BIO LOGIC CONSULTING

Lower Skeena Fish Passage

Closed Bottom Structure Assessments 2009

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Submitted to

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Executive Summary

A GIS model mapped 217 potential fish bearing crossings in 8 road accessible watershed groups and across direct tributaries to the Skeena River within the Lower Skeena priority area. An additional 32 crossings in five watersheds were identified during the field assessments that had not been mapped during the GIS exercise. Half of the unmapped crossing structures (16) were eligible for assessment. In the field, 182 mapped crossings (84%) were accessible while modeled crossings at an additional 35 sites could not be accessed for assessment. At 4 of 35 inaccessible sites, the crossings were located on private land. The remaining 31 sites were not accessible due to overgrown road conditions (no ATV access) or a deactivated bridge crossing downstream. At an additional 27% of modeled crossings, there was no crossing structure present either due to road deactivation (20 crossings) or modeling error (*e.g.* gas pipeline or hydro line showing as a road and creating 38 potential crossings).

Of the 214 accessible crossings, just over one quarter (28%) were open bottomed structures including 35 box culverts and 25 bridges. Nearly half (42% or 90 crossings) of the crossing structures were closed bottomed structures (CBS). At 39 of those, a fish passage assessment was not carried out either due to a lack of fish habitat gain (*e.g*. excessive gradient or natural barrier) or a lack of stream channel associated with the crossing structure (*e.g*. cross-ditch culvert). At the remaining 51 crossings a fish passage assessment was carried out. Of those, 49 of 51 crossings were barriers (76%) or potential barriers (20%) to safe fish passage, while 2 crossings were passable (4%).

Thirteen crossings have been identified as a high priority for remediation. The next step, the restoration phase, is to bring stakeholders together to confirm or revise the priority list and write up an Implementation Plan. In addition, there are some high fisheries value watershed groups in the Lower Skeena priority area that were not assessed in 2009 and assessments should take place in the 2010 if funding is available.

Cover photo: Exstew007 outlet at 2.7km up the Exstew mainline. Photo by Mike McCarthy.

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Introduction

Closed bottom crossing structures have often been observed to obstruct fish passage. In April 2008, the BC Ministry of Environment published a new strategic approach for planning and prioritizing closed bottom structures (CBS) for fish passage assessment and remediation (BC Ministry of Environment 2009a). As the first step of this strategic approach, BC Environment built a GIS model to prioritize watershed groups within BC sub-basins to ensure that any work carried out would be focused on areas with the highest fisheries values (Norris and Mount 2009). In the Skeena sub-basin, the Lower Skeena watershed group was identified as the 2nd priority for fish passage assessment.

This project included the planning, data collection and analysis phases of closed bottom structure assessments for the purpose of identifying fish passage barriers in need of restoration within the Lower Skeena priority area. The purpose of the project is to identify non-passable structures and rank them for remediation based on the anticipated increase in accessible fish habitat. The project was focused on the Lower Skeena watershed group within the Skeena sub-basin. The Lower Skeena area includes all major tributaries to the Skeena River east of the city of Terrace to Port Essington, with the exception of the Kalum and Lakelse watersheds. The Lower Skeena watershed fish passage project has been funded by Coast Tsimshian Resources Ltd. under the Forest Investment Account (FIA).

Methods

Selection of Watersheds within the Lower Skeena area

Within the Lower Skeena area, each 3rd order watershed had been assigned a fisheries value by BC Environment. The first phase of this project was a GIS-based planning exercise to ensure that assessment efforts would be focused where fisheries values and stream crossing densities were the highest within the Lower Skeena area. Maps were prepared of the Lower Skeena area to show road networks and fisheries value data. Since many of the watersheds within the Lower Skeena area are South of the Skeena River, a remote area accessible only by boat or helicopter, both the cost of access and the likelihood of remediation in a remote area also had to be considered.

The GIS analyst prepared an overview map of the Lower Skeena area showing the location of roads, the average fisheries value and accessibility of each watershed group (Figure 1). A GIS model developed by BC Environment (Norris and Mount 2009) was used to model the potential culvert locations in each of the watershed groups based on road intersections with anticipated fish habitat based on a combination of historical fish observations, natural obstructions (e.g. dams, waterfalls) and stream gradient (Table 1). Stream segments upstream of a fish observation were considered fish bearing until either a natural obstruction or excessive stream gradient (greater than 25%) was encountered (Norris and Mount 2009). Stream segments upstream of a natural obstruction or excessive stream gradient were considered non-fish bearing. Potential crossings on these mid-slope non-fish bearing stream segments were eliminated prior to the field work to reduce costs and focus assessment work on fish bearing streams.

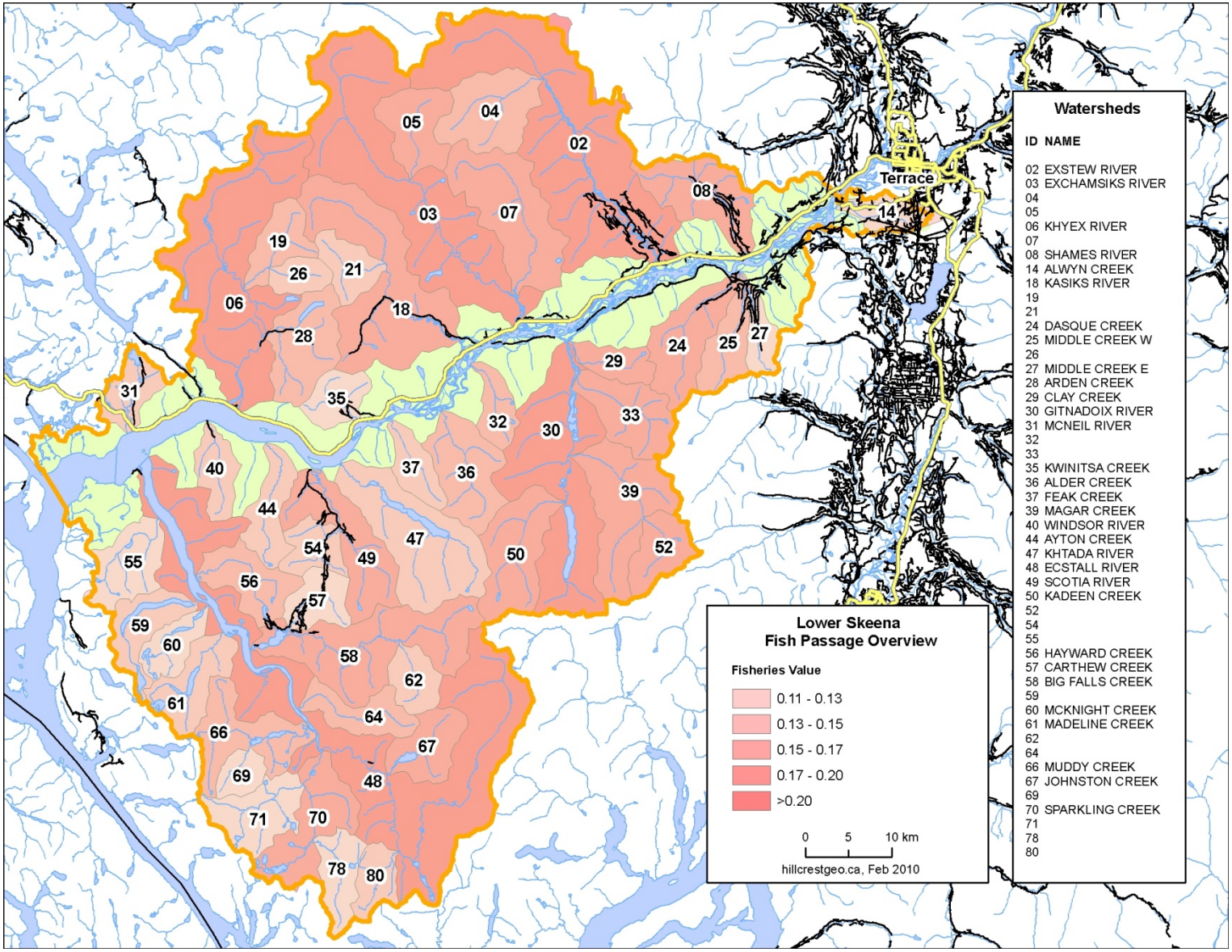

Figure 1. Road location and average fisheries value in the watershed groups within the Lower Skeena area.

