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Interim Report

WATERSHED RESTORATION PROGRAM

MISSION CREEK STREAM ASSESSMENT

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Project 511.01

January 23, 1995.





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January 20, 1995

Reference: 511.01

Mr. Phil Epp, P.Ag.
Ministry of Environment, Lands, and Parks
#201 - 3547 Skaha Lake Road
Penticton, B.C.
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Dear Phil:

Re: Interim report - Mission Creek Stream Channel Assessment Project

We are pleased to enclose 3 copies of our interim report on the Mission Creek stream and riparian zone assessment project. The objective of the report is to enable preliminary identification of potential restoration opportunities within the Mission Creek watershed. Note that some of the required background research on fish utilization and other issues has not yet been completed, so these interim results must be viewed with appropriate caution. Nevertheless, they should assist you to get started expeditiously in the process of developing restoration projects. We have only identified in this report the opportunities which have been checked to date in the field. There may be several other opportunities which will become apparent when the field checking is completed next spring.

In brief, there appear to be opportunities for restoration on Joe Rick, Hydraulic, and Mission Creeks. Details can be found in the report, and a summary of the opportunities identified to date is found in section 12.4.

Per your instructions, we are now proceeding to prepare interim reports for the Mid Shuswap and Upper Shuswap stream assessment projects, for which limited field checking has been done. To try to give you some immediate assistance in identifying possible WRP projects, however, we have prepared a tentative list of possible projects in these areas. The list is based on a rapid review of notes made during the helicopter reconnaissance, and the limited field checking done to date. Note also that some of these creeks have been suggested to Tom Johnson and Dan Hogan as candidates for the " watershed pair " monitoring program.

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Experience to date indicates that there will likely be more opportunities for WRP projects in the mid and upper Shuswap than in Mission Creek. Most of the Mission Creek streams are incised into the plateau in their mid and upper portions, and logging and road building adjacent to the streams is limited. This applies to some extent in the mid and upper Shuswap. However, the mid and upper Shuswap streams tend to have wider floodplains with more opportunities for forest harvesting impacts.

The following streams have been partially field checked:

Cherry Creek:

In the reach downstream of Severide Creek, there have been several slides originating on hillslopes below cutblocks, some of which have directly impacted the creek. Slides have dammed the creek, changed its course, and caused bank erosion and the introduction of large amounts of LWD and stumps into the channel.

Shuswap River:

Downstream of Sugar Lake are found some large unstable debris jams, containing a significant component of logging related wood. Even acknowledging the regulation of Sugar Lake by B.C. Hydro, some of these jams appear ready to mobilize.

Wap Creek:

Near its mouth, Wap Creek contains a huge amount of LWD, both in the channel and on the banks. The debris is causing bank erosion, possibly erosion of road fill, and lateral channel instability. This creek is important for both salmon and kokanee.

Kingfisher Creek:

Lower Kingfisher Creek contains huge amounts of unstable debris, which is causing accumulations of sand and gravel. Downstream of the powerline crossing, salmon unable to pass a debris jam were seen. There is a salmon counting fence on Danforth Creek.



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The following streams have not been field checked, but the helicopter reconnaissance suggested some restoration opportunities:

Currie Creek:

In the middle reaches of Currie Creek (tributary of Cherry) we observed slides from roads entering the creek, blocks with minimal or no buffers, and some eroding crossings.

Heckman Creek:

In the middle reaches were seen several locations in which roads came very close to the channel, LWD was present, and blocks had no buffers.

Monashee Creek:

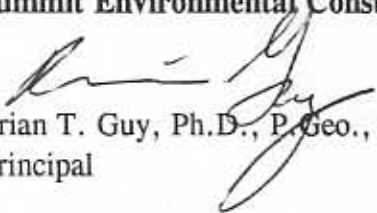
We observed many large debris jams on Monashee Creek, particularly between Heckman and Railroad Creeks. These may be related to observations made higher up of blocks without buffers.

Railroad Creek:

We observed unstable and washed out roads, trees lying in the stream, small buffers, and debris jams throughout Railroad Creek.

I hope that the enclosed report and the above-noted suggestions provide you with some useful early feedback on this project. Please give myself or Hugh a call if you have any questions.

Yours truly,
Summit Environmental Consultants Ltd.


Brian T. Guy, Ph.D., P. Geo., P.H.
Principal

Enclosures: Interim report - Mission Creek stream channel assessment project



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1.0 INTRODUCTION

1.1 Background

Mission Creek is a tributary of Okanagan Lake and is part of the Columbia River drainage system (Figure 1). It flows westward into the lake at the City of Kelowna from the Okanagan Highland. In 1994 the Mission Creek watershed was selected for inclusion in the provincial Watershed Restoration Program (WRP). The four phases of WRP are:

1. Assessment
2. Prescription
3. Implementation, and
4. Monitoring

In the Kamloops Forest Region the assessment phase has been divided into i) streams/riparian zones and ii) upslope area. Summit Environmental Consultants Ltd. ("Summit") was retained by the BC Ministry of Environment, Lands and Parks (BC MELP) in October 1994 to conduct the stream assessment component of the assessment phase of the WRP for the Mission Creek watershed. The overall intent of the Mission Creek WRP stream assessment project is to identify and evaluate potential opportunities to improve fish habitat and water quality at locations which have been negatively affected by forest harvesting activities within the watershed (see Appendix A - Terms of Reference). The assessment phase includes fish habitat and stream channel assessments, with emphasis on locations which may be associated with forest harvesting activities. This interim reports presents the results of the assessment project as of January 20, 1995. Comments received on the interim report will be incorporated into the draft and final reports.

1.2 Objectives

The specific objectives of the WRP stream assessment for Mission Creek are to:

Figure 1. Mission Creek location map.

1. Videotape a selected number of streams from a helicopter and provide audio commentary concerning geomorphological and stream habitat features and possible degraded sites. The streams that were inspected during this study were pre-selected by BC MELP staff in Penticton and included Darley, Hilda, Belgo, Pearson, Joe Rich, Hydraulic, Pooley, KLO, and Mission Creeks.
2. Review the video and audio tapes and map those sites which were identified as being potentially degraded. Classify the potentially degraded sites according to type, cause, source and degree of impact.
3. Conduct ground truthing surveys at approximately ten percent of the sites identified on the helicopter video. Photograph the sites and compile habitat information according to Appendices 2 and 3 of Watershed Restoration Technical Circular No. 8. (BC MELP/BC MOF, 1994).
4. Review existing literature, reports, historic and recent aerial photographs, and hydrotechnical data concerning each stream.
5. Collect anecdotal information on the streams from persons and agencies familiar with the streams.
6. Priorize degraded sites, reaches and/or streams for restoration and, if possible, propose initial remedial measures.
7. Identify and recommend further assessment procedures, as required.

1.3 Purpose of the Interim Report

The purpose of the interim report is provide MELP staff with sufficient information to proceed with planning 1995 WRP activities in the Mission Creek watershed. Only those stream reaches and sites that were inspected in the field in the autumn of 1994 are described in detail. Thus any recommendations on priorities for restoration should be considered as preliminary until the field program is completed during spring 1995.

2.0 METHODS

2.1 Overview

The methodology employed in this study included an initial helicopter survey of the streams, development of an impact coding system, review of the videotapes obtained during the helicopter surveys and coding of sites, field inspections of potential high impact sites, reviews of aerial photographs, maps and published information, and telephone and personal interviews with persons with knowledge of the streams.

2.2 Helicopter Surveys and Initial Site Classification

The helicopter surveys were conducted on October 22, 1994. A hydrologist/geomorphologist and a fisheries biologist were present on the flights. A video camera was mounted in the nose of the helicopter. A global positioning system (GPS) receiver in the helicopter provided continuous location coordinates in latitude/longitude units (degrees/minutes/hundredths of minutes) which were imprinted on the video tape. The helicopter flew up each stream from the mouth to the headwaters at an altitude of about 50-60 m and an air speed of about 60 km/h. All personnel in the helicopter were outfitted with microphones and provided verbal commentary direct to the video/audio tape regarding watershed and habitat characteristics and the location of potentially degraded sites.

When the helicopter surveys were completed, a coding system for stream impacts was drawn up for use when reviewing the video tape (Table 1). The intent of the coding system was to provide a standard method for classifying the sites and determining which sites were visited in the field. The coding system includes four elements; impact type, cause, source and potential impact (Table 1). The video tapes were reviewed in October and November, 1994 by Mr. Mark Gollner of Summit. To ensure consistency, Mr. Gollner reviewed all the video tapes for the Mission Creek watershed as well as the other three watersheds assessed in the 1994-95 WRP for the Okanagan-Shuswap Region (Naramata/Robinson Creeks, Upper Shuswap River, Middle Shuswap River). The sites identified on the video were then classified according to the code on Table 1 and the information summarized into tables, with one table per stream. The locations of the sites were plotted on 1:50,000 scale map sheets.

2.3 Field Surveys

The field surveys were initiated during November 1994. The field crew consisted of hydrologist/geomorphologist and a fisheries biologist. The objective was to visit all sites which had been classified from the videotape as having a high probable impact and where the source was either forestry (i.e., F.1 -source of problem is forestry activities, high probable impact) or unknown (i.e., U.1 - uncertain source, high impact). Overall, the number of F.1 and U.1 sites was approximately proportional to the length of the stream. Early snowfall at the higher elevations in the fall of 1994 limited the field visits to eight of the 34 sites identified as F.1 or U.1, or 24%. **This interim report covers only those sites visited in the fall of 1994.** In the field the code assigned to the site was reviewed and modified based on the field inspection, if needed.

The steps taken in the field included:

1. Verification of site location using a hand-held GPS receiver and maps (1:50,000 NTS and forest cover maps)

Table 1. Coding system for stream impacts.

