QUANTITATIVE ASSESSMENT OF FISH HABITAT CONDITIONS IN THE LOWER ELK RIVER

December 2, 2004

Streamline
ENVIRONMENTAL CONSULTING LTD

QUANTITATIVE ASSESSMENT OF FISH HABITAT CONDITIONS IN THE LOWER ELK RIVER

December 2, 2004

Prepared For:

BC HYDRO
BRIDGE COASTAL FISH AND WILDLIFE RESTORATION PROGRAM
6911 Southpoint Drive (E14)
Burnaby, BC
V3N-4X8

Prepared By:

J.P. Ebell, I.D. Redden, A.Sc.T. & I.D. Cuthbert, R.P. Bio.
STREAMLINE ENVIRONMENTAL CONSULTING LTD.
786 Quilchena Cres.
Nanaimo, BC V9T 1P6
Phone: 250-758-7980
Fax: 250-758-8505

Prepared with Financial Support of:

BC Hydro Bridge Coastal Fish and Wildlife Restoration Program

Streamline
ENVIRONMENTAL CONSULTING LTD

Executive Summary

Degraded fish habitat conditions within the lower Elk River mainstem have long been noted as a possible concern to fisheries production. The Elk River and its tributaries provide seasonal spawning and rearing habitat that is utilized by adfluvial and resident populations of rainbow and cutthroat trout as well as Dolly Varden char. During the second half of the last century the lower Elk River channel morphometry shifted from a comparatively narrow, single thread, stable channel to a multi-thread, laterally unstable channel with significant accumulation of gravel resulting in aggradation.

This study is an abridged fish habitat assessment that focuses on the quantification of four essential fish habitat indices within the lower 8 km of the Elk River mainstem: habitat units (length of pools, riffles and glides), large woody debris frequency, bank stability and riparian condition. The results suggest that fish habitat has been degraded by a variety of causes within the valley. The review was also able to highlight gaps in the management knowledge of the watershed that prevent an overall watershed restoration plan from being formed. The key knowledge gap is a lack of understanding as to how the Elk River functions to support the fishery resource. Preliminary reconnaissance of fish population dynamics indicates that degraded river conditions likely have little effect on adfluvial productivity.

In recent years, BC Hydro, local communities, government agencies and professional biologists have shown a growing interest in addressing the ecological health of the Elk River. This study was conceived and completed as a component of the Bridge Coastal Fish and Wildlife Restoration Program (BCRP) Elk River Channel Stabilization Project. Based on observations of river conditions and discussions with stakeholders, the project team identified the need to document conditions and begin to assemble the information needed to develop an overall watershed restoration plan for the Elk River.

This data report summarizes the information collected during a two day habitat reconnaissance of the lower 8.3 km of the Elk River in September, 2004.

Table of Contents

List of Figures

List of Tables

List of Photographs

List of Appendices

1.0 Introduction

Fish habitat conditions within the lower Elk River mainstem have been noted as a possible concern to fisheries production (BCRP, 2000). The Elk River and its tributaries provide seasonal spawning and rearing habitat that is utilized by adfluvial and resident populations of rainbow (*Oncorhynchus mykiss*) and cutthroat (*O. clarki*) trout as well as Dolly Varden char (*Salvelinus malma*).

Previous studies have found that the lower Elk River has shifted from a comparatively narrow, single thread, stable channel to a multi-thread, laterally unstable channel with significant accumulation of gravel resulting in aggradation (Mike Miles, 1999). Many factors are believed to have facilitated this change including extensive riparian and valley bottom logging, channel relocation or diversions due to road construction and the increase in flows in the river due to the construction of the Crest Creek / Heber River diversion. This change in river regime has resulted in a 4 to 7 times increase in the un-vegetated channel width. Fish habitat in the lower Elk River shows several typical signs of degraded conditions, including predominantly highly mobile substrates, limited pools, limited quantity and quality of large woody debris (LWD), eroding banks and alder-dominated, low quality riparian vegetation.

2.0 Goals and Objectives

An abridged fish habitat assessment of lower 8.3 km of the mainstem Elk River was completed to document conditions. The objectives of this study were to:

1. Assess current conditions using typical, quantitative fish habitat measures.
2. Identify and record habitat conditions that could limit fish productivity within the lower mainstem river.
3. Develop preliminary recommendations to guide future watershed and fish habitat restoration.

3.0 Study Area

The project focused on the lower 8.3 km of the Elk River from the Highway 28 Bridge downstream to the high water mark of Upper Campbell Lake (Figure 1). The entire area lies within Strathcona Provincial Park. This section of river included Reaches 1, 2, 3 and 4, which are among the most heavily impacted reaches of the river. These reaches are thought to offer the primary habitat utilized by lake populations of rainbow and cutthroat trout as well as the rearing of Dolly Varden char (Skip Rimmer, BC MWLAP. Pers. Com., 2004).

4.0 Methods

Field assessment took place on September 15th and 16th 2004. The reconnaissance was restricted to a lineal stream assessment to measure habitat quantity within the primary channel. Four criteria were measured according to standards detailed in WRP Technical Circular No 8 (Johnstone and Slaney, 1996).

1. *Habitat units*: All primary pools, riffles and glides were recorded in order of survey. The beginning and end of each unit was measured using a hip chain.
2. *Large Woody Debris*: The number of functioning LWD pieces per habitat unit was tallied following size criteria to confirm functionality.
3. *Riparian Condition*: The type and structural stage of the riparian was noted along each stream bank.
4. *Bank Stability*: The stability of the banks was noted along both stream edges.

