



Off-channel coho habitat created at Pierce Creek, October 2007.

Acknowledgements

This draft document was produced by the Project Team for the Chilliwack River Watershed Strategy as part of the Issues and Alternatives phase of the project. The following individuals are thanked for their invaluable contributions of time and information, which was used in the development of this document:

- Alan Kenney, Pacific Salmon Foundation
- Bob Stanton, Fisheries and Oceans Canada
- Bruce Usher, formerly BC Ministry of Environment
- Chris Gadsden, Chilliwack-Vedder River Cleanup Coalition
- Cory Hryhorczuk, BC Conservation Foundation/ Greater Georgia Basin Steelhead Recovery
- David Barnes, Fisheries and Oceans Canada
- David Lamson, Chilliwack River Action Committee (Project Co-Lead)
- Don Kozak, Chilliwack Fish and Game Protective Association
- Frank Kwak, Fraser Valley Salmon Society
- Greg Wilson, BC Ministry of Environment
- Jack Mussel, Skwah First Nation
- Jack Navak, Chilliwack Fish and Game Protective Association
- Kenji Miyazaki, BC Conservation Foundation/Greater Georgia Basin Steelhead Recovery
- Krista Englund, Fraser Valley Regional District/Fraser Valley Regional Watersheds Coalition (Project Co-Lead)
- Lance Lilley, Fraser Valley Regional District
- Lydia Jaremovic, Fisheries and Oceans Canada
- Mark Johnson, Fisheries and Oceans Canada
- Matt Foy, Fisheries and Oceans Canada
- Sandy Ritchie, Chilliwack Fish and Game Protective Association
- Shannon Sigurdson, Fraser Valley Regional District GIS
- Stacey Webb, Pacific Salmon Foundation
- Terry Bodman, Chilliwack Vedder Cleanup Coalition
- Tom Cadieux, Fisheries and Oceans Canada

This acknowledgement is solely intended to recognize the numerous individuals who contributed to the preparation of this document. These individuals are not responsible for the information or the recommendations made within the document, and the document does not necessarily reflect the opinions or views of all of these individuals. The report is a product of the CRWS Project Team, and it is the Project Team that is ultimately responsible for this document. All feedback should be directed at them and not to the individuals acknowledged above.

Table of Contents

1.0	General Description of the Issue	4
1.1	Need for Restoration.....	4
1.2	Long-term Effectiveness of Restoration Projects	5
1.3	Impacts of Restoration Projects to Other Values.....	5
1.4	Summary of Issues	5
2.0	Specific Locations/Examples	6
3.0	Contributing Factors/Causes.....	9
4.0	Overall Level of Community Concern	9
5.0	Organizations Involved in Restoration/Enhancement in CRW	10
5.1	BCCF/Greater Georgia Basin Steelhead Recovery Program	10
5.2	Chilliwack Fish and Game Protective Association	10
5.3	Chilliwack River Action Committee	11
5.4	Chilliwack Vedder River Cleanup Coalition	11
5.5	Fisheries & Oceans Canada/Chilliwack River Hatchery.....	12
5.6	Forestry Renewal BC.....	12
5.7	Fisheries Renewal BC	12
5.8	Fraser Valley Regional District	12
5.9	Fraser Valley Regional Watersheds Coalition	13
5.10	Fraser Valley Salmon Society	13
5.11	Private Landowners	13
5.12	Soowahlie First Nation.....	13
5.13	South Coast Conservation Program	14
5.14	Steelhead Society Habitat Restoration Corporation	14
6.0	Relevant Jurisdictions, Legislation, Policies & Guidelines	15
6.1	Federal.....	15
6.2	Provincial	18
7.0	Vision & Goals.....	23
7.1	VISION.....	23
7.2	GOALS.....	23
8.0	Options and Analysis	24
8.1	Protect Existing Habitat	26
8.2	Maintain Existing Projects.....	26
8.3	Maintain and Restore Natural Processes and Habitats.....	27
8.4	Protect Other Values	29
9.0	Recommendations	35
10.0	References.....	37
	Appendix A: Chilliwack River Watershed Restoration and Enhancement Projects	38
	Appendix B: Priority Restoration Projects	42

Chilliwack River Watershed Strategy Issues & Alternatives: **FISH HABITAT RESTORATION & ENHANCEMENT**

1.0 General Description of the Issue

1.1 Need for Restoration

Habitat conditions are dynamic and constantly change over time. While these changes may be natural, human activities within a watershed can greatly alter both the rate and the scale of these habitat changes, often resulting in negative consequences for certain flora and fauna within the watershed. As a result, restoring and enhancing habitat to attempt to return the natural environment to some predetermined state of quality has become an important aspect of habitat management. Because of the significance of fish and fisheries within the Chilliwack River Watershed, this report focuses on the restoration and enhancement of fish habitat, particularly for local salmonid populations.

The most effective way to maintain sufficient fish habitat to sustain native species into the future is to protect existing intact habitat (Roni et al., 2002). However, protecting remaining habitat alone will not be sufficient to sustain native salmon stocks over the long term. Therefore, efforts are needed to restore damaged habitats.

Within the Chilliwack River Watershed, fish production is constrained by a number of limiting habitat conditions, including the relative lack of off-channel and mainstem refugia and rearing habitat, reduced quantities of instream large woody debris, bank destabilization, river widening, and increased sediment load.¹ Many of these factors have been affected by human activities. For example, past timber harvesting, development, and dyke/road construction have reduced the abundance/quality of off-channel habitats. Forestry activities (e.g., road construction) may increase soil erosion and sedimentation, nutrient loading, in-stream hydrologic and temperature changes, and decrease water quality.² Forestry is also associated with issues around landslides, large woody debris, fish blockages, and human access to previously inaccessible areas.

In addition to local causes and effects of human activities within the watershed, anthropogenic impacts can also be associated with human activities occurring outside the watershed. For example, anadromous Pacific salmon have been shown to contribute 24-26% of the nitrogen found within riparian vegetation near spawning streams.³ Consequently, declines in salmon abundance due to oceanic conditions, downstream habitat, over fishing, etc, compared to historical levels have lead to a “nutrient subsidy reduction on freshwater habitat productivity”⁴ in certain watersheds.

¹ EBA Engineering Consultants Ltd. 2001.

² BC Ministry of Environment, Environmental Protection Division website. Available: http://www.env.gov.bc.ca/wat/wq/nps/NPS_Pollution/Forestry/forestry.htm (Feb 1, 2007).

³ Helfield and Naiman, 2002

⁴ Stein, no date

In response to these long term human activities and impacts, numerous agencies have conducted restoration projects in the watershed. Between 1995 and 2001, over \$2.3 million dollars was invested by Fisheries Renewal BC into restoration projects in the Chilliwack River Watershed.⁵ Projects have included road deactivations, riparian plantings, landslide rehabilitation/stabilization, and instream or off-channel works (Appendix A).

1.2 *Long-term Effectiveness of Restoration Projects*

While many of these projects have undoubtedly shown a level of success, the effectiveness of some has been reduced over time as a result of natural processes. High water events and landslides can change access to off-channel habitats (e.g., the Foley Creek side channel restoration project was cut off from Foley Creek as a result of the November 6, 2006 floods). Beaver activity (e.g., dam construction) can also reduce or eliminate access and change water flows through past projects.

Human activities impact restoration projects as well. For example, invasive species introduced by humans can change riparian vegetation and recreational activities can disturb soil and vegetation at restoration sites.

1.3 *Impacts of Restoration Projects to Other Values*

Restoration and enhancement projects can have secondary impacts on other values in the watershed. Expanding habitat for salmonids in certain areas can alter existing species assemblages, which can be of concern for endangered species. While some enhancement activities expand recreational opportunities by incorporating trail networks or improving access into an area, others may detract by placing structures that inhibit recreational use (e.g., large woody debris structures in streams). In addition, projects could take place on land that is sensitive from a cultural perspective, either because it is utilized for traditional activities or because it has archaeological significance.

1.4 *Summary of Issues*

As this discussion suggests, there are numerous issues associated with fish habitat restoration and enhancement:

- Ongoing development, road and dike construction, and forestry activities continue to impact fish habitat.
- Beaver activity may reduce the effectiveness of past restoration projects.
- Recreational activities can negatively impact fish habitat.
- Flooding, landslides and other physical processes can reduce the effectiveness of past restoration projects.
- Restoration and enhancement projects may lose effectiveness over time due to changing conditions and maintenance requirements.

⁵ EBA Engineering Consultants Ltd. 2001.

- Creating new fish habitat or enhancing access to existing habitat for salmonids may negatively impact species currently using the habitat (e.g. predation, flooding), some of which might be at risk.
- Placement of large woody debris or other structures into watercourses can prevent movement of commercial and recreational boaters, which are permitted to use these waterways under the *Navigable Waters Protection Act*.
- Restoration projects may affect sensitive cultural or historical values.

2.0 Specific Locations/Examples

Figure 1 shows the priority watersheds for restoration opportunities in the Chilliwack River Watershed, as prepared by EBA Engineering Consultants Ltd (2001), as well as a list of completed in-stream and riparian restoration projects as of 2001. A more complete and up-to-date list of restoration or enhancement projects within the watershed is provided in Appendix A.

Beaver activity is often a problem in newly formed habitat restoration areas, such as the Centennial Channel/Bulbeard complex, Borden Creek, and Yukalup Channel, or low gradient streams like Ryder Creek.⁶ Beavers are attracted to these areas because of the relatively consistent water flows and the fast growing deciduous trees such as alder and willow that form much of the riparian cover. Beavers are a significant enough problem on Ryder Creek that further habitat improvements on the portion of Ryder Creek running through the Chilliwack Fish and Game property may prove useless.⁷ The lower portion of Ryder Creek is almost impassable for upstream migration of coho because of the number of beaver dams. In 2006, access to the creek was maintained to a degree by volunteers from the Chilliwack Fish and Game Protective Association. Despite these efforts, a significant reduction in spawning coho seems to have occurred.

Recreational activity is most likely to cause a concern in areas with good road access, such as along active forestry roads and Chilliwack Lake Road, and in parks. Even restoration sites that have gated access are at risk.

Flooding, clay slides, landslides, and other river processes may cause a problem for restoration projects on high energy systems prone to avulsions, on tributaries with significant land use changes (e.g., from forestry or development), or along portions of the mainstem river between Tamihi and Vedder Crossing, which is geologically less stable due to the historic presence of a glacial lake in this area.

Species-at-risk are spread widely across the Chilliwack River Watershed in both terrestrial and aquatic environments, and in upland and lowland areas (see SCCP website mapping)⁸. Given that most fish habitat restoration projects take place within riparian zones, areas that provide habitat for endangered amphibians, fish, aquatic plants, and

⁶ Barnes, D. Fisheries and Oceans Canada. February 22, 2007. pers. comm..

⁷ Ritchie, Sandy. Chilliwack Fish and Game Protective Association. February 27, 2006. pers. comm.

