3809/WP#: P-1764

Reconnaissance (1:20,000) Fish and Fish Habitat Inventory of the Canadian Skagit River Watershed

Watershed Code: 970-110000

March 2008

Prepared for:

BRITISH COLUMBIA
Ministry of Environment

Lower Mainland Region
10470 152nd Street
Surrey, B.C.
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Prepared by:

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Cover Photos:

1. Skagit River falls upstream of the confluence of Snass Creek.
2. Klesilkwa River.
3. Skagit River rainbow trout.
4. Confluence of the Sumallo and Skagit Rivers.

Reconnaissance (1:20,000) Fish and Fish Habitat Inventory of the Skagit River Watershed

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Prepared for:

Duane Jesson
Ministry of Environment
Lower Mainland Region
Surrey, B.C.

Prepared by:

Neal Foord, R.P.Bio. # 1840
Triton Environmental Consultants Ltd.
Prince George, B.C.

March, 2008

Contract Details:

Ministry Contract #:	CLE07-097-ES
Triton Project #:	3809
FDIS Project #:	16332
Project Name:	Reconnaissance (1:20,000) Fish and Fish Habitat Inventory of the Skagit River Watershed
Project Type:	1:20,000 Reconnaissance
Report Date:	March 2008
Proponent:	Ministry of Environment, Lower Mainland Region
Company/Agency:	Triton Environmental Consultants Ltd.
Contact Person:	Neal Foord, Ryan Liebe
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Ministry Representative:	Duane Jesson Fisheries Biologist Ministry of Environment
Contract Monitor:	Duane Jesson Ministry of Environment

Locational Information:

MOE Regions:	2 (Lower Mainland) 8 (Okanagan)
FW Management Units:	2-1, 2-2, 2-17, 8-5
DFO Operational Area:	BC Interior
DFO Sub district:	29E (Chilliwack)
Forest Regions:	Coast, Southern Interior
Forest Districts:	Chilliwack, Cascades
Forest License #'s:	A19202 (Cattermole Timber Ltd.) A19203 (International Forest Products Ltd.)
First Nations' Claim Area:	Stó:lô Nation
1:50,000 NTS Maps:	92 H/02, 92 H/03, 92 H/06, 92 H/07
1:20,000 TRIM Maps:	092H.004, 092H.005, 092H.006, 092H.014, 092H.015, 092H.016, 092H.024, 092H.025, 092H.026, 092H.034, 092H.035, 092H.036.

Watershed Information:

Watershed Group:	SKGT (Skagit River)
UTM Coordinate of Watershed Mouth:	10.640659.5429259 (Ross Lake at U.S.A. border)
Tributary Status:	7^{th} order tributary to Ross Lake Reservoir at Canadian/U.S.A. Border. Watershed discharges into Skagit Bay (Pacific Ocean), U.S.A.
Watershed Area:	105,491 ha
BEC Zones/Subzones/Variants:	CMA, CWHds1, CWHms1, ESSFdc2, ESSFdcp, ESSFdcw, ESSFmw, ESSFmw1, IDFww, IMA, MHmm2

Sampling Design Summary:

Field Sampling Dates:	June 19th (Aerial Overflight) August 14th – 20th, 2007 October 22nd – 23rd, 2007
Number of Proposed Stream Surveys:	70
Number of Proposed Lake Surveys:	0
Number of Individual Watercourses:	2,296 Unique ILP's + 808 Unique WSC's = 3,104 Individual Watercourses
Number of Stream Reaches:	4,038
Number of Stream Reaches Designated as Wetlands:	56
Number of Lake Reaches:	55

Summary of Project Achievements:

Number of Stream Sites Surveyed in 2003:	77 + 16 fish-only sites = 93
Number of Lakes Surveyed:	0
Fish Species Captured:	BT, DV, DV×BT, EB, RB

Contractor Information

Project Manager:	*Name:*	Ryan Liebe, Triton Environmental Consultants Ltd.
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Field Crew:	*Names:*	Ryan Liebe, Justin Hooper, Mark LeRuez, Neal Foord
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Report Prepared by:	*Names:*	Neal Foord
Report Edited by:	*Name:*	Ryan Liebe
Maps Prepared by:	*Name:*	Neal Foord, Triton Environmental Consultants Ltd.
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Planning Information and Sampling Design Protocols

Relevant planning information is discussed in the following report, and can be found in its entirety in the planning report (Attachment 1). Specific project requirements, agreements with respect to the application of the standards, and other contractual obligations are recorded in the contract.

Disclaimer

This product has been accepted as being in accordance with approved standards within the limits of Ministry of Environment quality assurance procedures. Users are cautioned that interpreted information on this product developed for the purposes of the Forest and Range Practices Act and Regulations, for example stream classifications, is subject to review by a statutory decision maker for the purposes of determining whether or not to approve an operational plan.

Acknowledgments

Duane Jesson (Fisheries Biologist, Ministry of Environment) was the contract monitor for this project, and was responsible for making this project happen. His insight and assistance is greatly appreciated. Duane participated in the pre-field meeting, the aerial overflight, and accompanied our crew in the field during the October follow-up visit, and reviewed an earlier draft of this report. Iain Lunn (Ministry of Environment) and Scott Powell (Seattle City Light) were also at the pre-field meeting and assisted with the October sampling trip. We would like to thank Dr. Eric Taylor, Dept. of Zoology, University of British Columbia, and an unnamed lab assistant, who provided analysis and interpretation of the genetic samples collected from the watershed. Paul Graveline and Jason Friesen of North/South Consultants Inc. completed the ageing analysis of the samples collected in the watershed.

