MIDDLE SHUSWAP RIVER OFF-CHANNEL ACCESS ASSESSMENT

FINAL REPORT

Project No. COA-F17-F-1411

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Executive Summary

Low velocity and shallow side channel habitat along the Middle Shuswap River (MSR) provides rearing and refuge habitat for various fish species including juvenile coho and rainbow trout (Minor 2007). MSR mainstem connectivity to side channel habitat and floodplains has been reduced as a result of stabilised stream flows due to hydroelectric operations, non-hydro related bank protection works (BC Hydro 2003), and general degradation where livestock have unlimited access to the channel (RDNO 2014).

The objective of this preliminary assessment was to examine side channel and floodplain access for fish during the most common flow rates of the year: low flow periods at 30 cms and lower. The upstream and downstream confluences of side channels along the MSR were assessed on October 7 and 11, 2016 by cataraft. A total of 35 side channel access points were surveyed and photo-documented.

Overall, there was low to moderate riparian habitat at surveyed sites including instream vegetation, deep pools, Large Woody Debris (LWD) and some channel bed grain size variation. Bank protection works (e.g., riprap and LWD complexes) and unrestricted riparian access along the main channel of the MSR were observed throughout the survey as well as poor to good established riparian vegetation.

Following the preliminary assessment of side channel access condition, enhancement of sites could include opening up access to the inlet at side channel C to increase scour and productivity, and adding additional cover habitat (e.g., for side channels S and V with salmonid fry observed within isolated pools). Prior to any enhancement works, access to these sites should be fenced off from agricultural and grazing access to ensure conditions are protected from disturbance.

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1.0 INTRODUCTION

The Water Survey of Canada hydrometric station below Wilsey Dam (08LC003) indicates that from September to March over the 73-year record, mean discharge is approximately 30 cms. It is during this time of the year that early life stages of anadromous salmon (alevins to parr) will rear alongside resident fish. During observations of the Middle Shuswap River (MSR) between 2010 and 2014, Giles Shearing of SEC observed signs of channel straightening resulting in a loss of low flow off-channel habitat. The objective of this preliminary assessment was to examine side channel (and wetland) access for fish during low flow periods of the year (i.e., 30 cms and lower). To achieve this objective, Yucwmenlúcwu and SEC undertook two field visits to assess access and to determine potential projects for enhancement.

1.1 STATEMENT OF NEED

This report aims to address priority FWCP action items from the Shuswap Salmonid Action Plan and the Shuswap Riparian Wetlands Action Plan. From Table 2 (Downstream of Wilsey Dam) of the Shuswap Salmonid Action Plan, the following actions items are intended to be addressed by this report:

- Priority 1: [Assess opportunities to] Develop and/or improve side-channel access and habitat;
- Priority 1: Riparian improvements e.g. bank stabilization, fencing, armoring, and re-vegetation;
- Priority 1: Assess efficacy of previous habitat enhancements undertaken by the program; and
- Priority 2: Assess opportunities for watering areas with groundwater, with a focus on over-wintering and rearing of coho.

From the Shuswap Riparian Wetlands Action Plan, the following actions items are intended to be addressed by this report:

- Priority 2: Identify additional opportunities to secure category 1 and 2 areas in the system.

From the Action Plans noted, the following objectives were developed and framed the study:

Objective 1: was to see if fish are able to access side channel habitat between Wilsey Dam and the Mabel Lake confluence during average September to March water levels (approx. 30 cms).

Objective 2: from observations and collected data, present recommendations for potential side channel enhancement projects.

1.2 BACKGROUND

Four species of anadromous salmon spawn below Wilsey Dam:

1. Chinook salmon (*Oncorhynchus tshawytscha*)
2. Coho salmon (*O. kisutch*)
3. Sockeye salmon (*O. nerka*)
4. Pink salmon (*O. gorbuscha*)

A single record of anadromous Dolly Varden (*Salvelinus malma*) exists in the Fisheries Information Summary System (FISS) database from 1984. Fluvial sport fish species from the Salmonidae family include kokanee salmon

(*O. nerka*), rainbow trout (*O. mykiss*) and cutthroat trout (*O. clarki clarki*) (Environment 2014). Other fluvial sport fish species include mountain whitefish (*Prosopium williamsoni*), lake trout (*S. namaycush*), and bull trout (*S. confluentus*) (FISS 2017).

Non-sport fish species in the MSR include redside shiner (*Richardsonius balteatus*), northern pike minnow (*Ptychocheilus oregonensis*), bridgelip sucker (*Catostomus columbianus*), largescale sucker (*C. macrocheilus*), longnose dace (*Rhinichthys cataractae*), peamouth chub (*Mylocheilus caurinus*), prickly sculpin (*Cottus asper*) and slimy sculpin (*Cottus cognatus*) (FISS 2017).

Prior to construction of Wilsey Dam, chinook and possibly sockeye were known to ascend and spawn above Shuswap Falls (French 1995; Bengeyfield et al. 2001). In addition, anecdotal evidence suggests that chinook may have been found in Sugar Lake above Brenda Falls (i.e., the current location of Sugar Lake Dam) (French 1995). Pre-dam conditions for access would have facilitated a greater distribution of spawning salmon throughout the MSR watershed.

Table 1 shows the general spawning times of MSR salmon.

Table 1. Arrival and spawning times of four salmon species that spawn in the Middle Shuswap River downstream of Wilsey Dam (Sigma 1993a).

Species	Arrive	Start	Peak	End
chinook	1 Aug	15 Sept	25 Sept	7 Oct
sockeye	1 Sept	Late Sept	15-20 Oct	1 Nov
coho	unknown	15-30 Oct	5-15 Nov	1-15 Dec
kokanee	15 Sept	mid Sept	5-6 Oct	late Oct

Mountain whitefish compete with rearing salmon for food and are also believed to be a major predator in the MSR on salmon eggs, especially below Wilsey Dam. A significant mountain whitefish population was observed above Wilsey Dam in 1995 (Triton 1995).

This assessment focuses on spawning habitats for chinook and coho, priority salmon species in the MSR (FWCP 2011a). A Fish and Wildlife Compensation Program report on MSR salmon stocks suggests that there are limited options for pink and sockeye habitat restoration (FWCP 2011b). Pink do not return in great numbers and are not managed to the same degree as coho and chinook. Further, sockeye are known to have the greatest ability of all salmon to adapt to different spawning conditions (Burgner 1991). Therefore, this assessment assumes that spawning habitat identified as suitable for coho and chinook salmon is also suitable for sockeye and pink salmon. Coho and chinook have different spawning methods and fluvial requirements, described below in detail.

Interior Fraser Coho in the Middle Shuswap River

Interior Fraser River Coho entering the Thompson River basin have a lower homing fidelity than most salmon (i.e., weak tendency to return to their natal stream) (IFCRT 2006). Unlike MSR chinook, attributing coho to a watershed population is difficult. This can lead to weak genetic structure within watersheds (Shearing 2017). Coho migrating up the Thompson River select system branches (e.g., Adams, Eagle or Shuswap rivers) depending on which option provides optimal routing conditions identified by the fish sooner in their migration than their natal stream confluences. Therefore, coho may not spawn in the river from which they emerged (pers. comm. R. Bailey, DFO, 2012). Low homing fidelity makes understanding the number of individuals and their trend within the population and genetic structure difficult.

MSR coho are considered part of the South Thompson sub-population (IFCRT 2006). Coho escapement to the MSR has generally increased from critically low returns observed in the mid 1990s. In 2002, Interior Fraser Coho were listed as "Endangered" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (Irvine 2002). Agriculture and land development were then seen as (and may still be considered) serious pressures significantly impacting the productive capacity of streams used by Shuswap River coho (IFCRT 2006).

Adult coho enter the MSR from mid-October to the end of November with spawning occurring late October to December in the river mainstem, side channels and Bessette, Harris and Duteau creeks (Fee and Jong 1984; Triton 1995; ARC 2001a). Spawning in the MSR occurs earlier than reported in general species descriptions by Sandercock (1991). Eggs are eyed by late January and fry emerge in May (Triton 1994b). Coho generally return to spawn at 3 years of age (Irvine 2002). MSR coho are known to rear in off-channel habitats with wood cover (ARC 2001a). Coho salmon have longer freshwater residency times than other salmon on average.

Chinook in the Middle Shuswap River

MSR Chinook are part of the Fraser River's South Thompson chinook aggregate that includes the Middle and Lower Shuswap Rivers, Lower Adams River, Wap Creek, Little River, Seymour River, South Thompson Mainstem and Maria Slough. MSR chinook are included in the Thompson geographical region and South Thompson/Shuswap sub-region (DFO 2011).

Numerous studies of MSR chinook have provided insights into their region-specific spawning requirements (Griffith 1979; Fee and Jong 1984; Lister 1990; Sigma 1993a; Triton 1994b; Triton 1995; ARC 2001a; ARC 2001b; Guy and Uunila 2002; Bocking and Gaboury 2002). Research findings generally agree that chinook spawn as much as 9 km below Wilsey Dam, with most spawning 3.5 km downstream of the dam (ARC 2001a; Guy and Uunila 2002; pers. comm. Szczepan Wolski, Shuswap River Hatchery). Few redds are found downstream of the Bailey Bridge at Lawrence Road, 9 km downstream of Wilsey Dam (Guy and Uunila 2002; ARC 2001a pers. comm. S. Wolski). One hundred and five (105) redd locations were compiled and published by Guy and Uunila in 2002. Fifty-six (56) redds occurred 3.5 km downstream of Wilsey Dam and 50 redds occurred within a further 5.3 km downstream to the Bailey Bridge (Triton 1994a). Only five redds were found from the Bailey Bridge 15 km downstream to Mabel Lake (Triton 1994b; Guy and Uunila 2002). Substrate and flow velocities in the MSR floodplain 15 to 18 km upstream of Mabel Lake are considered poorly suited to the requirements of spawning chinook as a result of low gradient sandy bottom characteristics (ARC 2001a; Minor 2007).

MSR chinook start entering the Fraser River system in July and commence spawning in mid to late September, finishing by mid-October (Triton 1994b). Fry emerge in April; some migrate immediately downstream to Mabel Lake whereas others use off-channel and side channel refuge for initial rearing. Most fry migrate into Mabel Lake within approximately 60-90 days and leave Mabel Lake approximately 90-150 days post emergence (Triton 1994b).

In 1993, MSR chinook were observed holding in deep pools up to 5 to 6 weeks prior to spawning (Triton 1994b). Holding pools and holes (small pools) are an important habitat component of chinook spawning habitat. A limited amount of holding pools above Wilsey Dam has been noted as a factor that may affect the successful spawning and rearing activities of reintroduced salmon (pers. comm. S. Wolski, Shuswap River Hatchery Manager 2011).

Two developmental types of chinook spawn in the MSR and Bessette Creek systems, 4_1 ocean-type (sub yearling) and 4_2 stream-type (yearling), respectively (DFO 2011; Burgner 1991). Although sympatric, stream-type and ocean-type chinook have coexisted with nominal genetic contributions to one another for 1,000 to 10,000 years, described by Waples (2001) as ,"effectively behaving as separate biological species." The following sections describe the unique attributes of the two chinook types.

Ocean-Type Chinook

Approximately 95% of chinook returning to the MSR are 4_1 ocean-type and spawn in the river mainstem (ARC 2001b). MSR ocean-type chinook are also referred to as "Upriver Brights", a genetic cousin of Columbia River Upriver Brights with similar life-histories. Upriver Brights were likely once a single population prior to Cordilleran ice sheet recession some 11,000 years ago (pers. comm. R. Bailey). Most ocean-types out-migrate three to five months after emergence, with most returning at age four although up to 35 % return as jacks, 3 and 5 year olds (DFO 2011; Triton 1994b; Commission 2004). The majority of ocean-type chinook spawn in the river mainstem approximately 3.5 km downstream of Wilsey Dam (ARC 2001a).