Table 1. Summary of modeled crossings in watershed groups within the Lower Skeena Priority Area. (Short watershed ID corresponds to watershed ID in Figure 1)

Watershed Name	Short Watershed ID	Fish Value	Number of Modeled Culverts				Year	Schedule & Access
			Non Fish Habitat	Fish Habitat - Inferred	Fish Habitat - Observed	Total		
EXSTEW RIVER	LSKE-02	0.22	80	35		115	2009	Completed - Truck/ATV
KHYEX RIVER	LSKE-06	0.20		2		2	2009	Completed - Truck/ATV
DASQUE CREEK	LSKE-24	0.17	7	8	3	18	2009	Completed - Truck/ATV
SHAMES RIVER	LSKE-08	0.17	84	36	3	123	2009	Completed - Truck/ATV
unnamed (Alias Middle)	LSKE-25	0.17	20	12	4	36	2009	Completed - Truck/ATV
MCNEIL RIVER	LSKE-31	0.14	8	11		19	2009	Completed - Truck/ATV
ALWYN CREEK	LSKE-14	0.13		16	7	23	2009	Completed - Truck/ATV
unnamed (Alias Whitebottom)	LSKE-27	0.13	56	10		66	2009	Completed - Truck/ATV
KWINITSA CREEK	LSKE-35	0.12	11	5		16	2009	road overgrown - no access
ARDEN CREEK	LSKE-28	0.16		7	2	9	2009	gas line
KASIKS RIVER	LSKE-18	0.20	6	32	1	39	2009	gas line
BIG FALLS CREEK	LSKE-58	0.18	41	57		98	2010	Boat / Helicopter and ATV
SCOTIA RIVER	LSKE-49	0.17	10	46	3	59	2010	Boat / Helicopter and ATV
ALDER CREEK	LSKE-36	0.16	14	9	1	24	2010	Boat / Helicopter and ATV
HAYWARD CREEK	LSKE-56	0.15	12	48	4	64	2010	Boat / Helicopter and ATV
unnamed	LSKE-54	0.14	19	22	2	43	2010	Boat / Helicopter and ATV
AYTON CREEK	LSKE-44	0.14	15	7		22	2010	Boat / Helicopter and ATV
WINDSOR RIVER	LSKE-40	0.14	3	2		5	2010	Boat / Helicopter and ATV
CARTHEW CREEK	LSKE-57	0.12	25	38		63	2010	Boat / Helicopter and ATV
ECSTALL RIVER	LSKE-48	0.28	3	3		6	2010	helicopter if roads present
unnamed	LSKE-59	0.14	8	12	1	21	2010	helicopter
unnamed	LSKE-62	0.14	2	2		4	2010	helicopter - if any crossings?
SKEENA		-	42	186	12	240		variable
Grand Total			466	606	43	1115		

Within the Lower Skeena priority area, the maps were reviewed to make sure that assigned fisheries values were reasonable. During a project planning meeting, it was decided that only truck and ATV accessible watershed groups would be assessed in the fall of 2009. These vehicle-accessible areas are the highest priority since they will have the lowest associated costs for remediation. It will be less expensive to deploy heavy equipment to watersheds with vehicle access compared with watersheds on the South side of the Skeena which are accessible only by crossing the Skeena by air or boat.

Direct tributaries to the Skeena River were often not assigned a fisheries value. These crossings were only assessed if they were on a forest service or road permit road. Crossings on Highway 16 were only considered if they were downstream of crossing structures assessed for a watershed group.

Determining Fish Passage

A two person crew completed the field assessments. All field work was completed between October 8th and November 1st, 2009. Methods followed those outlined in the document "*Field Assessment for Fish Passage Determination of Closed Bottomed Structures*" (BC Ministry of Environment 2009). A Sokkia C330 auto-level was used for culvert slope measurements. For each road in a watershed of interest, the crew started at the farthest point and drove the road

looking for both modeled and unmapped crossing structures. The crew located each of the modeled crossings in the field where they existed and noted the type and condition of the crossing (*e.g*. open bottom or closed bottom structure). In each of the watersheds assessed there were crossing structures that had not been mapped during the modeling phase which were numbered from 1 and given a prefix representing the watershed or road (*e.g.* prefix "SH" for Shames River). A field form was completed for each of the closed bottom crossing structures, unless either the crossing was clearly a cross-ditch culvert (*i.e*. not associated with a stream) or the channel downstream and upstream of the crossing did not appear to be fish bearing (*e.g.* a natural obstruction or excessive gradient immediately upstream of culvert). For culvert crossings with multiple pipes, dimensions and slopes were measured for both, but only the pipe lowest in elevation was used for the barrier determination. If pipes were the same elevation, the diameters were added for the stream-width ratio (SWR) and the highest slope and length measurement were used.

If a full assessment was not completed for a CBS, the gradient upstream and downstream of the crossing were noted along with any other information suggesting that the stream could not support fish. Cross-ditch culverts were generally not identified during the GIS phase since they are not associated with a stream channel. However, in the case that a mapped crossing was a cross-ditch culvert, the site was flagged and the location was noted in the field notes. For open bottom crossing structures a waypoint was marked with a handheld Garmin GPS unit, a couple of photos were taken and the site was marked in the field with labeled flagging tape.

Assessing Habitat Value

Habitat value upstream of the crossing was recorded as high, moderate or low on the field assessment cards using the habitat value criteria outlined in the document '*Field Assessment for Fish Passage Determination of Closed Bottomed Structures*' (BC Ministry of Environment, 2009). Habitat value was considered high if there were high value spawning gravels, rearing habitat (*e.g.* deep pools, undercut banks, stable debris) and overwintering habitat (pools 30 cm deep at low stage) present. Fish habitat value was considered moderate if the stream is an important migration corridor or if there was suitable spawning or rearing habitat present. Fish habitat value was considered low if there was an absence of suitable spawning habitat and low rearing potential. If fish were observed at the crossing, the location and species were noted if possible.

Barrier Determination and Rank

At each crossing, the likelihood of a barrier to fish passage was estimated based on the cumulative score of 5 criteria, embeddedness, outlet drop, culvert slope, stream width ratio (SWR) and culvert length, as described in Table 2. A CBS with a cumulative score of less than 15 is considered passable. A CBS with a cumulative score of 15 to 19 is a potential barrier to safe fish passage while a cumulative score of 20 or greater is a barrier to safe fish passage. If a culvert is properly embedded it is considered passable without further consideration of other variables.