Chris Perrin of Limnotek Research and Development Inc. completed the water quality analysis that was originally part of the fish inventory project. Triton would also like to thank Kiyo Masuda and Shauna Bennett of Limnotek, Marc Laynes of Cascade Fishing Adventures, and Scott Cope from Westslope Fisheries for their cooperation while coordinating field activities. Helicopter services were provided by Brad Fandrich of Valley Helicopters Ltd.

Karla Graf (Triton) helped with the literature search, compiled the water quality and fish stocking information, and attended the pre-field meeting. Jenifer Bond and Carol Sapergia (Triton) assisted in the production of the project deliverables. Field work was conducted by Neal Foord, Justin Hooper, Mark LeRuez and Ryan Liebe of Triton. Neal Foord completed the data entry, watershed report, and GIS deliverables. Ryan Liebe edited all project deliverables and created the overflight video.

Table of Contents

List of Tables

List of Figures

List of Equations

List of Appendices

List of Attachments Available at the Surrey MOE Office

1. INTRODUCTION

Triton Environmental Consultants Ltd. (Triton) was retained by the British Columbia Ministry of Environment (MOE), Lower Mainland Region, to conduct a reconnaissance (1:20,000 scale) fish and fish habitat inventory (FFHI) of the Canadian portion of the Skagit River watershed. The project followed applicable Resource Information Standards Committee (RISC) standards, unless otherwise noted in this report. The pre-field planning (phases 1 to 3) portion of the project was completed in July, 2007 and the results are presented in Attachment 1. An aerial overflight was conducted on June 19th, 2007 to aid in the development of the phase 1-3 deliverables, and an edited version of the video is included in Attachment 2. Field sampling occurred from August 14th to 20th, 2007, and October 22nd to 23rd, 2007. This report, Appendices 1 to 3, and Attachments 1-4 present the results of the inventory and discuss the management implications of the findings and recommendations for additional work.

1.1 Project Scope/Objectives

The information gathered during fish and fish habitat inventory projects is used to report the fish species and their relative abundance and distribution, as well as habitat values, habitat capabilities, limiting factors, and management concerns within the project area (BC Fisheries 2001a). The data is critical for establishing baseline fisheries conditions, and provides information that can be used to model fish habitat and distribution in similar watersheds where funding for field studies is limited. The information is often used for integrated resource management, for example, to classify streams under the Forest and Range Practices Act for timber harvest, or to aid in determining appropriate crossing structures for transportation corridors.

The overall project objective was to collect fish habitat inventory information that will facilitate integrated resource and fisheries planning and decision making. The specific objectives of this project were to provide information on the fish species, distributions and relative abundance within the Skagit River watershed, and to provide stream biophysical data.

1.2 Location

The Canadian portion of the Skagit River watershed is located in the Cascade Mountains in southern British Columbia. The watershed occurs in a transitional area between coastal and interior ecosystems. The western and southern portion of the watershed is within the Skagit Ranges, while the eastern portion of the watershed is within the Hozameen Ranges. The Hozameen Ranges are much drier and have a more continental climate than the Skagit Ranges to the west due to the rain shadow effect of the Cascade Mountains.

The river flows northwest from its headwaters in Allison Pass for roughly 20 km, where it veers to the south at its confluence with Snass Creek. The river continues south to its confluence with Ross Lake at the Canada/U.S.A. border (Figure 1). Ross Lake is a reservoir created by the impoundment of the Skagit River by the Ross Dam at the confluence with Ruby Creek. The Skagit River is impounded by two additional dams further downstream (the Diablo Dam and Gorge Dam), before continuing west and discharging into the Pacific Ocean at Skagit Bay in Washington State, U.S.A.

