Gitanyow Fisheries Authority

Kitwanga River South
Fish Passage-Culvert Inspection &
Water Quality Effectiveness Evaluation Project 2007

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1.0 Executive Summary

123 stream crossings were surveyed in the southern Kitwanga River Watershed for fish passage using the Fish Passage-Culvert Inspection (Parker 2000) and for sediment risk using the Water Quality Effectiveness Evaluation (Carson et al. 2007). Two crossings on suspected fish bearing streams were classified as barriers with further habitat and fish assessment recommended. Six of 104 crossings surveyed ranked from moderate to extreme sediment risk, 59 ranked low risk, and the remainder were zero risk. Remedial recommendations included grass seeding, bioengineering, road deactivation and constructing waterbars.

Overall, current fish passage and sediment risks are considered minimal for this part of the watershed, with regards to forestry roads. However, absence of fish caught with gee trapping indicates potential blockages downstream, possibly at highway crossings, and is an area needing further investigation. Future sedimentation risk is considerable as road crossings age and deteriorate, and could eventually release into the watershed if not maintained or removed.

2.0 Introduction

The purpose of the Kitwanga River South Fish Passage-Culvert Inspection & Water Quality Effectiveness Evaluation Project was to identify stream crossings within the Lower Kitwanga River Watershed that could impede fish movement into upstream reaches and to assess the degree of sedimentation entering the stream from the surrounding roadway. Funding for this project was made available through the Forest Investment Account (FIA, Contract #07-FIA-02).

For this project the Gitanyow Fisheries Authority (GFA) conducted two independent assessments. The first was the Fish Passage-Culvert Inspection Procedure (FPCI, Parker 2000) and the second was the Water Quality Effectiveness Evaluation (WQEE, Carson et al. 2007). The objective was to compile a large amount of data from individual stream crossings in a single visit. The scope of this project only included roads under the B.C. Ministry of Forests (MoF) jurisdiction that crossed tributaries of the Kitwanga River, downstream of Gitanyow Lake. This survey excluded crossings along Highway 37 N and within the Villages of Kitwanga and Gitanyow, as they were not under MoF jurisdiction.

The majority of the Kitwanga River is located within Gitanyow Traditional Territory. Since its establishment in 1994, the GFA who represents the Gitanyow Hereditary Chiefs on fisheries related issues has been active in the stewardship of the Kitwanga River Watershed through a variety of fish and fish habitat assessment and enhancement initiatives.

A maze of road networks have been created in the Kitwanga River Watershed since logging began in the mid 1960's (Hampshire and Torunski, 2001). A total of 132 stream crossings on Forest Service Roads (FSR's) were identified on 1:20,000 TRIM mapsheets for the lower Kitwanga River and its tributaries. Most of these roads were built to minimal standards prior to the implementation of the Forest Practices Code in 1995, which introduced more fish-friendly protocols to road building activities.

Prior to this FPCI/WQEE survey, the most recent watershed-wide stream crossing survey was completed in 2001 by GFA. GFA deemed it worthwhile to amass a current and comprehensive watershed-wide inventory of stream crossing structures in the Kitwanga River Watershed. In 2006, GFA conducted the FPCI survey and the Stream Crossing Quality Index (SCQI) on 7 of the 132 crossings in 2006, leaving another 125 crossings to evaluate (McCarthy 2007).

A map was generated showing all stream crossings and each site was assigned a unique identifier number. Data collected in 2006 and 2007 will be used to identify potential remedial works of all crossings deemed as fish barriers and/or potential sediment sources.

The first component of the assessment was the FPCI, which documented the ability of a culvert to provide unimpeded fish passage. The FPCI assessment procedures were based on standards described by Parker (2000) and were performed on streams with confirmed or documented fish presence. Poorly placed culverts can restrict fish movement by creating excessive water velocity within a culvert and extreme plunge falls at the outlet. Culverts can be categorized into three fish-passage scenarios:

- Full barrier - stops all fish at all flow stages,
- Partial barrier - stops certain fish species or individual life stages, or stops movement at certain time of the year,
- No barrier - allows fish passage year-round.

A velocity barrier exists when the water velocity exceeds the swimming capability of fish at any or all life stages according to the guidelines cited in Parker (2000). Culverts without baffles should not have slopes exceeding 0.5 percent for culverts greater than 24 meters in length, and 1.0 percent for culverts less than 24 meters in length. Juvenile salmonids generally cannot swim through water flowing in excess of 0.5 meters/second. Most adult salmonids would have difficulty swimming at burst speed (maintained for up to 165 seconds) through water flowing in excess of 6 meters/second, with the exception of adult steelhead trout that can swim through water flowing at 8 meters per/second. Height barriers exist when they exceed the jumping ability of fish at any or all life stages according to the guidelines cited in Parker (2000). In general, pool depth must be at least 1.3 times greater than the jump height. Juvenile salmonids would have difficulty jumping heights exceeding 0.5 meters. The maximum jump height for adult salmonids is 3.4 m for steelhead trout, 2.4 m for coho and chinook salmon, 2.1 m for sockeye salmon and 1.5 m for chum and pink salmon (Parker 2000).

The second component of the assessment was the WQEE, which documented the amount of sediment input from crossings including road surfaces, ditchlines, and road fills. In 2006, GFA carried out a similar sedimentation survey using the SCQI method (Beaudry 2006) on 23 sites in the Kitwanga Watershed. GFA's goal was to survey the remaining crossings using the SCQI method, to have a consistent evaluation of crossings for the southern Kitwanga Watershed. However, in 2007, FIA determined they would no longer fund the SCQI procedure, and would instead fund the WQEE procedure.

Methodology and results of the 2006 SCQI survey can be found in <u>The 2006 Kitwanga River Fish Passage-Culvert Inspection and the Stream Crossing Quality Index Project</u> (McCarthy, 2007), which is on file at the Ministry of Forests office in Smithers, and as well can be obtained through contacting FIA directly.

Both the SCQI and the WQEE surveys systematically assess the sediment delivery potential of a road crossing by evaluating the size and characteristics of road related sediment sources and the likelihood of the eroded material reaching the stream.

The purpose of the WQEE is to measure the effects of forestry related activities on stream water quality (Carson et al. 2007). Of primary interest is water turbidity, which is a measure of the cloudiness or clarity of water. This method assumes that all forestry related sedimentation originates from a point source that can be easily identified and quantified on the ground. WQEE inspections are undertaken in locations with the highest likelihood of generating sediment, including road crossings and harvested areas in close proximity to a watercourse. For this project, WQEE surveys were completed on all road crossings found, including streams with definable channels (presence of scouring or alluvial deposition), and streams that flowed subsurface.