Table 2. Fish Barrier Scoring (from BC Ministry of Environment 2009b)

Risk	Embedded	Value	Outlet Drop (cm)	Value	Slope	Value	SWR	Value	Length (m)	Value
Low	>30 cm or >20% of Diameter and continuous	0	<15	0	<1%	0	<1	0	<15	0
Mod	<30 cm or 20% of Diameter but continuous	5	15 – 30	5	1-3%	5	1-1.3	3	15-30	3
High	No embedment or discontinuous	10	>30	10	>3%	10	>1.3	6	>30	6

Data Analysis and Proposed Solutions for Remediation

Once the field assessments were completed, the data were entered in to the provided spreadsheet (Appendix 1) and a ranked list was prepared for each of the watershed groups. BC Ministry of Environment (2009a) has provided restoration options to consider for CBS that are a barrier to fish passage. These include (from BC Ministry of Environment 2009b):

1. Removal of the structure and deactivation of the road if access is not required. (RM)
2. Replacing the culvert with a bridge or other open bottom structure. (OBS)
3. Replacing the structure with a streambed simulation design culvert. (SS)
4. Adding substrate material to the culvert and a downstream weir to reduce overall velocity and turbulence and provide low velocity areas. (EM)
5. Backwatering the structure to reduce velocity and turbulence. (BW)
6. Combination of 4 and 5.

Fish passage barriers were ranked within each watershed group based on the confirmed presence of fish, the fish habitat value and the potential habitat gain upstream of the crossing.

Where the best solution was replacing the existing structure, the decision-making matrix for selecting the type of new installation in the *Fish-stream Crossing Guidebook* was consulted (BC Ministry of Forests 2002). For now, open bottom structures (OBS) (*e.g.* wood box culverts) have been proposed rather than streambed simulation design culverts in all cases where the proposed solution is to replace the structure. This allows comparison of span lengths for the purpose of estimating costs during the priority ranking phase. The preference for OBS over streambed simulation design culverts is mostly because they appear to be easier to install. It may be useful to compare the site specific costs of both options during the design phase.

To provide a rough estimate of expected span length for any given OBS, the depth of fill and the stream channel width were considered. Where the stream channel was less than 2 metres wide and the fill was less than 1 metre deep, two meters were added to the stream channel width. In cases where the stream channel width was more than 2 metres wide and the fill was more than 1 metre deep, four metres were added to the stream channel width to allow for cribbing. These estimates are given only for the purpose of estimating costs and a proper design for each crossing needs to be completed before any work would begin.

Results

A GIS model mapped 217 potential fish bearing crossings in 8 road accessible watershed groups and across direct tributaries to the Skeena River within the Lower Skeena priority area. An additional 32 crossings in five watersheds were identified during the field assessments that had not been mapped during the GIS exercise. In the field, 182 crossings (84%) were accessible by truck, ATV or on foot; while modeled crossings at an additional 35 sites could not be accessed for assessment. At 4 of 35 inaccessible sites, the crossings were located on private land. The remaining 31 sites were not accessible due to overgrown road conditions (no ATV access) or a deactivated bridge crossing downstream. All crossing structures have been summarized in an excel workbook template provided by BC Environment (Appendix 1). Four maps (1:20,000 scale) were created to show the crossing structures within the Lower Skeena area and all assessment results (Appendix 2) and photos of each structure are available in electronic format (Appendix 3).

Closed Bottom Structure Assessments

Nearly half (42% or 90 crossings) of accessible crossings were closed bottomed structures (CBS). At 39 of those, a fish passage assessment was not carried out either due to a lack of fish habitat gain (*e.g.* excessive gradient or natural barrier) or a lack of stream channel associated with the crossing structure (*e.g*. cross-ditch culvert). At the remaining 51 crossings a fish passage culvert assessment (FPCA) was carried out. 49 of 51 crossings were barriers (76%) or potential barriers (20%) to safe fish passage, while 2 crossings were passable (4%).

The results are presented by watershed in order of highest fisheries value to lowest (from Table 1). Within each table, the crossing results have been prioritized by FPCA result (barrier, potential barrier, passable) then by known fish presence, habitat value and potential habitat gained. Any downstream structures have been identified, and a restoration solution has been proposed for the top structures in each watershed.

Exstew River Watershed

The Exstew River has the highest fisheries value (0.22) of any watershed group in the Lower Skeena that can be accessed by vehicle. Known fish observations in the Exstew River include five species of Pacific salmon (chinook, chum, coho, pink and sockeye), steelhead, cutthroat trout and Dolly Varden (char) as well as mountain whitefish (BC MOE, 2009c). Fish passage assessments were completed for 12 culvert crossings in the Exstew River watershed. There were 14 crossing structures in the Exstew River watershed that had not been identified during the mapping phase. These structures were numbered from 1 to 14 using the prefix ‘EX’ (*e.g.* EX001). Values for habitat gain upstream of these crossings were not available through GIS since they are not associated with a mapped stream, but an estimate was provided from the field observations where possible.

One third of the crossings assessed were a potential barrier and the other two thirds were a barrier to fish passage. Coho fry were observed at three of the crossings assessed. The structures were ranked in Table 3 based on the value of the fish habitat and the potential habitat gained at each of the crossing structures. A restoration solution has been proposed for the top

six ranked structures and photos of the inlets, outlets and upstream habitat for each are shown in Figure 2 through Figure 7.

In several cases, an OBS has been recommended for replacement of the existing CBS below an active beaver pond (e.g. EX004). Replacing the existing structure with an OBS will likely cause a loss of pond habitat upstream. The trade-off between gaining fish passage and loss of pond habitat must be considered carefully in each case.

The timing window for culvert replacement work in the Exstew River watershed would likely be a two week period in August which would be confirmed during the in-stream work notification and approval process (BC MOE 2005).

Many of the crossing structures in the Exstew River watershed are partially blocked with beaver dam debris and require maintenance. Beavers are active in the Exstew River, requiring more frequent maintenance of crossing structures or the dams can block fish passage and damage roads. Culverts that are being plugged from the upstream end should be cleared of debris as soon as possible, and beaver cages or trash racks should be properly installed if the structure cannot be replaced with an OBS.

Table 3. Fish Passage Culvert Assessment Results and Proposed Solutions for the Exstew Watershed.

Crossing ID	Location	Notes	FPCA Result	Habitat Value	Fish Sighted?	Fish Habitat Gain (m)	Dnstrm Crossings & ID	Beaver Activity	Channel Width (m)	Valley Fill	Proposed Solution
EX004	9U 494953 6031090	2 culverts plugged solid with beaver dam debris. Active beaver pond upstream. Culvert slope measured from top of culvert (intakes buried in mud). Coho fry inside culvert.	**21,Barrier**	High	Yes	500*	0	Yes	5	DF	OBS, 7m span
EX005	9U 495007 6031097	Intake completely plugged with beaver debris. Minimal flow. Drains same pond complex as Exstew004. Recommend clearing culvert, install beaver cage. Culvert sloping upward.	**21,Barrier**	High	No	500*	0	Yes	2	DF	OBS, 4m span
EX007	9U 496207 6030378	2 culverts. Left is set lower at outlet but inlet is bent upwards causing more water to flow into right culvert. Both inlets partially plugged with small woody debris. Large outlet pool, good habitat. Gradient increases upstream to 10%+	**31,Barrier**	Mod.	No	100*	0	No	5	SF	OBS, 9m span
377319	9U 494731 6031153	Mostly dry channel, isolated 2x2m pool below outlet with approx 30 stranded Coho fry, approx 40m from river. Beaver dam 5m upstream, water seeping through, not running over. Small beaver pond upstream of dam.	**26,Barrier**	Low	Yes	1277	0	Yes	2.7	DF	OBS, 5m span
377276	9U 493251 6033143	Collapsed beaver cage at inlet. Small pond upstream created by suspended intake.	**36,Barrier**	Low	No	130	0	Yes	6.2	DF	OBS, 11m span
377279	9U 493345 6033038	Poorly defined channel downstream. Mainly organic substrate. Dammed pool u/s from suspended inlet. Primary culvert 700mm, with 600mm culvert wedged inside. Beaver cage at inlet. Secondary culvert on right bank, intake 1/2 plugged with beaver dam material.	**26,Barrier**	Low	No	123	0, 377285 NCS	Yes	6	DF	OBS, 10m span
EX006	9U 495777 6030735	Small seepage stream, minimal flow, channel not well defined upstream. Debris jam in culvert barrel near inlet 2/3 full.	**26,Barrier**	Low	No	n/a	0	No	1	SF	
EX009	9U 496677 6029875	Small seepage stream. Minimal scouring, frequent subsurface sections, marginal fish habitat.	**26,Barrier**	Low	No	n/a	0	No	0.9	DF	
EX010	9U 496870 6029481	Small sidechannel of larger stream that crosses 377323 & 377326. Water backed up through culvert from debris jam 6m downstream. Fairly new installation. Intake bent. Evidence of widespread flooding throughout area (1-2 years ago?).	**18,Potential Barrier**	High	Yes	n/a	0	No	1.1	DF	
377321	9U 495625 6030837	Beaver dam inside culvert. Large beaver pond downstream, small upstream. No channel widths taken. Recommend clearing debris from culvert barrel.	**18,Potential Barrier**	Mod.	No	161	0	Yes	Beaver Pond	DF	
EX003	9U 493867 6032437	Recently installed culvert after road wash-out, appears to be x-ditch culvert. Man-made downstream channel 20m to river, 1.5m drop into river - barrier during low water. Sedge meadow wetland drains into upstream right road ditch before entering culvert.	**16,Potential Barrier**	Low	No	n/a	0	Yes	1.4	DF	
EX011	9U 496905 6029396	Culvert drains same beaver pond as bridge 40m North (377326) Intake suspended above water line, downstream mainly dry. If not replaced, fish can migrate through bridge.	**15,Potential Barrier**	Low	No	n/a	0	Yes	Beaver Pond	DF	

