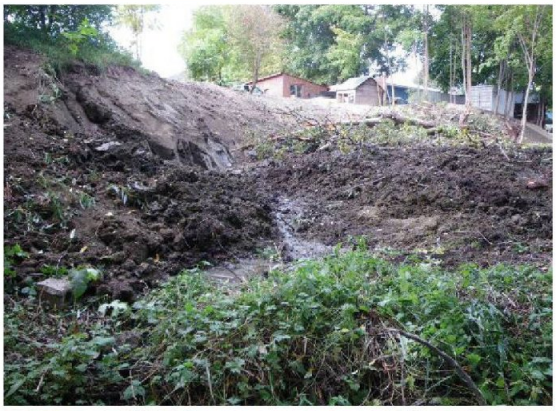
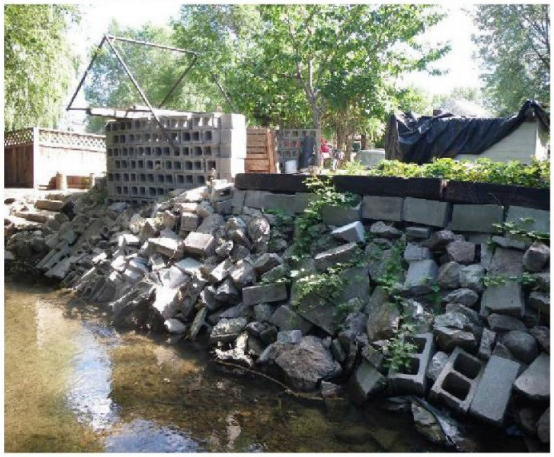
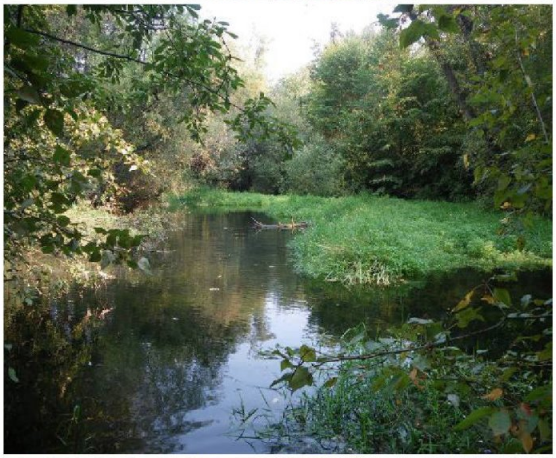
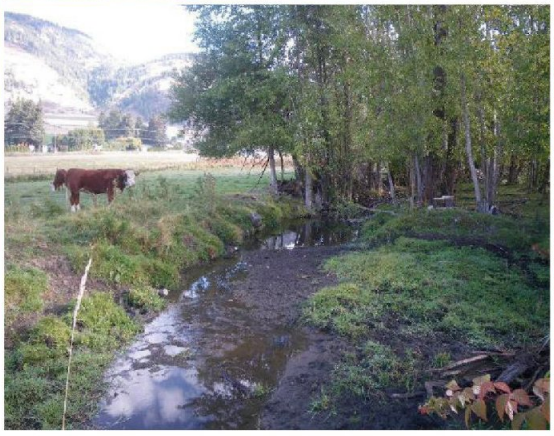
COLDSTREAM CREEK
BREWER CREEK
CRASTER CREEK

SENSITIVE HABITAT INVENTORY AND MAPPING (SHIM) – 2009 Survey Period

Inventory Summary Report

A Comprehensive Watercourse Catalogue


ECOSCAPE
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District of Coldstream
NULLI SECUNDUS

Okanagan Basin WATER BOARD

Prepared For:
District of Coldstream

Prepared By:
Ecoscape Environmental Consultants Ltd.

File No.:09-368
December 2009

SENSITIVE HABITAT INVENTORY AND MAPPING (SHIM) - 2009

Inventory Summary Report

Prepared For:

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Prepared By:

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STREAM LINE DATA

APPENDIX B:
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1.0 INTRODUCTION

Ecoscape Environmental Consultants Ltd. (Ecoscape) was retained by the District of Coldstream to complete Sensitive Habitat Inventory and Mapping (SHIM) of Coldstream Creek, Brewer Creek, and Craster Creek. The following report summarizes the inventory findings, which have been provided to the District of Coldstream and the Community Mapping Network (www.shim.bc.ca) in digital GIS format.

1.1 Project Background

As resource development and human populations increase in British Columbia, pressures for all resources and services have accelerated. Rapid growth has often overwhelmed the ability of local planners to manage land and preserve sensitive habitats (Mason and Knight, 2001). This has resulted in the loss or degradation of aquatic and riparian habitats that are critical for fish and a diverse wildlife assemblage. Accordingly, there is an urgent need to develop stronger tools and better methods to conserve, protect, and reclaim these habitats.

Sensitive Habitat Inventory and Mapping (SHIM) is a standard for fish and aquatic habitat mapping in urban and rural watersheds in British Columbia. SHIM attempts to ensure the collection and mapping of reliable, high quality, current, and spatially accurate information about local freshwater habitats, watercourses, and associated riparian communities.

SHIM is designed as a land-planning, computer-generated, interactive GIS tool that identifies sensitive aquatic and terrestrial habitats. It is intended to provide community, stewardship groups, individuals, regional districts and municipalities with an effective, low-cost delivery system for information on these local habitats and associated current land uses.

SHIM has numerous applications and can:

- Provide current information not previously available to urban planners, to allow more informed planning decisions and provide inventory information for integration into Official Community Plans;
- Identify and map areas of significant impairment (e.g., erosion, channelization, habitat degradation) and potential point sources of pollution;
- Assist in the design of stormwater/runoff management plans;
- Monitor for changes in habitat resulting from known disturbance;
- Help guide management decisions and priorities with respect to habitat restoration and enhancement projects;
- Assist in determining setbacks and fish/wildlife-sensitive zones;
- Identify sensitive habitats for fish and wildlife along watercourses;

- Provide a means of highlighting areas that may have problems with channel stability or water quality that require more detailed study;
- Provide baseline mapping data for future monitoring activities; and,
- Map and identify the extent of riparian vegetation available and used by wildlife and fisheries resources.

1.2 Project Objectives

The objectives of the project were to:

- Inventory and map the extents of Coldstream, Brewer, and Craster Creeks and associated riparian habitats, and important watercourse and fisheries habitat features;
- Provide the basis for accurately mapped baseline data that can be integrated into local mapping and planning initiatives; and,
- Augment and potentially enhance local land use planning maps and/or specific site or detailed planning surveys.

The primary functions of SHIM are to:

- Identify sensitive habitats and resources within local communities;
- Integrate property boundaries, land parcels, and road networks with locations of sensitive resources to facilitate Official Community Plans and Development Permit applications;
- Work within an interactive Geographical Information System (GIS) to provide useful map products for analysis and effective communication;
- Facilitate updating and exchange of information; and,
- Establish partnerships with provincial and municipal governments, stakeholders, and the public, to protect and manage aquatic habitats and associated functions (i.e. riparian communities and linear corridors etc.).

By combining resource information from a variety of sources, the goal is that SHIM will provide a robust baseline inventory (cataloguing the stream and all natural and anthropogenic features occurring within and along it) for improving integrated resource management and planning within the District of Coldstream.

2.0 SCOPE OF WORK

The project work scope was based on a proposal submitted to the District of Coldstream (Ecoscape 2009)[1]. The fundamental objective was to complete Sensitive Habitat Inventory and Mapping (SHIM) surveys on all creeks identified in the Request for Proposal including:

- Coldstream Creek (SHIM survey length = 19.8 km)
- Brewer Creek (SHIM survey length = 3.5 km)
- Craster Creek (SHIM survey length = 3.0 km)

Field inventory methods and data processing and management were to conform to SHIM Standards and Methodology. At the completion of the project, standard SHIM deliverables are to be provided to the District of Coldstream and subsequently to the Community Mapping Network (CMN) for publication in the SHIM atlas.

3.0 METHODOLOGY

Field inventory, data processing and data deliverables conformed to the SHIM Standards (Mason and Knight, 2001), which can be reviewed in full at:

http://www.shim.bc.ca/methods/SHIM_Methods.html

3.1 Centerline Survey

Danielle Drieschner was the principal surveyor and completed all field survey elements with the assistance of Kyle Hawes, R.P.Bio., Tyra Zeman, and Adam Patterson.

The stream centerline was mapped along the center of the bankfull (not floodplain) width. The creek was stratified into a series of successive sections (segments), each possessing and being characterized by different attributes or biophysical characteristics (i.e. hydraulic class, channel characteristics, substrates composition, and riparian class, etc.). The stream segmentation and associated attributes was the fundamental unit of the centerline survey with point features providing a more quantitative measure of relative disturbance/modification and aquatic habitat quality/complexity (i.e. area abundance of deep pools, spawning substrates, large woody debris, bank erosion, etc.).

Table 1 provides a complete list of features and corresponding attributes that were recorded using the Trimble Geo Explorer (GPS) and SHIM Data Dictionary.

[1] Drieschner, D and K, Hawes. 2009. Sensitive Habitat Inventory and Mapping (SHIM) Proposal for SHIM of Coldstream Creek. January 2009. Prepared for: District of Coldstream. Prepared by: Ecoscape Environmental Consultants Ltd. 18 pp.

Table 1. Overview of watercourse and habitat attributes to be collected using the SHIM Data Dictionary (Module 3, Mason and Knight, 2001). The complete data dictionary can be found in Appendix A.