MSR ocean-type chinook are assigned Conservation Unit (CU) number 15 (CU15). CU15 returns were forecast to be abundant in 2011, but have seen a decline since 2010. Ocean-type chinook are known to migrate along the continental shelf without migrating into the central Pacific Ocean and are therefore more susceptible to year-round fishing pressures, unlike coastal populations with central Pacific migration routes (Waples 2001).

Stream-Type Chinook

Stream-type chinook in the MSR system typically spawn in smaller streams, including Bessette Creek. Tributaries confluent with Bessette Creek, Duteau and Harris creeks, are used in years where flow is sufficient for migration into these streams (ARC 2001a). Stream-type chinook may also use the river mainstem to spawn ARC 2001b). Unlike ocean-type, stream-type juveniles overwinter and out-migrate after their first or second year. Stream-types are found to have large ocean-migrations and return to the river months before spawning occurs, generally in the late spring or summer (DFO 2011). Stream type chinook leave the MSR at around 10 grams as yearlings versus chinook yearlings which leave the Eagle River at approximately 2 grams.

Bessette Creek 4_2 fish are considered a conservation priority assigned Conservation Unit No. 16 (CU16). CU16 was identified a stock of concern in 2011 escapement forecasts (DFO 2011).

First Nations, Social and Economic Considerations

The MSR is an economically, socially, culturally, and ecologically important resource. Land uses surrounding the MSR are dominated by ranching and farming activities, as well as hydroelectric operations and infrastructure. These activities disrupt the natural interaction between the MSR mainstem and the adjacent floodplain habitat. During recent watershed sustainability planning for the Shuswap River (Regional District of the North Okanagan (RDNO 2014), overall watershed health of the Shuswap watershed was identified as being extremely important to Shuswap community members, and a strong stewardship ethic has developed. Many groups and organizations have gathered to improve and protect water quality, fisheries and fish passage, recreation, habitat restoration in the Shuswap River.

Many of these goals are shared by First Nations that have interests in and connection to the MSR. Both the Okanagan Indian Band and Splatsin have identified cultural and heritage resources in and around the MSR that include overall health of the ecosystem, protection of archaeological resources, access to the river, protection of the Shuswap watershed and salmon, and availability of food fisheries (RDNO 2014). Cultural fishing activities have been negatively impacted in the MSR as a result of declining salmon populations in this system. Enhancement and protection of salmonid habitat is imperative to reversing this declining trend and to restore productive cultural fishing practices and overall ecosystem health in the MSR.

2.0 METHODS

Two field visits took place on October 7 and 11, 2016. Field visit 1 occurred October 7, 2016 and covered the MSR from Wilsey Dam to the Bailey Bridge (9 km). Field visit 2 occurred October 11, 2016 and covered the Bailey Bridge downstream to the confluence of Mabel Lake (15 km). Access to side channels was gained from the foreshore off the river mainstem. Timing of the field visits was such that river discharge was close to the average non-peak flow of 30 cms. River discharges from the Water Survey of Canada gauging Station on October 7 and 11, 2016, were 25 and 28 cms, respectively.

During each field visit, the survey team recorded notes about limitations to off channel habitat, took waypoints, collected channel measurements and photo-documented side channel inlets and outlets. Data was collected on site cards based on the B.C. Ministry of Environment's Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Site Card Field Guide (2008). All side channels on river right were surveyed (priority). Many side channels on river left were surveyed. A side channel was defined as having a conspicuous inlet and outlet and the presence of water or recent scouring.

A 14 ft. cataraft (Photograph 7 in Appendix C) was used to access side channel inlet and outlets. Waypoints of survey sites were marked using a Garmin 62st GPS. Field data forms (Appendix A) were completed at each survey site to document biophysical characteristics at side channel inlets and outlets. General comments regarding side channel shape and function between the inlet and outlet were recorded on the site card data forms.

Field data forms were entered into a spreadsheet and waypoints were entered into Google Earth (to produce a .kmz file). Survey site waypoints from the October field assessments are shown below in Figures 1 through 4.

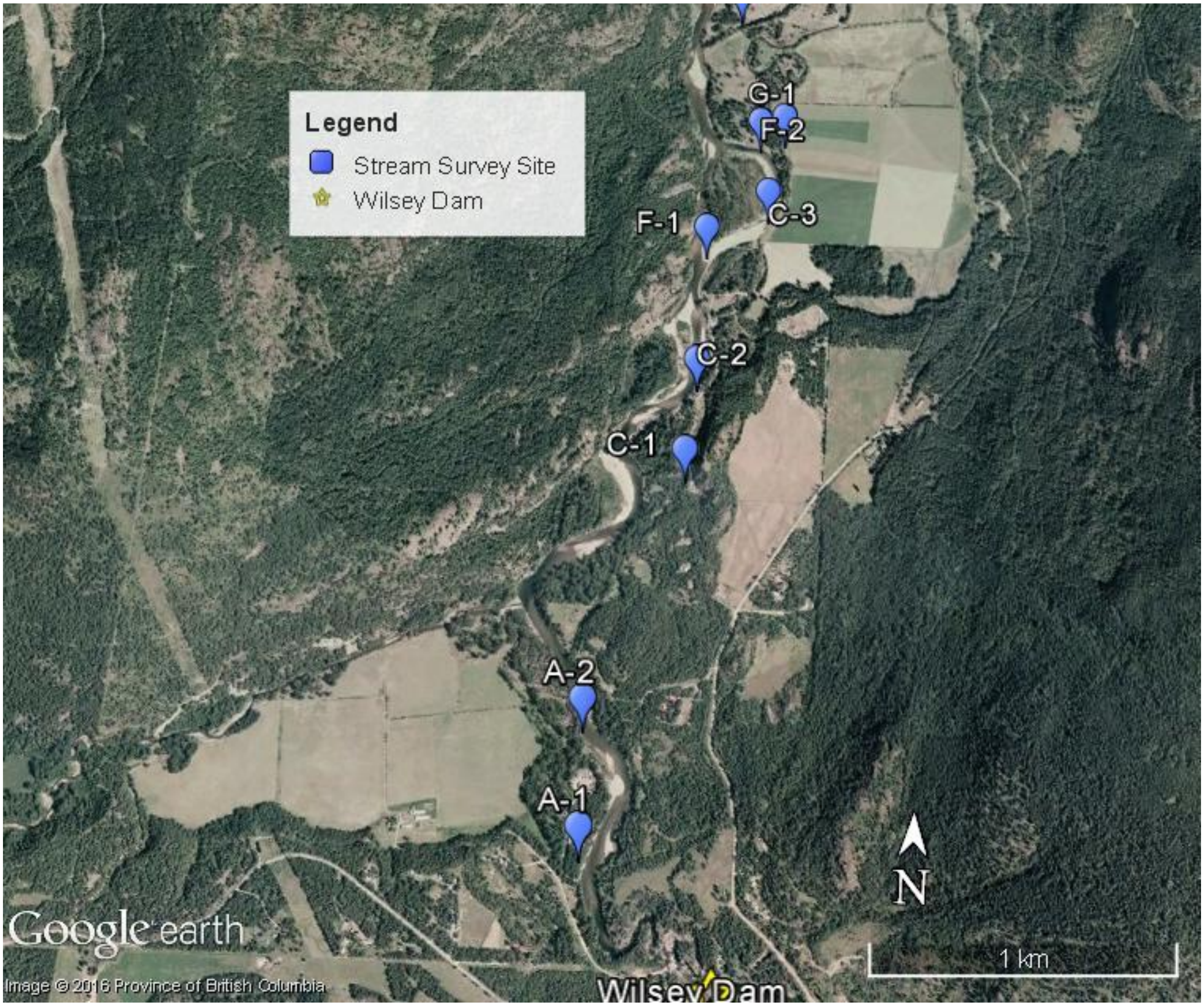

Figure 1. Stream survey sites A1-G1.

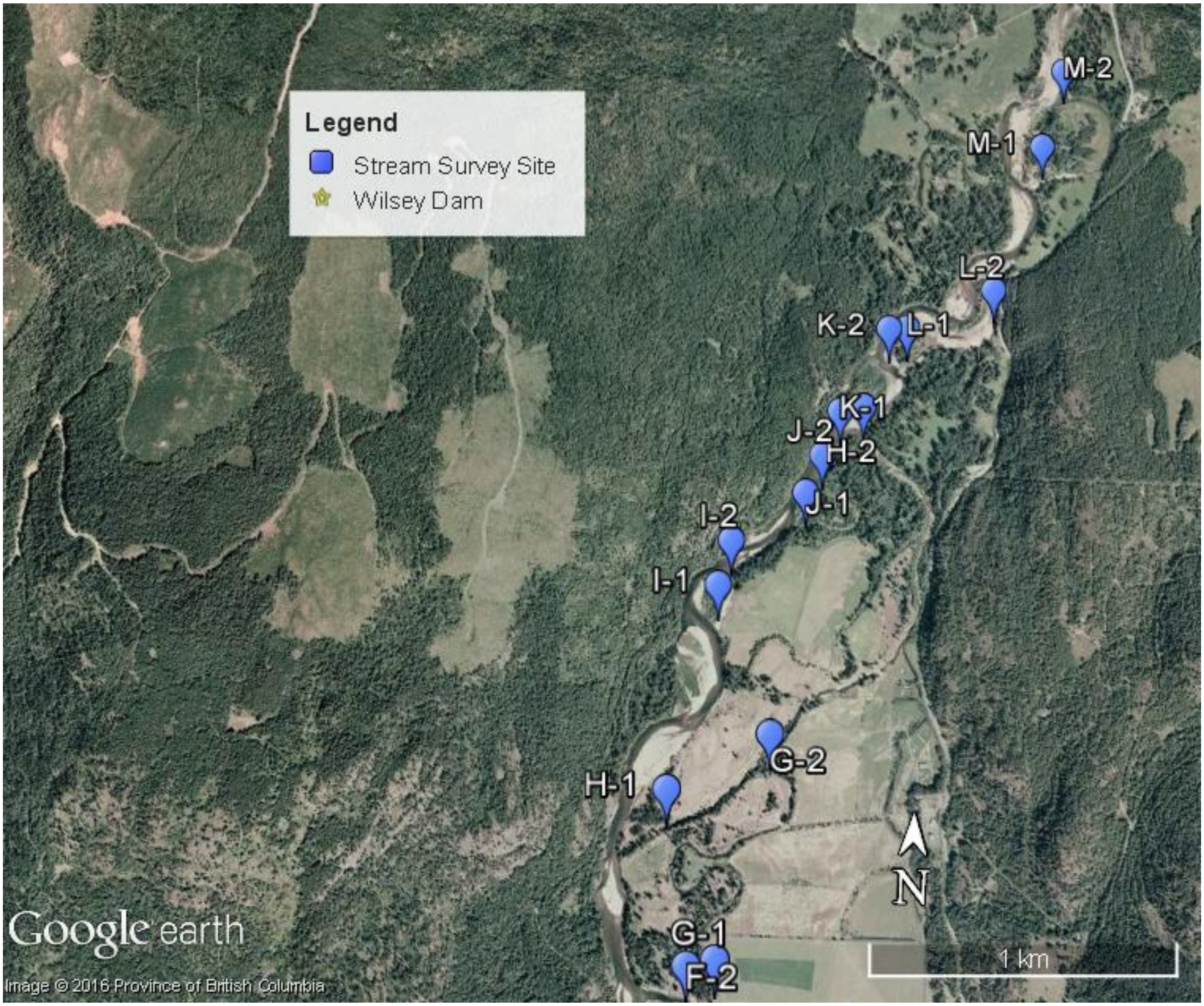

Figure 2. Stream survey sites F2-M2.

