Evaluation of Salmonid Populations in Wilson Creek (900-119900)

Prepared for

Sunshine Coast Community Forests
Sechelt, BC

Prepared by

FSCI Biological Consultants
Sechelt, BC

October 30, 2012

Table of Content

List of Figures

Page

List of Tables

Page

1.0 Introduction

In the summer of 2012, ***FSCI*** Biological Consultants conducted an overview and limited-detail fish and fish habitat assessment of the Wilson Creek watershed. This assessment addresses the distribution and current standing stock of rearing salmonids and an assessment of the aquatic habitat found in the Wilson Creek watershed.

The purpose of this report is to summarize existing data and provide results from 2012 field sampling. This project is not intended as a detailed and comprehensive assessment; but rather, provides an update on the existing conditions and compares these conditions to past data. A set of conclusions and recommendations for the protection of salmonid habitat is provided.

2.0 Study Area

Wilson Creek is a small coastal watershed that drains into the Strait of Georgia; approximately 10-km south of Sechelt, BC (**Figure 1**). The watershed area is approximately 2200-Ha and includes three fish-bearing streams: Wilson, Husdon and East Wilson Creeks (**Figure 1**). Wilson Creek is a third-order stream with an estimated channel length of 11.6-km. Husdon Creek is a first-order stream measuring approximately 5.9-km and East Wilson a second-order stream approximately 5.0-km long. All three streams bisect an assortment of public and private lands, including public and private forest lands and rural development (*Horel,* 2012).

All three streams are included within the Jervis Inlet (JERV) watershed group and have assigned provincial watershed codes (WSC). These codes are the basis for data warehousing and access of information for each stream. **Table I** provides the BC Watershed Codes for each stream and the approximate location of the stream. All organized data is typically submitted to the Provincial Inventory Branch using these reference codes.

Table I: *Watershed codes for Wilson Creek and its main tributaries.*

Stream and Lakes	WSC	Easting	Northing
Wilson Creek	900-119900-00000	448505	5476468
Husdon Creek	900-119900-23418	448792	5476830
East Wilson Creek	900-119900-24700	449511	5477741

The study area for this review and assessment includes the entire length of all three streams. Wherever possible each identified stream reach was accessed. In areas where access was difficult or hampered, an alternative access point was found that was considered to represent the stream reach.

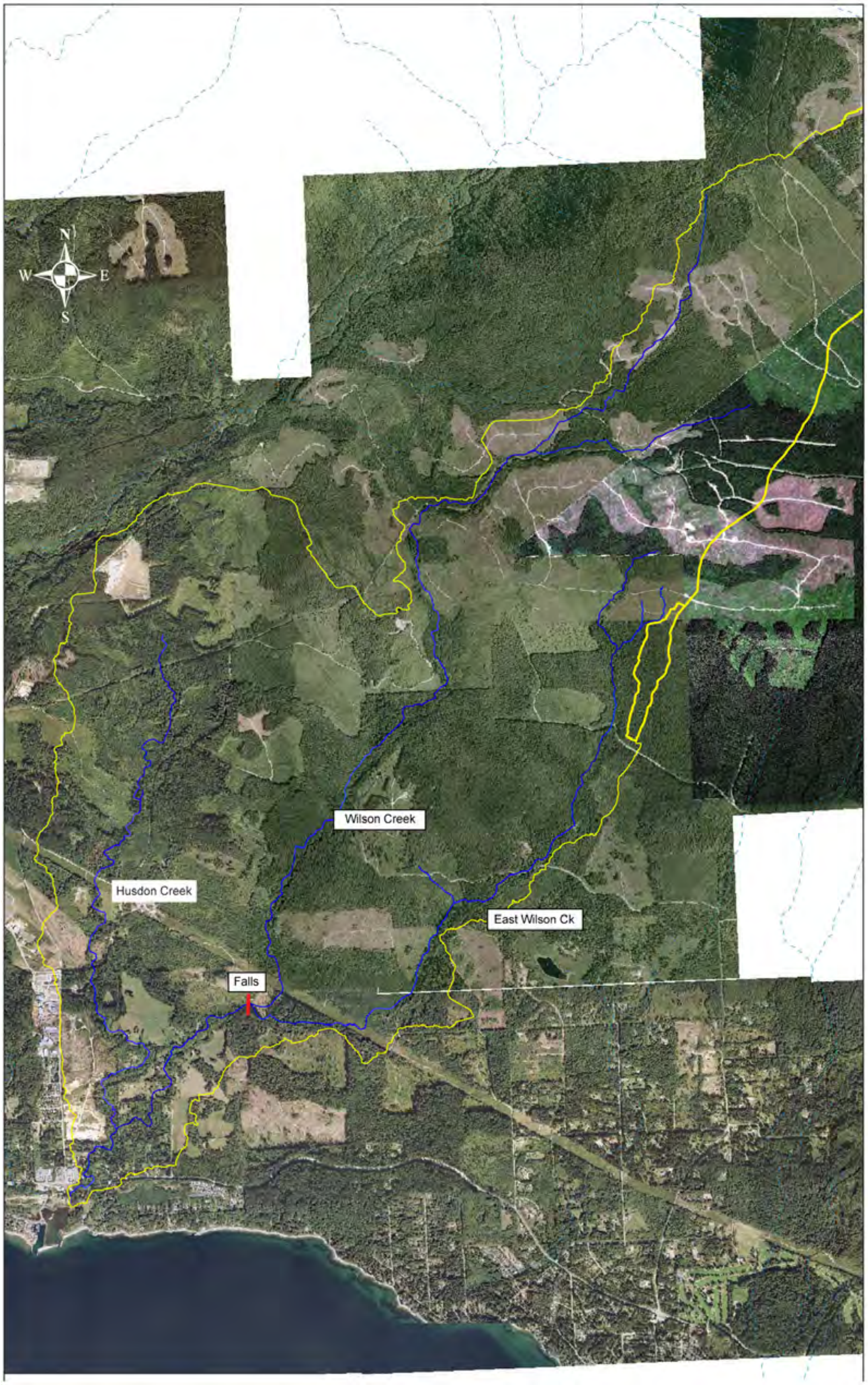


Figure 1: *The Wilson Creek watershed showing the mainstem of Wilson Creek and its primary tributaries Husdon and East Wilson Creeks.*

3.0 Known Fisheries Values

The health of a stream ecosystem is assessed on a variety of characteristics and features. While it is recognized that characteristics like changes in water chemistry and macroinvertebrate diversity may be used as a metric of watershed health, identification of rearing salmonids is a more prevalent metric. This approach has defensible merit in that salmonids, and in particular coastal cutthroat trout, have been referred to as “sentinels” of stream health (*Slaney and Roberts*, 2005), providing a measure of watershed condition based on their population strength.

Wilson Creek watershed has had a variety of fisheries work completed on it over the past 30-40 years. In addition, a portion of the available information is anecdotal or observational and has been inadequately documented. Regardless, it is agreed that Wilson Creek (and its tributaries) is “high value fish habitat” that supports a variety of salmonids including; Coho (*Oncorhynchus kisutch*), Chum (*O. keta*) and Pink (*O. gorbuscha*) salmon; anadromous and resident Cutthroat trout (*O. clarki clarki*); and Steelhead trout (*O. mykiss*) (*FISS*). The distribution of these species varies. In **Table II** the known distribution is summarized with the appropriate reference. In addition, **Figure 2** is used to show the overall distribution of “known” species throughout the watersheds.

Table II: *Species currently documented in target streams and references and/or studies that have confirmed the presence of salmonids.*

Streams	Species	Location	Reference
Wilson Creek	Co, Cm, Pk, Rb, Cct	All species except Cm are found upstream of the passage barrier at 0.5-km. There is some limited to the upper reaches (above the 0.5-km to Cm under “ideal” conditions.	FISS (1991) Harding and Erikson (1975)
		Cct and Co presence is documented upstream to the impassable falls at 2.7-km.	Bates (2000)
		Steelhead (rainbow) information is limited and numbers and sightings very low.	Bates (Unpubl.)
		The reaches, above the falls are occupied by resident Cutthroat trout.	Clarke (1985)
		The upper reaches, above the passage barrier are colonized by non—anadromous (resident) coastal cutthroat trout.	Clarke (1985), FISS (1991)
East Wilson Creek	Cct	Found through the majority of the stream length.	Clarke (1985), Bates (Unpubl)
		Numerous near vertical bedrock chutes and vertical falls likely restricts movement.	
Husdon Creek	Co, Cct	Found throughout extending to reach above BC Hydro ROW.	Bates (unpubl), Rosenfeld et al. (2000)

Co = coho; Cm = chum; Pk = pink; Rb = steelhead/rainbow; Cct = cutthroat; Dv = Dolly Varden.

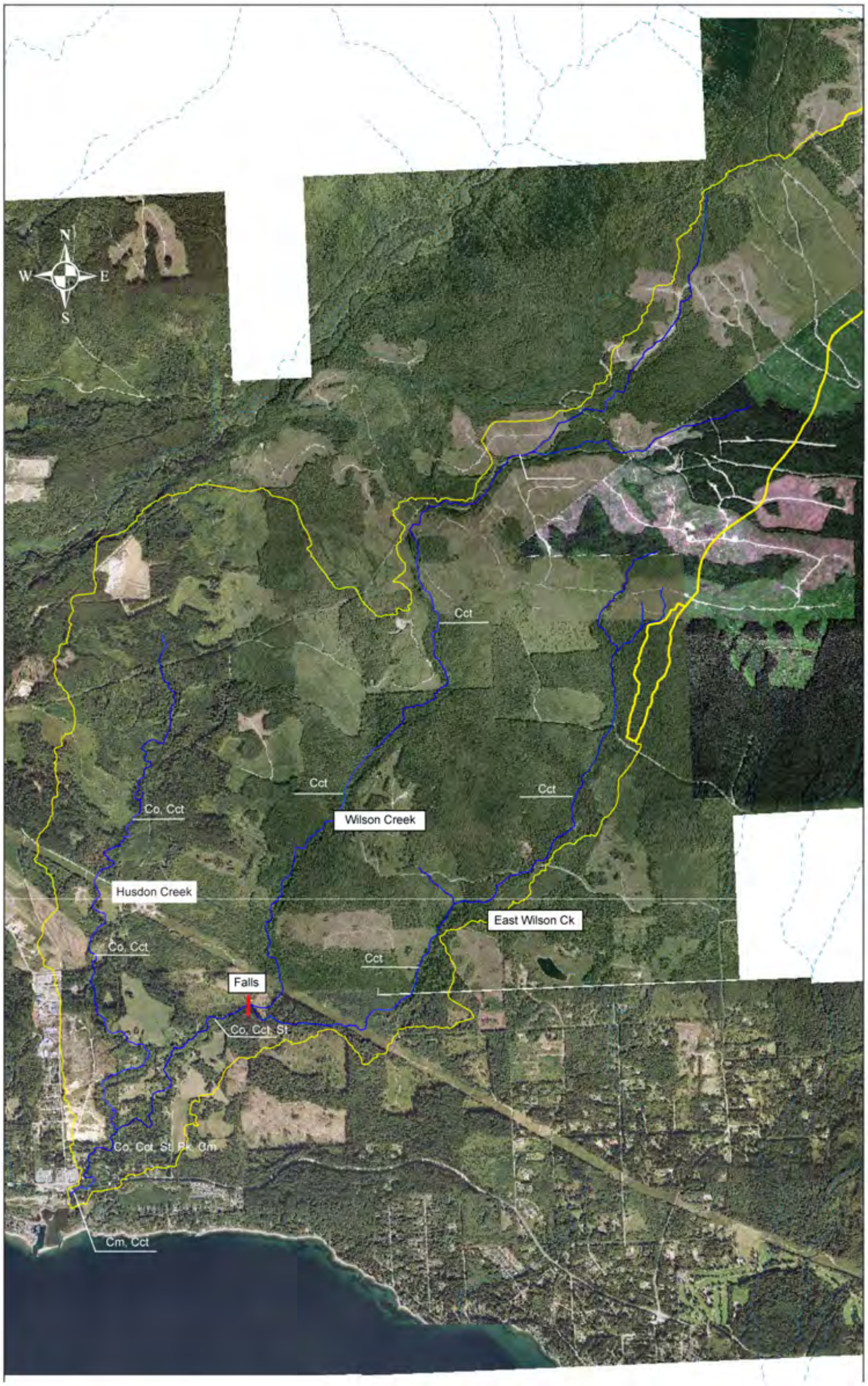


Figure 2: *The Wilson Creek watershed and salmonid distribution shown. Note that the anadromous salmonids are restricted to the lower reaches of Wilson Creek and Husdon Creek.*

In order to understand Wilson Creek salmonid populations and provide some degree of protection; a history of the life cycle, and a description of associated timing should be factored into area development and management planning. The life history of Wilson Creek salmonids is not unique and mirrors known information on timing from other area watersheds (REF). As a reference tool, the generalized life history for the Wilson Creek salmonid populations is presented **Tables III** (Wilson Creek), **IV** (Husdon Creek) and **V** (East Wilson Creek), highlighting key life history events and the approximate timing.