The coding system employed is a combination of four factors: Type, Cause, Source and Impact, which are outlined in the order they appear in the code, as follows:

1.	Type (Potential problem)	
	Water quality	Q
	Fish barrier	Fb
	Fish spawning habitat degradation	Fs
	Fish Rearing habitat degradation	Fr
2.	Cause (Likely cause of the problem)	
	Streambanks (slumps, slides, bank erosion)	S
	Road fill-slopes	F
	Culverts or bridges	C
	Debris	D
	Bank Protection	P
	Waterfall	W
3.	Source (Likely land use activity contributing to the problem)	
	Forestry	F
	Agriculture	A
	Highways/Roads/Railways	Hw
	Residential/recreational/industrial	R
	Natural	N
	Uncertain	U
4.	Impact (Estimated degree of impact)	
	High	1
	Medium	2
	Low	3
	Unknown	4

Examples:

Q.F.F.2 Water quality • Road fill-slopes • Forestry • Medium Impact
 Fs.D.F/N.1 Fish spawning habitat degradation • Debris • Forestry/Natural • High

2. General reconnaissance of the reach, typically over a distance of 250 m upstream and 250 m downstream of the site identified from the video
3. Fish habitat information was compiled by completing DFO/MELP Stream Information Summary System (SISS) forms. The forms include stream gradient, width (channel and wetted), depth, bed material, cover, bank height, debris, obstructions, and observed fish species. The information collected meets and generally exceeds the information included in Technical Circular no. 8 (BC MELP/BC MOF, 1994)
4. Examination and documentation of stream geomorphology, including bed and bank materials, stream gradient, sediment deposition areas, width of floodplain, slope of adjacent hillsides, presence/absence of exposed slopes, tree stability on banks and slopes, and potential sediment sources
5. Noted the amount of large woody debris (LWD) present in the streams; assessed implications for fish passage, spawning and rearing
6. Photographed stream habitat features and potential sources of problems, and
7. Noted any fish or wildlife observations.
8. Estimated how existing stream regimes (geomorphology, water quality, fish habitat) varies from natural (e.g., pre-harvest) conditions (including natural variation), and assessed the nature and extent of forest harvest impacts.
9. Assessed site feasibility for restoration, including site sensitivity to restoration (i.e., level of effort needed to produce a significant result), possible methods, site access and logistics.

2.4 Information Review and Summary

The field investigations were supplemented by reviewing published information on the subject streams and by telephone or personal interviews with persons familiar with each stream. Published information included:

- NTS 1:50,000 topographic maps
- BC MOF forest cover maps (typical scales 1:15,000-1:30,000)
- aerial photographs from 1992-1993 (colour) and the 1950s (black and white, Note: black and white photographs were not reviewed for the interim report)
- DFO/MOELP Stream Information Summary sheets
- available geomorphological and soil survey reports and maps

For each stream, reaches were delineated based on changes in stream gradient and/or valley shape (e.g., u-shaped or incised) as determined from the topographic maps and field notes.

The black and white aerial photographs from the 1950s were obtained for historical comparison with the 1992-93 photographs. The comparison will permit stream reach changes to be assessed and potential sediment sources to be inventoried.

3.0 REPORT FORMAT AND PROJECT DELIVERABLES

Each of the nine (9) streams, including the Mission Creek main stem, which were included in the Mission Creek WRP are described in a separate report section. The tributaries of Mission Creek are presented first in the order Darley Creek, Hilda Creek, Belgo Creek, Pearson Creek, Joe Rich Creek, Hydraulic Creek, Pooly Creek and KLO Creek, followed by Mission Creek.

In the interim report, there is an appendix for each stream which was assessed (Appendices B through G) which contains the photographs compiled for each stream plus a table with the video transcripts and impact codes. For the final report the appendices will also include SISS forms, SISS summaries, and other relevant stream-specific information. Laminated 1:50,000 scale NTS maps for the streams presented in this report will be included in the final report as Attachment 1, with the 1990s aerial photographs as Attachment 2, and the 1950s photographs as Attachment 3. The materials included in the appendices and attachments will make up a complete inventory of available information on each stream. Having the information compiled in a single should be an advantage during the prescription and implementation phases of the WRP.

4.0 DARLEY CREEK

Darley Creek is a tributary of Belgo Creek. It has a watershed area of 29 km². A total of two (2) sites were classified as F.1 or U.1 from the helicopter survey. None of these sites were inspected during the fall of 1994 due to excessive snow, but these sites will be field checked in the spring of 1995.

5.0 HILDA CREEK

Hilda Creek is another tributary of Belgo Creek and has a watershed area of 21 km². A total of four (4) sites were classified as F.1 or U.1 from the helicopter survey. No sites were inspected during the fall of 1994 due to excessive snow, but these sites will be field checked in the spring of 1995.

6.0 BELGO CREEK

6.1 General Description

Belgo Creek originates in the Thompson Plateau about 25 km west of Winfield, B.C.. It flows in a general south by southwest direction until it joins Mission Creek at 49° 29.05' N lat, 119° 09.12'W long near the point where Joe Rich Creek also joins Mission Creek. Its major tributaries include Darley Creek (see Section 4.0) and Hilda Creek (Section 5.0). Additional descriptive information about Belgo Creek is found in Table 6.1, and summary information on the field and office operations conducted for the stream assessment are found in Table 6.2. The NTS map sheet covering the creek (#82 E/14) is provided in Attachment 1 (not included with the interim report), and the video transcripts, photographs, SISS survey forms, and DFO/MELP Stream Information Summary Sheet are provided in Appendix C (only photos in interim report).

A total of 11 sites were classified as F.1 or U.1 from the helicopter video, and six (6) of these, or 55%, were inspected during the fall of 1994. One additional site was also inspected. Deep snow at the higher elevations prevented access to the remaining F.1 and U.1 sites.

Table 6.1. General characteristics of Belgo Creek.

Parameter	Information
NTS Map sheet no.	82 E/14 Kelowna
Latitude & longitude of mouth	49° 29.05' N lat, 119° 09.12'W long
Watershed area (km ²)	122
Stream length (km)	22.5
No. of reaches	4
Discharge (mean/highest month/lowest month)	Not gauged
Biogeoclimatic zones/subzones ¹	IDFmw1, Msmm, MSdm1

¹ Biogeoclimatic zone codes are in Appendix H.

General flow direction	South-Southwest
Next higher order stream or lake	Mission Creek
Land use	Forestry, some agriculture near mouth
Known water licences	
Known fish species	

Table 6.2 Field and office procedures for Belgo Creek

Task	Specific Information
Helicopter flight & videotape date	October 22, 1994
Video review date(s)	October 30 & 31, 1994
No. of F.1 & U.1 sites identified	11
No. of sites field checked, Autumn 1994	6 F.1/U.1, 1 other

6.2 Reach Descriptions

There are a total of four (4) stream reaches identified on Belgo Creek. Details for the individual reaches are found in Table 6.3. Stream survey forms for the reaches surveyed are included in Appendix B. Only reaches 1, 2 and 3 were inspected during the fall of 1994 and are described. Reach #4 will be inspected in spring 1995, weather and time permitting.

Reach #1 is generally a low gradient, meandering and slightly confined portion of the stream with bank heights ranging from 0.5-1 m. The maximum channel width is 10 m and the average wetted width is 7 m. The substrate consists mainly of gravels with a small amount of fines and some small cobbles and a medium degree of compaction. The fish habitat in this reach appears to be good with numerous areas of the channel with spawning size gravel, deep pools, undercut banks and overhanging vegetation. Upstream migration of fish may be somewhat impeded by the amount of LWD and numerous debris jams in the reach.

The lower portion of the reach is characterized by outwash terraces and other fluvioglacial deposits. The terrace surfaces have been cleared for agriculture. The floodplain at the confluence with Mission Creek includes a fan deposit which causes Mission Creek to bend around the confluence point. Upslope from site #7 is a large deposition area from a slide which occurred in 1990. It appears on the 1993 air photo that a "finger" of depositional material extends down to Belgo Creek, although this is a very small portion of the deposit. The slide originated in an ephemeral channel which drains a large cutblock to the west of the creek. Although the road has been re-established over the slide deposit, revegetation is incomplete and the deposit remains a potential sediment source to the creek.

Reach #2 is generally a low gradient, meandering portion of the stream with bank heights ranging from 0.5-1 m and a wide floodplain. A series of outwash terraces run parallel to the stream. The maximum channel width is 20 m and the average wetted width is 7 m. The substrate consists mainly of gravels and small cobbles and a medium degree of compaction. The fish habitat in this reach appears to be good with numerous areas of the channel with spawning size gravel, deep pools, undercut banks and overhanging vegetation.

Reach #3 is generally a low gradient, meandering portion of the stream with bank heights ranging from 0.5-1 m and a wider floodplain than Reach #2. Outwash terraces are complemented by hummocky kame terraces. The maximum channel width is 15 m and the average wetted width is 7 m. The substrate consists mainly of gravels and fines and a medium degree of compaction. The fish habitat in this reach appears to be good with numerous areas of the channel with spawning size gravel, deep pools, undercut banks and overhanging vegetation. Several juvenile fish (Rainbow trout) were seen in this reach.

Table 6.3 Stream reach data summary for Belgo Creek.

Reach #	Reach Length (m)	Gradient (%)	Map Sheet #	Site #'s Within Reach
1	4500	<5	82 E/14	1-8
2	7000	<5	82 E/14	9-15
3	8500	<5	82 E/14, 82 L/3	16-26
4	2500		82 L/3	27*
Stream Total	4	22500		27

* Ideal Lake

6.3 Field Check Site Descriptions

Site #: 2

Impact Code: N/A

Reach #: 1

Date Inspected: Nov. 4/94

Coordinates: 49°52'02"N 119°09'31W

Mapsheet #: NTS 82 E/14

Belgo Creek at this site is a low gradient (1.5%), meandering stream with low banks (<1 m) and a moderate amount of natural LWD. The site was initially given an Fs/Q•C•Hw•2 code relating to the road bridge, but was revised following the field check. The bridge appears to be in good condition with no encroachment on the stream, although there are some exposed cut slopes associated with Highway 33 and a secondary road. No photographs of this site were taken.

