed 2016 Vedder River Sediment Removal Project"), all reasonable efforts are to be made to optimize fish habitat outcomes as a result of the excavations.
 - 4.3. Additional offsetting measures include habitat enhancements, shall be incorporated where appropriate provided the enhancements will not result in serious harm not identified above:
 - 4.3.1. Site # 2 Lickman Bar: large woody debris will be keyed in around excavation site.
 - 4.3.2. Site #3 Bergman Bar: habitat excavation along the left bank, upstream and downstream of the main pit involving deepening the left bank microchannel for improved rearing capacity, reduced fish stranding and additional Chum spawning habitat.
 - 4.3.3. Site # 4 Railway Bar: habitat excavation at the downstream corner of pit along bank to maintain habitat values of small channel downstream of excavation.
 - 4.3.4. Site #5 Downstream of Rail Bridge: habitat excavation along the right bank, deepening the secondary channel and keying in large woody debris into the habitat channel and adjacent areas.
 - 4.3.5. Site #6 Yarrow Bar: maintaining a buffer zone for the microchannel, habitat excavation along the left bank, upstream and downstream of the main pit to improve flows, and keying in large woody debris.
 - 4.3.6. Site #7 Keith Wilson Bar: habitat excavation along right bank involving pools and sections of microchannel and keying in large woody debris.
 - 4.3.7. The Proponent shall provide no less than 1000 m³ of gravel for use by DFO to enhance spawning sites in the Chilliwack/Vedder River. The storage site for this gravel stockpile shall be chosen in consultation with DFO Habitat Restoration Unit (Annacis Island at 604-666-8266).
 - 4.4. All fish habitat offsetting measures shall be completed by September 15th, 2016.
 - 4.5. All fish habitat offsetting measures shall be considered completed and functioning when each site achieves an increased or neutral habitat rating and a positive or neutral overall habitat score.

- 4.6. If the results of monitoring as required in condition 5 indicate that the offsetting measures are not completed by the date specified and/or are not functioning according to the above criteria in 4.5, the Proponent shall give written notice to DFO and put in place contingency measures and associated monitoring measures to ensure the offsetting is completed and/or functioning as required by this Authorization.
- 4.6.1. In the event that the habitat assessment score and rating reveal offsetting measures are not functioning, the proponent will determine the reason for failure(s), develop a contingency plan to address the failure(s) and implement corrective action(s) within one calendar year to bring offsetting measures to a level consistent with the standard stated in the Authorization conditions 4.5.
- 4.6.2. Contingency plans shall be submitted to DFO for review and approval prior to implementation.
- 4.6.3. Following implementation of an offsetting contingency plan, the Proponent will monitor in accordance with the standards as stated in the Authorization conditions 5.1.1.
- 4.7. The Proponent shall not carry on any work(s), undertaking(s) or activity(ies) that will adversely disturb or impact the offsetting measures.

5. Conditions that relate to monitoring and reporting of implementation of offsetting measures (described above in section 4):

- 5.1. The Proponent shall report to DFO on whether the offsetting measures were conducted according to the conditions of this Authorization by providing the following:
- 5.1.1. An assessment report outlining habitat changes and environmental impacts for each site by implementing the following:
- 5.1.1.1. Detailed mapping of habitat conditions for each bar following the Vedder River Habitat Assessment Protocol (**Schedule 1 and Schedule 2**), which involves groundtruthing, aerial photography pre-excavation and post-excavation, approximately one year later, at similar river discharge rates, river cross-section surveys and hydraulic modelling.
- 5.1.1.2. Detailed assessment of habitat types and habitat ratings for each site following the Vedder River Habitat Assessment Protocol (**Schedule 1 and Schedule 2**).
- 5.1.1.3. Geo-referenced photographic assessment of the offsetting measures 4.3.1. to 4.3.6.
- 5.1.1.4. Identification of any functional concerns with the offsetting measures and description of any remedial measures taken.
- 5.1.2. A confirmation receipt from DFO Habitat Restoration Unit regarding the completion of 4.3.7 by December 31st, 2016.
- 5.2. The Proponent shall submit 1 monitoring report, by December 31st, 2017 to ReferralsPacific@dfo-mpo.gc.ca with reference to DFO file: 16-HPAC-00518.