Table III: *Generalized life history table for salmonid species known to utilize stream reaches in Wilson Creek. The timing highlights periods when "critical" events, such as spawning may be interrupted or impacted.*

Species	Life Stage Activity	Month											
		J	F	M	A	M	J	J	A	S	O	N	D
Coho salmon	Adult Migration										■	■	■
	Spawning											■	■
	Incubation	■	■	■	■							■	■
	Rearing	■	■	■		■	■	■	■	■	■	■	■
	Smolt Migration				■	■	■						
Chum salmon	Adult Migration										■	■	
	Spawning										■	■	
	Incubation	■	■	■							■	■	■
	Smolt Migration			■	■								
Pink salmon	Adult Migration								■	■			
	Spawning									■			
	Incubation	■	■							■	■	■	■
	Smolt Migration			■	■								
Steelhead trout	Adult Migration	■	■	■	■								
	Spawning		■	■	■								
	Incubation		■	■	■	■	■						
	Rearing*	■	■	■	■	■	■	■	■	■	■	■	■
	Smolt migration			■	■	■							
Cutthroat trout (Anadromous)	Adult Migration	■	■	■	■					■	■	■	■
	Spawning		■	■	■								
	Incubation		■	■	■	■	■						
	Rearing*	■	■	■	■	■	■	■	■	■	■	■	■
	Smolt migration			■	■	■	■						
Cutthroat trout (Resident)	Spawning			■	■	■							
	Incubation			■	■	■	■	■					
	Rearing	■	■	■	■	■	■	■	■	■	■	■	■

* Anadromous trout rear in Wilson/Husdon Creeks for up to two year before migrating.

Table IV: *Generalized life history table for salmonid species known to utilize stream reaches in Husdon Creek. The timing highlights periods when "critical" events, such as spawning may be interrupted or impacted.*

Species	Life Stage Activity	Month											
		J	F	M	A	M	J	J	A	S	O	N	D
Coho salmon	Adult Migration												
	Spawning												
	Incubation												
	Rearing												
	Smolt Migration												
Cutthroat trout (Anadromous)	Adult Migration												
	Spawning												
	Incubation												
	Rearing*												
	Smolt migration												

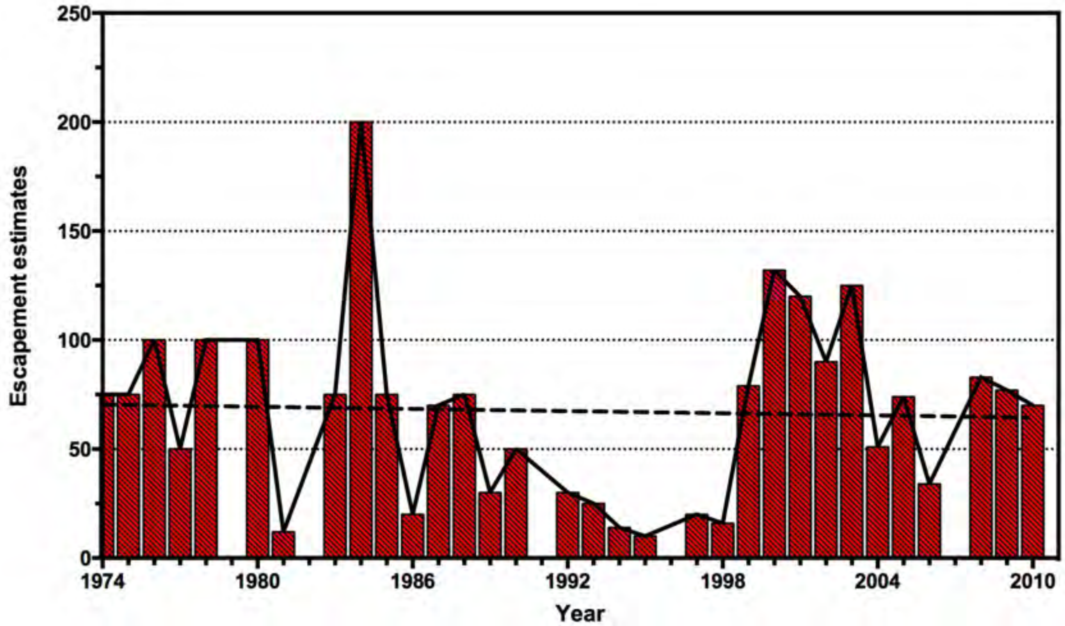
* 2-yr old smolts

Table V: *Generalized life history table for salmonid species known to utilize stream reaches in East Wilson Creek. The timing highlights periods when "critical" events, such as spawning may be interrupted or impacted.*

Species	Life Stage Activity	Month											
		J	F	M	A	M	J	J	A	S	O	N	D
Cutthroat trout (Resident)	Spawning												
	Incubation												
	Rearing												

As discussed above, fisheries information has been collected on Wilson Creek for many years. The most common information reported is annual adult salmon stream counts that date back to the mid 1970's. Unfortunately, only species of concern to Fisheries and Oceans Canada, namely Pacific Salmon were reported, with effort focused on coho and chum salmon. To date there is a good record of escapement for these species. **Figure 3** presents the current record of adult coho and chum salmon escapements within the anadromous length of Wilson Creek (approx. 2.5 km). In general the population appears to be stable albeit cyclical.

Stream condition should not be assessed solely on adult spawner escapement. Adult salmonid escapement, as an indicator, must be interpreted carefully and put into context. The impacts or influence experienced by salmonids in the marine environment should be considered. A stream may provide "ideal" conditions and produce the maximum number of juvenile each year, yet marine conditions such as reduced marine carrying capacity, and annual harvest may adversely influence survival to adult and ultimately the return escapement.



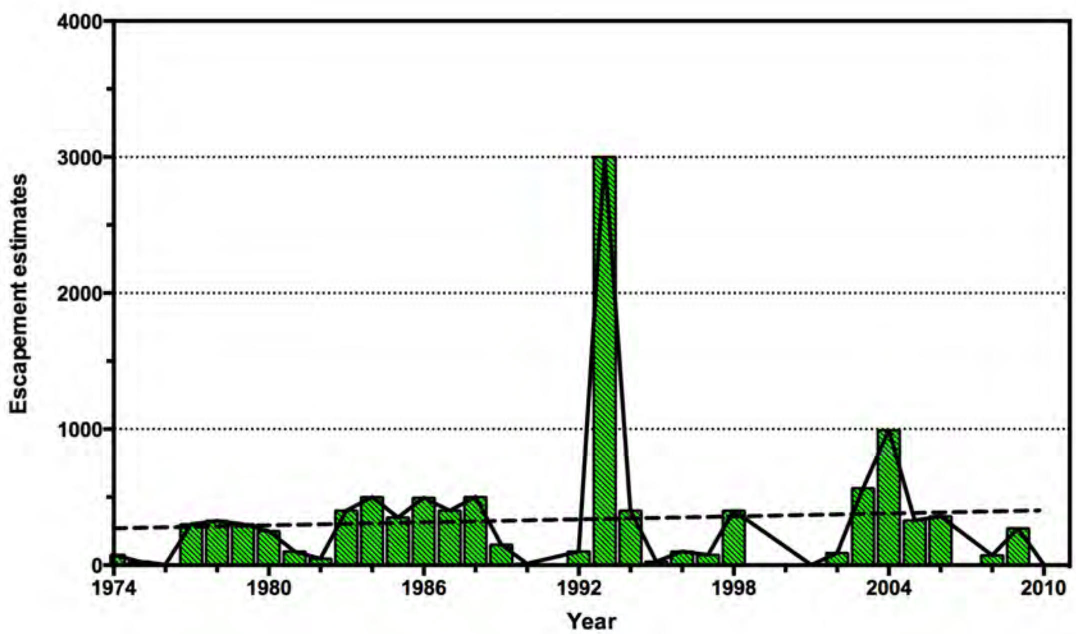


Figure 3: *Adult escapement estimates for Coho (top) and Chum (bottom) salmon in Wilson Creek between 1974 and 2010. Later estimates (late 1990's to present) are based on foot and snorkel surveys conducted between October and December of each year.*

Therefore, while escapement numbers may provide some insight and act as an indicator of a streams success and productivity, it should be tempered with the understanding that the freshwater environments may not be the limiting factor to overall population health. This is illustrated in **Figure 4** where marine survival for Georgia Strait coho is shown for the period 1986 to 2011 (*DFO***,** 2012). The figure shows a significant and steady decline in coho salmon survival over the last 20 years yet the escapement numbers for Wilson Creek appear (**Figure 3**) to be increasing, thereby confounding the use of escapement as a measure of stream condition. In this case, the observed increase may be as simple as the change in documenting escapements, implemented in the early 2000's or it could be an indication of improved habitat and instream conditions. Sufficient data is lacking to draw hard conclusions.

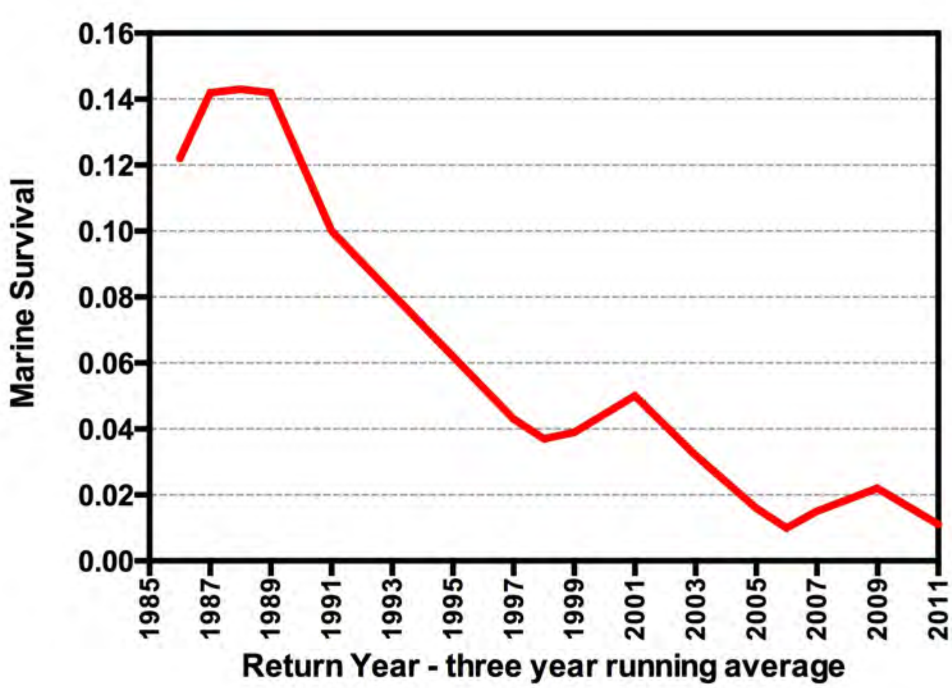


Figure 4: *Wild Coho salmon marine survivals for the Georgia Basin. Adapted from DFO (2012).*

Another metric for assessing Wilson Creek's performance is the estimation of the spawner utilization. Coho salmon provide the best record; using the above escapement numbers. Fisheries and Oceans Canada currently use target coho spawner numbers per stream length to ascertain whether a stream has adequate escapement. In small coastal coho streams a target of between 30 and 60 spawners per kilometer is considered a desirable number (McBain pers comm). This range may vary depending on the quality of habitat. Lower Wilson Creek is considered good coho habitat with abundant, stable and continually replenished spawning gravels. As a result, the number of spawners per kilometer can be compared to the target. **Figure 5** shows estimated spawners per kilometer over the escapement record. Accessible length has not changed because of the falls on Wilson Creek. There is a possibility numbers in Husdon Creek vary but this was omitted in the estimate. The results show that target numbers are achieved about 50% of the time after 2000 and well below prior to 2000.

While this appears to be an improvement when compared to the period prior to 2000, it must again be tempered with the understanding that in 2000 a more rigorous escapement monitoring process was implemented and possibly resulted in “better” estimates.

With these changes in monitoring procedure it is difficult to argue whether the stream conditions have resulted in increased escapement; if marine survival for Wilson Creek coho salmon has improved; or if the information collection methodologies are more thorough. Regardless, the message may be simply that the coho populations based on adult returns appear “stable” based on the most recent generations.

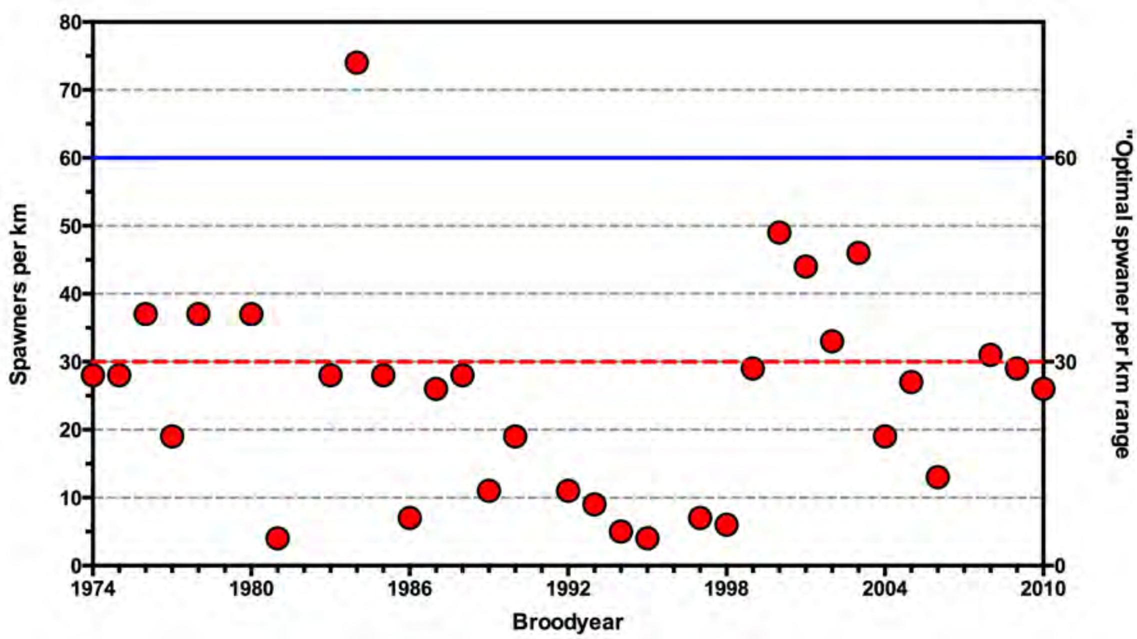


Figure 5: *The estimated spawning numbers per linear distance for Lower Wilson Creek. The range or target is between 30-60 spawners per kilometer.*

The above discussion focuses primarily on coho salmon adults. Detailed information on other species (with the exception of escapement data for chum salmon) does not exist.