Figure 2. Crossing structure EX004, the culvert outlets (left) and inlets (middle) and upstream (right).

Figure 3 Crossing structure EX005, the culvert outlet (left) and inlet (middle) and upstream (right).

Figure 4. Crossing structure EX007, the culvert outlets (left) and inlets (middle) and upstream (right).

Figure 5. Crossing structure 377319, the culvert outlet (left) and inlet (middle) and upstream (right).

Figure 6. Crossing structure 377276, the culvert outlet (left) and inlet (middle) and upstream (right).

Figure 7 Crossing structure 377279, the culvert outlets (left) and inlets (middle) and upstream (right).

Dasque River Watershed and Surrounding Areas

Roughly 25 kilometers (as the crow flies) west Southwest of Terrace, Dasque Creek flows North into the Skeena River. The Dasque watershed is accessed via the Whitebottom Forest Service Road (FSR). All crossings on the Whitebottom FSR and within the Lower Skeena project area (excluding Lakelse River and area) were assessed up to and including Dasque Creek. Shortly past the Dasque Creek bridge crossing, the Dasque FSR begins, and all crossings along this section of road were also assessed. Most of these crossing structures can be found on the Dasque area map, with a few of the crossings at the start of the Whitebottom FSR located on the Alwyn map (Appendix 2) . Crossing structures that had not been identified during the mapping phase were numbered from 1 using either the prefix 'DAS' for those located on the Dasque FSR (*e.g.* DAS001) or 'WB' for those located on the Whitebottom FSR. Values for habitat gain upstream of these crossings were not available through GIS since they are not associated with a mapped stream, but an estimate was provided from photos and field notes where possible.

Overall, the fisheries value in Dasque Creek is relatively high (0.17). Known fish observations in Dasque Creek include two species of Pacific salmon (coho and chinook), along with Bull trout, cutthroat trout and Dolly Varden (char) (BC Ministry of Environment 2009c). The road to the east of Dasque Creek that parallels the mainstem was severely overgrown and not accessible by ATV. The watershed to the east of Dasque Creek is known locally as Middle Creek, and known fish occurrences include Bull trout, coho, cutthroat trout and Dolly Varden. A bridge has been pulled on a major tributary flowing into Middle Creek (crossing 377386) and there was no access up the road to the east of Middle Creek. While fish observations data were not compiled for the smaller creeks in the adjacent area (smaller than 3rd order watershed), species occurring are assumed to be similar to Middle and Dasque creeks.

Fish passage assessments were completed for 20 culvert crossings in the Whitebottom FSR and Dasque FSR areas. Many of the crossings (70%) were dry or had very little flow at the time of assessment. One crossing provided safe passage for fish, while another 4 were a potential barrier, and the remaining 15 were barriers to fish passage. Crossings were ranked based on fish habitat value and potential habitat gain. One structure was identified for remediation as shown in Table 4. Crossing structure 377334 was found to be a barrier to safe fish passage (shown in Figure 8) and a proposed solution is to replace the existing structure with an OBS (*e.g.* wood box culvert).

Based on the known fish observations data summarized on the maps in Appendix 2 (BC MOE 2009c), coho, cutthroat trout and Dolly Varden (char) have been observed in a stream and lake connected to the stream crossed by structure 377334. Using this data, the timing window for replacement of structure 377334 would likely be in August, although notification and approval of the in-stream work window would be required (BC Ministry of Environment 2005).

Figure 8 Crossing structure 377334, the culvert outlet (left) and inlet (middle) and upstream (right).

Many of the crossing structures in these areas are likely used mainly during freshet when streams are often carrying significant bedload. In this type of system, culvert intakes need to be cleared of sediment regularly. Many of the structures assessed require maintenance. Beaver activity was observed at only three of the crossing structures but these structures require more frequent maintenance or the dams can block fish passage and threaten roads.

Table 4. Fish Passage Culvert Assessment Results and Proposed Solutions for the Dasque Watershed and surrounding areas.