Survey Component	Main Attribute	Detailed Feature Collected
Stream Centre Line	Stream Reference Information	Name; Watershed Code; Date; Time; Survey Conditions; Surveyors
	Stream Segment Points	Start; Stop; Reach Break; Elevation; Representative Photographs
	Stream Segment Class	Stream Section; State of Section (i.e. natural/modified/channelized); Dominant Hydraulic Type
	Segment Characteristics	Section Gradient; Fish Spawning; Canopy; Access; Gravel
	Segment Substrate Attributes	Dominant Substrate Type; Compaction
	Segment Channel Attributes	Widths (wetted, bankfull), Depths (wetted, bankfull)
	Segment Instream Cover	% Total Cover; % by Feature/Cover Type (large woody debris/deep pool/over stream vegetation etc.)
	Segment Riparian Attributes	Left and Right Bank Riparian Class (vegetation association; structural stage; bank slope; material etc.)
		Segment Summary Description
	Level of Impairment	Score 0 (Severely impaired) – 6 (Natural); Rationale
	Enhancement Opportunity Rating	0 (Nil) – 4 (Very High); Rationale
Watercourse and Habitat Features	Culvert Attributes	Type-Material; Condition; Barrier; Size; Baffles
	Obstruction Attributes	Type-Material; Barrier; Size; Photo
	Stream Discharge Attributes	Point of Discharge; Type-material; Size
	Erosion Feature	Type of Erosion; severity; exposure; material
	Fish Habitat Attributes	Type of Habitat (Spawning/rearing/cover); Size; Slope; Photo
	Enhancement Areas	Type of Enhancement; Potential or existing enhancement
	Wildlife Observations	Type of Observation; Wildlife species; Photo
	Wildlife Tree Attributes	Type of Tree; Size; Location
	Near Waterbody Attributes	Type of Waterbody (spring/side channel/pond etc.); Size
	Wetland Attributes (Polygon feature)	Wetland Type-Class; Photo
	Photograph Location	Location; Direction.

3.2 Level of Impact/Condition Scoring

Ecoscape developed and appended a Level of Impact rating to the data dictionary (Appendix B). This rating system was designed with the intent of providing a more measurable parameter in evaluating the watercourse condition and monitoring and evaluating habitat changes on local watercourses and associated riparian and floodplain communities. Individual reach scores will be assigned based on the criteria outlined in Table 2.

Table 2. Level of Impact rating criteria for Coldstream Inventory and Mapping

River Bank Impact Criteria[1]	Combined Segment Score
Nil-Nil (*Nil impacts on both banks*)	6
Nil-Low	5
Nil-Mod	4
Nil-High	3
Low-Low	4
Low-Mod	3
Low-High	2
Mod-Mod	2
Mod-High	1
High-High (*Impact on both banks is high*)	0

1. Numeric Bank Impact Scores: Nil=3 Low=2 Mod=1 High=0

The raw data and rationale for respective stream segment scores can be found in Appendix A within the Stream line data. Weighted scores for respective impact ratings were obtained by dividing the cumulative length of segments receiving the same SHIM impact rating by the total SHIM stream length to obtain a fractional abundance (% of SHIM stream length).

This value was then multiplied by the respective SHIM Score (0-6) equaling the weighted score. A zero (0) to six (6) rating system was developed to evaluate respective stream segments in terms of their degree of disturbance, where a stream segment not being recently modified (natural) received a score of 6 (nil), and a stream segment being highly modified on both banks/channelized/ditched, etc. received a score of 0 (both banks high). The sum of weighted scores was then divided by the maximum attainable score (6)[2] and transformed into a percentage value to yield the stream condition score.

3.3 Top of Bank Survey

Watercourse (lake, pond, stream and wetland) location and extent are critical for providing information to help determine the degree of protection to which a watercourse should be entitled. Determining the correct location of a stream, functionally (hydrologically) connected watercourses and wetlands, and their associated top of banks (TOB) is a necessary prerequisite for delineating Fisheries Sensitive Zones (FSZ). FSZs are an essential planning component in defining the Streamside Protection and Enhancement Area for development adjacent to a stream.

The top of bank was defined using the following criteria, as recognized by the Ministry of Environment and Department of Fisheries and Oceans Canada:

i) The point closest to the boundary of the active floodplain of a stream where a break in the slope of the land occurs such that the grade beyond the break is flatter than 3:1 at any point for a minimum distance of 15 metres measured perpendicularly from the break;

ii) For a floodplain area not contained within a ravine, the edge of the active floodplain of a stream where the slope of the land beyond the edge is flatter than 3:1 at any point for a minimum distance of 15 metres measured perpendicularly from the edge; or,

iii) The first significant break in a ravine slope where the break occurs such that the grade beyond the break is flatter than 3:1 for a minimum distance of 15 metres measured perpendicularly from the break, and the break does not include a bench within the ravine that could be developed.

3.4 Data Logging and Processing

GPS settings were in accordance with Resource Inventory Committee Standards to ensure the collection of spatially accurate data. The coordinate system used was North American Datum 83, UTM Zone 11 North.

Field (GPS) data were post processed (differentially corrected) in the office using base stations situated both in Penticton (SOPAC, Dominion Radio Astrophysical Observatory), and Kettle Falls, Washington (USFS, Colville National Forest).

[2] A combined weighted score of 6 would be attained if all segments were natural with no discernable human disturbance on either the right or left bank. Note this evaluation does not factor in impacts upstream of the District of Coldstream municipal boundary limit, which could still impact on water quality and habitat values.

Data dictionary tools designed for ARC View 3.x were employed to process the data and to export the data into ESRI shapefiles. Final mapping deliverables were produced in ArcGIS 9.2.

3.5 Quality Assurance and Quality Control

The Resource Inventory Committee and SHIM Methodology (Mason and Knight, 2001) provide specific requirements for quality assurance and quality control. These standards such as GPS settings/precision, logging intervals, and data management and deliverables were followed throughout the project. Data review and quality assurance and control were provided by Kyle Hawes, R.P.Bio. – Senior resource inventory biologist.

4.0 RESULTS

The following section summarizes the morphological and biophysical character of each of the surveyed watercourses. Summary results and discussions for individual watercourses are commensurate with their overall magnitude, habitat rating, and level of impact. Refer to the attached summary pages and corresponding figures (maps) for segment attributes and representative photos. The processed data from the centreline survey (Stream_line) and feature data has been included in Appendix A. In addition, this data can be found in digital format accompanying the complete inventory catalogue, which includes all point features, attributes, and representative photos (intended for use in an ESRI GIS platform). Furthermore, the reader is encouraged to refer to the Community Mapping Network, SHIM atlas (http://cmnbc.ca/).

4.1 Coldstream Creek

Coldstream Creek (Watershed Code: 310-939400-15400) originates on the south slopes of Silver Star Mountain and is approximately 29.8 km long from its headwaters to its confluence with Kalamalka Lake. Coldstream Creek flows southward through Noble Canyon and then westward through Lavington and Coldstream.

The total surveyed stream length was approximately 19.8 linear kilometers. Coldstream Creek was broken into a total of 42 segments (reaches) along its length (Map Set 1). Anthropogenic impacts to the stream channel and riparian areas were prevalent over the entire surveyed stream length. Approximately 89% of the surveyed length of Coldstream Creek was documented to be modified to some extent by urban, rural, and agricultural activities. Segments 1 through 4 occur within relatively higher density residential areas of Coldstream, with the exception of Segment 3, which flows through park along both banks. Rural residential landuse on larger properties begins in Segment 5, transitioning to increased agricultural use adjacent the creek around Segment 9. Generally, between Segment 9 and Segment 25, Coldstream Creek is influenced by agricultural practices to some extent; with landuse adjacent the creek including livestock grazing and cash crops of predominantly corn. At Segment 25, Coldstream Creek flows through rural residential neighbourhoods with intermittent influence from agriculture (primarily livestock) varying

between properties. Between the upstream end of Segment 29 through to Segment 35, Coldstream Creek was primarily dry during the fall survey period; only intermittently wetted in residual pools.

Components of stream segment attributes are discussed in Sections 4.1.1 to 4.1.3 and watercourse and habitat features are analyzed and summarized in Section 4.1.4.

4.1.1 Stream Primary Character

Coldstream Creek has been modified to some degree over approximately 17.6 km (89%) of the surveyed stream length, with approximately 2.1 km (11%) remaining natural (Table 3). Of the 17.6 km, about 748 m were characterized as being channelized, occurring in Segments 1, 18, 19, and 21, immediately upstream of the confluence with Kalamalka Lake and through much of the creek where it crosses to the north side of Highway 6. Stream segments characterized as natural occurred in Segments 7 and 8 downstream and upstream of Coldstream Creek Road, where wide, well-vegetated riparian areas exist. The riparian band along Segment 8 contains mature cottonwoods, as well as several mature non-native deciduous trees, which provide fisheries and wildlife habitat value, although historically introduced to the area. Segments 41 and 42 at the upper extents of the study area near Noble Canyon were also characterized as being natural, with influence from livestock and rural landuse still evident.

Table 3. Coldstream Creek summary of Primary Stream Character. Values shown below are based on SHIM field inventory and analysis of ~19.8 linear km of Coldstream Creek within the District of Coldstream.

Segments	Primary Character	Length (m)	Percentage of stream length
1, 18, 19, 21	Channelized	971.0	4.9%
2, 3, 4, 5, 6, 9, 10, 11, 12, 13, 14, 15, 16, 17, 20, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40	Modified	16635.0	84.4%
7, 8, 41, 42	Natural	2114.7	10.7%

Culverts occurred over approximately 238 m, or 1.2%, of the SHIM stream length. Culverts varied in length from 5 to 33 m, and the culvert under Highway 6 at the upstream end of Segment 16 was the only culvert which could potentially pose an obstruction to fish passage.

4.1.2 Stream Channel and Hydraulic Character

Coldstream Creek exhibits a primarily riffle/pool morphology for approximately 85% of the SHIM stream length. Approximately 8% of the 19.8 km surveyed exhibited run characteristics, while the remaining 7 segments and 7% of the SHIM length were characterized as either slough or beaver pond. Channelization of Coldstream Creek through fields between Segments 16 through 24, coupled with beaver activity, resulted in relatively deep, slow moving segments of stream. Rainbow trout were observed to be utilizing the deep water cover and woody debris throughout these segments. Within Segment 20, wetland ecosystems occur along the left bank of Coldstream Creek, with well-established aquatic vegetation and beaver activity resulting in low flood riparian sites and

red-osier dogwood – willow swamps. The hydraulic character details for the ~19.8 km of Coldstream Creek surveyed are summarized in Table 4.