Site #: 3

Impact Code: Fb/Q•D•N•3

Reach #: 1

Date Inspected: Nov. 4/94

Coordinates: 49°52'21"N 119°08'74W

Mapsheet #: NTS 82 E/14

The natural stream gradient of this site is low (1.5%). The stream is meandering and occasionally splits around islands and bars in sections, with low banks (<1 m) and a moderate amount of natural LWD. This site was initially given an Fb/Q•D•U•1 code but as a result of the field check the code was revised to N.3. The woody debris is scattered throughout the channel but appears

to be natural in origin, coming from the active undercutting of the banks on both sides of the channel. There has been some selective logging done on the floodplain on the right bank but it does not appear to have impacted the stream. No photographs were taken of this site but it is similar to site #4.

Site #: 4

Date Inspected: Nov. 4/94

Impact Code: Fb/Q•D•N•3

Coordinates: 49°52'32''N 119°08'65W

Reach #: 1

Mapsheet #: NTS 82 E/14

As mentioned above, this site is similar to site #3. The natural condition of site #4 is a low gradient (1.5%), meandering stream with low banks (<1 m). There is a moderate amount of natural LWD. The condition of the site at the time of the survey is shown in photo #1-4 Appendix B. From the helicopter video, this site was initially given an Fb/Q•D•U•1 code but was changed to N.3 as a result of the field check. The debris is scattered throughout the channel but appears to be natural in origin, coming from the active undercutting of the banks on both sides of the channel. The channel is somewhat confined through this reach, which may contribute to the tendency for the stream to undercut the banks.

There is an old road which comes down the hill from the end of the farm field to within 10 m of the right bank of the stream, but it has not impacted the stream. Some of the LWD in the debris jam at this site (photo #4) has been apparently cut and removed.

The reach between sites #4 and #5 includes some pasture land where floodplain deposits were visible on the aerial photographs. The deposits show that the channel has shifted in the past, indicating that bank erosion in the reach is a natural process, although it may have been modified by land use activities.

Site #: 11

Date Inspected: Nov. 4/94

Impact Code: Q•S•F•3

Coordinates: 49°55'14''N 119°06'15W

Reach #: 2

Mapsheet #: NTS 82 E/14

Like the downstream sites, the natural condition of site #11 is meandering with a low gradient (1.5%), low banks (<1m), and a moderate amount of natural LWD. No photographs were taken of this site. It was initially given an Fs/Q•F•F•2 code but was changed to F.3 from the field

inspection. This site appears to be very similar to site #4. A slide/slump from the road is located more than 100 m from the right bank of the stream and all of the LWD in the channel appears to be natural in origin. There is evidence of old logging on the floodplain of the right bank and there is an overgrown trail. No impacts on the stream channel from the trail were noted.

Site #: 20

Date Inspected: Nov. 4/94

Impact Code: Fb/Q•D•N•2

Coordinates: 49°58'15''N 119°04'36W

Reach #: 3

Mapsheet #: NTS 82 E/14

This site is very similar to site #3. It is naturally a low gradient (1.5%), meandering stream with low banks (<1 m) with a moderate amount of natural LWD. The condition of the site at the time of the survey is shown in photo #5-7 Appendix B. The field inspection resulted in the coding being changed from Fs/Q•C•F•1 to Fb/Q•D•N•2. The bridge does not encroach on the stream channel and a 20 m buffer has been maintained on both sides of the stream. The cutblock is relatively large and the terrain is a mixture of floodplain, outwash terrace, and kettled outwash. Two fish were observed at this site. Two debris jams were noted at the time of the site inspection; Photo 6 shows the debris jam 50 upstream from the bridge and Photo 7 shows the debris jam 20 m below from the bridge. Both debris jams appear to consist of natural LWD, originating from the undercut banks on both sides of the stream. However, it is possible that some of the LWD is a result of blowdown from within the buffer. A second visit to the site in the spring of 1995 when the snow has melted is recommended.

Site #: 23

Date Inspected: Nov. 4/94

Impact Code: Fs/Q•D•N•3

Coordinates: 49°59'23''N 119°04'46W

Reach #: 3

Mapsheet #: NTS 82 L/3

The channel substrate and bank material were completely obscured by snow cover during the field inspection. A small amount of natural LWD was laying across and within the channel, probably a result of the somewhat saturated characteristics of the site contributing to tree falls due to low soil strength. The site is low gradient (1.5%), meanders, has low banks (<1 m), and a moderate amount of natural LWD. This site was initially given an Fs/Q•D•F•1 code but was changed to Fs/Q•D•N•3 following the field visit. Historic logging was done on the floodplain of the stream and more recent logging is apparent on both sides of the channel. The buffer on the left bank is 5-

10 m wide and the buffer on the right bank is about 30 m wide. There is evidence of beaver activity.

Site #: 24

Impact Code: Fs/Q•C•F•3

Reach #: 3

Date Inspected: Nov. 4/94

Coordinates: 49°00'02''N 119°04'39W

Mapsheet #: NTS 82 L/3

The site is similar to the downstream sites with a low gradient (1.5%), meanders, low banks (<1 m) and a moderate amount of natural LWD. Originally coded as Fs/Q•C•F•1, it was revised to Fs/Q•C•F•3 in the field. The presence of an old log bridge was noted from the video, but the field check revealed that the bridge is a relatively new steel span bridge with no encroachment on the stream. No photographs were taken of this site as there was not sufficient daylight at the time of the site inspection, and the channel substrate and bank material were almost completely obscured by snow cover. A fish was seen at this site.

Site #: 25

Impact Code: Fb/Q•C•F•1

Reach #: 3

Date Inspected: Nov. 4/94

Coordinates: 49°??'??N 119°04'66W

Mapsheet #: NTS 82 L/3

Belgo Creek at this site is meandering with low banks (<1m), a low gradient (1.5%), and a moderate amount of natural LWD. This site was initially given an Fs/Q•C•F•1 code but could not be properly verified in the field due to the lack of daylight and the heavy snow cover. A second visit to the site in the spring of 1995 when the snow has melted is recommended. However it was determined that the stream crossing consists of two 1.2 m diameter culverts which may be a potential problem for fish passage. No photographs were taken of this site as there was not sufficient daylight at the time of the site inspection.

6.4 Summary

Not included in interim report. See Section 13.0 for the watershed summary.

7.0 PEARSON CREEK

7.1 General Description

Pearson Creek is a tributary to Mission Creek and flows generally southwest from St. Margaret Lake and Loch Long. The coordinates of the stream mouth are approximately 49°53'02''N (from map) 119°03'73W (GPS receiver). Additional descriptive information is provided in Table 7.1. The summary information on the field and office procedures carried out for the assessment of the creek are shown in Table 7.2. The NTS 1:50,000 scale maps covering the creek (82 E/14, 82 E/15) are included as Attachment 1 and video transcripts, photographs and DFO/MELP stream survey forms are included in the Appendix C (only photographs in interim report).

The review of the helicopter video footage identified a total of five (5) sites that were assigned F.1 or U.1 codes. One (1) of these sites was field checked in the fall of 1994. Heavy snowfall prevented access to the remaining sites. The detailed assessment for this site is presented in Section 7.3.

Table 7.1 General characteristics of Pearson Creek.

Parameter	Information
NTS Map sheet no.	82 E/14 Kelowna, 82 E/15 Damfino Creek
Latitude & longitude of mouth	49°53'02''N lat, 119° 03.73'W long
Watershed area (km ²)	77
Stream length (km)	19.5
No. of reaches	4
Discharge (m ³ /s) ² (mean/highest month/lowest month)	Mean 0.975/Jun 4.18 /Feb 0.121
Biogeoclimatic zones/subzones	IDFmw1, MSmm
General flow direction	Southwest

² Source: Water Survey of Canada (1989).

Next higher order stream or lake	Mission Creek
Land use	
Known water licences	
Known fish species	

Table 7.2 Field and office procedures for Pearson Creek.

Task	Specific Information
Helicopter flight & video tape	October 22, 1994
Video review dates	October 30&31, 1994
No. of F.1 & U.1 sites identified	5
No. of field sites checked, Autumn 1994	1 F.1/U.1, 1 other

7.2 Reach Descriptions

There are a total of four (4) stream reaches identified on Pearson Creek. Details for the individual reaches are seen in Table 7.3. Stream survey forms for the reaches surveyed are included in Appendix C (not included in interim report). Only Reach #1 is described in this interim report since Reaches 2-4 were not inspected during the fall of 1994. These reaches will be visited in spring 1995.

Table 7.3 Stream reach data summary for Belgo Creek.

Reach #	Reach Length (m)	Gradient (%)	Map Sheet #	Site #'s Within Reach
1	2250	<1	82 E/14	1-4
2	6750		82 E/14, 82 E/15	5-11
3	2500		82 E/15	12-15
4	8000		82 E/15	16-20
Stream Total	4	19500		20

Reach #1 is generally a low gradient and meandering portion of the stream with bank heights ranging from 0.5-1 m. Flow in some sections is split around bars and islands and there are a number of oxbow lakes. The floodplain near the confluence with Mission Creek is relatively broad and is framed by outwash terraces. The maximum stream channel width is 20 m and the average wetted width is 3.5m. The substrate consists mainly of gravels with a small amount of fines and some small cobbles and a medium degree of compaction. It was not possible to properly characterize the quality of the fish habitat due to heavy snow cover.

7.3 Field Check Site Descriptions

Site #: 3

Impact Code: Q•S•F•3

Reach #: 1

Date Inspected: Nov. 9/94

Coordinates: 49°53'N 119°03'17W

Mapsheet #: NTS 82 E/14

The natural condition of Pearson Creek at this site is a low gradient, meandering stream with low banks (<1 m) with a moderate amount of natural LWD in the stream channel (Photo 2, Appendix C). Conditions of the site at the time of the field survey are shown in photos 1-2 in Appendix V. This site was initially given an Fs/Q•S•U•1 code because of a slide observed from the helicopter, but following the field check and aerial photograph review the code was changed to Q•S•F•3. The slide originated from a road but did not reach the stream. The debris track from the slide stopped about 5 m upslope from the floodplain limit on the right bank of the stream. However review of the 1993 aerial photographs indicate that some debris and sediment may have reached the floodplain. This material on the floodplain may have been removed or modified during the 1994 freshet such that it was not detected in fall 1994. Although this site does not warrant further attention as a stream restoration opportunity, road instability may still exist in the area, and could contribute to further slides. The cutblock above the slide area was cut to the break in slope, which may have contributed to the instability.