Field crews were able to cover the majority of the watershed by pick-up truck, ATV, or on foot. Problematic crossings were then prioritized based on benefits gained by remediation in opening new habitat and/or by reducing sedimentation impacts. In addition to culvert crossings, bridges and deactivated crossings were visited and assessed for potential maintenance problems and sedimentation contribution and/or risk. An early onset of winter prevented several crossings from being assessed and these should be assessed in the 2008 field season.

Results of this assessment will be used to initiate funding of remedial works in 2008 and beyond from the various stakeholders responsible for forestry road maintenance within the southern Kitwanga River Watershed.

3.0 Description of Study Area

The Kitwanga River Watershed is bounded to the west by the Nass Mountain Range, to the east by the Kispiox Mountain Range, and to north by the Cranberry Watershed. The Kitwanga River drains towards the south into the Skeena River near the village of Kitwanga, B.C. (UTM 09055840 N, 6106300 E). It is a fifth order stream with a mainstem length of approximately 61 km and an average channel width of 15 m (5-40m) (Cleveland et al. 2006).

The river is comprised of the Upper Kitwanga River and the Lower Kitwanga River, with the divide being Gitanyow Lake (also referred to as Kitwanga or Kitwancool Lake). The Lower Kitwanga River has a mainstem length of approximately 36 km and receives drainage from four major tributaries: Tea Creek, Deuce Creek, Kitwancool Creek and Moonlit Creek (Figure 1).

The Upper Kitwanga River has a mainstem length of approximately 25 km and has no major fish-bearing tributaries. A barrier falls is located approximately 12.5 km upstream of Gitanyow Lake and all reaches above these falls are considered non-fish bearing (Biolith 1999). The reach directly above Gitanyow Lake is a wetland complex that provides high quality habitat for beavers. Beavers in this area significantly influence the system by restricting water flow and fish passage. Beaver dams cause extensive flooding, which has frequently altered the location of the mainstem channel (McCarthy et. al. 2003).

Gitanyow Lake is located to the north of Gitanyow Village and receives flow from the Upper Kitwanga River and several other smaller streams mostly concentrated on its west side. Gitanyow Lake is considered one of the ten important Skeena sockeye salmon producers (Cox-Rogers et. al. 2003). Biologically the Kitwanga Watershed is extremely rich, with an abundance of high valued fish habitat. It supports the following species of salmonids in addition to various species of coarse fish (Cleveland et al. 2006)

Sockeye/Kokanee Salmon (*Oncorhynchus nerka*)
Chinook Salmon (*O. tshawytscha*)
Pink Salmon (*O. gorbuscha*)
Chum Salmon (*O. keta*)
Coho Salmon (*O. kisutch*)
Steelhead / Rainbow Trout (*O. mykiss*)
Cutthroat Trout (*O. clarki*)
Dolly Varden (*Salvelinus malma)*
Bull Trout (*Salvelinus confluentus*)
Mountain Whitefish (*Prosopium williamsoni*).

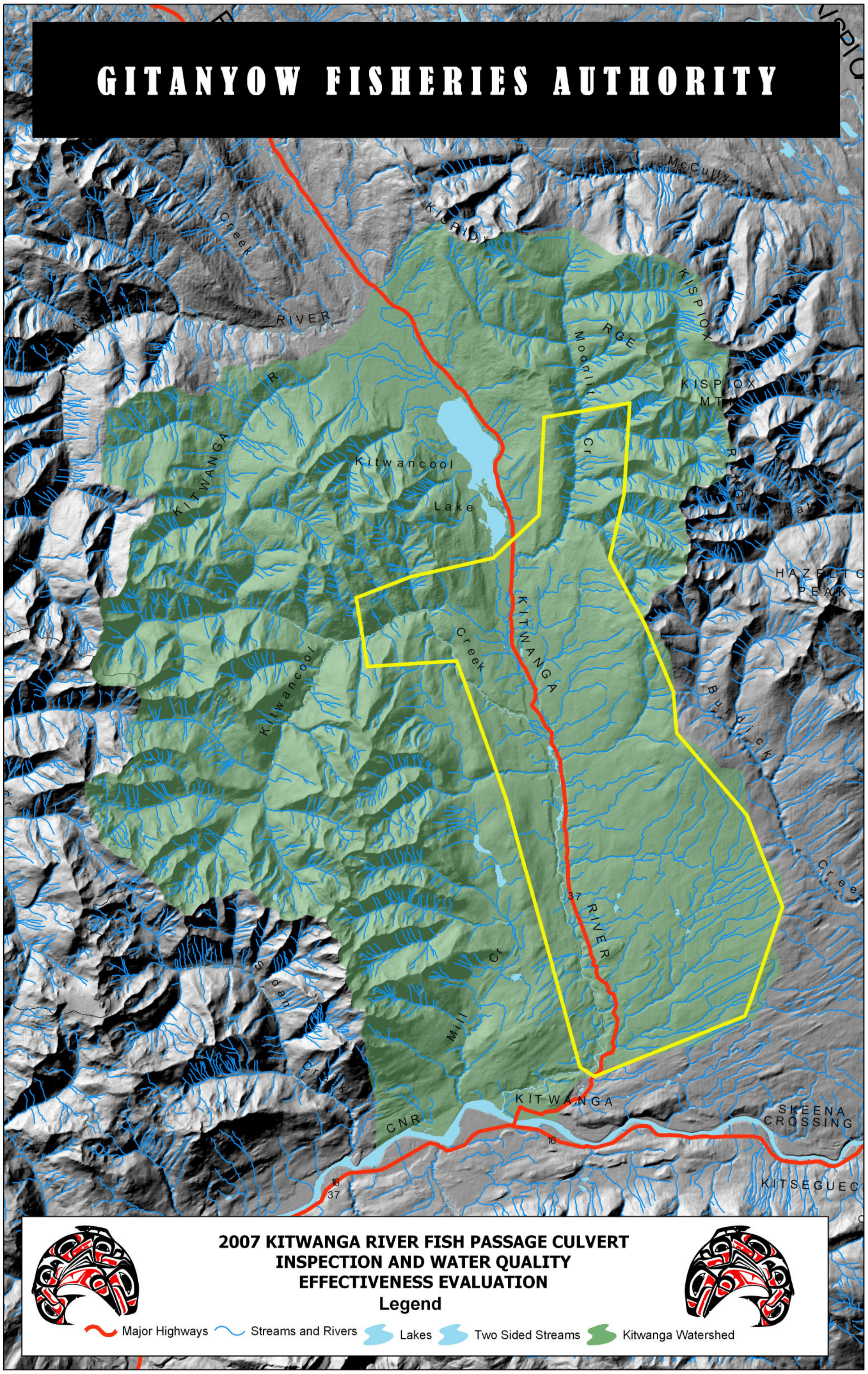

Figure 1: Map showing Kitwanga River Watershed shaded green. The yellow border shows the approximate boundary of the project study area.

