



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



Prepared for:

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Cover photo – Crossing 51891 over tributary to Hayward Reservoir. 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 Stave 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 Stave 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 white sturgeon and 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 Stave 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 43 crossings structures identified as requiring further assessment according to the criteria identified in the methodology. Of these, 16 crossings were rated as high priority for follow up with habitat confirmation assessments and potentially fish inventories. Twelve crossings were rated as moderate priority for follow up with habitat confirmation assessments and potentially fish inventories. Nine crossings were rated as low priority for follow up with habitat confirmation assessments and potentially fish inventories and six crossing were rated as “no fix”.

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.

The location of 149 potential crossing structures on modelled fish habitat that do not yet have associated PSCIS assessment information has been included in the report. Of note, a number of crossings that were previously not assessed were behind locked gates, on inaccessible private land or were on deactivated roads impassable for 4-wheel drive. 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. 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.

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 Stave 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 Stave River watershed. The Stave 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 - Conservation Section and the Fish and Wildlife Compensation Program (FWCP) – Coast Region. These objectives are included in the Stave 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 white sturgeon (*Acipenser transmontanus*) and resident salmonids.
- Maintain or improve opportunities to sustainably use ecosystem values for sustenance, social, ceremonial, recreational and commercial purposes.

To date, within the Stave River watershed, 129 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 Stave 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 Stave 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 Stave River watershed is located approximately 70 km east of Vancouver (Figure 2). The Stave River system is located within the traditional territory of the Katzie and Kwantle First Nations. The lower Stave

River flows through the communities of Maple Ridge and Mission. The northern part of the Stave Reservoir borders Golden Ears Provincial Park and the northern extent of the watershed is located within Garibaldi Provincial Park. Kwantlen First Nation’s reserves are located within the southern part of the watershed, as is privately owned suburban and agricultural land. The watershed is within the Chilliwack Natural Resource District.

The Alouette- Stave Falls – Ruskin generating complex is operated by BC Hydro and includes four dams, a 1,090 m long diversion tunnel and three powerhouses. Approximately 90% of the annual inflows to Alouette Lake Reservoir are diverted through the diversion tunnel to the Stave 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).

The Stave River is a 6th order stream that drains a watershed area of 1,013 km². Two thirds of the precipitation in the watershed falls between October and March driving flows in the watershed along with snow melt in the spring (Figure 1, FWCP 2017).

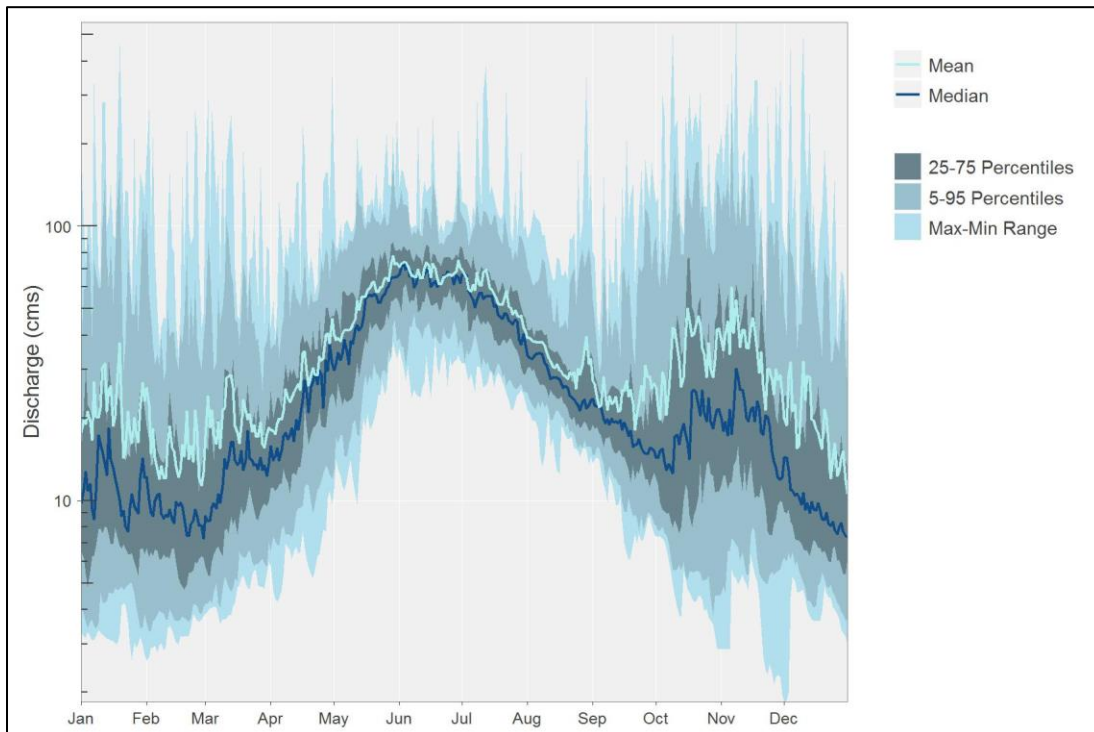


Figure 1. Stave River above Stave Lake (Station #08MH147 - Lat 49.55619 Lon -122.323067). Available daily discharge data from 1983 to 2014 plotted in R with fasstr (Goetz and Schwarz NA).

