



**ANALYSIS AND PRIORITY IDENTIFICATION OF EXISTING FISH PASSAGE DATA:  
ALOUETTE RIVER WATERSHED - COA-F18-F-2504**



Prepared for:

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Prepared with financial support of the Fish and Wildlife Compensation Program on behalf of its program partners BC Hydro, the Province of BC, Fisheries and Oceans Canada, First Nations and public stakeholders.

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**March 29, 2018**

Cover photo – PSCIS crossing 51786 located on Viking Creek. Photo credit – Masse 2012

## EXECUTIVE SUMMARY

Fish passage impediments created by road crossing structures in British Columbia are a significant challenge that can have a substantial cumulative impact on local fish populations by reducing access to critical habitat and fragmenting populations. Closed bottom road crossing structures (culverts) can present barriers to fish migration due to a number of factors including increased water velocity, turbulence, a vertical drop at the culvert outlet and/or maintenance issues. The rehabilitation of fish passage at road crossing structure barriers presents tangible opportunities to reconnect habitat values within currently fragmented ecosystems.

The Alouette River watershed was chosen for assessment and confirmation planning because of its high fisheries values and because it is a watershed impacted by dam creation and operation. An organized approach to fish passage remediation in the watershed is a step towards addressing high level objectives of both the British Columbia Ministry of Environment & Climate Change Strategy- Ecosystem Branch and the Fish and Wildlife Compensation Program (FWCP) – Coast Region. These objectives are included in the Alouette River Watershed Action Plan:

- the conservation and restoration of habitat capacity and diversity for fish and other aquatic organisms
- to sustain and increase the population viability of anadromous salmon and steelhead as well as resident salmonids.
- Maintain or improve opportunities to sustainably use ecosystem values for sustenance, social, ceremonial, recreational and commercial purposes.

Previously identified crossings that are barriers to fish passage in the Alouette watershed were prioritized based on past assessment information, available fisheries data as well as estimated upstream habitat quality and quantity. The results provide a planning tool to help guide further assessment and restoration of crossings.

A detailed review and prioritization ranking was conducted for 34 crossings structures identified as requiring further assessment according to the criteria identified in the methodology. Of these, nine crossings were rated as high priority for follow up with habitat confirmation assessments and potentially fish inventories. Eight crossings were rated as moderate priority for follow up with habitat confirmation assessments and potentially fish inventories. Sixteen crossings were rated as low priority for follow up with habitat confirmation assessments and potentially fish inventories and one crossing was rated not recommended for follow up ("no fix").

To date fish passage assessments have been conducted throughout most of the major potential fish bearing Alouette River watershed areas. Areas still requiring assessment of crossings are primarily within the University of British Columbia (UBC) Malcolm Knapp Research Forest and behind gates controlled by

BC Hydro. Access to these areas will need to be arranged as part of the field planning for assessments on the 95 modelled crossings located on stream reaches identified as fish bearing or potentially fish bearing. Assessment of these crossings is recommended and should be conducted according to Fish Passage Technical Working Group (FPTWG) protocols. The FPTWG has prepared on-line training resources, field work guidance, field assessment protocols and data forms to help guide the collection of data and submission of assessment deliverables.

Habitat confirmation checks conducted according to protocols developed by the FPTWG are recommended for the crossings rated as high priority. Habitat confirmation checks gather detailed field and background data on habitat quality and quantity, fisheries values, land use issues and regional fisheries concerns. This information is then incorporated into a standardized reporting format to further refine priority rankings and focus design (Phase 3) and remediation (Phase 4) on fish passage restoration opportunities into areas of critical habitat for species of interest.

This project was funded in part by the Fish and Wildlife Compensation Program (FWCP) on behalf of its program partners BC Hydro, the Province of BC, Fisheries and Oceans Canada, First Nations and the public, who work together to conserve and enhance fish and wildlife impacted by the construction of BC Hydro dams. The project was also funded by the Ministry of Environment & Climate Change Strategy-Ecosystem Branch.

This project would not have been possible without the highly skilled GIS, data analysis, modelling and mapping support of Simon Norris from Hillcrest Geographics.

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## **1 INTRODUCTION**

The health and viability of freshwater fish populations depends on access to suitable spawning, high water refuge, rearing and overwintering habitat. Watershed connectivity is important to accommodate population abundance fluctuations and the flow of genes that provides resilience to environmental stressors such as floods, landslides and extreme climate events.

Fish passage impediments created by road crossing structures in British Columbia are a significant challenge that can have a substantial cumulative impact on local fish populations by reducing access to critical habitat and fragmenting populations. Estimates based on fish passage data collected to date indicate that there are over 170,000 closed bottom culverts in the province that impede fish passage (FPTWG 2014). Closed bottom road crossing structures (culverts) can present barriers to fish migration due to increased water velocity, turbulence, a vertical drop at the culvert outlet and/or maintenance issues. Rehabilitation and replacement of crossing structure barriers can provide access to currently isolated high value habitats.

For this project, existing fish passage information in the Alouette River watershed, near Vancouver, British Columbia, was reviewed in order to prioritize and rank culverts for follow up in preparation for further assessment and restoration. A literature and Provincial Stream Crossing Inventory System (PSCIS) database review was conducted and rehabilitation opportunities were analyzed within the context of a GIS generated Fish Habitat Model of the known or potential fish habitat located upstream.

## **2 BACKGROUND**

As a result of high-level direction from the provincial government, a Fish Passage Strategic Approach protocol has been developed for British Columbia to ensure that the greatest opportunities for restoration of fish passage are pursued. A Fish Passage Technical Working Group has been formed to coordinate the protocol and data is continuously amalgamated within PSCIS. Currently, British Columbia Timber Sales (BCTS) administers most of the fish passage assessment, design and remediation contracts with the majority of funding typically provided by the Land Based Investment Strategy (LBIS). The strategic approach protocol involves a four phase process as described in (FPTWG 2011):

- Phase 1: Fish Passage Assessment – Fish stream crossings within watersheds with high fish values are assessed to determine barrier status of structures and document a general assessment of adjacent habitat quality and quantity.
- Phase 2: Habitat Confirmation – Assessments of crossings prioritized for follow up in Phase 1 studies are conducted to confirm quality and quantity of habitat upstream and down as well as to scope for other potential nearby barriers that could affect the practicality of remediation.
- Phase 3: Design – Site plans and designs are drawn for priority crossings where high value fish habitat has been confirmed.
- Phase 4: Remediation – Implementation of reconnection of isolated habitats through replacement, rehabilitation or removal of prioritized crossing structure barriers.

The scope of this project includes portions of the planning for the first two phases of fish passage assessment in the Alouette River watershed. The Alouette River watershed was chosen for assessment and confirmation planning because of its high fisheries values and because it is a watershed impacted by dam creation and operation. An organized approach to fish passage remediation in the watershed is a step towards addressing high level objectives of both the British Columbia Ministry of Environment & Climate Change Strategy - Ecosystem Branch and the Fish and Wildlife Compensation Program (FWCP) – Coast Region. These objectives are included in the Alouette River Watershed Action Plan (FWCP 2017):

- the conservation and restoration of habitat capacity and diversity for fish and other aquatic organisms
- to sustain and increase the population viability of anadromous salmon and steelhead as well as resident salmonids.
- Maintain or improve opportunities to sustainably use ecosystem values for sustenance, social, ceremonial, recreational and commercial purposes.

To date, within the Alouette River watershed, 72 fish passage assessments (Phase 1) conducted at crossing structures are documented in the PSCIS database. The assessments were completed using standardized protocols (MoE 2009, MoE 2011). The Fish and Wildlife Compensation Program and the Ecosystem Conservation Section of the Ministry of Environment & Climate Change Strategy have funded the review of existing PSCIS information and other background literature to prioritize and rank crossing rehabilitation opportunities in select watersheds for follow up with habitat confirmation assessments.

### **3 OBJECTIVES**

Objectives for the project include:

1. To review existing fish passage information in the Alouette River watershed in order to prioritize and rank crossing rehabilitation opportunities for follow up with habitat confirmation assessments.
2. Provide some of the background and field work tools necessary to facilitate an inventory of unassessed stream crossing structures on fish bearing and potentially fish bearing streams in the Alouette River watershed according to the FPTWG standards (MoE 2011).