Crossing ID	Location	Notes	FPCA Result	Habitat Value	Fish Sighted?	Fish Habitat Gain (m)	Dnstrm Crossings & ID	Beaver Activity	Channel Width (m)	Valley Fill	Proposed Solution
377334	9U 511506 6029684	Culvert inlet crushed in, very low flow. Inlet drop caused by debris jam.	36, Barrier	Mod.	No	417	377336, NCS	No	4.6	DF	OBS, 7m span
378013	9U 518490 6034757	Intake is plugged with beaver dam debris, non-functional beaver cage at inlet. Dense over stream vegetation downstream (alder, willow). Stream flows through private land d/s, may be crossing structure present.	21, Barrier	Mod.	No	3129	unknown - private land	Yes	2	DF	OBS, 4m span
378137	9U 498353 6025948	Dry channel, only a bit of rust in culvert. Stream runs down ditch for 60m and then through culvert. Stream 7% upstream. Bystander (and previous MOE employee) said Coho used to use stream 10 years ago.	36, Barrier	Mod.	No	163	377377 - NCS, hydro line	No	3	SF	OBS, 5m span
377347	9U 501840 6028043	Inlet 1/2 plugged with sediment. Dry channel at assessment. Good upstream habitat.	31, Barrier	Mod.	No	125	0	No	5.4	SF	
377358	9U 501030 6026766	Water flowing 5m downstream of culvert, but no water through culvert. Deep pools, no gravels, lots of cover. 8cm outlet drop onto boulder grade, no outlet pool.	26, Barrier	Mod.	No	105	0	No	3.1	SF	
377364	9U 500835 6026576	Dry channel at assessment. Culvert partially crushed and outlet 1/2 filled with substrate. 23% upstream.	29, Barrier	Mod.	No	64	377363, NCS hydro line	No	4.2	DF	
378124	9U 500917 6026697	Dry channel. Small wetland area upstream. Large outlet pool although water drops 44cm onto boulder falls.	36, Barrier	Mod.	No	25	0	No	2	DF	
377366	9U 500693 6026549	Dry channel at assessment. Substrate buildup at inlet causing drop into culvert. No pool at outlet, water falls over boulders.	26, Barrier	Mod.	No	68	377364	No	2.1	DF	
DAS007	9U 497830 6025560	3m falls over boulder & LWD approx. 12m downstream of CBS.	26, Barrier	Mod.	No	n/a		No	1.4	SF	
DAS008	9U 497878 6025573	Downstream channel not well defined. Flow over boulders 2 m downstream of culvert. 70cm falls over rock 0.5m upstream of culvert. Stream subsurface 5m upstream.	21, Barrier	Mod.	No	n/a		No	1.5	SF	
377376	9U 505779 6026366	No outlet pool, water falls over boulders. Rip-rap 0.5m falls approx 5m downstream of culvert. Stream is subsurface approx 15m upstream of inlet. No crossing found downstream (378134).	39, Barrier	Low	No	769	377373, NCS deact.	No	1.7	SF	
377405	9U 494411 6024201	Dry channel, rust line in culvert approx 1/3 depth. CBS approx. 20m upstream of Skeena River. No gravels present.	21, Barrier	Low	No	158	0	No	4.3	DF	
WB001	9U 508342 6026937	Dry channel at assessment. 2 CBS, lower elevation one is buried in bed load at inlet. Very large bed load during freshet.	36, Barrier	Low	No	n/a		No	4	DF	
WB005	9U 510574 6028783	Overflow CBS for dry stream channel with bridge (377342). Baffles inside culvert. Braided channel downstream.	26, Barrier	Low	No	n/a		No	5.5	DF	
WB003	9U 510244 6028443	Dry at assessment, but definite channel present. No spawning gravels present, some deep pools.	26, Barrier	Low	No	n/a		No	3.2	DF	
377387	9U 496529 6025378	No channel downstream, empties into Skeena River. Beaver dam 4m upstream completely blocking flow.	19, Potential Barrier	Mod.	No	1290	0	Yes	5	DF	
WB002	9U 516931 6033777	Very high rust line in culvert suggesting beaver dam blow-out or abnormal high water event. Gravel/cobble accumulated below outlet. Beaver cage @ inlet, inlet obscured by dense veg. and jammed with beaver sticks. Dry channel d/s, u/s 0.5m channel meandering through shrub swale.	18, Potential Barrier	Low	No	n/a		Yes	1.4	DF	
377341	9U 510820 6028845	2 culverts. Right is primary. Function as both cross-ditch and overflow for stream to West (bridge crossing 377342). Dry channel, likely wet only during freshet or flood events. Marginal habitat. Both culverts 1/2 blocked with rock debris.	16, Potential Barrier	Low	No	343	377336, NCS	No	2.8	DF	
DAS005	9U 496521 6025373	Dry channel, 21% downstream slope to Skeena.	15, Potential Barrier	Low	No	n/a		No	n/a	DF	
377402	9U 495059 6024291	Damage (tear) to culvert at inlet.	14, Passable	Low	No	146	0	No	8.5	SF	

Shames

Roughly 25 kilometers west of Terrace on Highway 16, the Shames River flows south into the Skeena River (Appendix 2). The local ski resort is located in the Shames watershed and the main road is in very good condition for vehicle traffic. Many of the branch roads were either overgrown or had to be accessed with an ATV. Crossing structures that had not been identified during the mapping phase were numbered from 1 using the prefix 'SH' (*e.g.* SH001).

Overall, the fisheries value in the Shames River watershed is relatively high (0.17). The mainstem and fish bearing portions of tributaries to it are used by four species of Pacific salmon (coho, chinook, chum and pink) and steelhead, as well as Dolly Varden (char) and cutthroat trout (BC Ministry of Environment 2009c).

Fish passage assessments were completed for five culvert crossings in the Shames River watershed. The valley walls are generally very steep and habitat upstream and downstream of many crossings was too steep to support fish populations. All 5 assessed crossings were barriers to fish passage. Crossings were ranked based on fish habitat value and potential habitat gain. One structure was identified for remediation as shown in Table 5. Crossing structure 377970 was found to be a barrier to safe fish passage (shown in Figure 9). A proposed solution is to replace the existing structure with an OBS (*e.g.* wood box culvert). The cost of replacing this structure with an OBS is expected to be fairly high given the deep fill over the existing culvert (2.5m) and the length of the existing structure (18m). All of the other CBS had gradient or other natural barriers to fish passage either up or down stream of the structure. Crossing structure 378062 was downstream of another crossing structure (378063) by roughly 50 metres. The upstream crossing (378063) was not assessed due to a 1.5 metre falls 2 metres upstream of the inlet, an upstream gradient of 35% and subsurface flows.

Table 5. Fish Passage Culvert Assessment Results and Proposed Solutions for the Shames Watershed.

Crossing ID	Location	Notes	FPCA Result	Habitat Value	Fish Sighted?	Fish Habitat Gain (m)	Dnstrm Crossings & ID	Beaver Activity	Channel Width (m)	Valley Fill	Proposed Solution
377970	9U 504591 6035427	Nice creek, no barriers in immediate area, no excessive gradient, DV should use creek.	**39, Barrier**	Mod.	No	438		No	1.3	DF	OBS, 6m span
378062	9U 505487 6032048	Stream enters from right following ditch for 20m. Big pool at outlet.	**34, Barrier**	Mod.	No	83		No	1.7	DF	
377945	9U 504108 6035858	Gradient barrier (step-pool) downstream. 1m cascade over boulders 20m downstream (x2). Some spawning gravel present but stream power high and bed material moving frequently.	**29, Barrier**	Low	No	403		No	8	DF	
378058	9U 505420 6032232	60cm falls over boulders 6m us, old road with collapsing WBC approx 15m upstream, water pooled in ditch seems stagnant.	**34, Barrier**	Low	No	95		No	1.1	DF	
377927	9U 503791 6036096	Small woody debris accumulated at inlet. No benefit to replacement with OBS due to excessive gradient u/s. 1/5m falls over road fill debris 10m downstream.	**34, Barrier**	Low	No	29		No	1.9	DF	

Figure 9 Crossing structure 377970, the culvert outlet (left) and inlet (middle) and upstream (right).

Alwyn Creek

The fisheries value in the Alwyn Creek watershed is 0.13, one of the lowest values for watersheds in the Lower Skeena area. Known fish observations in Alwyn Creek include three species of Pacific salmon (coho, chinook and pink), along with Dolly Varden (char) and cutthroat trout (BC Ministry of Environment 2009c). Crossing structures that had not been identified during the mapping phase were numbered from 1 using the prefix 'AL' (*e.g.* AL001). Values for habitat gain upstream of these crossings were not available through GIS since they are not associated with a mapped stream. Fish passage assessments were completed for 10 culvert crossings in the Alwyn watershed as summarized in Table 6. All of the crossings were on private or non-tenure roads. There were four crossings in the Alwyn watershed that could not be assessed as they were located on private lands. One of the crossings (377973) was downstream of another (377946) but all four crossings were the most upstream crossings on a given stream segment (shown on the Alwyn map in Appendix 2). Beavers are very active in the Alwyn watershed.

Of the 10 crossings, fish should be able to safely pass through one, two others are potential barriers and the remaining seven are barriers to fish passage. Crossings were ranked based on fish habitat value and potential habitat gain and four structures were identified for remediation as shown in Table 6. Three of the structures are upstream of an OBS (shown in Figure 18) which may be a barrier to fish passage.