7.4 Summary

Not included in interim report. See Section 13.0 for the watershed summary.

8.0 JOE RICH CREEK

8.1 General Description

Joe Rich Creek originates in the Okanagan Highland about 30 km east-southeast from the city of Kelowna. It initially flows south before turning back near the intersection of Highway 33 and the road to the Big White ski area, from where it flows in a general north-northwest direction. It joins Mission Creek at 49° 52'N latitude, 119° 09' longitude, just upstream of where Belgo Creek flows into Mission Belgo Creek. Major tributaries include Schram Creek and Tress Creek. Additional descriptive information about Joe Rich Creek is found in Table 8.1, and summary information on the field and office operations conducted for the stream assessment are found in Table 8.2. The NTS map sheet covering the creek (#82 E/14) is provided in Attachment 1 (not in the interim report), and the video transcripts, photographs, SISS survey forms, and DFO/MELP Stream Information Summary Sheet are provided in Appendix D (only photographs in interim report).

A total of three (3) sites were classified as F.1 or U.1 from the helicopter video, and one of these was inspected during the fall of 1994. Deep snow at the higher elevations prevented access to the remaining F.1 and U.1 sites.

Table 8.1. General characteristics of Joe Rich Creek.

Parameter	Information
Map sheet no.	82 E/14 Kelowna
Latitude & longitude of mouth	49° 52'N latitude, 119° 09' longitude
Watershed area (km ²)	45
No. of reaches	5
Discharge (m ³ /s) (mean/highest month/lowest month)	Mean 0.22/May 0.89/Jan 0.05
Biogeoclimatic zones/subzones	IDFmw1, MSmm

General flow direction	South then North-Northwest
Next higher order stream or lake	Mission Creek
Land use	Forestry, some agriculture near mouth. Roads parallel for about 2/3 of stream length
Known water licences	
Known fish species	

Table 8.2 Field and office procedures for Joe Rich Creek.

Task	Specific Information
Helicopter flight & video tape	October 22, 1994
Video review dates	October 30&31, 1994
No. of F.1 & U.1 sites identified	3
No. of field sites checked, Autumn 1994	1 F.1/U.1

8.2 Reach Descriptions

There are a total of five (5) stream reaches identified on Joe Rich Creek. Details for the individual reaches are in Table 8.3. Of these, only sites in Reach #2 were surveyed in the fall of 1994.

Reach #1 is situated in an area where the floodplain is up to 700 m wide and much of the area has been cleared for agriculture. It has a low gradient except in the last 1 km before the confluence with Mission Creek where it drops about 40 m to meet Mission Creek. Bank erosion is visible in places within the agricultural land and there are several eroded gullies formed in the outwash terraces south of the creek which drain to the creek. There is little if any recent forest harvest activity in the reach and the second growth is well established.

Reach #2 is generally a low gradient and meandering portion of the stream with bank heights ranging from 0.5-1 m. The maximum channel width is 4 m and the average wetted width is 2m. The substrate consists mainly of gravels with a small amount of fines and some small cobbles and

a medium degree of compaction. This reach has excellent fish habitat but fish access is currently restricted to some areas due to the excessive amount of LWD in the channel. Several areas with spawning size gravel were seen as well as undercut banks and overhanging vegetation.

Descriptions of reaches 3 to 5 will be completed for the final study report.

Table 8.3 Stream reach data summary for Joe Rich Creek.

Reach #	Reach Length (m)	Gradient (%)	Map Sheet #	Site #'s Within Reach
1	6250		82 E/14	1-5
2	6250	<5	82 E/14	6-12
3	1750		82 E/14	13, 14
4	750		82 E/14	15
5	750		82 E/14	none
Stream Total	5	15750		15

8.3 Field Check Site Descriptions

Site #: 7

Impact Code: Fb/Q•D•F•1

Reach #: 2

Date Inspected: Nov. 9/94

Coordinates: 49°48'48N 119°04'92W

Mapsheet #: NTS 82 E/14

At this site Joe Rich Creek is a low gradient, meandering stream with low banks (1 m) with a moderate amount of natural LWD (Photo 3, Appendix D). The general condition of the site at the time of the survey is shown in Photos 1-5 Appendix D. This site was initially given an Fs/Q•F•F•1 code based on the proximity of a landslide above the channel. As a result of the field check the code was revised to Fb/Q•D•F•1. The slide (Photo 5) originated from an old logging road 100 m above the channel on the right bank and has deposited a substantial amount of LWD and other organic debris on the right bank and into the channel (Photo 1). This slide has caused increased erosion on the left bank of the stream and some bank undercutting is apparent.

In addition to this slide, there is substantial erosion of the Highway 33 fillslope above the left bank of the stream (Photo 4). A large composite fan of deposited sediment from the fillslope has formed on the floodplain, and in places it is no more than 5 m from the channel. As this fan progresses towards the channel, the stream is simultaneously eroding its left bank and moving towards the fan.

The area between sites 7-9 includes several old slumps or slides on the right valley wall and Highway 33 fillslope erosion on the left wall. The old logging areas are now well revegetated but gully areas are probably still an important source of sediment and the old roads may still be unstable.

8.4 Summary

Not included in the interim report. See the watershed summary in Section 13.0.

9.0 HYDRAULIC CREEK

9.1 General Description

Hydraulic Creek is a tributary to Mission Creek and flows generally east and north upstream of Hydraulic Lake (McCullough Reservoir) and then northwest downstream of the lake. The coordinates of the stream mouth are 49°50'81N 119°21'21W. Additional descriptive information is provided in Table 9.1. The summary information on the field and office procedures carried out for the assessment of the creek are shown in Table 9.2. The NTS 1:50,000 scale maps covering the creek (82 E/14, 82 E/11) are included as Attachment 1 (not in the interim report) and video transcripts, photographs and DFO/MELP stream survey forms are included in the Appendix E (photographs only in the interim report).

The review of the helicopter video footage identified only two (2) sites that were assigned F.1 or U.1 codes. Both of these sites were field checked in the fall of 1994 as well as one (1) non-F.1/U.1 site. The detailed assessments for these sites are presented in Section 9.3.

Table 9.1. General characteristics of Hydraulic Creek.

Parameter	Information
Map sheet no.	82 E/14 Kelowna, 82 E/11
Latitude & longitude of mouth	49° 50.81'N latitude, 119° 21.21'W longitude
Watershed area (km ²)	121
Stream length (km)	29.5
No. of reaches	6
Discharge (m ³ /s) (mean/highest month/lowest month)	Mean 0.166/May 0.805/Feb 0.048
Biogeoclimatic zones/subzones	IDFxh1a, IDFxh1, IDFmw1, MSmm, MSdm1, ESSFdm1
General flow direction	East and North then Northwest
Next higher order stream or lake	Mission Creek
Land use	Forestry, some agriculture near mouth and downstream of Hydraulic Lake. Hydraulic L. is a drinking/irrigation water reservoir.
Known water licences	
Known fish species	

Table 9.2 Field and office procedures for Hydraulic Creek.

Task	Specific Information
Helicopter flight & video tape	October 22, 1994
Video review dates	October 30&31, 1994
No. of F.1 & U.1 sites identified	2
No. of field sites checked, Autumn 1994	2 F.1/U.1, 1 other

9.2 Reach Descriptions

A total of six (6) stream reaches were identified on Hydraulic Creek. Details for the individual reaches are in Table 9.3. Only one reach, #4, was inspected in autumn 1994 and the remainder will be inspected in spring 1995.

Reach #4 is generally a low gradient and meandering portion of the stream with bank heights ranging from 0.5-1 m. The maximum channel width is 12 m and the average wetted width is 6 m. The substrate consists mainly of gravels with a small amount of fines and some small cobbles and a medium degree of compaction. This reach has excellent fish habitat but fish access is currently restricted to some areas due to the excessive amount of LWD in the channel. Several areas with spawning size gravel were noted as well as many deep pools, undercut banks and overhanging vegetation.

Table 9.3 Stream reach data summary for Hydraulic Creek.

Reach #	Reach Length (m)	Gradient (%)	Map Sheet #	Site #'s Within Reach
1	250		82 E/14	1
2	2000		82 E/14	2-6
3	6500		82 E/14	7-13
4	5500	<5	82 E/14	14-19
5	3250		82 E/14	20
6	12000		82 E/14, 82 E/11	21-25*
Stream Total	29500			25

*Sites 26-30 are on Stirling Creek, a tributary of Hydraulic Creek.

9.3 Field Check Site Descriptions

Site #: 15

Date Inspected: Nov. 2/94

Impact Code: Fb/Q•D•F•1

Coordinates: 49°48'79N 119°13'14W

Reach #: 4

Mapsheet #: NTS 82 E/14

At Site #15 (Photos 1-4, Appendix E) the stream has a low gradient, meanders, low banks (<1 m) and a relatively small amount of natural LWD (Photo 1). The field check confirmed the Fb/Q•D•F•1 code assigned by the video survey. No buffer strip is present along the stream at this site, however it is possible that a buffer was initially retained and that all of the trees have since blown down. There is a substantial amount of windfall into and across the stream, most of which is creating water quality and fish barrier concerns. Also, an ephemeral channel which discharges directly to Hydraulic Creek is crossed twice by a logging road.

Site #15 is a strong candidate for a WRP project.

Site #: 16

Date Inspected: Nov. 2/94

Impact Code: Fb/Q•D•F•1

Coordinates: 49°48'08N 119°12'52W

Reach #: 4

Mapsheet #: NTS 82 E/14

This site is very similar to Site #15 and is located adjacent to the same cutblock. The condition of the site at the time of the survey is shown in Photos 4-6, Appendix E. The debris jam at this location is apparently primarily an accumulation of the LWD which has come from the windfall upstream of this point. Just upstream from the SE block boundary (Photo 6) there is a marked decrease in the amount of LWD across the channel, indicating that the removal of timber from the cutblock is the cause of the substantial windfall at both sites #15 and #16.