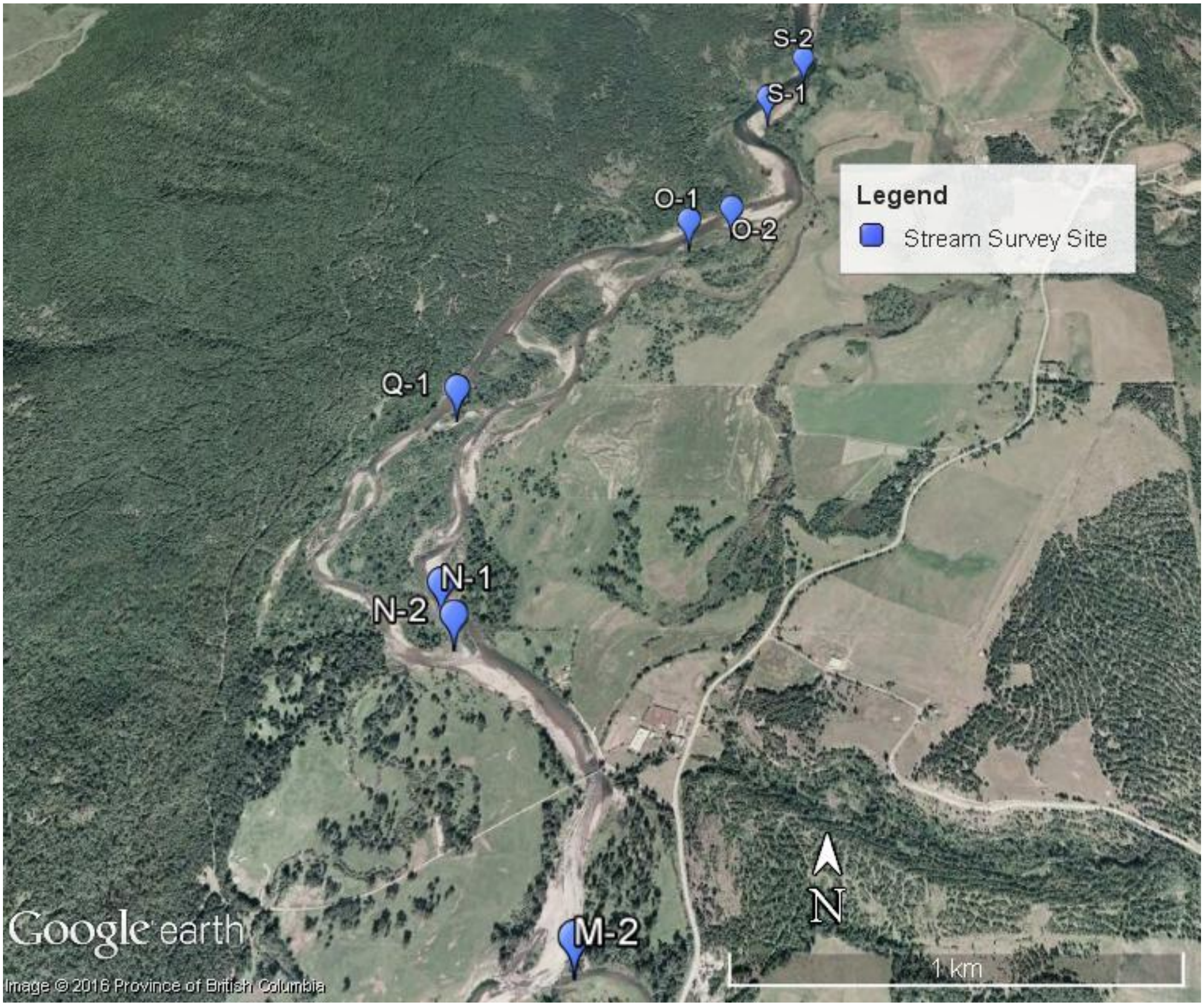

Figure 3. Stream survey sites M2-S2.

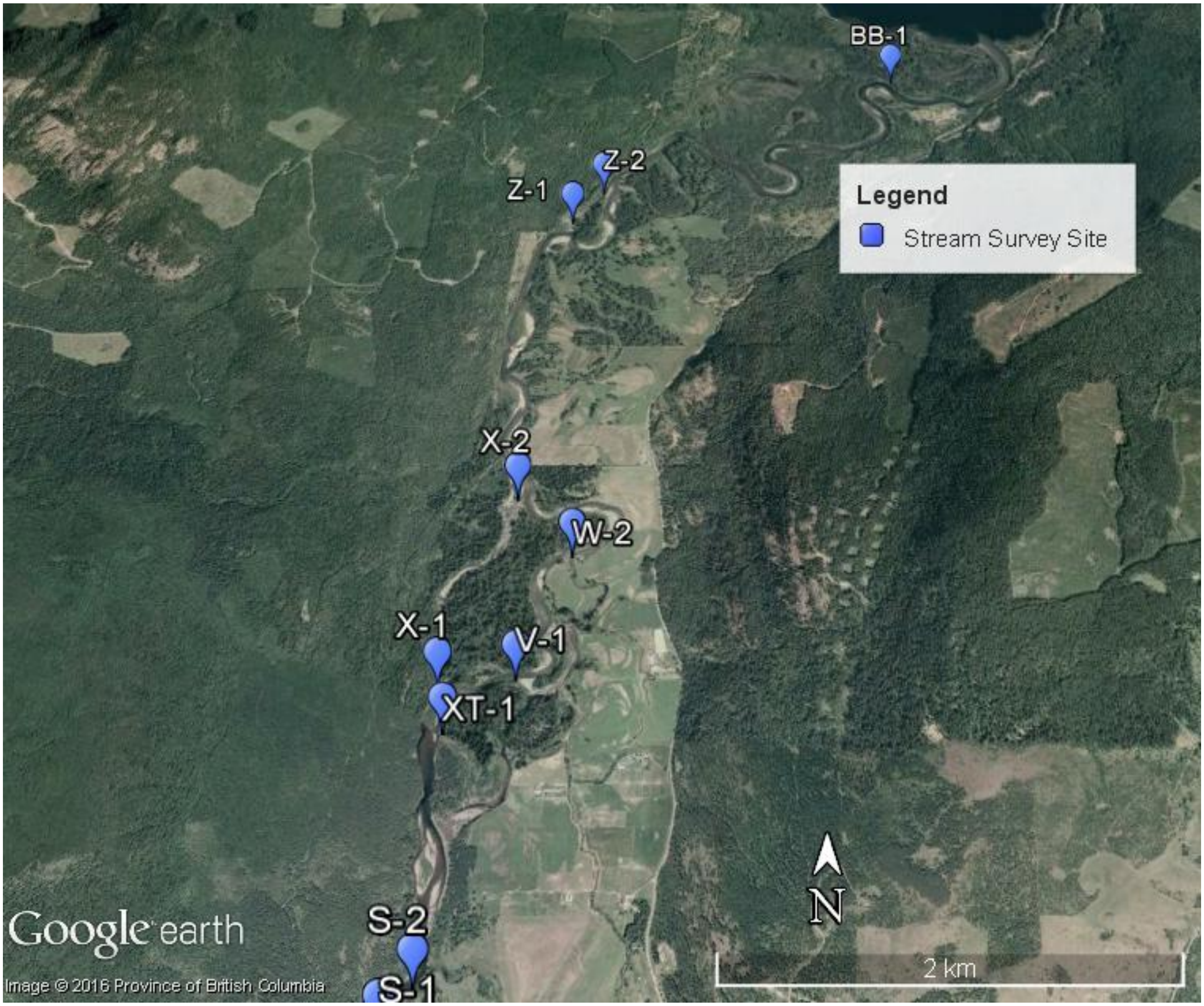

Figure 4. Stream survey sites S1-BB-1.

For this study, side channels are defined as hydraulically connected (either ephemerally or continuously) to the mainstem channel of the MSR. A survey emphasis was placed on side channels on river right that would be more easily accessed for enhancement works. Collected data is presented in summarized format in the following section.

3.0 PROJECT OUTCOMES

A total of 20 side channels along the MSR between Wilsey Dam and the Mabel Lake confluence were assessed. Summary results of the preliminary MSR side channel assessment for stream access, riparian cover and channel bed characteristics are provided below in Table 2. Additional data collected is presented in Appendix D.

Of the 20 side channels surveyed, ten side channel entrances did not contain water sufficient for fish access. Of these channels, only two were completely dry. The remaining 8 side channels did not have access at their upstream confluence with the mainstem; however, they contained flows connected to their downstream confluence, often with sufficient flow rates to permit fish access.

In Table 2, vegetation cover varied amongst the side channel assessment sites but the most dominant cover types were represented by instream vegetation, deep pools, and Large Woody Debris. Canopy closure was generally absent or low (0-20%). Riparian vegetation was most often observed to be in either the early seral shrub or the pole/sapling growth stages, typical of ecosystems influenced by active floodplain conditions. Riparian vegetation comprised of shrubs (e.g., willow) and deciduous (e.g., cottonwood) trees. In higher elevation and undisturbed areas, mature mixed coniferous (e.g., western redcedar) and deciduous (e.g., birch) forest extended to the foreshore (e.g., sites G-1, L-1 and XT-1). Overhanging vegetation did not provide substantial cover habitat in the surveyed side channels; however, it was generally represented by grasses where present.

Large Woody Debris (LWD) was observed in approximately 24 of the 35 sites assessed. Sites with a higher percentage of wood were generally characterized by the presence of a log jam (e.g., sites L1 and X1). LWD can be an important influence on pool development and add to overall complexity (B.C. Ministry of Environment, Lands and Parks and Ministry of Forests 1997).

Table 2. Summary of Middle Shuswap River side channel data.

			Mainstem Access	Vegetation and Cover Type						Channel Substrates		
Site	Date	Channel Width (m)	Wetted Access off Mainstem	% Small Woody Debris	% Large Woody Debris	% Crown Closure	% Overhanging Vegetation	% Instream Vegetation	Vegetation Stage	Dom. Bed Material	Sub-dom. Material	D95 (mm)
A-1	7-Oct-16	10.9	No	<30	<30	41-70	<30	0	YF	F	0	0
A-2	7-Oct-16	3.55	Yes	<20	0	1-20	<50	<5	INIT	F	G	140
C-1	7-Oct-16	7.4	No	<30	<70	21-40	40	100	YF	F	0	0
C-2	7-Oct-16	5.74	Yes	<10	0	1-20	0	40	INIT,SHR	S	C	14
C-3	7-Oct-16	9	Yes	<5	5	0	<10	<5	SHR	G	0	16
F-1	7-Oct-16	59.3	No	<20	<20	1-20	<10	<10	MF	G	C	14
F-2	7-Oct-16	25	Yes	<10	0	0	<10	5	PS	F	0	0
G-1	7-Oct-16	14.4	Yes	0	<20	1-20	30	80	SHR	F	0	0
G-2	7-Oct-16	14	Yes	<40	<30	1-20	<40	<10	INIT,MF	F	0	10
H-1	7-Oct-16	20	No	<30	<10	1-20	30	5	YF	F	0	14
H-2	7-Oct-16	13.6	Yes	<5	0	0	0	<20	SHR,YF	G	F,C	10
I-1	7-Oct-16	17	No	<5	<5	0	0	<5	INIT	G	C	12
I-2	7-Oct-16	12.7	No	<5	<10	0	0	60	SHR,MF	S	0	10
J-1	7-Oct-16	6.9	No	<20	<20	1-20	50	100	YF,MF	S	0	0
J-2	7-Oct-16	5.8	No	<5	0	0	<10	95	SHR	F	0	0
K-1	7-Oct-16	15	Yes	<30	<20	1-20	5	0	MF	S	G	8
K-2	7-Oct-16	18.3	Yes	<5	40	0	0	<5	INIT, YF	S	G	13
L-1	7-Oct-16	12	Yes	<20	<40	21-40	30	<5	SHR, MF	G	C	9
L-2	7-Oct-16	29.3	Yes	0	0	1-20	10	5	YF	F	G	3
M-1	7-Oct-16	34	No	<10	<20	0	<20	<5	0	G	C	12
M-2	7-Oct-16	18	Yes	0	<5	0	5	10	SHR	F	0	11
N-1	11-Oct-16	4.1	Yes	<5	<20	0	<5	<5	SHR	F	G	7
N-2	11-Oct-16	4.3	Yes	0	60	0	10	10	SHR	F	C	13
O-1	11-Oct-16	15.8	No	30	10	1-20	0	0	PS	G	F	4
O-2	11-Oct-16	26.4	No	0	0	1-20	<10	90	PS,YF	F	0	0
Q-1	11-Oct-16	20	Yes	5	5	0	<20	0	PS	G	C	60
S-1	11-Oct-16	0	No	<10	<5	0	<5	<10	PS	G	C	7
S-2	11-Oct-16	28.3	Yes	<5	0	1-20	<5	<30	YF	F	0	0
V-1	11-Oct-16	5.2	Yes	30	<5	21-40	0	0	PS	F	G	6
W-2	11-Oct-16	26	Yes	0	0	0	0	<5	INIT	F	0	0
X-1	11-Oct-16	30	Yes	5	50	0	10	5	SHR	F	G	15
XT-1	11-Oct-16	7.3	No	0	<5	1-20	40	100	SHR	Grass	0	0
Z-1	11-Oct-16	15	Yes	0	60	0	0	0	SHR	F	0	1
Z-2	11-Oct-16	30	Yes	0	<5	0	5	<5	SHR	F	0	0
BB-1	11-Oct-16	18	Yes	<10	40	1-20	10	30	YF	F	0	0