4.0 Methods

Two independent field assessments were carried out for this project. The first assessment, the Fish Passage - Culvert Inspection (FPCI) Procedures, which assesses the ability of a culvert to provide unrestricted fish passage to salmonids at all life stages, was carried out according to the guidelines described in Parker (2000).

The second assessment, the Water Quality Effectiveness Evaluation (WQEE), which measures the input of fine sediment into streams from road crossings, was carried out according to the guidelines described in Carson et al. (2007). FPCI surveys were conducted at culvert crossings where streams had a good likelihood of containing fish, however WQEE surveys were conducted at all crossings found. The FPCI and the WQEE were undertaken between September and November, 2007, when young-of-the-year salmonids were of sufficient size to be captured by Gee trapping.

Initial planning included identification of all stream crossings in the Kitwanga Watershed and the assignment of unique identifier numbers for each. A 1:50,000 map was produced for this project showing all road crossings including Forests Service roads, Ministry of Transportation (MoT) highways and roads and private roads. The unique identifier numbers formed the basis of a GIS database containing all relevant information on site location, type of crossing structure, fish habitat quality, and fish passage and sedimentation concerns.

Tributary streams with gazetted names include Tea Creek, Earl Creek, Deuce Creek, Ace Creek, Kitwancool Creek, Ten Link Creek, Moonlit Creek and Cher Nobel Creek. Approximately 80 streams are unnamed. On the final map produced for this project (see Appendix 3), tributaries were assigned the same identifier numbers (1-23) used in Watershed Restoration Program (WRP) Level I surveys conducted by Biolith (1998). Unnamed tributaries draining into the west side of the Kitwanga River between Kitwanga Lake and the Skeena River confluence were not assessed under WRP and remain unnamed in this report.

4.1 Pre-Field Planning

Prior to entering the field, 1:20,000 TRIM mapsheets were produced for the entire project area showing waterways, road networks, and 20-meter contour intervals. On these maps, stream reaches with gradients exceeding 20 percent were highlighted and all reaches downstream were considered as potentially fish bearing unless a confirmed fish barrier existed. Note however that the GFA still considers stream reaches (<20% gradient) above sections of >20% gradient fish-bearing until proven otherwise by a detailed assessment. Literature was reviewed for information relating to streams with confirmed fish presence and locations of impassable barriers then noted on field maps. However, because resident populations often exist above barriers, the presence of a gradient barrier did not preclude conducting an FPCI.

4.2 Field Assessment

At each site, data was collected on the geographical location, crossing structure characteristics, fish habitat quality, and fish usage. In addition, the roadway on either side of the crossing was assessed for sedimentation potential including the road surface, ditches, and cutbanks.

Afterwards, the site was designated as either a full, partial or no barrier, and all notable sedimentation sources were identified. Other information collected included road and stream name, GPS location, 1:20,000 mapsheet number, and the watershed code. In addition, photographs were taken of the crossing structure, stream channel, and adjacent roadway.

In the field, information was recorded on two independent data forms adopted from Carson et al. (2007) for collecting WQEE data and Parker (2000) for collecting FPCI data. The two surveys were linked by inserting the barrier ranking from the FPCI data form into the WQEE form and by inserting the WQEE score into the Sediment Source/Degree field on the FPCI data form.

4.2.1 Fish Passage Culvert Inspection (FPCI)

Data was recorded on Form A field cards provided by Parker (2000). The culvert was measured for dimensions, flow rate, slope, and outflow drop. Streams were measured for flow rate, gradient, habitat quality, and pool depth at outflow. In addition, any sedimentation sources and maintenance problems were identified. If the crossing structure was deemed a potential barrier, according to the Parker (2000) guidelines, the site was sampled for fish presence using baited Gee traps. Often, because crews were returning to the same areas on consecutive days anyways, trapping was conducted on non-barrier sites just to gather information.

An Excel spreadsheet with the information collected on the Form A field cards is titled Kitwanga South FPCI database 2007 and provided in Appendix 2.

4.2.2 Water Quality Effectiveness Evaluation (WQEE)

Sites were evaluated for fine sediment contribution from mass wasting that occurred in the past and from surface erosion that is ongoing. Stream crossings were divided into 10 road elements (Column 1 on the WQEE field form; the left/right designation is relative to the evaluator facing downstream):

- Left road surface (LRS),
- Left road upper and lower ditches [LRD(U), LRD(L)],
- Left road upper and lower cutbanks [LRC(U), LRC(L)],

- Right road surface (RRS),
- Right road upper and lower ditches [RRD(U), RRD(L)], and
- Right road upper and lower cutbanks [RRC(U), RRC(L)].

One extra element was added to determine mass wasting contribution over the culvert itself (eroding fill material). In the field, each road element was assessed and scored according to a series of characteristics:

- Connectivity to the stream (Column 2): none = 0, little = 0.2, half = 0.5, a lot = 0.8, all = 1.0,
- Portion of fine sediment in erodible material (Column 3): none = 0, little = 0.2, half = 0.5, a lot = 0.8, all = 1.0,
- Fine sediment contribution from mass wasting (m^3, Column 4): length x width x depth,

- Fine sediment contribution from surface erosion (m^3, Column 7 and 8): length x width x depth.

A series of calculations were undertaken to arrive at the sediment contribution of each element, and instructions for these calculations are clearly provided in the field data form. An Excel spreadsheet including the information collected in the WQEE survey titled Kitwanga South WQEE Database is provided in Appendix 2.

4.3 Data Analysis

Fish passage status was determined using the Parker (2000) guidelines and sediment delivery status was determined in an independent survey using the Carson et al. (2007) guidelines. Stream crossing sites were then ranked according to the benefits gained by remediation. A 1:50,000 TRIM mapsheet was produced showing the location of the important sites along with its FPCI/WQEE classification.

4.3.1 FPCI

After completing the field assessments, sites were grouped into one of the following three categories:

- Full or Partial Barrier – fish bearing or suspected fish bearing streams with excessive water velocity inside the culvert and/or jump height at the culvert outlet for a salmonid at any life stage.
- Full or Partial Barrier on Suspected Non Fish-Bearing Streams – some of these require further fish sampling to confirm fish presence/absence.
- Other Priority Crossings - crossing structures that are not barriers but have maintenance issues such as bent, broken or plugged culverts.