⁸ Website: www.sccp.ca (accessed March 6, 2007).

aquatic mammals such as shrews, the potential impacts of these projects on species-at-risk needs to be considered.

In terms of conflicts between kayakers/rafters and restoration projects, the main stem of the Chilliwack River as well as popular recreational tributaries (e.g., Tamihi Creek) are likely to be of most concern.

Impacts to cultural values can occur in areas that are still used traditionally by First Nations and areas with archaeological sites. Due to the sensitivity of these sites, this information is not made readily available and efforts must be made to determine where these activities and sites are within the watershed on a case by case basis.

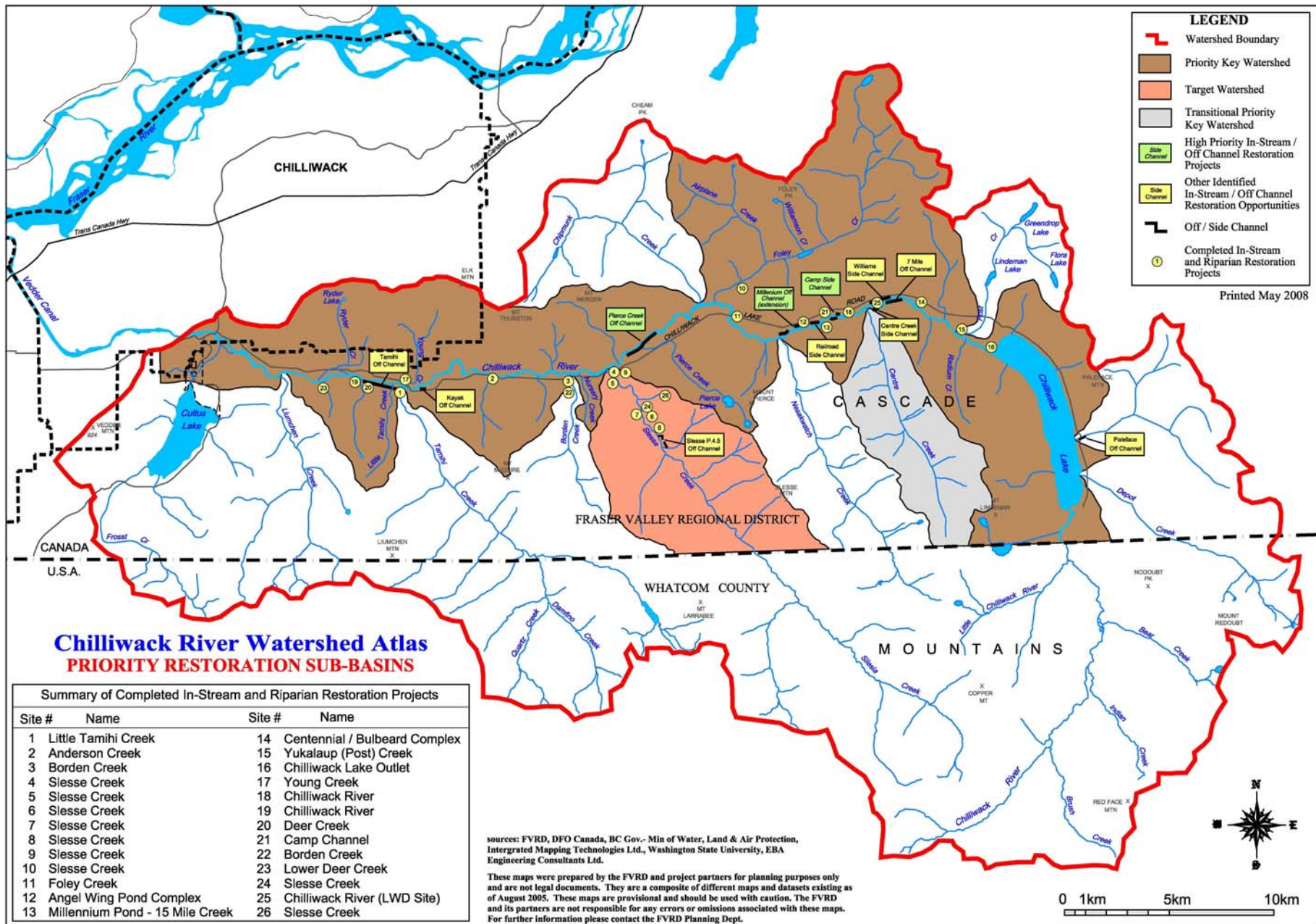


Figure 1. Priority watersheds and restoration projects in the Chilliwack River Watershed (as identified by EBA, 2001).

3.0 Contributing Factors/Causes

Need for Restoration

- Long history of human activities and landscape scale modifications in the watershed
- Ongoing development in the watershed (e.g., forestry, power projects, rural development, etc.), which impacts habitat
- Ineffective policies for preventing watershed-scale impacts to habitats and species
- Impacts to fish stocks that occur outside of the watershed (e.g., over harvesting)

Impacts to Restoration Projects

- Lack of funding/resources for monitoring and maintaining projects over the long term
- Lack of ownership of projects on crown lands (e.g., no single person/agency is responsible)
- Difficulty in controlling invasive species once established
- Lack of awareness and/or respect amongst recreational users of the impacts of their activities at restoration sites

Impacts of Restoration Projects to Other Values

- Lack of understanding of natural and cultural values and how they will be impacted by proposed restoration projects
- Lack of a legislated or formal process for evaluating potential impacts
- Lack of funding support for assessing impacts to other values, beyond the key target species (usually wild pacific salmon)

4.0 Overall Level of Community Concern

During public outreach activities conducted as part of this watershed strategy, the community expressed a high level of concern about fish and fish habitat quality and quantity within the Chilliwack River Watershed. Specific concerns about restoration and enhancement activities were not raised, but are an integral component of habitat management.

5.0 Organizations Involved in Restoration/Enhancement in CRW

5.1 BCCF/Greater Georgia Basin Steelhead Recovery Program

The BC Conservation Foundation (BCCF) was formed in 1969 for the following purposes:

- To promote and assist in the conservation of the fish and wildlife resources of the Province of British Columbia through the protection, acquisition or enhancement of fish and wildlife habitat, and;
- To provide for such other purposes that in the determination of the directors contribute to the betterment of the fish and wildlife resources of the Province of British Columbia.⁹

One of the key programs delivered by the BC Conservation Foundation is the Greater Georgia Basin Steelhead Recovery Program (GGBSRP), which began in 2002.¹⁰ This program aims to:

- Stabilize and restore wild steelhead stocks and habitats to healthy self-sustaining levels
- Maintain and restore angling opportunities

Through the GGBSRP, BCCF fisheries technicians, biologists and engineers have conducted many activities in the Chilliwack River Watershed, including Chilliwack River nutrient enhancement, adult and juvenile steelhead enumeration, and habitat restoration projects.

5.2 Chilliwack Fish and Game Protective Association¹¹

The Chilliwack Fish and Game Protective Association was incorporated in October 1936 for the following purposes:

- a. To promote the propagation and conservation of fish and wildlife
- b. To promote the conservation, protection, restoration and enhancement of habitat suitable for fish and wildlife.
- c. To gather and disseminate information and educate the public with respect to all aspects of the propagation, conservation and enjoyment of fish and wildlife and the protection of their natural habitat.

⁹ Website: http://www.bccf.com/bccf_mission.htm (February 1, 2007).

¹⁰ Website: <http://www.bccf.com/steelhead/about-steelhead.htm> (March 12, 2007).

¹¹ Ritchie, Sandy. Chilliwack Fish and Game Protective Association. February 27, 2006. pers. comm.

- d. To educate the public with respect to the responsible use and enjoyment of recreational resources and to promote reasonable public access to forest, rivers and recreational areas of British Columbia.

For a century, the Chilliwack Fish and Game Protective Association has been involved in projects to enhance and sustain the natural habitat of fish and wildlife throughout British Columbia, including the Chilliwack River Watershed. They are particularly active in watersheds in close proximity to the Fish and Game Clubhouse on Chilliwack Lake Road.

5.3 *Chilliwack River Action Committee*¹²

The Chilliwack River Action Committee (CRAC) has coordinated a number of restoration and enhancement projects (e.g., Tolmie Slide, Lovely Pond, Ryder Creek, etc). These projects have helped mitigate the impacts of clay slides and have improved fish habitat. CRAC formed in 1997 to primarily to deal with the problem of river siltation caused by eroding clay slides and later became a registered BC Society and a charitable organization capable of issuing official income tax receipts. The mission of the society is to preserve the health and sustainability of the Chilliwack River Watershed and its fish resources for future generations to enjoy. Funding for projects is raised by grants and fundraisers.

5.4 *Chilliwack Vedder River Cleanup Coalition*¹³

The Chilliwack-Vedder River Cleanup Coalition (CVRCC) formed in 2002, uniting a group of citizens who were concerned about the increasing amount of garbage being left along the Chilliwack/Vedder River. The Coalition has two major objectives: a) to educate the public on the value of the river and the need to keep it clean, and b) to organize groups and individual volunteers to clean up the river using an “adopt-a-stream” model. The idea is inspired by the successful Adopt-a-Highway program that has kept many roadways clean in North America.

The Coalition has divided the Lower Chilliwack River (i.e. from the Chilliwack River Hatchery to the Vedder Canal) into many small segments (1-2 km long) that can be adopted by the general public. This enables civic clubs, individuals, garden clubs, businesses, churches, and other organizations to maintain certain sections. Volunteers perform garbage pickup 3-4 times a year. The Coalition receives support from the City of Chilliwack, the Fraser Valley Regional District, and Fisheries and Oceans Canada to cover the cost of supplies and tipping fees at the Bailey Landfill. In addition to the cleanups, the Coalition educates the public about the importance of keeping riparian areas clean through various events around the Fraser Valley and through their website (<http://www.cleanrivers.ca/>).

¹² Website: <http://www.fishingwithrod.com/crac/about.html> accessed January 29, 2007

¹³ Website: <http://www.cleanrivers.ca/> accessed January 29, 2007

5.5 *Fisheries & Oceans Canada/Chilliwack River Hatchery*

Fisheries and Oceans Canada staff play a key role in restoration and enhancement in the watershed. The resource restoration group of the Habitat and Enhancement Branch design and construct restoration projects throughout the watershed. They also provide in kind advice and support to other groups undertaking this work. Staff at the Chilliwack River Hatchery also support restoration efforts. For example, hatchery staff conduct carcass placements, monitor channels (includes carcass recovery, downstream juvenile trapping and gee trapping), remove beaver dams that obstruct fish migration, maintain works to improve fish access, control access to restoration channels and adjust flows when needed, and assist with restoration projects when requested. These tasks are secondary to the main work of hatchery staff and are only provided when time and budget permits or when an urgent request is made.