Deliverables of this project are intended to encourage the collection of future fish passage data according to FPTWG standards including upload into the PSCIS database. This is so that the work will not be unnecessarily repeated and so that further phases of the Fish Passage Strategic Approach protocol can be prioritized on a watershed and province wide basis towards road structure barriers providing the best opportunities for rehabilitation.

### **4 STUDY AREA**

The Alouette River watershed is located approximately 50 km east of Vancouver and drains an area of 331 km<sup>2</sup> in a generally south-west direction. The Alouette Lake Reservoir is located above the Alouette Dam within the Coast Mountains and covers an area of approximately 16 km<sup>2</sup>. The Alouette River below

the Alouette Lake Reservoir is approximately 20 km long and drains into the Pitt River approximately 6 km from the confluence with the Fraser River. The Alouette River system is located within the traditional territory of the Katzie and Kwantle First Nations. The lower Alouette River flows through the Golden Ears Provincial Park to primarily private farm land, residential areas and the municipality of Maple Ridge. The north end of the watershed on the west side of the Alouette River and Alouette Lake Reservoir is located with the Golden Ears Provincial Park. The watershed is within the Chilliwack Natural Resource District (FWCP 2017).

The Alouette Dam was built in 1926. The structure was replaced in 1984 and the spillway was rebuilt in 1993. The Alouette Lake Reservoir created upstream of the dam can discharge to either Stave Lake Reservoir via a diversion tunnel and the Alouette Generating Station, or water can be released over the spillway and/or low level outlet. The normal operating range of the reservoir fluctuates between 112.6 – 125.5 m (Andrusak 2016, BC Hydro 2018).

The Alouette - Stave Falls – Ruskin generating complex is operated by BC Hydro and includes four dams, a 1090 m long diversion tunnel and three powerhouses. Approximately 90% of the annual inflows to Alouette Lake Reservoir is diverted through the diversion tunnel to the Alouette Generating Station, located on the shore of Stave Lake Reservoir. At the south end of Stave Lake Reservoir is Stave Falls Generating station. Flows from the generating station discharge into Hayward Reservoir. Flows from Hayward Reservoir are in turn controlled by the Ruskin Dam before discharge to the Stave River (FWCP 2017).

Flows in the watershed are driven primarily by rain events in the fall and snowmelt in the spring as illustrated in the hydrograph from the hydrometric station located on the undammed North Alouette River (Figure 2). Since 2005, surface release flows of 3 m<sup>3</sup>/s have been discharged over the Alouette Dam in the spring to facilitate kokanee/sockeye smolt outmigration to the ocean via the Alouette River (Figure 3, FWCP 2017).

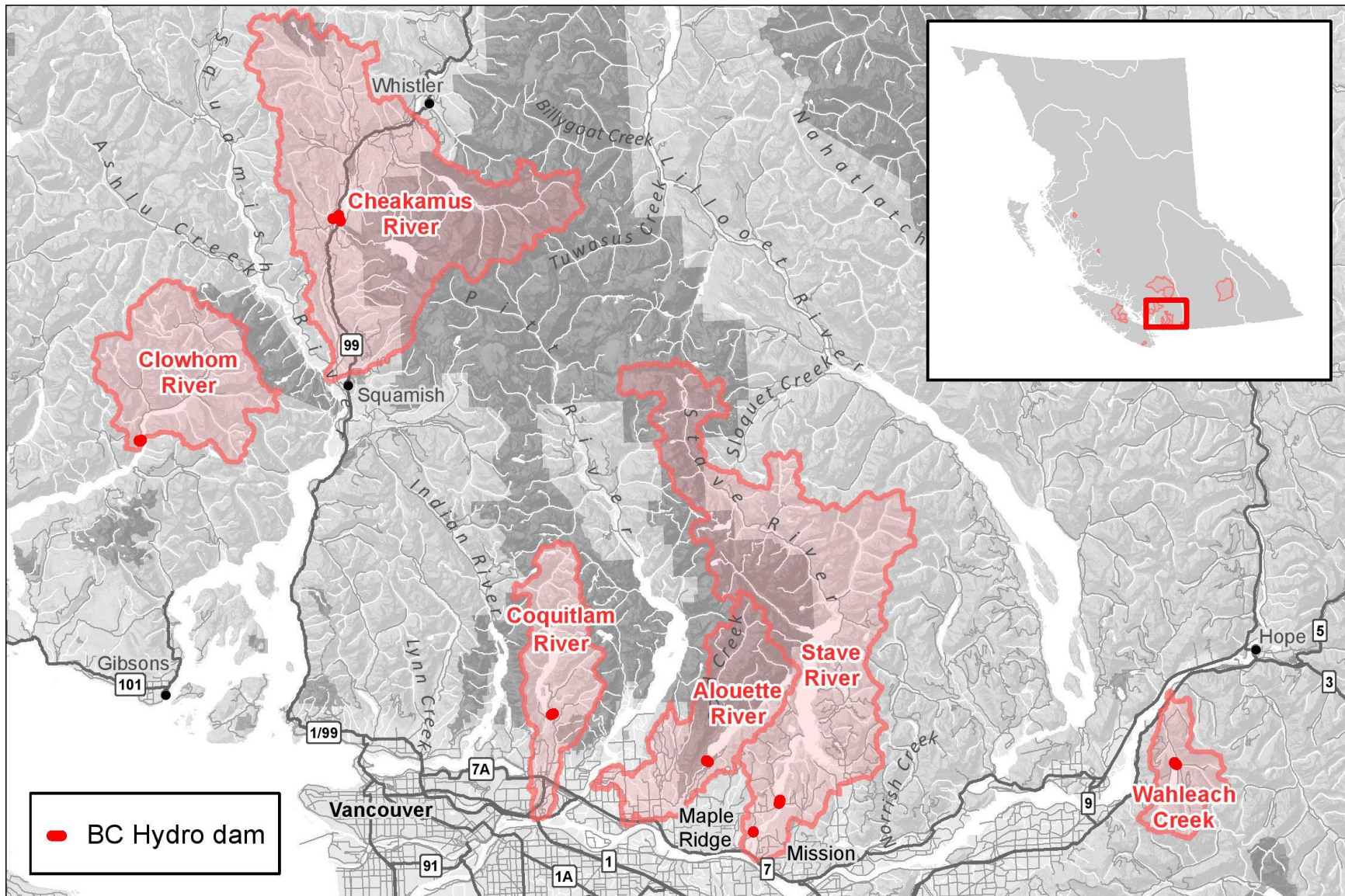


Figure 1. Map of study area.

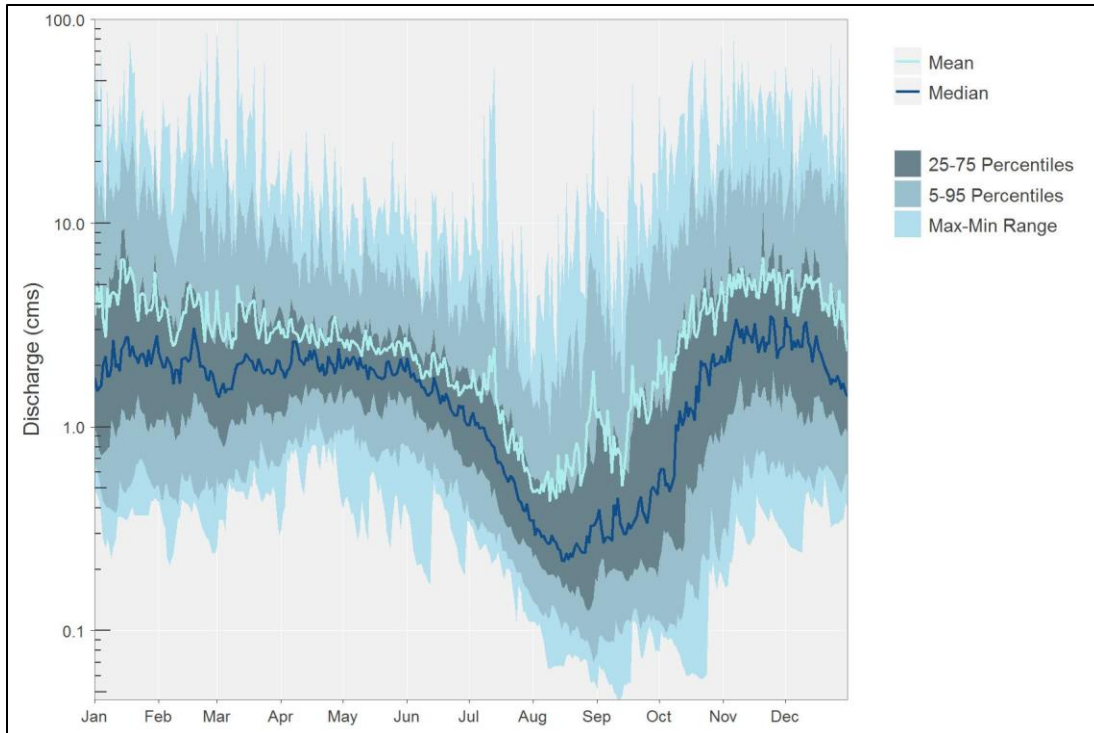


Figure 2. North Alouette River in Maple Ridge (Station #08MH006 - Lat 49.242649 Lon -122.580177). Available daily discharge data from 1911 to 2014 plotted in R with fasstr (Goetz and Schwarz NA).