With no access to adult escapement for other species, primarily trout, comparing changes in rearing the juvenile and resident populations standing stock may better reflect stream condition. Prior to examining the rearing population status a review of the existing habitats was conducted.

4.0 Fish Habitat

A review of aquatic habitat was conducted for both Wilson and East Wilson Creeks in August and September 2012. Effort focused on the stream reaches that had known fish presence with emphasis on the reaches below the vertical falls and barrier to anadromous fish (**Figure 6**). Husdon Creek was not assessed at this time but all conclusions and recommendations developed for Wilson Creek apply to the Husdon Creek watershed where fish values are high (*Rosenfeld et a*l 2000).

The streams were first divided into lengths of similar physical characteristics. These lengths or "reaches" were determined using recent LiDAR (Light Detection and Ranging) and ortho-photographic information; as well as stream slope and water input information (tributary streams). A stream reach is a length of channel greater than 100-m that is comprised of similar meso-habitat features (*Johnston and Slaney*, 1996; *Hawkins et al*., 1988) and may also be assigned based on fish passage barriers and anthropogenic influences.

Once determined, the reach boundaries were added to the map of the Wilson Watershed (**Figure 6**) and stream longitudinal profiles established (**Figure 7)**. Reach boundaries were then compared to earlier studies and where appropriate a field type and generalized stream channel type were assigned (*Hogan and Bird*, 1996). **Table VI** provides a summary of the stream reaches and channel type.

Table VI: *Summary of general reach characteristics for the reaches within the Wilson Creek watershed.*

Stream	Reach	Lgth (m)	Bf (m)	Slope (%)	Dom /Sub-Dom Substrate	Channel Type*
Wilson Creek	1	1000	7.2	1.5	Gravel/Cobble	RPc-w
	2	1700	8.0	2.6	Cobble/Gravel	RPc-w
	3	3420	7.1	9.5	Cobble/Boulder	RPb-w
	4	3850	6.9	6.1	Boulder/Cobble	CPb-w
	5	1640	4.1	12.8	Boulder/Cobble	CPb
Husdon Creek	1	3600	3.7	3.2	Fines/Gravels	RPg-w
	2	1750	1.3	4.7	Gravel/Fines	RPg-w
East Wilson Creek	1	3750	4.0	5.7	Cobble/Boulder	RPb-w
	2	520	2.9	13.5	Boulder/Cobble	CPb-w
	3	500	2.0	23.0	Boulder/Cobble	SPb-w
	4	210	2.5	11.9	Boulder/Cobble	SPb-w

* *Hogan and Bird* (1996)

Dominant substrate was assigned to bed paving substrate that constituted at least 50% of the observed substrate. This was a qualitative value using substrate sizes in *Johnston and Slaney* (1996).

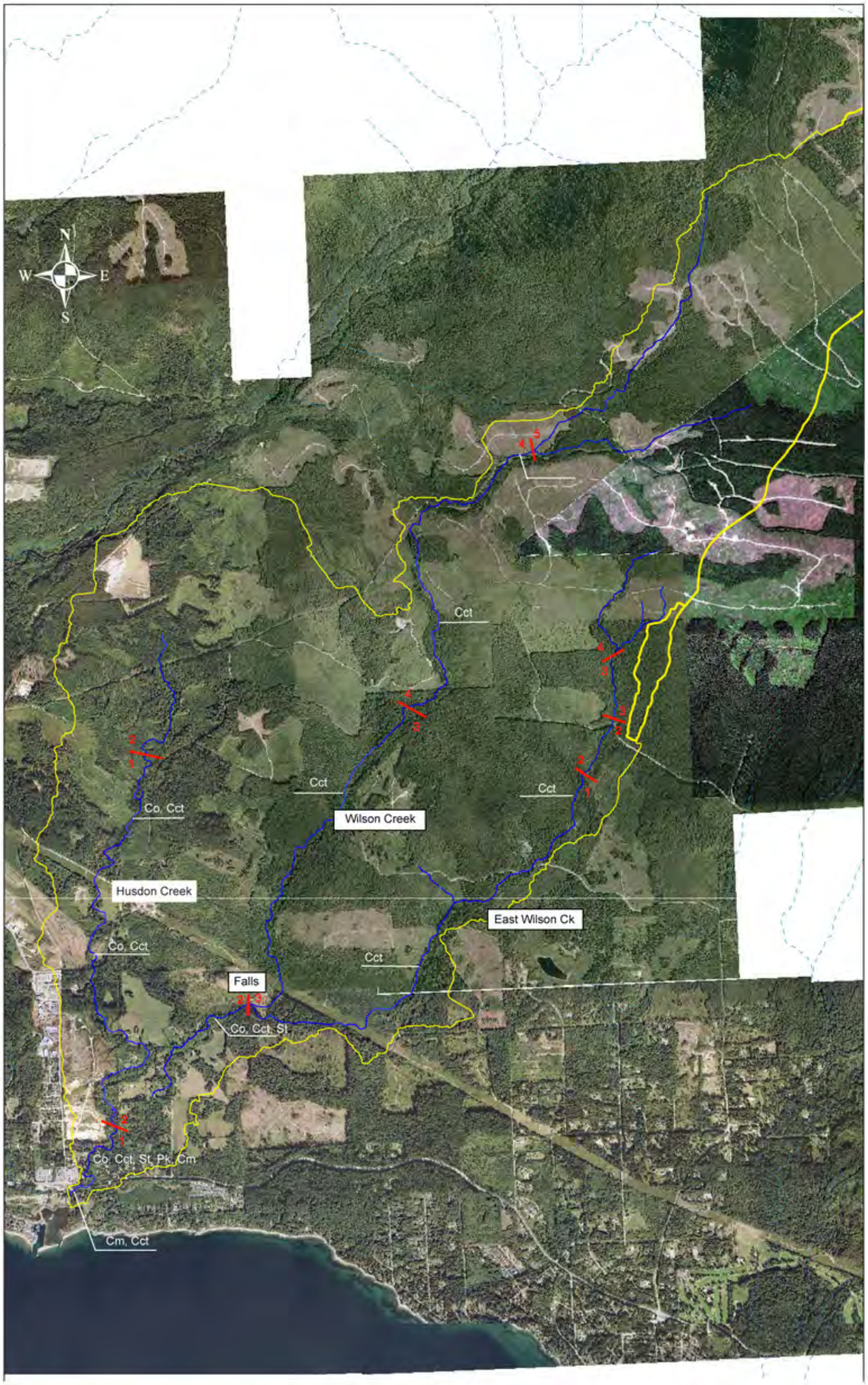


Figure 6: *The Wilson Creek watershed streams and the approximate locations of the assigned stream reaches. Reach designation is based on water inputs (tributary), slope and barriers to migration.*

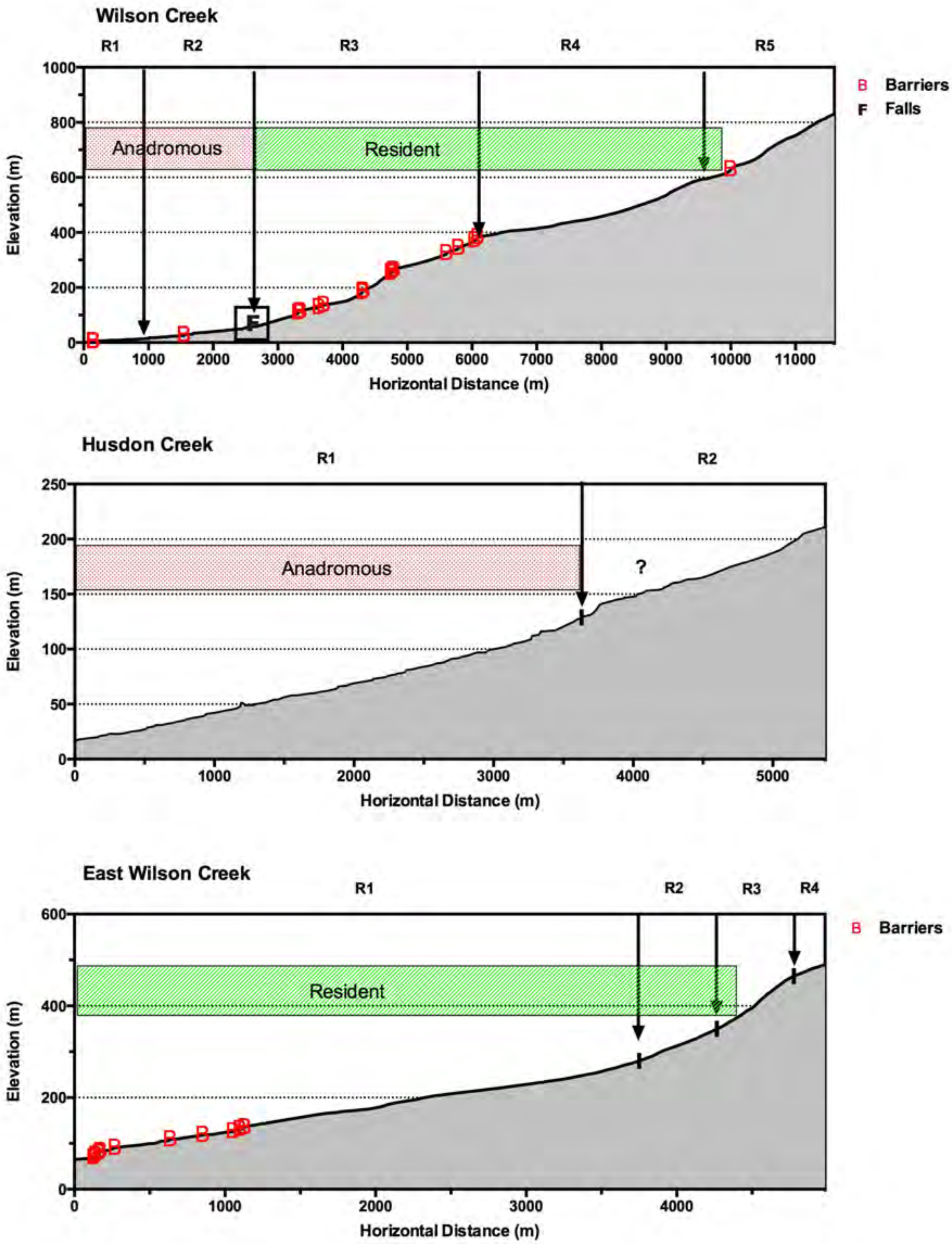


Figure 7: *Longitudinal profile for Wilson, Husdon and East Wilson Creeks. The reach breaks are indicated with a vertical arrow, and barriers and impassable falls are identified. The extent of salmonid distribution is highlighted for each stream.*

In general the habitat observed in Wilson and East Wilson Creeks was considered good. **Figures 8** through **14** show examples of the dominant habitats observed within the associated reach. While localized variation was observed the figures present an image of the majority of the reach habitat.

There were a few areas of concern. In Reach 2 and 3 of Wilson Creek there were lengths of stream impacted by bank change at each location. The cause appeared to be a result of upland anthropogenic influence, identified as:

- Riparian loss on private forest (**Figure 15**),
- Riparian loss along the Hydro ROW (**Figure 16**), and
- Rural developed areas on Reach 1 and 2 of Wilson Creek (**Figure 17**).

Stream complexity in areas of both streams was excellent. Again, there are small areas that have been impacted through access or development but generally the streams observed and measured provided high quality in-stream complexity. In some cases it is this complexity that has helped maintain the meso-habitat features of the creeks.

In order to assess fish habitat on Wilson and East Wilson Creeks a modified Fish Habitat Assessment Procedures (*Johnston and Slaney*, 1996) was conducted. The purpose of the habitat assessment was to compare meso-habitat occurrence with data reported in earlier years. As a result the procedure for collecting data on habitat mirrored earlier data collection.

The habitat data collected in 2012 was collected in three randomly selected areas in Reach 1, 2 and 3 of Wilson Creek and Reach 1 of East Wilson Creek. These same stream lengths were also the areas where rearing salmonids were sampled. The summary data sheets for 2012 are presented in Appendix I while the earlier data is found in *Clarke* (1985), *Ellis* (Unpubl, 1995), and *Bates* (Unpubl, 1997).

In comparing previous conditions to present, a degree of professional judgment is needed. Ideally species such as juvenile coho prefer pool habitat for rearing while avoiding riffle and glides, conversely steelhead juveniles will utilize all mesohabitats and cutthroat trout utilize pool and riffle depending on the age class (*Bisson et al*, 1981). In using a modified FHAP (*Johnston and Slaney*, 1996) it is possible to reduce bias by assigning a value of ranking to key habitat features. If we assume that pool habitat is important to stable rearing the ranking will dictate success.