5.6 *Forestry Renewal BC*

The Watershed Restoration Program (WRP) was a provincial initiative under the BC Forest Renewal Plan implemented jointly by the BC Ministries of Environment, Lands and Parks, and Forests in partnership with the Ministry of Skills, Training and Labour and cooperatively with the Ministry of Aboriginal Affairs and Agriculture in the mid-1990s.¹⁴ The goal of the program was to accelerate hillslope stabilization and the recovery of natural resources and habitat adversely affected by logging prior to the introduction of the Coastal Fishery/Forestry Guidelines and the Forest Practices Code (1993). In order to achieve this goal, the program focused on hillslope stabilization, logging road deactivation, and stream channel/riparian habitat restoration. A significant amount of restoration assessment and work was conducted under this program in the Chilliwack River Watershed (e.g., MA Whelen and Associates, 1995).

5.7 *Fisheries Renewal BC*

Fisheries Renewal BC was a provincial program that ran between 1995 and 2001. During this period, over \$2.3 million dollars was invested into restoration projects in the Chilliwack River Watershed (EBA Engineering Consultants Ltd., 2001). Projects ranged from road deactivations, to riparian plantings and/or treatments, to landslide rehabilitation/ stabilization, to instream or off-channel works. This program ended when the provincial government changed in 2001.

5.8 *Fraser Valley Regional District*

The Fraser Valley Regional District is involved in restoration projects in the Chilliwack River Watershed in several capacities. FVRD Parks conducted restoration work at Thompson Regional Park in 2005 and may continue restoration efforts in the future. FVRD, in partnership with the Fraser Valley Regional Watersheds Coalition, also coordinates restoration projects on crown land in the watershed (e.g., Pierce Ponds in 2006-2008). Finally, FVRD provides technical support for other agencies conducting

¹⁴ MA Whelen and Associates Ltd, 1995.

restoration projects in the watershed (e.g., letters of support, mapping information, communication/coordination, etc.).

5.9 *Fraser Valley Regional Watersheds Coalition*¹⁵

The Fraser Valley Regional Watersheds Coalition (FVRWC) formed in 1997 to promote the understanding and action of communities in the Fraser Valley area to achieve healthy watersheds and the communities that they support. This community-based coalition spans multiple municipalities, levels of government and governmental departments, as well as community groups and citizens. For five years, the FVRWC was the delivery agent for Fisheries Renewal BC funding in the Fraser Valley. Since the disappearance of Fisheries Renewal funding, the FVRWC has obtained grants from organizations like the Pacific Salmon Commission, the BC Ministry of Transportation, and the Pacific Salmon Foundation to fund watershed work. Over the years, the Coalition has been involved with numerous projects in the Chilliwack River Watershed, most recently off-channel habitat work at Pierce Ponds and Salwein Creek.

5.10 *Fraser Valley Salmon Society*¹⁶

The Fraser Valley Salmon Society (FVSS) formed in 1984 to ensure equitable distribution and conservation of Chinook salmon on the Fraser River. Activities undertaken by the society range from expanding salmon fishing opportunities, to providing catch/effort data, providing public education via newsletters, and organizing an annual All About Fishing event. Over the years, the FVSS has contributed financial and in kind resources (e.g., volunteer labour) to numerous restoration projects on the Chilliwack-Vedder River.

5.11 *Private Landowners*

Individual landowners may also play a significant role in restoring and enhancing fish habitat in the watershed. In the past, several landowners have worked with the Chilliwack River Action Committee to conduct projects on their land. There is potential to work with additional landowners in the future to expand habitat on private lands.

5.12 *Soowahlie First Nation*

The reserve for the Soowahlie Indian Band is located on the banks of the Chilliwack River immediately upstream of Vedder Crossing. Of Soowahlie's approximately 300 members, about 200 live on the 1100 acre reserve. The reserve is bounded by the Chilliwack River on the north and Cultus Lake to the east. The close proximity to Cultus Lake and its salmon populations was a principle determinant in the Band's settlement of the area and played a role in their survival for thousands of years. Today, salmon continue to be of cultural and spiritual importance to the community. Salmon are featured on the Band totem and in the Band's expressions and dances; they are important to the Band's economic opportunities for the future.

¹⁵ Website: <http://www.fvrwc.org/who.html> (January 29, 2007).

¹⁶ Website: <http://members.shaw.ca/fraservalleysalmonsociety/#history> (March 12, 2007).

Soowahlie Band members played a key role in drafting the Recovery Strategy for Cultus Lake sockeye and were co-petitioners in 2002 of the COSEWIC emergency assessment of Cultus sockeye.

Over the years, the Soowahlie Indian Band have undertaken several habitat restoration projects on or adjacent to their reserve lands, including the creation of lakes and upgrades to Sweltzer Creek, a tributary to the Chilliwack River. In 1996, in collaboration with Fisheries and Oceans Canada, Soowahlie First Nation worked on restoring old river channels and connecting them to groundwater filled man-made lakes, creating several hundred meters of quality spawning and rearing habitat. In 2005 and 2006, band members planted indigenous trees and shrubs and removed garbage and other deleterious material along the riparian corridor of Sweltzer Creek. Band members also removed Eurasian water milfoil from the upper portions of the creek, allowing chum and chinook to spawn in areas previously unavailable.

Soowahlie continues to endorse habitat improvements on their reserve and have applied for funding for three restoration projects in 2007.

*5.13 South Coast Conservation Program*¹⁷

The South Coast Conservation Program was established in 2005 as a multi-partner, landscape-level conservation program for the South Coast (or Lower Mainland) of B.C. The primary objective of this program is to coordinate and facilitate the implementation of conservation actions to maintain and restore species and ecosystems at risk on the South Coast of B.C. Program partners include the BC ministries of Environment, Agriculture and Land, and Forests and Range, the Department of National Defense, Environment Canada (Canadian Wildlife Service), several local governments, the University of British Columbia, and non-government associations. The program will be initially focused on the Chilliwack Forest District due to the high levels of biodiversity in this region. Key initiatives of the program include the collection of data on species at risk, the development of an interactive and comprehensive mapping database for species at risk, the development and dissemination of guidelines and other information sources for species at risk, and the development of a South Coast Multi-species Recovery Implementation Plan.

*5.14 Steelhead Society Habitat Restoration Corporation*¹⁸

The Steelhead Society Habitat Restoration Corporation (SSHRC) is a non-profit, incorporated subsidiary of the Steelhead Society that seeks to:

- initiate and consult on watershed restoration projects in-house from a multidisciplinary perspective, and

¹⁷ Website: <http://www.sccp.ca/> (February 28, 2007).

¹⁸ Website: http://www.ecobc.org/index.cfm?act=org&org_ID=386 (March 12, 2007)

- enhance and conserve/rehabilitate the wild salmon and steelhead resource in BC through the management of priority watershed restoration projects.

From the mid-the 1990's to 2000, the SSHRC was a Forest Renewal BC multi-year agreement holder and partner with industry, conservation groups, First Nations, and communities. Over this time period, the society completed over 100 in-stream projects, producing over 500,000 adult salmon and restoring over 200,000 square metres of wild habitat.¹⁹ Many of these projects were located in the Chilliwack River Watershed.

6.0 Relevant Jurisdictions, Legislation, Policies & Guidelines

While a number of laws and regulations exist to protect fish and fish habitat, most of these only indirectly govern actions relating to habitat restoration and enhancement projects. Rather, various provincial and federal policies and guidelines help to provide guidance and direction for how, when, and where such projects should and should not occur. The most relevant laws and policies applicable to restoration within the Chilliwack River Watershed are briefly discussed below.

6.1 Federal

Fisheries Act (R.S., 1985, c. F-14)²⁰

Section 35 (1) of the *Fisheries Act* states that “No person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat.” This requirement (known as HADD), is permitted with the correct approvals being granted. Similarly, no “deleterious substances” (Section 36) are allowed to be introduced into fish habitat, unless permission is obtained. In BC, the *Fisheries Act* is administered both by Fisheries and Oceans Canada and the BC Ministry of Environment. Proponents of projects that may result in either HADD or deleterious substance introductions to fish habitat need to consult with DFO for approvals and potential project requirements prior to commencing. In considering the project, DFO may apply their principle of “no net loss” (see DFO Policy for the Management of Fish Habitat) if applicable, and may require suitable compensation or mitigative strategies to prevent or compensate for any potentially negative consequences of the project. Therefore, the *Fisheries Act* applies to habitat restoration and enhancement projects not only by regulating how these activities are performed, but also by requiring habitat restoration and projects to be conducted as a result of “no net loss” compensation for other projects.

DFO Policy for the Management of Fish Habitat (1986, reprinted 1991)²¹

The Policy for the Management of Fish Habitat outlines the strategy used by DFO in issuing *Fisheries Act* permits, including the principle of “no net loss”. This principle is

¹⁹ Website: http://www.portaec.net/library/ocean/steelhead_society_habitat.html (March 12, 2007)

²⁰ Available: <http://lois.justice.gc.ca/en/F-14/index.html> (Feb 6, 2007).

²¹ Available: http://www.dfo-mpo.gc.ca/oceans-habitat/habitat/policies-politique/operating-operation/fhm-policy/index_e.asp (Feb 6, 2007).

defined in this Policy as “A working principle by which the department strives to balance unavoidable habitat losses with habitat replacement on a project-by-project basis so that further reductions to Canada's fisheries resources due to habitat loss or damage may be prevented.” The purpose of this policy is to result in the long-term “net gain” in “productive capacity of habitats for selected fisheries brought about by determined government and public efforts to conserve, restore and develop habitats.”

Species-at-Risk Act (2002, c. 29)²²

The federal *Species at Risk Act* (SARA) makes it an offence in sections 32 and 33 to:

- kill, harm, harass, capture or take an individual of a listed species that is extirpated, endangered or threatened;
- possess, collect, buy, sell or trade an individual of a listed species that is extirpated, endangered or threatened, or its part or derivative;
- damage or destroy the residence of one or more individuals of a listed endangered or threatened species or of a listed extirpated species if a recovery strategy has recommended its reintroduction.

These prohibitions apply to all SARA listed species that occur on federal lands (e.g. lands owned by the federal government, such as national parks, lands used by the Department of National Defence, reserve lands, and most of the land in the three territories). In addition, these prohibitions apply to listed aquatic species (e.g., fish) because of the *Fisheries Act*, and migratory birds covered by the *Migratory Birds Convention Act*, wherever they occur.

For other listed species that occur on non-federal lands, the provinces and territories are given the first opportunity to protect them through their laws. If the province or territory does not act, SARA has a "safety net". The Governor in Council, on the recommendation of the Minister of the Environment, may order that the prohibitions in sections 32 and 33 apply for a given species in a province or territory. The Minister must make a recommendation if, after consultation with the provincial or territorial minister, the Minister finds that the species or its residence is not effectively protected. To date, this power has not been exercised.

In BC, some protection is given to species at risk through the existing *BC Wildlife Act* (see below). In addition, a *Wildlife Amendment Act* has been drafted and will, when passed, increase the protection of species at risk in BC (e.g., expand the number of species protected).

Protected Species

A total of 233 species were included in Schedule 1 of the *Species at Risk Act* when it was passed by Parliament in December 2002. Other species are put on the list as a result of the work of the scientists and conservationists who are members of the Convention on the

²² Available: http://www.sararegistry.gc.ca/the_act/default_e.cfm (January 30, 2007).