The average channel gradient throughout the surveyed portion of Coldstream Creek was around 1% (Table 5). The stream gradients averaged for each of the 42 segments varied from 0 to 3%. Short lengths of the channel with steeper gradients were recorded, including the concrete flume in Segment 14, which has a grade of 7% below the dam.

Table 4. Coldstream Creek summary of hydraulic character. Values shown below are based on SHIM field inventory and analysis of ~19.8 linear km of Coldstream Creek within the District of Coldstream.

Segments	Hydraulic Character	Length (m)	Percentage of stream length
20	Beaver Pond	221.8	1%
2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 23, 24, 25, 26, 27, 28, 29, 30, 36, 37, 38, 39, 40, 41, 42	Riffle/Pool	16691.1	85%
22, 33, 34, 35	Run	1664.7	8%
1, 15, 19, 21, 31, 32	Slough	1142.9	6%
	Wetland	0.0	0%

Table 5. Coldstream Creek stream channel summary. Values shown below are based on SHIM field inventory and analysis of ~19.8 linear km of Coldstream Creek within the District of Coldstream.

	Gradient (%)			Stream Channel		
Segments	Average	Min	Max	Mean Bankfull Width (m)	Min (m)	Max (m)
1 to 42	1.1	0	3.0	6.0	2.6	32.0

4.1.3 Instream Habitat Cover/Complexity

Total and relative instream cover is a field estimate of the type and amount of in-channel cover available to fish. Total cover represents the total percentage of the wetted area of respective segments occupied by cover. The relative abundance (%) of cover types (e.g., deep pool, large woody debris, etc.) is an estimate of the distribution (of respective cover types) within the total cover estimate for the segment.

Approximately 46% of the SHIM stream length was noted to provide structural instream cover for fish habitat (Table 6). Only three segments were estimated to have a total percentage of the wetted area occupied by cover of less than 20%, accounting for only 1% of the surveyed stream length. Cover in Segment 13 was largely limited to boulder cover associated with bank armouring, while Segments 30 and 34 occurred in open field with unrestricted livestock access, and cover consisted of some overhanging grasses and undercut banks.

There were 22 segments, which had estimated total cover between 21% - 40%, accounting for nearly 2.9 km of stream. Six segments had estimated total cover between 41% to 50% of the wetted area - accounting for a total of 1.8 km of stream. There were 9 segments with

total cover estimated from 51% to 75%, and segments 15 and 20 had estimated total cover exceeding 75% of the wetted area of the segment. Segments 15 and 20 both had extensive deep water cover and instream vegetation associated with flooding upstream of the constructed dam in Segment 15 and beaver activity influencing hydraulic character in Segment 20.

A more quantitative assessment of notable fish habitat features can be found in Section 4.1.4.4.

Table 6. Coldstream Creek summary and distribution of instream cover/habitat complexity. Values shown below are based on SHIM field inventory and analysis of ~19.8 linear km of Coldstream Creek within the District of Coldstream

Segment Number	% Total Cover	Combined Segment Length (m)	Percentage of SHIM Stream Length	Percentage of Total cover by Cover Type [a]						
				B	DP	IV	LWD	OV	SWD	UC
	<10%									
13, 30, 34	11-20%	192.3	1%	7%	11%	14%	0%	34%	5%	29%
4, 6, 8, 9, 10, 12, 14, 16, 18, 22, 29, 31, 32, 33, 35, 36, 37, 38, 39, 40, 41, 42	21-40%	2870.3	15%	8%	21%	2%	26%	15%	21%	7%
1, 2, 17, 25, 27, 28	41-50%	1775.7	9%	10%	28%	7%	17%	11%	16%	10%
3, 5, 7, 11, 19, 21, 23, 24, 26	51-75%	3724.0	19%	3%	23%	4%	27%	15%	24%	4%
15, 20	>75%	328.0	2%	2%	65%	15%	10%	3%	5%	0%

a. Cover codes: B=boulder; DP=deep pool; IV=instream vegetation; LWD=large woody debris; OV=overstream vegetation; SWD=small woody debris; UC=undercut bank

4.1.4 Watercourse and Habitat Features

The following section summarizes feature data collected and nested within the line segments. All features are measured and recorded individually and provide a more robust and quantitative measure of watercourse impairment and habitat quality.

4.1.4.1 Modifications

Modifications to the stream channel and riparian area were documented on over 6.9 km, or 35% of the surveyed length of Coldstream Creek. Modifications had a cumulative linear measurement of over 2.2 km along the left bank, 2.3 km along the right bank, and 2.9 km instream (Table 7). Unrestricted livestock access occurs along over 2.8 km, or 14% of the SHIM stream length. Bank stabilization, retaining walls and riprap accounted for 1.9 km along the left bank and 2 km along the right bank.

Modifications such as water withdrawals, pipe crossings and fences are not effectively quantified by stream length. Fifty nine fences, five (5) pipe crossings, and five (5) water withdrawals were noted along Coldstream Creek. Pipe crossings may be higher in number, as there were some culverted sections of stream where visual confirmation of the inside of the culvert was not possible.

Table 7. Coldstream Creek summary of artificial features/modifications. Features and values shown below are based on SHIM field inventory (2009) and analysis of ~19.8 linear km of creek within the District of Coldstream.

	Left Bank			Right			Instream		
Type	Length (m)	% of total length of modifications	% of SHIM stream length	Length (m)	% of total length of modifications	% of SHIM stream length	Length (m)	% of total length of modifications	% of SHIM stream length
Bridge	181.87	2.64%	0.92%	181.87	2.64%	0.92%	3.60	0.05%	0.02%
Channelization	88.00	1.28%	0.45%	88.00	1.28%	0.45%			
Dam	0.80	0.01%	0.00%	0.80	0.01%	0.00%			
Detention Pond				10.00	0.15%	0.05%			
Dock				5.00	0.07%	0.03%			
Fences	33.33	0.48%	0.17%	6.45	0.09%	0.03%	40.51	0.59%	0.21%
Garbage/Pollution	41.00	0.59%	0.21%	2.00	0.03%	0.01%	27.20	0.39%	0.14%
Livestock Access	2.50	0.04%	0.01%	1.30	0.02%	0.01%	2805.60	40.69%	14.23%
Livestock Crossing	17.00	0.25%	0.09%	17.00	0.25%	0.09%			
Other	41.40	0.60%	0.21%	3.00	0.04%	0.02%	0.40	0.01%	0.00%
Pipe Crossing	1.45	0.02%	0.01%	1.45	0.02%	0.01%			
Retaining Wall/Bank Stabilization	1057.30	15.33%	5.36%	833.10	12.08%	4.22%	16.00	0.23%	0.08%
Rip rap	800.00	11.60%	4.06%	1127.80	16.36%	5.72%	32.50	0.47%	0.16%
Water Withdrawal	3 along left bank			2 along right bank					
	2264.65			2277.77			2925.81		

4.1.4.2 Discharges/Waterbodies

A discharge includes any substance that enters a watercourse via an artificial structure (i.e., pipe), whether it is a contribution of clean cold water from a spring, or pollution from a sewage outlet or storm drain.

A total of 40 discharges were documented along Coldstream Creek during the field inventory (Table 8). A total of 11 storm drains were recorded, with an average diameter of 430 mm and a maximum observed discharge pipe diameter of 600 mm. The field survey took place primarily in late summer and fall, and only 16 discharges were flowing at the time of the survey. In Segment 8 along the left bank (looking downstream) of Coldstream Creek, a discharge along the hillslope was recorded as septic effluent due to its strong odour. While the origin and content of this seepage was not confirmed, several seepage points were documented in the same location during the top of bank survey and further analysis is recommended. A total of six (6) discharges were described as agricultural runoff due to the associated landuse where they were documented. Tile drains totaled 15, and seven (7) discharges with ambiguous origins were classified as other.

Discharge locations noted above should be cross-referenced with water quality data that has been commissioned for the Coldstream Creek watershed to date. Synthesizing this information, along with waterbody features collected during the SHIM survey, will aid the District of Coldstream and stakeholders in identifying impacts to water quality and prioritizing action items for enhancement.

Table 8. Summary of discharges identified on Coldstream Creek. Values shown below are based on SHIM field inventory (2009) and analysis of ~19.8 linear km of Coldstream Creek within the District of Coldstream.

Type	Count	Mean Diameter (m)	Min Diameter (m)	Max diameter (m)	Number flowing during survey
Agricultural Runoff	6	0.25	0.1	0.5	1
Septic Effluent	1				1
Other	7	0.22	0.15	0.35	1
Storm Drain	11	0.43	0.15	0.6	5
Tile Drain	15	0.11	0.05	0.2	8
Total	40				16

A total of 39 waterbody features were recorded along Coldstream Creek within the study boundary (Table 9). Of the 39 waterbodies recorded, 18 were wetted or flowing into Coldstream Creek during the survey.

Table 9. Summary of waterbody features identified on Coldstream Creek. Values shown below are based on SHIM field inventory (2009) and analysis of ~19.8 linear km of Coldstream Creek within the District of Coldstream.

Type	Count	Mean Width (m)	Mean Depth (m)	Average Temperature of Flowing Waterbodies	Number flowing/wetted during survey
Natural Springs	20	0.34	0.02	11.26	12
Side Channel	3	1.70	0.22	9.2	1
Tributary	12	0.63	0.02	9.03	3
Wetland	2			6.5	2
Other	2	0.4	0.04		0
Total	39				18

4.1.4.3 Bank Stability and Erosion

Stream bank erosion was documented on over approximately 28% of the left bank and 26% of the right bank of Coldstream Creek (Table 10). Encroachment associated with residential, rural and agricultural land use, and the associated lack of riparian vegetation and structure are key factors, which have degraded the bank and channel integrity of Coldstream Creek. Bank stability has been largely addressed in residential areas with armouring (riprap) and retaining walls - constructed of various materials. In many cases, material such as concrete, tires and debris have been dumped along the bank and into the stream channel. Unrestricted livestock access to entire stream segments has also contributed to the high bank and channel instability over the 19.8 km of stream surveyed. Unrestricted livestock access and extensive associated erosion were documented in Segments 24, 30, 31, 34 and 42.