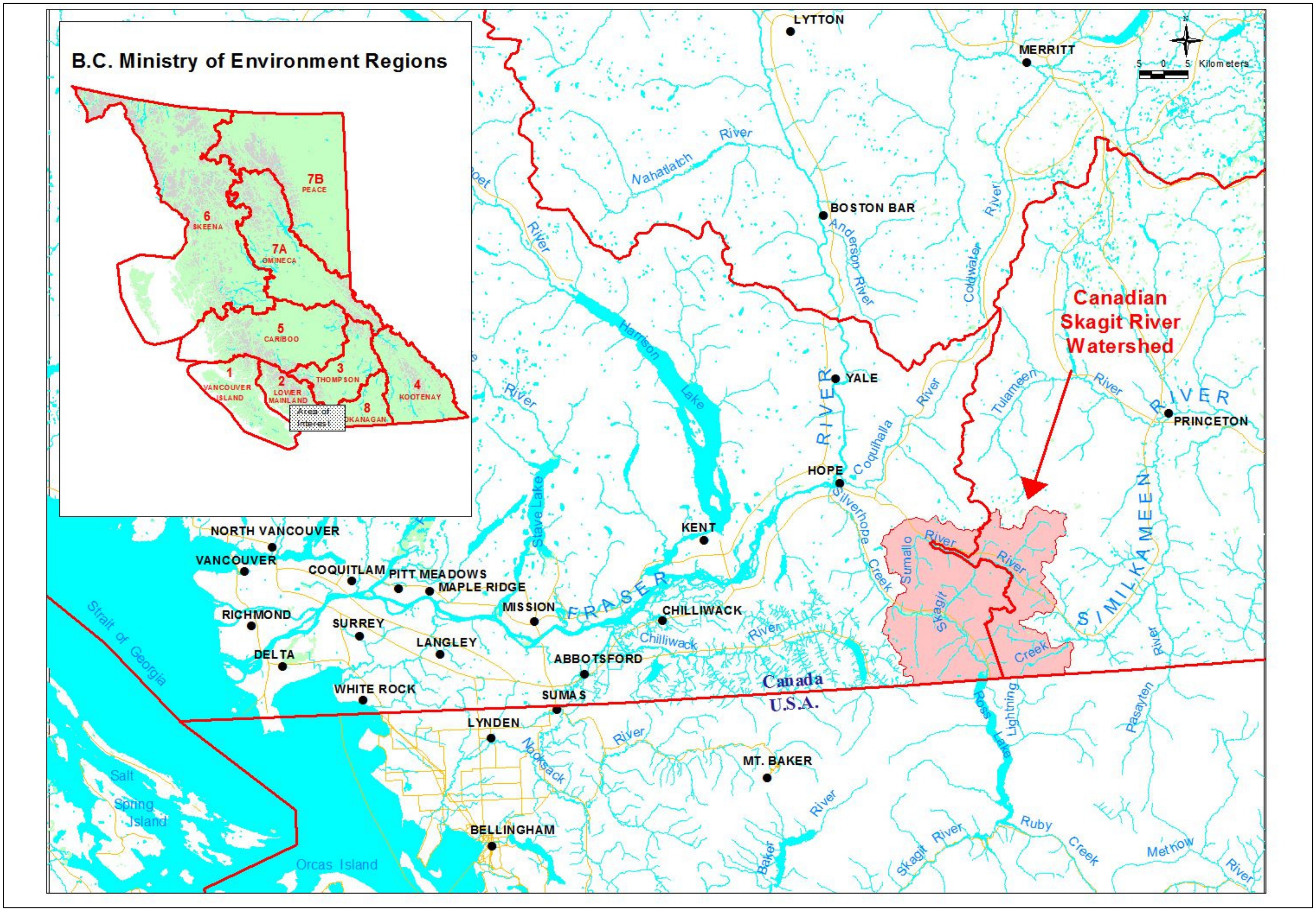


Figure 1. Location of the Skagit River watershed within the Province of British Columbia.

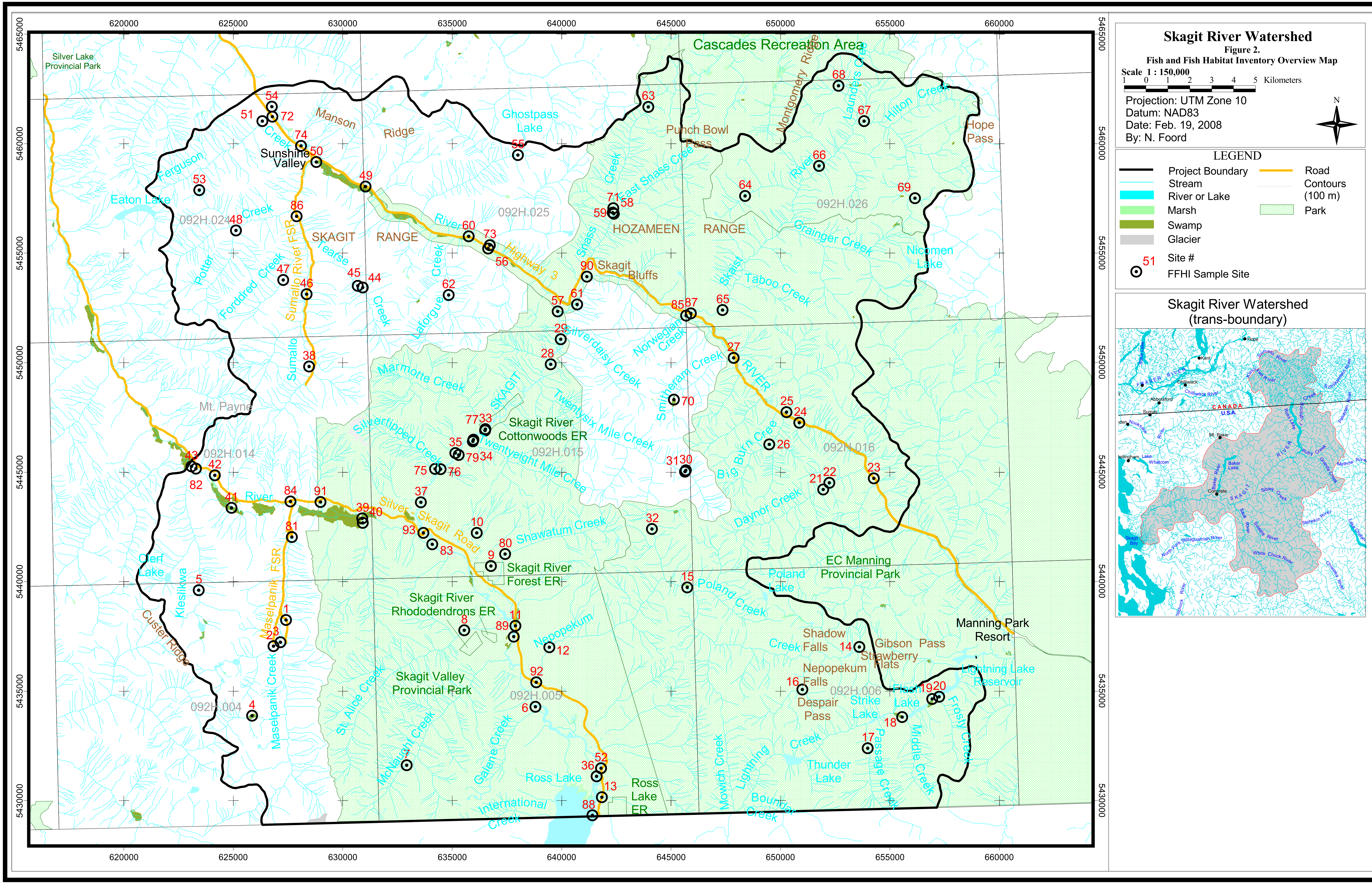
The eastern portion of the watershed is within the MOE Region 8 (Okanagan), while the western portion is in Region 2 (Lower Mainland). Most of the watershed falls within the Chilliwack Forest District, Coast Forest Region, although the headwaters of the Skaist River in the northeast corner of the watershed are within the Cascades Forest District, Southern Interior Forest Region. Most of the project area falls within the Manning Landscape Unit (LU), though the headwaters of the Klesilkwa River upstream of Maselpanik Creek are within the Silverhope LU, and the Lightning Creek watershed is part of the Similkameen LU (Integrated Land Management Bureau 2008a).