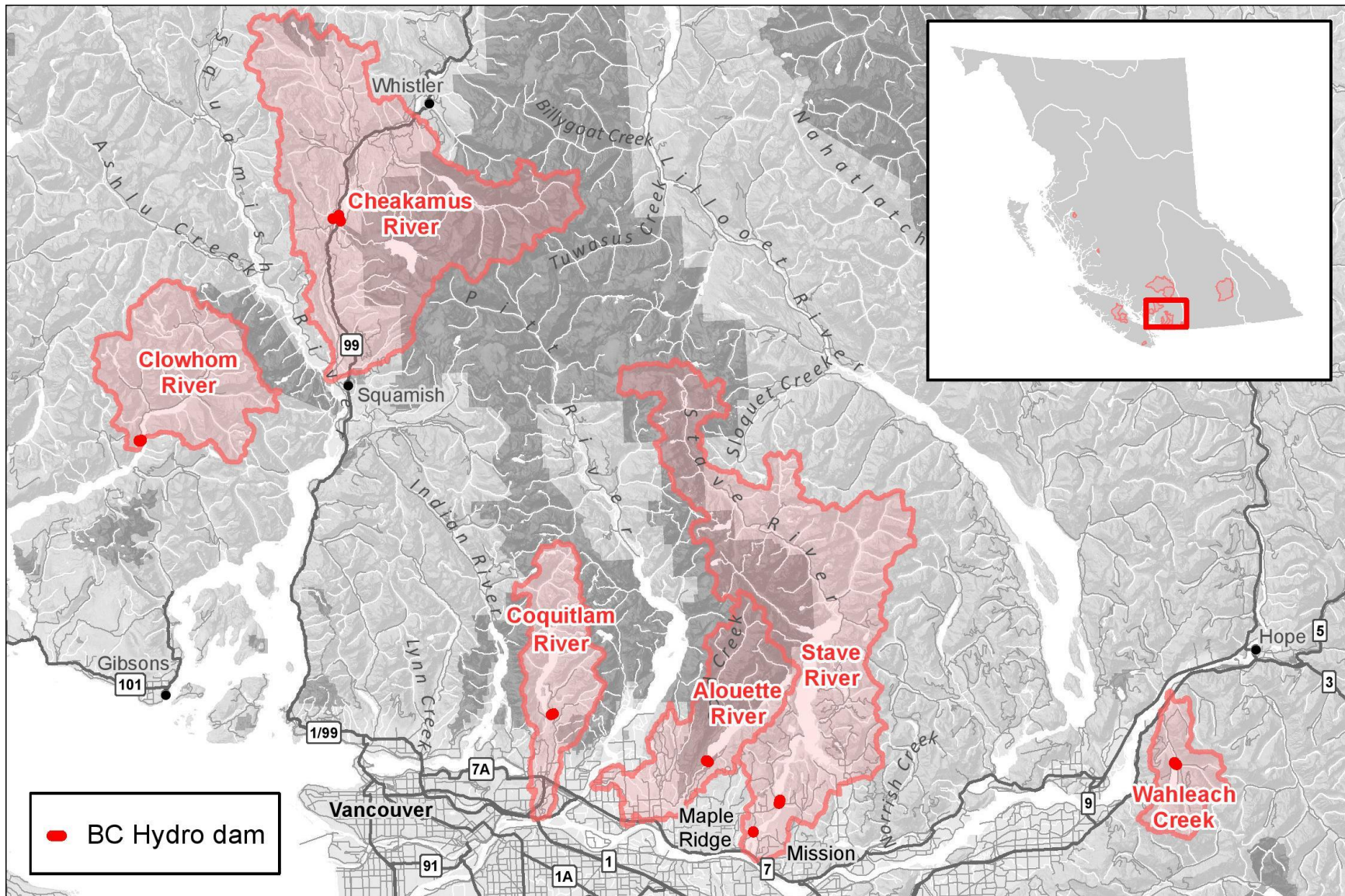


Figure 2. Map of study area.

4.1 Fisheries

Numerous fish species are present within the Stave River watershed, including anadromous steelhead (*Oncorhynchus mykiss*), white sturgeon 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). The Lower Fraser River population of white sturgeon is considered threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2012).

Construction of the Hayward dam blocked passage to the upper watershed for anadromous species. Additionally it flooded a historic river channel that was 6 km long. Before inundation, this section provided 2 km of spawning habitat for all salmonid species and the upper portions were likely suitable for steelhead parr rearing. There is some debate as to whether anadromous species were historically able to ascend above Stave Falls. Upstream of the Hayward Dam, resident fish species such as rainbow trout (*O. mykiss*), cutthroat trout (*O. clarki spp.*), bull trout (*Salvelinus confluentus*), kokanee (*O.nerka*), lamprey (*Lampetra spp.*), largescale sucker (*Catostomus macrocheilus*) and cyprinids occur above Stave Falls. There is some uncertainty to whether the char in the watershed are bull trout, dolly varden (*S. malma*) or a combination of both (FWCP 2017).