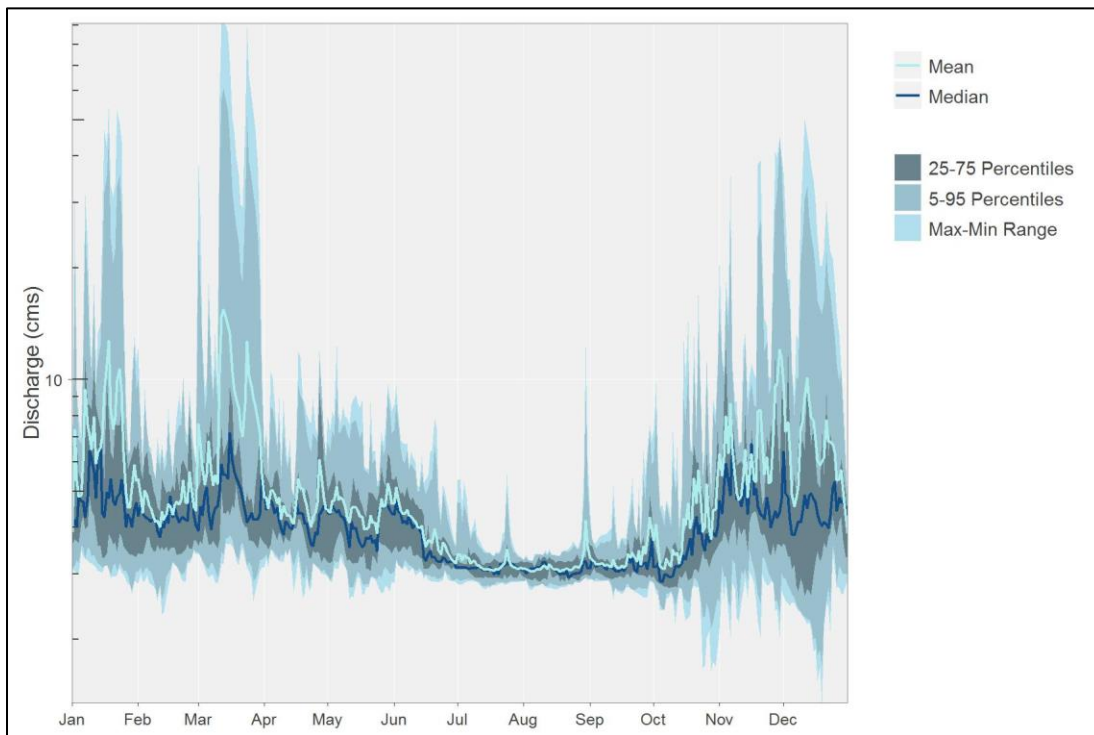


Figure 3. Alouette River near Haney (Station #08MH005 - Lat 49.238998 Lon -122.57975). Available daily discharge data from 2005 to 2014 plotted in R with fasstr (Goetz and Schwarz NA).

#### 4.1 Fisheries

Numerous fish species are present within the Alouette River watershed, including anadromous steelhead (*Oncorhynchus mykiss*) and all five species of salmon native to the North Pacific Basin: chinook salmon (*O. tshawytscha*), coho salmon (*O. kisutch*), sockeye salmon (*O. nerka*), chum salmon (*O. keta*) and pink salmon (*O. gorbuscha*) (Table 1). Historically steelhead and anadromous salmon had access to Alouette Lake; however, the construction of the Alouette Dam in the 1920s resulted in complete barrier for all these species and resulted in the extirpation of chinook and sockeye stocks in the system. Upstream of the dam within the reservoir and its tributaries, numerous resident species are present including rainbow trout (*O. mykiss*), cutthroat trout (*O. clarkii spp.*), bull trout (*Salvelinus confluentus*), kokanee (*O. nerka*), largescale sucker (*Catostomus macrocheilus*), longnose sucker (*C. catostomus*), northern pikeminnow (*Ptychocheilus oregonensis*) and peamouth chub (*Mylocheilus caurinus*). Bull trout and coastal cutthroat trout, *clarkia* subspecies (*O. clarkii clarkii*) are both considered species at risk (special concern) provincially (FISS 2018, FWCP 2017).

Oral histories document several Katzie main village sites along the Alouette River where fishing occurred for white sturgeon and salmon (Katzie First Nation 2017).

The Alouette River Sockeye Restoration Program (ARSRP) is a joint initiative between the Katzie First Nation, Alouette River Management Society, BC Hydro, BC Ministry of Environment and Climate Change, Fisheries and Oceans Canada and local stakeholders. The ARSRP has an objective to promote the re-establishment of anadromous Alouette sockeye and to evaluate the feasibility of fish passage past the Alouette Dam (ARMS 2016).

As mentioned, since 2005 water releases of 3 m<sup>3</sup>/s have been discharged over the Alouette Dam in the spring to facilitate kokanee/sockeye smolt outmigration to the ocean via the Alouette River (Figure 3). Although adult sockeye have returned to the lower Alouette River watershed and have been transferred to the Alouette Reservoir by truck by the Alouette River Management Society very few of these fish have yet produced offspring (FWCP 2017).

In 2010, Ward & Associates Ltd. (2010) completed some investigation into the feasibility of fish passage above the Alouette Dam for the Ministry of Environment Ecosystem Branch. Results of their work indicate that provision of a fish-way is possible at the dam due to the small head difference (16 m maximum) between the spill-crest water level and the water surface in the river downstream. They report that sockeye salmon would be expected to use the ladder in the summer months with pink salmon expected in September/October during odd years. Coho salmon would be expected at the dam during November/December and Steelhead from December – April. Although chum salmon are weak swimmers they opportunistically colonize and would be expected to use a ladder during October/November.

Information on the bull trout population in the Alouette River watershed demonstrates a low number of spawners indicating that the population may be at risk of extinction. Gold Creek, the main tributary to the Alouette Lake Reservoir has been identified as likely the only tributary with significant areas of habitat suitable for spawning, although further surveys of Moyer Creek, the upper Alouette River, and the lower reach of Evans Creek have been recommended (Wilcox 2015).

Reservoir operations generally impact the success of spawning within the lower reaches of reservoir tributary streams by either blocking passage to spawning reaches or by the inundation of eggs after spawning by rising reservoir levels. Spawning habitat availability in the Alouette Reservoir has been identified as a potential limiting factor to kokanee recruitment (Andrusak 2016). With a goal of restoring reservoir productivity and enhancing the sport fishery the reservoir has been fertilized since 1999. A monitoring program is conducted annually by the Ministry of Environment & Climate Change Strategy collecting a suite of physical, chemical and biological parameters to measure the ecosystem response to the program (Harris *et al.* 2010).

Past fish passage assessments have been conducted in the watershed by the Alouette River Management Society (ARMS 2004) and Masse Environmental Consultants Ltd. (MEC 2012). At the time of reporting, only data from MEC (2012) was collated within the PSCIS database. Background fish inventory work in the watershed was sparse within government report repositories but included work conducted by Davies (1996) and numerous digital summaries of fish salvages related to construction projects.

Table 1. Fish species present in the Alouette River watershed (FISS 2018).