Site #: 18

Date Inspected: Nov. 2/94

Impact Code: Fb•D•N•2

Coordinates: 49°47'75N 119°12'04W

Reach #: 4

Mapsheet #: NTS 82 E/14

This site was initially given an Fb/Q•C•R•2 code but as a result of the field check the code was revised to Fb•D•N•2. The natural condition of this site is low gradient, meandering stream with low banks (<1 m) and a relatively small amount of natural LWD (Photo 11, Appendix E). The rectangular concrete culvert (1.25 m square) shown in Photo 7 was installed in 1945 as part of the Kettle Valley Railway crossing at this site. Water is still passing through the culvert but the culvert opening is restricted to approximately one-half the original size due to the beaver dam at the upstream end (Photos 8-9). This beaver dam has created a large pond upstream of the culvert which provides excellent fish rearing and wetland habitat. However, fish migration through the culvert to the pond is presently not possible.

9.4 Summary

Not included in the interim report. See Section 13.0 for the watershed summary.

10.0 POOLEY CREEK

Pooley Creek is a tributary of KLO Creek. Two (2) sites were classified as F.1 or U.1 from the helicopter survey. No sites were inspected during the fall of 1994 due to excessive snow, but these sites will be field checked in the spring of 1995.

11.0 KLO CREEK

11.1 General Description

KLO³ Creek is a tributary to Mission Creek and flows in a general north by northwest direction. The stream mouth is located at approximately 49°51'N 119°22'W, about 8.5km southeast of Kelowna. Deposits of river gravels, stratified sands and basal till are exposed near the mouth (Nasmith, 1962). Additional descriptive information is provided in Table 11.1. The summary information on the field and office procedures carried out for the assessment of the creek is shown in Table 11.2. The NTS 1:50,000 scale map covering the creek (82 E/14) is included as Attachment 1 (not included with interim report) and video transcripts, photographs and DFO/MELP stream survey forms are included in Appendix F (photographs only in interim report).

The review of the helicopter video footage identified a total of three (3) sites that were assigned F.1 or U.1 codes. One (1) of the sites, #3, was field checked in the fall of 1994 as well as one (1) non-F.1/U.1 site. Heavy snowfall prevented access to the remaining sites. The detailed assessment for this site is presented in Section 11.3.

³ KLO originally was an acronym for Kelowna Land and Orchard Company.

Table 11.1. General characteristics of KLO Creek.

Parameter	Information
Map sheet no.	82 E/14 Kelowna
Latitude & longitude of mouth	49° 51'N latitude, 119° 21.83'W longitude
Watershed area (km ²)	30
Stream length (km)	13.75
No. of reaches	5
Discharge (m ³ /s) (mean/highest month/lowest month)	Mean 0.287/May 1.70/Feb 0.051 ⁴
Biogeoclimatic zones/subzones	IDFxl, IDFmw1, MSmm, PPxl
General flow direction	Northwest
Next higher order stream or lake	Mission Creek
Land use	
Known water licences	
Known fish species	

Table 11.2 Field and office procedures for KLO Creek.

Task	Specific Information
Helicopter flight & video tape	October 22, 1994
Video review dates	October 30&31, 1994
No. of F.1 & U.1 sites identified	3
No. of field sites checked, Autumn 1994	1 F.1/U.1, 1 other

⁴ At McCullough Rd. 1976-1982 only.

11.2 Reach Descriptions

A total of five (5) stream reaches were identified on KLO Creek. Details for the individual reaches are presented in Table 11.3. Only Reach #2 was visited during the site visits and is the only reach described here.

Reach #2 ranges from a somewhat open channel configuration with low banks below site #3 to an incised portion with higher banks at site #4. The maximum channel width is about 11 m and the average wetted width is 3.3 m. The gradient is consistently 5% and the substrate consists mainly of large gravels and small cobbles with a high degree of compaction. This reach has moderate to poor fish habitat. No areas with spawning size gravel were seen.

Table 11.3 Stream reach data summary for KLO Creek.

Reach #	Reach Length (m)	Gradient (%)	Map Sheet #	Site #'s Within Reach
1	1500		82 E/14	1, 2
2	8500	5	82 E/14	3-9
3	2500		82 E/14	10-13
4	1000		82 E/14	14
5	250		82 E/14	15
Stream Total	5	13750		15

11.3 Field Check Site Descriptions

Site #: 3

Impact Code: Q•C•R•3

Reach #: 2

Date Inspected: Nov. 2/94

Coordinates: 49°49'56N 119°21'95W

Mapsheet #: NTS 82 E/14

The stream at this site has a low gradient (Photos 1-2, Appendix F) but is relatively straight with confining valley walls. This site was initially given an Fb/Q•C•F•1 code but as a result of the field check the code was revised to Q•C•R•3. Both of the bridge crossings at this site consist of concrete abutments with wood decks, and were probably used to access the Kettle Valley Railway further upstream or to service the irrigation pipe at Site #4. The wood decks were rotting at the time of the field inspection and some undermining of the abutments by the stream current was evident.

A sand and gravel extraction operation is located near the stream at site #3. It appeared to be closed at the time of the field visit. In some sections there is little buffer between the gravel operation and the creek.

Site #: 4

Impact Code: N/A

Reach #: 2

Date Inspected: Nov. 2/94

Coordinates: 49°49'56N 119°21'95W

Mapsheet #: NTS 82 E/14

This a low gradient site was initially given an Fb/Q•D•R•1 which was revised to having no classification. The pipe is not a concern as a fish barrier or as a sediment source. Just upstream from the pipe (Photo 4) there has been some windfall across the stream and it is possible that it could cause the accumulation of more LWD in the stream. The debris could potentially work it's way downstream and impact one or both of the bridge structures at site #3.

11.4 Summary

Not included in the interim report. See the watershed summary in Section 13.0.

12.0 MISSION CREEK MAINSTEM

12.1 General Description

Mission Creek drains directly into Okanagan Lake at the City of Kelowna, which is largely constructed on the alluvial fan that was deposited by Mission Creek since deglaciation (Nasmith,

1962). It flows south and southwest in the upper reaches and then generally west in the lower reaches. The coordinates of the stream mouth are 49°50'63N; 119°29'01W. Mission Creek is diked for its lowest 5-6 km before discharging into the lake. Portions of the floodplain and some upslope areas in reaches 1-8 have been cleared for agriculture and/or suburban development. Additional descriptive information is provided in Table 12.1. The summary information on the field and office procedures carried out for the assessment of the creek are shown in Table 12.2. The NTS 1:50,000 scale maps covering the creek (82 E/14, 82 E/15 and 82 L/2) are included as Attachment 1 (not included in interim report) and video transcripts, photographs and DFO/MELP stream survey forms are included in the Appendix G (photographs only in the interim report).

The review of the helicopter video footage identified a total of eight (8) sites that were assigned F.1 or U.1 codes. Seven (7) of the sites were field checked in the fall of 1994 as well as two (2) non-F.1/U.1 sites. Heavy snowfall prevented access to the remaining sites. The detailed assessments for these sites are presented in Section 12.3.

Table 12.1. General characteristics of Mission Creek.

Parameter	Information
Map sheet no.	82 E/14 Kelowna, 82E/15, 82 L/2
Latitude & longitude of mouth	49° 50.63'N latitude, 119° 29.01'W longitude
Watershed area (km ²)	836
Stream length (km)	68
No. of reaches	12
Discharge (m ³ /s) (mean/highest month/lowest month)	Mean 6.05/May 23.0/Feb 1.01
Biogeoclimatic zone(s)	PPxh1, IDFxh1a, IDFxh1, IDFmw1, MSmm
General flow direction	South-Southwest then West
Next higher order stream or lake	Okanagan Lake
Land use	Suburban, recreation, agriculture, forestry

Known water licences	
Known fish species	

Table 12.2 Field and office procedures for Mission Creek.

Task	Specific Information
Helicopter flight & video tape	October 22, 1994
Video review dates	October 30&31, 1994
No. of F.1 & U.1 sites identified	8
No. of field sites checked, Autumn 1994	7 F.1/U.1, 2 other

12.2 Reach Descriptions

Twelve (12) stream reaches were delineated on Mission Creek. Details for the individual reaches are shown in Table 12.3. Four (4) of these, #5, #6, #7 and #8, were inspected during the fall of 1994 and are described in this interim report. The remaining reaches will be inspected in spring 1995.

Reach #5 is a deeply incised portion of the stream with a gradient ranging from 10-15%. The substrate consists mainly of bedrock and boulder/cobble with a maximum channel width ranging from 15-20 m. One large waterfall and a series of small falls/chutes combine to make this reach an impassable barrier to upstream fish migration.

Reach #6 is a low gradient (2-3%), relatively wide, and meandering section of the stream in which the channel is occasionally split around islands and bars. The substrate consists mainly of coarse gravel and small cobble with some boulders. Many deep pools and off-channel habitat are present within this reach. There were some areas noted with spawning size gravel, and overall this reach comprises good fish habitat.

Reach #7 has similar gradient, substrate and channel characteristics to reach #6 with the exception of having some bedrock outcrops creating deep pools and concentrating the flow. There are numerous small islands, gravel bars and braided sections throughout the reach. Some of the islands are vegetated indicating relative stability. A substantial amount of beaver activity was noted within this reach. Some of the banks within the reach are 2-3 m high consisting of fluvial deposits. This reach also has areas of good fish habitat.

Reach #8 has a higher gradient than reach #7 and a change in substrate to a higher proportion of cobbles and small boulders. The channel is more confined with generally higher, actively eroding banks (2-3 m) on both sides of the stream. Beaver activity is also present in this reach of the stream.

12.3 Field Check Site Descriptions

Site #: 23

Impact Code: Fb•W/D•N•3

Reach #: 5

Date Inspected: Nov. 9/94

Coordinates: 49°51'23N; 119°18'31W

Mapsheet #: NTS 82 E/14

Site #23 is a steep-walled bedrock canyon (Photos 1-3, Appendix G) with a series of small falls or chutes that are 3-5 m high and at least one larger waterfall. Initially coded as Fb•W/D•N/U•1, the coding was changed to Fb•W/D•N•3 during the field check. It was noted from the video that there was a debris jam at the downstream end of the large waterfall, but the jam could not be inspected during the site visit because access by foot to the large falls was impossible. Photos 1-3 in Appendix G show conditions at this site; in particular Photo 3 shows a natural debris jam which is inhabited by a beaver located at the upstream end of this reach. A number of incised gulleys reach the creek near Site #23.