In addition, gradients were measured intermittently along each reach using a Suunto optical clinometer. Blue ribbons were hung every lineal 100 m for future reference and assessment consistency. Point observations and prominent landmarks were noted and referenced to the chained distance. Photographs were taken of specific observations and 'typical' references and also referenced to the chained distance.

Preliminary reaches were delineated using 1:20,000 TRIM mapping to determine stream gradient, channel confinement and the location of major tributary inflows (greater than 10 % of the watershed area). Final reach delineation was confirmed in the field based on channel character and obvious reach break points.

Brief walks past secondary channel areas indicated that their character was similar to the mainstem in terms of habitat units, functional LWD, riparian type and bank stability. In addition to assessing the primary mainstem channel, observations were also made on side channel areas, riparian forest types and the un-assessed mainstem and tributary areas. These observations were used to help develop an understanding of the condition of the river.

During the assessment period early fall rain had raised the river water level to mid stage. Cross channel wading was difficult and channel widths were not taken due to the wadding risk. Channel widths were instead determined using 1995 aerial photos. Wetted widths were not considered relevant given the increased river level. Some interpretation of the habitat units was made to classify the units as per lower flow conditions. This was not found to be a substantial factor in most riffle and glide units however it was considered in identifying borderline pool units i.e. would a pool be deep enough at a lower flow level to still be considered a pool or would it be apart of a glide?

5.0 Results

The fieldwork resulted in the assessment of 8.3 km of primary mainstem channel. Four mainstem reaches were established within the assessment length. Reach locations are shown in Figure 1. Table 1 quantifies the lineal length of habitat assessed summarizing and analyzing the four features surveyed. The field notes from the quantitative stream survey are summarized in Appendix III.

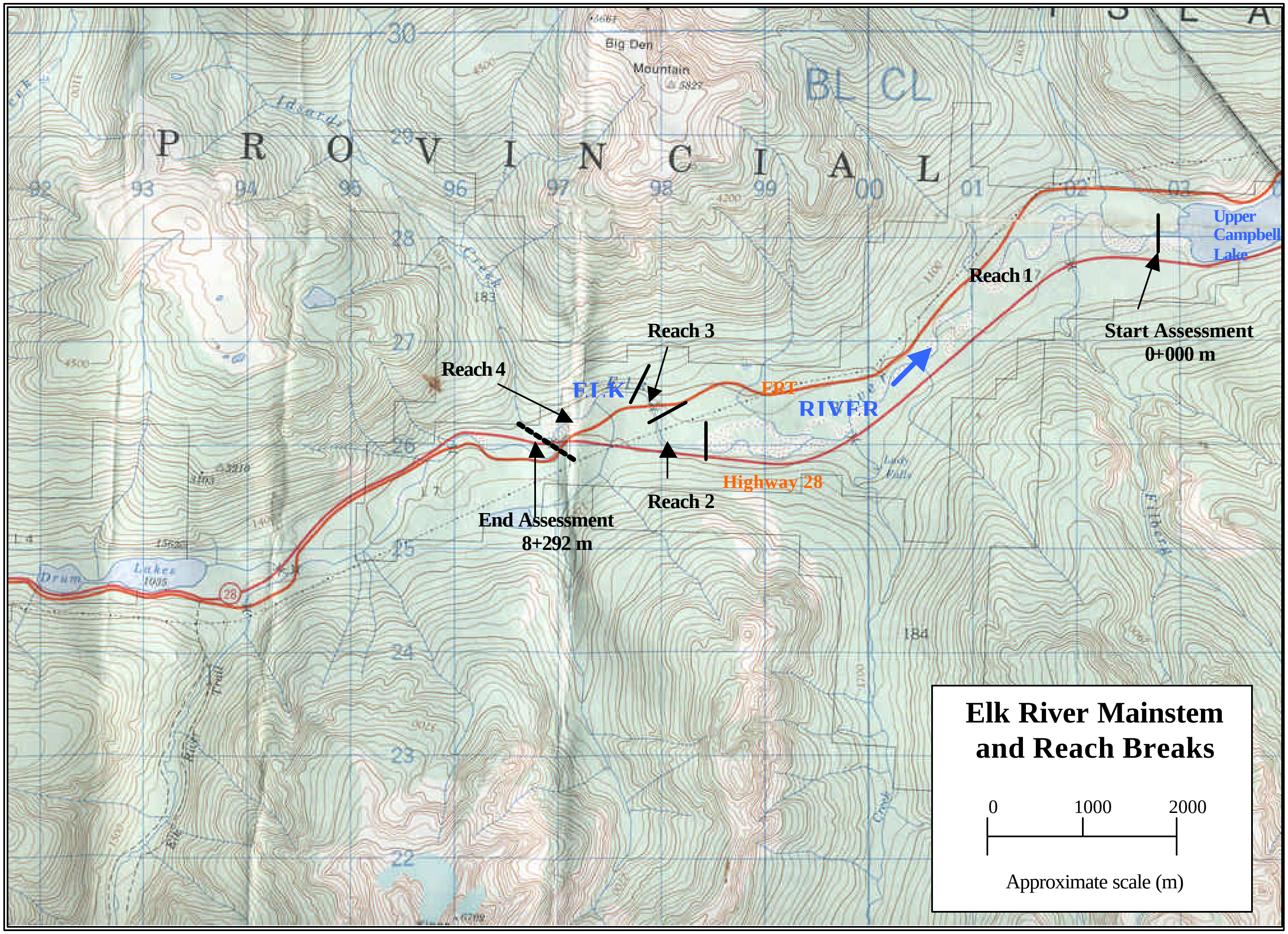

Figure 1. Elk River Mainstem and Reach Breaks

5.1 Reach 1

Reach 1 begins at the mean high water mark of Upper Campbell Lake and extend 6342 m upstream to a point 324 m downstream of the hydro line crossing where high banks begin to confine the channel. Highway 28 follows along the right flood plain of the river at times forming the immediate bank of the river and at other points being a few hundred meters inland. The deactivated Elk River Transport (ERT) Road bisects the left flood plain. This logging mainline also forms the stream bank at some points. The reach is characterized by a low gradient of 0.6% and an alluvial and dynamic nature.