Crossing sites consisting of culverts deemed as full or partial barriers were analyzed in detail including Q100 (100 year flood potential) calculations and proper culvert dimensions that will accommodate a 100 year flood event. The Q 100 and optimal Q100 culvert diameter formula is as follows (Parker, 2000):

A = ((Ww+Wbf) * Dbf) / 2

Where A = bankfull area at average annual peak
Ww = mean wetted width
Wbf = mean bankfull width
Dbf = mean bankfull depth,

Then Q100 is calculated as:

Q100 = 3 * A

Then optimal culvert diameter is calculated as:
Total round culvert diameter required = Q100 * 1.16
Total elliptical culvert diameter required = Q100 * 1.25

Barrier sites were given a ranking score based on fish species presence, full or partial barrier, habitat quality, amount new habitat gained by remediation, and the percentage of stream barred. Based on the ranking matrix shown in Table 1, barrier crossings are given the following rank: High 55-39, Moderate 38-26, Low 25-15. A list of barrier sites was then compiled in order of their ranking score to be used later for prioritizing future remedial works.

Table 1: Ranking matrix for crossings with confirmed or undetermined barriers (Parker 2000).

Fish Species	Habitat Value	Barrier Type	Length of New Habitat	Stream Barred	Limiting to Upstream Barrier
Multiple or Significant 10	H 10	Full 10	>1 km 10	>70% 10	Yes 5
Single 6	M 6	Partial 6	0.5 to 1 km 6	51 to 70% 6	No 0
Other 3	L 3	Undeter 3	< 0.5 km 3	<50% 3	

Multiple or significant species refers to either two or more salmonid species, or a regionally significant blue or red listed species; single species refers to a single salmonid species; other species refers to coarse fish species. If no fish were captured during the FPCI on barrier sites, but fish presence is documented or suspected, then the crossing was still considered a barrier. Limiting to upstream barrier refers to another barrier crossing located upstream.

An Excel sheet titled FPCI Scores 2007 contains this analysis and is found in an Excel file titled Kitwanga South FPCI Scores 2007, which is provided in Appendix 2.

4.3.2 WQEE

A series of calculations were undertaken to arrive at the sediment contribution of each element and are clearly provided in the field data form (Carson et al. 2007). The total fine sediment contribution of each road element is added together to arrive at a total crossing score. Each site was classified according to the WQEE ranking guidelines as either low (<1 m^3), moderate (1-5 m^3), high (5- 20 m^3), very high (20-50 m^3), or extreme (>50 m^3). A GFA biologist assessed the validity of a ranking for any given site based on photos and professional judgment.

- Fine sediment contribution from mass wasting (m^3, Column 6): length x width x depth x connectivity x portion of fine sediment,
- Fine sediment contribution from surface erosion (m^3, Column 11): length x width x expected depth of erosion x connectivity x portion of fine sediment, and
- Total fine sediment contribution (m^3, Column 12) = mass wasting contribution (m^3) + surface erosion contribution (m^3).

4.4 Reporting

The outline of this report was structured to point out the most significant problem crossings, while providing access to all the information gathered throughout the project. First, Table 2 outlines all crossings where FPCI surveys were conducted, which were full/partial barriers, crossings that are barriers on suspected non fish-bearing streams and crossings requiring maintenance. Second, a description of the barrier crossings is provided, along with justification for classifying streams as suspected non fish-bearing. Third, crossings with sedimentation potential are then outlined, and ranked from extreme to low, and those with maintenance issues are presented in Table 3.

5.0 Results

5.1 Fish Passage Culvert Inspection (FPCI)

Full and/or partial FPCI assessments were conducted on 19 crossings, with the results summarized in Table 2. Two crossings were ranked and given an FPCI score, 9 sites had culvert maintenance issues and 9 had full/partial barriers on suspected non fish-bearing streams, some of which require further fish sampling.

Table 2: Summary of FPCI assessments completed in 2007.

Site #	Road Name	Priority Rank	Score	Maintenance Issues	Barrier or Suspected Non Fish-Bearing (SNFB)	Stream Length Gained (m)	% Stream Barred	Q100 Culvert Diameter Required	
								Round	Oval
119	18 Mile Rd.	Na	0	None	No barrier	Na	Na	Na	Na
138	Kitwancool FSR spur	Na	0	None	Partial barrier on SNFB	Na	Na	Na	Na
139	Kitwancool FSR	Na	0	Bent culvert with log jammed in it.	Partial barrier on SNFB	Na	Na	Na	Na
140	Kitwancool FSR	Na	0	Debris building up at downstream end.	Partial barrier on SNFB	Na	Na	Na	Na
143	Kitwancool FSR	Na	0	Grown over with veg'n	No barrier	Na	Na	Na	Na
166	14 Mile Rd.	Na	0	None	Partial barrier on SNFB	Na	Na	Na	Na
167	Olive Branch Rd.	Na	0	None	Partial barrier on SNFB	Na	Na	Na	Na
182	Mill Lakes Main	Na	0	Beaver dam in culvert	No barrier	Na	Na	Na	Na
183	Mill Lakes Main	Na	0	None	No barrier	Na	Na	Na	Na
203	11 Mile Rd.	Na	0	None	Partial barrier on SNFB	Na	Na	Na	Na
213	Olive Branch Rd.	Na	0	None	Partial barrier on SNFB	Na	Na	Na	Na
221	8 Mile Lake Rd.	Na	0	Wood culvert collapsing and needs replacing.	Partial barrier of SNFB	<100m	Na	Na	Na
227	8 Mile Lake Rd.	Na	0	Wood culvert that is collapsing.	No barrier	Na	Na	Na	Na
232	8 Mile Lake Rd.	Na	0	Beaver dam in culvert. Complete blockage.	No barrier	Na	Na	Na	Na
252	18 Mile Branch Rd	Na	0	Culvert is collapsing.	Partial barrier on SNFB	Na	Na	Na	Na
270	Tea Lake FSR	High	42	None	Full barrier	700	78	1600	2130 X 1400
298	Canoe Creek FSR	Na	0	None	No barrier	Na	Na	Na	Na
299	Canoe Creek FSR	Na	0	None	No barrier	Na	Na	Na	Na
346	11 Mile Rd.	High	42	Debris jam at outlet. Fuel barrel in culvert.	Partial barrier	4690	92	1970	2440 X 1750

5.1.1 Culvert Crossings – Full or Partial Barriers

Site 346 – 11 Mile Rd. (17 km north of Kitwanga) – Tributary 14 (Biolith 1998)

Site 346 was classified as a partial barrier and ranked as a high priority crossing (FPCI Score = 42). The unnamed FSR crosses the mainstem of trib 14 approximately 20 m upstream from the highway 37 crossing. No fish sampling was conducted during this survey but Johnston and Saimoto (2002) captured bull, rainbow and cutthroat trout at the highway 37N crossing below the site, therefore it is highly recommended that site 346 be re-sampled to confirm the presence or absence of fish (Photo 1).

Photo 1: Site 346 - Looking upstream at culvert outlet.