Stage definitions: Young Forest (YF), shrub canopy (SHR), seral intermittent forest (INIT), mature forest (MF), pole saplings (PS)

Bed material definitions: Fines (F), sand (S), gravel (G), cobble (C)

Dominant grain size varied between sites from sand to gravel bedded. Where fine sand occurred, this substrate dominated the channel bed. Where gravel occurred, sand and/or cobbles were present as sub-dominant substrate. Eleven sites (i.e., A, C, G, J, K, N, V, W, X, Z and BB) were sand dominant at the upstream and downstream confluence. The remaining sites had a mixture of substrates at the upstream and downstream confluences. Average D_{95}[1] for all 20 sites was 0.1 mm. Sites for which no D_{95} was specified indicate unmeasurable sand particles. Grain size observations were only made at the side channel upstream and downstream confluence with the MSR mainstem and did not include channel bed characteristics in between the confluences.

Other general observations made during the field survey include:

- Access for cattle was generally unrestricted across the MSR floodplain and to the main stem river channel in numerous locations;
- Numerous kokanee spawning. Predation by bald eagles and gull species observed;
- Trout fry observed in a number of residual pools and side channels; and
- Various bank protection works have been completed along this section of the MSR and include riprap and Large Woody Debris inputs, primarily on river right.

4.0 RECOMMENDATIONS

Enhancement of side channel habitat features for anadromous yearlings and resident fish species is achievable along the MSR. In fact, numerous side channels including the Maltman and Huwer side channels have created significant side channel habitat for juvenile fish and spawning kokanee. However, there remains many opportunities for further enhancement. This study highlights numerous locations along the MSR downstream of Wilsey Dam suitable for enhancement.

There are generally four different types of side channel restoration or enhancement projects that would require specific considerations and would require additional assessment before determining construction costs. Side channel projects include construction and restoration of groundwater channels, reconnection of overflow channels to the mainstem channel, and restoration of wall-based channels and floodplain ponds (Castle 2004). Suitable sites are generally represented by gravels (inferring porous floodplain), water sources, relative elevation of the floodplain to the river, and any restrictions to flow (e.g., levees, log jams, road fills) that may isolate the floodplain from the mainstem river channel (Castle 2004). Any future side channel site restorations should be as self-sustaining through natural processes as possible, and sites should be protected from disturbance, and consider the surrounding condition, water quality, groundwater influence, fish usage and riparian vegetation condition.

Before proceeding with any restoration or enhancement activities, protecting potential side channel restoration sites by means of riparian fencing would be important to restrict cattle access to instream and riparian habitat. This precaution would prevent unintended damage to sites that require limited disturbance and potentially maintenance to become established and functional. Engagement with local landowners is key to exploring potential collaborative side channel restoration activities.

Following fencing activities, restoration or enhancement of side channel habitats could include riparian planting of a mix of coniferous and deciduous tree species with consideration for local beaver activity, and reopening side channel habitat and placement of LWD pieces (e.g., stable root wads, debris clusters, log jams) to promote the development of deep pools. Side channel sites that are greater than 7 m bankfull width and have a greater gradient more than 2% are recommended for LWD enhancement (B.C. Ministry of Environment, Lands and Parks and Ministry of Forests 1997).

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1 D_{95} is the grain for which 95 percent of all grains in the distribution are smaller.

Results of this preliminary survey identified the following side channels as potential sites for future study and enhancement:

- Inlet of side channel C (photographs 5 and 6 in Appendix C) to restore connectivity with the mainstem channel; and
- Side channels S (photographs 58 and 59 in Appendix C) and V (photograph 62), where salmonid fry were observed within isolated pools.

Yucwmenlúcwu and SEC in partnership with regional community stewards plan on developing projects based on findings and recommendations presented in this report to bring forth to the FWCP for funding in future years.

7.0 SUBMISSION AND SIGNATURE

Thank you for your attention. Please contact the undersigned should you require more information.

Sincerely,

Robyn Laubman, B.Sc. R.P.Bio.
Senior Biologist, Yucwmenlúcwu

Giles Shearing, M.Sc. Candidate, AScT
Principal and Lead Consultant, SEC

BIBLIOGRAPHY

ARC. 2001a. "Shuswap River Fish/Aquatic Information Review." Kamloops, BC: Arc Environmental Ltd.

ARC. 2001b. "Shuswap River Mable Lake to Wilsey Dam Spawner/Habitat Survey Data Report." *Arc Environmental Ltd.*, February, 1–73.

B.C. Hydro. 2003. Bridge-Coastal Fish & Wildlife Restoration Program. Volume 2 Revised Jan 06/03: Middle Shuswap River Watershed. 38 p. Accessed online at: http://www.shuswapwatershed.ca/docs/3.%20Parts%20of%20a%20Watershed/Resources/Rivers/MiddleShuswapRiver_BCH_ch12_final.pdf.

B.C. Ministry of Environment, Lands and Parks and Ministry of Forests. 1997. Fish Habitat Rehabilitation Procedures. Watershed Restoration Technical Circular No.9. Eds. P.A. Slaney and D. Zaldokas. 50 p.

Bengeyfield, W., D, Hay, S, Joyce and J. Greenbank, 2001. "Evaluation of Restoring historic passage for anadromous fish at BC Hydro Facilities." MOE file 34560- 27/Punt-R. Vancouver: BC Hydro.

Burgner, R. L. 1991. "Life History of Sockeye Salmon." In *Pacific Salmon Life Histories*, edited by C Groot and L Margolis, 16–22. Vancouver, BC: UBC Press.

Castle, D. 2004. Side Channel and Off Channel Habitat Restoration. Washington Department of Forestry. Accessed online at: http://www.wou.edu/las/physci/taylor/g407/g407sp15.htm.

DFO. 1998. "Salmon Watershed Planning Profiles for the South Thompson-Shuswap Habitat Management Area." *Fisheries and Oceans Canada*, March. Vancouver, BC, 1–376.

ee, J., and J. Jong. 1984. "Evaluation of Chinook and Coho Outplanting Opportunities in the Middle Shuswap River Above and Below Shuswap Falls." Victoria, BC: 1–86.

French, D. E. 1995. "Historic Review of Anadromous Salmonid Passage Above Shuswap Falls, British Columbia." Kelowna, BC: Okanagan University College.

FWCP. 2011b. "Middle Shuswap Watershed Salmonid Action Plan - Final Draft." *Fish and Wildlife Compensation Program*, October. Burnaby, BC, 1–19.

FWCP. 2011a. "Middle Shuswap River: Watershed Plan - Final Draft." *Fish and Wildlife Compensation Program*, October. Burnaby, BC, 1–25.

Guy, B. T., and L. Uunila. 2002. "Survey of Gravel Recruitment Needs: Middle Shuswap River, Bridge River, Seton River and Cayoosh Creek." Vernon, B.C.: Summit Environmental, 1–63.

IFCRT. 2006. "Conservation Strategy for Coho Salmon (Oncorhynchus Kisutch), Interior Fraser River Populations." Fs23-517/2007E-PDF. Vancouver, BC: Fisheries and Oceans Canada.

Irvine, J. R. 2002. "COSEWIC Assessment and Status Report on the Coho Salmon Oncorhynchus Kisutch Interior Fraser Population in Canada." Ottawa: Committee on the Status of Endangered Wildlife in Canada.

Lister, D. B. 1990. "An Assessment of Fisheries Enhancement Potential of B.C. Hydro Operations at Shuswap River." Clearbrook, BC: D. B. Lister & Associates Ltd.

Ministry of Environment. 2014. *Fisheries Information Summary System*. Victoria, B.C.: British Columbia Ministry of Environment. http://a100.gov.bc.ca/pub/fidq/fissSpeciesSelect.do.

Minor, T. 2007. “Middle Shuswap Sensitive Ecosystem Inventory and Sensitive Habitat Inventory Mapping Project.” Lumby, B.C. *Whitevalley Community Resource Centre Society*, August, 1–68.

Regional District of the North Okanagan (RDNO). 2014. Shuswap River Watershed Sustainability Plan. 55 p. Accessed online at: http://www.rdno.ca/docs/141114_SRWSP_FinalFormat.pdf.

Sandercock, F. K. 1991. “Life History of Coho Salmon.” In *Pacific Salmon Life Histories*, edited by C. Groot and L. Margolis, 395–445. UBC Press.

Sigma. 1993. “Shuswap Flow Capability Study: British Columbia Hydro and Power Authority: Environmental Resources Division.” Sigma Engineering Ltd.

Waples, R. S. et al. 2001. “Characterizing Diversity in Salmon From the Pacific Northwest*1.” *Journal of Fish Biology* 59 (December): 1–41. doi:10.1006/jfbi.2001.1764.

APPENDIX A: Reconnaissance (1:20,000) Fish and Fish Habitat Inventory Field Site Card (Ministry of Environment 2008)

SITE CARD

STREAM NAME (gaz.) (local)
WATERSHED CODE
ILP MAP # ILP # NID MAP # NID #
REACH # – SITE # FIELD UTM MTO SITE LG MTO ACCESS
DATE YY MM DD TIME AGENCY CREW FISH FORM Y ☐ N ☐

CHANNEL	mthd								GRADIENT %			EMS		MTO	REQ. #		MTO	WATER
CHANNEL WIDTH (m)									MTO			TEMP	°C		COND.	µS/cm		
WETTED WIDTH (m)												pH			TURB.	T M L C		
RES. POOL DEPTH (m)												FLD SNS						

W_b Dp (m) MTO STAGE L M H | No Vis. Ch. ☐ Dry/Int. ☐ DW ☐ Tribs. ☐

COVER

COVER	Total						
Type	SWD	LWD	B	U	DP	OV	IV
AMT							
LOC							

CROWN CLOSURE

0	1-20%	21-40%	41-70%	71-90%	> 90%
0	1	2	3	4	5

LWD FNC N F A DIST C E | INSTREAM VEG N A M V
LB SHP U V S O | RB SHP U V S O
TEXTURE F G C B R A | TEXTURE F G C B R A
RIP. VEG. N G S C D M W | RIP. VEG. N G S C D M W
STAGE INIT SHR PS YF MF NA | STAGE INIT SHR PS YF MF NA

MORPHOLOGY

BED MATERIAL Dominant Subdom.
D95 (cm) D (cm) Morph.