Photo 1. Reach 1, 0+050 m view upstream, typical. Sept 15, 2004

The mean channel width is 65 m at sites where the channel is confined into one primary channel. At many points secondary channels braid and reform making the channel width up to 150 m wide. A total of 51 % of the reach length was assessed as glide and riffles occupy 44 %. Pools account for only 5 % of the total length of Reach 1. The flood plain is also extensive with widths of 500 m common along both banks. Within the flood plain young deciduous trees form 45 % of the riparian cover while a young mixed forest of conifers and deciduous trees form the next highest percentage of cover at 16 %. Some sites of mature trees are also found along the riverbank. The channel substrate in Reach 1 is cobble and large gravel that is loosely embedded. Sand is also evident in some backwater deposition areas. A total of 165 pieces of functional LWD were counted throughout the reach resulting in 1.7 pieces per channel width. Much of the LWD counted were root wads washed from the channel banks or a mix small conifer and deciduous logs. Eroding banks are frequent throughout the reach with 30 % of the bank length being actively eroded.

Photo 2. Reach 1, 0+225 m upstream view, typical. September 15, 2004

Photo 3. Reach 1, 2+886 m upstream view, typical. Sept 15, 2004

5.2 Reach 2

Reach 2 extends from Reach 1 to the bedrock confinement approximately 174 m downstream of the Elk River Transport road. With a length of 421 m and an average gradient of 1.25 % Reach 2 is a relatively short, low gradient reach. High gravel and hardpan banks confine the reach. The river remains in one primary channel throughout the reach and the mean channel width is 40 m. Cobble is the most dominant substrate with some larger gravel being sub-dominant. Several scattered boulders are present throughout the lower end of the reach. The reach is comprised of 67 % riffle, 28 % glide and 6 % pool length. There were 13 pieces of functional LWD in the reach for a density of 1.2 pieces per channel width. A total of 39 % of the bank length was assessed as being eroding and unstable. The riparian cover has a diverse composition of 33 % mature mixed forest, 25 % young deciduous forest, 21% young mixed forest and 13 % mature coniferous forest.

Photo 4. Reach 2, 6+403 upstream view, typical. September 16, 2004

5.3 Reach 3

Reach 3 is a confined bedrock canyon reach that is 281 m in length. The ERT Road Bridge crosses the center of the reach with the start being 174 m downstream and the top reach break being 107 m upstream. A formal water survey station is established immediately downstream of the bridge with both a gauging transect and a water level data recorder. The bedrock tightly confines this reach to a channel width of 19 m creating deep pool areas during lower flows and likely a high flume during high flows. The gradient within the reach is 0.5 %. Pools account for 84 % of the length within the reach while riffles make up 14 % and glides 3%. The reach was nearly devoid of large woody debris with only 2 pieces tallied or 0.1 pieces per channel width. The banks are vegetated in 52 % mixed mature forest, 24 % mature conifers and 24 % young conifers. Eroding banks within a short length accounted for 6 % of the reach length.

Photo 5. Downstream end of Reach 3, 6+763 m start of bedrock constriction. Note flow station cable and the ERT bridge in background. September 16, 2004.

5.4 Reach 4

A 1248 m section of Reach 4 was assessed from the top of the Reach 3 bedrock canyon to the Highway 28 Bridge crossing. Reach 4 appeared to continue past the assessment cut-off point and the upper reach break was not determined. The mean gradient within the assessed length of Reach 4 was 1.5 %. The channel character returns to the dynamic alluvial nature of Reach 1 with some minor braiding and extensive gravel bars. The mean channel width is 48 m. The substrate is dominated by cobble with some small boulders and large gravel being subdominant. Riffle habitat dominated the reach at 66 % of the reach length; glide length accounted for 30 % and pool length was 4 %. The flood plain in this reach was narrower, being less than a few hundred meters wide. The banks are vegetated in 30 % mature mixed forest, while 22 % is young mixed forest and 20 % young deciduous forest. Actively eroding banks are common with 40 % of the bank length assessed as eroding. There was very little LWD with only 12 pieces of active LWD tallied throughout the assessed reach. This accounts for 0.5 pieces of LWD per channel width.