1.3 Access

There are two main transportation corridors that provide road access to the Skagit River watershed. Highway 3 (Crowsnest Highway) follows the Sumallo River downstream from its confluence with Ferguson Creek to its confluence with the Skagit River, at which point it continues upstream along the Skagit River to Allison Pass. Further to the east, the highway passes Manning Park Resort, and all-season roads provide access to Lightning Lake at the head of the Lightning Creek drainage, and to the ski hill in the headwaters of Nepopekum Creek. The highway and a series of trails through E.C. Manning Park provide good access to the upper portions of the Skagit River, as well as the lower reaches of most of the major tributaries upstream of (and including) the Sumallo River. Another series of trails can be used to access the Lightning Creek drainage. The Sumallo River Forest Service Road (FSR), which branches off of Highway 3 at Sunshine Valley to the south, provides access to the upper portions of the Sumallo River drainage, though many of the adjoining cutblock access roads have been deactivated, are overgrown, or are otherwise undrivable, even with a four-wheel drive. The Ferguson Creek FSR, which branches off of Highway 3 at the waste transfer station just west of Sunshine Valley, is completely overgrown and cannot be used for vehicular access.

The Silver-Skagit Road provides access to the lower portions of the Klesilkwa River and lower reaches of the Skagit River. The all-season gravel road is in good condition, and can be used to transport boats to Ross Lake. The road crosses the international border, and is also used to access the Hozameen Campground on Ross Lake in the U.S.A. The road does not connect to any other U.S. route, and campers must return via the Silver-Skagit Road. An adjoining network of hiking trails provides good access to the middle portions of the Skagit River, and to the lower reaches of several left bank tributaries, including Nepopekum Creek and Shawatum Creek. The Maselpanik FSR provides four-wheel drive access to the lower half of the Maselpanik Creek drainage, though the roads in the upper portion of the watershed are no longer drivable. A bridge on the Klesilkwa FSR at 0.5 km is out, and the road cannot currently be used to access the upper portions of the Klesilkwa River.

Sunshine Valley is the only community in the watershed, located on Highway 3 at the confluence of Ferguson Creek and the Sumallo River, and accounts for the only private land in the watershed (approximately 3.6 km^2). The community consists mostly of recreational properties, and has a population of 167 (BC Stats 2007). The nearest services are located in Hope, 19 km west of Sunshine Valley. The Silver-Skagit Road, used to access much of the watershed, also begins in Hope. An overview map of the Skagit watershed is presented in Figure 2, which shows the main transportation routes in the watershed, as well as the Manning Park Resort, community of Sunshine Valley, and other relevant features referred to in this report.



Skagit River Watershed
Figure 2.
Fish and Fish Habitat Inventory Overview Map
Scale 1 : 150,000
Kilometers
Projection: UTM Zone 10
Datum: NAD83
Date: Feb. 19, 2008
By: N. Foord
LEGEND
Project Boundary
Stream
River or Lake
Marsh
Swamp
Glacier
Site #
FFHI Sample Site
Road
Contours (100 m)
Park
Skagit River Watershed (trans-boundary)
Cascades Recreation Area
Silver Lake Provincial Park
Skagit Valley Provincial Park
EC Manning Provincial Park
Skagit River Cottonwoods ER
Skagit River Forest ER
Skagit River Rhododendrons ER
Ross Lake ER
Manning Park Resort
SKAGIT RANGE
HOZAMEEN RANGE
Highway 3
Silver Skagit Road
Sunshine Valley
Mt. Payne
Eaton Lake
Ghostpass Lake
Nicomen Lake
Ross Lake
Lightning Lake Reservoir
Thunder Lake
Strike Lake
Flash Lake
Poland Lake
Clerf Lake
Punch Bowl Pass
Hope Pass
Gibson Pass
Despair Pass
Skagit Bluffs
Shadow Falls
Nepopekum Falls
Strawberry Flats
Custer Ridge
Manson Ridge
Montgomery Ridge
092H.024
092H.025
092H.026
092H.014
092H.015
092H.016
092H.004
092H.005
092H.006

1.4 Climate and Topography

The Skagit River is located in the Cascade Mountains, in a transitional area from the moist, coastal climate of the lower Fraser Valley, to the drier, continental climate of the Southern Interior. The Skagit River mainstem separates the Skagit Ranges (to the west) and Hozameen Ranges (to the east). Elevations within the watershed range from 2,596 m at the peak of Silvertip Mountain to approximately 478 m at Ross Lake. A 43 ha glacier (based on TRIM, source air photo data is from 1995) is present on the eastern face of Silvertip Mountain which feeds Silvertipped Creek, and another glacier is located just east of Camp Peak at the headwaters of Maselpanik Creek (approximately half of the glacier is located south of the international border). A few small glaciers are also located in the headwaters of Passage Creek, but none are located in Canada (Granshaw and Fountain 2003).

Due to the steep, rocky topography, wetlands are rare and make up only 0.5% (496 ha) of the watershed area, based on the TRIM map base. The vast majority of the wetlands are located along the valley bottoms in the Sumallo River and Klesilkwa River drainages. Most of the wetlands encountered while performing the stream surveys are classified as swamps as most had mineral soils (or small amounts of well-decomposed organic soils with no significant peat moss) and dense shrubs and herbaceous plant cover (Province of British Columbia 1995). Some open-water wetlands are present near Sunshine Valley where Ferguson Creek has been diked.