DISTURBANCE INDICATORS			beavdam	aban ch	erdbk	avul	SWD	LWD	jam
			O1	B1	B2	B3	D1	D2	D3
ex rif	no pl	elev br	mult ch	dis line	hom bd	finger	lg wdg	ex bar	ex bd scr
C1	C2	C3	C4	C5	S1	S2	S3	S4	S5

PATTERN TM ME IM IR SI ST
ISLANDS N O I F S AN
BARS N SIDE DIAG MID SPAN BR
COUPLING DC PC CO
CONFINEMENT EN CO FC OC UN N/A

FEATURES

C	NID MAP #	NID #	TYPE	HT / LG (m)	mthd	PHOTO	COMMENTS	UTM
						R___ F___		MTO
						R___ F___		
						R___ F___		
						R___ F___		

SITE CARD

STREAM NAME (gaz.) (local)
WATERSHED CODE
ILP MAP # ILP # NID MAP # NID #
REACH # – SITE # FIELD UTM MTO SITE LG MTO ACCESS
DATE YY MM DD TIME AGENCY CREW FISH FORM Y ☐ N ☐

CHANNEL	mthd								GRADIENT %			EMS		MTO	REQ. #		MTO	WATER
CHANNEL WIDTH (m)									MTO			TEMP	°C		COND.	µS/cm		
WETTED WIDTH (m)												pH			TURB.	T M L C		
RES. POOL DEPTH (m)												FLD SNS						

W_b Dp (m) MTO STAGE L M H | No Vis. Ch. ☐ Dry/Int. ☐ DW ☐ Tribs. ☐

COVER

COVER	Total						
Type	SWD	LWD	B	U	DP	OV	IV
AMT							
LOC							

CROWN CLOSURE

0	1-20%	21-40%	41-70%	71-90%	> 90%
0	1	2	3	4	5

LWD FNC N F A DIST C E | INSTREAM VEG N A M V
LB SHP U V S O | RB SHP U V S O
TEXTURE F G C B R A | TEXTURE F G C B R A
RIP. VEG. N G S C D M W | RIP. VEG. N G S C D M W
STAGE INIT SHR PS YF MF NA | STAGE INIT SHR PS YF MF NA

MORPHOLOGY

BED MATERIAL Dominant Subdom.
D95 (cm) D (cm) Morph.

DISTURBANCE INDICATORS			beavdam	aban ch	erdbk	avul	SWD	LWD	jam
			O1	B1	B2	B3	D1	D2	D3
ex rif	no pl	elev br	mult ch	dis line	hom bd	finger	lg wdg	ex bar	ex bd scr
C1	C2	C3	C4	C5	S1	S2	S3	S4	S5

PATTERN TM ME IM IR SI ST
ISLANDS N O I F S AN
BARS N SIDE DIAG MID SPAN BR
COUPLING DC PC CO
CONFINEMENT EN CO FC OC UN N/A

FEATURES

C	NID MAP #	NID #	TYPE	HT / LG (m)	mthd	PHOTO	COMMENTS	UTM
						R___ F___		MTO
						R___ F___		
						R___ F___		
						R___ F___		

APPENDIX B: Budget and Schedule

A) Labour Expenses (i.e. Salaries/Wages)

Service	Daily Rate	Total Days	Total Cost	FWCP Contribution
Nov. Field Survey - Yucwmenlucwu	$560.00	1	$560.00	$560.00
Nov. Field Survey - SEC	$600.00	1	$600.00	$600.00
April Field Survey - Yucwmenlucwu	$560.00	1	$560.00	$560.00
April Field Survey - SEC	$600.00	1	$600.00	$600.00
Summary Report - Yucwmenlucwu	$560.00	3	$1,680.00	$1,680.00
Sub-Total(A)			**$4,000.00**	**$4,000.00**

B) Materials, Equipment, Transportation and Field Expenses

Item	Number Units	Unit Cost	Total Cost	FWCP Contribution
Vehicle Mileage - 2 trips SEC	720	$0.55	$396.00	$396.00
Vehicle Mileage - 2 trips April field survey	280	$0.55	$154.00	$154.00
Sub-Total(B)			**$550.00**	**$550.00**

C)Project Administration Costs

Item	Number Units	Unit Cost	Total Cost	FWCP Contribution
Project Management and Administration - Yucwmenlucwu	1	$440.00	$440.00	$440.00
Sub-Total(C)			**$440.00**	**$440.00**
Total Expenses			**$4,990.00**	**$4,990.00**

Revenue

Sources	Other	In-kind	Volunteer	Total
Non-FWCP Total	**$0.00**	**$0.00**	**$0.00**	**$0.00**
Total FWCP Funding Request				**$4,990.00**
Total Revenue (should equal Total Expenses)				**$4,990.00**

Total Project Cost: $4,990.00

APPENDIX C: Field Survey Photographs

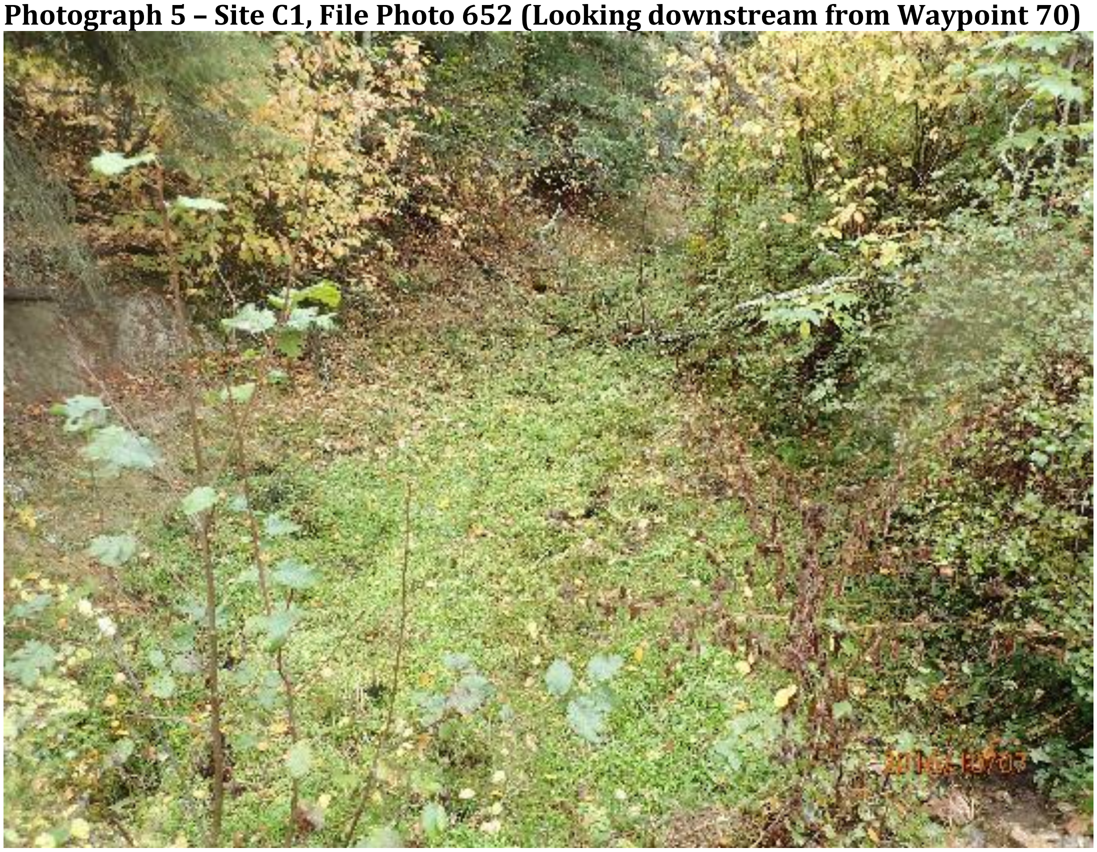
Photograph 1 – Site A1, File Photo 647 (Looking downstream from Waypoint 68)

Photograph 2 – Site A1, File Photo 648 (Looking upstream from Waypoint 68)

Photograph 3 – Site A2, File Photo 649 (Looking downstream from Waypoint 69)

Photograph 4 – Site A2, File Photo 650 (Looking upstream from Waypoint 69)

Photograph 5 – Site C1, File Photo 652 (Looking downstream from Waypoint 70)



Photograph 6 – Site C1, File Photo 653 (Looking upstream from Waypoint 70)

Photograph 7 – Site C2, File Photo 655 (Looking downstream from Waypoint 71)

Photograph 8 – Site C2, File Photo 656 (Looking upstream from Waypoint 71)

Photograph 9 – Site C3, File Photo 660 (Looking upstream from Waypoint 73)

Photograph 10 – Site C3, File Photo 661 (Looking downstream from Waypoint 73)

Photograph 11 – Site F1, File Photo 658 (Looking downstream from Waypoint 72)

Photograph 12 – Site F2, File Photo 664 (Looking upstream from Waypoint 74)

Photograph 13 – Site F2, File Photo 665 (Looking downstream from Waypoint 74)

Photograph 14 – Site G1, File Photo 666 (Looking upstream from Waypoint 75)

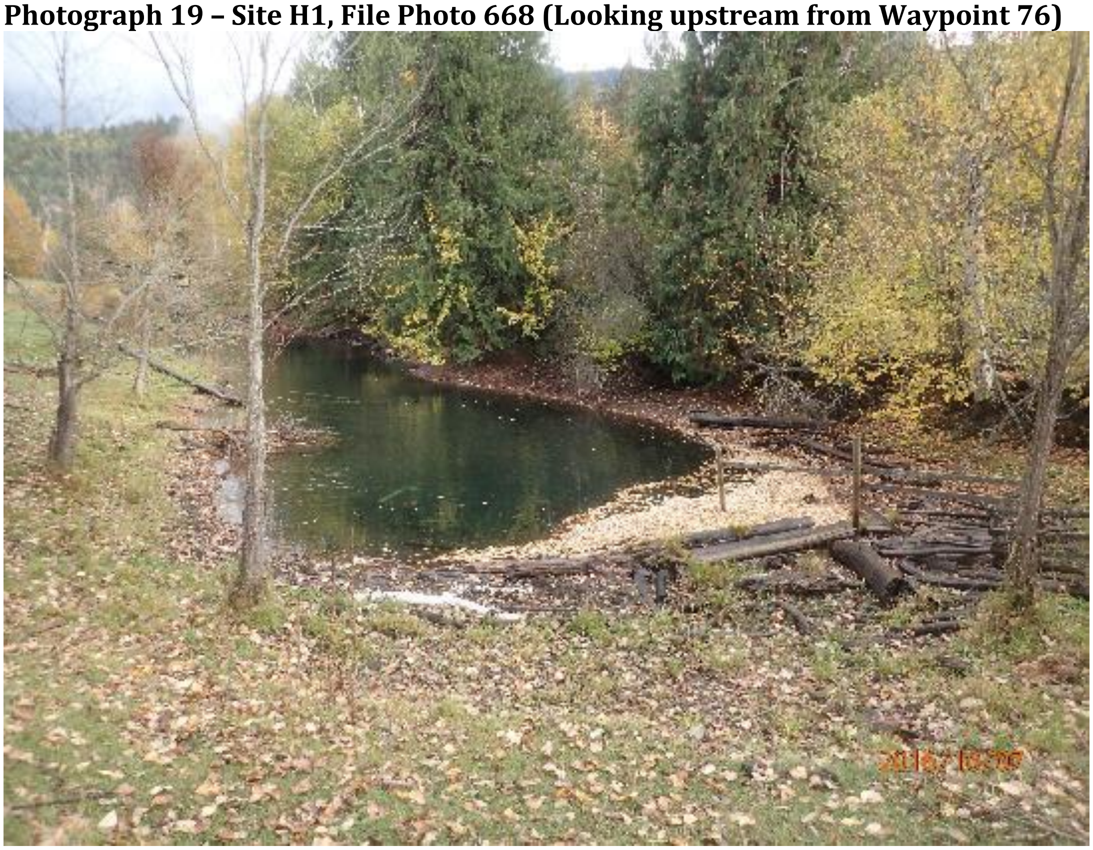
Photograph 15 – Site G1, File Photo 667 (Looking downstream from Waypoint 75)