Status of Endangered Wildlife in Canada (COSEWIC). SARA also currently includes 39 endangered or threatened species in Schedule 2 and 103 species of special concern in Schedule 3. These species are those that COSEWIC has added to its list over the past 25 years, but, as of the end of 2001, had yet to reassess with its updated criteria and current information.

Permitted Activities

Agreements, permits, and licences can be obtained to allow someone to do something that would otherwise be a SARA offence. The following activities may be allowed as long as measures are taken to minimize the impact, and the activities do not jeopardize the survival or recovery of the species:

- scientific research about the conservation of the species done by a qualified person
- an activity that benefits the species or enhances its chances of survival in the wild
- an activity whose effect on the listed species is incidental

For example, a scientist may be allowed to handle and tag an endangered species so that its movements can be tracked. Or, water flow could be diverted in a marsh to improve habitat for listed species in the area, although this might disturb some individuals of the species in the short-term. Or, fishermen may be given a permit allowing the by-catch of endangered or threatened fish under certain circumstances.

Requirements for Habitat Restoration Projects

Currently, SARA has limited applicability to habitat restoration projects, especially when projects occur on lands not owned by the federal government (i.e., nearly 100% of the land in the watershed). Only aquatic species and migratory birds themselves, or their residences, are protected on non-federal lands. However, if these species or their residences may be damaged by a proposed project, a permit may be required.

Although the legislation affords relatively little legal protection to species at risk, it is hoped that these species will be protected through voluntary efforts (i.e., stewardship). In this case, the SARA process should guide practices on private, First Nations, and crown land. A restoration project may be treated the same as a development project and proceed through a similar process. This may involve conducting an assessment to determine which species at risk occur on the site and undertaking steps to ensure that these species are not affected by the proposed project.

Navigable Waters Protection Act (R.S., 1985, c. N-22)²³

Administered by Transport Canada, the *Navigable Waters Protection Act* regulates instream works within “navigable waters” with the intent of protecting the public right of navigation within Canada. Transport Canada defines navigable waters as “any body of water capable of being navigated by floating vessels of any description for the purpose of transportation, commerce or recreation. This includes both inland and coastal waters. The

²³ Available: <http://laws.justice.gc.ca/en/N-22/index.html> (February 6, 2007).

final authority to determine the navigability of a waterway rests with the Minister of Transport or his/her designated representative.”²⁴

Section 5 (1) of the Act states that “no work shall be built or placed in, on, over, under, through or across any navigable water unless (a) the work and the site and plans thereof have been approved by the Minister, on such terms and conditions as the Minister deems fit, prior to commencement of construction.” Work includes:

- any bridge, boom, dam, wharf, dock, pier, tunnel or pipe and the approaches or other works necessary or appurtenant thereto,
- any dumping of fill or excavation of materials from the bed of a navigable water,
- any telegraph or power cable or wire, or
- any structure, device or thing, whether similar in character to anything referred to in this definition or not, that may interfere with navigation.

The Navigable Waters Works Regulations requires that all tools and materials be removed from the stream following completion of the works, and to remove any portion of a works that leads to subsequent debris accumulation.

Requirements for Habitat Restoration Projects

If a proposed habitat restoration project will take place in navigable waters (e.g., placement of structures such as large woody debris or platforms, or some channel and bank works below the high water mark like groynes, rip rap, or gravel placement), approval may be required under the *Navigable Waters Protection Act*.²⁵ It is recommended that proponents contact the nearest Navigable Waters Protection Program office of Transport Canada to determine if an approval is required. A Navigable Waters Protection (NWP) Officer will assist the proponent in determining what information and documentation is required for preparing and submitting an application under the *NWPA*. There are two types of processes which can be followed concerning construction of new works. The approval process, subsection 5(1), is followed when the work has the potential to interfere with navigation. The determination process, subsection 5(2), is followed when NWPP officer determine that the work does not interfere with navigation. The approval process is usually longer and requires public advertisement of the details of the proposed work and an environmental assessment in accordance with the *Canadian Environmental Assessment Act*. If approval of the proposed work is granted, it may include conditions that must be followed to mitigate potential impacts of the project on navigation and the environment. The determination process does not require formal advertisement or an environmental assessment.

6.2 Provincial

Water Act (RSBC 1996, c 483)²⁶ and Water Act Regulation (1988, amended 2004)²⁷

²⁴ Available: <http://www.tc.gc.ca/marinesafety/Ships-and-operations-standards/nwp/menu.htm> (February 6, 2007).

²⁵ Available: <http://www.tc.gc.ca/marinesafety/Ships-and-operations-standards/nwp/guide.htm> (March 5, 2007)

²⁶ Available: http://www.qp.gov.bc.ca/statreg/stat/W/96483_01.htm (February 9, 2007).

The *Water Act*, particularly Section 9 (changes in and about a stream), and Part 7 of the Water Act Regulations, regulates the use and protection of water resources in BC, making it an offense to alter or divert a stream without formal approval by the Province. The intent is to ensure preservation of water quality, water quantity, instream habitat, and riparian habitat from instream or near-stream activities not permitted by the Province.

Requirements for Habitat Restoration Projects

Proponents of instream or near-stream works that will result in changes to the stream require one of the following²⁸:

1. Water Licence from Ministry of Environment (MOE), Water Stewardship Division (WSD), authorizing the works, or
2. Water Act, Section 9 Approval from WSD, or
3. Compliance with Water Act, Water Regulation, Part 7 including notification to MOE, or
4. Order from the Comptroller of Water Rights or designate, or
5. Authorization under the Mines Act or Forest Practices Code Act.

The item required depends on both the agency/individual making the change in and about water and the nature of the project. When conducted by the federal government, the provincial government, or their agents, fish habitat or stream restoration projects require notification only. When conducted by other groups, an approval is required.

Fish Protection Act (S.B.C. 1997 c 21)²⁹ and Riparian Areas Regulations (2004)³⁰

Administered by the BC Ministry of Environment, the *Fish Protection Act* serves to enable the protection of fish and fish habitat by prohibiting stream-blocking dams on major rivers in BC, by permitting regional water managers to consider impacts on fish and fish habitat in reviews of licenses, by allowing streams to be designated as “Sensitive Streams,” and by requiring recovery plans to be prepared for sensitive streams.

The Riparian Areas Regulation (RAR), enacted under Section 12 of the *Fish Protection Act* in July 2004, replaced the prior Streamside Protection Regulation. The purpose of RAR is to protect fish habitat from development pressures by obligating local governments to issue development approvals based on the results of riparian areas assessments completed by the proponent. The Fraser Valley Regional District is currently preparing a policy framework for determining how to fully implement the intent of their obligations under these regulations.

Requirements for Habitat Restoration Projects

²⁷ Available: http://www.qp.gov.bc.ca/statreg/reg/W/Water/204_88.htm (February 9, 2007).

²⁸ From BC Ministry of Environment, Water Stewardship Division Website. Available: http://www.env.gov.bc.ca/wsd/water_rights/licence_application/section9/index.html (February 9, 2007).

²⁹ Available: http://www.env.gov.bc.ca/habitat/fish_protection_act/act/documents/act-theact.html (February 6, 2007).

³⁰ Available: http://www.env.gov.bc.ca/habitat/fish_protection_act/riparian/riparian_areas.html (February 6, 2007).

It is highly unlikely that a restoration or enhancement project would trigger the need for a RAR assessment. Instream works that comply with the *Water Act* and associated regulations and best management practices are not considered to trigger the *Riparian Areas Regulation*.³¹ Fish habitat enhancement activities, including riparian planning, invasive plant species removal, and garbage removal, are also acceptable activities as long as care is taken to minimize impacts to fish habitat and the creation of sediment. In addition, if a *Fisheries Act* authorization is issued for a project by DFO, the requirements of the RAR do not apply.

Wildlife Act (RSBC 1996, c 488)³² and Wildlife Act Permit Regulation (2000)³³

The BC *Wildlife Act* protects and manages populations of wildlife in BC, which includes “raptors, threatened species, endangered species, game or other species of vertebrates prescribed as wildlife,” as well as fish. Sections of note include:

- **Section 6:** “If the Lieutenant Governor in Council considers that a species of wildlife is threatened with imminent extinction throughout all or a significant portion of its range in British Columbia because of the action of humans, the Lieutenant Governor in Council may, by regulation, designate the species as an endangered species.”
- **Section 9 (1) :** “A person commits an offence if the person disturbs, molests or destroys (a) a muskrat house or den, except on diked land, or (b) a beaver house or den or beaver dam. (2) Subsection (1) does not apply... if the action is authorized by regulation.”
- **Section 34:** “A person commits an offence if the person, except as provided by regulation, possesses, takes, injures, molests or destroys (a) a bird or its egg, (b) the nest of an eagle, peregrine falcon, gyrfalcon, osprey, heron or burrowing owl, or (c) the nest of a bird not referred to in paragraph (b) when the nest is occupied by a bird or its egg.”

Legal designation as endangered or threatened under the *Wildlife Act* increases the penalties for harming a species, and also enables the protection of habitat in a Critical Wildlife Management Area.³⁴ At present, four species are legally designated: the Vancouver Island Marmot (*Marmota vancouverensis*), American White Pelican (*Pelecanus erythrorhynchus*), and Burrowing Owl (*Athene cunicularia*) as Endangered, and the Sea Otter (*Enhydra lutris*) as Threatened. When the [Wildlife Amendment Act](#) is brought into force, invertebrates and plants will also be eligible for listing, and residences of listed species may be protected.

Species on the Provincial Red and Blue Lists affected by forest and range practices are also eligible for listing as a Category of Species at Risk in the *Forest and Range*

³¹ BC Ministry of Water, Land and Air Protection, 2006.

³² Available: http://www.qp.gov.bc.ca/statreg/stat/W/96488_01.htm (February 6, 2007).

³³ Available: http://www.env.gov.bc.ca/pasb/fw_permreg.html (February 6, 2007).

³⁴ Available: <http://www.env.gov.bc.ca/wld/faq.htm> (March 5, 2007)

Practices Act (FRPA) and the [Private Managed Forest Land Act](#). Once listed, management tools enabled under FRPA, such as wildlife habitat areas and general wildlife measures, can be used to address the species' habitat requirements. Species included in the Category of Species at Risk, along with regionally important wildlife, are known as "Identified Wildlife", and are managed under the [Identified Wildlife Management Strategy](#) (IWMS). The IWMS provides direction, policy, procedures and guidelines for managing Identified Wildlife.

Requirements for Habitat Restoration Projects

Permits required under the *Wildlife Act* are specified in the Wildlife Act Permit Regulation, and are administered by the BC Permit and Authorization Service Bureau (PASB). These permits can be either authorization permits (e.g., "trapping, hunting or killing wildlife for any of the following reasons: crop protection, population control, scientific research, public safety, or ceremonial, educational or humane purposes") or exemption permits (e.g., to engage in activities that result in the destruction of beaver dams, muskrat dens, and particular types of bird nests or eggs).