Authorization Limitations and Application Conditions

The Proponent is solely responsible for plans and specifications relating to this Authorization and for all design, safety and workmanship aspects of all the works associated with this Authorization.

The holder of this Authorization is hereby authorized under the authority of Paragraph 35(2)(b) of the *Fisheries Act*, R.S.C., 1985, c.F. 14 to carry on the work(s), undertaking(s) and/or activity(ies) that are likely to result in serious harm to fish as described herein. This Authorization does not purport to release the applicant from any obligation to obtain permission from or to comply with the requirements of any other regulatory agencies.

This Authorization does not permit the deposit of a deleterious substance in water frequented by fish. Subsection 36(3) of the *Fisheries Act* prohibits the deposit of any deleterious substances into waters frequented by fish unless authorized by regulations made by Governor in Council.

This Authorization does not permit the killing, harming, harassment, capture or taking of individuals of any aquatic species listed under the *Species at Risk Act* (SARA) (s. 32 of the SARA), or the damage or destruction of residence of individuals of such species (s. 33 of the SARA) or the destruction of the critical habitat of any such species (s. 58 of the SARA).

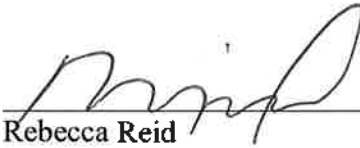
At the date of issuance of this authorization, no individuals of aquatic species listed under the *Species at Risk Act* (SARA) were identified in the vicinity of the authorized works, undertakings or activities.

The failure to comply with any condition of this Authorization constitutes an offence under Paragraph 40(3)(a) of the *Fisheries Act* and may result in charges being laid under the *Fisheries Act*.

This Authorization must be held on site and work crews must be made familiar with the conditions attached.

This Authorization cannot be transferred or assigned to another party. If the work(s), undertaking(s) or activity(ies) authorized to be conducted pursuant to this Authorization are expected to be sold or transferred, or other circumstances arise that are expected to result in a new Proponent taking over the work(s), undertaking(s) or activity(ies), the Proponent named in this Authorization shall advise DFO in advance.

Date of Issuance: JUL 22 2016

Approved by: 
Rebecca Reid
Regional Director General
Pacific Region
Fisheries and Oceans Canada



Fisheries and Oceans
Canada

Pêches et Océans
Canada

Pacific Region
200-401 Burrard Street
Vancouver, BC
V6C 3S4

Région du Pacifique
Pièce 200 – 401 rue Burrard
Vancouver, (C.-B.)
V6C 3S4

Your file *Votre référence*

SEP 13 2016

Our file *Notre référence*
16-HPAC-00518

Mr. Frank Van Nynatten
Environmental Services and Engineering
City of Chilliwack
8550 Young Road
Chilliwack, BC
V2P 8A4

Mr. John Pattle
Head, Flood Safety Section
Ministry of Forests, Lands and
Natural Resource Operations
Unit 200 – 10428 153rd Street
Surrey, BC
V3R 1E1

Dear Mr. Van Nynatten and Mr. Pattle:

**Subject: Notification of modifications to dates in conditions of Paragraph 35(2)(b)
Fisheries Act authorization 16-HPAC-00518**

The Fisheries Protection Program (the Program) of Fisheries and Oceans Canada hereby modifies the conditions that relate to the period during which the work, undertaking or activity that will result in serious harm to fish can be carried on, for the authorization issued to you under paragraph 35(2)(b) of the *Fisheries Act* on July 22nd, 2016.

The period during which the work, undertaking, or activity can be carried on is now from July 22nd, 2016 to September 30th, 2016. Other dates in the authorization are modified as follows:

- Condition 4.4 September 30th, 2016.

The Program has determined that the modification of the dates in the conditions of authorization will not increase the level of harm to fish and habitat described in the authorization.

A copy of this letter must be kept on site while the work is in progress. Work crews must be familiar with and able to adhere to the conditions.

Failure to comply with the conditions of the authorization may lead to prosecution under the *Fisheries Act*.

Canada

If you or anyone conducting work on your behalf have any questions, please contact Teri Ridley at our Kamloops office at 250-851-4939, by fax at 250-851-4951, or by email at Teri.Ridley@dfo-mpo.gc.ca.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Rebecca Reid', written in a cursive style.

Rebecca Reid
Regional Director General
Pacific Region
Fisheries and Oceans Canada

Cc: Bruce Wright, Nova Pacific Environmental Ltd.