Photograph 16 – Site G2, File Photo 670 (Looking upstream from Waypoint 78)

Photograph 17 – Site G2, File Photo 671 (Looking downstream from Waypoint 79)

Photograph 18–File Photo 672 (Wood jam just outside of side channel G confluence with side channel H)

Photograph 19 – Site H1, File Photo 668 (Looking upstream from Waypoint 76)

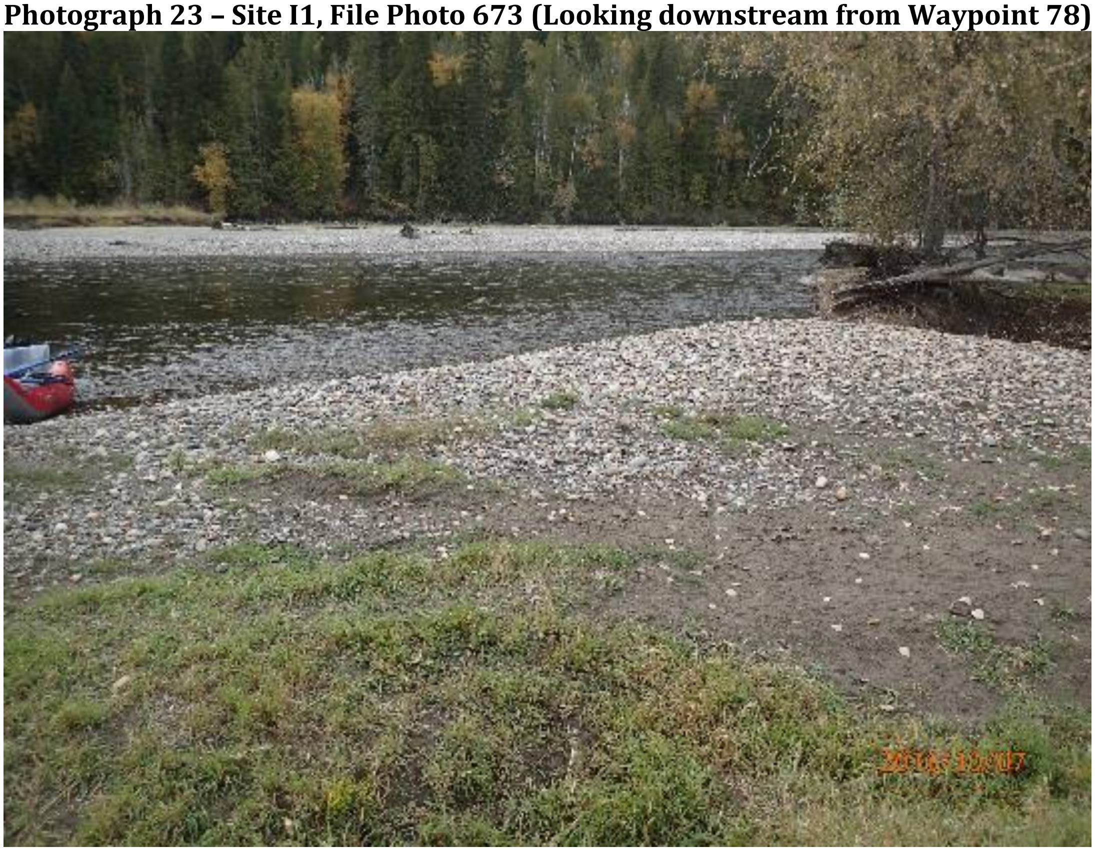


Photograph 20 – Site H1, File Photo 669 (Looking downstream from Waypoint 76)

Photograph 21 – Site H2, File Photo 684 (Looking upstream from Waypoint 82)

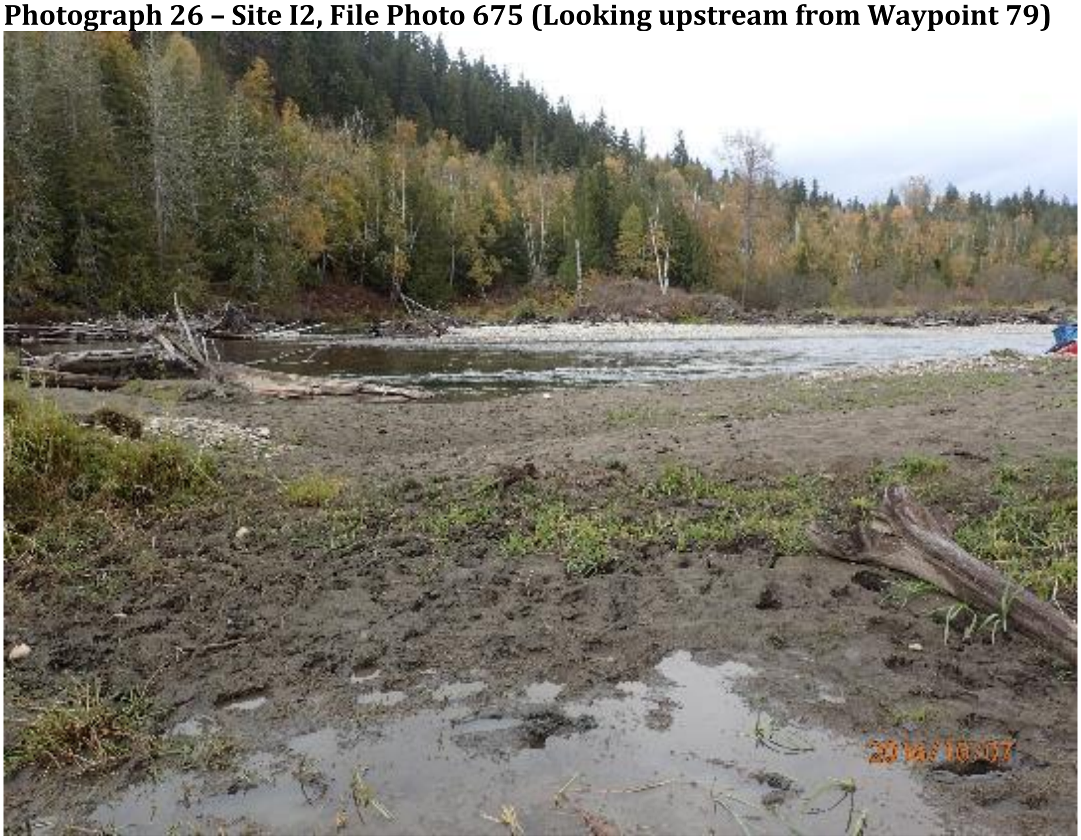
Photograph 22 – Site H2, File Photo 683 (Looking downstream from Waypoint 82)

Photograph 23 – Site I1, File Photo 673 (Looking downstream from Waypoint 78)



Photograph 24 – Site I1, File Photo 674 (Looking upstream from Waypoint 78)

Photograph 26 – Site I2, File Photo 675 (Looking upstream from Waypoint 79)



Photograph 27 – Site I2, File Photo 676 (Looking downstream from Waypoint 79)

Photograph 28 – Site J1, File Photo 677 (Looking upstream from Waypoint 80)

Photograph 29 – Site J1, File Photo 678 (Looking downstream from Waypoint 80)

Photograph 30 – Site J1 File Photo 679 (inlet at confluence ~ 2 m channel bed from water level)

Photograph 31 – Site J2, File Photo 680 (Looking downstream from Waypoint 81)

Photograph 32 – Site J2, File Photo 681 (Looking upstream from Waypoint 81)

Photograph 33 – Site J2 File Photo 682 (from gravel confluence with MSR)

Photograph 34 – Site K1, File Photo 686 (Looking upstream from waypoint 83)

Photograph 35 –File Photo 685 (at H2 confluence with K1 at waypoint 83)

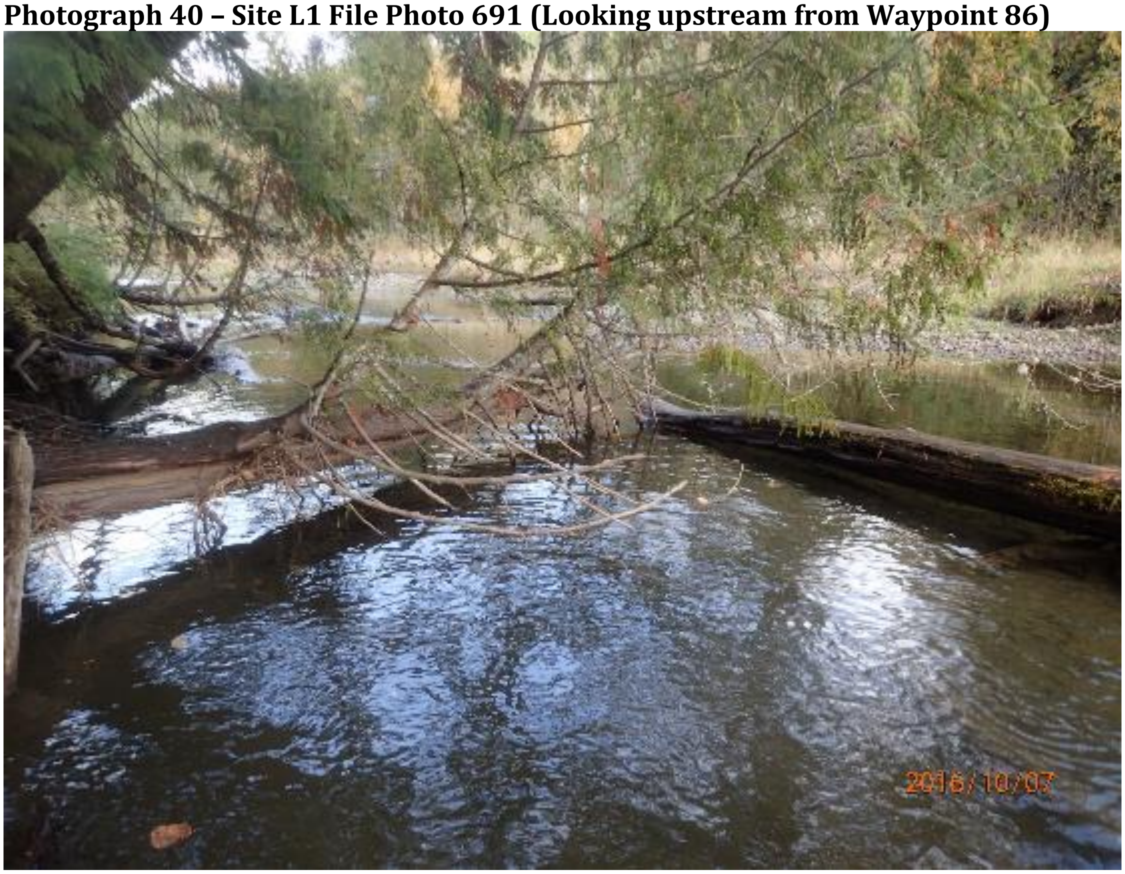
Photograph 36–Site K1 File Photo 688 (Looking downstream at subsurface flows between waypoints 83 and 84)

Photograph 37–Site K1 File Photo 687 (Looking upstream at subsurface flows between waypoints 83 and 84)

Photograph 38 – Site K2 File Photo 690 (Looking downstream from Waypoint 85)

Photograph 39 – Site K2 File Photo 689 (Looking upstream from Waypoint 85)

Photograph 40 – Site L1 File Photo 691 (Looking upstream from Waypoint 86)



Photograph 41 – Site L1 File Photo 692 (Looking downstream stream from Waypoint 86)