Numerous habitat restoration projects have been completed in the Stave River watershed by the Fraser Valley Watersheds Coalition. Among these are projects focusing on spawning habitat restoration as well as the creation of salmon overwintering and rearing habitat (FVWC 2009, 2016, 2017),

A large number of fish surveys have been completed within the Stave River watershed, with many of these focusing on anadromous species, or as part of studies on behalf of hydroelectric or mining development. Fish distribution information is also available from inventory surveys, including a reconnaissance inventory for the watershed completed in 1987 (Norris 1990). Stream classifications have also been completed for forestry in the watershed (Scott 1998a, 1998b, 1998c, 1998d, 1998e). These reports often identify barriers to fish passages.

Table 1. Fish species reported in the Stave River watershed (FISS 2018).

Scientific name	Species name	Species code
<i>Acipenser transmontanus</i>	White Sturgeon	WSG
<i>Ameiurus nebulosus</i>	Brown Catfish (formerly Brown Bullhead)	BNH
<i>Catostomidae</i>	Sucker (General)	SU
<i>Catostomus macrocheilus</i>	Largescale Sucker	CSU
<i>Cottus aleuticus</i>	Coastrange Sculpin (formerly Aleutian Sculpin)	CAL
<i>Cottus asper</i>	Prickly Sculpin	CAS
<i>Couesius plumbeus</i>	Lake Chub	LKC
<i>Cyprinidae</i>	Minnow (General)	C
<i>Esox lucius</i>	Northern Pike	NP
<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 richardsoni</i>	Western Brook Lamprey	BL
<i>Lepomis gibbosus</i>	Pumpkinseed	PMB
<i>Micropterus salmoides</i>	Largemouth Bass	LMB
<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>Richardsonius balteatus</i>	Redside Shiner	RSC
<i>Salvelinus confluentus</i>	Bull Trout	BT
<i>Salvelinus fontinalis</i>	Brook Trout	EB
<i>Salvelinus malma</i>	Dolly Varden	DV

5 METHODS

To identify priorities for crossing structure rehabilitation, a literature and PSCIS database review was conducted for the Stave 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, 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 Stave 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 3rd 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"> • 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.
Medium	<ul style="list-style-type: none"> • Important migration corridor. • Presence of suitable spawning habitat. • Habitat with moderate rearing potential for the fish species present.
Low	<ul style="list-style-type: none"> • 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).

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 Stave 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.

*Gradient Range	Channel Type
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 Stave River watershed, 129 crossing structure assessments are catalogued within the PSCIS database (Table 4). Of these, 83 crossings are located on modelled fish habitat. For these crossings, 35 are documented as barriers and 12 are assessed as potential barriers and 33 are considered passable and 3 are unknown (most likely fords and passable). Maps are provided as Attachment 1.

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

PSCIS Stream Crossings	Barrier	Potential	Passable	*Unknown	Total
Modelled as on potential fish habitat	35	12	33	3	83
Modelled as on non-fish habitat	16	2	15	5	38
No modelling data (not on mapped stream)	5	1	2	0	8
Total	56	15	50	8	129

*most commonly fords and passable

A detailed review and prioritization ranking was conducted for 43 crossings structures identified as requiring further assessment according to the criteria identified in the methodology (Table 5). Of these, 16 crossings were rated as high priority for follow up with habitat confirmation assessments and

potentially fish inventories (Tables 5 - 6). Twelve crossings were rated as moderate priority for follow up with habitat confirmation assessments and potentially fish inventories (Table 5, Table 7). Nine crossings were rated as low priority for follow up with habitat confirmation assessments and potentially fish inventories (Table 5, Appendix 3) and 6 crossing were 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 149 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 Masse Environmental Consultants in 2011 (Masse 2012) have detail related to why they were not assessed in the “comments” column of the Appendix 4 table. Many crossings were accessible by boat only in the upper watershed, were behind locked gates, on inaccessible private land or were on deactivated roads impassable for 4-wheel drive.

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 Stave 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.

Category	Number of Crossings	Location	Comments
High priority crossings	16	Table 6	Habitat confirmation and potential fish inventory recommended as high priority.
Moderate priority crossings	12	Table 7	Fish habitat confirmation with potential fish inventory recommended as moderate priority.
Low priority crossings	9	Appendix 1	Fish habitat confirmation with potential fish inventory recommended as low priority.
No fix	6	Appendix 2	Likely non-fish bearing or passable. Follow up not recommended
Total	43		

Table 6. High priority crossings for habitat confirmation.