The average height of bank erosion on the left bank was 2 m, while that on the right bank averaged 1.9 m. In some locations of stream, steep, high eroding banks were noted with accumulation of clay and fines instream, resulting in embeddedness of gravel substrates that may have previously been suitable for spawning fish (e.g., kokanee and rainbow trout).

There were 42 areas of erosion noted with heights greater than 3 m. Of the 218 recorded incidents of erosion, 169 points had severity greater than 10 m^2. Erosion was observed to be relatively consistent throughout Coldstream Creek to varying degrees. The average area of exposure was around 67 m^2 for both banks. The recorded maximum exposure for a single continuous incident was 480 m^2, stretching for about 400m along the left bank of Segment 24.

Table 10. Summary of bank erosion recorded along Coldstream Creek. Features and values shown below are based on SHIM field inventory (2009) and analysis of ~19.8 linear km of creek within the District of Coldstream.

Left Bank					Right Bank				
Cumulative Length (m)	Average Height (m)	Area (m^2)	Average Area of Exposure (m^2)	Percent of SHIM stream length	Cumulative Length (m)	Average Height (m)	Area (m^2)	Average Area of Exposure (m^2)	Percent of SHIM stream length
5593.30	2.00	8589.54	67.63	28%	5044.10	1.97	7529.69	67.23	26%

4.1.4.4 Fish Habitat

Deep pools were the predominant habitat feature type observed and recorded on Coldstream Creek within the surveyed stream length (Table 11). Deep pools occurred over nearly 1270 linear metres, or 6.4% of Coldstream Creek, accounting for approximately 42% (relative area abundance) of all habitat features recorded. Large woody debris was the next most prominent habitat type, occurring over approximately 690 linear metres and accounting for 33% of habitat features.

Spawning habitat, identified by the presence of clean suitably-sized gravel for resident and adfluvial rainbow trout and adfluvial kokanee, occurred over ~560 linear metres of the SHIM stream length with an area of approximately 1277 m^2. Suitable spawning habitat accounted for over 14% of the combined measured area of habitat features. While no kokanee were observed to be spawning (survey timing preceded onset of kokanee migration) in Coldstream Creek, rainbow trout were documented frequently throughout the length of stream surveyed, beyond all noted obstructions. A resident rainbow trout population is present throughout Coldstream Creek to at least the upper limits of the study area in Segment 42.

Upstream migration of adfluvial fish species is limited to approximately 7.4 km upstream from the confluence with Kalamalka Lake, due to the presence of falls, a concrete flume and a dam located in Segment 14.

Table 11. Summary of habitat features. Values shown below are based on SHIM field inventory (2009) and analysis of ~19.8 linear km of Coldstream Creek within the District of Coldstream.

Type	Combined Length (m)	Mean Width (m)	Combined Area (m^2)	Mean wetted Depth (m)	Percent of SHIM stream length	Relative area Distribution
Boulder	3.50	2.50	8.75	0.60	0%	0%
Deep Pool	1269.60	2.91	3690.85	0.88	6%	42%
Instream Vegetation	3.50	2.80	9.80	0.60	0%	0%
Over Stream Vegetation	76.00	4.30	326.80	0.39	0%	4%
Undercut Bank	73.50	0.89	65.23	0.53	0%	1%
Small Woody Debris	156.90	3.22	505.61	0.36	1%	6%
Large Woody Debris	690.10	4.15	2862.91	0.43	3%	33%
Spawning Gravel	559.50	2.28	1277.12	0.16	3%	15%
Total	**2832.60**		**8747.08**		**14.36%**	

4.1.4.5 Obstructions / Barriers

Obstructions included all features that had the potential to prevent the normal passage of fish during all or part of the year. A summary of potential obstructions or barriers to upstream fish migration is summarized in Table 12.

A falls and associated dam structure and concrete flume in Segment 14 impose a barrier to upstream fish passage from below. However, fish were documented to occur upstream of this barrier. The flooded area upstream of the dam has naturalized and provides valuable fish and wildlife habitat. Removal of the dam in the interest of restoring fish passage is not perceived to be enough of a habitat gain. If passage mitigation were to be considered, alternatives are recommended such that the upstream wetland ecosystem is preserved.

The culvert that flows beneath Highway 6 between Segments 16 and 17 may also be a barrier to fish passage; therefore, the habitat gain with removal of the falls and dam may only be approximately 400 m. A concrete apron with a grade of approximately 15% occurs at the culvert outlet and the culvert is curved/jointed under the highway.

Persistent debris was the most common potential obstruction noted, with 20 incidents documented. Beaver dams and log jams were also present along Coldstream Creek. In total, there were 5 confirmed obstructions, 6 unknown and 14 potential. Woody debris accumulations throughout the stream are dynamic, changing with water levels from year to year. Therefore, some of the features recorded during the 2009 field inventory may become dislodged and dismantled through both natural and human causes.

Table 12. Coldstream Creek summary of potential obstructions/barriers to upstream fish migration. Features and values shown below are based on SHIM field inventory (2009) and analysis of ~19.7 linear km of creek within the District of Coldstream.

Type	# of obstructions occurring	Barrier	Cumulative Length (m)	Mean Wetted Width (m)	Mean Depth (m)	Mean Height (m)
Beaver Dam	2	1 potential, 1 yes	4.7	4.05	0.7	1.3
Log Jam	2	1 unknown, 1 yes	12	5	0.70	2.35
Falls	1	yes	30	5	0.03	1.80
Persistent Debris	20	13 potential, 5 unknown, 1 yes	93.00	4.79	0.28	0.94
Dam	1	yes	0.40	5.60	0.05	1.40
		Total	140.20			

4.1.5 Stream Impact Summary

Ecoscape developed and appended a Level of Impact rating to the data dictionary (Appendix B). This rating system was designed with the intent of providing a more measurable parameter in evaluating the watercourse condition and monitoring and evaluating habitat changes on local watercourses and associated riparian and floodplain communities. The raw data and rationale for respective stream segment scores can be found in Appendix A within the Stream line data. Methodology for calculating the weighted scores and fractional abundance is described above in Section 3.2.

The sum of weighted SHIM scores equaled 2.5 (out of 6), with Coldstream Creek receiving a stream grade of 42% (Table 13). Three segments received a score of 0, indicating that impacts were high along both banks. There were 11 segments receiving an impact score of 1, exhibiting moderate impacts along one bank and high on the other, accounting for 20% of the stream length. An additional 11 segments, or 28% of the stream length, received a score of 2, indicating that both banks exhibited moderate impacts or one bank was low and one high. A total of 8 segments received a score of 3 (1 bank nil, 1 bank high, or 1 bank low and 1 bank moderate) and accounted for 16% of the stream length. Six stream segments had relatively low impacts receiving a score of 4 for having both banks low, or 1 bank nil and 1 bank moderate. Only 5% of the 19.8 km had levels of impact considered to be nil on one bank and low on the other.

Table 13. Coldstream Creek summary of Level of Impact. Values shown below are based on SHIM field inventory and analysis of ~19.8 linear km of Coldstream Creek within the District of Coldstream

Segments	SHIM Impact Score	Length (m)	Percentage of stream length	Weighted Score
30, 31, 34	0	1179.2	6%	0.00
1, 13, 14, 18, 19, 21, 22, 24, 26, 32, 33	1	3949.1	20%	0.20
2, 4, 12, 20, 23, 25, 35, 37, 38, 39, 40	2	5495.6	28%	0.56
6, 11, 15, 16, 27, 29, 36, 41	3	3155.0	16%	0.48
3, 5, 7, 10, 17, 28	4	4918.1	25%	0.99
8, 9, 42	5	1078.7	5%	0.27
N/A	6		0%	0.00
			Weighted Score	**2.50**
			Stream Grade	**41.69%**

4.1.6 Preliminary Prioritization of Channel and Riparian Rehabilitation

The SHIM survey of Coldstream Creek revealed that approximately 17.6 km, or 89% of the total surveyed stream length, has been modified to some degree. Modifications ranged from channelized sections with retaining walls, encroachment to the top of bank and lack of riparian vegetation, to rural areas with unrestricted livestock access for entire segment lengths. Coldstream Creek has also been channelized through much of its length, with earth berms occurring along both banks and only a narrow band of native vegetation as the stream flows through agricultural properties. Modifications instream and along the stream banks result in impacts to the watercourse, such as non-point-source pollution, sedimentation and associated degradation to water quality and fish habitat.

Opportunities to restore instream and riparian habitats are limited in some areas due to close proximity to transportation infrastructure, such as where the railway or highway is located at or near the stream's top of bank. There are also limitations where the creek flows through private properties. Over time, possibly through the development application process within the District of Coldstream, it may be possible to remove retaining wall structures, re-grade banks and revegetate riparian areas on a property-by-property basis. Improvements in watershed stewardship and education to stream-side property owners may be beneficial, to help address riparian vegetation removal, yard waste, debris, bank protection works and overall encroachment within the riparian area.

Opportunities for re-vegetating riparian areas with native vegetation and stabilizing banks with bioengineering techniques are present throughout Coldstream Creek. There are several areas where the stream flows through fields with an absence of riparian structure. Willow live-staking along Coldstream Creek throughout these segments that may be largely comprised of grasses would help to provide shade, bank stability and fish and wildlife habitat. It is also key to establish livestock exclusion fencing along those segments, which currently exhibit unrestricted livestock access (Segments 24, 30, 31, 34, and 42 in their entirety, while shorter sections of livestock access occur in other segments). While the livestock observed in these areas may be in smaller numbers, from 2 head of cattle observed in Segment 30 to nearly a dozen horses in Segment 24, the impacts to the

stream bank and riparian areas are extensive and persistent. Fencing of the above 5 segments alone would be a step to restoring approximately 2.4 km of stream.