August 8, 2016

Approval File: 2004412

City of Chilliwack
8550 Young Road
Chilliwack BC V2P 8A4

Attention: Frank Van Nynatten

Re: Application for Approval to make changes in and about Vedder River and Vedder Canal

An approval for the proposed changes in and about the Vedder River and Vedder Canal has been granted, subject to the conditions noted on the attached Approval document 2004412.

As part of the six year Section 11 Change Approval authorization, all specified reports required within the terms and conditions of the Approval must be submitted to Sandra Jensen, Authorizations Specialist, within the timelines established.

For each year of construction, the following persons, holders of water licences downstream, are to be advised 5 days prior to commencement of construction: 1) C031376 - Yarrow Waterworks District; 2) C065404 - Fisheries & Oceans Canada for Conservation (Construct Works); 3) F019953 and F020104 - Fraser Valley Duck & Goose for Irrigation; and 4) F019954 - Hooge Bruno for Domestic on Woodroffe Creek near Peach Creek Bar.

The holder of this Approval shall also advise the Southern Railway of British Columbia, 5 days prior to commencement of construction.

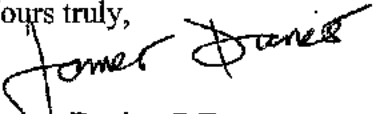
The holder of this Approval will also submit the DFO Authorization for the 2018 and 2020 proposed gravel removal years with the necessary reports required by May 30 of that biennial year.

Please be advised that applications for an approval can take up to 140 days to process. To improve our ability to review your application in a timely manner, please consider submitting information outlined in the South Coast Approval Guidelines available at:
http://www.env.gov.bc.ca/wsd/water_rights/licence_application/section9/approval_application_guidance_water_act_sec-9-south_coast_feb-2013.pdf.

The holder of this Approval shall retain an independent, appropriately qualified professional to conduct environmental monitoring of all in-stream works authorized under this Approval. The Environmental Monitor is responsible and accountable for ensuring that all the works approved under this Approval are conducted according to all applicable legislations and Best Management Practices. The Environmental Monitor is to seek advice from FLNR, or any other agency, when appropriate.

If you have any questions or concerns please contact the Water Information Technician at 604-586-4400.

Yours truly,



James Davies, P.Eng
Assistant Water Manager

Enclosure

pc: Bruce Wright, Nova Pacific Environmental Ltd.
Stella Chu, City of Abbotsford
John Pattle, FLNRO
Seabird Island
Shxw'ow'hamel First Nation
Skawahlook
Sto:lo Nation
Sto:lo Tribal Council
Soowahlie First Nation
People of the River Referral Office
Sumas First Nation
Shxwha:y Village
Squiala First Nation
Yakweakwioose Band
Aitchelitz First Nation
Skowkale First Nation
Tzeachten First Nation
Leq'a:me! First Nation

JS/ bgs

APPROVAL

WATER SUSTAINABILITY ACT - Subsection 11(1) and 11(2)
(Changes in and about a stream)

District of Chilliwack

is hereby authorized to make changes in and about a stream as follows:

- (a) The name of the stream is Vedder River and Vedder Canal, herein referred to as "the stream".
- (b) The changes to be made in and about the stream are:

To remove approximately 100,000 cubic meters of sediment and construct offsetting measures at specified gravel bars within the reaches of the Vedder River and Vedder Canal in the area bounded between the Vedder Crossing Bridge downstream to the Highway 1 Bridge, every two (2) years commencing with the 2016 fisheries window and concluding with the 2020 fisheries window. Works within the foreshore and the bed of the Vedder River and Vedder Canal may be within land owned by the City of Abbotsford, the City of Chilliwack or the Crown, held under Land Act Reserve R162023, held under Crown Land File 2411740. Sediment will be transported to a designated stockpile site that is held by the City of Abbotsford, the City of Chilliwack or the Crown.
- (c) This Approval does not authorize entry on privately held land or Crown land.
- (d) This Approval does not constitute authority of any other agency. The holder of this Approval shall have the necessary permits from other agencies concerned prior to the commencement of the works authorized herein.
- (e) The holder of this Approval must have permits or other written consent from any affected right-of-way holders before commencing work that could affect utilities or other structures within the right-of-ways.
- (f) This Approval does not authorize the alteration or removal of any works held under a water licence.
- (g) The holder of this Approval shall take reasonable care to avoid damaging any land, works, trees, or other property and shall make full compensation to the owners for any damage or loss resulting from the exercise of rights granted hereunder.
- (h) The holder of this Approval has been provided a six year authorization in order to remove an approximate biennial quantity of 100,000 cubic meters of gravel from 2016 to 2020.