PSCIS ID	Map ID	Stream	Road	UTM (9U)	¹ Habitat Gain (km)	Lake/Wetland (ha)	Stream Width (m)	Species upstream	¹ Road Tenure	Habitat Value	Comments
51837	092G110	Steelhead Ck	McCoomb Drive	549205 5453490	1		4.9		Local	Medium	Lake upstream. Assessment comments indicate nice habitat, gravels present.
51845	092G110	Steelhead Ck	Dwedney Trunk	549013 5453267	1.3		3.5		Collector	Medium	Lake upstream.
51847	092G109	Phillips Ck	Hudson Ave	543369 5453401	0.9		4.4		Local	Medium	Prioritized (Masse 2012). Beaver pond rearing areas upstream. Average gradients are low.
51853	092G110	trib to Steelhead Ck	12459 Dwedney Trunk	549177 5453023	8.8		3	CT	Collector	Medium	Large stream. Mapped as trib to Steelhead Ck. Assessment comments indicate candidate for instream substrate retention baffles.
51855	092G110	trib to Steelhead Ck	Dwedney Trunk	549170 5453008	8.8		7.3	CT	Collector	High	Prioritized (Masse 2012). Large stream. Mapped as trib to Steelhead Ck. Assessment comments indicate candidate for instream substrate retention baffles.
51865	092G109	Phillips Ck	Berg Ave	543147 5452878	1.4		2.5	CT	Local	High	Assessment comments indicate excellent spawning habitat.
51875	092G110	Steelhead Ck	Dwedney Trunk	549753 5452359	6.9		7	CT	Collector	High	Prioritized (Masse 2012). Large stream. Assessment comments indicate likely passable to larger fish and candidate for backwatering.
51891	092G110	Trib to Hayward Reservoir	Dewdney Trunk Rd	545464 5452290	0.3		3.4		Collector	Low	Larger channel width. Perched culvert. Habitat looks decent in photos.
51909	092G110	Trib to Hayward Reservoir	Dewdney Trunk Rd	544696 5452096	1.7		3.1	CCT	Collector	Medium	Assessment comments indicate low gradient and complex habitat present with pools and abundant cover.
51911	092G109	Phillips Ck	Dwedney Trunk	543195 5451955	1.4	2.7	6.2	CT	Collector	High	Prioritized (Masse 2012). Nice pond upstream with CT above.
51916	092G105	Hairsine Ck	Keystone	546129 5448025	0.2		5.4	CT	Collector	High	Prioritized (Masse 2012). Large stream with good habitat.
51947	092G110	trib to Lost Ck	Twin Lakes	555444 5466229	0.3		4.3		Norske	Medium	Large width and description of habitat is good.

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PSCIS ID	Map ID	Stream	Road	UTM (9U)	¹ Habitat Gain (km)	Lake/ Wetland (ha)	Stream Width (m)	Species upstream	¹ Road Tenure	Habitat Value	Comments
62308	092G110	Trib to Steelhead Ck	Private Drive	549967 5451589	0.6		1.9	CT	Collector	Low	Good gravels upstream.
62311	092G110	Trib to Hayward Reservoir	Railway Trail	546053 5451583	1.9		5		4197624	Medium	Prioritized (Masse 2012). Site of T10-T11 Salmonid Habitat Project (DFO 2000). Appears to still be barrier to juvenile salmonids.
62361	092G105	Trib to Hairsine	Shaw	546387 5448835	1.3		3.6		Local	Medium	Larger channel width. Private property.
62374	092G105	Hairsine	Keystone	545489 5448631			5.4		Collector	High	Prioritized (Masse 2012). Baffles in culvert should allow passage for larger fish but outlet drop appears to be barrier to small juveniles. PSCIS crossing is not pinned to stream network.

¹Habitat Gain – a modelled estimate of continuous linear distance of fish habitat (<20% gradient) located immediately upstream of the crossing. ²Norske = Norske Skog Canada Limited.

Table 7. Moderate priority crossings for habitat confirmation.

PSCIS ID	Map ID	Stream	Road	UTM (9U)	¹ Habitat Gain (km)	Lake/Wetland (ha)	Stream Width (m)	Species upstream	¹ Road Tenure	Habitat Value	Comments
51907	092G110	Trib to Hayward Reservoir	Dewdney Trunk Rd	544987 5452097	0.3		2.5		Collector	Low	Assessment comments indicate poor habitat and lower potential gain, but CO noted below.
51918	092G104	Trib to Silverman lake	Anderson	543478 5446466	4.6		1.8		Local	Low	Assessment comments indicate low value habitat but photos and width look ok.
51923	092G110	Trib to Cardinalis	Sabo Rd	550743 5455070			2.1		Local	Medium	Prioritized (Masse 2012). Large falls (8m high) downstream in Cardinalis Creek (FISS 2018). Could provide spawning habitat for resident rainbow population.
51971	092G104	Donatelli Brook	Hayward	543436 5446450	4.6		2.1		Collector	Low	Assessment comments indicate low value habitat but photos and width look ok.
52028	092G110	Trib to Stave Lk	Powerline/Pilgram St.	545775 5453932	0.7		2.7		Urban	Low	Larger channel but assessment comments indicate poor habitat value.
62350	092G104	Adrian Ck	Wilson St	543150 5449719	0.2		4.5		Collector	Medium	Larger stream but modelling indicates >20% at 200 m.
62351	092G104	Adrian Ck	Rail trail	543201 5449672	0.3		4.5		4873645	Medium	Larger stream. Modelling indicates steep at 250 m with another culvert at 70 m.
62367	092G104	Thompson Ck	Wilson St	542749 5448877	1		2.8		Collector	High	Assessment comments indicate fish passage provided to culvert. Stream "manicured" u/s in private land, and includes some fish passage structures. Chum observed below.
62407	092G105	Trib to Silverman lake	Manzer St	545030 5446623	0.4		2.2		Local	Low	Assessment comments indicate low value habitat but photos and width look ok.

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

7 DISCUSSION AND CONCLUSION

Previously identified crossings that are barriers to fish passage in the Stave 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 43 crossings structures identified as requiring further assessment according to the criteria identified in the methodology. Of these, 16 crossings were rated as high priority for follow up with habitat confirmation assessments and potentially fish inventories. Twelve crossings were rated as moderate priority for follow up with habitat confirmation assessments and potentially fish inventories. Nine crossings were rated as low priority for follow up with habitat confirmation assessments and potentially fish inventories and six crossing were rated as “no fix”.