Lakes comprise 0.2% of the watershed area (218 ha; does not include the Ross Lake Reservoir). There are 102 lakes shown on the TRIM map base, though 11 are classified as “intermittent”, and one located at the base of a scree/talus slope is classified as “indefinite” in the TRIM attribute table. Only 33 of the lakes are larger than 1 ha, and only 3 are larger than 10 ha (Lightning Lake, 55.0 ha; Thunder Lake, 29.4 ha, and Flash Lake, 12.7 ha). Lightning Lake was artificially increased in size when it was connected to the Similkameen River watershed when Little Muddy Creek was impounded.

Six weather stations are or have been located within or in close proximity to the project area. Table 1 shows the mean annual temperature, precipitation, rainfall, and snowfall at each station for their period of operation. Only the Hope Slide station, located just north of Highway 3 in Sunshine Valley, is currently active. As expected, stations in the eastern portion of the study area (Manning Park and Allison Pass) experience a cooler mean annual temperature, while those near Sunshine Valley with a more coastal climate are warmer. The Skagit River station has the warmest mean annual temperature, but was operational during an earlier period than the other stations. The mean annual precipitation at Manning Park and Allison Pass is similar to Hope Slide and Skagit River, but a much greater proportion falls as snow (57% - 67% at the eastern stations, 21% - 24% at the Hope Slide stations, and 32% at the Skagit River location).

There are three active snow courses located in the watershed, at the confluence of Potter Creek and the Sumallo River, the top of an unnamed 1,130 m high mountain on the right bank of the Klesilkwa River, and near the outlet of Lightning Lake. Four other snow course locations exist in the watershed but are no longer active. Table 2 shows the mean snow depth and snow-water equivalent at each station. The snowpack generally continues accumulating until late March, except at Lightning Lake, the highest elevation course where the snowpack often continues to accumulate until April.

Table 1. Environment Canada and Ministry of Transportation weather station climate data for stations within or near the project area (Environment Canada 2000).

Station Name	Station ID	Start Date (d/m/y)	End Date (d/m/y)	Elevation (m)	Mean Annual Temperature (˚C)	Mean Annual Precipitation (mm)	Mean Annual Rainfall (mm)	Mean Annual Snowfall (cm)
Manning Park	1124890	1/11/1952	1/4/1961	1,198	3.0 (1.9-4.2)	1,058 (1,043-1,073)	459 (390-529)	598 (544-653)
Allison Pass	1110350	1/9/1958	1/10/1972	1,341	1.9 (1.0-2.7)	1,457 (1,198-1,906)	402 (242-580)	1,046 (752-1,545)
Allison Pass DOH	1110352	1/11/1974	31/5/1989	1,340	1.9 (0.6-2.7)	1,096 (900-1,487)	357 (203-508)	676 (477-1,216)
Hope Slide	1113581	1/5/1975	active	674	6.1 (4.7-7.6)	1,199 (891-1,851)	913 (629-1,270)	284 (588-139)
Hope Slide	1113580	1/5/1967	1/4/1974	701	4.9 (4.3-5.3)	964 (1,235-1,549)	766 (571-1,012)	469 (328-697)
Skagit River	1117410	1/12/1936	1/9/1955	515	6.8 (5.7-8.0)	1210 (592-1,463)	830 (359-1053)	379 (195-619)

*Brackets indicate range of annual means for the active periods of the stations. Climate data for some parameters is not available for all years indicated for some stations.

Table 2. B.C. Ministry of Environment snow course data (B.C. Ministry of Environment 2008).

Name	Course ID	Start Year	End Year	Elevation	Mean Snow Depth (cm) and Snow-Water Equivalent (mm)											
					January		February		March		April		May		June	
					Snow	Water	Snow	Water	Snow	Water	Snow	Water	Snow	Water	Snow	Water
Tashme	3D01	1944	1950	670			56	142	58	173	44	179				
New Tashme	3D01A	1947	1984	700			74	206	84	267	69	255	16	73		
Sumallo River	3D01B	1979	1995	880			71	198	76	244	64	240	20	82		
Sumallo River West	3D01C	1992	active	790			57	169	62	206	37	137	9	41		
Lightning Lake	3D02	1947	active	1,220			62	172	86	255	102	329	63	236		
Klesilkwa	3D03	1947	1947	610			86	203	46	135	0	0				
Klesilkwa	3D03A	1948	active	1,130	48	124	74	211	91	275	88	311	27	117	12	66

The Skagit River valley forms a major boundary for ecosystems within British Columbia, and across North America. The valley forms the boundary between the Humid-Temperate Ecodomain to the west and the Dry Ecodomain to the east. The western portion of the watershed falls within the Cool Hypermaritime and Highlands Ecodivision, Coast and Mountains Ecoprovince, Pacific Ranges Ecoregion, and Eastern Pacific Ranges Ecosection. East of the Skagit River Valley, the watershed is within the Semi-Arid Steppe Highlands Ecodivision, Southern Interior Ecoprovince, Northern Cascade Ranges Ecoregion, and Hozameen Range Ecosection.

Six biogeoclimatic ecosystem classification (BEC) zones are present within the Skagit River watershed (Meidinger and Pojar 1991; Figure 3). The Skagit River valley downstream from the confluence of Twentyeight Mile Creek to the U.S. border, to approximately 1,000 m elevation, is within the wet-warm subzone of the Interior Douglas-fir BEC zone (IDFww). The valley bottom upstream from Twentyeight Mile Creek, and the valley bottoms of major tributaries, are within the southern moist submaritime subzone and variant of the Coastal Western Hemlock BEC zone (CWHms1). The lower 3 km of the St. Alice Creek and McNaught Creek valleys above the IDFww zone are within the southern dry submaritime subzone and variant (CWHds1), but climb into the CWHms1 above this.