This round metal culvert was considered a partial barrier for several reasons. First, velocity was measured at 1.57 m/s at relatively low flows (5 cm culvert water depth compared to 23 cm high water mark in culvert). Therefore, at low flows the velocity is too high for juvenile salmonids, and at high flows it may be too high for adults (Parker 2000). Second, the culvert gradient was measured at 5% which, for a culvert of this length (23.5 m), Parker (2000) states gradients should not be higher than 0.5%. Finally, the existing culvert diameter was 1400mm and the

Q100 culvert diameter was calculated to be 1970mm for a round culvert, therefore this culvert is undersized. The Q100 for an elliptical culvert was calculated at 2440 by 1750mm.

The stream habitat downstream of the culvert was considered moderate for rearing and spawning, with riffle-pool morphology and a gradient of 5% (Photo 2). The average wetted and bankfull widths were 1.4 m and 2.6 m respectively (average of upstream and downstream measurements). Biolith (1998) described the stream as seasonal, however with a bankfull width of 2.6 m measured at site 346, this stream clearly has substantial flow for a portion of the year, and could provide valuable fish habitat during that time. As well, Biolith (1998) described habitat in reach 2, which extends up to 6.1 km upstream of the confluence with the Kitwanga River, as providing potential spawning habitat, with gravel and cobbles and cover provided by LWD, SWD and undercut banks. As well, Biolith (1998) found no barriers in the lower reaches of this stream.

Photo 2: Site 346 - Looking downstream at riffle-pool/glide habitat.

From 1:20,000 TRIM data, it is estimated that 4.7 km of habitat would be made available upstream if this culvert were replaced, before gradients became too steep for fish passage. A more detailed fish habitat assessment, along with fish sampling, is recommended for this stream.

Finally, this culvert had significant maintenance issues, which are addressed in section 5.3.

Site 270 - Tea Lake FSR:

Site 270 was classified as a full barrier and ranked as a moderate priority crossing (FPCI Score = 42; Photo 3). The Tea Lake FSR crosses a tributary to Tea Creek approximately 200 m upstream from the confluence of Tea Creek, and 3 kilometers upstream of the Tea Creek/Kitwanga River confluence. No fish were caught with gee trapping at this site, however it connects directly to Tea Creek with no permanent barriers. Tea Creek is known to support coho and chinook salmon, and cutthroat and rainbow trout (Biolith 1998). There is a non-permanent barrier ~50 m downstream of the culvert caused by small woody debris that could be removed (Photo 4).

This round metal culvert was considered a full barrier for several reasons. First, it has a culvert outfall drop of 96 cm and a plunge pool of only 80 cm depth. This culvert drop is higher than the maximum jump heights for juveniles listed in Parker (2000) of 0.5 m (coho and chinook) and 0.6 (cutthroat and rainbow trout). Second, the culvert gradient is steep at 3.5% for its length of 12.1 m. Parker (2000) recommends slopes no greater than 1% for culverts less than 24 m in length. The water velocity at the time of survey was only 0.16 m/s however the water depth in the culvert was only 2 cm. The measured high water mark was 15 cm inside the culvert, therefore velocities would be much greater at peak water levels. Third, the Q100 culvert diameter was calculated to be 1600 mm for a round culvert, compared to 900 mm of the existing culvert, therefore this culvert is undersized. The Q100 for an elliptical culvert was calculated at 2130 by 1400 mm. In addition, in the event the upstream beaver dam dislodges, the existing culvert would not handle the flow, and a large-scale sediment transfer to Tea Creek would be expected. Finally, the beaver stop would block access to adult fish.

Photo 3: Site 270 - Looking upstream at culvert. Large culvert outfall drop evident, as well as beaver stop that would prevent adult fish passage. Turbid water from exposed banks visible.

Photo 4: Looking upstream at non-permanent barrier to upstream migration, ~ 50m downstream of site 270 culvert. Note small amount of flow going over barrier at time of survey.

The stream habitat value downstream of the culvert was considered moderate for rearing and spawning, with riffle-pool gravel morphology, some deep pools, and a gradient of 2.5% (Photo 5). The average wetted and bankfull widths were 1.2 m and 1.5 m respectively, downstream of the culvert, and were not measured upstream because it is a beaver pond. Upstream of the culvert is a well-established beaver dam complex that if accessible to juvenile fish, could provide excellent rearing habitat (Photo 6).

Photo 5: Looking upstream at pool ~75m downstream of site 270 culvert. Low flow conditions and high amounts of suspended sediment evident.

Photo 6: Looking upstream at beaver pond just upstream of site 270 crossing. Good potential for rearing here if it was accessible to fish.

The extent of fish habitat upstream of the culvert was not assessed beyond the beaver dam complex during this project. Stream length gained by removing the culvert barrier was estimated at 700 m from 1:20,000 TRIM data. The stream should be assessed upstream of the culvert to verify the length and quality of upstream habitat. As well, fish sampling throughout the beaver dam complex and upstream is recommended.

5.1.2 Problem Culverts on Suspected Non Fish-Bearing Streams

The following crossings were classified as full/partial barriers. Following is justification for classifying them as suspected non fish-bearing, and recommendations for further survey.

Site 138 (Kitwancool FSR): GFA crews caught no fish near this culvert, and gradients of over 40% were found on TRIM maps downstream of the crossing downstream (site 139).

Site 139 (Kitwancool FSR): Gradients of over 40% were found on TRIM maps downstream of the culvert. As well, GFA crews caught no fish near this culvert, or at site 138 upstream, potentially indicating no resident populations exist. Electro-shocking is recommended to confirm fish presence/absence in this reach.

Site 140 (Kitwancool FSR): Gradients of 25% were measured in the field, and over 30% were found on TRIM maps, downstream of this crossing. As well, GFA crews caught no fish near this culvert.

Site 166 (14 Mile Rd): Gradients of over 30% were found immediately upstream, and steep bedrock falls downstream of this culvert, and no fish presence at the crossing (Johnston and Saimoto 2002). Biolith (1998) observed fish of unknown species. As well, GFA crews caught no fish near this culvert.

Habitat near this crossing was good for spawning and rearing, and moderate for over-wintering. Morphology was riffle-pool with gravel. The stream channel was highly over-grown with shrubs and there was very little LWD.

This culvert was determined to be a velocity barrier to juvenile fish with a measured velocity of 0.44 m/s at the time of survey. As well, the culvert gradient is 5%. Further fish sampling is recommended in this stream.

Site 167 (Olive Branch Rd): This crossing is approximately 2km upstream from site 166. GFA crews caught no fish near this culvert. Habitat near this crossing consisted of abundant cover from LWD, and was considered good for rearing. Morphology was riffle-pool with gravel. Further fish sampling is recommended in this stream.