To date Phase 1 - Fish Passage Assessments have been conducted throughout most of the major potential fish bearing Stave River watershed areas. Areas still requiring assessment of crossings are accessible by boat only in the upper watershed, are behind locked gates, are on private land or are on deactivated roads that may require an all-terrain vehicle (Masse 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. Assessment of these crossings 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.

8 REFERENCES

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Appendix 1

Low Priority Crossings

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

PSCIS ID	Map ID	Stream	Road	UTM (9U)	Habitat Gain (km)	Lake/Wetland (ha)	Stream Width (m)	Species upstream	Road Tenure	Habitat Value	Comments
51724	092G110	Trib to Cascade	Sylvester Rd	556511 5456857	0.5		0.9		Collector	Low	Assessment comments and photos indicate passable at end of October. Lake habitat upstream.
51765	092G110	Trib to Cardinalis	Sabo Rd	550761 5454121	1		2.3		Local	Medium	Large falls (8m high) downstream in Cardinalis Creek (FISS 2018).
51767	092G110	Trib to Stave Lk	Florence Lake FSR	546347 5453915	1.5		4.1		DCK	Low	Very steep (20%). Unlikely fish bearing above.
51827	092G110	Trib to Cardinalis	Smith Rd	550645 5453748	0.6		2.7		Local	Low	Large falls (8 m high) located downstream in Cardinalis Ck.
51830	092G110	Trib to Stave Lk	Pilgram St	545926 5453809	1		2.1		Local	Low	Steep stream (20% downstream). Unlikely fish bearing. Habitat value rated low.
51840	092G110	Trib to Cardinalis	Johnston Rd	552172 5453315	0.4		4		Local	Medium	Prioritized (Masse 2012). Large falls (8m high) downstream in Cardinalis Creek (FISS 2018).
51846	092G110	Trib to Hayward Reservoir	Cathy Cres.	544065 5453400	0.6		3.1	CCT	Local	Low	Local residents indicate seasonally dewater. Some gravels present.
51850	092G110	Brown Ck	Dwedney Trunk	547738 5453129	2		8	CT	Collector	High	Average gradient in first reach >20 % with 100m section >30%. Very unlikely that natural upstream migration happening.
51860	092G110	Trib to Steelhead Ck	Private Drive	550977 5452750	0.4		1.5		Local	Low	Assessment comments indicate poor habitat upstream. Many barriers downstream (driveways).
54147	092G110	Trib to Belcharton Ck	13229 Stave Lake Rd	554775 5454651	0.4		1.8		Local	Low	Smaller stream into private yard.
62319	092G110	Trib to Hayward Reservoir	4197624	545512 5450975	1		1.5		4197624	Low	Assessment data and photos indicate poor habitat value.
62385	092G105	Hairsine Ck	Keystone	546974 5447536	0.2		4.6	CT	Collector	High	Fry observed upstream with smallish modelled potential habitat gain.
51724	092G110	Trib to Cascade	Sylvester Rd	556511 5456857	0.5		0.9		Collector	Low	Assessment comments and photos indicate passable at end of October. Lake habitat upstream.

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

PSCIS ID	Map ID	Stream	Road	UTM (9U)	¹ Habitat Gain (km)	Lake/ Wetland (ha)	Stream Width (m)	Species upstream	Road Tenure	Habitat Value	Comments
51765	092G110	Trib to Cardinalis	Sabo Rd	550761 5454121	1		2.3		Local	Medium	Large falls (8m high) downstream in Cardinalis Creek (FISS 2018).
51767	092G110	Trib to Stave Lk	Florence Lake FSR	546347 5453915	1.5		4.1		DCK	Low	Very steep (20%). Unlikely fish bearing above.
51827	092G110	Trib to Cardinalis	Smith Rd	550645 5453748	0.6		2.7		Local	Low	Large falls (8 m high) located downstream in Cardinalis Ck.

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

Appendix 2

Crossings with No Fix Recommended

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

PSCIS ID	Map ID	Stream	Road	UTM (9U)	¹ Habitat Gain (km)	Lake/ Wetland (ha)	Stream Width (m)	Species upstream	² Road Tenure	Habitat Value	Comments
51761	092G110	Brown Ck	Hoover Lake Rd	548442 5455100	0.5		6.1		Mission	Low	Steep gradients below culvert. No further assessment required
51764	092G110	Brown Ck	Hoover Lake Rd	548398 5454584	1.1		3.9		Mission	Medium	Steep gradients below culvert. No further assessment required
51848	092G110	Steelhead Ck	Private Drive	548753 5453149	1.7		4.2		3606559	High	Assessment comments and photos indicate passable.
51888	092G110	Trib to Steelhead Ck	Thomas Rd	550298 5452122	1.4		2.7		Local	Low	Assessment comments and photos indicate passable.
51892	092G110	Trib to Hayward Res	Rollins Lake Rd	544337 5452308	1.7		4.2	CCT	Local	High	Assessment comments and photos indicate passable.
62312	092G110	Trib to Hayward Lk	Yeo St.	545121 5451556	0.3		2.5		Local	Low	Assessment comments indicate steep gradient 35 % downstream.

¹Habitat Gain – a modelled estimate of continuous linear distance of fish habitat (<20% gradient) located immediately upstream of the crossing. ² Mission = The Corporation Of The District Of Mission.