<u>Photo 6</u>. Reach 4, 7+792 m upstream view, typical. September 16, 2004

Table 1. Elk River Quantitative Stream Survey Summary, September 2004

	Reach 1		Reach 2		Reach 3		Reach 4	
Habitat Unit Summary								
		Quality Rating *		Quality Rating *		Quality Rating *		Quality Rating *
Reach Length (m)	6342		421		281		1248	
Mean Channel Width (m)	65		40		19		48	
gradient	0.6		1.25		0.5		1.5	
Total lineal Pool Length (m)	323		25		238		45	
Total Lineal Riffle Length (m)	2795		280		43		827	
Total Lineal Glide Length (m)	3224		116		9		376	
Total Number of Habitat Unites	85		8		6		18	
Total Number of Pools	11		1		3		2	
Total Number of Riffles	35		3		2		8	
Total Number of Glides	39		4		1		8	
% of Lineal Length Pool	5 %	poor	6 %	poor	84%	good	4 %	poor
% of Lineal Length Riffle	44 %		67 %		14%		66 %	
% of Lineal Length Glide	51 %		28 %		3%		30 %	
Total channel widths per reach	97.6		10.5		14.8		26.0	
Frequency (channel width per pool)	8.9	poor	10.5	poor	4.9	fair	13.0	poor
Frequency (channel width per riffle)	2.8		3.5		7.4		3.3	
Frequency (channel width per glide)	2.5		2.6		14.8		3.3	
Pool riffle ratio by %	1:8.8		1:11		0.16:1		1:17	
Pool frequency per 100m								
Total LWD	165		13		2		12	
LWD / channel width	1.7	fair	1.2	fair	0.1	poor	0.5	poor
Riparian Vegetation Summary								
	Reach 1		Reach 2		Reach 3		Reach 4	
	(m)	%	(m)	%	(m)	%	(m)	%
Reach Length	6342		421		281		1248	
Highway	464	4	0	0	0	0	0	0
Mature Conifer	1595	13	117	14	136	24	178	7
Mature Deciduous	913	7	70	8	0	0	190	8
Mature Mixed	1361	11	274	33	293	52	760	30
Young Conifer	356	3	0	0	133	24	173	7
Young Deciduous	5703	45	207	25	0	0	510	20
Young Mixed	1972	16	174	21	0	0	545	22
Sapling Deciduous	320	3	0	0	0	0	140	6
Eroding Banks Summary								
	(m)	%	(m)	%	(m)	%	(m)	%
Reach Length	6342		421		281		1248	
Eroding Banks	3813	30	327	39	31	6	986	40
Stable Banks	8853	70	515	61	531	94	1510	60

* *Diagnostic tables from WRP Technical Circular No.8 were used to guide the quality ratings given.* ***It should be noted that the diagnostics used are intended for streams with channel widths of less than 15 m.***

6.0 Discussion

The data collected and observations made during this field study along with previous studies on river channel stability provide a current picture of fish habitat conditions within the Elk River. The four habitat criteria assessed: *habitat units, functional woody debris, riparian condition* and *bank stability* indicate that the fish habitat quality is marginal in the lower Elk River. Each of these criteria is discussed below.

6.1 Habitat Units

Within the alluvial reaches of 1, 2 and 4, pool habitat is limited. Pools represented only 5 % of the total habitat in Reach 1, 6 % in Reach 2 and 4 % in Reach 4. Riffle length on the other hand was 44 % of the total habitat length in Reach 1, 67 % in Reach 2 and 66 % in Reach 4.

A common interpretation of this habitat index is that a ratio of 1 pool to 1 riffle is optimal for small streams, although the ratio does vary depending on stream size and gradient (Carlson et al. 1990). Platts et al. (1983) states that some of the highest standing crop of salmonids have been sampled in river drainages with a pool to riffle ration of 0.4: 1. The ratio of pools to riffles assessed in the lower Elk River is 1:8.8 in Reach 1, 1:11 in Reach 2 and 1:17 in Reach 3.

Given the unconfined alluvial character of the lower Elk River an analysis of pool frequency in terms of natural channel geometry and profile is particularly helpful in understanding the state of the river's health and fish habitat opportunities. Study of river geomorphology in unconfined rivers of all sizes has shown the natural mean spacing of pools to be 5.6 to 6.7 times the channel width (Newbury and Gaboury 1994). Within the Elk River the frequency of channel width per pool was 8.9 in Reach 1, 10.5 in Reach 2 and 13 in Reach 4. These frequencies are all rated as "poor" using the diagnostic tables provided by Johnstone and Slaney (1996).

Well-defined pools were most often associated with unique topographic features such as a high bank, which forced a river direction change or a tributary inflow. Studies have shown that LWD normally plays a significant part in promoting pool frequencies. The assessment found that in some instances jams of LWD did create small pool sites however LWD in Elk River was generally observed to be small, scattered and often mobile. The scour areas associated with LWD were commonly insufficient in area and depth to meet the pool criteria of this study. Hydrological scour forces also appeared unable to maintain well-defined pools in normal pool sites such as outside bends and riffle bases. The lack of pool area is likely the result of dynamic substrate movement within the channel. Based on typical channel geometry and patterns, sites that normally would be expected to be pool areas were instead glide areas. This is reflected in the abundance of glides, which represent 51 % of available habitat in Reach 1, 28 % in Reach 2 and 30 % in Reach 4.

Photo 7. Reach 1 pool site at Cervus Creek inflow. September 15, 2004

The effect of boulders within some glide and riffle units provided some surprising results in terms of potential cover and holding habitat. The alluvial substrate of the river offered few sites where large boulders existed however at a few locations boulders have accumulated from high banks. These boulders appeared partially moss covered and stable. The scour sites associated with these boulders rarely offered an area and depth that could be classified as a pool, however the quality of the habitat produced was of value for cover, holding and foraging. The presence and success of these boulder features in providing fish habitat complexity suggests that further investigation into the viability of addressing habitat needs using this template should be considered.