Site 203 (11 Mile Rd): This crossing is near the headwaters of this stream, and the gradient increases to over 40% upstream of the crossing, as observed from TRIM data. GFA crews caught no fish near this culvert. There would be minimal habitat gained for fish by replacing this culvert.

Site 213 (Olive Branch Rd): This crossing is near the headwaters of this stream, and there are 40%+ gradients below and above the crossing. GFA crews caught no fish near this culvert. There would be very little or no habitat gained by replacing this culvert.

Site 221 (8 Mile Lake Rd): This crossing is approximately 1.5 km upstream from this unnamed streams confluence with the Kitwanga River. Johnston and Saimoto (2002) characterized this stream, in the vicinity of the highway 37 crossing, as having very little fish value, although no sampling was done. GFA crews caught no fish near this culvert. The gradient increased to >20% approximately 100 m upstream from the crossing. There would be minimal or no habitat gained by replacing this culvert.

Site 252 (18 Mile Branch Rd): This crossing is approximately half way between the confluence of this stream with the Kitwanga River and its headwaters. Biolith determined the Gitanyow Access Road (crossing located downstream) to be a barrier to fish passage on this stream. GFA crews caught no fish near this culvert. A section of bedrock cascades approximately 100 m long were found, starting ~50m downstream from the crossing. Cascade in Photo 7 is representative of that 100 m stretch. This cascade section is suspected as a barrier to fish passage; however, electro-shocking is recommended upstream to confirm fish presence/absence.

Photo 7: Site 252 - Looking upstream at cascade barrier ~ 50m downstream from crossing.

5.2 Sedimentation Potential (WQEE Rating)

A total of 123 sites were visited, or an attempt was made to find them. Twenty-three of which were not previously mapped at the 1:20,000 level but were surveyed as they were found. Another 23 sites that were shown on the map were mapping errors and were either not found, or were found in different locations than where they were shown on the map. WQEE evaluations were completed on every crossing that was found, whether it was previously unmapped or not. Therefore, a total of 104 WQEE evaluations were completed. Crossings were scored and ranked as per Carson et al. (2007).

5.2.1 WQEE Ranking: Extreme

Site 186 (Mills Lake Road – Deuce Creek):

- WQEE score = 514 m^3

There were 4 sections of mass wasting on the RRC at this site (Photo 8 shows the largest of these sections). The estimated volume of surface material lost to mass wasting was 635 m^3, and the net erodible area was 1280 m^2.

Another sediment issue at this site is a beaver dam constructed in a retention pool in the RRDU (Photo 9). Because this dam is retaining water, it is preventing a portion of the ditchline from re-vegetating. As well, there is a risk of sediment input if the dam dislodges.

Recommendations are for grass-seeding the area of mass wasting and using bioengineering techniques, such as modified brush layers, if necessary. The beaver(s) and associated dam in the ditchline should be removed and regular maintenance conducted in order to keep the area free of standing water and allow the ditchline to re-seed.

Photo 8: Site 186 - Looking at exposed RR cutbank needing revegetation. This was the largest of 4 areas of mass wasting near this crossing.

Photo 9: Site 186 - Looking downstream at beaver ponded water in RRDU. High sediment accumulation in pond poses risk to water quality if dam dislodges. Dam is at the far end of photo, highlighted in red.

5.2.2 WQEE Ranking: Very High

No sites ranked very high.

5.2.3 WQEE Ranking: High

Site 313 (Mills Lake Rd):

- WQEE score = 12 m^3

This site is well vegetated except for an area of mass wasting on the RRC, with a net erodible area of 24m^2 (Photo 10). Grass seeding and construction of a few modified brush layers is recommended.

Photo 10: Site 313 - Looking at exposed RR cutbank needing re-vegetation.

Site 168 (Olive Branch Rd – Tributary 19 (Biolith 1998)):

- WQEE score = 6 m^3

This site was well vegetated except for the RRS where the stream flows down the road. Recommend further investigation to determine natural stream channel location and further fish trapping. This stream may need to be diverted back to its original channel.

5.2.4 WQEE Ranking: Moderate

Site 270 (Tea Lake FSR):

- WQEE score = 2 m^3

Work was recently done on this crossing and there were exposed areas that were not re-vegetating at the time this survey was performed (Photo 11). Grass seeding should occur immediately in the spring to avoid further sedimentation downstream. The WQEE score of 2 (moderate) is believed to under-represent the sediment contribution at this site. It is clear from observation of the substrate downstream of the crossing that a considerable amount of sediment has been deposited into this stream (Photo 12), and into Tea Creek (confluence <100m from crossing).

Photo 11: Site 270 - Looking across from right to left at culvert inlet. Silty water and exposed soil are evident.

Photo 12: Site 270 - Looking at silt covered cobble downstream of culvert as evidence of high levels of past sedimentation.

Site 278 (Canoe Creek FSR):

- WQEE score = 1.3 m^3

Sedimentation is occurring at this site from a variety of sources, however both road surfaces are the biggest contributors. Deactivation and grass seeding is recommended.

Site 137 (West Kitwancool FSR Spur):

- WQEE score = 1.2 m^3

This site is well vegetated except for the LRS and the LRDU. Water has been flowing down the road directly into the watercourse. Cross-ditching is recommended to divert this water into the LRDU. Re-seeding of the LRDU is also recommended.

5.2.5 WQEE Ranking: Low

Most sites with a low ranking required no remedial action, however there are recommendations for the following sites:

Site 115 (Old deactivated bridge site on the Kitwanga River):

This site scored low (0.08 m^3) because sediment does not currently have an entry point into the river. The old bridge abutment is still in place on the right bank, and diverts water towards the left bank causing erosion. The LRS is very silty and muddy most of the year, but a berm on the left bank of the river prevents silty water from entering the stream (Photo 13). This bank will likely erode away allowing a major entry of silt directly into a known salmon spawning bed.

It is recommended that the right bank abutment be removed and the left bank armoured with rip rap. The combination of these two actions should minimize further unnatural streambank erosion. In addition, roadbed material (sandy-gravel) should be added to the LRS and it should be grass-seeded.

Photo 13: Site 115 - Looking at silty puddle on LRS. Kitwanga River is in the background but not visible in photo.

Site 347 (11 Mile Rd.):

Washed out bridge crossing with ATV crossing in place. Recommend deactivation and seeding.

Site 235 (Tea Lake FSR):

Road surfaces are transporting sediment into the watercourse, and should be inspected by a road engineer for the appropriate course of action.

Site 227 (8 Mile Lake Rd.):

Grass-seed section of LRC.

Site 232 (8 Mile Lake Rd):

Beaver dam in culvert ponding water over road. Sediment risk if dam blows. Requires trapping and maintenance of culvert and/or beaver stop installed.

Site 279 (Canoe Creek FSR):

Woodbox culvert collapsing into stream. Recommend removing structure and grass seeding.