Appendix 3

Unassessed Modelled Crossings on Potential Fish Habitat

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

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	¹Habitat Gain (km)	Lake/ Wetland (ha)	Species Upstream	²Road Tenure	³Comments
10300974	092G104		Hayward St	543435 5446488	4.6			Collector	
10300975	092G105		Woodward St	543858 5446567	4.2			Local	
10300985	092G110		Cardinal St	550112 5452017	1			Local	Could not locate - no crossing
10301030	092G110		Roach St	550126 5452336	0.7			Local	No crossing
10301047	092G105	Hairsine Ck	Keystone Ave	546677 5447795	0.2		CT	Collector	Doesn't exist
10301735	092G110		SYLVESTER RD	556149 5458694	0.6			MoTI	
10302146	092G105	Hairsine Ck	Keystone Ave	545776 5448444	0.2		CT	Collector	
10302165	092G104		unnamed lane	542651 5446770	9.6		CAS,CM,CO,CT,LMB,PMB,TSB	Lane	Private Drive. No access.
10302342	092G110		Webb Ave	549160 5452933	8.9		CT,RB,SP	Local	
10302452	092G115		Lost Lease FSR	558000 5472956	0.1			FLNRORD	Road deactivated. No access.
10302468	092G110		Florence Lake Rd	548234 5465269	0.1			Resource	Gated.
10302469	092G110		Florence Lake Rd	548251 5465453	0.8			Resource	Gated.
10302470	092G110	Foam Ck	Florence Lake Rd	548874 5465936	0.2	20.8	RB	Resource	Gated.
10302598	092G110			546423 5456417	0	45.6	ACT,CAS,CSU,CT,NSC,RB,RSC,SU,TSB	Unclassified	Not assessed, locked gate.
10302653	092G119			541585 5495955	1.6			Unclassified	
10302654	092G119			541827 5495809	0.8			Unclassified	
10302655	092G119			541662 5495642	2.9			Unclassified	
10302656	092G119			541639 5495527	3			Unclassified	
10302667	092G119			542066 5494876	0.2			Unclassified	
10302668	092G119			542244 5494541	0.2			Unclassified	
10302669	092G119			542182 5494732	0.4			Unclassified	

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

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	¹Habitat Gain (km)	Lake/ Wetland (ha)	Species Upstream	²Road Tenure	³Comments
10302670	092G119			542086 5494873	0.2			Unclassified	
10302671	092G119		1	541664 5497219	0.2			Delta	
10302699	092G119			542617 5494331	0.5			Unclassified	
10302701	092G119			540286 5496720	0.3			Unclassified	
10302702	092G119			540938 5496650	0.3			Unclassified	
10302704	092G110			549156 5452922	8.9		CT, RB, SP	Unclassified	
10302770	092G110		H	558024 5466543	0.2			Norske	Road deactivated. No access.
10302859	092G104			542875 5447666	0.2			Unclassified	Private Drive. No access.
10302862	092G110	Steelhead Ck		549213 5453764	0.7			Unclassified	Deactivated
10302864	092G110			549952 5451166	0.1		CT	Unclassified	
10302889	092G110			551208 5454864	1.7		DV, RB	Unclassified	
10302959	092G115		100	559579 5472638	0.1			Raymond Halarewich	Road deactivated. No access. Access potential through Blacklock Creek (R03663).
10303027	092G115		SV1200	558147 5477636	0			B & M Logging Ltd.	Boat access only.
10303028	092G115			557775 5482274	0.8			Unclassified	
10303037	092G110			555080 5461604	0			Unclassified	
10303039	092G110			556309 5459174	0.1			Unclassified	
10303049	092G110	Davis Ck		555798 5458884	2		CT, KO, LSU, NSC, RB, WCT	Unclassified	
10303051	092G115	Roaring Ck		558565 5477235	1.7	60.4	RB	Unclassified	Boat access only.
10303056	092G115	Roaring Ck		557523 5477774	2.5	60.4	RB	Unclassified	Boat access only.
10303057	092G110			557681 5467352	0.1			Unclassified	Road deactivated. No access.
10303061	092G115			558558 5477324	0.2			Unclassified	Boat access only.
10303062	092G115	Roaring Ck		556842 5478000	2.5	60.4	RB	Unclassified	Boat access only.
10303063	092G115		SV1200	558615 5477400	0.1			B & M Logging Ltd.	Boat access only.