In evaluating and comparing the condition of the habitat in the target reaches the following criteria are compared (*Johnston and Slaney*, 1996):

- Percentage of pool area
- Pool frequency
- LWD per channel width
- Percent pool cover
- Boulder cover - riffles
- Overhead canopy cover

Figure 8: *Example of the habitat found in Reach 1 on Wilson Creek. Habitat is dominated by suitable spawning gravels and large woody debris LWD creates complexed scour pools. Riparian areas are disturbed as a result of rural development although LWD recruitment appears to occur.*

Figure 9: *Example of the habitat found in Reach 2 on Wilson Creek. Habitat provides suitable spawning gravels and LWD complexed scour pools.*

Figure 10: *Example of the habitat found in lower-Reach 3 on Wilson Creek. Scour pools dominated habitat with extensive lengths of cobble/boulder riffles. Evidence of channel scour was attributed to LWD influence and channel complexity.*

Figure 11: *Example of the habitat found mid-Reach 3 on Wilson Creek. Scour pools dominate habitat with extensive lengths of cobble/boulder riffles. Evidence of channel scour is attributed to LWD influence and channel complexity.*

Figure 12: *Example of the habitat found in upper-Reach 3 on Wilson Creek. Scour pools dominate habitat with extensive lengths of cobble/boulder riffles. Evidence of channel scour is attributed to LWD influence and channel complexity.*

Figure 13: *Example of the habitat found in upper-Reach 2 on East Wilson Creek. Scour pools dominate habitat with extensive lengths of boulder/bedrock control riffles and barriers. Channel scour is attributed to LWD influence and channel complexity.*

***Figure 14**: Example of the habitat found in lower/mid-Reach 1 on East Wilson Creek. Habitat is dominated by boulder and cobble riffles with dammed pools created by LWD. Volume of LWD helps provide stable meso-habitat features and deposition “sinks” for bedload.*

Figure 15: *Compromised riparian canopy on mid-Wilson Creek. The riparian buffer is poorly managed resulting in extensive blow-down. The top photo depicts the area in 2006 while in the lower photo depicts the same general area in 2012. Noted in the lower photo: the conifer riparian has re-established but there will be no future LWD recruitment for any years.*

Figure 16: *Large failing bank between Blower and Tyson Road. The top of the escarpment appears to have been cleared initially for a powerline and possible access. The bank continues to fail contributing large amounts of fine sediment and gravels and large accumulations of LWD.*

Figure 17: *A sediment wedge located upstream of Blower Road in Reach 2 of Wilson Creek. This wedge is dominated with gravels and fine sediments. Sorting is evident with a significant fraction of cobble. Habitat infilling has occurred. It is assumed much of the material has been generated at the Tyson Road failure shown in Figure 16. The material is moving through the system.*

Using these parameters and the diagnostics table adapted from *Johnston and Slaney* (1996) (**Table VII**) calculated values were assigned a simple rating of; Good, Fair and Poor, based on the calculated parameter value. The qualitative outcome was then assigned a numeric value that was added and an average score determined. This final average score was used to assign a condition to the target reach. **Table VIII** is a summary of the results based on the reported habitat assessments.

There are alternative ways of determining the "value" of the aquatic fish habitat in Wilson and east Wilson Creeks. The method chosen was selected because of the simplicity and suitability for comparing previous years, providing a qualitative score. Data compared included the 2012 assessment, 1995 field data, and data from *Clarke* (1985). Copies of the data are included in **Appendix I**.

Table VII: *Diagnostics table for salmonid habitat conditions at the reach level. The table was adapted from Johnston and Slaney (1996).*

Habitat Parameter	Gradient or W_b Class	Use	Quality		
			Poor	Fair	Good
Percent pool (by area)	<2 %, < 15 m wide	Summer/winter rearing habitat	< 40 %	40 - 55%	> 55 %
Percent pool (by area)	2-5 % , < 15 m wide	Summer/winter rearing habitat	< 30 %	30 - 40 %	> 40 %
Percent pool (by area)	>5 % , < 15 m wide	Summer/winter rearing habitat	< 20 %	20 - 30 %	> 30 %
Pool frequency (mean pool spacing)	<2 %, < 15 m wide	Summer/winter rearing habitat	> 4 channel widths per pool	2 - 4 channel widths per pool	< 2 channel widths per pool
Pool frequency (mean pool spacing)	2-5 % , < 15 m wide	Summer/winter rearing habitat	> 4 channel widths per pool	2 - 4 channel widths per pool	< 2 channel widths per pool
Pool frequency (mean pool spacing)	>5 % , < 15 m wide	Summer/winter rearing habitat	> 4 channel widths per pool	2 - 4 channel widths per pool	< 2 channel widths per pool
LWD pieces per bankfull channel width	all	Summer/winter rearing habitat	< 1	1 - 2	> 2
% wood cover in pools	< 5 %, < 15 m wide	Summer/winter rearing habitat	most pools in low category 0 - 5 %	most pools in moderate category 6 - 20 %	most pools in high category > 20 %
Boulder cover in gravel-cobble riffles	all	Summer/winter rearing habitat	< 10 %	10 - 30 %	> 30 %
Overhead cover	all	Summer/winter rearing habitat	< 10 %	10 - 20 %	> 20 %
Substrate	all	Winter rearing habitat	interstices filled: sand or small gravel subdominant in cobble or boulder dominant	interstices reduced: sand subdominant in some units with cobble or boulder dominant	interstices clear: sand or small gravel rarely subdominant in any habitat unit

Table VIII: *Summary of diagnostic results for the reaches compared between the present assessment (2012) and previous years assessments. The overall rating is based on the mean of the parameters compared in the table.*

Reach	% Pools		Pool Frequency		LWD/Bankfull Width		% Wood Cover		Dominant Substrates		% Boulder Cover		% Canopy Cover		Overall Rating	
	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating
Wilson																
2012																
1	27	P	0.8	G	2.1	G	25	G	LG	G	0	P	59	G	2.4	F
2	38	F	0.8	G	2.4	G	25	G	C	F	15	F	53	G	2.6	G
3	54	G	0.5	G	1.5	F	25	G	C/B	G	10	F	73	G	2.7	G
1995																
1	10	P	1.8	G	na	-	11	F	LG	G	7	P	na	-	2.2	F
2	33	F	0.7	G	na	-	33	G	C	G	15	F	na	-	2.6	G
3	na	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1985																
1	26	P	1.1	G	na	-	21	G	LG	G	2	P	na	-	2.2	F
2	51	G	0.7	G	na	-	11	F	C	G	3	P	na	-	2.4	F
3	30	F	1.3	G	na	-	33	G	C/B	G	10	F	na	-	2.6	G
E. Wilson																
2012																
1	50	G	1.1	G	3.2	G	50	G	C/B	G	43	G	70	G	3.0	G
1985																
1	20	F	0.4	G	na	-	5	P	C	G	3	P	na	-	2.0	F

By utilizing this scoring system to describe the current condition of habitat, it appears that both streams have “good” habitat. In comparing the current score to earlier assessments the trend appear to be an improvement between 1985 and 2012.

This method of comparison is coarse, but does support the opinion that the current condition of salmonid habitat in Wilson Creek is generally good, albeit changing with various natural events.

5.0 Salmonid Rearing

The results of the habitat comparison suggest that the current condition of the habitat in the Wilson and East Wilson Creeks is good. Current adult information also suggests that Wilson Creek may be producing adult coho salmon at an expected level. The final comparison examines total biomass density in select target and high-value stream reaches in both Wilson and East Wilson Creeks.

Juvenile and resident salmonid populations were assessed using closed electrofishing techniques. In 2012, a Model LR-24 Smith Root Electrofishing unit was used with a 2-person crew. Sample sites were first identified within the target reaches and isolated at the top and bottom using 6-mm mesh stop-seine nets. Isolation prevented immigration and emigration at the site. This method is consistent with the sampling methods in 1995 and 1985.

The crew approached the sites from the downstream end, upstream in a predetermined pattern. Captured fish were immediately removed from the water and placed in recovery buckets on shore. Minimums of 3-passes were made at each site.

Collected fish were anaesthetized after each pass, and enumerated and sampled individually. Individual species, length (1.0-mm) and weight (0.1-gm) were collected. Fish were then allowed to recover in fresh water and finally released back into the area from which they were captured. Size data is used to determine age classes and these records
were retained for future reference.

Following the sample completion, each isolated area was measured. A length and at least 3 wetted widths were recorded. This provided a sample area for standing stock estimates at the sample sites.

Catch data for each site was then used to estimate the total number of fish rearing at each sample location. The multiple catch methodology assumes consistent catchability and using *Carle and Strub* (1978) a maximum likelihood estimate for N is determined using an iterative process using:

$$T = \sum_{i=1}^{k} C_i$$

$$X = \sum_{i=1}^{k} (k - i) C_i$$

Where:

i = pass number
k = number of removals (passes)
C_i = number of fish caught in ith pass
X = and intermediate statistic used below
T = total number of fish caught in all passes

The estimated N for each sample site was then determined using the iterative process by substituting values for n until:

$$\left[\frac{n+1}{n-T+1}\right]\prod_{i-1}^{k}\left[\frac{kn-X-T+1+(k-i)}{kn-X+2+(k-1)}\right]\leq 1.0$$

Population estimates and the measured weight by age class from each site were then used to determine the average biomass per unit area (grams/m^2). These estimates are plotted and compared to the results reported in 1995 and 1985 (**Figure 18**).

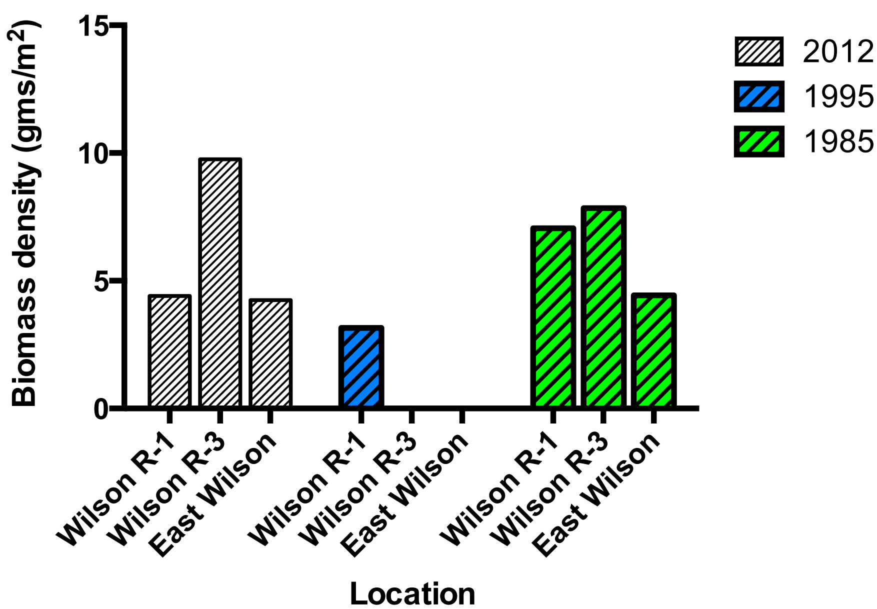


Figure 18: *The estimated rearing salmonid biomass density measured in Reach 1 and 3 of Wilson Creek and Reach 1 on East Wilson Creek and compared to data reported in 1995 and 1985. Errors are not provided, as data sets were limited.*

The information presented in **Figure 18** is an aggregate of all rearing species (lower Wilson) and age classes (all sites) and is not intended to provide detailed age and species breakdown. **Figure 18** provides a comparative snapshot and indication examining whether salmonid rearing, in high value reaches has declined. Given the information provided, it appears the population is sustaining itself. This conclusion must be accepted cautiously as the overall sample size is small and was intended to compare to earlier works that also had limited sample sizes.

6.0 Conclusions

The condition of existing habitat and salmonid populations in Wilson Creek and its tributaries is generally good. There are areas in the watershed that have been impacted through development, but overall the quality and complexity of habitat and salmonid productivity is high. As a result, the following conclusions were derived based on the 2012 assessment.

- Fish habitat observed and measured throughout all reaches of Wilson and East Wilson Creek are generally in good condition. A few areas of impacted riparian forest were noted and may result in future degradation of stream features through loss of large woody debris recruitment. Assuming conifers are the preferred LWD, it may take decades before LWD recruitment occurs naturally. In that period the existing in-channel structure will be lost and a measureable change in habitat can be expected.

  Areas that have been identified as having "impacted" and/or poorly functioning riparian canopy include an area of private forest lands on upper Wilson Creek; linear development on mid Wilson and East Wilson Creeks; and rural development on lower Wilson and Husdon Creek. In these areas the riparian canopy was removed. These areas are suffering from inadequate age class structure, windfall loss or have been cleared for rural development. The impacted areas were not the "norm" and overall the riparian canopy along all three creeks was considered good.

- There were limited examples of channel instability found during the field assessment. On lower Wilson Creek a significant slope failure between Tyson and Blower Roads was noted. This failure appears to be a result of upslope development activity. Ideally a terrain specialist would be consulted to suggest methods to stabilize. This failure contributes sands, gravels and limited large woody debris downstream.

  Any other significant failures observed were considered "natural" and appeared indicative of the topography.

- In the length of stream between Blower and Tyson Roads a length of significant sediment deposition was noted. This material dominated by small cobble, gravels and sand appears to have resulted from the upstream bank failure discussed above. Given the nature of the material, it is expected this sediment wedge will continue to migrate downstream with high water events. The result will be continual replenishment of materials suitable for spawning. There should be some expected infilling of pool habitats but this is expected to be transient as channel scour and infilling continues.

This sediment wedge does pose two immediate concerns. At its current location the material have reduced the existing channel capacity. There is a risk that the reduced capacity may result in more frequent inundation of the area floodplain resulting in Wilson Creek spilling onto adjacent properties. While a concern for landowners, it is unlikely to have a significant negative impact on fish and fish habitat.

The second concern is that this material may eventually create a larger infill at a failed bridge crossing below Blower Road and again at the Highway 101 culvert where the channel capacity has been reduced by physical structures. Channel deposition resulting from the highway crossing is evident.

Fisheries and Oceans Canada has been notified of both locations and will track bedload movement/buildup during adult escapement surveys.

- Salmonid distribution extends throughout the length of all three streams. In the case of anadromous salmonids, the distribution is restricted to the lower 2 reaches on Wilson Creek and the majority of Husdon Creek.