West of the Skagit River valley, the leeward moist maritime subzone and variant of the Mountain Hemlock BEC zone (MHmm2) occurs above the CWHms1, above approximately 1,300 m elevation. East of the Skagit River valley the moist-warm subzone of the Engelmann Spruce – Subalpine Fir BEC zone (ESSFmw) occupies this slope position. The ESSFmw also occurs in small pockets west of the Skagit River valley, in the headwaters of a tributary to Potter Creek, and the east-facing slopes of the Laforgue Creek valley.

In the upper reaches of the Skaist River, the cascade variant of the ESSFmw (ESSFmw1) gives way to the moist warm woodland subzone and variant (ESSFmww) above 1,600 to 1,700 m elevation. Above 1,900 m, the moist warm parkland subzone and variant (ESSFmwp) predominates.

The Coastal Mountain-heather Alpine (CMA) BEC zone occurs above elevations of 1,600 to 1,800 m west of the Skagit River valley, and the Interior Mountain-heather Alpine (IMA) BEC zone occurs to the east of the Skagit River valley, at elevations of 1,700 to 1,900 m. Both of these separate BEC zones are entered as Alpine Tundra (AT) in the FDIS database.

1.5 Summary of Existing Fisheries Information

A significant amount of existing fisheries information was available for the Skagit River watershed prior to the commencement of this inventory. The watershed is among the most popular trout fisheries in the province, and as such, angler data is prolific. The Skagit Environmental Endowment Commission (SEEC), established in 1984 by an international treaty between Canada and the U.S.A., provides funding for research and enhancement within the watershed on both sides of the border. An excellent bibliography of relevant research, including fisheries studies, is available on their webpage (http://www.skagiteec.org/research/BiblioFolder_view).

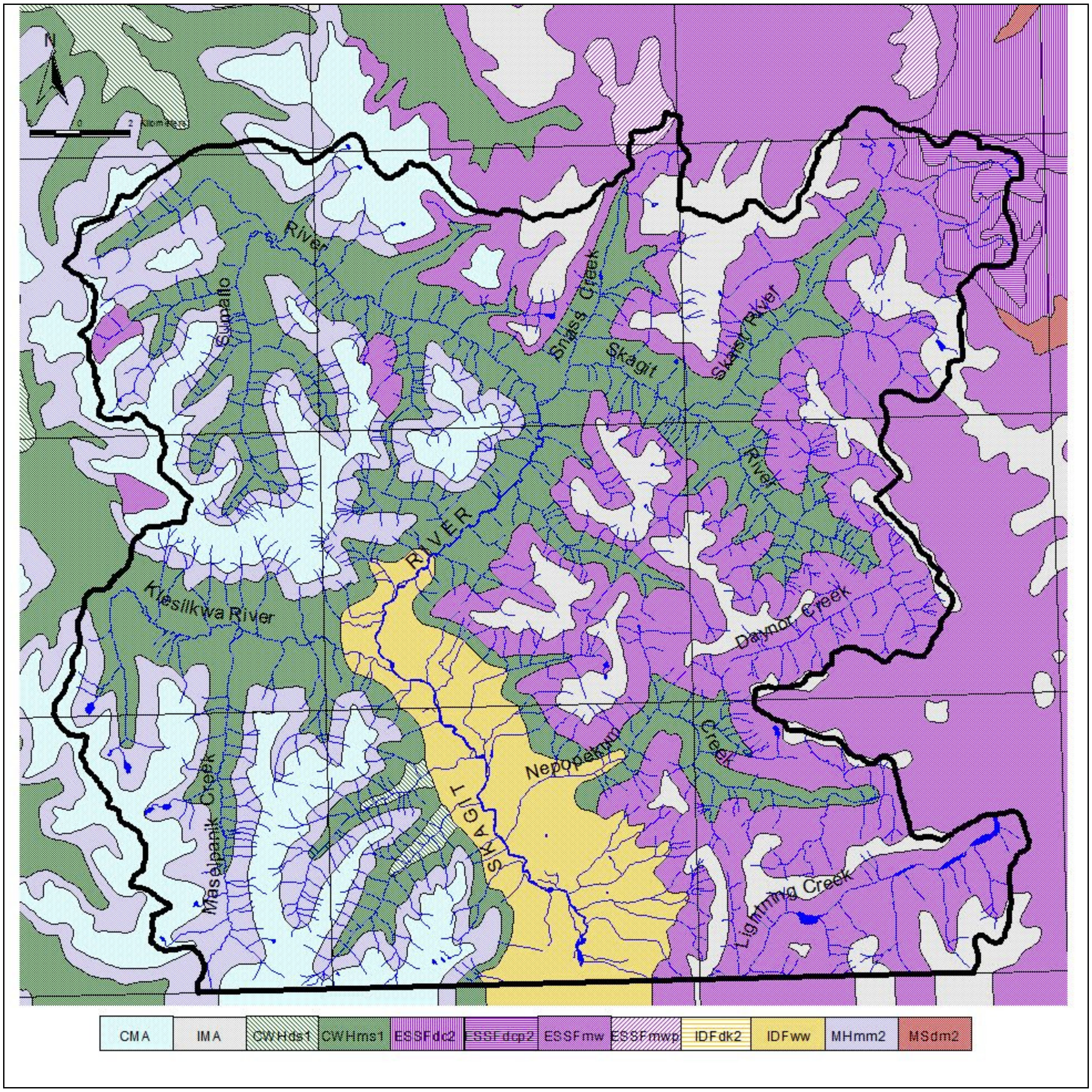


Figure 3. BEC zones, subzones, and variants within the Skagit River Watershed (map created using data from the Integrated Land Management Bureau, 2007).