- i) The holder of this Approval must notify the Water Manager immediately if there are significant changes to the proposed works from the biyearly Hydraulic Report and Proposed Vedder River Sediment Removal Project Report submitted to FLNR for the gravel removal;
 - ii) Significant changes may need to be authorized by FLNR prior to construction.
 - iii) The work authorized shall be completed on or before December 31, 2020, and the holder of this Approval shall advise the Water Information Technician (604-586-4400) when the changes have been completed.
-
- (i) A copy of this Approval (and associated plans/drawings listed on this Approval) must be available for inspection, upon request, at any location where the authorized changes in and about a stream are being undertaken.
 - (j) Work in the stream channel shall occur only during the period of July 15 to September 30, so that the fisheries interests are protected.
 - (k) Work must be carried out during favourable weather and low flow.
 - (l) Upon commencement of the project, the work shall be pursued to completion as quickly as possible.
 - (m) Equipment and machinery used in or near the stream channel must be in good operating condition and free of leaks, excess oil and grease.
 - (n) Care shall be exercised during all phases of the work to prevent the release of silt, sediment, sediment-laden water, raw concrete, concrete leachate or any deleterious substances.
 - (o) All proposed work shall be completed in isolation of the stream flows.
 - (p) Vegetation along the banks of the stream shall be disturbed as little as possible. Vegetation removed for the purposes of temporary access must be replanted using native species that are suitable for the site conditions.
 - (q) All excavated material and debris shall be removed from the site or placed in a stable area above the high water mark of the stream and mitigative measures to protect the excavated material and debris from erosion and reintroduction into the watercourse shall be used, such as, but not limited to, covering the material with erosion blankets or seeding and planting with native vegetation.
 - (r) Sediment removal boundaries must be clearly delineated prior to commencement of work. All sediment excavation for removal purposes shall be completed in isolation of the stream flows.
 - (s) Discharge and runoff water from the site into any watercourses may not exceed 25 mg/L above suspended solid levels of the receiving waters during normal dry weather

operation and 75 mg/L above suspended solid levels of receiving waters during storm events.

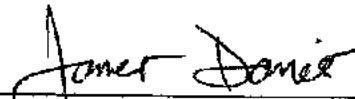
- (t) If dewatering or isolation of flow will be conducted, and the stream is known or suspected to contain fish and/or amphibians, the holder of this Approval will designate an appropriately qualified environmental professional to salvage any fish and amphibians present, prior to commencement of work in the stream channel. It is the responsibility of the holder of this Approval to obtain any permits needed prior to the salvage.
- (u) Large woody debris and the stubs of large diameter trees must be left in place or retained on-site where it is safe to do so.
- (v) All temporary works (including a ford, stream crossing and flow bypass) shall be removed on completion of the project, and the stream channel restored to its natural condition.
- (w) A spill containment kit must be readily accessible on-site and no equipment or machinery refueling shall take place within 30 meters of any watercourse.
- (x) The works shall be designed and installed so as not to restrict fish passage and/or lead to fish stranding.
- (y) All works shall comply with the information provided in the Vedder River and Canal Flood Protection Method Statement provided with the application and all works shall comply and be located as shown in the drawings submitted on the Proposed Biennial Year Vedder River Sediment Removal Project report, prepared by Nova Pacific Environmental Ltd.
- (z) Archeological sites (both recorded and unrecorded) are protected under the Heritage Conservation Act and must not be altered or damaged without a permit from the Archeology Branch. The holder of this Approval must advise everyone who will be involved in ground-disturbance and construction that if archeological materials are encountered, activities must be halted and the Archeology Branch contacted at 250-953-3334 for direction.
- (aa) All work shall be carried out in accordance with the Ministry of Environment's "Standards and Best Practices for In-stream Works". The Ministry's guidance can be found at the following link: <http://www.env.gov.bc.ca/wld/documents/bmp/iswstdsbpsmarch2004.pdf>
- (bb) The holder of this Approval must hire an appropriately Qualified Professional to conduct Environmental Monitoring on all in-stream works authorized under this Approval.
 - i) The Environmental Monitor shall attend the site prior to conducting any instream works to complete salvages and assist in the isolation of the stream, implementation of erosion and sediment control measures and perform environmental monitoring to ensure there is minimal environmental impact on the land and potentially fish and fish habitat of the stream.