Scientific name	Species name	Species code
<i>Ameiurus nebulosus</i>	Brown Catfish (formerly Brown Bullhead)	BNH
<i>Catostomidae</i>	Sucker (General)	SU
<i>Catostomus catostomus</i>	Longnose Sucker	LSU
<i>Catostomus macrocheilus</i>	Largescale Sucker	CSU
<i>Coregoninae</i>	Whitefish (General)	WF
<i>Cottidae</i>	Sculpin (General)	CC
<i>Cottus asper</i>	Prickly Sculpin	CAS
<i>Cottus cognatus</i>	Slimy Sculpin	CCG
<i>Cyprinidae</i>	Dace (General)	DC
<i>Cyprinidae</i>	Minnow (General)	C
<i>Cyprinus carpio</i>	Carp	CP
<i>Gasterosteidae</i>	Stickleback (General)	SB
<i>Gasterosteus aculeatus</i>	Threespine Stickleback	TSB
<i>Hybognathus hankinsoni</i>	Brassy Minnow	BMC
<i>Ictaluridae</i>	Bullhead (General)	BH
<i>Lampetra ayresi</i>	River Lamprey	RL
<i>Lampetra tridentata</i>	Pacific Lamprey	PL
<i>Lepomis gibbosus</i>	Pumpkinseed	PMB
<i>Misgurnus anguillicaudatus</i>	Oriental Weatherfish	OWF
<i>Mylocheilus caurinus</i>	Peamouth Chub	PCC
<i>Oncorhynchus clarki clarki</i>	Coastal Cutthroat Trout	CCT
<i>Oncorhynchus clarki spp.</i>	Cutthroat Trout (Anadromous)	ACT
<i>Oncorhynchus gorbuscha</i>	Pink Salmon	PK
<i>Oncorhynchus keta</i>	Chum Salmon	CM
<i>Oncorhynchus kisutch</i>	Coho Salmon	CO
<i>Oncorhynchus mykiss</i>	Rainbow Trout	RB
<i>Oncorhynchus mykiss</i>	Steelhead	ST
<i>Oncorhynchus mykiss</i>	Steelhead (Winter-run)	WST
<i>Oncorhynchus nerka</i>	Kokanee	KO
<i>Oncorhynchus nerka</i>	Sockeye Salmon	SK
<i>Oncorhynchus tshawytscha</i>	Chinook Salmon	CH
<i>Pacifastacus leniusculus</i>	Signal Crayfish	CRA
<i>Petromyzontidae</i>	Lamprey (General)	L
<i>Prosopium williamsoni</i>	Mountain Whitefish	MW
<i>Ptychocheilus oregonensis</i>	Northern Pikeminnow	NSC
<i>Rhynchithys cataractae</i>	Longnose Dace	LNC
<i>Richardsonius balteatus</i>	Redside Shiner	RSC
<i>Salmonidae</i>	Cutthroat Trout	CT
<i>Salmonidae</i>	Salmon (General)	SA
<i>Salvelinus confluentus</i>	Bull Trout	BT
<i>Salvelinus fontinalis</i>	Brook Trout	EB
<i>Salvelinus malma</i>	Dolly Varden	DV
<i>Salvelinus namaycush</i>	Lake Trout	LT



## 5 METHODS

To identify priorities for crossing structure rehabilitation, a literature and PSCIS database review was conducted for the Alouette River watershed and data was analyzed within the Fish Habitat Model developed by Hillcrest Geographics and the BC Ministry of Environment (MoE 2016). The Fish Habitat Model identifies potential stream crossing locations and models known and potential fish habitat based on gradient. Gradient is calculated at intervals along a stream of at least 100 m to delineate segments based on a set of user provided gradient thresholds (MoE 2016). Following segment delineation, the average gradient of each segment is calculated and used to symbolize potential fish habitat as riffle/cascade, step-pool, or step-pool very steep, according to a set of average stream slope categories (0 - 5%, 6 - 13% and 13– 20%).

Past fish passage assessment reports for the Alouette River watershed were first reviewed to identify crossing structure barriers previously ranked as high or moderate priorities for rehabilitation. All previously prioritized crossings underwent a detailed review. To identify previously un-prioritized crossing structure barriers located on potentially high value streams, road crossing structures that met the following criteria in the Fish Habitat Model and/or PSCIS database also underwent a detailed review.

- Stream crossing barriers and potential barriers on streams with confirmed fish presence upstream of the structure.
- Stream crossing barriers and potential barriers on streams documented as  $\geq 1.5\text{m}$  wide with linear lengths of modelled upstream habitat  $<20\%$  gradient for  $\geq 100\text{ m}$ .
- Stream crossing barriers and potential barriers located on streams classified as 3<sup>rd</sup> order or higher.
- Stream crossing barriers and potential barriers located on streams with  $>1\text{ ha}$  of modelled wetland and/or lake habitat upstream of the structure.
- Stream crossing barriers and potential barriers on streams with habitat value rated as “high” in past fish passage assessment data. Habitat value ratings are assigned during fish passage assessments and are defined in the *Field Assessment for Determining Fish Passage Status of Closed Bottom Structures* (MoE 2011, Table 2).

Table 2. Habitat Value Criteria.

Habitat Value	Fish Habitat Criteria
High	<ul style="list-style-type: none"> <li>• The presence of high value spawning or rearing habitat (e.g., locations with abundance of suitably sized gravels, deep pools, undercut banks, or stable debris), which are critical to the fish population.</li> </ul>
Medium	<ul style="list-style-type: none"> <li>• Important migration corridor.</li> <li>• Presence of suitable spawning habitat.</li> <li>• Habitat with moderate rearing potential for the fish species present.</li> </ul>
Low	<ul style="list-style-type: none"> <li>• The absence of suitable spawning habitat, and habitat with low rearing potential (e.g., locations without deep pools, undercut banks, or stable debris, and with little or no suitably sized spawning gravels for the fish species present).</li> </ul>

Adapted from: MoE 2011

Crossing structures that underwent the detailed review were ranked for further assessment as either high priority, medium priority, low priority, or “no fix”, based on past assessment information, available fisheries data as well as upstream potential habitat quantity and quality. A combination of some or all of the following information was incorporated into this prioritization ranking:

- Contractor crossing prioritization in past fish passage assessment reports and data.
- Available fisheries data - Fish species present or suspected at the crossing location.
- Habitat quantity:
  - Stream width as documented in the PSCIS database as well as at nearby sample sites documented within the Fisheries Information Summary System (FISS).
  - Linear length of modelled upstream potential habitat (<20%). Consideration was given to the “net” amount of habitat available upstream which is defined as habitat upstream of the crossing uninterrupted by subsequent barrier road crossing structures.
  - Area of modelled wetland and/or lake habitat upstream of the structure connected to crossing location by contiguous modelled gradients <20%.
- Habitat quality:
  - Past crossing assessment and nearby FISS stream sample site comments regarding habitat quality, slope information in PSCIS/FISS databases and project reports as well as apparent habitat quality in site photos.
  - Modelled threshold gradient and average gradient outputs of upstream potential habitat generated by the Fish Habitat Model were also reviewed which is discussed in more detail below.

Gradient is a key factor in fish distribution and channel type. High value rearing, overwintering and spawning habitat is often located within channel types with lower gradients, while high gradient sections typically present upstream migration barriers and less available habitat. For this reason, waterbody segments in the Alouette River watershed were delineated and categorized into gradient categories using the Fish Habitat Model. The model outputs were used to identify potential gradient barriers as well as to help prioritize rehabilitation opportunities by estimating the slope and quantity of potential fish habitat upstream of a crossing.

The Fish Habitat Model utilized stream segments from the GIS stream layer (1:20,000) of the Freshwater Atlas for its gradient analysis (MoE 2016). For this project, the gradient categories detailed in Table 3 were utilized to delineate and classify habitat. The model starts at the mouth of a stream and iterates through each vertex of the stream flow line, calculating the gradient between the given vertex and the next vertex at least 100m upstream. It delineates additional stream segments at locations where the gradient exceeded the defined thresholds. Following delineation, the average gradient of each stream layer segment located within potential fish habitat was calculated with results classified according to the channel type categories. Finally, for potential habitat upstream of each crossing, stream lengths were

summed within the average gradient categories with total areas of wetland and lake habitat also calculated.

Table 3. Stream gradient threshold and average gradient categories generated from the Fish Habitat Model and associated channel type.