Site #: 27

Impact Code: Q•S•N•3

Reach #: 6

Date Inspected: Nov. 9/94

Coordinates: 49°51.31'N; 119°15.62'W

Mapsheet #: NTS 82 E/14

Natural features of this site include a 30-50 m high actively eroding bank on the right side of the stream. Conditions of the site at the time of the survey are shown in Photos 4-7 in Appendix G. This site was initially given an Fb/Q•S•N•3 code but the code was revised to Q•S•N•3 in the field. This site was surveyed at the recommendation of Mr. Malcolm Campbell of Black Mountain Irrigation District. Photo 6 shows a small debris jam on the left bank of the stream 50 m upstream from the eroding bank.

Site #: 29

Impact Code: Q•D•N/F•1

Reach #: 6

Date Inspected: Nov. 9/94

Coordinates: 49°51.49'N; 119°14.32'W

Mapsheet #: NTS 82 E/14

At Site #29 the stream has a low gradient and is relatively wide with coarse substrate material (Photos 8-12, Appendix G). This site was initially given an Fb•D•F•1 code but as a result of the field check the code was revised to Q•D•N/F•1. Photo 8 shows a large debris jam on the left bank which has the potential to travel further downstream during high flows. The majority of the debris consists of trees with root-wads and beaver-cut trees, however there are several pieces of LWD with cut ends and some milled timbers (6"x10"x6'). LWD at this site is scattered throughout the channel for a distance of 500 m (Photo 9), the majority being natural in origin. Two domestic water wells/pump houses are within 50 m of the channel (Photo 12) and the accompanying road ends at the right stream bank (Photo 11). The road is a potential source of sediment to the stream.

Site #: 43

Impact Code: Fb•D•R•1

Reach #: 7

Date Inspected: Nov. 3/94

Coordinates: 49°52.04'N; 119°06.84'W

Mapsheet #: NTS 82 E/14

This site (Photo 13-18, Appendix G) is similar to site #29. Site #43 was initially given an Fb•D•U•1 code but as a result of the field check the code was revised to Fb•D•R•1. Photo 13 shows the intricate rock weirs and pools that have been constructed in the channel, spanning the entire channel width at this location. It is not apparent whether or not this was done as part of a

fisheries enhancement project. About 20 m upstream from the weirs, a deep pool (>2 m) is controlled by LWD across the channel (Photo 14). LWD is scattered throughout the channel for a distance of 300m upstream from the weirs (Photo 15), including two large debris jams. All of the debris appears to be natural in origin, but some pieces have cut-ends, probably due to past attempts to remove some of the debris jam. Most of the debris appears stable but the site could be enhanced by selective removal or by anchoring some of the pieces.

An old cut block is located about 400 m upslope on the north side of the channel, that is apparently currently used for grazing. An ephemeral stream drains the area to Mission Creek.

Site #: 45

Date Inspected: Nov. 3/94

Impact Code: Fb/Q•D•N•1

Coordinates: 49°52.12'N 119°06.78'W

Reach #: 7

Mapsheet #: NTS 82 E/14

This site is similar to site #43 (Photos 19-23, Appendix G). Initially classed as Q•D•F•1 from the helicopter survey, the code was revised to Fb/Q•D•N•1 in the field. A large debris jam (approx. 30 m x 4 m x 1 m) is blocking a secondary channel along the right bank flowing around a vegetated island that is approximately 6 m wide (Photo 19). Most of the debris consists of beaver-cut or uprooted trees, and some of the longer pieces extending over the channel have been cut. Similar to site #43, most of the debris appears stable but the site could be enhanced by selective removal or by anchoring some of the pieces. LWD scattered across the channel continues upstream for 200 m (Photo 21). There are several large pools at this site, they are controlled by downstream accumulations of gravel (Photos 22, 23).

Site #: 47

Date Inspected: Nov. 3/94

Impact Code: Q•D•N•2

Coordinates: 49°52.71'N; 119°04.43'W

Reach #: 7

Mapsheet #: NTS 82 E/14

The natural condition of this site is similar to that at site #45. This site was initially given an Fb•D•U•1 code but as a result of the field check the code was revised to Q•D•N•2. There are four debris jams at this site and all appear to be old beaver dams which have been broken apart by the stream flow cutting away the centre portions of the dams. The debris in the channel continues for approximately 200 m, but all of the debris at this site appears to be stable.

Site #: 51

Impact Code: Q•D•F•1

Reach #: 7

Date Inspected: Nov. 3/94

Coordinates: 49°53.25'N; 119°03.83'W

Mapsheet #: NTS 82 E/14

This site is similar to the other Reach 7 sites (Photos 24-26, Appendix G). As a result of the field inspection, the code was changed to Q•D•F•1 from Fb•C•F•2. The site is very close to site #52 and together could be treated as one site for restoration purposes. There is a substantial amount of LWD scattered across the channel, most of the pieces are in relatively short lengths (2-3 m) and have cut-ends. At high water levels this debris could be carried further downstream and possibly impact the bridge located immediately downstream.

Site #: 52

Impact Code: Q•D•F•1

Reach #: 7

Date Inspected: Nov. 3/94

Coordinates: 49°53.52'N; 119°03.64'W

Mapsheet #: NTS 82 E/14

This site is similar to the other Reach 7 sites (Photos 27-29 Appendix G). Initially given an Fb/Q•D•F•1 code, the field check resulted in the fish barrier (Fb) code being removed as a potential problem. Logging has recently taken place (probably 1994) within 10 m of the stream. Photo #28 shows recently felled trees on the right bank, some of which were felled directly into the channel. Historically the floodplain has been selectively logged on both sides of the stream and many large diameter stumps still remain. Some of these stumps have been transported into the channel from the eroding, undercut banks. As with site #51, the debris could be transported downstream and impact the bridge.

Site #: 56

Impact Code: Fb/Q•D•N•3

Reach #: 8

Date Inspected: Nov. 4/94

Coordinates: 49°56.94'N; 119°02.56'W

Mapsheet #: NTS 82 E/14

The condition of this site is similar to that at site #52 but the stream banks are higher (2-3 m) and there is a substantial amount of bank undercutting. The condition of the site at the time of the survey is shown in Photo 30-32 (Appendix G). This site was initially given an Fb/Q•D•U•1 code but as a result of the field check the code was revised to Fb/Q•D•N•3. At the time of the site visit a recent heavy snowfall obscured the substrate and the majority of the channel (photo #31). One large debris jam was observed which appears to be stable (Photo 30). The LWD in the debris jam

consists of beaver-cut trees and other natural LWD. This debris jam would only constrict the flow of the stream, and become unstable, at peak water levels because it is currently stranded on a gravel bar 2-3 m above the thalweg of the channel. There is recent evidence of beaver-cut trees 100 m upstream from the debris jam (Photo 32).

12.4 Summary

Not included in the interim report. See Section 13.0 for the watershed summary.

13.0 MISSION CREEK WATERSHED SUMMARY AND RECOMMENDATIONS

This section briefly summarizes the opportunities which have been identified to date for stream restoration projects within the Mission Creek watershed. Only a relatively small number of the sites which had been identified during the helicopter reconnaissance (October 1994) as having potential for stream restoration have been field checked. Therefore, this list will likely be expanded for the final study report. In addition, note that all of the required background research (eg on fish utilization, examination of historic aerial photos, discussions with knowledgeable individuals, etc.) has not yet been completed. Thus the identification of restoration opportunities in the present report should be considered preliminary.

Nonetheless, there appear to be opportunities for stream restoration on Joe Rich, Hydraulic, and Mission Creeks, as outlined here:

Joe Rich Creek (Section 8.0 of this report):

The section of stream near site 7, within reach 2, downstream of the Big White road appears to be a candidate for further investigation. At site 7, the stream has been impacted by a significant slide from an old logging road on the east (right bank side) of the stream, and is simultaneously being affected by severe gulying occurring on the fillslope of Highway 33. Other historic instabilities

on road fillslopes are evident upstream of this site, although these have not been inspected in the field. The upstream and downstream boundaries of a possible reach for restoration have not yet been determined.

Hydraulic Creek (Section 9 of this report):

Between sites 15 and 16, at about elevation 1200 m on the Thompson Plateau downstream of McCullough Reservoir, there is a substantial amount of harvesting related LWD in the channel, resulting from blowdown. The LWD is significantly impacting the channel through this section, creating fish barriers, causing bank erosion, bed-material aggradation, and increased lateral instability.

Mission Creek (section 12 of this report):

There appear to be at least three areas impacted by forest harvesting activities which are worthy of further investigation. Within about 500 m of site 29 (midway between Daves and Cardinal Creeks) is a large debris jam and a great deal of LWD throughout the channel. Much of this material appears to be natural in origin (at least has no cut ends), but there is some logging debris and some milled timbers.

Sites 43 and 45 (just upstream of Joe Rich Creek) are characterized by large accumulations of moderately stable and unstable debris, some of which is natural in origin and some of which is related to harvesting. Selective removal or anchoring of material could be considered in an effort to stabilize the LWD.

Sites 51 and 52 (just upstream of the Pearson Creek confluence and a bridge over Mission Creek) are characterized by large accumulations of debris, most of which is 2-3 m long with cut ends due to forest harvesting. The debris is unstable and could threaten the bridge. Very recent logging has occurred, with some trees felled into the creek (and still found in the creek). Stream banks

are undercut and are eroding. Some stumps formerly resident on the floodplain are now found in the channel.

14.0**REFERENCES**

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- Nasmith, H. 1962. Late glacial history and surface deposits of the Okanagan Valley, British Columbia. Bulletin No. 46. B.C. Department of Mines and Petroleum Resources. Victoria. 46 pp. + 3 maps.
- Water Survey of Canada. 1989. Historical Streamflow Summary: British Columbia. Inland Waters Directorate. Environment Canada. Ottawa. 1056 pp.