- ii) The Environmental Monitor is responsible for observing the methods of construction and preparing information and reports on the compliance of the construction activities.
- (cc) The Environmental Monitor is hereby granted authority to stop the work authorized under this Approval if deemed necessary by the Environmental Monitor to address risks to the environment.
- (dd) The Environmental Monitor shall inspect the extraction area for fish stranding at least once during the fall, winter and spring after water levels have declined.
- (ee) The holder of this Approval must provide a brief post-construction report within 60 days of completion of the works.

That report shall include a signed statement from the Environmental Monitor summarizing: the in-stream works undertaken, the timing of those works, the total in-stream area directly affected, the frequency of monitoring; whether or not they observed or were otherwise aware of any non-compliance with the terms and conditions of this Approval; and a description of any environmental incidents, non-compliance or other difficulties, and how these were addressed and reported. The report shall be provided as a hard copy addressed to Sandra Jensen, Authorizations Specialist, labelled with the file number of this Approval.

- (ff) The holder of this Approval must provide a Monitoring Plan [Vedder River Gravel Excavation Habitat Changes and Environmental Impacts report] to Sandra Jensen, Authorizations Specialist, by May 30 of the next proposed biennial, labelled with the file number of this Approval.
- (gg) The holder of this Approval must submit an Offsetting and Mitigation Plan to Sandra Jensen, Authorizations Specialist, by May 30 for each biennial in which gravel removal is proposed for review and comment. The report shall be labelled with the file number of this Approval.
- (hh) The holder of this Approval must submit the Sediment Removal Plan [Proposed Biennial Vedder River Sediment Removal Project report] to Sandra Jensen, Authorizations Specialist, by May 30 for each biennial in which gravel removal is proposed for review and comment. The report shall be labelled with the file number of this Approval.
- (ii) The holder of this Approval must submit the Hydraulic Analysis report to Sandra Jensen, Authorizations Specialist, by May 30 for each biennial in which gravel removal is proposed for review and comment. The report shall be labelled with the file number of this Approval.
- (ij) The holder of this Approval shall advise the following holders of water licences downstream, 5 days prior to commencement of construction: 1) C031376 - Yarrow Waterworks District; 2) C065404 - Fisheries & Oceans Canada for Conservation (Construct Works); 3) F019953 and F020104 – Fraser Valley Duck & Goose for Irrigation and 4) F019954 – Hooge Bruno for Domestic on Woodroffe Creek near Peach Creek Bar.

- (kk) The holder of this Approval shall protect the Yarrow Waterworks District water licence works located on the Wilson Road stockpile site with appropriate fencing, a 30 meter setback and additional mitigative measures, as specified in the July 22, 2016 email response from Chilliwack to FLNR, when the stockpile site will be utilized during sediment removal.
- (ll) The holder of this Approval shall advise the Southern Railway of British Columbia, 5 days prior to commencement of construction.
- (mm) The holder of this Approval shall protect all the wildlife of the Blue Heron Nature Reserve and shall take all measures to avoid any impact or disturbance to the wildlife.



James Davies, P.Eng
Assistant Water Manager

Appendix B: Habitat Enhancement – Habitat Channels and LWD Placements

LWD Placement – General

Large Woody Debris placement at each site is dependent on supply of suitable logs, stumps and root wads. No anchors are employed due to the changing nature of the target placement locations and concerns that anchoring materials such as cable and ballast would detrimentally effect river conditions and constitute a safety hazard. As the activity is frequent and repeated with each excavation cycle, a percentage of washouts and other natural modifications are expected. GPS coordinates were recorded for each of the major LWD placements. Additional single stumps were keyed in upon occasion but where these were of poor quality or difficult to secure, they were not tracked. This section also includes photos and brief descriptions of habitat channels that were enhanced or added.

DRAFT

1: Giesbrecht Bar

Photos of LWD placed at Giesbrecht Bar and GPS locations



G1: LWD #G2016-1 – two pieces of LWD placed in scalped pit along the river side.