Table 6. Fish Passage Culvert Assessment Results and Proposed Solutions for the Alwyn Watershed. Fish habitat gain for unmapped crossing structures have values followed by an asterix (*) which indicates these values have been roughly estimated from photos and field notes.

Crossing ID	Location	Notes	FPCA Result	Habitat Value	Fish Sighted?	Fish Habitat Gain (m)	Dnstrm Crossings & ID	Beaver Activity	Channel Width (m)	Valley Fill	Proposed Solution
378014	9U 524396 6034855	Large stream. Old hydrometric station adjacent to outlet. Beaver dam 1m u/s of dual culverts, water running over top.	**34, Barrier**	High	No	4148	378021 collapsing OBS	Yes	4.5	DF	**OBS, 10m span**
377977	9U 519731 6035867	Beaver cage at inlet & outlet. Overflow culvert set 1m above stream bed. This site undergoes regular beaver dam blow-outs upstream. 377968 is potential barrier downstream.	**21, Barrier**	High	No	2457	377968 - potential barrier	Yes	2.7	DF	**OBS, 5m span**
378039	9U 524277 6034004	Beaver cage laying to side of creek.	**31, Barrier**	High	No	460	378021 collapsing OBS	Yes	3.6	DF	**OBS, 6m span**
AL002	9U 524301 6034042	Water is not turbid (but all other tribs to Alwyn very turbid on assessment day). Outlet pool plugged up with log debris. Upstream very small stream, low gradient with gravels.	**31, Barrier**	High	No	<500*	378021 collapsing OBS	No	1.6	DF	**OBS, 4m span**
377995	9U 525122 6035538	Man-made dam/pond approx 30m upstream creating 2m falls/cascades. Culvert well of right bank immediately d/s of outlet. Plastic pipe drawing water from outlet into well.	**31, Barrier**	High	No	**30**	378014	Yes	2.8	DF	
378020	9U 524335 6034519	Would be very expensive to fix due to deep fill over culvert (>4m).	**29, Barrier**	Mod.	No	1169	378021 collapsing OBS	No	2.3	DF	
378044	9U 523313 6033928	Two culverts, same elevation. Both have holes rusted through and most water is coming from underneath and through Right culvert.	**25, Barrier**	Low	No	173	378024 deact. NCS	No	1.9	DF	**RM**
378019	9U 520768 6034402	RC sticking out of road. Old beaver dams us and ds. Debris backed up at left culvert inlet, right culvert only has a little water in it. Water has run over road. ATV access along hydro line.	**16, Potential Barrier**	Mod.	No	3560	377983 OBS	Yes	3	DF	**RM**
377968	9U 518698 6036032	Minimal benefit however is located downstream of high value fish habitat at crossing 377977. Abandoned beaver pond upstream, beaver stop at inlet, partially blocked with wood debris. MOT road.	**16, Potential Barrier**	High	No	3252	377969 OBS	Yes	3.7	DF	**OBS, 9m span**
378041	9U 522984 6033956	Two culverts, cedar cribbing on top. 1m falls over LWD approx 10m downstream. Left culvert partially filled with gravel at inlet.	**13, Passable**	Mod.	No	633	378024 deact. NCS	No	2	DF	

Figure 10 Crossing structure 378014 on Matson Rd., the culvert outlets (left), inlets and beaver dam (middle), and upstream (right).

Figure 11 Crossing structure 377977 on Kozier Rd., the culvert outlet (left), inlet (middle), and upstream (right).

Figure 12 Crossing structure 378039 on Matson Rd., the culvert outlet (left), inlet (middle), and upstream (right).

Figure 13 Crossing structure AL002 on Matson Rd., the culvert outlet (left), inlet (middle), and upstream (right).

Figure 14 Crossing structure 377968 on Old Remo Rd., the culvert outlet (left), inlet (middle), and upstream (right).

In addition, two crossing structures listed in Table 6 have been flagged for removal (RM). Consultation with stakeholders would be necessary to determine whether crossing structures 378044 and 378019 should be removed. The culverts are rusted and should either be replaced or removed. Both crossings are located along an old road accessed from the hydro line access road past the Old Remo substation. The road is used regularly by recreational ATV operators. Further down the road, a culvert (378034) was

found sitting in the stream, likely the result of a wash-out from an unmaintained crossing. This structure should be removed. The three structures proposed for removal are shown in Figure 15. The highest priorities of the three are 378019 and 378034.

Figure 15. Crossing structures along the hydro line which should be removed or replaced with OBS. (378044 is shown on the left, 378019 is in middle and 378034 is shown on the right).

McNeil River and area

The Green River FSR (419960) has been partially deactivated and access was gained using an ATV. There is no vehicle access past kilometer 6. Four of the modeled crossing structures had been removed, while two crossing structures remained. The two remaining crossing structures, 377474 and 377479, crossed streams that were determined to be non-fish bearing due to a sustained 35% channel gradient both downstream and upstream of the culvert, and a 30 meter waterfall immediately upstream of the culvert, respectively. Only one modeled crossing was identified in the nearby Antigonish Creek watershed (Lachmach FSR) and there was no stream channel at the mapped location. A crossing structure North of Minerva Lake was not assessed due to an ATV impassable slide on the road before the crossing structure. All crossing structures are shown on the McNeil River map (Appendix 2).

Amsbury and Delta

Two smaller watersheds, Amsbury and Delta creeks are located west of Terrace and east of the Shames River. Roads in the area of the two creeks were accessed mainly by ATV. All crossing structures are shown on the Alwyn map (Appendix 2).

Four crossing structures were assessed and are listed in Table 7. The first two crossings listed in Table 7 are located on highway 16. The third crossing (377316) is on a permitted road (R07369A). Crossing structures 377316 and 378064 are not a priority for remediation due to the low habitat value in the stream and lack of connectivity with the Skeena River.

Table 7. Fish Passage Culvert Assessment Results and Proposed Solutions for the Amesbury and Delta Watersheds.

Crossing ID	Location	Notes	FPCA Result	Habitat Value	Fish Sighted?	Fish Habitat Gain (m)	Dnstrm Crossings & ID	Beaver Activity	Channel Width (m)	Valley Fill	Proposed Solution
377964	9U 514849 6035934	Beaver dam 3m and 10m upstream of CBS. Minimal flow. Outlet spills onto boulder rip-rap 2m deep, no outlet pool. Slow moving shallow pools downstream. Hwy 16 crossing.	**42, Barrier**	Mod.	No	1,008	377976 OBS	Yes	4.1	DF	
377981	9U 514307 6035503	Large culvert structure, base lined with concrete creating shallow high velocity rapids. 2m falls over boulders 50m upstream. Minimal benefit due to steep gradient upstream.	**32, Barrier**	Low	No	379	0	No	8.6	DF	
377316	9U 510444 6032230	Minimal Benefit. No connectivity of channel to Skeena River. Recommend clearing intake.	**26, Barrier**	Low	No	641	378066	No	2.9	DF	
378064	9U 510643 6032136	Minimal Benefit. No connectivity of channel to Skeena River.	**24, Barrier**	Low	No	809	0	Yes	n/a	DF	

Two crossing structures, 377309 and 377311, were not assessed because they were not fish bearing streams due to the steep gradient both upstream and downstream of the crossings. However, the 600mm culvert structure 377309 is buried under rock debris and the stream has cut a new channel through the road beside the culvert. Although the stream is considered non-fish bearing, the road has already undergone severe erosion. The crossing structure requires maintenance or should be removed. Similarly, the culvert inlet of crossing structure 377311 was found to be 75% buried under rock debris and part of the road has washed out. The crossing structure requires maintenance or should be removed. While there may not be fish passage issues at some of these structures, there are environmental concerns (e.g. road washout) and potential liabilities associated with leaving the structures as they are.