Photograph 42 – Site L2 File Photo 694 (Looking upstream from Waypoint 87)

Photograph 43 – Site L2 File Photo 695 (Looking downstream from Waypoint 87)

Photograph 44 – Site M1 File Photo 696 (Looking upstream from Waypoint 88)

Photograph 45 – Site M1 File Photo 697 (Looking downstream from Waypoint 88)

Photograph 46 – Site M2 File Photo 698 (Looking upstream from Waypoint 89)

Photograph 47 – Site M2 File Photo 699 (Looking downstream from Waypoint 89)

Photograph 48 – Site N1 File Photo 700 (Looking upstream from Waypoint 92)

Photograph 49 – Site N1 File Photo 701 (Looking downstream from Waypoint 92)

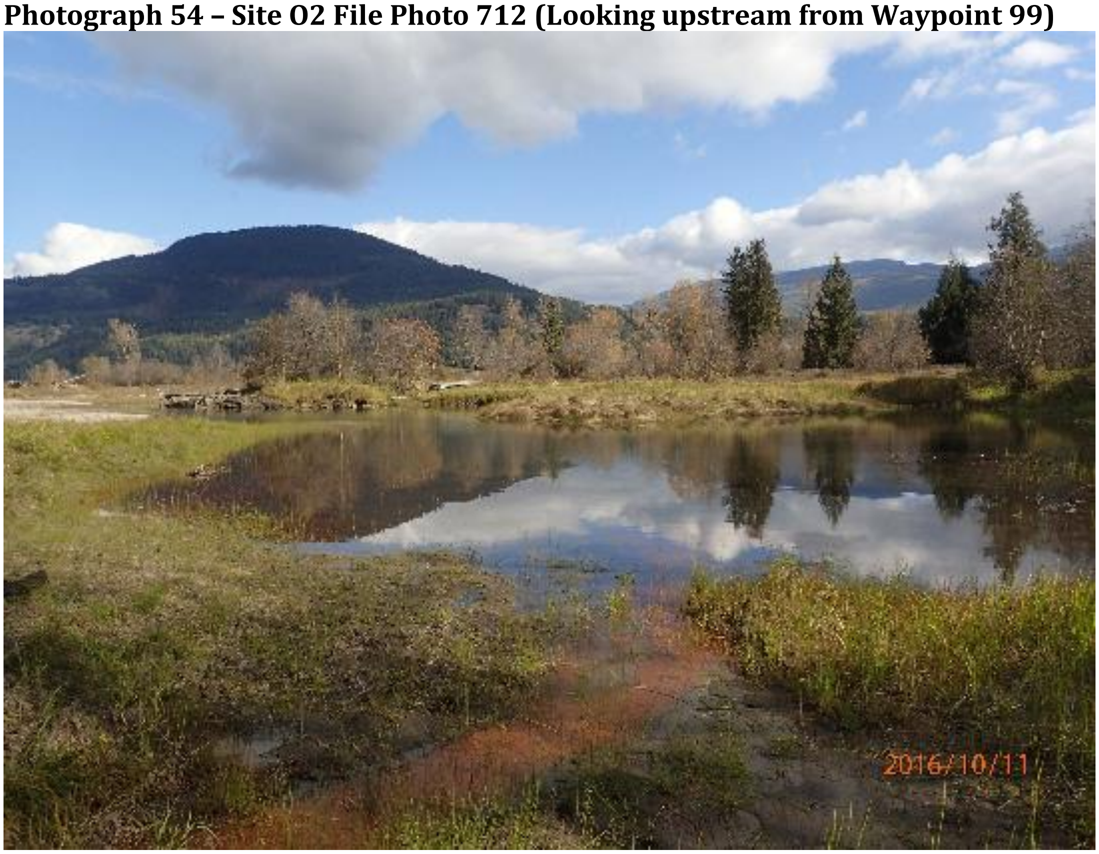
Photograph 50 – Site N2 File Photo 702 (Looking upstream from Waypoint 93)

Photograph 51 – Site N2 File Photo 703 (Looking downstream from Waypoint 93)

Photograph 52 – Site O1 File Photo 710 (Looking upstream from Waypoint 98)

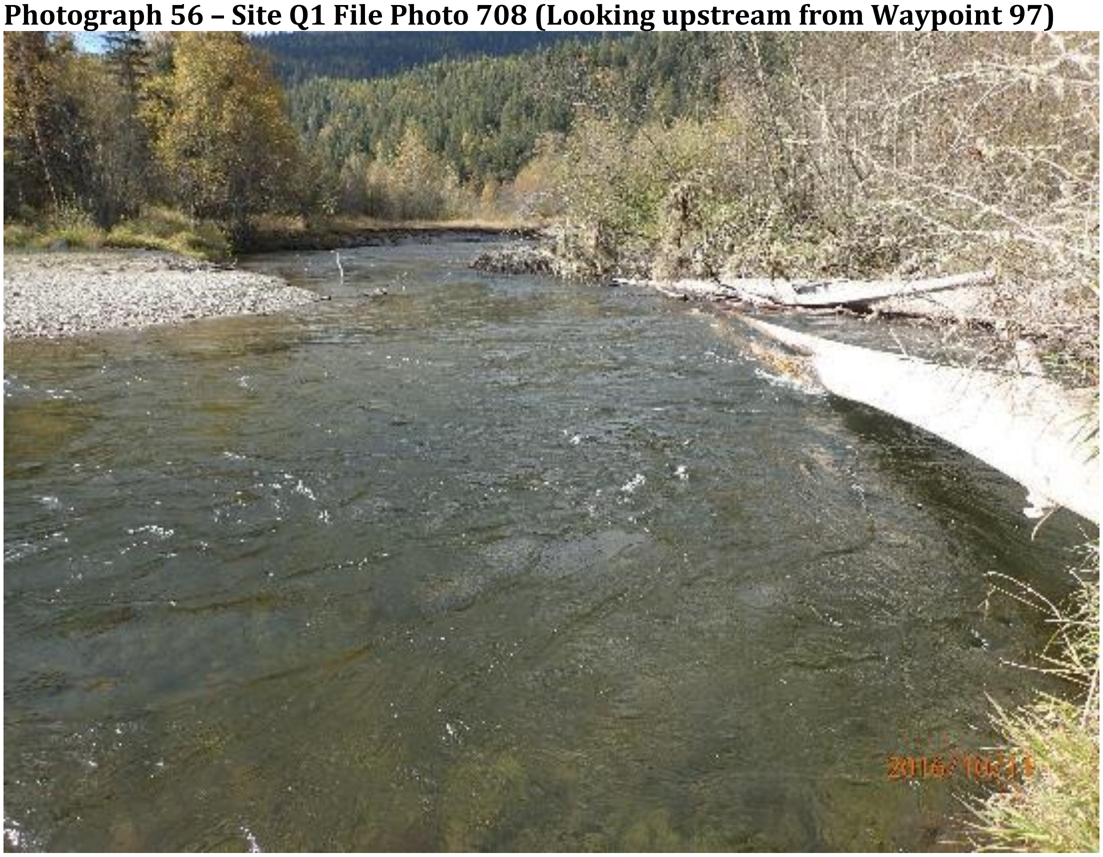
Photograph 53 – Site O1 File Photo 711 (Looking downstream from Waypoint 98)

Photograph 54 – Site O2 File Photo 712 (Looking upstream from Waypoint 99)



Photograph 55 – Site O2 File Photo 713 (Looking downstream from Waypoint 99)

Photograph 56 – Site Q1 File Photo 708 (Looking upstream from Waypoint 97)



Photograph 57 – Site Q1 File Photo 709 (Looking downstream from Waypoint 97)

Photograph 58 – Site S1 File Photo 715 (Looking upstream from Waypoint 100)

Photograph 59 – Site S1 File Photo 716 (Looking downstream from Waypoint 100)

Photograph 60 – Site S2 File Photo 717 (Looking upstream from Waypoint 101)

Photograph 61 – Site S2 File Photo 718 (Looking downstream from Waypoint 101)

Photograph 62 – Site V1 File Photo 721 (Looking upstream from Waypoint 105)

Photograph 63 – Site V1 File Photo 722 (Looking downstream from Waypoint 102)

Photograph 64 – Site W2 File Photo 727 (Looking upstream from Waypoint 108)

Photograph 65 – Site W2 File Photo 728 (Looking downstream from Waypoint 109)

Photograph 66 – Site X1 File Photo 723 (Looking upstream from Waypoint 105)

Photograph 67 – Site X1 File Photo 724 (Looking downstream from Waypoint 105)

Photograph 68 – Site XT-1 File Photo 719 (Looking upstream from Waypoint 102)

Photograph 69 – Site XT-1 File Photo 720 (Looking downstream from Waypoint 102)

Photograph 70 – Site Z1 File Photo 730 (Looking upstream from Waypoint 110)

Photograph 71 – Site Z1 File Photo 731 (Looking downstream from Waypoint 110)

Photograph 72 – Site Z1 File Photo 732 (Looking upstream at logjam from Waypoint 110)

Photograph 73 – Site Z2 File Photo 733 (Looking upstream from Waypoint 111)

Photograph 74 – Site BB-1 File Photo 735 (Looking downstream from Waypoint 112)

Photograph 75 – Site BB-1 File Photo 736 (Looking upstream from Waypoint 112)

APPENDIX D: Survey Field Data

Site	Date	Channel width (m)	Wetted Width (m)	Residual Pool Depth (m)	Dry / Intermittent	Dewatering	Total Cover	Cover % Small Woody Debris	% Large Woody Debris	% Boulder	% Undercut Bank	% Deep Pool	% Overhanging Vegetation	% Instream Vegetation	Crown closure (%)
A-1	7-Oct-16	10.9	0	0	Yes		Moderate	<30	<30	0	<5	0	<30	Jan-00	41-70
A-2	7-Oct-16	3.55	2.13	0.24			Abundant	<20	0	0	50	<5	<50	<5	1-20
C-1	7-Oct-16	7.4	3	0.01	Yes	Yes	Moderate	<30	<70	0	0	<5	40	100	21-40
C-2	7-Oct-16	5.74	2.84	0.52			Moderate	<10	0	5	0	30	0	40	1-20
C-3	7-Oct-16	9	7.3	0.1			Trace	<5	5	0	5	0	<10	<5	0
F-1	7-Oct-16	59.3	0		Yes		Moderate	<20	<20	0	0	0	<10	<10	1-20
F-2	7-Oct-16	25	12	2			Moderate	<10	0	0	0	0	<10	5	0
G-1	7-Oct-16	14.4	3.6	0.4			Abundant	0	<20	<10	0	<30	30	80	1-20
G-2	7-Oct-16	14	9	0.7			Abundant	<40	<30	0	0	<30	<40	<10	1-20
H-1	7-Oct-16	20	9	2.5			Abundant	<30	<10	0	0	40	30	5	1-20
H-2	7-Oct-16	13.6	4.1	0.03			Moderate	<5	0	0	0	0	0	<20	0
I-1	7-Oct-16	17	0	0	Yes		Trace	<5	<5	0	<5	0	0	<5	0
I-2	7-Oct-16	12.7	4.7	0.23	Yes		Abundant	<5	<10	0	0	0	0	60	0
J-1	7-Oct-16	6.9	0		Yes		Abundant	<20	<20	0	<5	0	50	100	1-20
J-2	7-Oct-16	5.8	of residual pool 1.8m	0.05	Yes		Abundant	<5	0	0	20	0	<10	95	0
K-1	7-Oct-16	15	8	0.5			Moderate	<30	<20	0	5	20	5	0	1-20
K-2	7-Oct-16	18.3	8.4	0.3			Abundant	<5	40	0	0	0	0	<5	0
L-1	7-Oct-16	12	10	0.08			Abundant	<20	<40	0	<10	50	30	<5	21-40
L-2	7-Oct-16	29.3	9.9	0.8			Moderate	0	0	10	0	20	10	5	1-20
M-1	7-Oct-16	34	4.4	0.35	Yes		Moderate	<10	<20	0	<10	0	<20	<5	0
M-2	7-Oct-16	18	17	0.68			Moderate	0	<5	0	<10	10	5	10	0
N-1	11-Oct-16	4.1	3.8	0.35			Moderate	<5	<20	0	<10	20	<5	<5	0
N-2	11-Oct-16	4.3	2.5	0.59			Abundant	0	60	0	20	40	10	10	0
O-1	11-Oct-16	15.8	0	0	Yes	Yes	Abundant	30	10	0	0	0	0	0	1-20
O-2	11-Oct-16	26.4	1.7	0.01	Yes	Yes	Abundant	0	0	0	0	0	<10	90	1-20
Q-1	11-Oct-16	20	10	10			Abundant	5	5	<5	<5	40	<20	0	0
S-1	11-Oct-16		3.5	0.59	Yes	Yes	Trace	<10	<5	0	<5	<5	<5	<10	0
S-2	11-Oct-16	28.3	11.6	0.18	Yes	Yes	Moderate	<5	0	0	0	0	<5	<30	1-20
V-1	11-Oct-16	5.2	4.3	0.35	Yes	Yes	Moderate	30	<5	0	20	0	0	0	21-40
W-2	11-Oct-16	26	24	1.2			Moderate	0	0	0	10	20	0	<5	0
X-1	11-Oct-16	30	17	0.69			Abundant	5	50	0	<20	60	10	5	0
XT-1	11-Oct-16	7.3	/		Yes		Abundant	0	<5	0	0	0	40	100	1-20
Z-1	11-Oct-16	15	5	0.57			Abundant	0	60	0	0	<20	0	0	0
Z-2	11-Oct-16	30	28	1.5			Trace	0	<5	0	5	5	5	<5	0
BB-1	11-Oct-16	18	16	1			Moderate	<10	40	0	20		10	30	1-20