Throughout Coldstream Creek, it was frequently noted that fencing occurred at the top of bank, with lack of riparian vegetation beyond the top of bank and subsequent erosion, as well as an absence of a vegetated buffer to help mitigate for runoff from fields into Coldstream Creek. Fencing should be located such that it allows for a wider riparian band between adjacent landuse and Coldstream Creek. The Provincial Riparian Areas Regulation could be used as a guideline for determining riparian setbacks, which would generally be based on 3 times the channel width in determining the Zones of Sensitivity (ZOS) for large woody debris (LWD), bank stability, channel movement, shade and litter fall and insect drop (the RAR methodology is described briefly below).

Many of the disturbed and modified stream segments, riverine wetlands, and riparian associations along Coldstream Creek have a high capability to regenerate in conjunction with remedial efforts such as bank stabilization and riparian planting.

To assist in the prioritization of sites, where rehabilitative efforts would realize the greatest potential net benefits in habitat and potential water quality improvements, key areas were extracted using the SHIM data. Recognizing that erosion is the prevalent symptom of stream channel and habitat impairment (i.e., encroachment, unfettered livestock access, channelization, riparian removal etc.), Ecoscape extracted key problem areas according to erosion using the following criteria:

Severity of erosion:
1. Length of erosion > 100 m and/or
2. Height of erosion > 3 m and/or
3. Exposure Area > 40 m^2

Incidents of erosion not meeting the above criteria were excluded, highlighting the areas of greatest concern. This is illustrated in Map Set 2. Where general clusters of erosion features fulfilling the above criteria occurred within a segment a priority area was identified. In addition, individual severe erosion features, such as those occurring along both banks of an entire segment accompanied by unfettered livestock access were flagged as priority sites.

This preliminary exercise extracted a total of 22 Priority Areas (Map Set 2). Of these, 11 sites were classified as Highest Priority, six (6) sites classified as Moderate Priority, and five (5) sites classified as Lowest Priority. It should be noted that water quality parameters collected during water sampling by the Ministry of Environment have not been factored into this analysis. However, such a review may be carried out simply by over-laying such water quality data points onto the maps supplied (Map Set 2), which may corroborate the preliminary site prioritizations as shown or identify additional key areas.

4.1.7 Riparian Setbacks

The detailed assessment methodology under the Provincial Riparian Areas Regulation (RAR) utilizes a number of factors to determine riparian setbacks based on the site potential vegetation type (SPVT) and channel type, including the Zones of Sensitivity (ZOS) for:

- Large woody debris, bank and channel stability,
- Litterfall and insect drop, and
- Shade.

As an example, the zones of sensitivity for a stream reach (segment) with a SPVT of treed and a riffle-pool channel morphology would be as follows:

- Large woody debris, bank and channel stability = 3 x Channel width (min. 10m / max. 15m)
- Litterfall and insect drop = 3 x Channel width (min. 10m / max. 15m)
- Shade = 3 x Channel width (max. 30m)

From this, the Streamside Protection and Enhancement Area (SPEA) is determined by the largest calculated zone of sensitivity within respective reaches.

Ecoscape collected channel measurements frequently along Coldstream Creek to determine the averages for wetted widths and bankfull widths for segment information, and to provide an estimate of what the riparian setback may be along a given segment. This analysis is intended to suggest preliminary SPEAs (minimum setbacks) within each segment of the surveyed stream length. However, SPEA values determined are not intended to eliminate the requirement for site specific property assessments of proposed development adjacent Coldstream Creek, and subsequent detailed SPEA determination using legal surveys. Based on experience on other watercourses, the estimated SPEA using SHIM channel information (collected by Ecoscape) has resulted in SPEA estimates being generally within +/- 0.5m of that determined during site specific detailed RAR assessments. Having the approximate SPEA for various segments throughout Coldstream Creek will be a valuable tool for District of Coldstream staff when evaluating development applications.

Table 14. Preliminary riparian setback analysis of Coldstream Creek by stream segment using SHIM (2009) bankfull (channel) measurements.

Reach	Length (m)	Channel Width (m)	Zones of Sensitivity[1]			Streamside Protection Enhancement Area (SPEA)	Enhancement Opportunity Rating
			Litter and Insect Drop (3 x Chan. Width/ min. 10m max 15m)	Bank and Channel Stability (3x Chan. Width/min. 10m-max 30m)	Shade (3x Chan. Width max 30m)		
1	127	4.4	13.2	13.2	13.2	**13.2**	Low
2	806	4.8	14.4	14.4	14.4	**14.4**	Low
3	468	6.4	15	15	19.2	**19.2**	Moderate
4	269	6.3	15	15	18.9	**18.9**	Low
5	1772	6.3	15	15	18.9	**18.9**	Low
6	134	4.9	14.7	14.7	14.7	**14.7**	Moderate
7	866	6.7	15	15	20.1	**20.1**	Low
8	318	6.9	15	15	20.7	**20.7**	Low

9	137	6.1	15	15	18.3	**18.3**	Low
10	935	6	15	15	18	**18**	Low
11	833	6.2	15	15	18.6	**18.6**	High
12	548	6.6	15	15	19.8	**19.8**	High
13	154	6	15	15	18	**18**	High
14	157	5.2	15	15	15.6	**15.6**	High
15	174	18	15	30	30	**30**	Low
16	268	5	15	15	15	**15**	Low
17	556	4.2	12.6	12.6	12.6	**12.6**	Low
18	521	3.7	11.1	11.1	11.1	**11.1**	Moderate
19	101	6	15	15	18	**18**	Moderate
20	222	32	15	30	30	**30**	Moderate
21	222	6.2	15	15	18.6	**18.6**	Moderate
22	418	4.8	14.4	14.4	14.4	**14.4**	Moderate
23	468	5.2	15	15	15.6	**15.6**	Moderate
24	870	5	15	15	15	**15**	High
25	1528	5.5	15	15	16.5	**16.5**	Moderate
26	744	4.8	14.4	14.4	14.4	**14.4**	Moderate
27	334	4.4	13.2	13.2	13.2	**13.2**	Moderate
28	322	4.4	13.2	13.2	13.2	**13.2**	High
29	649	3.8	11.4	11.4	11.4	**11.4**	High
30	326	2.6	10	10	10	**10**	High
31	333	3.5	10.5	10.5	10.5	**10.5**	High
32	186	3.3	10	10	10	**10**	Moderate
33	450	3	10	10	10	**10**	High
34	521	3.4	10.2	10.2	10.2	**10.2**	High
35	276	4.2	12.6	12.6	12.6	**12.6**	High
36	400	5.4	15	15	16.2	**16.2**	Moderate
37	231	5.8	15	15	17.4	**17.4**	Moderate
38	458	3.5	10.5	10.5	10.5	**10.5**	Moderate
39	304	4	12	12	12	**12**	Low
40	385	4.4	13.2	13.2	13.2	**13.2**	Low
41	363	5.7	15	15	17.1	**17.1**	Low
42	623	4.3	12.9	12.9	12.9	**12.9**	Moderate

1. Zones of Sensitivity have been determined based on the Channel Type for all segments being riffle pool – based on stream gradients. Site Potential Vegetation Type (SPVT) is treed.

4.2 Brewer Creek

4.2.1 Stream Primary Character

Brewer Creek (Watershed Code 310-939400-15400-44200-0550) is an approximately 8.6 km long tributary to Coldstream Creek. Brewer Creek enters Coldstream Creek approximately 14.3 km upstream from the confluence of Kalamalka Lake and Coldstream Creek. The SHIM survey focused on the length of Brewer Creek occurring within the District of Coldstream municipal boundaries, which is approximately 3.5 km. Brewer Creek was broken into 11 segments. The primary character of Segments 1 through 8 was classified as being modified, accounting for ~2.2 km, or nearly 63% of the SHIM stream length (Table 15). Segments 9, 10 and 11 at the upstream end of the study boundary were classified as natural, with limited anthropogenic disturbance and well-established riparian areas.

A total of seven (7) culverts were documented along the SHIM length of Brewer Creek, for a total of 88 m of stream culverted, or 3% of the stream length. Culverts did not appear to pose a barrier to fish passage, although no flows were observed in Brewer Creek during the field survey downstream of Dawe Road.

Table 15. Brewer Creek summary of Primary Stream Character. Values shown below are based on SHIM field inventory and analysis of ~3.5 linear km of Brewer Creek within the District of Coldstream

Segments	Primary Character	Length (m)	Percentage of stream length
1, 2, 3, 4, 5, 6, 7, 8	Modified	2195.8	63%
9, 10, 11	Natural	1297.9	37%

4.2.2 Stream Channel and Hydraulic Character

Approximately 2.9 km, or 83%, of the SHIM stream length of Brewer Creek has a riffle-pool hydraulic character (Table 16). While the stream was not flowing during the field survey, Segments 1 and 2 were classified as runs. As the stream gradient increased with Segment 10 to a step-pool morphology, this segment was classified as cascade-pool according to the data dictionary.

The average channel gradient throughout Segments 1 through 8 of Brewer Creek was around 1% (Table 17). The average stream gradient from Segments 9 through 11 was 9.3%, with a minimum average grade, through these upper segments, of 5% and a maximum of 18%. The bankfull width was relatively consistent throughout the SHIM stream length, averaging 2.4 m in Segments 1 through 8 and 3.4 m wide towards the upstream end of the survey stream length (approaching the municipal boundary).

Table 16. Brewer Creek summary of hydraulic character. Values shown below are based on SHIM field inventory and analysis of ~3.5 linear km of Brewer Creek within the District of Coldstream.

Segments	Hydraulic Character	Length (m)	Percentage of stream length
3, 4, 5, 6, 7, 8, 9, 11	Riffle/Pool	2892.4	83%
1, 2	Run	511.2	15%
10	Cascade/Pool	90.1	3%

Table 17. Brewer Creek stream channel summary. Values shown below are based on SHIM field inventory and analysis of ~3.5 linear km of Brewer Creek within the District of Coldstream.