It is reasonable to assume that the paucity of pool areas and apparent substrate mobility through the glides and riffles limits trout and char productivity within the Elk River. Mobile substrate offers increased risk during the egg incubation period. The mobile substrate through the riffle areas may also degrade opportunities for benthic invertebrate production thus decreasing food availability. It can be assumed that though the trout and char populations are capable of thriving during some periods in the abundant riffle habitat, they are also dependant upon pool sites to provide important holding, rearing and cover habitat. The value of the pool areas for fish production is supported anecdotally with a statement by a local professional sport fishing guide that the premium fishing sites in the river are the major pools assessed (Paul Smith per com 2004).

Photo 8. Reach 1, 6+342 m boulders functioning in mainstem, downstream view. September 16, 2004

The restoration of fish habitat by the promotion of pool forming structures may be of value however the risk of failure of instream wood and rock structures may be high at this stage in channel development. Channel stability has been assessed as being in a recovery and stabilizing mode (M. Miles 1999). A channel risk assessment is recommended to assess the opportunities for instream boulder and log structures.

6.2 Large Woody Debris

Woody debris was observed along much of the channel length assessed. A lot of the LWD was not considered functional for instream structures but was playing an important role in stabilizing gravel bars and capturing fine organic debris during flood events.

Within the wetted channel the functional pieces of LWD per channel width was assessed to be 1.7 in Reach 1 and 1.2 in Reach 2. Both these frequencies are diagnosed as "fair". In Reach 4 the pieces of LWD per channel width decreased to 0.5 and was diagnosed as "poor". The LWD was found to be relatively small compared to the channel. A majority of the wood is second growth logs that were small in diameter. Old growth and second growth stumps are also numerous offering only limited cover or scour value as individual structures. Alder logs that have a relatively short functional LWD lifespan were also noted to be a significant component of the LWD tallied. The wood was generally noted to be not well anchored and subject to move from event to event.

Channel instability is recognized as a significant concern in the Elk River. During 2004, BCRP initiated a gravel bar staking project to begin addressing this concern. On the gravel bars, numerous examples were seen of LWD functioning to promote bar stabilization and re-vegetation. In many sites throughout the alluvial reaches there appears to be the opportunity to assist bar stabilization and the formation of a single thread channel through the addition of further LWD on more active bar sites. A channel-risk assessment is recommended to confirm the opportunities for this work.

Photo 9. Reach 4, 7+260 m woody debris functioning to stabilize bar, downstream view. September 16, 2004

6.3 Riparian Condition

A mature riparian forest of conifers or mixed species is essential to both bank stability and a quality supply of LWD. Within the Elk River healthy mature forests accounted for 24 % of the total riparian vegetation in Reach 1, 47 % in Reach 2, 76 % in Reach 3 and 37 % in Reach 4. Thus a majority of the channel length is vegetated in various stages of young and deciduous forests providing limited riparian values. This is particularly the case in Reaches 1 and 4, which account for the majority of the channel length surveyed.

Studies completed over the last 10+ years have found that the lower Elk River shifted from a historic channel character of a comparatively narrow, single thread, stable channel to a multi-thread, laterally unstable, gravel in-filled channel. Commercial harvest of the riparian forest has undoubtedly contributed to this condition. The flashy nature and alluvial character of the Elk River relied on an old growth type riparian forest condition to provide hardened stream banks and stability to the channel. A focus on restoring this condition is arguably the greatest need in the watershed.

Photo 10. Reach 1, 1+166 m upstream view of typical reach with young deciduous forest. September 15, 2004

Photo 11. Deciduous riparian area in Reach 1 with no conifer under story. Note old growth cedar stumps. September 15, 2004

The riparian assessment completed in this study offers only a cursory understanding of the current habitat conditions and needs. Reconnaissance walks through the riparian types noted varying conditions in each broad category. Within some deciduous forests, young conifers are established as an under story species while in other deciduous sites conifers were devoid and the understory diversity was marginal. On some sites tree growth was rapid while on others sites it was not. This was particularly the case for young seedling conifers that appeared chlorotic and stunted at some sites while showing good growth in others.

A thorough riparian assessment is recommended along with prescription development.

<u>Photo 12</u>. Chlorotic conifer seedling commonly observed to be in need of nutrient and alder release. September 16, 2004

6.4 Bank Stability

Actively eroding banks were present along 30 % of reach 1, 39 % of Reach 2, 6 % of reach 3 and 40 % of reach 4. This erosion activity was taking place on both low-lying gravel banks as well as high hardpan banks. Substrate eroding from these banks sites is being carried by the river as bed load and redistributed within the system. This is undoubtedly contributing to river instabilities and a loss of habitat. As discussed above, the weak riparian structure plays an important role in this situation.

Opportunities to address bank stability lie in improvements to and maturity of the riparian area. Stabilizing peak flows and reducing diversions from other watershed will also play an important role in allowing banks to stabilize. At some sites specialized bioengineering or in channel energy dissipation may offer relief and an opportunity for bank stabilization.

Photo 13. Reach 1, 0+137 m bank erosion and weak riparian structure. September 15, 2004

6.5 Fisheries Considerations

The trout and char populations dependant upon the Elk River system are not well understood. Most of the populations are likely dependant upon life stages within both Upper Campbell Lake and the Elk River. Based on studies in Buttle Lake and Upper Campbell Lake drainages it is considered likely that a resident population of Dolly Varden is present in the Elk River. Resident trout populations are expected to be very small or non-existent (S. Rimmer, MWLAP. Pers. Com., 2004).