Open Bottom Structures

Of the 217 accessible modeled and 32 unmapped crossings, one quarter (24%) were open bottomed structures (OBS) including 35 box culverts (also known as log culverts) and 25 bridges. At 27% of modeled crossings, there was no crossing structure present either due to road deactivation (20 crossings) or modeling error (e.g. gas pipeline or hydro line showing as a road and creating 38 potential crossings). While the scope of this project did not include assessments of OBS, the condition of each wood box culvert was noted in the field and summarized in Table 8. Several are a barrier to fish passage, and others need urgent maintenance before they too become barriers. The photo in Figure 16 shows an example of a collapsing wood bridge on a fish bearing stream (crossing structure 378065, Alwyn map). Photos of crossing structure 377976 in Figure 17 illustrate an example of a collapsing wood box culvert (Alwyn map). Figure 18 shows three more crossings in need of maintenance, 378021, DAS010 and WB006. Photos of all crossing structures are available electronically as Appendix 3.

Table 8 List of wood box culverts (and one concrete box culvert), summary of field notes and whether maintenance (action) is required.

Crossing ID	Location	Field Notes	Action Needed
377339	9U 511373 6029291	collapsed	Yes
377355	9U 504715 6027261	nearly filled with substrate	Yes
377976	9U 514777 6035630	collapsing WBC, intake blocked and creating fish barrier	Yes
378021	9U 522577 6034391	collapsing WBC, needs removal	Yes
378054	9U 523345 6033524	needs maintenance, nearly filled with sediment	Yes
378120	9U 492714 6026914	inlet completely covered with rock debris	Yes
DAS003	9U 494130 6024073	silt fence blocking wbc	Yes
DAS010	9U 498299 6025933	concrete structure nearly filled up with substrate	Yes
WB006	9U 511440 6029358	wbc at stream grade, water trickling underneath from wetland upstream	Yes
377255	9U 491657 6035089	advanced state of decay, no stream associated with it	No
377256	9U 491782 6034844	advanced state of decay but not collapsing	No
377258	9U 490322 6034632	ok, no scouring or alluvial deposits	No
377262	9U 522791 6035450	not great condition, but ok	No
377267	9U 491362 6033689	ok, no scouring or alluvial deposits	No
377269	9U 491327 6033618	WBC over small seepage stream. Beaver dam 8m d/s has water backed up through structure. Beaver sighted in pond.	No
377273	9U 491364 6033389	ok	No
377274	9U 490367 6033578	ok	No
377277	9U 491930 6032818	no comment	No
377297	9U 492235 6032499	no stream channel, WBC advanced decay	No
377320	9U 495514 6031030	very rotten but intact WBC	No
377335	9U 496809 6028954	ok	No
377350	9U 501948 6028146	no comment	No
377375	9U 499112 6026060	no comment	No
377407	9U 494207 6024108	no comment	No
377894	9U 500686 6037844	no comment	No
377975	9U 504788 6035222	starting to rot, still intact, ok condition	No
378123	9U 492480 6026373	no comment	No
378149	9U 495714 6024534	no comment	No
DAS001	9U 493180 6023668	no comment	No
DAS002	9U 493977 6024074	no comment	No
DAS006	9U 497368 6025850	no comment	No
DAS009	9U 498080 6025686	no comment	No
EX001	9U 492943 6033544	starting to decay, still intact	No
EX002	9U 493606 6032731	ok, decaying but still intact	No
EX008	9U 496578 6030001	ok	No

Figure 16 Old collapsing bridge across Delta Creek (crossing structure 378065)

Figure 17. Collapsing WBC creating a 1 meter fish barrier (left) and upstream habitat (right). Crossing structure 377976 on unnamed creek east of Amsbury Creek.

Figure 18 WBC in poor condition. Crossing 378021 (left), DAS010 (middle) and WB006 (right). DAS010 and WB006 are nearly blocked with alluvial deposits resulting in poor fish passage conditions.

Recommendations

1. Based on the results for each of the watersheds assessed in the Lower Skeena, the structures that are barriers to fish passage have been listed in Table 9 in a proposed order of priority based firstly on fish habitat value and secondly on fish habitat gain upstream of each crossing structure. In some cases, streams with definite flow during the assessment were ranked higher in priority than streams that were dry during the assessment. In cases of unmapped crossings, the upstream habitat gain was estimated using maps, field notes and site photos. During the implementation planning phase (see recommendation 7), it may be worthwhile to revise the priority list if there are cost savings associated with fixing structures in the same watershed, as opposed to mobilizing equipment and personnel to multiple watersheds. For example, it may be more cost effective to fix the top four priority structures in the Exstew watershed before fixing the structures in the Alwyn watershed.

2. Although outside of the scope of this contract, for cases where required maintenance at a crossing structure was noted in the field notes, this has been shown in Table 9 (barriers to fish passage) and Table 11 (potential barriers to fish passage and passable structures). A blank cell under the column for maintenance does not mean that no maintenance is required, but rather that it was not noted in the field notes.

3. In several cases, an OBS has been recommended for replacement of the existing CBS below an active beaver pond. Replacing the existing structure with an OBS will likely cause a loss of pond habitat upstream. The trade-off between gaining fish passage and loss of pond habitat must be considered carefully in each case.

Table 9. Proposed list of priority crossing structures for restoration of safe fish passage. Fish habitat gain for unmapped crossing structures have values followed by an asterix (*) which indicates these values have been roughly estimated from photos and field notes.

Priority	Watershed	Crossing ID	Fish Habitat Value	Fish Habitat Gain (m)	Dnstrm Crossings & ID	Channel Width (m)	Proposed Solution	Maintenance Needed?
High	Exstew	EX004	High	500*	0	5	**OBS, 7m span**	
High	Alwyn	378014	High	4148	378021 OBS potential barrier	4.5	**OBS, 10m span**	
High	Alwyn	378039	High	460	378021 OBS potential barrier	3.6	**OBS, 6m span**	
High	Alwyn	377977	High	2457	377968 - potential barrier	2.7	**OBS, 5m span**	
High	Alwyn	AL002	High	<500*	378021 OBS potential barrier	1.6	**OBS, 4m span**	Yes
High[1]	Alwyn	377968	High	3252	377969 OBS	3.7	**OBS, 9m span**	Yes
High	Exstew	EX005	High	500*	0	2	**OBS, 4m span**	
High	Exstew	EX007	Mod.	100*	0	5	**OBS, 9m span**	
High	Shames	377970	Mod.	438		1.3	**OBS, 6m span**	
High	Whitebottom	377334	Mod.	417	377336, NCS	4.6	**OBS, 7m span**	
High	Exstew	377319	Low	1277	0	2.7	**OBS, 5m span**	
High	Exstew	377276	Low	130	0	6.2	**OBS, 11m span**	
High	Exstew	377279	Low	123	0, 377285 NCS	6	**OBS, 10m span**	
Mod.	Dasque	378013	Mod.	3129	unknown - private land	2	**OBS, 4m span**	Yes
Mod.	Dasque	378137	Mod.	163	377377 - NCS, hydro line	3	**OBS, 5m span**	
Mod.	Alwyn	378044	Low	173	378024 deact. NCS	1.9	**RM**	
Mod.	hwy 16	377964	Mod.	1,008	377976 OBS	4.1		Possibly

[1] Potential barrier based on culvert size (stream channel ratio) and lack of embeddedness. Benefit of restoration extends to upstream crossing structure (377977).