<b>*Gradient Range</b>	<b>Channel Type</b>
0 – 5%	Riffle and cascade pool
6 – 13%	Step pool
14 – 20%	Step pool - very steep
>20%	Non fish habitat

\*Rounded to the nearest percent

Gradient threshold and average gradient categories were rounded to the nearest percent. Segments downstream of sections up to 13% grade were delineated and classified according to channel type groupings adapted from the British Columbia Channel Assessment Procedure Guidebook which include riffle and cascade pool and step-pool (FPC 1996, Table 3). Stream segments with sections containing gradients from 14 – 20% were classified as step pool - very steep. Stream segments upstream of 100 m sections with an average gradient >20% were considered non fish habitat. Although fish have been reported to utilize habitat with gradients up to 30% (Baxter 1999), a cutoff of 20% was used as the goal was to identify and prioritize crossing rehabilitation opportunities. Stream segments with gradients between 20-30% are extremely steep and do not typically provide high value spawning or rearing habitat.

## 6 RESULTS

In the Alouette River watershed, 72 crossing structure assessments are catalogued within the PSCIS database (Table 4). Of these, 58 crossings are located on modelled fish habitat. For these crossings, 27 are documented as barriers and 5 are assessed as potential barriers and 26 are considered passable. Maps are provided as Attachment 1.

Table 4. Summary of PSCIS crossings within the Alouette River watershed.

<b>PSCIS Stream Crossings</b>	<b>Barrier</b>	<b>Potential</b>	<b>Passable</b>	<b>Total</b>
Modelled as on potential fish habitat	27	5	26	<b>58</b>
Modelled as on non-fish habitat	5	0	1	<b>6</b>
No modelling data (not on mapped stream)	5	1	2	<b>8</b>
<b>Total</b>	<b>37</b>	<b>6</b>	<b>29</b>	<b>72</b>

A detailed review and prioritization ranking was conducted for 34 crossings structures identified as requiring further assessment according to the criteria identified in the methodology (Table 5). Of these, nine crossings were rated as high priority for follow up with habitat confirmation assessments and potentially fish inventories (Tables 5 - 6). Eight crossings were rated as moderate priority for follow up

with habitat confirmation assessments and potentially fish inventories (Table 5, Table 7). Sixteen crossings were rated as low priority for follow up with habitat confirmation assessments and potentially fish inventories (Table 5, Appendix 3) and one crossing was rated as “no fix” (Table 5, Appendix 4). Available links to photos stored in the PSCIS database are provided in the “Stream” column of priority tables.

The location of 95 potential crossing structures on modelled fish habitat that do not yet have associated PSCIS assessment information has been included in Appendix 4. Of note, a number of crossings that were not assessed during the assessments conducted by MEC in 2011 (Masse 2012) have detail related to why they were not assessed in the “comments” column of the Appendix 4 table. A detailed digital summary of all PSCIS barrier and potential barrier crossings and modelled crossings on streams modelled as observed fish bearing or potentially fish bearing is provided as Attachment 2. A key to the data included in Attachment 2 is detailed in Appendix 5.

To date Phase 1 - Fish Passage Assessments have been conducted throughout most of the major potential fish bearing Alouette River watershed areas. Areas still requiring assessment of crossings are primarily within the University of British Columbia (UBC) Malcolm Knapp Research Forest and behind gates controlled by BC Hydro (Masse 2012, Appendix 4).

Table 5. Summary of crossings that underwent a detailed review and associated prioritization ranking. Maps provided as Attachment 1.

<b>Category</b>	<b>Number of Crossings</b>	<b>Location</b>	<b>Comments</b>
High priority crossings	9	Table 6	Habitat confirmation and potential fish inventory recommended as high priority.
Moderate priority crossings	8	Table 7	Fish habitat confirmation with potential fish inventory recommended as moderate priority.
Low priority crossings	16	Appendix 1	Fish habitat confirmation with potential fish inventory recommended as low priority.
No fix	1	Appendix 2	Likely non-fish bearing or passable. Follow up not recommended
<b>Total</b>	<b>34</b>		

Table 6. High priority crossings for habitat confirmation.

PSCIS ID	Map ID	Stream	Road	UTM (10U)	<sup>1</sup> Habitat Gain (km)	Lake/Wetland (ha)	Stream Width (m)	Species upstream	<sup>1</sup> Road Tenure	Habitat Value	Comments
51722	092G109	<a href="#">Trib to Spring Ck</a>	Anderson	530516 5455934	2.1		3.4		Local	Medium	Assessment comments indicate highly turbid downstream but clear upstream and abundant gravels present with overhanging vegetation cover throughout. Could provide good refuge and rearing habitat for salmonids.
51785	092G109	<a href="#">Viking Ck</a>	Spur	539006 5463516	0.5		6.5		Recreation	Medium	Larger stream. Could provide BT rearing.
51786	092G109	<a href="#">Viking Ck</a>	Spur	539150 5463467	0.7		9.3		Unknown	Medium	Larger stream. Could provide BT rearing.
51824	092G109	<a href="#">Trib to N. Alouette</a>	233 St	530868 5454677	3.1		2.8		Local	High	Stream appears to be engineered for spawning at this location. Coho observed spawning during 2011 assessment. Assessment comments indicate fully embedded but does not appear so in photos. Suspect barrier to juvenile salmonids at most flows.
51844	092G109	<a href="#">Trib to Alouette</a>	216 Ave	527489 5454253	2.5		2.3	CO,CT,L,TSB	Arterial	Medium	Provides access to 1.2 km of potential rearing habitat before next crossing.
51908	092G109	<a href="#">Trib to Kanaka Ck</a>	240th	532243 5452636	2.2		3.3		Local	High	Larger channel size and low gradient above crossing.
54136	092G109	<a href="#">Trib to Spring Ck</a>	111 Ave	530776 5456301	1.6		2.2		Local	Medium	Assessment comments indicate highly turbid downstream of crossing 51722 with clear flows here. Could provide good refuge habitat for juvenile salmonids.
62316	092G109	<a href="#">McKenny Ck</a>	Dewdney Trail and 208 St	525815 5452042	0.5		2.8	C,CC,CCT,CO,CT,L,PMB,SP,TSB	Arterial	Medium	Prioritized (MEC 2012). Good potential for CO rearing and overwintering upstream.
62321	092G109	<a href="#">McKenny Ck</a>	Loughhead Hwy	526051 5451706	0.1		2.4	C,CC,CCT,CO,CT,L,PMB,SP,TSB	MoTI	Medium	Good potential for CO rearing and overwintering upstream.

<sup>1</sup>Habitat Gain – a modelled estimate of continuous linear distance of fish habitat (<20% gradient) located immediately upstream of the crossing. <sup>2</sup>DCK = District Manager Chilliwack (FLNRORD).

Table 7. Moderate priority crossings for habitat confirmation.

PSCIS ID	Map ID	Stream	Road	UTM (10U)	<sup>1</sup> Habitat Gain (km)	Lake/Wetland (ha)	Stream Width (m)	Species upstream	<sup>1</sup> Road Tenure	Habitat Value	Comments
51787	092G109	<a href="#">Viking Ck</a>	Golden Ears Park Rd	538791 5463494	0.3		6.1		Local	Medium	Large stream width. In park. Good rearing habitat.
51816	092G109	<a href="#">Trib to N. Alouette</a>	136 Ave	530452 5455258	0.4		1.1		Local	Medium	Assessment comments indicate good habitat. Unassessed modelled crossings downstream.
51825	092G109	<a href="#">Trib to N. Alouette</a>	Balsam St	531034 5454636	2.9		1.8		Local	High	Prioritized (MEC 2012). Assessment comments indicate excellent spawning habitat and log structures built into stream to form spawning channel upstream. Photos indicate natural barriers to small juveniles.
51882	092G109	<a href="#">W Ck</a>	126 Ave	527757 5453221	1.3		1.7		Local	Medium	Low gradient stream. Assessment comments indicate abundant overhanging vegetation and undercut banks for cover.
51893	092G109	<a href="#">Balabanian Ck</a>	Abernethy Rd	530332 5452894	1.3		3	CO,L,RB	Collector	Low	CO upstream. Assessment comments indicate low habitat value, but appears decent in photos.
51894	092G109	<a href="#">Trib to Balabanian Ck</a>	124 Ave	530891 5452845	0.7		2.7	CO	Local	Low	Habitat value rated low and assessment comments indicate potentially passable.
51905	092G109	<a href="#">W Ck</a>	4767304	527837 5452855	0.9		1.5		Collector	Low	Assessment comments indicate passable but appears to be barrier to some life stages/species in photos.
52080	092G109	<a href="#">Trib to Alouette R</a>	East Alouette	537802 5459755			2.2		Unknown	Low	Unmapped stream with likely steep gradients upstream but could be explored.