The Elk River has long been known to provide important spawning habitat for adfluvial populations of trout and char (Haig Brown, 1959). Unpublished surveys by the Provincial Fisheries Branch over the past decade appear to suggest that habitat dependence beyond spawning in the Elk River may be minimal. Oligotrophic stream conditions and cold water may discourage adult holding and juvenile rearing behavior in the river. Snorkel survey results suggest that large numbers of newly emerged fry may migrate to the lake to rear (C. Wightman and S. Rimmer, MWLAP. Pers. Com., 2004). This differs from typical trout behavior where adult fish hold for extended periods in the river prior to spawning and emergent fry are dependant upon a river rearing stage of up to a year or more prior to emigrating to larger water bodies.

The hypothesis suggested by the Provincial fisheries personnel is an important consideration in planning fish habitat restoration within the Elk River. If fish populations within the Elk River have evolved to only rely on the river for spawning, the currently degraded river conditions within the river may not significantly limit fisheries production. Conversely, if (i) there is a portion of these populations that rear in the river, or if (ii) they would rear in the river if habitat were more suitable, or if (iii) a resident population of

Dolly Varden depend on these reaches or could increase their productivity if habitat were more suitable, then restoring habitat quality should increase fish production.

To guide future watershed restoration, more information and analyses is required on habitat use and fish population dynamics in the Elk River. To build this knowledge would require a review of past studies, raw data and uncompleted work. Further field study of fish population dynamics would also be necessary.

7.0 Conclusions and Recommendations

Based on the four key habitat quality indicators considered, the results of this survey and analysis indicate that fish habitat in the lower Elk River is poor to moderate quality as a result of historical resource use and development. This is particularly the case in reaches 1, 2 and 4 which are alluvial. Reach 3 is bedrock controlled and subject to less degradation from watershed events and resource disturbances.

This study highlights gaps in the management knowledge of the watershed that should be addressed to facilitate the development of a robust and effective watershed restoration plan. The most critical knowledge gap is with respect to fish use of the Elk River, and how the river functions to support adfluvial trout populations of Upper Campbell Lake.

Field observations made during 2004 suggest that the degraded channel state is gradually shifting towards recovery, and gravel bars are being re-vegetated. Ecosystem restoration can be an effective means to accelerate this recovery and enhance the quality and productivity of fish and wildlife habitat.

The following steps are recommended to continue progress towards the restoration of the Elk River ecosystem:

1. Initiate riparian assessment and prescription development throughout the mainstem and valley bottom tributaries.
2. Review past studies, BC Ministry raw data and incomplete work to extract relevant fish population and habitat use information and identify data gaps.
3. Address data gaps to gain sufficient knowledge of the river and fishery resource to develop a comprehensive watershed restoration plan.
4. Implement the watershed restoration plan.

8.0 Acknowledgements

Streamline Environmental Consulting ltd. would like to acknowledge the financial support of BC Hydro through its Bridge Coastal Fish and Wildlife Restoration Program (BCRP). We also wish to thank Paul Smith and the Gold River Streamkeepers for their assistance with the field component of this assessment. Finally we wish to thank Craig Wightman and Skip Rimmer of the BC Ministry of Water, Land and Air Protection for sharing their knowledge of the Elk River and its fisheries values.

9.0 References

Bilby R.E. and J.W. Ward. 1991. Characteristics and function of large woody debris in streams draining old growth, clear-cut and second growth forests in southwestern Washington. Canadian Journal of Fisheries and Aquatic Sciences 48: 2499–2508.

Bridge-Coastal Fish and Wildlife Restoration Program (BCRP). 2000. Volume 2: Campbell River Watersheds. BC Hydro, Burnaby, BC.

Carlson, J.Y., C.W. Andrus, and H.A. Froehlich. 1990. Woody debris, channel features, and macro invertebrates of streams with logged and undisturbed riparian timber in Northwestern Oregon. U.S.A. CJFAS 47: 1103-1111.

Haig-Brown, Roderick. 1959. Fisherman's Summer published in To Know a River, 1996. Douglas and McIntyre. Vancouver, BC. 372pp.

Johnston, N.T. and P.A. Slaney. 1996. Fish Habitat Assessment Procedures. Watershed Restoration Technical Circular No. 8. Ministry of Environment, Lands and Parks. Victoria. 97 pp.

M. Miles and Associates Ltd. 1999. Channel stability analysis: Elk River, Crest River and Heber River. Prepared for BC Hydro, Burnaby, BC.

Newbury, Robert W. and Marc Gaboury. 1995. Stream Analysis and fish Habitat Design - A Field Manual. Co-published by Manitoba Natural Resources. 262pp.

Platts, W.S., W.F. Megahan, G. W. Minshall. 1983. Methods for Evaluating Stream, Riparian and Biotic Conditions. U.S. Forest Service. Ogden, Utah. Technical report # INT-138.

Rimmer, Skip. 2004. Personal communications. Ministry of Water Land and Air Protection. Nanaimo B.C.

Slaney P.A. and A.D. Martin, 1996 Planning Fish Habitat Rehabilitation: Linking to Rehabilitation, Watershed Restoration Program. Tech Circ 9. 23 pp

Smith, Paul. 2004 Personal communications. Gold River Salmonid Stewardship Society. Gold River B.C.

Wightman, Craig. 2004. Personal communications. Ministry of Water Land and Air Protection. Nanaimo B.C.