- Review of limited adult escapement data for coho and chum salmon from lower Wilson Creek show little change between 1974 and 2010. Variation in escapement numbers may be a result of poor ocean survival rather than freshwater production. This is purely speculative, as no smolt migration data exists for Wilson Creek.

- The number of spawning coho per kilometer is less than “ideal” and may be a reflection of reduced ocean survival or interception of adult coho. When reviewing the records from 2000 to 2010 spawner density appears to improve. This may be a result of more diligent spawner escapement assessment implemented by DFO in 2000.

- The upper, non-anadromous reaches of Wilson and East Wilson Creek are colonized by non-anadromous, resident coastal cutthroat trout. These are small headwater fish that likely have a life cycle lasting up to five years. The presence of young-of-the-year (YOY) supports the conclusion that this population is viable, reproducing and self-sustaining.

- The presence of various age classes both in the lower, anadromous and upper non-anadromous reaches suggest preferred habitats exists for all life stages. There were no obvious bottlenecks to production with the exception of low summer flows and when compared to data from 1985, the biomass density is similar and likely not statistically different. Data limitations prevent a more rigorous evaluation.

under-seeded as a result of reduced adult escapement (Bates Unpubl. Data collected with the SIB).

- Low summer flows, by rain and run-off dictate the available in-stream rearing habitat in all three streams. These natural low summer flows are considered the regulating factor to juvenile salmonid production in the anadromous reaches and cutthroat trout production in the non-anadromous reaches.

7.0 Recommendations

The review of the Wilson Creek watershed suggests that, the state of fish and fish habitat is good; despite development pressures on various reaches resulting in localized areas of impact. Overall, development within Wilson Creek appears to provide adequate protection. To ensure this continues the following recommendations are presented for consideration:

- Well-established riparian protection buffers must be implemented and maintained throughout the length of Wilson Creek and its tributaries. This should include both public and private forestlands. It is recognized that on private forestlands this may be an issue but the overall health of resident cutthroat trout populations depends on well maintained and functioning riparian corridors.

  On public lands governed by the Forest and Range Protection Act (FRPA) at least 20-30-m Riparian Reserve Zone (RRZ) and 20-m Riparian Management Zone (RMZ) is required on most reaches of the three streams. This appears to vary further upslope. Given the nature of the terrain in some areas, and the importance of the riparian to maintaining the quality habitat, it is recommended that adjacent development maximize the RRZ and exceed the minimum RMZ setbacks. This is more critical on steeper sided stream channels where the regulations may protect trees and riparian on the slope but leave them exposed at the break in slope and increased blow-down.

- Areas throughout the Wilson Creek watershed are prone to blow-down. In areas observed along the right-of-way and private forestlands, losses of remaining riparian can be found. It is recommended that wherever possible, the RRZ is maximized and wind-firmed. It is also recommended that these treated areas be assessed pre and post harvest. The losses, including any un-foreseen affects on watercourses, must be adequately documented. The goal is to “raise the bar” and better understand successful wind firming methods for this area while protecting the riparian corridors. Maintenance and protection of the riparian corridors must be a priority to ensure Wilson Creek and its tributaries continue to be high value habitat.

- On private lands within the Sunshine Coast Regional District (SCRD) and District of Sechelt (DoS), the Riparian Area Regulations (RAR) is

- On private lands within the Sunshine Coast Regional District (SCRD) and District of Sechelt (DoS), the Riparian Area Regulations (RAR) is applicable. The RAR ensures any new or re-development proposed within 30-m of the bankfull edge complete a Riparian Area Assessment (RAA) and the subsequent establishment of a Streamside Protection and enhancement area (SPEA). This SPEA can be as large as 30-m and requires the area be left to regenerate "naturally". These regulations should be enforced and where appropriate monitored.

- There is little evidence to support the hypothesis that lower bank failures (Reach 2 – Wilson Creek) have resulted from upstream forest practices (*Horel*, 2012). Regardless, it may be beneficial to work with landowners in an effort to stabilize areas of concern and monitor channel "change" through this stream reach.

  While no instream works are recommended without prior consultation with the appropriate professionals, the SCCF can help direct property owners to the appropriate agencies and professionals.

- It is recommended to establish "permanent" monitoring sites above and below a pre-determined operational area. A monitoring program developed by the appropriate professional(s) and structured to include community stewardship groups such as "Stream Keepers" is encouraged. In many high-profile "developments" monitoring is considered a necessity and designed so that data collected can be defended with the appropriate level of statistical rigor.

  As an example we have developed monitoring programs that rely on a variety of metrics selected from valued ecosystem components. Developed plans can monitor fish, amphibians or macroinvertebrate populations, water chemistry (temperature, nutrients), channel morphology or riparian health/development.

8.0 References

Bates, D.J., 2000.Comparison of select life history features in wild versus hatchery coastal cutthroat trout (*Oncorhynchus clarki clarki*) and the implications towards species fitness. Doctoral Dissertation, Simon Fraser University.

Carle, F.L. and Strub, M.R. 1978. Method for estimating population size from removal data. Biometrics. 33(4): 521-630.

Clarke, B. 1985. Salmonid populations of Wilson Creek. BC Ministry of Environment. Surrey, BC.

DFO, 2012. 2011 Marine Survival Forecast of Southern British Columbia coho. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/037.

Harding, E.A. and Erickson, L.J. 1975. An inventory of streams on the Sechelt Peninsula. Inventory Section. BC Fish and Wildlife Branch, Victoria, B.C.

Hogan, D.L. and Bird, S.A. 1995. Channel assessment procedure. BC Ministry of Environment, Lands and Parks and BC Ministry of Forests. WRP Tech Circular No. 7, Victoria BC.

Horel, G. 2012. Wilson Creek watershed assessment. Prepared for Sunshine Coast Community Forest. Sechelt, BC.

Slaney, P. and Roberts, J. 2005. Coastal cutthroat trout as sentinels of the lower mainland watershed health. Strategies for coastal cutthroat trout conservation, restoration and recovery. B.C. Ministry of Environment, Lower Mainland Region 2, Surrey, B.C.

Johnston, N.T. and Slaney, P.A. 1996. Fish habitat assessment procedures. Watershed Restoration Technical Circular No. 8. Watershed Restoration Program. B.C. Ministry of Environment, Lands and parks and Ministry of Forests. Victoria, B.C.

Hawkins, C.P., Kershner, J.L., Bisson, P.A., Bryant, M.D., Decker, L.M., Gregory, S.V., McCullough, D.A., Overton, C.K., Reeves, G.H., Steedman, R.J. and Young, M.K. 1993. A hierarchical approach to classifying stream habitat features. Fisheries 18:3-12.

Rosenfeld, J.S., Porter, M., and Parkinson, E. 2000. Habitat factors affecting the abundance and distribution of juvenile cutthroat trout (*Oncorhynchus clarki*) and coho salmon (*Oncorhynchus kisutch*). Can. J. Fish. Aquat. Sci. **57**(4): 766–774. doi:10.1139/f00-010.

9.0 Closure

Services performed by ***FSCI*** Biological Consultants for this report have been conducted in a manner consistent with the level of skill ordinarily exercised by members of the fisheries profession practicing under similar conditions in the area in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this report. No warranty or guarantee, express or implied is made concerning the results, comments, recommendation, or any other part of this report.

Respectfully submitted,

D. Bates, Ph.D., R.P.Bio.
Biologist

10.0 Appendices

15.4 Bfw.

Fish Habitat Survey

Date	14/08/2012	Reach No.:	1	Crew:	JW/DB	Reach Length:	151.2
Stream Name:	Wilson Creek	Weather:	Clear	Time:	830	Temperature:	15
WSC:	900-119900					Total Reach Lgth	1700

	%
Pool	26.69
Riffle	40.92
Glide	32.39

Unit #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total	Mean
Unit Type:	R	P	P	R	G	P	R	P	G	R	G	P										
Grad %	2	0	0	2	1	0	3	0	1	3	0	0										1.00
Lgth (m)	11.5	5	17.4	8.1	16.9	5.6	8.3	17.5	22.4	21.1	5.7	11.7									151.2	
Ww (m)	5	4	3.6	8.3	5	2.5	9.4	3.9	5.6	4.5	4.5	2.5										4.90
Bfw (m)	8.3	11.1	11.1	13.7	8.1	7.1	11.4	8.9	9.2	11.8	9.8	7.5										9.83
Wet Area	57.5	20.0	62.6	67.2	84.5	14.0	78.0	68.3	125.4	95.0	25.7	29.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	727.4	
Bankfull Area	95.5	55.5	193.1	111.0	136.9	39.8	94.6	155.8	206.1	249.0	55.9	87.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1480.8	
Bankfull Depth	0.55	0.80	0.85	0.40	0.60	0.60	0.40	0.80	0.60	0.50	0.55	0.70										0.61
Average Depth	0.15	0.53	0.50	0.09	0.30	0.30	0.10	0.40	0.30	0.20	0.25	0.40										0.29
P Max Dpth (m)	0	0.5	0.7	0	0	0.75	0	0.6	0	0	0	0.5										
Crest Ht.	0	0.15	0.2	0	0	0.12	0	0.1	0	0	0	0.05										
Res. depth	0	0.35	0.5	0	0	0.63	0	0.5	0	0	0	0.45	0	0	0	0	0	0	0	0		
Pool type		sc	sc			sc		sc				d										
LWD																						
Total LWD	2	1	3	0	7	2	2	5	4	8	0	1									35	
Func LWD	2	1	3	0	6	2	2	5	3	8	0	1									33	
																					0	
Cover																						
In. Boulder (%)	0	0	0	0	0	0	0	0	0	0	0	0										
In. Veg. (%)	0	0	0	0	0	0	0	0	0	0	0	0										
Ov. Veg (%)	20	5	10	0	25	5	0	0	0	10	0	20										
Canopy Cover (%)	40	40	80	40	80	80	50	50	50	30	90	90										
Cutbanks (%)	10	10	10	5	10	5	0	20	10	10	0	30										
Off Channel																						
Type																						
Access																						
Length																						
Bed Type (%)																						
Fines	10	30	30	5	15	20	5	40	10	5	10	20										
Sm. Gravel	20	30	30	35	40	30	25	20	40	25	20	40										
Lg. Gravel	60	40	40	50	40	40	50	40	40	60	60	40										
Cobbles	0	0	0	10	5	10	20	0	10	5	10	0										
Boulder	0	0	0	0	0	0	0	0	0	5	0	0										
Bedrock	0	0	0	0	0	0	0	0	0	0	0	0										
Velocity																						#DIV/0!
Spawning (%)	60	40	60	60	60	30	20	10	30	60	60	35										
Total Area	34.50	8.00	37.58	40.34	50.70	4.20	15.60	6.83	37.63	56.97	15.39	10.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	318.0	
D_{90}																						
D_{MAX}																						
% Pool (Cascade)																						
Pool Est (Cas)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

2.53

11.5/ 1.2

8.1/ 0.82

16.9/ 1.72

8.3/ 0.94

22.4

21.1

9.83

5.7

5.00
0.94
1.2
2.53

2.4

FSCI Biological Consultants

Fish Habitat Survey

Date	14/08/2012	Reach No.:	2	Crew:	JW/DB
Stream Name:	Wilson Creek	Weather:	Clear	Time:	1200
WSC:	900-119900				

Reach Length:	131.1
Temperature:	15
Total Reach Lgth	1700

Unit #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total	Mean
Unit Type:	P	R	G	P	R	P	R	G	P	R	P	G										
Grad %	1	4	0	0	2	0	3	1	0	5	0	1										1.42
Lgth (m)	7.3	26.8	6.8	10.3	8.7	12.6	14.6	11.7	5.6	3	13.2	10.5									131.1	
Ww (m)	4.3	6	5.6	4.4	3.5	4.5	3.8	3.6	3.8	8.7	6.2	2.4										4.73
Bfw (m)	6.2	11.7	11.7	6.2	6.5	8.2	9.2	9.7	10.2	10.2	9.3	6.7										8.82
Wet Area	31.4	160.8	38.1	45.3	30.5	56.7	55.5	42.1	21.3	26.1	81.8	25.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	614.8	
Bankfull Area	45.3	313.6	79.6	63.9	56.6	103.3	134.3	113.5	57.1	30.6	122.8	70.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1190.8	
Bankfull Depth	0.75	0.35	0.50	0.60	0.55	0.80	0.50	0.75	0.70	0.70	1.20	0.65										0.67
Average Depth	0.35	0.15	0.20	0.40	0.15	0.40	0.10	0.25	0.40	0.10	0.08	0.25										0.24
P Max Dpth (m)	0.45	0	0	0.55	0	0.7	0	0	0.45	0	1.2	0										
Crest Ht.	0.1	0	0	0.1	0	0.1	0	0	0.1	0	0.1	0										
Res. depth	0.35	0	0	0.45	0	0.6	0	0	0.35	0	1.1	0	0	0	0	0	0	0	0	0		
Pool type	sc			sc		sc			sc		sc											
LWD																						
Total LWD	0	2	3	10	1	10	1	5	6	0	10	2									50	
Func LWD	0	1	2	10	1	10	1	1	5	0	5	0									36	
																					0	
Cover																						
In. Boulder (%)	20	30	5	5	20	0	5	0	0	5	0	0										
In. Veg. (%)	0	0	0	0	0	0	0	0	0	0	0	0										
Ov. Veg (%)	5	5	5	0	0	10	0	10	0	0	60	0										
Canopy Cover (%)	70	60	50	40	40	40	40	60	60	60	60	60										
Cutbanks (%)	0	0	0	5	0	20	0	10	10	0	20	10										
Off Channel																						
Type																						
Access																						
Length																						
Bed Type (%)																						
Fines	25	5	10	30	5	30	0	5	25	0	30	10										
Sm. Gravel	20	20	20	20	15	50	40	50	15	10	25	30										
Lg. Gravel	20	35	40	30	40	20	50	30	40	30	25	30										
Cobbles	20	20	25	15	25	0	10	15	20	60	15	20										
Boulder	25	20	5	5	10	0	0	0	0	0	5	10										
Bedrock	0	0	0	0	5	0	0	0	0	0	0	0										
Velocity																					#DIV/0!	
Spawning (%)	5	0	10	10	0	50	20	5	10	0	30	5										
Total Area	1.57	0.00	3.81	4.53	0.00	28.35	11.10	2.11	2.13	0.00	24.55	1.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	79.4	
D_{90}																						
D_{MAX}																						
%Pool (Cascade)																						
Pool Est (Cas)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