APPENDIX A

**Terms of Reference
(Not included in Interim Report)**

15.0

GLOSSARY

- Alluvial fan Sediment deposit usually occurring where a stream emerges from a confined valley into a broader valley. Typically resembles a segment of a cone.
- Colluvial deposits Gravity deposits (e.g., rockfalls) along valley sides. Usually found in the more confined stream reaches.
- Fluvial deposits Generally well sorted gravels, sands and silts transported and deposited by streams and rivers.
- Fluvioglacial deposits Materials deposited by glacial meltwater either in contact with ice or beyond the ice margin as outwash.
- Kames Ice contact deposits resembling steep knolls. Formed when stagnant ice left hummocks of drift which were modified by water flowing around the base.
- Kame terraces Ice contact, stratified deposits along the valley sides originating from meltwaters flowing between the glacier and the valley wall.
- Outwash terraces Materials deposited by meltwaters downstream from a glacier. Subsequent downcutting leaves terrace features on the valley sides.
- Oxbow Lake Small lake created when a stream meander is isolated by the stream channel overrunning the meander loop during high flows. Oxbow lakes typically accumulate channel-fill deposits during subsequent floods.

Thalweg

In a stream, the line of maximum depth along the channel bottom.

APPENDIX B

Belgo Creek Photographs



Photo 1. Natural LWD across the channel, upstream view.
Stream Name: Belgo Creek **Site #:** 4
GPS Coordinates: 49°??'??N 119°08'65W

Reach #: 1
Code: Fb/Q·D·N·3



Photo 2. Natural LWD across the channel stranded on a gravel bar, upstream view.
Stream Name: Belgo Creek **Site #:** 4
GPS Coordinates: 49°??'??N 119°08'65W

Reach #: 1
Code: Fb/Q·D·N·3



Photo 3. Undercut banks and overhanging vegetation, downstream view.
Stream Name: Belgo Creek Site #: 4 Reach #: 1
GPS Coordinates: 49°??'??N 119°08'65W Code: N/A



Photo 4. Old debris jam which has had some pieces cut and removed, downstream view.
Stream Name: Belgo Creek Site #: 4 Reach #: 1
GPS Coordinates: 49°??'??N 119°08'65W Code: Fb/Q•D•N•3



Photo 5. Bridge crossing with sufficient vertical & horizontal clearance, downstream view.
Stream Name: Belgo Creek **Site #:** 20 **Reach #:** 3
GPS Coordinates: 49°??'??N 119°04'36W **Code:** Q-C-F-3



Photo 6. Natural debris jam 50m u/s from the bridge crossing, upstream view.
Stream Name: Belgo Creek **Site #:** 20 **Reach #:** 3
GPS Coordinates: 49°??'??N 119°04'36W **Code:** Fb/Q-D-N-2



Photo 7. Natural debris jam 20m d/s from the bridge crossing, downstream view.
Stream Name: Belgo Creek **Site #:** 20 **Reach #:** 3
GPS Coordinates: 49°??'??N 119°04'36W **Code:** Fb/Q•D•N•2



Photo 8. Natural LWD across the channel with a 5m buffer on the left bank, upstream view.
Stream Name: Belgo Creek **Site #:** 23 **Reach #:** 3
GPS Coordinates: 49°??'??N 119°04'46W **Code:** N/A



Photo 9.

Natural LWD across the channel, downstream view.

Stream Name: Belgo Creek

Site #: 23

Reach #: 3

GPS Coordinates: 49°??'??N 119°04'46W

Code: Fb/Q•D•N•3

APPENDIX C
Pearson Creek Photographs



Photo 1. Main channel opposite the slide (no impact on the stream) from the road, downstream view.

Stream Name: Pearson Creek

Site #: 3

Reach #: 1

GPS Coordinates: 49°??'??N 119°03'17W

Code: N/A



Photo 2. Main channel opposite the slide (no impact on the stream) from the road, upstream view.

Stream Name: Pearson Creek

Site #: 3

Reach #: 1

GPS Coordinates: 49°??'??N 119°03'17W

Code: N/A

APPENDIX D

Joe Rich Creek Photographs



Photo 1. LWD blocking the channel from the slide on the right bank, downstream view.
Stream Name: Joe Rich Creek **Site #:** 7 **Reach #:** 2
GPS Coordinates: 49°48'48N 119°04'92W **Code:** Fb/Q•D•F•1



Photo 2. 20m d/s from the slide on the right bank, downstream view.
Stream Name: Joe Rich Creek **Site #:** 7 **Reach #:** 2
GPS Coordinates: 49°48'48N 119°04'92W **Code:** N/A



Photo 3. Just u/s from the slide on the right bank, upstream view.

Stream Name: Joe Rich Creek

Site #: 7

Reach #: 2

GPS Coordinates: 49°48'48N 119°04'92W

Code: N/A

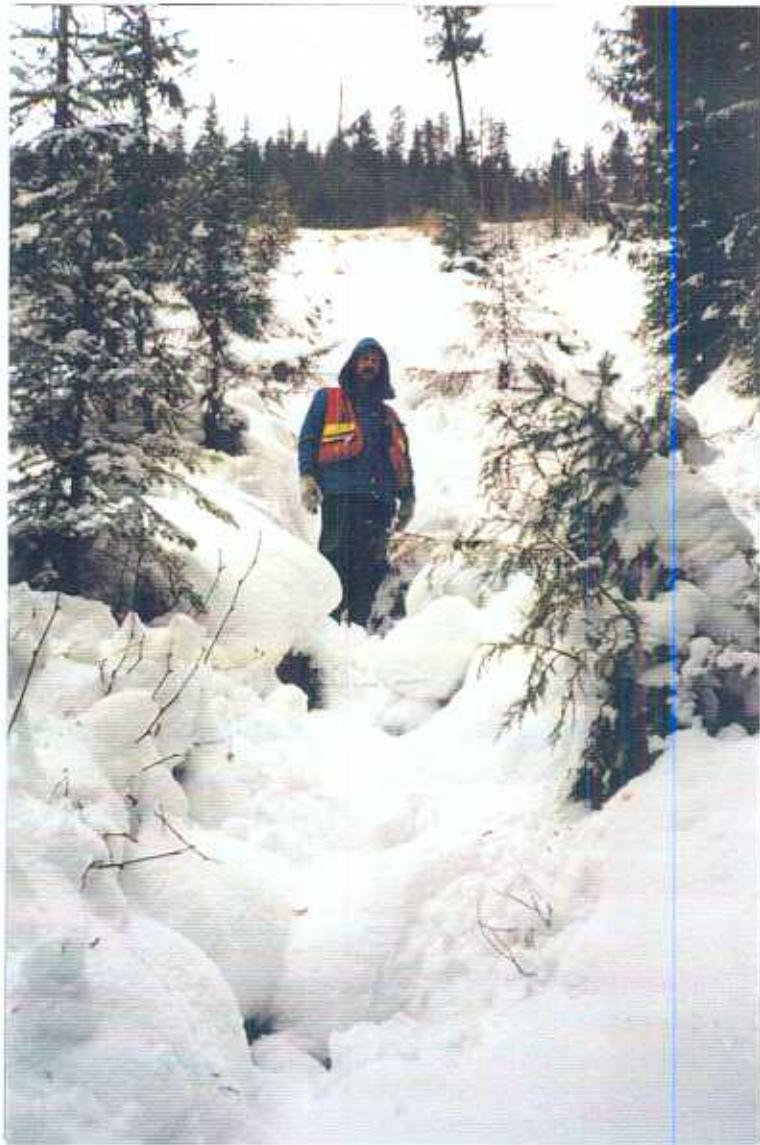


Photo 4.

Highway road-fill material actively eroding (rills 1-2m deep) onto the floodplain and into the channel on the left bank of the stream.

Stream Name: Joe Rich Creek **Site #:** 7

GPS Coordinates: 49°48'48N 119°04'92W

Reach #: 2

Code: Q•F•Hw•2



Photo 5.

Slide on the right bank of the stream as seen from the highway.

Stream Name: Joe Rich Creek Site #: 7 Reach #: 2

GPS Coordinates: 49°48'48N 119°04'92W Code: Fb/Q•D•F•1

APPENDIX E

Hydraulic Creek Photographs



Photo 1.

Natural LWD across the stream just d/s from the SW block boundary, downstream view.

Stream Name: Hydraulic Creek Site #: 15

Reach #: 4

GPS Coordinates: 49°48'79N 119°13'14W

Code: Fb/Q•D•N•3



Photo 2.

Windfall, from within the block, across the stream just u/s from the SW block boundary, upstream view.

Stream Name: Hydraulic Creek Site #: 15

Reach #: 4

GPS Coordinates: 49°48'79N 119°13'14W

Code: Fb/Q•D•F•1



Photo 3. Windfall continuing u/s for virtually the entire length of the block, downstream view.
Stream Name: Hydraulic Creek **Site #:** 15 **Reach #:** 4
GPS Coordinates: 49°48'73N 119°13'12W **Code:** Fb/Q•D•F•1



Photo 4. Debris jam (1m high) 500m u/s from the SW block boundary, upstream view.
Stream Name: Hydraulic Creek **Site #:** 15/16 **Reach #:** 4
GPS Coordinates: 49°48'08N 119°12'52W **Code:** Fb/Q•D•F•1



Photo 5. Just d/s from the SE block boundary, 757m u/s from the SW block boundary, downstream view.

Stream Name: Hydraulic Creek **Site #:** 15/16 **Reach #:** 4
GPS Coordinates: 49°48'08N 119°12'52W **Code:** N/A



Photo 6. Just u/s from the SE block boundary, upstream view.