Priority	Watershed	Crossing ID	Fish Habitat Value	Fish Habitat Gain (m)	Dnstrm Crossings & ID	Channel Width (m)	Proposed Solution	Maintenance Needed?
Mod.	Alwyn	377995	High	**30**[2]	378014	2.8		
Mod.	Dasque	377347	Mod.	125	0	5.4		Yes
Mod.	Dasque	377358	Mod.	105	0	3.1		
Mod.	Shames	378062	Mod.	83	No	1.7		
Low	Dasque	DAS007	Mod.	n/a	*natural downstream barrier	1.4		
Low	Dasque	DAS008	Mod.	5*		1.5		
Low	Alwyn	378020	Mod.	1169	378021 collapsing OBS	2.3		no
Low	Dasque	377366	Mod.	68	377364	2.1		
Low	Dasque	377364	Mod.	64	377363, NCS hydro line	4.2		Yes
Low	Dasque	378124	Mod.	25	0	2		
Low	Whitebottom	WB001	Low	n/a		4		Yes
Low	Exstew	EX006	Low	n/a	0	1		Yes
Low	Exstew	EX009	Low	n/a	0	0.9		
Low	Whitebottom	WB005	Low	n/a		5.5		
Low	Dasque	WB003	Low	n/a		3.2		
Low	Delta area	378064	Low	809	0	n/a		
Low	Dasque	377376	Low	769	377373, NCS deact.	1.7		
Low	Delta area	377316	Low	641	378066	2.9		Yes
Low	Shames	377945	Low	403	No	8		
Low	Amsbury	377981	Low	379	0	8.6		
Low	Whitebottom	377405	Low	158	0	4.3		
Low	Shames	378058	Low	95	No	1.1		
Low	Shames	377927	Low	29	No	1.9		Yes

[2] GIS modeling predicted over 100m of upstream habitat gain, but a man-made pond structure with cascade may be a limiting factor.

Table 10. Maintenance issues noted at passable crossing structures and potential barriers to safe fish passage.

Priority	Watershed	Crossing ID	Fish Habitat Value	Fish Habitat Gain (m)	Dnstrm Crossings & ID	Channel Width (m)	Proposed Solution	Maintenance Needed?
Potential Barrier	Alwyn	378019	Mod.	3560	377983 OBS	3	**RM**	Yes
Potential Barrier	Whitebottom	377387	Mod.	1290	0	5		Yes
Potential Barrier	Exstew	377321	Mod.	161	0	Beaver Pond		Yes
Potential Barrier	Exstew	EX010	High	100*	0	1.1		
Potential Barrier	Dasque	377341	Low	343	377336, NCS	2.8		Yes
Potential Barrier	Whitebottom	WB002	Low	500*		1.4		Yes
Potential Barrier	Exstew	EX003	Low	n/a	0	1.4		
Potential Barrier	Exstew	EX011	Low	n/a	0	Beaver Pond		
Potential Barrier	Dasque	DAS005	Low	n/a		n/a		
Passable	Alwyn	378041	Mod.	633	378024 deact. NCS	2		Yes
Passable	Dasque	377402	Low	318		8.5		Tear in culvert at inlet

4. In the Alwyn watershed, one of the structures which is a priority for restoration is upstream of a structure which is a potential barrier (377968). Another two priority structures (378014 and 378039) are upstream of an OBS (shown in Figure 16) which may be a barrier to fish passage. These potential barriers downstream (377968 and 378021) must be considered for restoration along with the three priority structures in the Alwyn watershed. If fish passage can be restored through the downstream structures along with the priority structures, this would result in significant habitat gain in the Alwyn watershed.

5. The results of the analysis phase are reported in this document. The next phase of the Lower Skeena Fish Passage project is the ***restoration phase***, which requires regional input to confirm a list of structures identified for restoration of fish passage and creation of an ***Implementation Plan*** that considers operational issues and includes detailed designs and costing for specific structures (see BC Ministry of Environment 2009a for details). In the strategic planning document for fish passage assessments, the next steps are as follows (from BC Ministry of Environment 2009a):

    i. **Implementation plan** – create a table which details the structures identified for restoration of fish passage, the amount of unobstructed habitat as well as

the number of potential culverts upstream of a given crossing (start with table 9).

ii. **Consensus -** At the regional or sub-regional level, all parties with an interest in maintaining or using the road should be involved to decide which structures should be fixed or removed. This should include people with expertise in both fisheries/habitat biology and engineering. Things that should be considered include:

a. Habitat value
b. Fish life cycles
c. Cost/benefit
d. Acceptability of embedded culverts
e. Scheduled structure replacement date
f. Life of structure
g. Availability of personnel and equipment
h. Longevity of road
i. Active hauling
j. access

iii. **Detailed costing** – once the implementation plan is complete and sites have been identified for restoration, site specific designs can be drawn up with detailed cost estimates. This will be required to move forward with letting contracts, obtaining necessary approvals for in-stream works and finalizing schedules to complete the work.

iv. **Reporting and evaluation**: A subset of restored structures should be re-evaluated using the field assessment methodology (BC MOE 2009b) and the data should be submitted in the same format as new assessment data.

6. Watershed groups in the Lower Skeena priority area that could not be accessed by vehicle were not assessed in 2009 and have been summarized in Table 11. Given the extensive road networks and high fisheries values in some of the less accessible watersheds (*e.g.* Ecstall, Scotia), the remaining watersheds should be prioritized for field assessments in 2010 if funding is available. Information is needed regarding road status and deactivation plans for the remaining watersheds. Three of the watersheds (48, 59 and 62) have extremely remote access and would likely have to be completed by helicopter. Once the new assessment data is available, the implementation plan for the Lower Skeena priority area should be updated and endorsed by affected parties (as per the steps in recommendation 5: amend implementation plan, consensus, detailed costing, and reporting and evaluation).

Table 11. List of watershed groups within the Lower Skeena area that still require assessment.

Watershed Name	Short Watershed ID	Fish Value	Number of Modeled Culverts				Year	Schedule & Access
			Non Fish Habitat	Fish Habitat - Inferred	Fish Habitat - Observed	Total		
BIG FALLS CREEK	LSKE-58	0.18	41	57		**98**	**2010**	Boat / Helicopter and ATV
SCOTIA RIVER	LSKE-49	0.17	10	46	3	**59**	**2010**	Boat / Helicopter and ATV
ALDER CREEK	LSKE-36	0.16	14	9	1	**24**	**2010**	Boat / Helicopter and ATV
HAYWARD CREEK	LSKE-56	0.15	12	48	4	**64**	**2010**	Boat / Helicopter and ATV
unnamed	LSKE-54	0.14	19	22	2	**43**	**2010**	Boat / Helicopter and ATV
AYTON CREEK	LSKE-44	0.14	15	7		**22**	**2010**	Boat / Helicopter and ATV
WINDSOR RIVER	LSKE-40	0.14	3	2		**5**	**2010**	Boat / Helicopter and ATV
CARTHEW CREEK	LSKE-57	0.12	25	38		**63**	**2010**	Boat / Helicopter and ATV
ECSTALL RIVER	LSKE-48	0.28	3	3		**6**	**2010**	helicopter if roads present
unnamed	LSKE-59	0.14	8	12	1	**21**	**2010**	helicopter
unnamed	LSKE-62	0.14	2	2		**4**	**2010**	helicopter - if any crossings?
SKEENA		-	42	186	12	**240**		variable
Grand Total			466	606	43	1115		

7. Crossings in Amsbury, Delta and parts of the Alwyn watershed should be considered for deactivation (removal of crossing structure). While there may not be fish passage issues at some of these structures, there are environmental concerns (e.g. road washout) and potential liabilities associated with leaving the structures as they are.

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Appendix 1 Fish Passage Culvert Assessment Data Summary

Appendix 2. Site Maps

Appendix 3. Site Photos (available in electronic format)