	Gradient (%)			Stream Channel		
Segments	Average	Min	Max	Mean Bankfull Width (m)	Min (m)	Max (m)
1 through 8	1.2	1.0	2.5	2.4	1.8	3.0
9 through 11	9.3	5.0	18.0	3.4	3.2	3.6

4.2.3 Instream Habitat Cover and Complexity

Approximately 34% of the SHIM stream length was noted to provide structural instream cover for fish (Table 18). Over 600 m of stream provided total instream cover between 51 and 75%, located in the upper limits of the study area in Segment 11. Large woody debris was the prominent fish habitat feature recorded in this segment accounting for about 40% of the total cover, while small woody debris and deep pools followed with 25% and 15% respectively. Segment 10 exhibited percent total cover between 41% and 50%, while six (6) segments had total cover estimates between 21% - 40%, accounting for over 400 m of stream length. Only three (3) segments were estimated to have a total percentage of the wetted area occupied by cover of less than 20%, accounting for only 4% of the surveyed stream length.

Table 18. Brewer Creek summary and distribution of instream cover/habitat complexity. Values shown below are based on SHIM field inventory and analysis of ~3.5 linear km of Brewer Creek within the District of Coldstream.

		Combined Segment Length (m)	Percentage of SHIM Stream Length	Percentage of Total cover by Cover Type [a]						
Segment Number	% Total Cover			B	DP	IV	LWD	OV	SWD	UC
7	<10%	44.1	1%	20%	5%	0%	0%	30%	35%	10%
5, 6	11-20%	103.0	3%	19%	11%	9%	0%	46%	7%	8%
1, 2, 3, 4, 8, 9	21-40%	406.3	12%	4%	14%	7%	24%	33%	15%	2%
10	41-50%	40.5	1%	50%	15%	0%	30%	5%	0%	0%
11	51-75%	604.3	17%	5%	15%	0%	40%	10%	25%	5%

a. Cover codes: B=boulder; DP=deep pool; IV=instream vegetation; LWD=large woody debris; OV=overstream vegetation; SWD=small woody debris; UC=undercut bank

4.2.4 Watercourse and Habitat Features

The following section summarizes feature data collected and nested within the line segments. All features are measured and recorded individually and provide a more robust and quantitative measure of watercourse impairment and habitat quality.

4.2.4.1 Modifications

Modifications to the stream channel and riparian area occurred over 961 m, or 28% of the surveyed length of Brewer Creek (Table 19). Modifications had a cumulative linear measurement of approximately 712 m along the left bank and 724 m along the right bank. Retaining walls/bank stabilization and riprap accounted for 64% of the left bank modifications and over 66% of right bank modifications. There were several stream crossings, fencing and bank armouring throughout the residential areas of Brewer Creek, where the stream is largely confined as it flows through private properties. Bridge crossings numbered 28 along Brewer Creek and 12 fence crossings were documented.

Table 19. Brewer Creek Summary of artificial features/modifications. Features and values shown below are based on SHIM field inventory (2009) and analysis of ~3.5 linear km of creek within the District of Coldstream.

	Left Bank			Right			Instream		
Type	Length (m)	% of total length of modifications	% of SHIM stream length	Length (m)	% of total length of modifications	% of SHIM stream length	Length (m)	% of total length of modifications	% of SHIM stream length
Bridge	72.0	7.5%	2.1%	72.0	7.5%	2.1%	0.6	0.1%	0.0%
Dam							0.6	0.1%	0.0%
Fences	2.7	0.3%	0.1%	2.7	0.3%	0.1%	1.3	0.1%	0.0%
Garbage/Pollution	16.3	1.7%	0.5%	7.5	0.8%	0.2%	1.9	0.2%	0.1%
Livestock Access*									
Other	3.8	0.4%	0.1%	3.8	0.4%	0.1%			
Pipe Crossing	0.0	0.0%	0.0%	0.0	0.0%	0.0%			
Retaining Wall/Bank Stabilization	345.3	35.9%	9.9%	394.7	41.1%	11.3%			
Rip rap	271.8	28.3%	7.8%	243.4	25.3%	7.0%			
Trail							1.8	0.2%	0.1%
Water Withdrawal				1 along right bank					
	711.88			724.08			6.20		

*Unsure of extent of cattle use; excrement noted along bank and adjacent trail

4.2.4.2 Discharges/Waterbodies

There were only five (5) discharges identified along Brewer Creek. Three (3) were classified as storm drains and two (2) as tile drains. All tile drains had a diameter of 0.10 m, while perceived storm drains varied from 0.10 to 0.30 m. During the field survey, one storm drain was flowing in Segment 7 near Dawe Road, while the stream channel itself was dry. One pvc tile drain was flowing in Segment 8; downstream of this discharge Brewer Creek was dry, and low flows became consistent upstream of this discharge.

Two waterbody features recorded as natural springs were documented in the upper segments of Brewer Creek during the field survey. Defined channels occurred, although neither feature was flowing at time of survey.

4.2.4.3 Bank Stability and Erosion

Low bank stability was recorded for Segments 4 and 8, where encroachment to the top of bank contributed to bank instability and consistent erosion. Along the left bank, minor to intermediate severity erosion occurred on just over 18% of surveyed stream length. The right bank was comparable with just over 17% eroding (Table 20).

Bank stability was recorded as "medium" in 8 of the 11 segments occurring along Brewer Creek, often attributed to anthropogenic bank stabilization efforts. Segment 10, where the falls occur, had high bank stability associated with bedrock banks.

In contrast to Coldstream Creek, livestock access was not a contributing factor to erosion along Brewer Creek. Livestock access was documented to occur in the upper, natural segments of Brewer Creek, where sporadic presence of fecal matter was noted, although noticeable impacts on the stream banks was not documented during the fall survey.

Table 20. Summary of bank erosion recorded along Brewer Creek. Features and values shown below are based on SHIM field inventory (2009) and analysis of ~3.5 linear km of creek within the District of Coldstream.

Left Bank					Right Bank				
Length (m)	Average Height (m)	Area (m^2)	Average Area of Exposure (m^2)	Percent of SHIM stream length	Length (m)	Average Height (m)	Area (m^2)	Average Area of Exposure (m^2)	Percent of SHIM stream length
634.2	1.2	673.4	29.3	18.2%	607.8	1.1	654.1	31.2	17.4%

4.2.4.4 Fish Habitat

No incidental fish observations were made during the 2009 field survey of Brewer Creek. However, active fish sampling methods were not employed.

Fish habitat features recorded throughout Brewer Creek were limited to a combined measured length of about 230 m, of which large woody debris accounted about 77% (Table 21). Overstream vegetation and deep pools had the next highest relative distribution, at approximately 16% and 6% respectively. The sum of individual areas of measured habitat features totaled 714 m^2.

Fish habitat features were generally limited throughout residential areas of Brewer Creek, with most features recorded in upper sections where the stream character was more natural and there was good recruitment of woody debris. Large woody debris features were typically associated with scour pools and presence of small woody debris.

Segments 1 to 9 were primarily dry during the field survey. Residents along Brewer Creek explained that flows are generally limited to 5 - 6 weeks during and following spring freshet.

Table 21. Summary of habitat features. Values shown below are based on SHIM field inventory (2009) and analysis of ~3.5 linear km of Brewer Creek within the District of Coldstream.

Type	Combined Length (m)	Mean Width (m)	Combined Area (m^2)	Mean wetted Depth (m)	Percent of SHIM stream length	Relative area Distribution
Boulder	0.0	0.0	0.0	0.0	0.0%	0.0%
Deep Pool	24.3	1.8	45.1	0.3	0.7%	6.3%
Instream Vegetation	0.0	0.0	0.0	0.0	0.0%	0.0%
Over Stream Vegetation	48.0	3.1	113.6	0.1	1.4%	15.9%
Undercut Bank	0.0	0.0	0.0	0.0	0.0%	0.0%
Small Woody Debris	1.3	1.8	2.3	0.0	0.0%	0.3%
Large Woody Debris	156.5	3.4	553.0	0.2	4.5%	77.4%
Spawning Gravel	0.0	0.0	0.0	0.0	0.0%	0.0%
Total	**230.10**		**714.05**		**6.59%**	

4.2.4.5 Obstructions / Barriers

In addition to the lack of continuous stream flows, a total of 11 potential obstructions to fish passage were documented along Brewer Creek within the District of Coldstream municipal limits (Table 22). Persistent debris was the most common type of obstruction noted, with two potential obstructions occurring at approximately 460 m and 730 m upstream of the confluence with Coldstream Creek. All other obstructions occurred in Segments 10 and 11, with bedrock falls in Segment 10 posing the only definite barrier to fish passage.

Table 22. Brewer Creek summary of potential obstructions/barriers to upstream fish migration. Features and values shown below are based on SHIM field inventory (2009) and analysis of ~3.5 linear km of creek within the District of Coldstream.

Type	# of obstructions occurring	Barrier	Cumulative Length (m)	Mean Wetted Width (m)	Mean Depth (m)	Mean Height (m)
Falls	1	Yes	5.0	2.6	0.04	2.3
Persistent Debris	10	4 potential, 6 unknown	37.9	4.2	0.2	1.2
		Total	42.9			

4.2.5 Stream Impact Summary

The sum of weighted SHIM scores equaled 3.7 (out of 6), with Brewer Creek receiving a stream grade of 61% (Table 23). Segment 7 was the only segment to receive a score of 0, based on the high anthropogenic impacts occurring as the stream flows through private residential properties. The natural conditions of Segments 10 and 11 resulted in stream scores of 6, indicating that impacts were relatively nil along the approximately 1.2 km of stream length.

Table 23. Brewer Creek summary of Level of Impact. Values shown below are based on SHIM field inventory and analysis of ~3.5 linear km of Brewer Creek within the District of Coldstream.