Stream Name: Hydraulic Creek **Site #:** 15/16 **Reach #:** 4
GPS Coordinates: 49°48'08N 119°12'52W **Code:** N/A



Photo 7. Concrete culvert (1.25m diam.) under the old railway bed of the KVR, upstream view.
Stream Name: Hydraulic Creek **Site #:** 18 **Reach #:** 4
GPS Coordinates: 49°47'75N 119°12'04W **Code:** N/A



Photo 8. Beaver dam partially blocking the upstream end of the culvert, upstream view from within the culvert.
Stream Name: Hydraulic Creek **Site #:** 18 **Reach #:** 4
GPS Coordinates: 49°47'75N 119°12'04W **Code:** Fb•D•N•2



Photo 9. U/S end of the culvert showing 40cm opening remaining, downstream view.
Stream Name: Hydraulic Creek **Site #:** 18 **Reach #:** 4
GPS Coordinates: 49°47'75N 119°12'04W **Code:** Fb•D•N•2



Photo 10. Beaver pond created by the dam at the culvert, upstream view.
Stream Name: Hydraulic Creek **Site #:** 18 **Reach #:** 4
GPS Coordinates: 49°47'75N 119°12'04W **Code:** N/A



Photo 11. Steel drain pipe (25cm diam.) entering the channel on the left bank 20m d/s from the culvert, downstream view.

Stream Name: Hydraulic Creek

Site #: 18

Reach #: 4

GPS Coordinates: 49°47'75N 119°12'04W

Code: N/A

APPENDIX F
KLO Creek Photographs



Photo 1. Bridge crossing at the rock quarry with some erosion around the abutments, downstream view.

Stream Name: Klo Creek

Site #: 3

Reach #: 2

GPS Coordinates: 49°49'56N 119°21'95W

Code: Q•C•R•3



Photo 2. Bridge crossing 100m u/s from rock quarry with some erosion around the abutments, downstream view.

Stream Name: Klo Creek

Site #: 3

Reach #: 2

GPS Coordinates: 49°49'56N 119°21'95W

Code: Q•C•R•3



Photo 3. Non-functional water pipe crossing over the channel, downstream view.
Stream Name: Klo Creek **Site #:** 4 **Reach #:** 2
GPS Coordinates: 49°49'56N 119°21'95W **Code:** N/A



Photo 4. Trees across the channel 20 u/s from the water pipe, upstream view.
Stream Name: Klo Creek **Site #:** 4 **Reach #:** 2
GPS Coordinates: 49°49'56N 119°21'95W **Code:** Fb/Q·D·N·3

APPENDIX G

Mission Creek Photographs



Photo 1. Series of falls/chutes with some natural LWD, downstream view.
Stream Name: Mission Creek **Site #:** 23/24 **Reach #:** 5/6
GPS Coordinates: 49°51'23N 119°18'31W **Code:** Fb•W/D•N/F•1



Photo 2. Recently felled trees from a beaver 50m u/s from falls, upstream view.
Stream Name: Mission Creek **Site #:** 23/24 **Reach #:** 5/6
GPS Coordinates: 49°51'23N 119°18'31W **Code:** Fb•W/D•N/F•1



Photo 3. Beaver lodge in an old debris jam 50m u/s from falls, downstream view.
Stream Name: Mission Creek **Site #:** 23/24 **Reach #:** 5/6
GPS Coordinates: 49°51'23N 119°18'31W **Code:** Fb•W/D•N/F•1



Photo 4. Natural eroding bank on the right bank, upstream view.
Stream Name: Mission Creek **Site #:** 27 **Reach #:** 6
GPS Coordinates: 49°51'47N 119°15'60W **Code:** Fs/Q•S•N•3



Photo 5. 50m u/s from natural eroding bank on the right bank, upstream view.
Stream Name: Mission Creek Site #: 27 Reach #: 6
GPS Coordinates: 49°51'47N 119°15'60W Code: Fs/Q•S•N•3



Photo 6. 50m u/s from natural eroding bank, debris on the left bank, downstream view.
Stream Name: Mission Creek Site #: 27 Reach #: 6
GPS Coordinates: 49°51'47N 119°15'60W Code: Fs/Q•S•N•3



Photo 7.

Natural eroding bank with active slumping 5m from the channel.

Stream Name: Mission Creek

Site #: 27

Reach #: 6

GPS Coordinates: 49°51'47N 119°15'60W

Code: Fs/Q•S•N•3



Photo 8. Large debris jam on the left bank, downstream view.
Stream Name: Mission Creek Site #: 29
GPS Coordinates: 49°51'49N 119°14'32W

Reach #: 6
Code: Q•D•N/F•1



Photo 9. LWD scattered across the channel, upstream view.
Stream Name: Mission Creek Site #: 29
GPS Coordinates: 49°51'56N 119°14'18W

Reach #: 6
Code: Q•D•N/F•1



Photo 10. Braided stream channel u/s from the debris, upstream view.
Stream Name: Mission Creek **Site #:** 29 **Reach #:** 6
GPS Coordinates: 49°51'49N 119°14'32W **Code:** N/A



Photo 11. New road on the right bank immediately adjacent to the channel.
Stream Name: Mission Creek **Site #:** 29 **Reach #:** 6
GPS Coordinates: 49°51'56N 119°14'18W **Code:** Q•F•R•1



Photo 12. New road and domestic water well on the right bank 50m from the channel.
Stream Name: Mission Creek **Site #:** 29 **Reach #:** 6
GPS Coordinates: 49°51'56N 119°14'18W **Code:** N/A



Photo 13. Intricate weir structures spanning the width of the channel, upstream view.
Stream Name: Mission Creek **Site #:** 43 **Reach #:** 7
GPS Coordinates: 49°52'04N 119°06'84W **Code:** Fb•D•R•1



Photo 14. Deep pool and LWD across the channel 20m u/s from weir structures, upstream view.
Stream Name: Mission Creek **Site #:** 43 **Reach #:** 7
GPS Coordinates: 49°52'04N 119°06'84W **Code:** Fb•D•N/F•1



Photo 15. LWD continuing u/s for 300m from weir structures, upstream view.
Stream Name: Mission Creek **Site #:** 43 **Reach #:** 7
GPS Coordinates: 49°52'12N 119°06'75W **Code:** Fb/Q•D•N•2



Photo 16. Debris jam blocking a side channel u/s from weir structures, downstream view.
Stream Name: Mission Creek **Site #:** 43 **Reach #:** 7
GPS Coordinates: 49°52'22N 119°05'64W **Code:** Fb•D•N/F•1



Photo 17. Natural eroding bank 50m u/s from debris jam, upstream view.
Stream Name: Mission Creek **Site #:** 43 **Reach #:** 7
GPS Coordinates: 49°52'22N 119°05'64W **Code:** Q•S•N•3



Photo 18. Deep pool 300m d/s from weir structures, downstream view.
Stream Name: Mission Creek **Site #:** 43 **Reach #:** 7
GPS Coordinates: 49°51'97N 119°06'92W **Code:** N/A



Photo 19. Large debris jam consisting mainly of beaver-cut trees, downstream view.
Stream Name: Mission Creek **Site #:** 45 **Reach #:** 7
GPS Coordinates: 49°52'67N 119°04'54W **Code:** Fb/Q·D·N·1



Photo 20. Large diameter tree (1m) cut by beaver and other small debris, upstream view.
Stream Name: Mission Creek **Site #:** 45 **Reach #:** 7
GPS Coordinates: 49°52'70N 119°04'43W **Code:** Q·D·N·2



Photo 21. LWD continuing for 200m u/s, upstream view.
Stream Name: Mission Creek **Site #:** 45 **Reach #:** 7
GPS Coordinates: 49°52'70N 119°04'43W **Code:** Fb/Q·D·N·2



Photo 22. Large pool (10m x 20m x 0.5m), upstream view.
Stream Name: Mission Creek **Site #:** 45
GPS Coordinates: 49°52'70N 119°04'43W

Reach #: 7
Code: N/A



Photo 23. Large pool (15m x 30m x 1m) controlled by a gravel bar, downstream view.
Stream Name: Mission Creek **Site #:** 45
GPS Coordinates: 49°52'39N 119°05'69W

Reach #: 7
Code: N/A



Photo 24. Bridge crossing with some LWD in the channel just u/s, downstream view.
Stream Name: Mission Creek **Site #:** 51 **Reach #:** 7
GPS Coordinates: 49°53'25N 119°03'83W **Code:** Q•D•F•1



Photo 25. 100m u/s from the bridge, some LWD in the channel with cut-ends, upstream view.
Stream Name: Mission Creek **Site #:** 51 **Reach #:** 7
GPS Coordinates: 49°53'25N 119°03'83W **Code:** Q•D•F•1



Photo 26. 200m u/s from the bridge, some LWD in the channel, downstream view.
Stream Name: Mission Creek **Site #:** 51 **Reach #:** 7
GPS Coordinates: 49°53'25N 119°03'83W **Code:** Q•D•F•1



Photo 27. 200m d/s from felled trees the two secondary channels join, upstream view.
Stream Name: Mission Creek **Site #:** 52 **Reach #:** 7
GPS Coordinates: 49°53'52N 119°03'64W **Code:** N/A



Photo 28. Recently felled trees into the channel on the right bank, downstream view.
Stream Name: Mission Creek **Site #:** 52 **Reach #:** 7
GPS Coordinates: 49°53'52N 119°03'64W **Code:** Q·D·F·1



Photo 29. Just u/s from recently felled trees into the channel on the right bank, upstream view.
Stream Name: Mission Creek **Site #:** 52 **Reach #:** 7
GPS Coordinates: 49°53'52N 119°03'64W **Code:** N/A



Photo 30. Natural debris jam (stable) caused by a beaver, upstream view.
Stream Name: Mission Creek **Site #:** 56 **Reach #:** 8
GPS Coordinates: 49°56'94N 119°02'56W **Code:** Fb/Q•D•N•3



Photo 31. LWD (natural) on the gravel bars, upstream view.
Stream Name: Mission Creek **Site #:** 56 **Reach #:** 8
GPS Coordinates: 49°56'94N 119°02'56W **Code:** Fb/Q•D•N•3



Photo 32.

Beaver-cut tree stumps.

Stream Name: Mission Creek

Site #: 56

Reach #: 8

GPS Coordinates: 49°56'94N 119°02'56W

Code: N/A

APPENDIX H

**Key to Biogeoclimatic Zone, Subzone,
and Variant Unit Symbols in the Mission
Creek Watershed**

ATTACHMENT 1

**NTS 1:50,000 Map Sheets showing site
numbers, stream reaches and impact codes
(Not included in Interim Report)**

ATTACHMENTS 2 & 3

**Aerial Photographs
(Not included in Interim Report)**