Site 280 (Canoe Creek FSR):

Road surfaces and ditches contributing sediment at this site. Recommend deactivation and grass seeding.

Site 299 (Canoe Creek FSR):

Road surfaces are transporting sediment into the watercourse, and should be inspected by a road engineer for the appropriate course of action.

Site 166 (14 Mile Rd.):

Left road surface is transporting sediment into the watercourse, and should be inspected by a road engineer for the appropriate course of action.

Site 252 (14 Mile Rd.):

Tire ruts drawing water into creek on RRS which should be cross-ditched and seeded. RRC needs seeding.

Site 139 (Mills Lake FSR):

Road surfaces are transporting sediment into the watercourse and should be inspected by a road engineer for the appropriate course of action. Culvert very damaged and should be replaced, with road being altered to properly drain at the same time.

Site 318 (Mills Lake FSR):

Debris in ditch should be removed to allow vegetation to establish.

Site 337 (18 Mile Branch Rd.):

Deep eroded ruts on LRS draining into creek. Should be inspected by a road engineer for the appropriate course of action. Section on RRC needs grass-seeding.

5.3 Maintenance Requirements

Common maintenance issues encountered were bent/crushed/jammed round metal culverts, collapsing woodbox culverts, culverts overgrown with vegetation and beaver dams in culverts. Culverts requiring maintenance are summarized in Table 3 and referenced photos are found in Appendix 1.

Table 3: Summary of crossings found with maintenance issues in 2007.

Site #	Type of crossing	Culvert diameter (mm)	Maintenance issue	Photo #
123	Ford	Na	Surface flow across road. Needs deactivation or culvert.	875 & 876
137	Metal round	Not measured	Minor damage at downstream end. Blocked by logs at upstream end.	3591 & 3593
139	Metal round	600	Major damage at downstream end, minor damage at upstream end. Log jammed in downstream end.	3583 & 3589
140	Metal round	800	Minor debris buildup cleared from downstream end, resulting from overgrowth of vegetation which should be cleared.	3581
141	Metal round	Not measured	Nearly plugged at upstream end with substrate. Logs have fallen over downstream end and should be cleared to prevent blockage.	3573 & 3575
142	Metal round	Not measured	Minor damage and overgrowth of vegetation at downstream end.	3569
143	Metal round	800	Minor buildup of debris in downstream end resulting from overgrowth of vegetation which should be cleared.	3561 & 3562
165	Log bridge	Not measured	Partially collapsed. Road surface material falling through bridge deck.	958
167	Metal round	Not measured	Minor damage at inlet.	1146
182	Metal round	1000	Beaver dam inside culvert (o.6m height). Water backed up on upslope side and percolating through roadbed into forest. Requires maintenance road washout and sedimentation of stream.	3457, 3460 & 3462
197	Wood culvert	Not measured	Collapsed at outlet with water percolating through roadbed.	1408
199	Log bridge	Not measured	Collapsed causing partial barrier. Debris jam at inlet damming water upstream.	1449
204	Wood bridge	Not measured	Broken bridge decking bunched up at outlet. Should be deactivated.	1410 & 1411
205	Log corduroy bridge	Not measured	Water flowing over road. Crossing jammed.	1216 & 1217
221	Log culvert	~2300	Collapsing culvert needs replacing.	3635
227	Wood culvert	Not measurable	Collapsing culvert needs replacing.	3628 & 3629
232	Metal round	800	Culvert completely blocked by beaver dam. Water flowing over road.	3620, 3621, 3624, 3626
235	Metal round	Not measured	Getting blocked by debris and sediment at both ends. Should be cleared now before becoming a blockage.	3672 & 3674
236	Metal round	Not measured	Minor debris and overgrowth of vegetation at upstream end. Should be cleared now before becoming a blockage.	3682
237	Wood culvert	Not measured	Not clearly passing water, road starting to collapse into it. May need to be replaced or deactivated.	3711-3717
252	Metal round	1100	Collapsing in center. Bent at downstream end.	858
279	Wood culvert	Not measured	Collapsing into stream at outlet.	1197
286	Wood culvert	Not measured	Collapsed and needs replacing/deactivation.	908
291	Metal round	Not measured	Getting plugged at inlet, water backing up.	1163
315	Metal round	Not measured	Rocks and wood starting to build up at outlet.	3490 & 3491
317	Metal round	Not measured	Bent on upstream side but still working.	3495 & 3496
318	Metal round	Not measured	Crushed at both ends.	3497 & 3498
336	Wood crossing	Not measured	Appears to be an ATV crossing over an old deactivation. Fresh layout ribbon in area indicates this area may be reactivated.	864.865,866
343	Wood culvert	Not measured	Collapsing in center with 2 large holes. EXTREME DRIVING HAZARD and should be dealt with.	1360, 1363, 1364
346	Metal round	1400	Rock/wood debris jam at inlet. Fuel barrel in culvert (contents unknown).	1389 & 1391
347	Bridge	Not measured	Washed out bridge, converted to ATV crossing structure. Rotting with bridge timbers creating debris jam. Should be cleaned.	1420 & 1421

5.4 Kitwanga South Watershed: Summary of Stream Crossings

A total of 132 stream crossings under MoF jurisdiction were identified in the south Kitwanga River watershed, 7 of which had FPCI and SCQI assessments completed in 2006 (McCarthy 2006). This left 125 crossings to be assessed, 100 of which were completed through this project. Another 23 unmapped crossings were visited as part of this survey, for a total of 123 survey attempts (some sites were mapping errors and did not exist in the field).

6.0 Discussion

The Kitwanga River South FPCI and WQEE project for 2007 was successful in identifying two crossings that are potentially full or partial barriers to fish passage. Both of these streams need further fish habitat assessment to confirm the amounts of habitat that will be gained by replacing the crossings. Although no fish were caught through Gee trapping, previous studies indicate fish presence in these sub-watersheds (Biolith 1998, Johnston and Saimoto 2002).

A total of 6 crossings were found ranging from moderate to extreme sediment risk, and another 59 ranking low for sediment risk. Of 104 crossings where WQEE surveys were completed, 39% showed no sediment impacts, 57% showed low impacts, 3% showed moderate impacts, 2% showed high impacts and <1% showed extreme impacts. Overall, the majority of road crossings have re-vegetated to the extent where sediment risk is low, as measured by the WQEE survey.

Significant maintenance issues were evident at 31 stream crossings. Maintenance issues included bent or damaged metal culverts, collapsing wood/log culverts and bridges, and beaver dams blocking culverts. These maintenance issues pose a significant risk to water quality because if they fail, they could release significant amounts of sediment into the watershed.