Segments	SHIM Impact Score	Length (m)	Percentage of stream length	Weighted Score
7	0	440.8	13%	0.00
N/A	1	N/A	N/A	N/A
4, 5, 6	2	781.0	22%	0.45
1, 2	3	511.2	15%	0.44
3	4	296.3	8%	0.34
8, 9	5	275.6	8%	0.39
10, 11	6	1188.8	34%	2.04
			Weighted Score	**3.66**
			Stream Grade	**61.02%**

4.2.6 Opportunities and Constraints – Overview

With approximately 63% of Brewer Creek being modified to some extent, the condition of this watercourse would improve with increased stewardship from adjacent private landowners. Items to address include overall expansion and naturalization of the riparian area along both banks, as well as erosion mitigation, and ceasing the dumping of yard waste over the banks into the channel. On an individual property basis, retaining structures and bank stabilization should be removed, in favour of bank re-grading, bio-engineering and riparian revegetation.

Segments 9, 10 and 11 are in a relatively natural state and no enhancement measures are recommended. There is potential along Segments 1 to 3 to naturalize the stream channel, creating sinuosity where Brewer Creek has been channelized/confined, and restore and enhance wetland complexes that occur between the channelized Brewer Creek and Coldstream Creek near their confluence. While the extents of wetland features in this area were not captured within the scope of this SHIM survey of centerline and top of bank, they are visible from the available ortho-imagery and surface water connections to Coldstream Creek were picked up as waterbody features in the SHIM survey. Conservation and enhancing the biological function of these features should be a priority.

4.2.7 Riparian Setbacks

As described in Section 4.1.7 for estimated riparian setbacks along Coldstream Creek, stream channel measurements were recorded throughout the SHIM survey of Brewer Creek. Table 24 provides a riparian setback analysis based on the average bankfull widths recorded for each of the 11 stream segments and based on the RAR detailed assessment methodology for determining SPEA widths.

This analysis is intended to suggest preliminary SPEAs (minimum setbacks) within each segment of the surveyed stream length. However, SPEA values determined are not intended to eliminate the requirement for site specific property assessments of proposed

development adjacent Brewer Creek, and subsequent detailed SPEA determination using legal surveys. Given the steep ravine in the upper segments of Brewer Creek, setbacks would be based from top of ravine, rather than high water level of Brewer Creek. Furthermore, additional professional studies would be required to address slope stability in prescribing an appropriate setback.

Table 24. Preliminary riparian setback analysis of Brewer Creek by stream segment.

			Zones of Sensitivity[1]				
Reach	Length (m)	Channel Width (m)	Litter and Insect Drop (3 x Chan. Width/ min. 10m max 15m)	LWD/Bank and Channel Stability (3x Chan. Width/min. 10m-max 30m Riffle Pool, 2X channel width, min 10m, max 15 m Cascade-pool)	Shade (3x Chan. Width max 30m)	Streamside Protection Enhancement Area (SPEA)	Enhancement Opportunity Rating
1	346.5	2.3	10	10	10	**10**	Low
2	164.7	2.5	10	10	10	**10**	Moderate
3	296.3	2.7	10	10	10	**10**	Moderate
4	94.4	3.3	10	10	10	**10**	Moderate
5	495.6	1.8	10	10	10	**10**	Moderate
6	190.9	2.2	10	10	10	**10**	Moderate
7	440.8	2.5	10	10	10	**10**	Moderate
8	166.5	3	10	10	10	**10**	Low
9	109.1	3.2	10	10	10	**Ravine**	Low
10	90.1	3.6	10.8	10	10.8	**Ravine**	Nil
11	1098.7	3.5	10.5	10	10.5	**Ravine**	Nil

1. Zones of Sensitivity have been determined based on the Channel Type for most segments being riffle pool and Segment 10 being step pool and Segments 9 and 11 being cascade pool – based on RAR stream gradients. Site Potential Vegetation Type (SPVT) is treed.

4.3 Craster Creek

4.3.1 Stream Primary Character

Craster Creek (Watershed Code 310-939400-15400-44200) is an approximately 13.2 km long tributary to Coldstream Creek. Craster Creek enters Coldstream Creek approximately 15.1 km upstream from the confluence of Kalamalka Lake and Coldstream Creek. The SHIM survey focused on the length of Craster Creek occurring within the District of Coldstream municipal boundaries, which is approximately 3 km. Craster Creek was broken into 12 segments. Nearly 20% of the stream length is described as channelized, including Segments 1, 2, and 5 (Table 25). An additional 57.5%, or 1.7 km, of Craster Creek is characterized as modified, although the primary character is not channelized. The remaining 23% of SHIM stream length has a natural primary character.

Only three (3) culverts were documented along the SHIM length of Craster Creek, for a total of 80.5 m of stream culverted, or 3% of the stream length. Two of the culverts were noted to be unknown or potential barriers to fish passage as the inlet was not clearly visible and/or the culvert was angled under the road.

Table 25. Craster Creek summary of Primary Stream Character. Values shown below are based on SHIM field inventory and analysis of ~3 linear km of Craster Creek within the District of Coldstream.

Segments	Primary Character	Length (m)	Percentage of stream length
1, 2, 5	Channelized	594.4	19.7%
3, 4, 6, 7, 8, 10	Modified	1733.7	57.5%
9, 11, 12	Natural	687.35	23%

4.3.2 Stream Channel and Hydraulic Character

Approximately 2.5 km, or 84%, of the SHIM stream length of Craster Creek has a riffle-pool hydraulic character (Table 26). Segment 1 was classified as a run, representing 6% of the SHIM stream length, and the remaining 10% consisted of a riffle for approximately 295 m in Segment 5.

The average channel gradient throughout Craster Creek was around 2% (Table 27), with a minimum of 1% and a maximum of 4.5% in the upper reaches of Craster Creek within the study boundary. The mean bankfull width was 3.9 m, while the minimum average width recorded was 1.7 in Segment 5 and the maximum 6.7 m in Segment 11.

Table 26. Craster Creek summary of hydraulic character. Values shown below are based on SHIM field inventory and analysis of ~3 linear km of Craster Creek within the District of Coldstream.

Segments	Hydraulic Character	Length (m)	Percentage of stream length
5	Riffle	295.7	10%
2, 3, 4, 6, 7, 8, 9, 10, 11, 12	Riffle/Pool	2527.4	84%
1	Run	192.3	6%

Table 27. Craster Creek stream channel summary. Values shown below are based on SHIM field inventory and analysis of ~3 linear km of Craster Creek within the District of Coldstream.

	Gradient (%)			Stream Channel		
Segments	Average	Min	Max	Mean Bankfull Width (m)	Min (m)	Max (m)
1 to 12	2.0%	1.0%	4.5%	3.9	1.7	6.7

4.3.3 Instream Habitat Cover/Complexity

Approximately 32% of the SHIM stream length was noted to provide structural instream cover for fish (Table 28). Total cover within any of the 12 identified segments was not estimated in excess of 40% of the wetted area. A total of 10 segments were estimated to exhibit total cover between 21% - 40%, equating to nearly 915 m of stream length. Segment 1, located in a channelized portion of stream confined by the railway along the right bank and weedy field with unrestricted livestock access on the left bank, was estimated to have only 10% total cover. Distribution of cover type was relatively consistent in Segment 5, which was estimated to have 20% cover throughout the 219 m segment. The lower reaches of Craster Creek were dry during the field survey.

Table 28. Craster Creek summary and distribution of instream cover/habitat complexity. Values shown below are based on SHIM field inventory and analysis of ~3 linear km of Craster Creek within the District of Coldstream

Segment Number	% Total Cover	combined Segment Length (m)	Percentage of SHIM Stream Length	Percentage of Total cover by Cover Type [a]						
				B	DP	IV	LWD	OV	SWD	UC
1	≤10%	19.2	1%	0%	0%	0%	0%	75%	25%	0%
3	11-20%	43.8	1%	15%	15%	5%	20%	25%	20%	0%
2, 4, 5, 6, 7, 8, 9, 10, 11, 12	21-40%	914.8	30%	11%	13%	0%	34%	20%	15%	7%

a. Cover codes: B=boulder; DP=deep pool; IV=instream vegetation; LWD=large woody debris; OV=overstream vegetation; SWD=small woody debris; UC=undercut bank

4.3.4 Watercourse and Habitat Features

The following section summarizes feature data collected and nested within the line segments. All features are measured and recorded individually and provide a more robust and quantitative measure of watercourse impairment and habitat quality.

4.3.4.1 Modifications

Modifications to the stream channel and riparian area occurred over approximately 1.4 km, or 48% of the surveyed length of Craster Creek (Table 29). Modifications had a cumulative linear measurement of approximately 267 m along the left bank, 265 m along the right bank, and 943 m instream. Instream modifications were largely attributed to livestock access, which occurred over 916 m of Craster Creek. While three of the livestock access points documented livestock enclosures with consistent stream access, 520 m are attributed to upper segments of Craster Creek where cattle excrement was documented sporadically along and within the stream channel. Unlike other stream segments, where retaining walls/ bank stabilization and riprap accounted for the majority of modifications, bank armouring only accounted for 15.7% and 15% of left and right bank modifications respectively. The downstream end of Segment 5 flows through a concrete flume under a building and is further channelized and lacking riparian structure and function throughout the remainder of the segment.

Table 29. Craster Creek Summary of artificial features/modifications. Features and values shown below are based on SHIM field inventory (2009) and analysis of ~3 linear km of creek within the District of Coldstream.