<sup>1</sup>Habitat Gain – a modelled estimate of continuous linear distance of fish habitat (<20% gradient) located immediately upstream of the crossing. <sup>2</sup>DCK = District Manager Chilliwack (FLNRORD).

## 7 DISCUSSION AND CONCLUSION

Previously identified crossings that are barriers to fish passage in the Alouette watershed were prioritized based on past assessment information, available fisheries data as well as estimated upstream habitat quality and quantity. The results provide a planning tool to help guide further assessment and restoration of crossings. It should be noted that the methodology used for this analysis is one of many possible approaches that incorporates assumptions about the value of fish habitat based on limited data, inferred quantities as well as somewhat subjective interpretations of habitat quality.

A detailed review and prioritization ranking was conducted for 34 crossings structures identified as requiring further assessment according to the criteria identified in the methodology. Of these, nine crossings were rated as high priority for follow up with habitat confirmation assessments and potentially fish inventories. Eight crossings were rated as moderate priority for follow up with habitat confirmation assessments and potentially fish inventories. Sixteen crossings were rated as low priority for follow up with habitat confirmation assessments and potentially fish inventories and one crossing was rated not recommended for follow up "no fix".

To date Phase 1 - Fish Passage Assessments have been conducted throughout most of the major potential fish bearing Alouette River watershed areas. Areas still requiring assessment of crossings are primarily within the University of British Columbia (UBC) Malcolm Knapp Research Forest and behind gates controlled by BC Hydro (MEC 2012). Access to these areas will need to be arranged as part of the field planning for assessments on modelled crossings located on stream reaches identified as fish bearing or potentially fish bearing.

The location of 95 potential crossing structures on modelled fish habitat that do not yet have associated PSCIS assessment information has been included in Appendix 4. Of note, a number of crossings that were not assessed during the assessments conducted by MEC in 2011 (Masse 2012) have detail related to why they were not assessed in the "comments" column of the Appendix 4 table. Assessment of crossings not yet assessed is recommended and should be conducted according to FPTWG protocols. The FPTWG has prepared [on-line training resources](#), [field work guidance](#), [field assessment protocols and data forms](#) to help guide the collection of data and submission of [assessment deliverables](#).

Phase 2: Habitat confirmation checks conducted according to [protocols](#) developed by the FPTWG (MoE 2011) are recommended for the crossings rated as high priority. Habitat confirmation checks gather detailed field and background data on habitat quality and quantity, fisheries values, land use issues and regional fisheries concerns. This information is then incorporated into a [standardized reporting format](#) to further refine priority rankings and focus [design](#) (Phase 3) and [remediation](#) (Phase 4) on fish passage restoration opportunities into areas of critical habitat for species of interest.

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**Appendix 1**

Low Priority Crossings



Analysis and Priority Identification for Fish Existing Passage Data - Alouette River Watershed

PSCIS ID	Map ID	Stream	Road	UTM (10U)	<sup>1</sup> Habitat Gain (km)	Lake/Wetland (ha)	Stream Width (m)	Species upstream	<sup>1</sup> Road Tenure	Habitat Value	Comments
54116	092G109	<u>Mike Lk Cr</u>	Mike Lake Rd	533991 5457845	3.3	12.1	6	CT, RB, SB, TSB	Unknown	High	Prioritized (MEC 2012). Mislabeled as moderate priority on map. Average slope of stream at confluence with Alouette River modelled at 28%. Suspect lake upstream stocked and fish not historically able to migrate to crossing.
51839	092G109	<u>N. Millionaire Cr</u>	130 Ave	532132 5454178	5.3		3	CT, RB	Local	Medium	Very steep. Fish use unlikely.
54135	092G109	<u>Mill Lk outflow</u>	Golden Ears Park Rd	534343 5456242	3.3	12.1	7	CT, RB, SB, TSB	Local	High	Prioritized (MEC 2012). Average slope of stream at confluence with Alouette River modelled at 28%. Suspect lake upstream seeded with fish and fish not historically able to migrate to crossing.
51867	092G109	<u>Trib to Alouette</u>	127 Ave	528925 5453400	1.9		0.5		Local	Low	Highly modified channel into ditch.
52061	092G109	<u>Trib to Alouette</u>	Abernethy Rd	528929 5453341	1.8		1		Local	Low	Assessment comments and photos indicate poor habitat value.
51904	092G109	<u>Trib to Alouette</u>	124th Ave	528615 5452849	1		2.2		Collector	Low	Assessment comments indicate 1m lock block retaining wall barrier located 50 m upstream of crossing
51899	092G109	<u>Latimer Cr</u>	12396-244 St	533048 5452703	0.8		0.5		Local	Low	Very small stream and assessment comments indicate "no habitat" upstream.
51903	092G109	<u>Trib to Alouette</u>	124th Ave	528941 5452848	0.6		1.5		Collector	Low	Stream goes subsurface downstream. Garbage and sediments in stream.
51880	092G109	<u>Legion Cr</u>	Abernethy Rd	529224 5453190	0.6		3		Collector	Low	Outflow on private property behind barbwire fence.
51902	092G109	<u>Trib to Alouette R</u>	corner of 124 and 224 Ave	529075 5452838	0.5		2		Local	Low	Muddy substrate, poor habitat, low flows.
52066	092G109	<u>Trib to Alouette R</u>	East Alouette	535289 5456452	0.3	2.4	2.5		Unknown	Low	Stream models as >20% gradient at 170 m upstream. Habitat value rated low.
51900	092G109	<u>Legion Cr</u>	22505-124 Ave	529303 5452846	0.3		2		Local	Low	Assessment comments and photos indicate poor habitat value.

Analysis and Priority Identification for Fish Existing Passage Data - Alouette River Watershed

PSCIS ID	Map ID	Stream	Road	UTM (10U)	<sup>1</sup> Habitat Gain (km)	Lake/ Wetland (ha)	Stream Width (m)	Species upstream	<sup>1</sup> Road Tenure	Habitat Value	Comments
51793	092G109	<u>Trib to Alouette R</u>	Golden Ears Park Rd	538187 5462777	0.2		2.1		Local	Low	Dry steep stream.
54100	092G109	<u>Trib to Alouette R</u>	4197959	536645 5458311	0.1		2.1		Unknown	Low	Small modelled potential habitat gain.
52081	092G109	<u>Trib to Alouette R</u>	East Alouette	537506 5459381			2		Unknown	Low	Steeper unmapped stream with no fix recommended in assessment comments.
51843	092G109	<u>N. Millionaire Cr</u>	139 Ave	532116 5454053			0.7		Local	Medium	Narrow channel with little fish habitat. Gradient 20% downstream of culvert.

<sup>1</sup>Habitat Gain – a modelled estimate of continuous linear distance of fish habitat (<20% gradient) located immediately upstream of the crossing. <sup>2</sup>DCK = District Manager Chilliwack (FLNRORD).

**Appendix 2**

Crossings with No Fix Recommended





Analysis and Priority Identification for Fish Existing Passage Data - Alouette River Watershed

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<b>PSCIS ID</b>	<b>Map ID</b>	<b>Stream</b>	<b>Road</b>	<b>UTM (10U)</b>	<b><sup>1</sup>Habitat Gain (km)</b>	<b>Lake/ Wetland (ha)</b>	<b>Stream Width (m)</b>	<b>Species upstream</b>	<b><sup>1</sup>Road Tenure</b>	<b>Habitat Value</b>	<b>Comments</b>
52079	092G109	Trib to Alouette R	East Alouette	535659 5457694			2.4		Unknown	High	Access to coho spawning/rearing area. Appears functional for purpose.

<sup>1</sup>Habitat Gain – a modelled estimate of continuous linear distance of fish habitat (<20% gradient) located immediately upstream of the crossing..