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

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	¹ Habitat Gain (km)	Lake/Wetland (ha)	Species Upstream	² Road Tenure	³ Comments
10303064	092G115		SV1200	558831 5477345	0.3			B & M Logging Ltd.	Boat access only.
10303345	092G110	Foam Ck		549226 5465623	2.4	21.5	RB	Unclassified	Gated.
10303408	092G110			544213 5454616	0.9			Unclassified	
10303499	092G110	Davis Ck	private driveway	555287 5458300	3.1	47.2	CT,KO,LSU,NSC,RB,WCT	Driveway	Not assessed. Private property, talked to owner but still no access.
10303506	092G105			546646 5449200	0.8			Unclassified	Private Drive. No access.
10303509	092G105			546578 5449099	0.9			Unclassified	Private Drive. No access.
10303510	092G105			545908 5449032	0.1			Unclassified	No crossings - vegetated ditch
10303564	092G110			543837 5454096	0			Unclassified	
10303606	092G110			550904 5455283	0		DV,RB	Unclassified	Private Drive. No access.
10303607	092G110			550833 5455322	0		DV,RB	Unclassified	Private Drive. No access.
10303627	092G110			545749 5453861	0.8			Unclassified	Not assessed, locked gate.
10303629	092G110	Seventynine Ck		547860 5458788	8.5			Unclassified	
10303679	092G110			550767 5455391	0		DV,RB	Resource	
10303684	092G110			554484 5459260	1.3			Unclassified	
10303685	092G110			554256 5459366	1.1			Unclassified	
10303687	092G110			557068 5457209	0.1			Unclassified	Not assessed, private property gated.
10303688	092G110			545263 5451343	0.5			Unclassified	
10303689	092G110			548255 5453812	1.8			Unclassified	Deactivated
10303690	092G110			555218 5458941	0.5			Unclassified	
10303693	092G110	Seventynine Ck		545310 5458901	4.1			Resource	Gated.
10303712	092G109			543188 5453086	1.4		CT	Unclassified	
10303716	092G110			554928 5461662	0.6			Unclassified	
10303717	092G110			554999 5461528	0.1			Unclassified	

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

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	¹ Habitat Gain (km)	Lake/ Wetland (ha)	Species Upstream	² Road Tenure	³ Comments
10303720	092G110			556474 5456891	0.6			Unclassified	Not assessed, not there.
10303884	092G115			559007 5489420	0.2			Unclassified	
10303885	092G115			559312 5489412	0			Unclassified	
10303886	092G115	George Good Ck		558944 5489544	1.6			Unclassified	
10303892	092G110	Davis Ck	SMITH RD	554569 5458096	3.1	47.2	CT,KO,LSU,NSC,RB,WCT	MoTI	
10303893	092G110	Davis Ck	SMITH RD	555037 5458101	3.1	47.2	CT,KO,LSU,NSC,RB,WCT	MoTI	
10303894	092G110	Davis Ck	SMITH RD	554487 5458095	3.1	133.2	CT,KO,LSU,NSC,RB,WCT	MoTI	
10303895	092G110	Davis Ck	SMITH RD	554620 5458097	3.1	47.2	CT,KO,LSU,NSC,RB,WCT	MoTI	
10303913	092G115			557851 5483314	0			Unclassified	
10303914	092G115			558255 5485132	0.4			Unclassified	
10303915	092G115			557959 5483776	0.5			Unclassified	
10303916	092G115			558292 5485279	0.1			Unclassified	
10303918	092G115			558112 5484621	0.2			Unclassified	
10303920	092G115			559657 5487308	1.3			Unclassified	
10304269	092G115		WN1300	559945 5487162	0			Interwest	
10304279	092G110		10	558314 5472080	1.8			FLNRORD	Road deactivated. No access.
10304308	092G115		01	552795 5483995	0.4			FLNRORD	
10304310	092G115		01	556303 5480727	0.3			FLNRORD	
10304311	092G115		01	556257 5476964	0.1			FLNRORD	Boat access only.
10304312	092G115		01	544921 5491671	0.1			FLNRORD	
10304314	092G115		01	553564 5483151	0.5			FLNRORD	
10304315	092G115		01	554565 5475382	0			FLNRORD	
10304316	092G119		01	539143 5496975	0.3			FLNRORD	
10304317	092G115		01	551641 5487690	0.1			FLNRORD	
10304318	092G115		01	552267 5486733	0.4			FLNRORD	
10304319	092G115	Roaring Ck	01	556601 5478199	2.5	60.4	RB	FLNRORD	Boat access only.

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

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	¹Habitat Gain (km)	Lake/ Wetland (ha)	Species Upstream	²Road Tenure	³Comments
10304320	092G115		01	551461 5488015	0			FLNRORD	
10304321	092G119		01	542042 5495461	0.4			FLNRORD	
10304322	092G119		01	542399 5494937	0.3			FLNRORD	
10304323	092G115			546209 5490772	0.2			Unclassified	
10304324	092G115		01	545597 5491604	0.1			FLNRORD	
10304325	092G115		01	556299 5479158	0.3			FLNRORD	Boat access only.
10304326	092G115		01	550560 5488408	0.2			FLNRORD	
10304327	092G115		01	553594 5482903	0.6			FLNRORD	
10304328	092G115		01	555405 5476205	0.4			FLNRORD	Boat access only.
10304329	092G115		01	553840 5482362	0.5			FLNRORD	
10304330	092G115		01	554208 5481980	1.1			FLNRORD	
10304331	092G115		01	552326 5486533	0.2			FLNRORD	
10304335	092G114		01	542966 5493876	0.3			FLNRORD	
10304336	092G115		01	544618 5491645	0			FLNRORD	
10304340	092G115		01	543638 5491798	0.1			FLNRORD	
10304341	092G115		01	550106 5488594	0.2			FLNRORD	
10304343	092G115		01	549814 5488744	0.6			FLNRORD	
10304344	092G119		01	540372 5496286	0.3			FLNRORD	
10304345	092G115		01	552469 5485950	0.1			FLNRORD	
10304346	092G115		01	552027 5487263	0			FLNRORD	
10304347	092G119		01	539753 5496594	0.3			FLNRORD	
10304350	092G119		01	542590 5494677	0.2			FLNRORD	
10304351	092G119		01	542602 5494371	0.6			FLNRORD	
10304352	092G115		01	553093 5483789	0.7			FLNRORD	
10304353	092G115		01	544071 5491299	0.2			FLNRORD	
10304354	092G114		01	543241 5493633	0			FLNRORD	