Studies on angler use and catch on the Canadian portion of the Skagit River have been ongoing since 1986. Rainbow trout (*Oncorhynchus mykiss*) catch rates are reported to be variable among the surveys, but suitably high so as to produce a quality angling experience for fishermen (Scott *et al.* 2003). Catch rates for char are reported as low, and catch data for cutthroat trout (*O. clakii*) and eastern brook trout (*Salvelinus fontinalis*) was too low to produce catch estimates (Scott *et al.* 2003). "Research angling" took place on the Skagit River from 1986 to 1994 (Burrows and Neuman 1995a), and indicated catch-and-release regulations in the watershed are effective as 6-10% of the catch was reported to have damaged maxillaries, suggestive of past angler captures. Snorkel surveys, conducted annually since 1982, also indicate increased numbers of rainbow trout since the introduction of catch-and-release regulations (Burrows and Neuman 1995b).

A five-year study of the effect of sport fishing regulations on the Ross Lake fishery also indicated that catch-and-release regulations have resulted in an increased catch of rainbow trout (Looff 1996). Total catch numbers for Dolly Varden (*S. malma*), eastern brook trout, and cutthroat trout are low. Dolly Varden catch numbers likely include bull trout (*S. confluentus*), since that species was not differentiated from Dolly Varden until the early 1980's (Haas and McPhail 1991), and even today many anglers are unaware that Dolly Varden and bull trout are separate species.

As part of a management plan to maintain the Skagit River fishery (Neuman 1988), rainbow trout have been stocked into the Sumallo River. The dates and strains of rainbow trout released are shown in Table 3. In addition to the Sumallo River, several lakes in the Skagit Watershed have also been stocked with various strains of rainbow trout (Table 4), either in support of established fisheries, or to create new "wilderness" fishing experiences in previously barren lakes.

Table 3. Stocking information for the Sumallo River (FISS 2007).

Release Date (d/m/y)	Species	#	Stock	Life Stage
1/1/1923	rainbow trout	5,000	Pinantan	Eyed egg
1/1/1939	steelhead	240,000	Sweltzer River	Eyed egg
1/1/1953	steelhead	1,841	Sweltzer River	Unknown
6/15/1988	rainbow trout	7,605	Skagit	Yearling
6/15/1988	rainbow trout	7,605	Skagit	Yearling
7/15/1989	rainbow trout	3,500	Blackwater	Yearling
7/15/1989	rainbow trout	3,500	Blackwater	Yearling

A number of lake surveys and creel census' have been conducted on Lightning Lake, and the presence of rainbow trout which support a small fishery are well known (FISS 2007). Rainbow trout are present throughout the Lightning Creek watershed, and numerous surveys have also been conducted on Flash Lake, Strike Lake, Thunder Lake, and portions of the Lightning Creek mainstem (FISS 2007, Griffith 1993). Assessments of the stocked populations of rainbow trout in Nicomen Lake and Poland Lake have also been conducted (Griffith 1993). Shadow Lake near the Manning Ski Resort has also been surveyed, but no fish were captured, and it is suspected to be barren. The lake was noted to be completely dry during the summer months (FISS 2007). A summary of lake sampling information is presented in Table 5.

A genetic study of the char in the Skagit River watershed was conducted in 1994 which confirmed the presence of both bull trout and Dolly Varden in the watershed (McPhail and Taylor 1995). The study also found a high level of hybridization between these two species within the watershed. Dolly Varden were predominant in the tributary streams examined, including the Klesilkwa and Sumallo rivers, and the lower reaches of Nepopekum, St. Alice, McNaught, Ferguson, and Maselpanik creeks, while bull trout predominate in the Skagit River mainstem (McPhail and Taylor 1995). Bull trout were found spawning in a stretch of the Skagit River mainstem downstream from the Twentysix Mile Bridge to the mouth of Shawatum Creek. Redds were first observed on or around October 19th and no new redds were noted past October 31st (McPhail and Taylor 1995). Two eastern brook trout were also captured while sampling for char, one in the Skagit mainstem and the other in Nepopekum Creek. Two juvenile Dolly Varden/brook trout hybrids were also identified by genetic analysis (McPhail and Taylor 1995).

Table 4. Lake stocking information for the Skagit River Watershed.

Release Date	Gazetted Name	Species	#	Stock	Watershed Code	Waterbody ID
8/1/1982	Clerf Lake	RB	37,000	Dragon	970-110000-84800-80600	00053SKGT
8/1/1983	Clerf Lake	RB	20,000	Dragon	970-110000-84800-80600	00053SKGT
1/1/1942	Nicomen Lake	RB	15,000	Knouff	970-110000-94100-31700	00031SKGT
1/1/1943	Nicomen Lake	RB	9,000	Pennask	970-110000-94100-31700	00031SKGT
1/1/1944	Nicomen Lake	RB	8,000	Knouff	970-110000-94100-31700	00031SKGT
1/1/1944	Nicomen Lake	RB	5,000	Pennask	970-110000-94100-31700	00031SKGT
1/1/1945	Nicomen Lake	RB	8,000	Knouff	970-110000-94100-31700	00031SKGT
1/1/1947	Nicomen Lake	RB	10,000	Knouff	970-110000-94100-31700	00031SKGT
1/1/1948	Nicomen Lake	RB	10,000	Knouff	970-110000-94100-31700	00031SKGT
1/1/1949	Nicomen Lake	RB	5,000	Pinantan	970-110000-94100-31700	00031SKGT
1/1/1951	Nicomen Lake	RB	10,000	Peterhope	970-110000-94100-31700	00031SKGT
1/1/1959	Nicomen Lake	RB	20,000	Oregon	970-110000-94100-31700	00031SKGT
1/1/1954	Poland Lake	RB	5,000	Beaver	970-110000-80900-45300	00055SKGT

Table 5. Lake sampling information for the Skagit River Watershed.