**Appendix 3**

Unassessed Modelled Crossings



Analysis and Priority Identification for Fish Existing Passage Data - Alouette River Watershed

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	<sup>1</sup> Habitat Gain (km)	Lake/ Wetland (ha)	Species Upstream	<sup>2</sup> Road Tenure	<sup>3</sup> Comments
10300863	092G109		121A Ave	530655 5452291	0.2			Local	No crossing.
10300865	092G109		Abernethy Way	530109 5452941	0.1			Collector	Not assessed, does not exist, subdivision.
10300866	092G109		128 Ave	530188 5453658	2.7		CM,CO,CT,L,PK,RB	Collector	Not assessed, could not find crossing.
10300871	092G109	McKenny Ck	123 Ave	525765 5452672	1.2		C,CC,CCT,CO,CT,L,PMB,SP,TSB	Collector	
10300878	092G109		Acadia St	527966 5452183	0.1			Local	No crossing present.
10300879	092G109		Mountainview Cres	527902 5452398	0.4			Local	No crossing present.
10300880	092G109		122 Ave	528489 5452451	0.4			Local	
10300883	092G109		122 Ave	528918 5452447	0.2			Local	No crossing.
10300884	092G109		224 St	529031 5452871	0.5			Arterial	
10300888	092G109		124 Ave	529039 5452847	0.5			Local	
10300889	092G109		128 Ave	527770 5453661	1.7		L,TSB	Local	
10300891	092G109		122 Ave	530623 5452441	0.8		CO,L,RB	Local	Not assessed, no define channel upstream.
10300892	092G109		232 St	530639 5452419	0.7		CO,L,RB	Arterial	No crossing.
10300893	092G109		124B Ave	530100 5453010	0.1			Local	Not assessed, does not exist, subdivision.
10300894	092G109		125A Ave	530086 5453104	0.2			Local	Not assessed, does not exist, subdivision.
10300895	092G109		126 Ave	530079 5453194	0.3			Local	Not assessed, does not exist, subdivision.
10300900	092G109		232B St	530818 5452324	0.2			Local	No crossing.
10300932	092G109		Fenton Rd	522614 5457260	1.3			Local	
10300939	092G109		232 St	530565 5455004	0.7			Local	No crossing. Stream seems to flow south.
10300940	092G109		130 Ave	532178 5454054	5.4		CT,RB	Local	
10300945	092G109		216 St	527483 5454215	2.4		CO,CT,L,TSB	Arterial	
10300951	092G109		Abernethy Way	528974 5453282	1.8			Local	
10300952	092G109		224 St	529065 5456091	1.6		CO,SB,TSB	Local	
10300954	092G109	Donegani Ck	224 St	529309 5457251	7.8		LNC,LSU	Local	Private. Gated. No access.

Analysis and Priority Identification for Fish Existing Passage Data - Alouette River Watershed

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	<sup>1</sup> Habitat Gain (km)	Lake/Wetland (ha)	Species Upstream	<sup>2</sup> Road Tenure	<sup>3</sup> Comments
10301040	092G109		Golden Ears Park Rd	538020 5462590	0.2			Local	
10301044	092G109		216 St	527473 5455317	0.1		SB,TSB	Local	
10301346	092G109		239B St	532106 5454253	5.2		CT,RB	Local	Not assessed, does not exist.
10301381	092G109		Foreman Dr	530037 5455558	0.1			Local	No crossing.
10301476	092G109		Anderson Creek Dr	530488 5455980	2.2			Local	
10301696	092G109		144 Ave	528317 5457021	1.7			Local	Private. Gated. No access.
10301865	092G109		Rock Ridge Dr	531349 5454969	2.4			Local	
10301866	092G109		235A St	531336 5454960	2.4			Local	
10302121	092G109		127 Ave	528972 5453405	1.9			Local	
10302136	092G109		216 St	527490 5455277	2.8		BH,CO,CT,L,SB	Local	
10302197	092G109		Neaves Rd	525855 5457476	1.2		SB	Collector	
10302397	092G109		Anderson Creek Dr	530342 5456051	2.3			Local	Not assessed, no road.
10302425	092G109		235 St	531224 5454894	2.6			Local	No crossing.
10302603	092G109	Donegani Ck		529396 5457976	7		LNC,LSU	Unclassified	UBC Malcolm Knapp Research Forest
10302852	092G109			530730 5456555	1.4			Unclassified	Not assessed, 142 does not go through.
10302886	092G109	Blaney Ck		530433 5460194	13		CH,CT,DV,RB	Unclassified	UBC Malcolm Knapp Research Forest
10302887	092G109			530725 5459768	0.5			Unclassified	UBC Malcolm Knapp Research Forest
10302897	092G109	Donegani Ck		529502 5458839	2.1			Unclassified	UBC Malcolm Knapp Research Forest
10302898	092G109			529384 5459075	0.6			Unclassified	UBC Malcolm Knapp Research Forest
10303448	092G109			530526 5460951	1			Unclassified	UBC Malcolm Knapp Research Forest
10303459	092G109			532146 5458926	1.5			Unclassified	
10303460	092G109			530918 5462561	0.5			Unclassified	
10303461	092G109			530808 5462901	0.1			Unclassified	
10303517	092G109			532355 5456453	1			Unclassified	UBC Malcolm Knapp Research Forest
10303518	092G109			532327 5456499	0.7			Unclassified	UBC Malcolm Knapp Research Forest

Analysis and Priority Identification for Fish Existing Passage Data - Alouette River Watershed

<b>Crossing ID</b>	<b>Map ID</b>	<b>Stream Name</b>	<b>Road Name</b>	<b>UTM (10U)</b>	<b><sup>1</sup>Habitat Gain (km)</b>	<b>Lake/ Wetland (ha)</b>	<b>Species Upstream</b>	<b><sup>2</sup>Road Tenure</b>	<b><sup>3</sup>Comments</b>
10303519	092G109			532384 5456421	1.6			Unclassified	UBC Malcolm Knapp Research Forest
10303521	092G109			532985 5456320	1.3			Unclassified	UBC Malcolm Knapp Research Forest
10303524	092G109			529626 5457303	0.9			Unclassified	UBC Malcolm Knapp Research Forest
10303525	092G109			531075 5457184	0.6			Unclassified	UBC Malcolm Knapp Research Forest
10303526	092G109	Donegani Ck		529107 5457181	8		LNC,LSU	Unclassified	UBC Malcolm Knapp Research Forest
10303527	092G109	Donegani Ck		529403 5457713	7.3		LNC,LSU	Unclassified	UBC Malcolm Knapp Research Forest
10303529	092G109			531234 5457424	0.3			Unclassified	Not assessed, Hemlock Rd does not go through.
10303530	092G109			533251 5457871	0.4			Unclassified	UBC Malcolm Knapp Research Forest
10303531	092G109			532067 5458625	1.8			Unclassified	
10303538	092G109			528935 5456846	2.4		CO,CP,PCC,SB,TSB	Unclassified	
10303539	092G109			527517 5456214	5.5		BH,CO,CT,L,SB	Unclassified	
10303559	092G109			533114 5459635	0.6			Unclassified	
10303561	092G109			529804 5458427	1.5		LNC,LSU	Unclassified	UBC Malcolm Knapp Research Forest
10303569	092G109			524608 5456800	4.1		SB,TSB	Unclassified	
10303570	092G109			524585 5456812	4.1		SB,TSB	Unclassified	
10303571	092G109			524240 5457150	4.6		SB,TSB	Unclassified	
10303583	092G109			528012 5456488	0.5			Unclassified	Irrigation canals. Road not passable (too muddy).
10303588	092G109			531700 5456657	0.6			Unclassified	
10303589	092G109	Spring Ck		529959 5456990	5.3			Unclassified	UBC Malcolm Knapp Research Forest
10303590	092G109	Loon Ck		530458 5460796	5.2		CT,DV	Unclassified	UBC Malcolm Knapp Research Forest
10303595	092G109			529670 5457623	0.5			Unclassified	UBC Malcolm Knapp Research Forest
10303596	092G109			532051 5456867	2.6		CT,RB	Unclassified	UBC Malcolm Knapp Research Forest
10303597	092G109			531727 5456895	0.4			Unclassified	UBC Malcolm Knapp Research Forest
10303609	092G109			531384 5460765	5.8		CT	Unclassified	UBC Malcolm Knapp Research Forest
10303610	092G109			530915 5457057	0.8			Unclassified	UBC Malcolm Knapp Research Forest
10303611	092G109			532317 5458111	1.2		CT,RB	Unclassified	