7.0 Conclusion and Recommendations

7.1 Deactivation of Non-Essential Roads

Non-essential roads should be deactivated to reduce the overall road density and cumulative sedimentation impacts. GFA recommends further assessment of two sections of road for potential deactivation, including:

- Canoe Creek branch at Km 4.0 (approximately 4km of road; Sites 21, 276, 277, 278, 279, 280)

Justification: This road is located in the Tea Creek headwaters and is in extremely poor condition. Pooled, silty water collects at most of the crossings and runs directly into the associated streams. In addition, numerous sinkholes in the roadbed pose a significant driving hazard. Most crossing structures consist of wood box culverts that have deteriorated to a state that warrants replacement or removal. GFA recommends deactivating this road by removing all crossing structure to allow for fish passage, cross ditching all approaches to streams, and grass seeding the roadbed.

- Unnamed road between Sites 200 and 205

Justification: This road is located between 11 Mile Road and Canoe Creek FSR and is in extremely poor condition. One bridge crossing has collapsed into the stream bed, and at other crossings water is flowing over the road. Other than the one bridge crossing, most crossing structures consist of wood box culverts that are in a deteriorated state.

7.2 Additional Fish Sampling and Fish Habitat Assessment

Several sites should be re-visited to conduct additional fish sampling and fish habitat assessment. See recommendations in Sections 5.1.1 and 5.1.2.

7.3 Remediation of Crossings Contributing Sediment

Remedial actions were recommended on several crossings. See recommendations in Sections 5.2.1 to 5.2.5.

7.4 Maintenance of Road Crossings

Address all maintenance issues listed at crossings in Table 3 Section 5.3 of this report.

7.5 Further Sedimentation Surveys

At the time of this project, the WQEE had not been field validated, as had its predecessor the SCQI (Pers. comm., Beaudry 2008). As not all of the intended sites were surveyed during this project, due to the onset of winter, it is recommended that they are surveyed with the WQEE evaluation once it has been field validated. As well, GFA recommends re-surveying a subset of crossings that were completed in 2007 with the field-validated WQEE method, to determine whether the results from this years work provide valuable water quality information.

7.6 Stream Crossing Standards for Future Roads

GFA recommends that all new crossings on fish-bearing streams be either bridged or consist of an open-bottom culvert. These structures will allow the original streambed to remain intact and normal water velocities to be maintained, and in addition, would require less maintenance and upgrading than round or oval culverts. Round and oval culverts are prone to scouring at the outflow resulting in sedimentation of the stream and potentially the creation of a barrier-causing waterfall.

This would require consultation between the BC Ministry of Forest, forestry companies, and the Gitanyow Hereditary Chiefs before any new roads are built in the Kitwanga River Watershed. GFA can provide the technical support to determine the fish-bearing status of all streams along a proposed road route. In addition, GFA technicians can gather useful information regarding stream flow rates, fish habitat value, local terrain conditions and other details valuable to a road engineer entering into the planning phase.

7.7 Road Signage

Placing signs with road names at the start of all logging roads is recommended. This will reduce the confusion of describing where sites are located.

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8.0 References

Beaudry, P. and Associates. 2006. Results of the Stream Crossing Quality Index (SCQI) survey for the Nichyeskwa Watershed, Skeena Stikine Forest District. Report prepared for The Trustees of the Babine Watershed Monitoring Trust c/o BV Research Centre. 37 pp.

Beaudry, P. January 2008. Personal communication. M.Sc, RPF, CPSEC. Forest Hydrologist P. Beaudry and Associates Ltd., Prince George, BC.

Biolith Scientific Consultants Inc. 1998. Level I Detailed Assessment of Fish and Fish Habitat in the South Kitwanga River and its Tributaries. Terrace, BC. 372 pp.

Biolith Scientific Consultants Inc. 1999. Level I Detailed Field Assessment of Aquatic and Riparian Habitat for the North Kitwanga River Sub-Basin. Terrace, BC. 326 pp.

Carson, B., D. Maloney, S. Chatwin, M. Carver and P. Beaudry. 2007. Protocol for Evaluating the Potential Impact of Forestry and Range Use on Water Quality (Water Quality Routine Effectiveness Evaluation). Forest and Range Evaluation Program, B.C. Min. For. Range and B.C. Min. Env., Victoria, BC. 47pp.

Cleveland, M.C. 2000. Limnology of Kitwanga Lake: an attempt to identify limiting factors affecting sockeye salmon (*Oncorhynchus nerka*) production. Gitanyow Fisheries Authority, Kitwanga, B.C. 97 pp.

Cleveland, M.C., S. Cox-Rogers and K. Rabnett. 2006. Kitwanga Sockeye Salmon Recovery Plan (KSRP). Gitanyow Fisheries Authority, Kitwanga, BC. Department of Fisheries and Oceans, Prince Rupert, BC. Skeena Fisheries Commission, Hazelton, BC. 52 pp.

Cox-Rogers, S., J.M.B. Hume and K.S. Shortreed. 2003. Stock status and lake production relationships for wild Skeena River sockeye salmon. Canadian Science Advisory Secretariat Research Document – 2004/010.

Gottesfeld, A.S., K.A. Rabnett and P.E. Hall. 2002. Conserving Skeena fish populations and their habitat. Skeena Fisheries Commission, Hazelton, BC. 281 pp.

Hampshire, A. and L. Torunski. 2001. Enhancing Environmental Values – Watershed Restoration Plan for the Kitwanga River Watershed. Report by McElhanney Consulting Services Ltd. for the Kispiox District Ministry of Forests. 30pp.

Johnston, D. and R. Saimoto. 2002. Highway 37 Stream Crossing Database Version 2. Rivers and Creeks Consulting Services and SKR Environmental Consultants Ltd.

McCarthy, M. and E. Hamelin. 2003. The Upper Kitwanga River Beaver and Coho Salmon Management Plan, Gitanyow Fisheries Authority, Kitwanga, BC. 31pp.

McCarthy, M. 2007. The 2006 Kitwanga River Fish Passage-Culvert Inspection and the Stream

Crossing Quality Index Project. Gitanyow Fisheries Authority, Kitwanga, BC. 36 pp.

Parker, M.A. 2000. Fish Passage – Culvert Inspection Procedures. Watershed Restoration Technical Circular No. 11. Ministry of Environment, Lands and Parks, Williams Lake, BC. 47 pp.

Appendix 1 – Photographs

Appendix 2 – FPCI and WQEE Summary Spreadsheets

Appendix 3 – Updated Map – Kitwanga River South Stream Crossings

Appendix 4 – Sample Area Information Card

NOTE: Appendices 1-4 are included on the attached CD's. To obtain a copy of the appendices please contact the Forest Investment Account (http://www.for.gov.bc.ca/hcp/fia) or the Ministry of Forests and Range at 1-888-540-8611.