G2: LWD #G2016-2 – several pieces of LWD placed in scalped pit along the bank side. Note a platform of boulders created upstream of LWD complex to enhance fish habitat.



G3: LWD #G2016-3 – two pieces of LWD placed in scalped pit along the bank side. Note a platform of boulders created downstream of LWD complex to enhance fish habitat.

LWD Identifiers and GPS locations

LWD ID	GPS location
G2016-1	10U 0573714 5438680
G2016-2	10U 0573799 5438662
G2016-3	10U 0573772 5438652

2: Lickman Bar

Photos of LWD placed at Lickman Bar and GPS locations



L1: LWD #L2016-1 –LWD structure placed along the bank side of the pit.



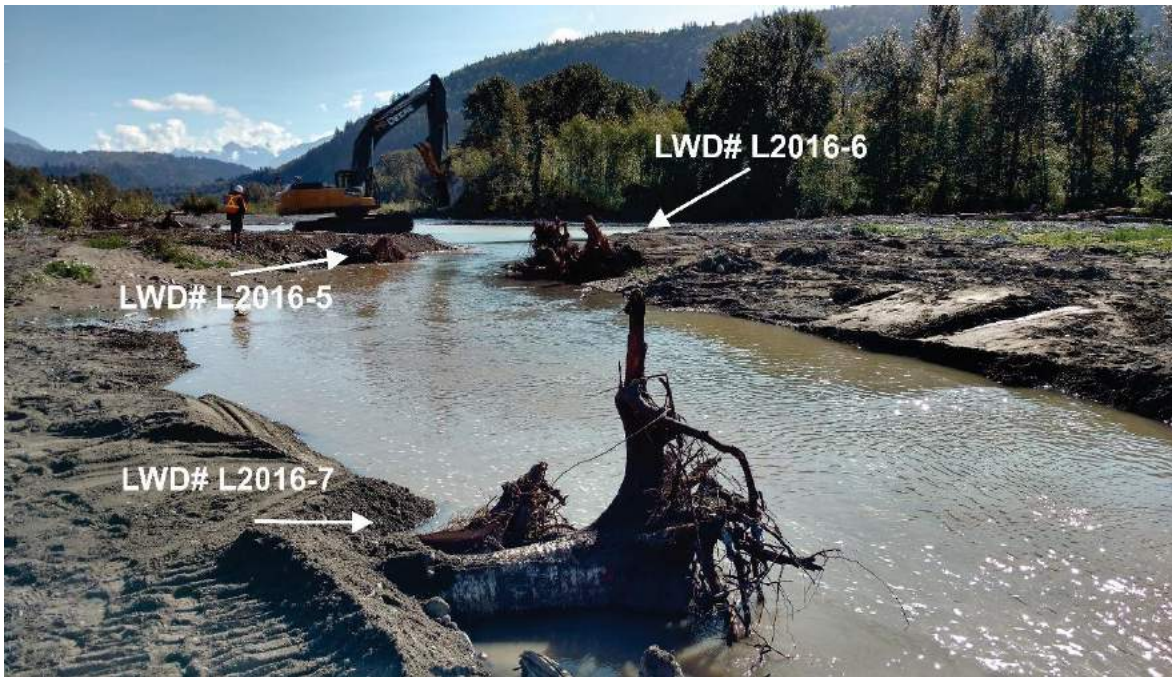
L2: LWD #L2016-2 –LWD structure placed along the bank side of the pit upstream of LWD #L2016-1.



L3: LWD #L2016-3 –LWD structure placed along the bank side of the pit upstream of LWD #L2016-2.



L4: LWD #L2016-4 –LWD structure placed in microchannel downstream of southwest outlet.



L5: LWD #L2016-5, LWD #L2016-6, and LWD #L2016-7 – Three LWD structures placed along excavated habitat channel.

LWD Identifiers and GPS locations

LWD ID	GPS location
L2016-1	10U 0572489 5438874
L2016-2	10U 0572500 5438874
L2016-3	10U 0572514 5438875
L2016-4	10U 0572466 5438797
L2016-5	10U 0572460 5438876
L2016-6	10U 0572448 5438867
L2016-7	10U 0572428 5438883

Lickman Bar Habitat Channel Enhancement

A habitat channel was constructed downstream of excavation to connect flow from the deep pit to the secondary channel to maintain it flowing to the right.