BC Ministry of Environment Standards, Guidelines, and Best Management Practices

The Provincial Ministry of Environment has recently released a number of documents describing best management practices (BMPs) or standards that relate to habitat restoration and enhancement activities in order to minimize the impact of these activities on aquatic and riparian habitat.

For example, 'Standards and Best Practices for Instream Works' (2004)³⁵ provides information related to governance and best management practices that are intended to assist in the planning and operations of instream or near-stream works so that they comply with existing legislation, regulations, and policies, and meet provincial standards of performance. Specific sections within this document include:

- Standards and Best Practices for Stream Channel Maintenance (Ch. 7.2)
- Standards and Best Practices for Habitat Enhancement and Restoration (Ch. 7.5)
- Standards and Best Practices for Beaver and Beaver Dam Management (Ch. 7.6).

In addition to these BMPs, other reports and guidelines prepared by the Ministry of Environment pertaining to instream works include:

- Instream Flow Guidelines (working draft only)³⁶
- Best Management Practices for Amphibians and Reptiles in Urban and Rural Environments in British Columbia (BC Ministry of Water, Land and Air Protection, 2004)³⁷
- Guidelines for Reduced Risk Instream Work Windows (BC Ministry of Environment, 2006)³⁸

³⁵ Available: <http://wlapwww.gov.bc.ca/wld/documents/bmp/iswstdsbpsmarch2004.pdf> (February 6, 2007).

³⁶ Available: http://www.env.gov.bc.ca/wld/BMP/instreamflow_wkgdrft.html (February 6, 2007).

³⁷ Available: <http://www.env.gov.bc.ca/wld/BMP/herptile/bmphertile.html> (February 6, 2007).

³⁸ Available: http://wlapwww.gov.bc.ca/sry/wateract/work_windows_sry.pdf (February 6, 2007).

- Develop with Care: Environmental Guidelines for Urban and Rural Land Development in British Columbia (BC Ministry of Environment, 2006)³⁹
- Land Development Guidelines for the Protection of Aquatic Habitat (prepared in conjunction with Department of Fisheries and Oceans, 1993).⁴⁰
- Guidelines for Dealing with Development Effects on Species and Ecosystems at Risk on the South Coast of British Columbia (BC Ministry of Environment, 2006 DRAFT)⁴¹

³⁹ Available: http://www.env.gov.bc.ca/wld/documents/bmp/devwithcare2006/develop_with_care_intro.html (February 6, 2007).

⁴⁰ Chilibeck, B., Chislett, G., Norris, G., 1993. Land Development Guidelines for the Protection of Aquatic Life. Fisheries and Oceans Canada and the BC Ministry of Environment, Lands and Parks. Available: <http://www-heb.pac.dfo-mpo.gc.ca/publications/pdf/165353.pdf> (February 9, 2007).

⁴¹ Available: <http://www.sccp.ca/> (February 28, 2006)

7.0 Vision & Goals

7.1 VISION

The Chilliwack River Watershed contains the amount and diversity of habitat needed to support healthy and robust populations of all native aquatic species.

7.2 GOALS

The following are some general goals for fish habitat restoration and enhancement in the Chilliwack River Watershed and potential measures for how progress towards these goals might be measured:

Goal #1: Help decision makers to limit the impact of human activities (e.g., development, forestry, recreation) to fish habitat and ecological processes that maintain these habitats.

Goal #2: Use an adaptive management approach that balances investment with the return of benefits to ensure that existing restoration projects are functioning as intended to the extent possible.

Goal #3: Promote the restoration of the ecological processes that create and maintain fish habitat over the long term to the extent possible.

Goal #4: Increase as practical the amount, type, and distribution of fish habitat needed to support healthy and robust native salmonid population levels.

Goal #5: Ensure that restoration projects consider and mitigate the potential impacts to other values in the watershed (e.g. species at risk, recreational opportunities, cultural and historic sites, etc).

Potential indicators that could be used to measure progress towards these goals include changes in human activities (e.g., land use) over time, the amount and type of fish habitat present in the watershed over time, the distributions and levels of fish stocks over time, and abundance and diversity of species utilizing restoration projects.

8.0 Analysis and Options

8.1 *Prioritization of Restoration Projects*

Several efforts have been undertaken in the past to identify and prioritize restoration needs in the Chilliwack River Watershed (Scott et al., 1993; M.A. Whelen and Associates, 1995; EBA Engineering Consultants Ltd., 2001). The most recent assessment was completed by EBA Engineering Consultants Ltd. in 2001 following the “Planning and Priority Setting for the Next Five Years, Phase 3, Watershed-Level Planning” process developed by the BC Watershed Restoration Program Provincial Coordination team. In their assessment, EBA concluded that fish production in the Chilliwack River, particularly for species such as coho salmon, is limited by the lack of:

- off-channel refugia and rearing habitat,
- instream LWD,
- instream pool complexes, and
- stable spawning beds (EBA Engineering Consultants Ltd., 2001).

In order to address these limiting factors, EBA Engineering Consultants Ltd. identified priorities for instream restoration, riparian restoration, up-slope restoration, and project evaluation, monitoring and maintenance. Some of these priorities have been addressed since 2001 and some are still outstanding (Appendix B).

While EBA Engineering Consultant’s watershed restoration plan provides an excellent basis for prioritization of future restoration work in the watershed, it is important to reassess the content and recommendations of such plans on a regular basis. The Project Team for the Chilliwack River Watershed Strategy and the habitat and enhancement working group utilized the EBA Engineering Restoration Plan as a starting point to identify additional limiting factors and restoration needs for the watershed. During meetings, local fishing and stewardship groups and professionals from resource management agencies (e.g. BC MOE and DFO) confirmed that the factors originally identified by EBA Engineering still limit fish production in the Chilliwack River Watershed and noted two additional factors that potentially limit fish production: sedimentation from clay slides; and a lack of nutrients (e.g., particularly in the upper watershed, which due to its geological history, contributes few nutrients to the system).

Clearly, many activities could be undertaken in the Chilliwack River Watershed to improve fish habitat. Prioritizing restoration activities assists resource management agencies, stewardship groups, and funding agencies allocate scarce resources to projects expected to have the most significant effect within the watershed. In a recent restoration prioritization scheme produced for the Pacific Northwest, Roni et al. (2002) suggest that on-the-ground efforts be preceded by a watershed assessment that identifies restoration needs within a watershed (Figure 2). Following such an assessment, they recommend that efforts be dedicated to the following in order of priority:

1. reconnect isolated habitats
2. restore watershed processes (long term)

3. restore habitat (short term)

These recommendations consider a number of factors, such as the response time, probability and variability of success, and the duration of a given restoration action. Reconnecting isolated off-channel habitats are rated as a high priority because this action provides an immediate biological response, is likely to last many decades, and has a high likelihood of success. Riparian restoration and road improvements are rated lower because they may not produce results for several decades. Roni et al. (2002) recommends that instream actions be undertaken only after or in conjunction with efforts to restore watershed processes. In addition, they recognize that other considerations must be taken into account when determining priorities for specific watersheds, such as the needs of individual species (e.g., limiting factors for individual species), site access, fish production potential, probability of success, response time, and cost effectiveness of specific actions.

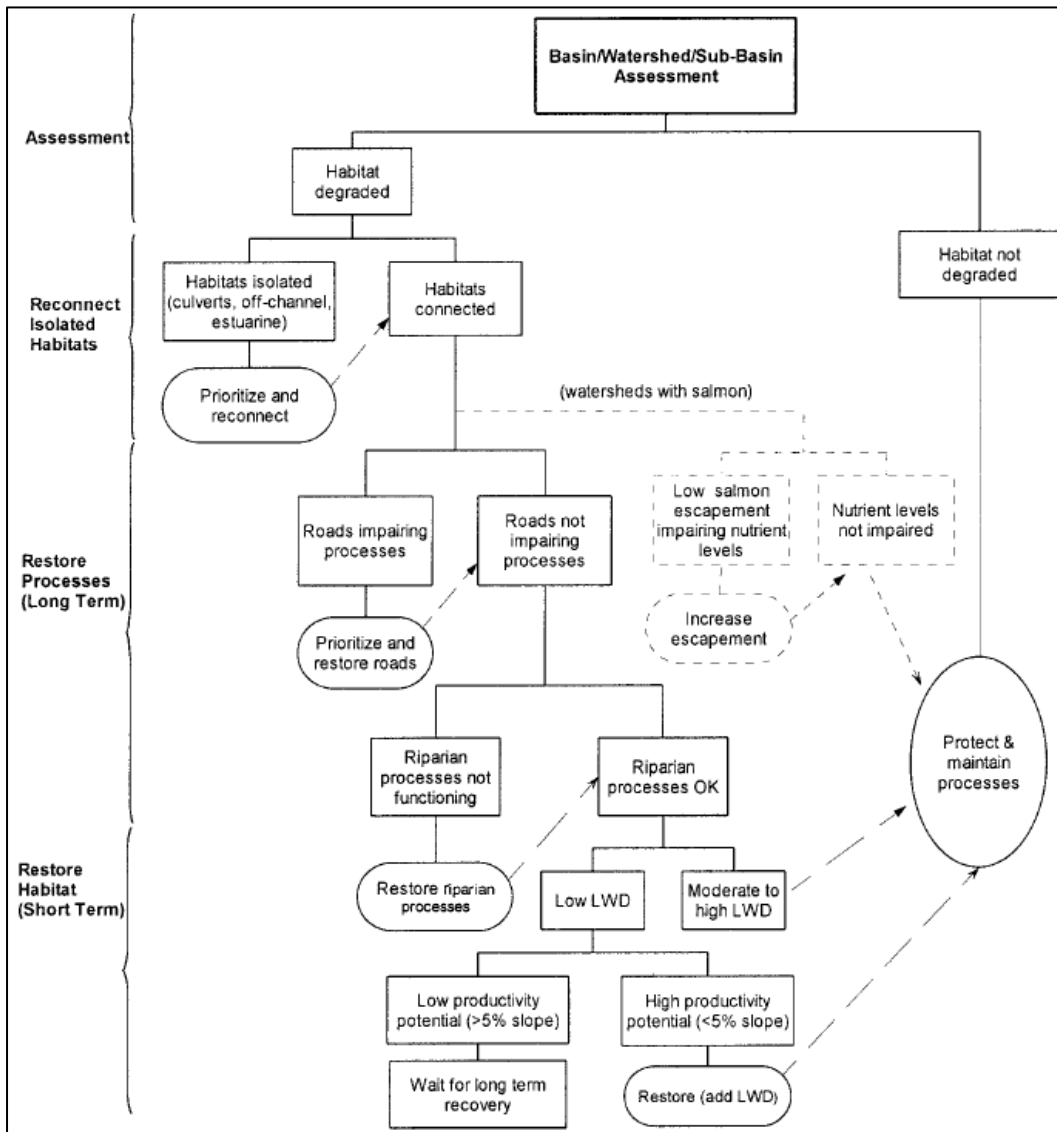


Figure 2. Flow chart by Roni et al (2002) showing strategy for prioritizing restoration projects.