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

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	¹ Habitat Gain (km)	Lake/ Wetland (ha)	Species Upstream	² Road Tenure	³ Comments
10304367	092G110		CR200	552479 5455111	0.2			Mission	Gated road, no access
10304437	092G110		07	559045 5468130	0.1			FLNRORD	Road deactivated. No access.
10304464	092G115		702-SR3-2	556309 5480737	0.3			Teal	
10304465	092G115		702-SR3-2	556359 5480766	0.2			Teal	
10304497	092G110		SL3B	554304 5461309	0.2			Teal	
10304553	092G110		15	557805 5467759	0.6			FLNRORD	Road deactivated. No access.
10304554	092G110		N	559024 5468635	1.4			Norske	Road deactivated. No access.
10304569	092G115		02	557887 5482279	0.7			FLNRORD	
10304571	092G115		02	557610 5481868	0.4			FLNRORD	
10304574	092G115		02	556894 5481357	0.5			FLNRORD	
10304575	092G115		02	558157 5482821	0.2			FLNRORD	
10304580	092G115		R	557617 5472778	0.3			Norske	Road deactivated. No access.
10304582	092G115		11	557872 5472802	0.3			FLNRORD	Road deactivated. No access.
10304584	092G115		Lost Lease FSR	557579 5472788	0			FLNRORD	
10304586	092G115		11	557412 5472755	0.1			FLNRORD	
10304588	092G115		Lost Lease FSR	557374 5472739	0.2			FLNRORD	
10304589	092G110		CR210	552226 5455237	0.5			Mission	Gated road, no access
10304622	092G105		C150	547008 5449832	0			Mission	
10304623	092G110	Weatherhead Ck	SL200	553232 5462565	3.4			Teal	Road deactivated. No access. Bridge pulled here. Deep crossing. No photos.
10304627	092G110		HL1000	548413 5454693	0.9			Mission	
10304664	092G110		SL6A	553740 5460004	0.2			Teal	
10304698	092G110		Lost Lease FSR	556999 5468812	0			Norske	Duplicate of 544659.
10304724	092G115		702-SR1-1	556300 5480714	0.3			Teal	

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

Crossing ID	Map ID	Stream Name	Road Name	UTM (10U)	¹Habitat Gain (km)	Lake/ Wetland (ha)	Species Upstream	²Road Tenure	³Comments
10304760	092G110		DL220	546894 5459607	0.3			Mission	Not assessed, walked in, no crossings present.
10304761	092G110		DL220	546882 5459482	0.8			Mission	
10304836	092G115		SV1600	553801 5483130	0.2			0793663 B.c. Ltd.	
10304848	092G110		SL100	553635 5461580	0.9			Teal	
10304871	092G110			549169 5462823	2.4	80.5	EB,RB,RB/CT,TR		
10304872	092G110			548812 5465603	1.8				Gated.
10304892	092G115		702-SR8-1	545005 5491647	0.6			Teal	

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

² Mission = The Corporation Of The District Of Mission, Norske = Norske Skog Canada Limited, Teal = Teal Cedar Products Ltd., FLNRORD = Timber Sales Manager Chinook.

³Comments 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 / pscis-assessments
map_tile	map_tile	1:50,00 mapsheet	nts-50k-grid-digital-baseline-mapping-at-1-50-000-nts
stream_name	gnis_name	The BCGNIS (BC Geographical Names Information System) name associated with the GNIS feature id	freshwater-atlas-stream-network
stream_order	stream_order	The calculated modified Strahler order.	freshwater-atlas-stream-network
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	digital-road-atlas-dra-master-partially-attributed-roads ministry-of-transportation-mot-road-features-inventory-rfi forest-tenure-road-segment-lines
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 freshwater-atlas-stream-network
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 freshwater-atlas-stream-network
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 freshwater-atlas-stream-network
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 freshwater-atlas-stream-network
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 freshwater-atlas-stream-network
*slope		Derived slope of stream at crossing	Fish Habitat Model freshwater-atlas-stream-network
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 freshwater-atlas-stream-network
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 freshwater-atlas-stream-network

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 freshwater-atlas-stream-network
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 freshwater-atlas-stream-network
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 freshwater-atlas-stream-network
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 freshwater-atlas-stream-network freshwater-atlas-lakes
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 freshwater-atlas-stream-network freshwater-atlas-wetlands
spp_upstream	species_code	Codes for fish species located on stream segments upstream of the subject crossing.	known-bc-fish-observations-and-bc-fish-distributions
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").	digital-road-atlas-dra-master-partially-attributed-roads ministry-of-transportation-mot-road-features-inventory-rfi forest-tenure-road-segment-lines
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.	pscis-assessments
*Prioritized		Reference to assessment report where crossing was prioritized.	
*assessment_comment	assessment_comment	Assessment comments recorded in database from PSCIS assessment.	pscis-assessments
*image_view_url	image_view_url	Link to photos taken during PSCIS assessment.	pscis-assessments

*PSCIS summary only