Appendix I. Financial Statement

Elk River Fish Habitat Reconnaissance Assessment   Project #   2087A

Financial Statement Form

	BUDGET		ACTUAL	
	BCRP	Other	BCRP	Other
INCOME				
Total Income by Source	$ 5,000.00	$ 1,200.00		
Grand Total Income (BCRP + other)	$ 6,200.00			
EXPENSES				
Project Personnel				
Wages				
Consultant Fees			$ 4,205.00	$ 400.00
Gold River Streamkeepers				$ 800.00
subtotal	**$ -**	**$ -**	**$ 4,205.00**	**$ 1,200.00**
Materials and Equipment				
Air Photos				$ -
Field Gear and Supplies			$ 234.73	$ -
Vehicles and Mileage			$ 289.50	
Survey Gear Rental				
Meals and Accommodations			$ 146.24	
Excavator				
subtotal	**$ -**	**$ -**	**$ 670.47**	**$ -**
Administration				
Photocopies & Printing			$ 119.96	
Photographs				
Courier, Copying				
Communications				
subtotal	**$ -**	**$ -**	**$ 119.96**	**$ -**
Total Expenses	$ 5,000	$1,200	$ 4,995.43	$ 1,200.00
Grand Total Expenses (BCRP + others)	**$ 6,200.00**		**$ 6,195.43**	
BALANCE (Grand Total Income - Grand Total Expenses)	$0		$ 4.57	
Unspent Funds Returned to BCRP				**$4.57**

Appendix II. Performance Measures – Actual Outcomes

Performance Measures – Target Outcomes												
Project Type	Primary habitat benefit targeted of project (linear m)	Primary Target Species	Estuarine	In-stream Habitat – Mainstream	In-stream Habitat – Tributary	Riparian	Reservoir Shoreline Complexes	Riverine	Lowland Deciduous	Lowland Coniferous	Upland	Wetland
Preliminary Habitat Assessment												
Fish Habitat Assessment	Length of habitat surveyed to determine future assessment and restoration requirements	RB, CT, DV		8292 m		8292 m		8292 m				

Appendix III. Quantitative assessment data. September 2004

Elk River - Quantitative Assessment Data **Sept 15 and 16th, 2004**

Survey Crew: John Ebell / Paul Smith Stream flow: mid stage, recent heavy rain

						Riparian cond.		Bank Stability			
Reach #	**Dist (m)**	**Hab type**	**Unit Length (m)**	**Grad %**	**LWD #**	**Rt bank**	**Lt. bank**	**Rt bank**	**Lt. bank**	**photo**	**Comments**
1	0	g	63		14	ym	ym	1	1	1	start at HWM and M Miles 0+000
1	63	p	21	0.5	6	ym	ym	0	0		
1	84	r	53		4	ym	ym	0	1		
1	137	g	88		7	yd	ym	0	1		rip rest rt bank and unstable bank
1	225	p	24		5	yd	yd	0	0	1	
1	249	g	29		2	yd	yd	0	0		
1	278	r	64		0	ym	yd	1	1	1	
1	342	g	64		5	ym	yd	1	0	1	LWD poorly functional, note yd forest and eroding banks
1	406	r	96		9	yd	yd	0	0		
1	502	g	28		2	yd	yd	0	0		
1	530	p	15		0	ym	yd	1	0		
1	545	r	45		0	yd	yd	0	0		
1	590	g	177		9	hwy	mm	1	0		
1	767	p	65		3	yd	ym	0	1		
1	832	g	121	0.5	7	yd	ym	0	1		
1	953	r	145		1	yd	ym	0	0		1073 inflow of Tlools Ck. on Lt bank
1	1098	g	28		0	yd	ym	0	1	1	
1	1126	r	40		0	ym	yc	0	0		
1	1166	g	36		0	ym	yd	0	0		
1	1202	r	19		1	ym	yd	0	1		
1	1221	g	108		4	yd	yd	0	0		
1	1329	r	9		0	ym	yd	0	0		
1	1338	g	252		8	yd	yd	0	1		

Appendix III cont. Quantitative assessment data. September 2004

						Riparian cond.		Bank Stability			
Reach #	Dist (m)	Hab type	Unit Length (m)	Grad %	LWD #	Rt bank	Lt. bank	Rt bank	Lt. bank	photo	Comments
1	1590	r	14		2	yd	yd	0	1		
1	1604	g	46	0.3	1	yd	yd	0	0		
1	1650	p	10		2	yd	yd	0	1	1	
1	1660	g	9		0	yd	yd	0	1		
1	1669	r	190		3	yd	yd	0	0		
1	1859	g	35		1	yc	yc	0	0		
1	1894	p	74		0	yc	yc	1	1		
1	1968	r	49		0	yc	yc	1	1		
1	2017	g	124		0	ym	ym	1	1	1	
1	2141	r	89		0	ym	yd	0	1		
1	2230	g	109		1	yd	yd	0	1	1	old rd access to lt bank
1	2339	r	35		0	yd	yd	0	0		
1	2374	g	21		1	yd	yd	0	0		
1	2395	r	68		0	yd	md	0	0		
1	2463	p	17		Lj	yd	yd	0	1		
1	2480	r	97		6	yd	md	0	1	1	d/s start of old ML on Lt bank
1	2577	g	94		3	yd	md	0	0		
1	2671	r	19		0	mm	md	0	1		erosion of rip rap Lt bank
1	2690	g	133		Lj,Lj,Lj	mm	ym	0	0	1	
1	2823	r	43		4	yd	mm	0	1		
1	2866	g	158		4	yd	mc	0	0		big bar on Lt needs staking
1	3024	r	85	1	1	mm	mc	1	0		
1	3109	g	386		5	mm	mc	0	0		
1	3495	p	30		0	ym	yd	0	1		
1	3525	r	125		1	ym	yd	0	1		
1	3650	g	62		0	md	yd	0	0	1	4.0 km M Miles