Another existing prioritization scheme has also been proposed⁴² that sets out slightly different criteria for prioritizing habitat restoration projects:

- The first priority over new projects is to repair non-functioning past projects, if feasible;
- The next priority among new restoration projects is threatened species or stocks;
- Projects that benefit multiple species should be selected over single species;
- Stream reaches of potentially lost opportunities should be higher priority; and
- Streams, tributaries or reaches should be targeted on a “best first, worst last” basis.

These two schemes can be utilized to support or refine the recommendations given by EBA Engineering Consultants Ltd. in 2001 and prioritize future restoration projects beyond the EBA plan. The following sections analyze the proposed projects in consideration of the priorities identified by EBA Engineering Consultants Ltd. and the prioritization schemes outlined by Roni et al. (2002) and the US Forest Service.

8.2 *Protect Existing Habitat*

Many agencies, laws and processes exist to protect existing fish habitat from damage or destruction. Under this heading, the goal of the watershed strategy should be to assist regulatory agencies and decision makers make existing processes and laws more effective or create new ones. It has been suggested that in order to protect fish habitat more effectively in the watershed, critical habitat areas should be identified (e.g., critical spawning grounds, important rearing areas, etc.). Identifying areas of critical importance for fish could help decision makers avoid impacts to these areas (i.e., development, flood mitigation, and forestry activities could be directed away from these areas). The risk of identifying critical areas is that it could lead to a perception that impacts to non-critical areas are acceptable. In addition, due to the highly variable nature of rivers, the location of important habitats may change from year to year.

8.3 *Maintain Existing Projects*

Ensuring the proper functioning of previously constructed restoration projects could be considered as reconnecting isolated habitats, which is one of the first priorities identified by Roni et al. (2002) and is the first priority identified by the US Forest Service. Many restoration projects in the Chilliwack River Watershed have been undertaken in the past two decades. While most of these projects are known or assumed to be functioning at present, some are no longer functioning (e.g., Slesse R4, Foley Creek, Soowahlie, and Deer Creek side channels) while others have not been monitored to ensure proper functioning. Therefore, one of the priorities in the Chilliwack River Watershed should be to assess and evaluate the effectiveness of these projects and to maintain or rehabilitate those that are still effective (or potentially effective). In addition, projects that are currently not monitored should be assessed and a process to monitor these projects over the long term should be developed. In some cases, the original proponents of the project

⁴² Wilson, G. 2007. BC Ministry of Environment. pers. comm..

may be able to take on this role (e.g., DFO is able to provide some monitoring of past DFO designed projects through local hatchery staff). In other cases, agencies like DFO and the MOE may be able to support local groups conduct this work as volunteers or through some other mutually beneficial arrangement. The Chilliwack River Hatchery in particular is in an ideal position to support such efforts.

8.4 *Maintain and Restore Natural Processes and Habitats*

According to Roni et al. (2002), restoring natural process that create and maintain habitat is more desirable and a higher priority than instream restoration projects because restoring processes (a) benefits the watershed over the long term, (b) provides suitable habitat for all species that historically utilized the watershed, and (c) avoids the problem of building habitats that benefit one species while degrading habitat for others. Restoring natural processes involves restoring conditions that form, connect, and sustain habitats over the long term, such as the supply and movement of sediment from hill slopes, recruitment of woody debris, shading of the stream by riparian forests, and delivery of water to the stream channel. Activities undertaken under this umbrella include removing roads and culverts, restoring riparian areas, and stabilizing slopes.

The restoration plan completed by EBA Engineering Consultants Ltd. (2001) recognized the value of restoring natural watershed processes through activities to restore riparian areas (e.g., 13 locations along the mainstem of the Chilliwack River were identified as priorities for riparian assessment) and deactivate old forestry roads (e.g., 10.5 km of roads were identified as a high priority for deactivation). These high priority recommendations not completed should be pursued. Riparian restoration should continue to be priorities as these efforts benefit terrestrial species as well as fish.

Due to the complex nature of watershed processes, further detailed assessments will likely be required to identify priority activities needed to restore watershed processes. For example, a detailed assessment of all clay slides is needed to determine which slides are affecting fish habitat most significantly. This assessment will help to identified priority activities to address sedimentation of fish habitat from clay slides.

It should be noted that restoring certain watershed processes (e.g., restoring riparian forests to the point that they contribute required large woody debris to the river) will require a significant time period before any benefits are realized and may be beyond the capacity of the funders and groups currently supporting restoration activities in the watershed. Rather than attempting to pursue these significant restoration activities independently, it may be more effective for existing groups to work with individuals and agencies whose actions affect or have affected watershed processes to help them restore watershed processes through their future activities over the long term.

Agencies and groups involved with habitat restoration activities in the watershed agree to the value of restoring watershed processes over the long term, but also see a need to simultaneously restore or create habitat over the short term. While Roni et al. (2002) consider instream habitat manipulations and enhancements to be a lower priority than protecting existing habitat, reconnecting isolated habitats, and restoring natural processes,

they recognize that such projects play an important role in watershed restoration efforts and recommend that instream projects may need to be undertaken in conjunction with efforts to reconnect isolated habitats and restore watershed processes. It must be recognized; however, that naturally isolated habitats are often very valuable for species other than salmonids (e.g., amphibians) and reconnecting isolated habitats should only be done if isolation is a non-natural condition or connecting naturally isolated habitats will not negatively impact existing species assemblages.

Instream projects undertaken in the short term include the creation of off-channel habitat, placement of stable large woody debris and spawning beds, and nutrient enhancements. EBA Engineering Consultants Ltd. (2001) identified several priority off-channel projects, including the Pierce Ponds off-channel project, enhancements to Millennium Pond, expansion of the Camp side channel, and construction of a low flow intake structure on the Chilliwack River at the existing Deer Creek off-channel project. To date, much of the proposed work at Pierce Ponds has been completed or will be completed in 2007 and work is proposed for the Deer Creek intake. Opportunities to expand habitat at previous restoration projects like Millennium and Camp channels still remain.

EBA Engineering Consultants Ltd. (2001) did not identify priority restoration activities needed to address a lack of stable large woody debris, stable spawning grounds, or a lack of nutrients. Currently, none of the agencies or groups involved with restoration activities are interested in pursuing additional large woody debris placements on a large scale. Rather, there is some interest in evaluating the efficacy of existing large woody debris placements, and more broadly, examining the role of large woody debris in the Chilliwack River Watershed. This broader assessment could investigate the role of LWD in the watershed historically (e.g., utilizing the ecological reserve above the lake as a reference point) and currently and would consider both the positive (e.g., habitat creation) and potentially negative (e.g., destabilizing) effects of wood in the channel.

In terms of increasing stable spawning beds, one of the key suggestions is to increase spawning areas in the mainstem of the Chilliwack River in the upper watershed (e.g., upstream of Foley Creek). This suggestion is based on the observations that there is very little recruitment of gravel upstream of Foley Creek and few features (e.g., log jams or large woody debris) to hold gravel in place, and that the upper mainstem would provide invaluable spawning grounds for steelhead and pink salmon. There are some concerns about the potential effectiveness of such an activity (e.g., placing the gravel in a location where it is likely to remain), the potential impact on flooding or other river hazards, and the cost effectiveness of such a project. Therefore, if pursued on an experimental basis, this project should be preceded by an assessment to determine the most suitable location for a spawning gravel bed, an appropriate amount of gravel, and the potential hazards posed by the gravel placement. In addition, the project should be followed up by effectiveness monitoring.

To address the nutrient limiting factor over the short term, nutrients can be added directly to the system. Since nutrients are most lacking in the upper watershed, nutrient enrichments should focus on the upper mainstem, Chilliwack Lake, or upper tributaries. The BCCF began a slow nutrient release program in the upper river in 2006 which it

plans to continue for the next several years. There is also some interest in expanding nutrient enrichment to Chilliwack Lake, which would benefit sockeye. Over the long term, increased returns of pink and chum can help address a lack of nutrients.

This discussion summarizes both the priority recommendations from the EBA Engineering Restoration Plan plus priority projects for the various groups involved in restoration projects within the Chilliwack River Watershed over the short term. Unfortunately, prioritizing projects for the long term was beyond the scope of this analysis. Creating a list of priority restoration needs for the long term would be challenging as those priorities would likely change as conditions in the watershed change over time. Also, pragmatism/opportunism (i.e., undertaking projects due to momentum, available funding, personal interests, etc.) is an important factor in determining which projects are completed in reality and the importance of this should not be discounted.

A more flexible approach that would also help address some of the recommendations given for other aspects of this issue would be to hold an annual meeting between all watershed restoration interests to discuss restoration needs and priorities for the watershed. At this meeting, which would be most effective if held immediately following the labour day long weekend in September, restoration needs could be discussed and projects could be allocated amongst the various restoration groups active in the watershed.

8.5 *Protect Other Values*

A final consideration in habitat restoration is the protection of other values, such as species at risk, culturally sensitive areas, or important recreational areas. While restoration projects are typically not governed the same way as other projects that may impact these values (e.g., development), such projects do have the potential to influence these values in similar ways (e.g., through changes to hydrology or the physical destruction of habitat). Projects that focus on restoring watershed processes will typically benefit all species that historically utilized a reach, including native fish and other species at risk. However, habitat manipulation projects for a single species or a group of species may alter the natural characteristics of a site and affect other species utilizing the site, some of which may be at risk. In addition, any type of project that causes some level of disturbance or change on the landscape may affect important cultural or recreational sites.

Currently, there are few processes, laws, or guidelines that govern the protection of these values during restoration projects. One way to mitigate impacts to other values during restoration projects is to follow guidelines established for development proposals, such as the draft “Guidelines for Dealing with Development Effects on Species and Ecosystems at Risk on the South Coast of British Columbia” produced by the BC Ministry of Environment in 2006, which involves conducting a species at risk assessment prior to completing the project and adjusting the project design to mitigate potential impacts where required. Over the long term, it may be desirable to develop similar guidelines specific for habitat restoration projects that recognize the differences between restoration projects and development. Note that individual agencies may be able to provide technical support for any assessments that may be required (e.g., the BC Ministry of Environment

may be able to assist with a species at risk survey and Sto:lo Nation may be able to assist with archaeological site identification).

While guidelines would be useful, they would not completely eliminate the challenges associated with considering species-at-risk and other values when undertaking restoration projects. One of the key challenges is that many fish habitat restoration projects are funded by external agencies that wish to expand habitat for salmon in the most cost effective way possible. In some cases, these agencies are not willing to fund activities related to species at risk or cultural sensitivity assessments. Therefore, agencies, non-profit groups, or others seeking to restore fish habitat may not be able to obtain sufficient funds to complete the necessary assessments. If funding is received to conduct the appropriate assessments, project proponents may face another obstacle associated with a limited ability to modify the design to a point that threatens the proponent's ability to meet the project objectives.