Habitat channel construction and placement of LWD. September 27, 2016.



Deep pit outflowing into newly constructed habitat channel. September 27, 2016.



View of completed habitat channel looking downstream. September 27, 2016.



Habitat channel connected to the secondary channel and flowing to the right. September 27, 2016.

3: Bergman Bar

Photos of LWD placed at Bergman Bar and GPS locations



B1: LWD #B2016-1 –LWD structure placed downstream along left bank habitat channel.



B2: LWD #B2016-2 –LWD structure placed along left bank habitat channel upstream of LWD #B2016-1.



B3: LWD #B2016-3 –LWD structure placed along left bank habitat channel upstream of LWD #B2016-2.

LWD Identifiers and GPS locations

LWD ID	GPS location
B2016-1	10U 0570619 5438437
B2016-2	10U 0570625 5438445
B2016-3	10U 0570727 5438583

Bergman Bar Habitat Channel Enhancement

A habitat channel was excavated along the left bank to improve rearing capacity, provide additional Chum Salmon spawning habitat and reduce the potential for fry stranding. This work was intended to provide habitat that is independent of the surface flow at the upstream end of the bar and will maintain sub-gravel flow in case the inlet flow cut off.



Habitat channel construction work in progress looking upstream. August 26, 2016.



Habitat channel construction. Pools and riffles structures applied. August 26, 2016.



View of completed habitat channel at upstream connection to the river. August 31, 2016.



Completed habitat channel looking downstream. August 31, 2016.



View of completed habitat channel at its downstream connection to the river. August 31, 2016.

4: Railway Bar

Railway Bar Habitat Channel Enhancement

Excavating the downstream corner of the pit along the bank to maintain habitat values of the small channel downstream of the excavation provides a simple enhancement that can be maintained on a regular basis.



Right bank side channel before enhancement, looking upstream. August 13, 2016.



Right bank side channel after enhancement, looking upstream. August 13, 2016.

5: Yarrow Bar

Photos of LWD placed at Yarrow Bar and GPS locations



Y1: LWD #Y2016-1 – one piece of LWD placed along the bank side at downstream end of the pit.



Y2: LWD #Y2016-2 – two pieces of LWD placed downstream of the pit near the third opening.



Y3: LWD #Y2016-3 –LWD structure placed along left bank side channel downstream of access ramp.



Y4: LWD #Y2016-4 –LWD structure placed along left bank side channel downstream of LWD #Y2016-3.



Y5: LWD #Y2016-5 –LWD structure placed along left bank side channel downstream of LWD #Y2016-4.



Y6: LWD #Y2016-6 –LWD structure placed along left bank side channel upstream of access ramp. Unlike more typical LWD placements, LWD #Y2016-6 and -7 were placed with the rootwad buried and the stem overhanging the channel. This avoided the need to disturb the flowing channel but still provided excellent cover.



Y7: LWD #Y2016-7 –LWD structure placed along left bank side channel upstream of LWD #Y2016-6.

LWD Identifiers and GPS locations

LWD ID	GPS location
Y2016-1	10U 0569562 5437851
Y2016-2	10U 0569546 5437846
Y2016-3	10U 0569556 5437835
Y2016-4	10U 0569534 5437828
Y2016-5	10U 0569521 5437822
Y2016-6	10U 0569634 5437865
Y2016-7	10U 0569663 5437876

Yarrow Bar Habitat Channel Enhancement

Two habitat excavations upstream and downstream of the site were implemented to improve flows along the left bank.

Upstream habitat excavation photos:



Upstream excavation site prior to work. September 7, 2016.



Upstream habitat excavation, work in progress. View towards left bank side channel. September 7, 2016.



'Riffle structure' connection to the river at the upstream end of habitat excavation. September 8, 2016.



Completed upstream habitat excavation. View towards left bank side channel. September 10, 2016.

Downstream habitat excavation photos:



Left bank side channel widening. View upstream. September 8, 2016.



Left bank side channel reconnection with a 'riffle structure' after access ramp decommission. September 8, 2016.

6: Keith Wilson Bar

A habitat channel along the right bank was excavated to improve flow and retain a habitat edge along the bank.



Construction of a habitat channel along the right bank. September 29, 2016.



Habitat channel connected to the pit, looking from upstream of work. September 29, 2016.



Habitat channel completed, looking downstream. September 30, 2016.

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