8.8

14.85

Pool
Riffle
Glide

FSCI Biological Consultants

Fish Habitat Survey

Date	13/08/2012	Reach No.: 3	Crew: JW/DB	Reach Length: 71.8
Stream Name:	Wilson Creek	Weather: Clear	Time: 1200	Temperature: 15
WSC:	900-119900			Total Reach Lgth 3420

451297 5481305

	%
Pool	53.98
Riffle	46.02
Glide	0.00

12.76

Unit #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total	Mean
Unit Type:	R	P	R	P	R	P	R	P	R	P	R	P										
Grad %	1	0	5	0	3	0	3	0	5	1	5	1										2.00
Lgth (m)	2.7	10	11.1	7	4.3	4.2	5.7	6.2	4.8	4.6	8.7	2.5									71.8	
Ww (m)	1.8	2.7	2.4	3	1.5	2.1	2	5.4	3.2	2.1	2.8	1.8										2.57
Bfw (m)	3.5	4.3	6.9	4.7	5.2	5.7	4.1	6.9	8.3	6	6.5	5.6										5.64
Wet Area	4.9	27.0	26.6	21.0	6.5	8.8	11.4	33.5	15.4	9.7	24.4	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	193.5	
Bankfull Area	9.5	43.0	76.6	32.9	22.4	23.9	23.4	42.8	39.8	27.6	56.6	14.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	412.4	
Bankfull Depth	0.47	0.40	0.29	0.50	0.38	0.45	0.27	1.40	0.50	0.90	0.50	0.90										0.58
Average Depth	0.07	0.40	0.09	0.40	0.08	0.20	0.07	0.65	0.08	0.20	0.10	0.15										0.21
P Max Dpth (m)	0	0.6	0	0.65	0	0.22	0	0.8	0	0.3	0	0.2										
Crest Ht.	0	0.1	0	0.15	0	0.08	0	0.05	0	0.08	0	0.05										
Res. depth	0	0.5	0	0.5	0	0.14	0	0.75	0	0.22	0	0.15	0	0	0	0	0	0	0	0		
Pool type		sc		sc		sc		d		sc		sc										
LWD																						
Total LWD	1	4	0	2	0	1	2	4	0	7	2	0									19	
Func LWD	1	4	0	2	0	1	2	4	0	4	2	0									16	
																					0	
Cover																						
In. Boulder (%)	5	5	10	20	10	5	20	5	5	20	10	20										
In. Veg. (%)	0	0	0	0	0	0	0	0	0	0	0	0										
Ov. Veg (%)	10	5	5	10	0	5	20	5	0	0	5	0										
Canopy Cover (%)	80	50	50	80	80	80	80	80	80	80	70	70										
Cutbanks (%)	0	10	0	15	0	5	0	10	0	0	0	0										
Off Channel																						
Type																						
Access																						
Length																						
Bed Type (%)																						
Fines	5	10	5	10	5	10	0	5	10	0	0	0										
Sm. Gravel	10	20	20	20	30	20	20	25	30	20	20	30										
Lg. Gravel	5	30	40	20	40	30	20	30	30	30	30	30										
Cobbles	70	35	30	30	20	40	40	40	25	20	30	20										
Boulder	10	5	15	20	5	0	20	0	5	30	20	20										
Bedrock	0	0	0	0	0	0	0	0	0	0	0	0										
Velocity																						#DIV/0!
Spawning (%)	0	5	5	10	0	0	0	10	0	20	5	20										
Total Area	0.00	1.35	1.33	2.10	0.00	0.00	0.00	3.35	0.00	1.93	1.22	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.2	
D_{90}																						
D_{MAX}																						
% Pool (Cascade)																						
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

July, 1995 Habitat Assessment Summary
Wilson Cr
Reach # 2 Reach length 1620 Sample length 143

# of POOLS	4	# in reach	45.3		Sample	Average		Reach
Unit #	4	5	9	11	Total	%	value	Total
Length	3.1	5.3	4.8	5.6	18.8	13.1	4.7	213
W.width	4.5	2.4	4.1	4.4	15.4		3.9	
Area	14	13	20	25	72	10	18	815
Depth	0.24	0.31	0.33	0.24			0.28	
Velocity	0.09	0.06	0.14	0.09			0.10	
Log	7.0	10.0	20.0	7.0		11.0	2.0	89.7
Boulder	1.0	2.0	5.0	2.0		2.5	0.5	20.4
Veg O	0.0	10.0	10.0	2.0		5.5	1.0	44.8
Cutbanks	0.0	10.0	15.0	15.0		10.0	1.8	81.5
Fines	40	20	10	20		23	4	183
S.gravel	20	30	20	35		26	5	214
L.gravel	10	25	25	25		21	4	173
Cobbles	20	15	25	10		18	3	143
Boulder	10	10	20	10		13	2	102
Bedrock	0	0	0	0		0	0	0

# of RIFFLES	5	# in reach	56.6			Sample	Average		Reach
Unit #	2	6	8	10	12	Total	%	value	Total
Length	53.3	7.0	7.1	20.3	4.9	92.6	64.7	18.5	1048
W.width	5.9	5.2	5.2	6.7	2.6	25.6		5.1	
Area	314	36	37	136	13	536	75	107	6068
Depth	0.11	0.10	0.11	0.15	0.13			0.12	
Velocity	0.18	0.25	0.33	0.25	0.33			0.27	
Log	0.0	0.0	0.0	1.0	0.0		0.2	0.2	12.1
Boulder	5.0	4.0	5.0	5.0	10.0		5.8	6.2	351.9
Veg O	1.0	0.0	0.0	0.0	0.0		0.2	0.2	12.1
Cutbanks	0.0	0.0	0.0	1.0	0.0		0.2	0.2	12.1
Fines	15	10	10	5	1		8	9	498
S.gravel	20	20	20	20	20		20	21	1214
L.gravel	25	20	30	30	20		25	27	1517
Cobbles	25	30	25	30	34		29	31	1748
Boulder	15	20	15	15	25		18	19	1092
Bedrock	0	0	0	0	0		0	0	0

# of GLIDES	3	# in reach	34.0	sample	Average		Reach
Unit #	1	3	7	Total	%	value	Total
Length	8.1	14.5	9.1	31.7	22.2	10.6	359
W.width	2.8	2.9	4.6	10.3		3.4	
Area	23	42	42	107	15	36	1211
Depth	0.16	0.17	0.10			0.14	
Velocity	0.13	0.14	0.14			0.14	
Log	5.0	2.0	4.0		3.7	1.3	44.4
Boulder	2.0	5.0	1.0		2.7	1.0	32.3
Veg O	0.0	1.0	20.0		7.0	2.5	84.8
Cutbanks	0.0	0.0	7.0		2.3	0.8	28.3
Fines	10	15	5		10	4	121
S.gravel	20	25	35		27	10	323
L.gravel	30	25	30		28	10	343
Cobbles	25	25	25		25	9	303
Boulder	15	10	15		13	5	162
Bedrock	0	0	0		0	0	0

September 1995 Habitat Assessment Summary

Wilson Cr

Reach # 3 Reach length 550 Sample length 64

# of POOLS	5	# in reach	43.0			Sample	Average		Reach
Unit #	3	5	8	10	12	Total	%	value	Total
Length	2.6	3.8	5.4	1.8	7.1	20.7	32.4	4.1	178
W.width	2.1	5.5	6.8	2.5	3.8	20.7		4.1	
Area	6	21	37	4	27	95	33	19	818
Depth	.32	.30	.33	.42	.71			0.42	
Velocity	.13	.12	.20	.08	.10			0.13	
Log	5.0	40.0	40.0	50.0	30.0		33.0	6.3	269.8
Boulder	5.0	5.0	5.0	10.0	0.0		5.0	1.0	40.9
Veg O	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Cutbanks	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Fines	30	10	20	0	30		18	3	147
S.gravel	20	25	30	15	30		24	5	196
L.gravel	20	25	30	5	30		22	4	180
Cobbles	10	5	5	0	5		5	1	41
Boulder	10	5	5	5	5		6	1	49
Bedrock	10	30	10	85	0		27	5	221

# of RIFFLES	5	# in reach	43.0			Sample	Average		Reach
Unit #	1	4	7	9	11	Total	%	value	Total
Length	11.5	4.5	6.0	5.0	2.9	29.9	46.8	6.0	257
W.width	5.3	5.6	7.9	2.0	3.2	24.0		4.8	
Area	61	25	47	10	8	151	52	30	1300
Depth	.19	.12	.12	.11	.19			0.15	
Velocity	.11	.33	.18	.20	.17			0.20	
Log	0.0	10.0	5.0	10.0	20.0		9.0	2.7	117.0
Boulder	30.0	30.0	10.0	5.0	0.0		15.0	4.5	195.0
Veg O	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
Cutbanks	0.0	2.0	5.0	0.0	0.0		1.4	0.4	18.2
Fines	10	5	20	20	5		12	4	156
S.gravel	15	10	15	30	10		16	5	208
L.gravel	20	15	15	30	40		24	7	312
Cobbles	20	25	10	5	40		20	6	260
Boulder	30	40	10	5	5		18	5	234
Bedrock	5	5	30	10	0		10	3	130

# of GLIDES	2	# in reach	17.2	sample	Average		Reach
Unit #	2	6		Total	%	value	Total
Length	5.7	7.6		13.3	20.8	6.7	114
W.width	2.8	3.6		6.4		3.2	
Area	16.0	27.0		43	15	22	370
Depth	.19	.18				0.19	
Velocity	.20	.08				0.14	
Log	5.0	0.0			2.5	0.5	9.3
Boulder	5.0	0.0			2.5	0.5	9.3
Veg O	0.0	0.0			0.0	0.0	0.0
Cutbanks	0.0	0.0			0.0	0.0	0.0
Fines	30	25			28	6	102
S.gravel	20	25			23	5	83
L.gravel	20	20			20	4	74
Cobbles	10	5			8	2	28
Boulder	10	5			8	2	28
Bedrock	10	20			15	3	56

WILSON CREEK REACH 4

HABITAT DESCRIPTION FORM

	CONSECUTIVE HABITAT TYPES					
1. Stream and Code						
2. Reach # and Gradient (from map)	4	4	4	4	4	4
3. Reach length (km)						
4. Habitat Class	Ri	Run	Ri	P	Run	P
5. Length (m) Section	3.5	16.0	6.2	5.4	4.6	4.5
6. Wetted Width (m)	3.25	3.8	1.0	3.8	4.1	3.8
7. Channel Width (m)	7.5	7.5	4.0	7.0	6.0	6.0
8. Area (m^2)	11.38	60.80	6.20	20.52	18.86	17.10
9. $\bar{x}$ Depth (m)	0.05	0.18	0.03	0.4	0.10	0.20
10. Velocity (cm/s)	—	—	—	—	—	-
11. Instream log (m^2) x depth (m)	/	/	/	/	/	/
12. Instream Boulder Cover (%)	5	<5	10	5	10	5
13. Instream Vegetation (m^2)	/	/	/	/	/	/
14. Overstream Vegetation (m^2)	/	/	2.0	/	2.0	/
15. Cutbanks (m^2)	0					
16. Turbidity (m)	.99					
17. Gradient %	7%	2	7	0.5	5	0.5
18. Fines	0	5	0	30	0	10
19. Small Gravel	5	10	40	35	10	20
20. Large Gravel	20	60	20	20	30	35
21. Cobbles	25	5	10	5	20	25
22. Boulders	50	20	30	10	40	5
23. Bedrock	0					
24. Compaction	1					
25. T^oC	4.0°C					
26. Time	1030					
	85.10.09					

WILSON CREEK.

HABITAT DESCRIPTION FORM

	CONSECUTIVE HABITAT TYPES					
1. Stream and Code						
2. Reach # and Gradient (from map)	4	4	4	4	4	4
3. Reach length (km)						
4. Habitat Class	R	G	Run	P	G	R
5. Length (m) Section	7.1	13.5	3.9	4.1	12.0	2.0
6. Wetted Width (m)	1.0	3.3	1.2	4.2	1.8	1.0
7. Channel Width (m)	6.0	6.0	6.0	5.0	8.0	8.0
8. Area (m^2)	7.10	44.55	4.68	17.22	21.60	2.00
9. $\bar{x}$ Depth (m)	0.09	0.25	0.15	0.20	0.15	0.08
10. Velocity (cm/s)						
11. Instream log (m^2) x depth (m)	—	3.0x0.1	—	—	20x0.3	—
12. Instream Boulder Cover (%)	<5	20	<5	15	0	0
13. Instream Vegetation (m^2)	—	—	—	—	—	—
14. Overstream Vegetation (m^2)	—	8.0	2.0	5.0	5.5	0.5
15. Cutbanks (m^2)	0	0	0	0	3.0	0
16. Turbidity (m)	.99 →					
17. Gradient %	6	1	7	0.5	2	7
18. Fines	0	5	0	0	5	0
19. Small Gravel	5	10	10	5	5	30
20. Large Gravel	70	15	20	5	75	40
21. Cobbles	20	30	20	60	10	30
22. Boulders	5	40	50	30	5	0
23. Bedrock	0 →					
24. Compaction	1 →					
25. T°C	4.0°C →					
26. Time	1030					
	85.10.09					

WILSON CREEK.