One way to address these challenges would be to make funding agencies aware of the need for proponents to consider other values in addition to fisheries values when completing projects. In addition, it may be desirable to develop a more formal evaluation process for habitat restoration projects at the proposal stage. This would avoid challenges associated with obtaining funding for a project and then determining through pre-project assessments that the accepted objectives for the project cannot be met without significant impacts to species at risk or other values. A pre-project proposal meeting held in September prior to the submission of any funding applications for the following year would be an appropriate place to discuss the potential impacts of various projects.

Finally, developing a better understanding of where fish habitat restoration efforts are likely to conflict with other values in the watershed (e.g., mapping of key cultural, natural, or recreational values) may help project proponents direct restoration efforts away from these areas.

8.6 Possible Options to Achieve VISION

Table 1 outlines a summary of various options that could be undertaken to address the need for restoration projects as well as the impacts to and impacts from restoration projects in the future. For each option, a description and rationale is given. Also noted are challenges that would need to be overcome in order to implement each option, the relative cost of implementation, the time required for implementation, the feasibility of implementation from both a public and agency perspective, and the potential champion(s) that could implement each option.

Table 1 Summary of options

Description	Rationale/Description	Challenges	Relative Cost*	Time-frame**	Feasibility	Potential Champion
GOAL 1: Protect Existing Fish Habitat						
Implement recommendations given in other sections of the watershed strategy	The other sections in the strategy provide recommendations for reducing the impact of various activities on fisheries and other values (e.g., see Issues and Alternatives Reports for: Forestry, River Hazards, IPPs, Illegal Dumping, Mining, etc.)	Variable	Variable	Variable	Variable	Variable
Create and share better information regarding the status and location of intact fish habitat (e.g., a map)	This information is needed to help decision makers better protect existing fish habitat	Risk of information being used for the wrong reasons; creating information that becomes outdated quickly	Moderate	Short-medium	Moderate	DFO Local groups
Create a resource list to assist decision makers contact individuals who have current knowledge about important habitats	This would ensure that decision makers have access to up to date information that is specific to their needs	Maintaining a current list; slightly more time consuming and difficult than referring to a map or other existing information	Low	Short-long	High	Knowledgeable people/agencies CRWS website
GOAL 2: Maintain Existing Restoration Projects						
Assess/prioritize the need for maintenance of past projects that have not been monitored since installation	This would enable agencies to identify and prioritize maintenance activities required to ensure these projects are functioning as intended and justify funding requirements	Disappearance of some groups and funders responsible for project installation; lack of funding, resources or labour	Low-moderate	Short-long	Moderate-high	Province MOE Federal DFO
Conduct maintenance activities on existing projects as required	Adjust or upgrade existing projects can be more cost effective than creating new projects that provide the same level of habitat	Lack of funding, resources or labour; not cost effective for some projects that require regular ongoing maintenance	Low-high	Short	Low-high	Province MOE Federal DFO CRAC, FVRWC, etc
Develop a process for monitoring restoration projects on an ongoing basis	This would ensure that future projects will be monitored and maintained over time, as long as resources can be found. Monitoring would include both effectiveness (fish productivity) as well as the physical functioning of the site.	Resources, time and ability (agencies with the ability to conduct projects may lack the resources to monitor over the long term)	Low-moderate	Short	Moderate-high	All agencies/ individuals who conduct projects, local groups
GOAL 3: Restore Ecological Processes						
Assess/prioritize the	Most clay slides have received some	Funding	High	Short	High if	CRAC

Description	Rationale/Description	Challenges	Relative Cost*	Time-frame**	Feasibility	Potential Champion
need for additional stabilization of clay slides & undertake priority works	stabilization efforts to date and an assessment is now needed to determine what efforts are still required and where				funding obtained	
Implement high priority riparian restoration and road deactivation actions identified by the EBA Engineering Restoration Plan	These activities have already been identified as priorities	Lack of funding (e.g., Forestry Renewal BC and Fisheries Renewal BC) to complete these activities	High	Medium	Moderate	Landowners, Land management agencies
Work with decision makers to restore watershed processes through future activities	Many of the activities needed to restore ecological processes are cost prohibitive for existing restoration groups – these will need to be implemented by land management agencies over the long term	High cost; long time frame; lack of funding	High	Long	Moderate	Landowners, Land management agencies
Examine the role of large woody debris in the Chilliwack River and develop recommendations to promote beneficial recruitment of LWD	LWD can have both positive (e.g., habitat creation) and negative (e.g., destabilizing, risk posing) effects on the Chilliwack River – efforts are needed to promote the beneficial effects while minimizing the negative effects	Complex process; long time scales; interjurisdictional nature of the problem	High	Short-medium	Moderate-high	FVRD, DFO, MOE
GOAL 4: Increase Habitat						
Place spawning gravel in a suitable location in the mainstem above Slesse Creek	The upper river lacks mainstem spawning habitat (gravels) for pink, steelhead and Chinook salmon	Potential impact on flooding; preventing gravel from washing downstream; cost of transporting & placing gravel	Potentially high	Short – medium term	Unknown	Province Federal Gov't Angler User Groups
Expand off channel habitat at locations identified as high priority in the EBA Engineering Plan	Significant effort has already been undertaken to identify potential off-channel habitat projects – these opportunities should be pursued before looking for additional sites	Funding and resources	High	Medium-long	High if funding obtained	FVRWC CRAC BCCF DFO MOE
Expand off channel habitat in Ryder Creek Watershed	Ryder creek is a productive salmon stream; this area may develop more over time and opportunities should be acted upon when they are available	Working with private landowners; obtaining funding	High	Short-medium	Depends on land-owners	CRAC

Description	Rationale/Description	Challenges	Relative Cost*	Time-frame**	Feasibility	Potential Champion
Stabilize the Willow run clay slide	The Willow Run clay slide is the only side that has not yet had any stabilization work completed	Funding	High	Medium	High if funding obtained	CRAC
Continue slow release nutrient enhancement	Nutrients are needed in the upper watershed to increase primary production because salmon returns to this portion of the watershed are lower than historic returns	Does not address the core problem causing low nutrients; funding	High	Short-long	High if funding obtained	MOE, BCCF
Continue carcass placement program	See above	See above	Low	Short-long	High	DFO hatchery
Organize an annual restoration meeting	An annual meeting would enable all groups with an interest in restoration to discuss needs and allocate projects amongst the groups	Lack of time and mandate to organize such a meeting	Low	Short-long	High	FVRD, FVRWC
GOAL 5: Protect Other Values						
Develop a list of knowledgeable individuals who are willing to share information	This would enable proponents of restoration projects to easily assess the potential impacts of their proposed projects prior to applying for funding	Keeping a list up to date	Low	Short	High	CRWS website
Develop guidelines for agencies and organizations conducting restoration projects to follow	These guidelines would outline the process to be followed to ensure that projects will not have an undue effect on other values (e.g. recreation, cultural, wildlife, etc)	Resources and buy in	Low-moderate	Short-medium	Moderate-high	MOE
Develop a more formal review process for restoration projects	A more formal review process would enable dialogue between various agencies and interests regarding potential restoration projects before funding is applied for and received	Agencies do not have resources to review all potential projects in detail; lack of ability/authority to set up a formal review process	Low-moderate	Short-medium	Moderate-high	MOE, DFO, FVRD, FVRWC, etc.
Provide better information regarding the location of other values (e.g. SAR, recreation, cultural, etc)	This would allow proponents to direct restoration efforts to areas where minimal conflict would be expected	Sufficient resources and data to complete a comprehensive mapping exercise; potential for this data to become out of date quickly; sensitivity regarding the release of info	High	Medium-long	Low-moderate	MOE, DFO, First Nations, Recreational Associations, etc.

Description	Rationale/Description	Challenges	Relative Cost*	Time-frame**	Feasibility	Potential Champion
Encourage funding agencies to fund preliminary assessments of other values/impacts	Proponents of restoration projects typically apply for external funding to complete such projects – funding for assessments must be available through these grants if they are to be completed	Funding agencies may not wish to support activities that do not directly contribute to increased habitat (i.e., assessments)	Low	Medium	Low-moderate	All agencies and groups that do restoration projects

***Relative Cost:**

Low = volunteer, staff or student time only

Moderate = Excessive staff time and/or up to \$5,000 additional funding required

High = More than \$5,000 additional funding required

****Timeframe:**

Short = within 1 year

Medium = within 2-5 years

Long = more than 5 years

9.0 Recommendations

The following recommendations represent the subset of options that the restoration working group and the Project Team for the Chilliwack River Watershed Strategy feel are the best options for restoring and enhancing fish habitat in the watershed at this time.

1. Protect existing fish habitat in the watershed by:

- a. Providing decision makers with better access to information about critical fish habitat in the watershed;
- b. Providing decision makers with information about how to avoid negatively impacting those areas and the importance of proactive planning to avoid habitat impacts from occurring;
- c. Developing a long-term prioritization plan along the Chilliwack River Watershed for watershed needs and habitat restoration or enhancement opportunities.

2. Maintain existing restoration projects by:

- a. Rehabilitating past restoration projects that are no longer effective or are not functioning as intended, if the anticipated benefit is likely to outweigh the cost of rehabilitation works;
- b. Developing a system for monitoring past restoration projects, prioritizing/ conducting maintenance over the long term, evaluating effectiveness in terms of fish and habitat, and utilizing local volunteers to complete monitoring and maintenance activities where possible.

3. Restore ecological processes in the watershed by:

- a. Working with individuals, groups, landowners, and agencies whose actions affect or have affected watershed processes to help them restore watershed processes through future activities over the long term;
- b. Assessing the need for future stabilization of clay slides, prioritizing works required to stabilize slides, and undertaking priority activities;
- c. Examining the positive (e.g., habitat creation) and potentially negative (e.g., increased flood risk) effects large woody debris in the Chilliwack River Watershed and developing recommendations to promote beneficial recruitment of LWD;
- d. Promoting the completion of the high priority road deactivations and riparian assessments/restorations identified by EBA Consultants (2001) (Appendix B).

4. Enhance and restore fish habitat by:

- a. Completing all high priority off-channel habitat restoration projects outlined in the EBA Watershed Restoration Plan (2001) (see Appendix B);

- b. Continuing efforts to augment nutrient levels in the upper watershed (e.g., through slow nutrient release and carcass placement) and monitor these programs and adjust as needed;
- c. Investigating the rationale for/potential benefit of placing spawning gravel in the mainstem of Chilliwack River above Foley Creek, and evaluate potential locations/amounts, costs, and risks associated with hydrological changes (e.g., increased flooding) and impacts to existing habitat;
- d. Holding an annual meeting to be attended by all groups and individuals with an interest in restoration, perhaps following the Labour Day long weekend, to discuss watershed restoration needs and allocate priority projects for the following year;
- e. Developing a common and accessible databases and mapping to track all restoration projects conducted and proposed for the Chilliwack River Valley.