Site	Left Bank Shape	Texture	Riparian Vegetation	Stage	Instream Veg.	Right Bank Shape	Texture	Riparian Vegetation	Stage	Bed Material Dominant	Subdominant Bed Material	D95 (cm)	D	Pattern	ISLANDS	Bars	Confinement	COMMENTS	PHOTO DOC.#/COMMENTS	COMMENTS
A-1	Sloping	F(ORG.)	M	YF	V	Sloping	F(ORG)	M	YF	F		0	11	SI	N	BR	OC	TRASH THROUGH CHANNEL	#647(LOOKING DS FROM WP68), #648(US FROM WP78).	HABITAT (off channel). (rear when water), (WRC-P13 canopy- snow berry, 3 hazenut, RCG
A-2	Overhanging	FG	S	SHR	V	Sloping	F,G	N	INIT	F	G	14	14	SI	N	N	CO		#649,FOC LG-6 (DSFROM WP69), #650(USFROMWP69)	water source-SWUhatchery outflow. Flows from hatchery into gravel bar that is incised to form channel along river left of MSR maintream. ET 10:40
C-1	Vertical	F	G,M	YF	V	Vertical	F	M	YF	F		0	0	SI	N	N	FC		#652(DS FROM WP70), #653(US FROMWP70)	HABITAT(HEALTHY RIPARIAN CORRIDOR,FENCE PROTECTED). Wildlife observ. (American Dipper) (Rough Grouse). Could open inlet to increase scour and productivity. Wp70 @ culvert road xing. ET 11:24
C-2	Sloping	F	G	INIT,SHR	V	Sloping	F	G	INIT,SHR	S	C	1.4	D95-1.2, 0-0.14	SI	N	N,MID@CONFLUENCE	FC		#655(dsFROMWP71), #656(USFROM WP71	outlet of maltman side channel. ET 12:00
C-3	Sloping	G,C	G	SHR		Sloping	G,C	G	SHR	G		0.16	0.16	SI	N	MID	FC		#660(USFROM WP73), #661(DSFROM WP73)	Wildlife observ. Juv. Bald eagle. Juvenile fish obs.
F-1	Vertical	C	D	PS		Sloping	C	M	MF	G	C	0.14	0.14	SI	I	N	FC		#652(DSFROM WP72), #653(USFROM WP72)	Wildlife observ. (salmon spawning in MSR main stream), (deer sign, mature bald eagle)
F-2	Sloping	F	G	SHR	N	Vertical	F	M	PS	F		0	0	SI	N	N	FC		#664(US FROM WP74), #665(DS FROM WP74)	spawning KO east confluence, backwater influence from MSR in to deep channel (river right) along armoured bank. IV close to MSR ~ 80% with aquatic veg.
G-1	Sloping	F	C	MF	V	Sloping	F	G	SHR	F		0	0	SI	N	SIDE,MID	CO		#666(USFROM WP75), #667(DSFROM WP75)	good flow in channel, ET 13:31
G-2	Sloping	F	G	INIT		Vertical	F	G,M	INIT,MF	F		0.1	0.1	SI	N	N	FC		#670(USFROMWP78), #671(DSFROM WP79), #672(WOOD JAM JUST OS OF sc g CONFLUENCE WITH SC H), HABITAT COW PASTURE.	
H-1	Sloping	F	G	SHR	A	Vertical	F	M	YF	F		0.14	0.14	SI	N	N	CO		#668(USFROMWP76), #665(DSFROM WP76)	flow derived from seepage or burried culvert. ET 14:09
H-2	Sloping	G,C	G,M	INIT,YF	V	Sloping	G	S,D	SHR,YF	G	F,C	0.1	0.1	SI	N	SPAN	OC	BEAVER DAM(SM)	#684(USFROM WP82) #683(DSFROM WP82) #685(@CONFLUENCE WITH SCK)	beaver dam present, ET 16:02
I-1	Sloping	G,C	G,D	PS		Sloping	F,G	G	INIT	G	C	0.12	0.12	SI	N	N	FC		#673(DS FROM WP78), #674(US FROM WP78)	COW PASTURE- COW ACCESS
I-2	Sloping	F	G,D	PS	A,V	Vertical	F,G	G,M	SHR,MF	S		0.09	0.09	SI	N	SPAN	CO		#675(USFROMWP79), #676(DSFROM WP79))	NOT CONNECTED @ DS END TO MSR. SAND BAR SPANS OUTLET. ET15:10
J-1	Vertical	F	G	SHR	V	Sloping	F	M	YF,MF	S		0	0	SI	N	N	CO		#677(USFROM WP80), #678(DSFROM WP80), #679(INLET@CONFLUENCE ~2m CHANNEL BED FROM WATER LEVEL)	
J-2	Vertical	F	S,D,M	SH	V	Vertical	F	S,D,M	SHR	F		0	0	ME	N	SPAN	CO		#680(DSFROM WP81, #681(USFROMWP81), #682(FROM GRAVEL CONFLUENCE WITH MSR	
K-1	Sloping	G,C	N	INIT	N	Vertical	G,C	S,M	MF	S	G	0.08	0.08	SI	N,O	SIDE,SPAN	OC			WP83 is for inlet for k-1. photo 686 wp83 (us). Subsurface flows BW wp83&wp84. photos us 687 ds 688
K-2	Sloping	F	G	INIT	A,V	Sloped	F,G	G,M	INIT, YF	S	G	0.13	0.13	SI	N	N	OC		#690(DSFROM WP85) #689(USFROM WP85)	
L-1	Vertical	F,G	M	MF	V	Vertical	F,C	G,S,M	SHR, MF	G	C	0.09	0.09	SI	N	SIDE	FC		#691(USFROMWP86),#692(DSFROM WP86)	large log jam @ inlet. Juvenile trout observed in deep pool. ET 16:54
L-2	Sloping	F	G	INIT	A,V	Vertical	B	M	YF	F	G	0.03	0.03	SI	N	N	OC		#694(USFROMWP87),#695(DSFROM WP87)	juvenile trout obs. Riprap-River right. ET 17:14
M-1		F	G,S,D	SHR,PS						G	C	0.12	0.12	ME,SI	N	SIDE,DIAG	FC		#696(USFROMWP88), #697(DSFROM WP88)	
M-2	Vertical	F	G	SHR		Vertical	F	G,S,D	SHR	F		0.11	0.11	SI	N	N	FC		#698(USFROM WP89), #699(DSFROM WP89)	Juvenile trout observed in Backwater upstream from MSR. ET 17:43
N-1	Vertical	F,G	G	SHR	V	Vertical	FG	G,S	SHR	F	G	0.07	0.07	ME	N	MID	OC		#700(us FROM WP92), #901(ds FROM WP92	spawning kokanee, Channel flow opposite to mainstem, end time 10:49
N-2	Vertical	F,C	G,S	SHR		Vertical	F,C	G,S	SHR	F	C	0.13	0.13	ME	N	N	OC		#702(usfromwp93), #703(DS from wp93	KO spawning, ET: 10:58
O-1	Vertical	F,G	G,D	PS		Vertical	F,G	G,D	PS	G	F	0.04	0.04	SI	N	SIDE	FC		#710(US FROM WP98), #711(DS FROM WP98)	et: 12:00
O-2	Sloping	F	G,S			Vertical	F,G	G,S,D	PS,YF	F		0	0	ME	N	SIDE	FC		#712(USFROMWP99), #713(DSFROM WP99)	Fry in pool downstream of dry upstream channel, ET 12:20, Side channel O flows into secondary channel
Q-1	Sloping	G,C	S,M	PS		Vertical	G,C	S,M	PS	G	C	0.6	0.6	ME					#708(USFROM WP97), #709(DS FROM WP97)	High velocity flows, ET 11:32, Q-2 not accessable
S-1	Sloping	G,C	G,S	PS		Vertical	G,C	G,S,D	PS	G	C	0.07	0.07	SI	N	SIDE,MID	OC		#715(US from wp100), #716(DS from WP100)	Fry in one of isolated pools, ET 12:53
S-2	Vertical	F	G,S	SHR		Vertical	F	G,D	YF	F		0	0	SI	N	SPAN	OC		#717(Usfrom wp101), #71(wp101	Flow at WP101 connected & main channel by way of back flooding, ET 13:06
V-1	Sloping	F,G	S,M	SHR		Undercut/Vertical	F,G	S,D	PS	F	G	0.06	0.06	SI	N	SPAN	OC		#721(US FROM WP105), #722(DS FROM WP102)	fry in isolated inlet pools. ET 14:08
W-2	Vertical	F	G	INIT	V	Vertical	F	G	INIT	F		0	0	SI	N	N	FC		#727(USFROMWP108), #728(DSFROMWP109)	KO SPAWNING, ET 15:14
X-1	Vertical	F,G	M	MF		Sloped	F,G	S	SHR	F	G	0.15	0.15	SI	N	N	FC		#723(USFROM WP105), #724(DS FROM WP105)	large log jam @inlet, ET 14:41
XT-1	Sloping	F	M	MF	V	Sloped	F	S	SHR	Grass		0	0		N	N	FC		#719(US from WP102), #720(Ds from WP102)	ET 13:34
Z-1	Vertical	F,G	G,S	SHR		Sloped	F,G	G,S	SHR	F		0.01	0.01	ME	N	MID	FC		#730(US FROM WP110), #731(DSROM WP110), #732(US LOG JAM WP110)	beaver dam, large log jam, water but no flow, photos/data from form not incl. other side channel to N. part of same off channel. ET. 16:09
Z-2	Sloping	F	G ,S,M	PS		Vertical	F	G,S	SHR	F		0	0	SI	N	N	FC		#733(US fromWP111), #734(DSFROM WP111)	survey done from boat, ET:1625
BB-1	Vertical	F	G,S,D	PS		Vertical	F	G,S,D	YF	F				SI	N	N	FC		#735(DSFROM WP112), #736)USFROM WP112)	large log jam @ inlet, ET 16:58