HABITAT DESCRIPTION FORM

	CONSECUTIVE HABITAT TYPES					
Stream and Code						
2. Reach # and Gradient (from map)	3	3	3	3	3	3
3. Reach length (km)						
4. Habitat Class	P	Ri	G	Ri	P	Ri
5. Length (m) Section	1.0	4.0	13.0	10.0	4.7	9.0
6. Wetted Width (m)	3.0	2.0	3.0	5.0	4.0	1.0
7. Channel Width (m)	>15	>15	>15	>15	>15	>15
8. Area (m^2)	3.0	8.0	39.0	50.0	18.80	9.0
9. $\bar{x}$ Depth (m)	0.25	0.03	0.30	0.02	0.15	0.05
10. Velocity (cm/s)						
11. Instream log (m^2) x depth (m)	1.5x0.1	2.0	3.0	20.0	8.0	3.0
12. Instream Boulder Cover (%)	—	—	—	—	—	—
13. Instream Vegetation (m^2)	—	—	—	—	—	—
14. Overstream Vegetation (m^2)	0	1.0	20	30.0	0	1.0
15. Cutbanks (m^2)	0	0	4.0	0	0	0
16. Turbidity (m)	0.99 →					
17. Gradient %	0.5	2.0	1.0	10.0	0.5	3.5
18. Fines	85	100	80	100	90	0
19. Small Gravel	10	0	20	0	5	70
20. Large Gravel	0	0	0	0	0	20
21. Cobbles	0	0	0	0	0	0
22. Boulders	5	0	0	0	5	10
23. Bedrock	0 →					
24. Compaction	0 →					
25. T°C	4.5°C →					
26. Time	1100					

8/10/09

WILSON CREEK HEADWATERS

HABITAT DESCRIPTION FORM

	CONSECUTIVE HABITAT TYPES					
1. Stream and Code						
2. Reach # and Gradient (from map)	3	3	3	3	3	3
3. Reach length (km)						
4. Habitat Class	P	Ri	P	Ri	P	Ri
5. Length (m) Section	4.0	5.5	2.5	2.0	2.0	1.0
6. Wetted Width (m)	4.0	2.2	3.0	1.5	4.0	4.0
7. Channel Width (m)	>15	>15	8	8	8	8
8. Area (m^2)	16.0	12.10	7.50	3.0	8.0	4.0
9. $\bar{x}$ Depth (m)	0.60	0.05	0.10	0.04	0.25	0.05
10. Velocity (cm/s)						
11. Instream log (m^2) x depth (m)	5.0 x 0.3	—	2.0 x 0.1	0	1.0 x 0.1	0
12. Instream Boulder Cover (%)	5	—	0	0	5	50
13. Instream Vegetation (m^2)	0 →					
14. Overstream Vegetation (m^2)	10.0	4.0	5.0	0.5	4.0	—
15. Cutbanks (m^2)	0 →					
16. Turbidity (m)	0.99 →					
17. Gradient %	0.5	2.0	0.5	3.0	0.5	10
18. Fines	70	5	80	40	30	0
19. Small Gravel	20	60	20	30	40	0
20. Large Gravel	5	30	0	20	20	0
21. Cobbles	0	5	0	10	0	20
22. Boulders	5	0	0	0	10	80
23. Bedrock	0 →					
24. Compaction	0 →					
25. T°C	4.5 →					
26. Time	1130					

85/10/09

WILSON CREEK

HABITAT DESCRIPTION FORM

	CONSECUTIVE HABITAT TYPES					
1. Stream and Code						
2. Reach # and Gradient (from map)	1	1	1	1	1	1
3. Reach length (km)	SITE 5	SITE 6				
4. Habitat Class	R	P	Ri	G	Ri	P
5. Length (m) Section	14.0	12.0	6.0	6.8	5.5/2.5	6.3
6. Wetted Width (m)	2.5	3.9	5.0	2.2	1/3.0	4.0
7. Channel Width (m)	6.0	8.0	10.0	>15	>10	10
8. Area (m^2)	35.0	46.8	30.0	14.96	13.0	25.20
9. $\bar{x}$ Depth (m)	0.25	0.40	0.05	0.35	0.10	0.50
10. Velocity (cm/s)						
11. Instream log (m^2) x depth (m)	–	3.0	1.0	–	8 x 0.1	15 x 0.2
12. Instream Boulder Cover (%)	5	0	0	0	0	0
13. Instream Vegetation (m^2)	–	–	–	–	–	–
14. Overstream Vegetation (m^2)	–	1.0	–	1.0	10.0	5.0
15. Cutbanks (m^2)	–	4.0	–	2.0	–	–
16. Turbidity (m)	0.99 →					
17. Gradient %	1.5	1.0	5.0	0.5	4	0.5
18. Fines	5	20	0	10	10	30
19. Small Gravel	30	30	25	30	30	40
20. Large Gravel	50	40	70	40	60	30
21. Cobbles	10	10	5	20	0	0
22. Boulders	5	0	0	0	0	0
23. Bedrock	0 →					
24. Compaction	0 →					
25. T^oC	6.5					
26. Time	1100					

85/10/10

WILSON CREEK

HABITAT DESCRIPTION FORM

	CONSECUTIVE HABITAT TYPES					
1. Stream and Code						
2. Reach # and Gradient (from map)	1	1	1	1	1	1
3. Reach length (km)						
4. Habitat Class	Ri	P	Run	Ri	G	Ri
5. Length (m) Section	17.0	7.9	9.8	11.0	7.1	13.0
6. Wetted Width (m)	2.5	3.3	2.17	3.55	3.7	4.9
7. Channel Width (m)	12.0	10.0	>12.0	10.0	7.0	10.0
8. Area (m^2)	42.50	26.07	21.27	39.05	26.27	63.70
9. $\bar{x}$ Depth (m)	0.15	0.30	0.30	0.12	0.18	0.15
10. Velocity (cm/s)						
11. Instream log (m^2) x depth (m)	1.0×0.1	3.0×0.2	–	–	–	1.0×0.1
12. Instream Boulder Cover (%)	–	5	10	–	–	–
13. Instream Vegetation (m^2)	–	–	–	–	–	–
14. Overstream Vegetation (m^2)	–	–	–	–	1.0.	–
15. Cutbanks (m^2)	–	4.0	–	–	2.0	–
16. Turbidity (m)	0.99					
17. Gradient %	3.0	0.5	2.0	3.5	0.5	1.0
18. Fines	10	40	20	10	30	15
19. Small Gravel	60	25	50	40	40	15
20. Large Gravel	20	10	20	20	25	50
21. Cobbles	10	20	0	30	5	20
22. Boulders	0	5	10	0	0	0
23. Bedrock	0					
24. Compaction	1.0					
25. T^oC	6.5					
26. Time	1100					

85/10/10

WILSON CREEK

HABITAT DESCRIPTION FORM

	CONSECUTIVE HABITAT TYPES					
Stream and Code						
2. Reach # and Gradient (from map)	1	1	1	1	1	1
3. Reach length (km)	SITE 7	SITE 8				
4. Habitat Class	P	Ri	G	P	Ri	P
5. Length (m) Section	8.1	12.5	11.0	11.0	5.3	6.9
6. Wetted Width (m)	3.0	2.0	3.0	3.8	2.0	2.0
7. Channel Width (m)	5.0	6.0	13.0	10.0	15.0	15.0
8. Area (m^2)	24.3	25.0	33.0	41.80	10.6	13.8
9. $\bar{x}$ Depth (m)	0.40	0.15	0.16	0.45	0.10	0.40
10. Velocity (cm/s)						
11. Instream log (m^2) x depth (m)	—	—	—	60x0.4	40x0.1	120x0.4
12. Instream Boulder Cover (%)	5	10	—	—	—	—
13. Instream Vegetation (m^2)	—	—	—	—	—	—
Overstream Vegetation (m^2)	2.0	—	12.0	4.0	2.0	—
15. Cutbanks (m^2)	0					
16. Turbidity (m)	0.99					
17. Gradient %	0.5	4	2	0.5	4	0
18. Fines	20	5	5	10	20	0
19. Small Gravel	10	15	30	70	80	30
20. Large Gravel	40	35	50	15	0	40
21. Cobbles	20	20	15	0	0	20
22. Boulders	10	25	0	5	0	10
23. Bedrock	0					
24. Compaction	0	1	1	0	0	0
25. T°C	6.5					
26. Time	1400					

85/10/10

WILSON CREEK

HABITAT DESCRIPTION FORM

	CONSECUTIVE HABITAT TYPES					
Stream and Code						
2. Reach # and Gradient (from map)	/	/	/	/	/	/
3. Reach length (km)						
4. Habitat Class	Ri	G	Ri	G	P	Run
5. Length (m) Section	8.9	10.0	4.5	10.5	16.0	9.8
6. Wetted Width (m)	1.5	2.0	5.9	4.6	8.2	2.5
7. Channel Width (m)	15.0	15.0	8.0	9.0	12.0	6.0
8. Area (m^2)	13.35	20.0	26.55	48.30	131.20	24.50
9. $\bar{x}$ Depth (m)	0.12	0.25	0.05	0.14	0.65	0.20
10. Velocity (cm/s)						
11. Instream log (m^2) x depth (m)	—	2.0x0.2	—	—	6.0x0.5	—
12. Instream Boulder Cover (%)	0 →					
13. Instream Vegetation (m^2)	0 →					
14. Overstream Vegetation (m^2)	0	18.0	—	4.0	2.0	—
15. Cutbanks (m^2)	0	0	0	1.5	7.0	2.0
16. Turbidity (m)	0.99 →					
17. Gradient %	4	0.5	5	0.5	0	1
18. Fines	0	30 (clay)	10	40	70	5
19. Small Gravel	25	50	60	40	20	60
20. Large Gravel	70	20	20	20	10	25
21. Cobbles	5	0	5	0	0	5
22. Boulders	0	0	5	0	0	5
23. Bedrock	0 →					
24. Compaction	1 →					
25. T°C	6.5 →					
26. Time	1400					

85/10/16

E WILSON CREEK.

HABITAT DESCRIPTION FORM

	CONSECUTIVE HABITAT TYPES					
Stream and Code						
2. Reach # and Gradient (from map)	1	1	1	1	1	1
3. Reach length (km)	SITE 3	SITE 4				
4. Habitat Class	Ri	G	Ri	G	Ri	G
5. Length (m) Section	7.2	14.0	5.3	6.0	6.4	13.5
6. Wetted Width (m)	5.5	3.8	1.5	3.5	3.0	3.5
7. Channel Width (m)	6.0	4.5	12.0	8.0	8.0	6.5
8. Area (m^2)	39.60	53.20	7.95	21.0	19.20	47.25
9. $\bar{x}$ Depth (m)	0.10	0.30	0.10	0.20	0.08	0.20
10. Velocity (cm/s)						
11. Instream log (m^2) x depth (m)	/	1.0	/	5.0x0.2	/	1.0x0.2
12. Instream Boulder Cover (%)	<5	0	<2	0	<1	0
13. Instream Vegetation (m^2)	0 →					
14. Overstream Vegetation (m^2)	2.5	0	0	10.0	0	4.0
15. Cutbanks (m^2)	2.0	3.0	0	2.0	0	1.0
16. Turbidity (m)	0.99 →					
17. Gradient %	2	1	8	1	9	1
18. Fines	5	30	0	5	40	35
19. Small Gravel	15	15	20	15	5	30
20. Large Gravel	40	30	30	50	40	10
21. Cobbles	30	10	45	30	10	20
22. Boulders	10	5	5	0	5	5
23. Bedrock	0 →					
24. Compaction	1	0	1	0	1	0
25. T^oC	6.5					
26. Time	1515					

85/10/10

1985

E. WILSON CREEK.

HABITAT DESCRIPTION FORM

	CONSECUTIVE HABITAT TYPES					
1. Stream and Code						
2. Reach # and Gradient (from map)	1	1	1	1	1	1
3. Reach length (km)						
4. Habitat Class	R	Chute	Ri	P	Ri	G.
5. Length (m) Section	16.0	12.0	4.9	12.0	11.0	6.4
6. Wetted Width (m)	3.0	3.6	2.0	6.9	3.0	1.5
7. Channel Width (m)	5.0	4.0	8.0	8.0	8.0	15.0
8. Area (m^2)	48.0	43.20	9.8	82.8	33.0	9.60
9. $\bar{x}$ Depth (m)	0.25	0.10	0.10	0.50	0.08	0.20
10. Velocity (cm/s)						
11. Instream log (m^2) x depth (m)	0	8.0x0.1	—	4.0x0.2	—	—
12. Instream Boulder Cover (%)	10	5	0	0	0	0
13. Instream Vegetation (m^2)	0 →					
14. Overstream Vegetation (m^2)	0	1.0	0	3.0	1.0	3.0
15. Cutbanks (m^2)	0	2	0	0	0	0
16. Turbidity (m)	099 →					
17. Gradient %	3	12	5	1	3	2
18. Fines	20	20	0	40	0	0
19. Small Gravel	5	10	35	45	50	50
20. Large Gravel	10	20	40	10	30	30
21. Cobbles	15	40	25	5	10	10
22. Boulders	30	10	0	0	5	0
23. Bedrock	20	0	0	0	5	10
24. Compaction	1	1	0	0	1	0
25. T^oC	6.5					
26. Time	1515					

85/10/10

Population Estimates using Maximum Likelihood Estimate
Carle and Strub (1978)

Project: East Wilson
Sample Site: EWWC-1
Date:

Catch		Time
1	16	382
2	6	326
3	7	315

T	29
X	38
n	34

N **0.98**

Est Population (N) =	**34**
p	**0.45**
Variance	**18.49**
SE	**4.30**
95% CI	**8.60**
N(Lower)	**25**
N(upper)	**43**

Total grams	283.72
Grams/m2	4.24
Est No/m2	0.51
Est No/m	0.92

Size data

Spp	**Lgth**	**Wt**	**CC**
Cct	40	0.6	0.94
Cct	40	0.7	1.09
Cct	41	0.7	1.02
Cct	41	0.8	1.16
Cct	42	0.7	0.94
Cct	43	0.8	1.01
Cct	45	1	1.10
Cct	46	1.2	1.23
Cct	71	3.6	1.01
Cct	74	3.9	0.96
Cct	75	4.3	1.02
Cct	77	6	1.31
Cct	78	4.8	1.01
Cct	78	5.3	1.12
Cct	85	6.3	1.03
Cct	85	7.2	1.17
Cct	87	7	1.06
Cct	88	7.1	1.04
Cct	90	7.1	0.97
Cct	92	7	0.90
Cct	93	7.8	0.97
Cct	95	8	0.93
Cct	96	8.4	0.95

Area	Length	Ww
67.0	37	1.81

Spp	**Ave Wt**	**No**	**% Total**	**Adj. No.**
CCT	0.81	8	0.27	9
CCT	4.65	6	0.20	7
CCT	8.37	11	0.37	12
CCT	20.85	4	0.13	5
CCT	44.70	1	0.03	1
Total		30		34

Cct	103	10.8	0.99
Cct	108	15.4	1.22
Cct	120	17.8	1.03
Cct	126	20.5	1.02
Cct	126	20.7	1.03
Cct	132	24.4	1.06
Cct	162	44.7	1.05

Population Estimates using Maximum Likelihood Estimate
Carle and Strub (1978)

Project: Wilson Creek
Sample Site: UWWC - 8 a
Date:

Catch		Time
1	9	193
2	9	231
3	6	181

T	24
X	27
n	34

N **1.00**

Est Population (N)=	**34**
p	**0.32**
Variance	**70.83**
SE	**8.42**
95% CI	**16.83**
N(Lower)	**17**
N(upper)	**51**

Total grams	**437.18**
Grams/m2	**12.36**
Est No/m2	**0.96**
Est No/m	**3.27**

Size Data

Spp	Lgth	Wt	CC
Cct	28	0.2	0.91
Cct	40	0.6	0.94
Cct	43	0.8	1.01
Cct	75	5.2	1.23
Cct	77	5.1	1.12
Cct	77	5	1.10
Cct	78	4.9	1.03
Cct	79	5.1	1.03
Cct	79	4.9	0.99
Cct	80	5	0.98
Cct	83	5.8	1.01
Cct	83	5.7	1.00
Cct	86	6.9	1.08
Cct	91	7.1	0.94
Cct	94	7.7	0.93
Cct	105	10.7	0.92
Cct	113	14.2	0.98
Cct	117	15.8	0.99
Cct	125	21	1.08
Cct	132	20.6	0.90
Cct	143	26.9	0.92
Cct	145	29.3	0.96
Cct	150	35.1	1.04

Area	**Length**	**Ww**
35.4	10.4	3.4

Spp	Ave Wt	No	% Total	Adj No.
Cct	0.5	3	0.13	4
Cct	5.7	12	0.50	17
Cct	13.6	3	0.13	4
Cct	26.6	5	0.21	7
Cct	65.0	1	0.04	1
Total		24		34

Cct	188	65	0.98

Population Estimates using Maximum Likelihood Estimate
Carle and Strub (1978)

Project:
Sample Site: uWWC -02
Date:

Catch		Time
1	4	134
2	0	121
3	1	94

T	5
X	8
n	5.4

N **0.44**

Population N =	**5.4**
p	**0.61**
Variance	**1.67**
SE	**1.29**
95% CI	**2.58**
N(Lower)	**3**
N(upper)	**8**

Total grams		82.7
Grams/m2		7.19
No/m2		0.47
No/m		1.17

Size data

Spp	Lgth	Wt	CC
Cct	67	3.2	1.06
Cct	79	5.1	1.03
Cct	115	14.6	0.96
Cct	124	18.2	0.95
Cct	153	35.5	0.99

Area	Length	Ww
11.5	4.6	2.5

Spp	Ave Wt	No	% Total	Ad.j No.
Cct	4.15	2	0.40	2
Cct	16.4	2	0.40	2
Cct	35.5	1	0.20	1
Total		5		5

Population Estimates using Maximum Likelihood Estimate
Carle and Strub (1978)

Project:
Sample Site: uWWC-3
Date:

Catch		Time
1	15	212
2	7	217
3	3	183

T	25
X	37
n	27

N **0.83**

Est Population (N) =	**27**
p	**0.57**
Variance	**5.16**
SE	**2.27**
95% CI	**4.54**
N(Lower)	**22**
N(upper)	**32**

Total grams		269.12
Grams/m2		9.71
No/m2		0.97
No/m		3.21

Size data			
Spp	**Lgth**	**Wt**	**CC**
Cct	35	0.4	0.93
Cct	37	0.5	0.99
Cct	43	0.8	1.01
Cct	67	3.2	1.06
Cct	68	3.1	0.99
Cct	72	3.9	1.04
Cct	76	4.2	0.96
Cct	77	5.6	1.23
Cct	78	5.2	1.10
Cct	79	5.1	1.03
Cct	80	5	0.98
Cct	81	5.3	1.00
Cct	85	5.9	0.96
Cct	87	6.3	0.96
Cct	88	7.3	1.07
Cct	94	8.8	1.06
Cct	112	14.1	1.00
Cct	115	14.6	0.96
Cct	116	16.4	1.05
Cct	123	17.3	0.93
Cct	124	18.2	0.95
Cct	127	19.5	0.95
Cct	139	26.8	1.00

Area	Length	Ww
27.7	8.4	3.3

Spp	**Ave Wt**	**No**	**% Total**	**Adj No.**
Cct	0.57	3	0.12	3
Cct	4.41	8	0.32	9
Cct	6.72	5	0.20	5
Cct	16.68	6	0.24	6
Cct	33.90	3	0.12	3
Total		25		27

Cct	153	35.5	0.99
Cct	160	39.4	0.96

Population Estimates using Maximum Likelihood Estimate
Carle and Strub (1978)

Project: Wilson
Sample Site: WWC-1
Date:

Catch		Time
1	63	353
2	15	355
3	7	315

T	85
X	141
n	86

N **0.99**

Est Population (N)=	**86**
p	**0.73**
Variance	**1.28**
SE	**1.13**
95% CI	**2.26**
N(Lower)	**84**
N(upper)	**88**

Total grams		391.55
Grams/m2		4.34
No/m2		0.95
No/m		4.20

Size data

Spp	Lgth	Wt	CC
Cct	72	3.9	1.04
Cct	78	5.0	1.05
Cct	83	5.6	0.98
Cct	88	7.8	1.14
Cct	90	7.7	1.06
Cct	90	7.4	1.02
Cct	91	7.9	1.05
Cct	96	9.3	1.05
Cct	97	10	1.10
Cct	97	9.9	1.08
Cct	99	10.6	1.09
Cct	99	10.1	1.04
Cct	102	10.1	0.95
Co	50	1.6	1.28
Co	51	1.6	1.21
Co	51	1.5	1.13
Co	52	1.5	1.07
Co	53	1.9	1.28
Co	53	1.7	1.14
Co	53	1.6	1.07
Co	53	1.1	0.74
Co	54	1.8	1.14
Co	54	1.8	1.14

Area	Length	Ww
90.2	20.5	4.4

Spp	Ave Wt	No	% Total	Adj. No.
Cct	8.10	2	0.02	2
Cct	8.76	11	0.13	11
Co	2.59	68	0.80	69
Co	7.40	1	0.01	1
Rb	8.40	1	0.01	1
Rb	41.30	2	0.02	2
Total		85		86

Co	55	1.9	1.14
Co	55	1.9	1.14
Co	55	1.8	1.08
Co	55	1.9	1.14
Co	55	2	1.20
Co	55	2.1	1.26
Co	56	2.1	1.20
Co	56	2	1.14
Co	56	2.1	1.20
Co	56	2	1.14
Co	56	2	1.14
Co	57	2.3	1.24
Co	57	2.1	1.13
Co	57	2.1	1.13
Co	57	2	1.08
Co	57	1.7	0.92
Co	57	2.3	1.24
Co	58	2.8	1.44
Co	58	2.5	1.28
Co	58	2.2	1.13
Co	58	2.2	1.13
Co	58	2	1.03
Co	58	2.3	1.18
Co	58	2	1.03
Co	58	2.2	1.13
Co	59	2.2	1.07
Co	59	2.4	1.17
Co	59	2.2	1.07
Co	60	2.6	1.20
Co	60	2.5	1.16
Co	60	2.6	1.20
Co	61	3	1.32
Co	61	3.1	1.37
Co	61	2.6	1.15
Co	61	2.6	1.15
Co	61	2.7	1.19
Co	61	2.8	1.23
Co	61	2.1	0.93
Co	62	3.4	1.43
Co	62	2.8	1.17
Co	62	2.8	1.17
Co	62	3.1	1.30
Co	63	3.1	1.24
Co	64	3.7	1.41
Co	65	3.5	1.27
Co	66	3.5	1.22
Co	66	3.5	1.22
Co	67	3.6	1.20
Co	67	4.2	1.40
Co	68	4.5	1.43
Co	68	3.4	1.08
Co	68	3.8	1.21
Co	69	4	1.22

Co	70	4.4	1.28
Co	70	4.2	1.22
Co	70	4.1	1.20
Co	70	4.2	1.22
Co	71	4.2	1.17
Co	84	7.4	1.25
Rb	92	8.4	1.08
Rb	147	43.1	1.36
Rb	151	39.5	1.15

Population Estimates using Maximum Likelihood Estimate
Carle and Strub (1978)

Project: Wilson
Sample Site: WWC-2
Date:

Catch		Time
1	7	230
2	2	237
3	3	157

T	12
X	16
n	13

N **0.87**

Est Population (N)=	**13**
p	**0.52**
Variance	**2.02**
SE	**1.42**
95% CI	**2.84**
N(Lower)	**10**
N(upper)	**16**

Total grams		37.05
Grams/m2		0.61
No/m2		0.21
No/m		0.81

Size data

Spp	Lgth	Wt	CC
Cct	76	4.8	1.09
Cct	78	5.5	1.16
Co	54	1.8	1.14
Co	55	2	1.20
Co	57	2.2	1.19
Co	58	2.3	1.18
Co	60	2.3	1.06
Co	61	2.9	1.28
Co	62	2.8	1.17
Co	62	3.2	1.34
Co	64	3.5	1.34
Tr	46	0.9	0.92

Area	Length	Ww
60.8	16.0	3.8

Spp	Ave Wt	No	% Total	Adj. No.
Cct	5.15	2	0.17	2
Co	2.56	9	0.75	10
TR	0.90	1	0.08	1
Total		12		13

Population Estimates using Maximum Likelihood Estimate
Carle and Strub (1978)

Project: Wilson
Sample Site: WWC-3
Date:

Catch		Time
1	58	613
2	0	
3	10	200

T	68
X	116
n	70

N **0.57**

Est Population (N)=	**70**
p	**0.72**
Variance	**4.25**
SE	**2.06**
95% CI	**4.12**
N(Lower)	**66**
N(upper)	**74**

Total grams		341.76
Grams/m2		4.46
No/m2		0.91
No/m		4.29

Size data

Spp	Lgth	Wt	CC
Cct	45	1	1.10
Cct	47	1.3	1.25
Cct	47	1.2	1.16
Cct	48	1.3	1.18
Cct	50	1.7	1.36
Cct	54	1.8	1.14
Cct	55	2.2	1.32
Cct	57	2.7	1.46
Cct	58	2.6	1.33
Cct	62	3.6	1.51
Cct	66	3.3	1.15
Cct	66	3.7	1.29
Cct	69	4.2	1.28
Cct	75	4.9	1.16
Cct	120	18.5	1.07
Cct	127	18.2	0.89
Cct	192	62.5	0.88
Co	40	1.4	2.19
Co	48	1.1	0.99
Co	51	1.5	1.13
Co	52	1.6	1.14
Co	52	1.7	1.21
Co	55	2.2	1.32

Area	Length	Ww
76.6	16.3	4.7

Spp	Ave Wt	No	% Total	Adj. No.
Cct	1.76	10	0.17	12
Cct	3.94	5	0.08	6
Cct	18.35	2	0.03	2
Cct	62.50	1	0.02	1
Co	2.76	31	0.53	37
Co	6.61	10	0.17	12
Total		59		70

Co	55	2.2	1.32
Co	56	2.7	1.54
Co	56	2.1	1.20
Co	57	7.5	4.05
Co	58	2.5	1.28
Co	58	2.4	1.23
Co	59	2.5	1.22
Co	59	2.4	1.17
Co	60	2.5	1.16
Co	60	2.6	1.20
Co	60	2.1	0.97
Co	61	1.7	0.75
Co	61	2.5	1.10
Co	62	3	1.26
Co	62	2.7	1.13
Co	62	2.7	1.13
Co	63	3	1.20
Co	63	3.7	1.48
Co	64	3.6	1.37
Co	64	3.2	1.22
Co	65	4.1	1.49
Co	65	4	1.46
Co	65	3.8	1.38
Co	65	3.2	1.17
Co	65	3.3	1.20
Co	66	3.9	1.36
Co	72	4.3	1.15
Co	75	5.5	1.30
Co	76	5.1	1.16
Co	78	5.6	1.18
Co	79	5.9	1.20
Co	86	7.4	1.16
Co	88	8.5	1.25
Co	90	10.1	1.39
Co	98	9.8	1.04