5. Mitigate the potential impact of restoration projects on other values by:

- a. Ensuring that agencies and interest groups knowledgeable about these values (e.g., species at risk, culturally sensitive sites, recreational sites) attend the annual restoration planning meeting;
- b. Developing a list of representatives from NGOs and government agencies who are knowledgeable about other values in the watershed;
- c. Developing a review process for proposed habitat restoration projects at the proposal stage;
- d. Encouraging Fisheries and Oceans Canada to take a leadership role in promoting ecosystem-based restoration (e.g., by more fully integrating consideration of other values when planning and executing fish habitat restoration projects);
- e. Developing guidelines (e.g., MOE BMP documents) that outline a process for restoration project proponents to follow in order to mitigate potential negative impacts and promote positive impacts to other species when conducting fish habitat restoration projects;
- f. Requesting that funding agencies fund activities required to ensure that other values are not negatively impacted during restoration projects (e.g., surveys and assessments).

10.0 References

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Appendix A: Chilliwack River Watershed Restoration and Enhancement Projects ⁴³

Name	Description	Year(s)	Proponent/Partners and funding*	Amount & Type Habitat Created or Restored	Target/Existing Species	Comments/Maintenance & Monitoring Needs
Little Tamihi Creek	Riffle-pool sequence	1998-99	SSHRC (\$16,000)	1,250 m ² channel	Coho, steelhead	No trapping completed, gee trapping needed
Anderson Creek	Side channel & pond	1995-96	DFO (\$65,000)	15,000 m ² pond; 400 m ² channel	Strong coho producer	Maintained most years; works well
Borden Creek	Side channel & ponds	1997-98	SSHRC (\$387,000)	26,500 m ² pond; 17,000 m ² channel	Coho	DFO maintains most years; beaver blockages removed in 2005; good producer; minor maintenance needed; trail maintained by TCT folks
Slesse Creek R1	Road deactivation & pond	1999-00	SSHRC (\$6,300)	30 m ² channel; 400 m ² pond		
Slesse Creek R1	Pond	1998-99	SSHRC/MOE (\$31,000)	1,500 m ² pond; 20 m ² channel		
Slesse Creek R4	Road deactivation & pond	1999-00	SSHRC/MOE (\$9,600)	300 m ² pond	good habitat for resident cutthroat, waterfowl, amphibians and watershrew?; coho can sometimes get in during high water	Minor assets - small projects; likely beaver problems; none maintained; good overwintering habitat for coho; could introduce high water to maintain fish access
Slesse Creek R4	Bar stabilization	1998-99	SSHRC/MOE (\$18,600)	100 m ² channel		
Slesse Creek R4	Groundwater channel & pond	1996-98	SSHRC/MOE (\$266,000)	2,300 m ² pond; 1,200 m ² channel		
Slesse Creek R6	Off channel pond complex	1997-98	SSHRC (10,000)	200 m ² pond; 20 m ² channel		
Slesse Creek R1	Mainstem LWD	1999-00	MOE/Fraser Association (\$20,000)	800 m ² channel		
Foley Creek	Side channel & LWD	1998-99	CFDC /DFO/MOE (\$20,000)	800 m ² pond; 3,200 m ² channel	Coho, steelhead	Should be looked at; low maintenance requirements; worked well; some damage

⁴³ Summary of restoration projects in the Chilliwack River Watershed (upstream of Vedder Crossing) completed to 2006 (updated from EBA, 2001).

Name	Description	Year(s)	Proponent/Partners and funding*	Amount & Type Habitat Created or Restored	Target/Existing Species	Comments/Maintenance & Monitoring Needs
						to intake; people have taken wood; high energy system
Angel Wing Pond	Side channel & ponds	1997-99	CFDF/DFO (\$284,000)	15,000 m ² pond; 13,000 m ² channel	Coho	Works really well; minor maintenance on the intake; designed for schoolkids (bus access); coho, resident cutthroat, steelhead
Millennium Pond-15 Mile	Ground water fed side channel & ponds	1998-00	DFO/Fraser Association (\$112,000)	6,000 m ² pond; 2,300 m ² channel	12,000 coho smolts	Excellent project; big producer; together with Centennial has doubled wild coho production
Centennial/Bulbeard	Side channel & ponds	1997-98	CFDC/DFO (\$646,000)	75,000 m ² pond; 45,000 m ² channel	Endangered springs, coho, spring, pink (50,000), chum, steelhead	Biggest and most productive site
Yukalaup (Post) Creek	Side channel & ponds	1997-98	DFO (\$102,000)	2,000 m ² pond; 3,500 m ² channel	Early chum, pink spring, coho	Small, not a lot of side channels
Chilliwack Lake Outlet	Gravel placement	1995-96	DFO (\$25,000)	2,500 m ² channel	70 steelhead spring 2006; all species except sockeye	Excellent project, easy viewing
Young Creek	Riffle-pool sequencing, pond	1998-99	SSHRC (\$35,800)	2,000 m ² pond; 200 m ² channel	Coho	A bit of a failure; Jack Mussel has thoughts on how to improve
Chilliwack River (Allison Pool, Thurston up to Centre/Foley)	Scattered LWD placement (39 struct.)	1998-99	Tamihi Logging/MOE/FsRBC/BCCF (\$83,400)	11,400 m ² channel	All species	No maintenance required; good winter habitat
Chilliwack River	LWD placement (near centre)	1999-00	SSHRC/MOE (\$16,900)	240 m ² channel	All species	
Deer Creek	Side channel ponds	1999-00	DFO/Fraser Association (\$67,600)	3,800 m ² pond; 660 m ² channel	Coho	Deep pond; significant maintenance completed; more required
Camp Channel (Centre Creek Corrections Camp)	Side channel ponds	1999-00	MOE/SSHRC DFO through FRBC (\$87,000)	4,300 m ² pond; 1,100 m ² channel	Pink, coho, chum, steelhead	Productive; maintenance on intake in 2005

Name	Description	Year(s)	Proponent/Partners and funding*	Amount & Type Habitat Created or Restored	Target/Existing Species	Comments/Maintenance & Monitoring Needs
Borden Creek	Road deactivation/planting	2001	SSHRC (\$6,800)		All species	Access blocked because of dumping problems
Lower Deer Creek	Road deact./Rip. plant/ponds	2001	SSHRC (\$41,900)		Coho	ATV problems; could use some boulders to block access; problems with camping, washing vehicles in the creek, etc.
Slesse Creek	Road deact./Rip. plant/ponds	2001	SSHRC (\$6,800)			
Chilliwack River	Road deact./Rip. plantings	2001	SSHRC (\$6,800)			
Slesse Creek	Riparian treatment	2001	SSHRC (\$38,800)			
Slesse Park Slide	Clay slide stabilization	1999-2000	CRAC, BC Hydro, FsRBC			
Tolmie Slide	Clay slide stabilization	2001-2005	CRAC, FVRD, etc.			
Buxton Channel/Post Creek	Gravel placement		HCF????			
Soowahlie Channel	Pond-channel complex NEED INFO		DFO/First Nations			
Ushers Channel	Groundwater channel NEED INFO		DFO			
Wingfield pond at Fish and Game Club	NEED INFO					
Boulder Run	Riparian restoration	2005	Evergreen Foundation		Aquatic and terrestrial species	Moderate success; signs vandalized but many plants survived until 2006
Lovely Pond/Thompson Park	Off channel ponds & trail	2005	CRAC/DFO		Coho	Very successful
Pierce Ponds (in behind hatchery)	Off channel & spawning	1999, 2006	CRAC, DFO, FVRWC		Coho	Adults arrived in 2005; fry and carcasses put in ponds

Name	Description	Year(s)	Proponent/Partners and funding*	Amount & Type Habitat Created or Restored	Target/Existing Species	Comments/Maintenance & Monitoring Needs
Upper River Nutrient Enhancement - Post, Foley, Centre and Mainstem	Slow release fertilizer	2005, 2006	BCCF		Steelhead and other species	Went well operationally; field data not analyzed yet but more algae observed visually
Nonie Creek Off Channel	Off channel ponds	2006	CRAC		Coho	
Slesse Creek Side Channel	Side channel	2006	CRAC		All species	Designed to accept high flows to take pressure off the slide; pilot project

*Note that the funding estimates do not necessarily include in kind contributions, which are significant especially in the larger projects.

Acronyms

BCCF = BC Conservation Foundation

CFDC = Community Fisheries Development Corporation

CRAC = Chilliwack River Action Committee

DFO = Fisheries and Oceans Canada

FsRBC = Fisheries Renewal BC

FVRWC = Fraser Valley Regional Watersheds Coalition

FVRD = Fraser Valley Regional District

MOE = BC Ministry of Environment (formerly Ministry of Environment, Lands and Parks)

SSHRC = Steelhead Society Habitat Restoration Corporation

Appendix B: Priority Restoration Projects ⁴⁴

I. Off Channel Projects

Prior. Level	Name	Location	Project Type	Spp.
High	Pierce ponds	Adjacent to CR mainstem at Pierce Creek	Expand ponds, construct spawning channels	Coho, Rainbow trout
High	Millennium Pond enhancement	Adjacent to CR mainstem upstream of Nesakwatch	Spawning channel to connect ponds, expand existing pond (est \$15,000)	
High	Camp side channel	N side of CR mainstem between Nesakwatch & Centre	200m ² side channel (est. \$5,000)	Steelhead, Pink Salmon
High	Deer Creek	Downstream of Tamihi	Construct low flow intake	
Low	Tamihi Creek off channel	S side of CR mainstem downstream of Tamihi Crk	Off channel	Coho, Steelhead
Low	Kayak off channel	S side of CR mainstem near Tamihi bridge	Off channel	Coho
Low	Railroad side channel	S side of CR mainstem between Nesakwatch & Centre	Side channel	Steelhead, Pink Salmon
Low	Williams side channel	N side of CR mainstem upstream of Centre Crk	Road rehab, side channel	Coho, Steelhead
Low	Centre Creek side channel	S side of CR mainstem at Centre Creek		
Low	Seven Mile off channel	S side of CR mainstem upstream of Centre Creek	Reactivate abandoned side channel	Coho, Steelhead
Low	Paleface off channel	S side of Paleface close to entrance to Lake		Coho, Steelhead
Low	Slesse Creek off channel	E side of Slesse Creek 4km upstream from CR		

II. Riparian Assessment and Restoration

Prior. Level	Location	Disturbance History
High	Liumchen creek	Logged (no date)
High	Near LWD placements in CR mainstem upstream of slides	Logged (no date)
High	Pierce ponds	Burned 1938
High	Pierce ponds	Burned 1938
High	Pierce ponds	Burned 1938
High	Pierce ponds	None indicated
High	Near Foley creek side channel and LWD placement	Burned 1938
High	Adjacent to Millennium and Angelwing pond complex	Burned 1938
High	Immediately upstream of Millennium off channel	Burned 1938
High	Adjacent to potential Railroad side channel project	Burned 1938
High	Near CR LWD site at Centre Creek, adjacent to proposed Williams side channel	None indicated
High	Adjacent to proposed Williams side channel	None indicated

⁴⁴ From EBA, 2001