Appendix III cont. Quantitative assessment data. September 2004

						Riparian condition		Bank Stability			
Reach #	Dist (m)	Hab type	Unit Length (m)	Grad %	LWD #	Rt bank	Lt. bank	Rt bank	Lt. bank	photo	Comments
1	3712	r	107	0.5	0	mm	yd	0	0		
1	3819	g	49		0	mc	yd	1	0	1	
1	3868	r	47		1	mc	yd	1	0		boulders functioning to enhance channel and habitat
1	3915	g	145		0	mc	yd	1	0		
1	4060	r	79		1	mc	sd	0	0		
1	4139	g	18		0	mc	yd	0	0		
1	4157	p	23		0	mc	yd	0	0		
1	4180	g	10		0	mc	yd	0	0		
1	4190	r	47		0	mc	yd	0	0		
1	4237	g	30		0	yd	yd	0	0		
1	4267	r	55		0	mm	yd	0	0	1	
1	4322	g	113		3	ym	ym	1	0		
1	4435	r	80		0	md	md	1	0	1	
1	4515	g	17		0	yd	md	0	0		Cervus Ck inflow on Rt bank
1	4532	p	20		0	yd	md	0	0		inflow pool, fishy! Paul says it has not changed in years
1	4552	r	96		2	yd	md	1	1		
1	4648	g	49		2	yd	mm	0	1		
1	4697	r	70		6	yd	yd	0	0		
1	4767	g	47		1	yd	mm	0	1		
1	4814	r	24		4	yd	mm	1	0		lots of fry along stream margins
1	4838	g	59		Lj	yd	mm	1	1		
1	4897	r	35		0	yd	mm	1	0		
1	4932	g	142		0	yd	mm	1	0		
1	5074	r	100		0	mc	yd	1	0		
1	5174	g	121		0	mc	yd	1	0	1	
1	5295	r	139		2	mc	yd	1	0		

Appendix III cont. Quantitative assessment data. September 2004

						Riparian cond.		Bank Stability			
Reach #	Dist (m)	Hab type	Unit Length (m)	Grad %	LWD #	Rt bank	Lt. bank	Rt bank	Lt. bank	photo	Comments
1	5434	g	68		1	hwy	yd	0	0		
1	5502	r	214		3	yd	md	0	0		
1	5716	g	66		7	yd	md	0	0		
1	5782	r	188		10	yd	mc	0	0	1	
1	5970	g	51		0	hwy	sd	0	0	1	
1	6021	r	98		0	hwy	sd	0	0	1	
1	6119	g	46		0	hwy	sd	0	0		
1	6165	p	24		0	hwy	sd	0	0		
1	6189	g	22		0	ym	sd	1	0		
1	6211	r	131		0	ym	yd	1	0		
2	6342	g	30	1	3	yd	md	0	1	1	
2	6372	r	31		2	yd	mm	0	1		
2	6403	g	29		0	yd	mm	0	0		
2	6432	p	25		0	yd	mc	0	0		
2	6457	r	92		3	yd	mc	1	0		high eroding bank, possible bio eng
2	6549	g	17		0	ym	mm	1	0		
2	6566	r	157		4	ym	mm	1	0	1	6+666 m is center of hydro crossing
2	6723	g	40	1.5	1	mm	md	0	0		

Appendix III cont. Quantitative assessment data. September 2004

						Riparian cond.		Bank Stability			
Reach #	Dist (m)	Hab type	Unit Length (m)	Grad %	LWD #	Rt bank	Lt. bank	Rt bank	Lt. bank	photo	Comments
3	6763	p	76		1	mc	mm	0	0	1	6791 flow metering cable crossing
3	6839	r	31		0	mm	mc	0	1		
3	6870	g	9		0	mc	mm	0	0		
3	6879	p	20		0	mc	mm	0	0		
3	6899	r	12		1	mm	mm	0	0		
3	6911	p	133	0.5	0	yc	mm	0	0	1	6926 wl station, WL = 4.67, 6937 center of ERT bridge
4	7044	r	190	2	0	mm	md	0	0		New Reach
4	7234	g	26	1	0	sd	mm	0	0		
4	7260	r	58		5	sd	mc	0	0	1	good example protection
4	7318	g	56		2	sd	mm	0	1		
4	7374	r	42		1	yc	mm	0	1		
4	7416	g	30		0	ym	mm	0	1		high eroding bank bioeng solution?
4	7446	r	91		1	mm	yd	1	0		
4	7537	g	44		0	mm	yd	1	0		
4	7581	p	31		0	mm	yd	1	0	1	bo pool site, opportunity for LWD
4	7612	r	180		Lj +3	mm	yd	1	0		593 trib inflow on Rt bank
4	7792	g	92		0	yd	mc	0	1	1	LWD potential using bo etc
4	7884	r	135		3	ym	ym	1	1		rd access to Rt bank
4	8019	g	42		0	yc	ym	0	0		park's staking site on Rt bank
4	8061	p	14		0	ym	yd	0	0		
4	8075	g	58		0	ym	yd	0	0		good bo cluster site
4	8133	r	61		0	yc	ym	1	1		
4	8194	g	28		0	mc	yc	0	1		possible bio eng site on Lt bank
4	8222	r	70	1.5	0	mm	ym	0	0	1	inflow of Idsardi Ck on Lt bank
4	8292										End at center of Highway bridge