Analysis and Priority Identification for Fish Existing Passage Data - Alouette River Watershed

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	<sup>1</sup> Habitat Gain (km)	Lake/Wetland (ha)	Species Upstream	<sup>2</sup> Road Tenure	<sup>3</sup> Comments
10303612	092G109			532652 5458482	0.5		CT,RB	Unclassified	
10303654	092G109			539903 5466138	0.7			Unclassified	
10303655	092G109			539957 5466515	0.8			Unclassified	
10303657	092G109	North Alouette R		532994 5461298	7.2	15.1		Unclassified	
10303660	092G109			539736 5468039	0.1			Unclassified	
10303673	092G109			529245 5462682	0.1			Unclassified	
10303674	092G109	Mayfly Ck		532971 5462892	0.1			Unclassified	
10303695	092G109			531626 5462416	0.5			Unclassified	
10303711	092G109			531193 5462204	1.4			Unclassified	
10303767	092G109	Fenton Road Slough		523972 5457431	6.5			Unclassified	No road access.
10303768	092G114			538122 5476147	0.4			Unclassified	Boat access only
10303908	092G109			531498 5463249	0.7		CT	Unclassified	
10303911	092G109			524244 5457392	0.9			Unclassified	
10304098	092G109		236 St	531422 5455039	2.3			Local	
10304111	092G109		Gilbert Dr	530154 5455535	0			Local	No crossing.
10304176	092G109			532317 5454155	10.1				
10304196	092G109	North Alouette R		530799 5455115	25	15.1	CM,CO	Resource	No crossing.
10304215	092G109	North Alouette R		530842 5455065	26	15.1	CM,CO	Resource	No crossing.
10304228	092G109	North Alouette R		530780 5455146	24.9	15.1	CM,CO	Resource	No crossing.
10304809	092G109	McKenzie Ck	3	528718 5459408	0.2			UBC	Private. Gated.

<sup>1</sup>Habitat Gain – a modelled estimate of continuous linear distance of fish habitat (<20% gradient) located immediately upstream of the crossing. <sup>2</sup>DCK = District Manager Chilliwack(FLNRORD), UBC = University Of British Columbia, WCL = Weyerhaeuser Co. Ltd. <sup>3</sup>Comments from Masse 2012





**Appendix 4**

Key to Attachment 2 - Digital Summary of PSCIS and Modelled Crossings



Table heading	Column Name (BC data distribution)	Details/attribute	Source/URL
crossing_id / stream_crossing_id	stream_crossing_id	Unique crossing ID	Fish Habitat Model / <a href="#">pscis-assessments</a>
map_tile	map_tile	1:50,00 mapsheet	<a href="#">nts-50k-grid-digital-baseline-mapping-at-1-50-000-nts</a>
stream_name	gnis_name	The BCGNIS (BC Geographical Names Information System) name associated with the GNIS feature id	<a href="#">freshwater-atlas-stream-network</a>
stream_order	stream_order	The calculated modified Strahler order.	<a href="#">freshwater-atlas-stream-network</a>
road_name	road_name_full or rfi_highway_description or road_section_id	Dependent on logic incorporating distance of modelled crossing to associated road layers and presence absence of forest tenure information	<a href="#">digital-road-atlas-dra-master-partially-attributed-roads</a> <a href="#">ministry-of-transportation-mot-road-features-inventory-rfi</a> <a href="#">forest-tenure-road-segment-lines</a>
fish_habitat_threshold_type_atc rossing		Stream threshold category of stream at crossing (ex. FISH HABITAT - INFERRED - 055-135PCT = no fish habitat downstream of crossing with gradient > 13.5% for more than 100m)	Fish Habitat Model <a href="#">freshwater-atlas-stream-network</a>
habitat_gain_threshold_sub035		Total linear length (m) of inferred or observed fish habitat upstream of the crossing that does not exceed 3.5% gradient for more than 100 m.	Fish Habitat Model <a href="#">freshwater-atlas-stream-network</a>
habitat_gain_threshold_sub05		Linear length (m) of inferred or observed fish habitat upstream of the crossing that does not exceed 5.5% gradient (cascade) for more than 100 m.	Fish Habitat Model <a href="#">freshwater-atlas-stream-network</a>
habitat_gain_threshold_sub13		Linear length (m) of inferred or observed fish habitat upstream of the crossing that does not exceed 13.5% gradient (step-pool) for more than 100 m.	Fish Habitat Model <a href="#">freshwater-atlas-stream-network</a>
habitat_gain_threshold_sub20		Linear length(m) of inferred or observed fish habitat upstream of the crossing that does not exceed 20.5% gradient (step pool – very steep) for more than 100 m.	Fish Habitat Model <a href="#">freshwater-atlas-stream-network</a>
*slope		Derived slope of stream at crossing (rise/run)	Fish Habitat Model <a href="#">freshwater-atlas-stream-network</a>
upstr_len_slope_0_035		Linear length (m) of inferred or observed fish habitat upstream of the crossing with average gradient $\leq 3.5\%$ (riffle).	Fish Habitat Model <a href="#">freshwater-atlas-stream-network</a>
upstr_len_slope_035_055		Linear length (m) of inferred or observed fish habitat upstream of the crossing with average gradient from 3.5 - 5.5% (cascade).	Fish Habitat Model <a href="#">freshwater-atlas-stream-network</a>

Table heading	Column Name (BC data distribution)	Details/attribute	Source/URL
upstr_len_slope_055_135		Linear length (m) of inferred or observed fish habitat upstream of the crossing with average gradient 5.5 - 13.5% (step-pool).	Fish Habitat Model <a href="#">freshwater-atlas-stream-network</a>
upstr_len_slope_135_205		Linear length(m) of inferred or observed fish habitat upstream of the crossing with average gradient 13.5 - 20.5% (step pool – very steep).	Fish Habitat Model <a href="#">freshwater-atlas-stream-network</a>
upstr_len_slope_sub_205		Total linear length(m) of inferred or observed fish habitat upstream of the crossing with average gradient < 20.5%.	Fish Habitat Model <a href="#">freshwater-atlas-stream-network</a>
lake_area_ha	area_ha	Total area of lake habitat upstream of crossing and stream segments modelled with habitat threshold <20.5%.	Fish Habitat Model <a href="#">freshwater-atlas-stream-network</a> <a href="#">freshwater-atlas-lakes</a>
wetland_area_ha	area_ha	Total area of wetland habitat upstream of crossing and stream segments modelled with habitat threshold <20.5%.	Fish Habitat Model <a href="#">freshwater-atlas-stream-network</a> <a href="#">freshwater-atlas-wetlands</a>
spp_upstream	species_code	Codes for fish species located on stream segments upstream of the subject crossing.	<a href="#">known-bc-fish-observations-and-bc-fish-distributions</a>
road_tenure	road_class client_name	Dependent on logic incorporating distance of modelled crossing to associated road layers and presence absence of forest tenure information as well as presence of key words in attribute names (ex. FSR is output when "FSR" contained within DRA layer attribute "road_name_full" when DRA layer attribute "road_class" = "resource").	<a href="#">digital-road-atlas-dra-master-partially-attributed-roads</a> <a href="#">ministry-of-transportation-mot-road-features-inventory-rfi</a> <a href="#">forest-tenure-road-segment-lines</a>
upstr_crossing_ids		Unique identifiers for all modelled or PSCIS crossings located upstream of the subject modelled crossing on stream segments modelled as <20.5% threshold.	Fish Habitat Model
dnstr_crossing_ids		Unique identifiers for all modelled or PSCIS crossings located downstream of the subject modelled crossing.	Fish Habitat Model
*habitat_value_code	habitat_value_code	Habitat value code assigned during PSCIS assessment.	<a href="#">pscis-assessments</a>
*Prioritized		Reference to assessment report where crossing was prioritized.	
*assessment_comment	assessment_comment	Assessment comments recorded in database from PSCIS assessment.	<a href="#">pscis-assessments</a>
*image_view_url	image_view_url	Link to photos taken during PSCIS assessment.	<a href="#">pscis-assessments</a>

\*PSCIS summary only