	Left Bank			Right			Instream		
Type	Length (m)	% of total length of modifications	% of SHIM stream length	Length (m)	% of total length of modifications	% of SHIM stream length	Length (m)	% of total length of modifications	% of SHIM stream length
Bridge	11.5	0.8%	0.4%	11.5	0.8%	0.4%	16.0	1.1%	0.5%
Channelization	20.0	1.4%	0.7%	20.0	1.4%	0.7%			
Dam							0.3	0.0%	0.0%
Fences	0.8	0.1%	0.0%	0.8	0.1%	0.0%	4.2	0.3%	0.1%
Garbage/Pollution	8.5	0.6%	0.3%	8.0	0.6%	0.3%	6.2	0.4%	0.2%
Livestock Access							916.5	63.5%	30.4%
Pipe Crossing	0.2	0.0%	0.0%	9.2	0.6%	0.3%			
Retaining Wall/Bank Stabilization	114.1	7.9%	3.8%	87.7	6.1%	2.9%			
Rip rap	112.1	7.8%	3.7%	128.0	8.9%	4.2%			
	267.2			265.2			943.20		

4.3.4.2 Discharges/Waterbodies

A total of two (2) discharges were identified along Craster Creek, both of which were flowing during the field survey. Both storm drains had a diameter of 0.3 m.

One approximately 23 m long side channel was recorded along Craster Creek in Segment 7.

4.3.4.3 Bank Stability and Erosion

Bank erosion was recorded along 921 m, or 30.5% of the left bank of Craster Creek (Table 30). The average height was 1.6 m, with a total area of exposure of 1446 m^2. The right bank of Craster Creek was similar, with erosion to some degree occurring along 787 m of the SHIM stream length. The average height was also 1.6 m and the total area of exposure was approximately 1129 m^2. Frequent erosion occurred through residential areas of Craster Creek, where encroachment to the top of bank and riparian vegetation removal are common. Bank stability was recorded as "medium" for 11 of the 12 segments occurring along Craster Creek. Bank stability was characterized as "low" in Segment 4, with frequent erosion and embeddedness of stream substrates noted.

Erosion occurring within Segments 11 and 12 can largely be attributed to natural stream processes and is relatively minor, with the exception of a 4.5 m high eroding bank towards the downstream end of Segment 11.

Table 30. Summary of bank erosion recorded along Craster Creek. Features and values shown below are based on SHIM field inventory (2009) and analysis of ~3 linear km of creek within the District of Coldstream.

Left Bank					Right Bank				
Length (m)	Average Height (m)	Area (m^2)	Average Area of Exposure (m^2)	Percent of SHIM stream length	Length (m)	Average Height (m)	Area (m^2)	Average Area of Exposure (m^2)	Percent of SHIM stream length
921.0	1.6	1446.0	68.9	30.5%	787.0	1.6	1129.4	49.1	26.1%

4.3.4.4 Fish Habitat

Fish habitat features recorded throughout Craster Creek were limited to approximately 190 m, with nearly 52% consisting of large woody debris (Table 31). Overstream vegetation had a relative area distribution around 31%, largely attributed to dense shrub growth throughout Segment 7. Deep pools had the next highest relative abundance, with nearly 10% total cover, and small woody debris features accounted for nearly 8% of recorded fish habitat features. The combined area for recorded habitat features totaled 521 m^2.

Large woody debris features were typically associated with scour pools, as well as the presence of small woody debris. Deep pools recorded were deep relative to the segment and stage of flows, ranging from 0.5 m to 1.5 m.

Incidental observations of rainbow trout fry occurred towards the upstream segments of Craster Creek.

Table 31. Summary of habitat features. Values shown below are based on SHIM field inventory (2009) and analysis of ~3 linear km of Craster Creek within the District of Coldstream

Type	Combined Length (m)	Mean Width (m)	Combined Area (m^2)	Mean wetted Depth (m)	Percent of SHIM stream length	Relative area Distribution
Boulder	0.0	0.0	0.0	0.0	0.0	0.0
Deep Pool	22.6	2.2	51.5	0.9	0.7%	9.9%
Instream Vegetation	0.0	0.0	0.0	0.0	0.0	0.0
Over Stream Vegetation	80.0	2.0	160.0	0.0	2.7%	30.7%
Undercut Bank	0.0	0.0	0.0	0.0	0.0	0.0
Small Woody Debris	12.0	3.5	39.9	0.1	0.4%	7.7%
Large Woody Debris	75.2	3.5	269.2	0.2	2.5%	51.7%
Spawning Gravel	0.0	0.0	0.0	0.0	0.0	0.0
Total	**189.80**		**520.60**		**6.30%**	

4.3.4.5 Obstructions / Barriers

No definitive obstructions or barriers to fish passage were documented along Craster Creek within the survey length. A total of three (3) persistent debris obstructions were recorded, consisting of small and large woody debris accumulations, for a total cumulative length of 9.1 m. The average height was 1.2 m.

Table 32. Craster Creek summary of potential obstructions/barriers to upstream fish migration. Features and values shown below are based on SHIM field inventory (2009) and analysis of ~3 linear km of creek within the District of Coldstream

Type	# of obstructions occurring	Barrier	Cumulative Length (m)	Mean Wetted Width (m)	Mean Depth (m)	Mean Height (m)
Persistent Debris	3	3 Potential	9.1	6.1	0.3	1.2

4.3.5 Stream Impact Summary

The sum of weighted SHIM scores equaled 2.95 (out of 6), with Craster Creek receiving a stream grade of 49.1% (Table 33). Segments 1 and 5 received a score of 0, based on the high anthropogenic impacts and channelization of Craster Creek. Segments 9, 11, and 12 received scores of 5 or 6, representing low to nil bank impacts along 23% of the SHIM stream length.

Table 33. Craster Creek summary of Level of Impact. Values shown below are based on SHIM field inventory and analysis of ~3 linear km of Craster Creek within the District of Coldstream.

Segments	SHIM Impact Score	Length (m)	Percentage of stream length	Weighted Score
1, 5	0	488.0	16%	0.00
2, 6	1	216.6	7%	0.07
4	2	480.9	16%	0.32
3, 7	3	561.0	19%	0.56
8, 10	4	581.6	19%	0.77
9, 11	5	423.0	14%	0.70
12	6	264.4	9%	0.53
			Weighted Score	**2.95**
			Stream Grade	**49.13%**

4.3.6 Opportunities and Constraints – Overview

With approximately 48% of Craster Creek being modified to some extent, the condition of this watercourse would benefit from increased stewardship. Riparian restoration and enhancement is somewhat limited by the railway (along right bank in Segments 1 and 2), but in general the riparian area along both banks should be expanded with planting and setback fencing. Retaining structures and bank stabilization should be removed, in favour of re-grading banks, livestaking with willows and vegetating with native riparian trees and shrubs.

Livestock exclusion fencing should be set up where relatively unrestricted livestock access is occurring in Segments 1 and 10. The extent of livestock access in Segments 11 and 12 is unknown. However, cattle excrement was noted to occur within the stream channel periodically.

Segment 5 could be daylighted where Craster Creek flows beneath an outbuilding at the downstream end of the segment. Segment 5 is also lacking in riparian structure upstream of the flumed section under the building and would benefit from live-staking and riparian plantings, with exclusion fencing moved further from the top of bank.

4.3.7 Riparian Setbacks

As described in Section 4.1.7 for estimated riparian setbacks along Coldstream Creek, stream channel measurements were recorded throughout the SHIM survey of Craster Creek. Table 34 provides a riparian setback analysis based on the average bankfull widths recorded for each of the 12 stream segments and based on the RAR detailed assessment methodology for determining SPEA widths.

This analysis is intended to suggest preliminary SPEAs (minimum setbacks) within each segment of the surveyed stream length. However, SPEA values determined are not intended to eliminate the requirement for site specific property assessments of proposed development adjacent Craster Creek, and subsequent detailed SPEA determination using legal surveys. Given the steep ravine in the upper segments (9, 11, and 12) of Craster Creek, setbacks would be based from top of ravine, rather than high water level of Craster Creek. Furthermore, additional professional studies would be required to address slope stability in prescribing an appropriate setback.

Table 34. Riparian setback analysis of Craster Creek by stream segment.

			Zones of Sensitivity[1]				
Reach	Length (m)	Channel Width (m)	Litter and Insect Drop (3 x Chan. Width/ min. 10m max 15m)	LWD/Bank and Channel Stability (3x Chan. Width/min. 10m-max 30m Riffle Pool, 2X channel width, min 10m, max 15 m Cascade-pool)	Shade (3x Chan. Width max 30m)	Streamside Protection Enhancement Area (SPEA)	Enhancement Opportunity Rating
1	192.3	2.6	10	10	10	**10**	Moderate
2	106.4	2.8	10	10	10	**10**	Low
3	218.9	2.7	10	10	10	**10**	Moderate
4	480.9	3.1	10	10	10	**10**	Moderate
5	295.7	1.7	10	10	10	**10**	Moderate
6	110.2	3	10	10	10	**10**	Low
7	342.1	4.1	12.3	12.3	12.3	**12.3**	Moderate
8	158.5	3.7	11.1	11.1	11.1	**11.1**	Low
9	158.5	3.7	11.1	11.1	11.1	**Ravine**	Low
10	423.1	7.3	15	21.9	21.9	**21.9**	Low
11	264.5	6.7	15	13.4	20.1	**Ravine**	Low
12	264.4	5.4	15	10.8	16.2	**Ravine**	Nil

1. Zones of Sensitivity have been determined based on the Channel Type for most segments being riffle pool and Segments 11 and 12 being cascade pool – based on RAR stream gradients. Site Potential Vegetation Type (SPVT) is treed.

5.0 CLOSURE

This report has summarized detailed field inventory data collected during 2009 SHIM surveys within the District of Coldstream. The collection and management of data conformed to the SHIM methodology, which is a standard for fish and aquatic habitat mapping in urban and rural watersheds in British Columbia.

The 2009 inventory has resulted in the development of an up-to-date catalogue of watercourse and habitat features occurring within respective watercourses, which has numerous applications and can be used by the community, stewardship groups, individuals, and the District, as well as senior regulatory agencies. In maintaining the integrity of this SHIM database, periodic field inspections should be carried out to update watercourse and habitat feature mapping.

The inventory that has been summarized within this report was commissioned by and prepared for the District of Coldstream. The collection, processing, and management of data have conformed to SHIM standards. No other warranty is made, either expressed or implied.

Questions or inquires pertaining to SHIM methodology, data, and this summary report should be directed to the undersigned.

Respectfully Submitted,
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