Gazetted Name	Survey Date	Surface Area (ha)	Littoral Area (ha)	Volume (m^3)	Mean Depth (m)	Max Depth (m)	Waterbody ID
Flash	16/8/1950	16.2		296,036	1.8	4.6	00073SKGT
Flash	17/6/1980	13.5	13.5	152,325	1.1	3.5	00073SKGT
Lightning	2/8/1950	15.1		8,015,040	1.5	5	00069SKGT
Lightning	15/8/1950	26.3		1,195,737	7.9	9	00069SKGT
Lightning	28/5/1961	30.0		1,475,244	4.9	11.9	00069SKGT
Lightning	1/6/1974					16.4	00069SKGT
Lightning	15/6/1980	52.3	43.8	1,588,335	3	7.5	00069SKGT
Nicomen	11/8/1992	6.0	6.0	174,000	2.9	6	00031SKGT
Poland	29/7/1953					14	00055SKGT
Poland	12/8/1992	6.3	3.1	407,300	6.5	15.5	00055SKGT
Ross	1/9/1970	8270.8		4,194,305,280	100.5	160	00085SKGT
Strike	29/7/1953	8.9		379,912	4.3	7.3	00077SKGT
Strike	18/6/1980	7.8	7.0	246,720	3.2	7	00077SKGT
Thunder	1/1/1953	26.7					00081SKGT
Thunder	14/8/1992	33.4	6.4	5,748,400	17.2	38.1	00081SKGT
Shadow	1995						00066SKGT

Note: additional survey records without any new information have been omitted from the table.

Between 2001 and 2004, 67 char were captured and implanted with radio telemetry tags, and an additional 25 were tagged with external identification tags (Nelson 2006). The radio tags were used to determine movement patterns of bull trout in the Skagit River. The char were found to use the Skagit and Sumallo Rivers for rearing, but sub-adult and adult bull trout likely overwinter in the Ross Lake Reservoir. Two radio tagged fish are known to have migrated upstream past Sunshine Valley in the Sumallo River (Nelson 2006). Spawning occurred from near the confluence of Nepopekum Creek upstream to the Twentysix Mile Bridge just upstream of the confluence with the Klesilkwa River. Surveys of the Skagit River mainstem downstream from the Sumallo River confluence indicate that the bull trout population is likely fewer than 300 (not including juveniles). This estimate does not include the Sumallo River; the Sumallo River is believed to contribute an additional 50-60 fish to the population (Nelson 2006).

The provincial fisheries information summary system (FISS) was also consulted for streams and lakes within the project area. Westslope cutthroat trout (*O. clarkii lewisi*), rainbow trout, eastern brook trout, Dolly Varden, and bull trout are all known from the Ross Lake Reservoir. Eastern brook trout are noted to be migrants from a U.S. stocking program at Sourdough Lake near the lower end of the Ross Lake Reservoir, beginning in 1933 (FISS 2007). Westslope cutthroat trout have also been stocked on the American side the reservoir. Records for both of these species are sporadic through the lower Canadian Skagit River mainstem (FISS 2007).

Golden trout (*O. mykiss aguabonita*), a subspecies of rainbow trout native to California, but stocked elsewhere in the western U.S.A, have been reported from Nicomen Lake (R.K. Dahl, Conservation Officer, pers. comm *In* McPhail and Carveth 1994, p. 28). No other record of occurrence of this species in the Skagit Watershed, or elsewhere in British Columbia, was located. Additionally, there are reports that redside shiners (*Richardsonius balteatus*) have been introduced into the reservoir in the U.S.A. (D. Jesson, Fisheries Biologist, Ministry of Environment, pers. comm.), but no records of redside shiners in the Canadian portion of the Skagit River have been noted to date.

The FISS database was also consulted for known obstructions to fish migration. A set of three waterfalls (the highest noted to be 25 m) is known to exist on the Skagit River in a heavily confined section just upstream of the confluence of Snass Creek. The FISS database indicated that rainbow trout were present upstream of these falls, but that the falls formed the upper limit of distribution for Dolly Varden (FISS 2007). An alluvial fan on Shawatum Creek was noted to be at least a partial barrier to fish migration (later confirmed during the field sampling component of this inventory). A debris accumulation at the outlet of Nicomen Lake was noted to be at least a partial obstruction to fish migration at some flow levels (FISS 2007). There are three significant waterfalls shown on the TRIM map base which are likely to be barriers to fish migration. Derek Falls and Shadow Falls mark the reach 6 and 7 breaks (respectively) on Nepopekum Creek, and Nepopekum Falls occurs at the reach 1 break on a large, unnamed tributary to Nepopekum Creek (WSC: 970-110000-80900-78900) that drains the northern slopes of Lone Goat Mountain and Snow Camp Mountain.

2. RESOURCE/DEVELOPMENT INFORMATION

2.1 Parks and Protected Areas

The headwater areas of the Canadian portion of the Skagit River watershed, downstream to the confluence with the Sumallo River on the north bank, and Smitheram Creek on the south bank, fall within E.C. Manning Provincial Park. A 400 m wide buffer along Highway 3 west from the confluence of the Sumallo River to Seventeen Mile Creek is also within the park. The Lightning Creek drainage, as well as headwater areas of tributaries to the left bank of the lower Skagit River (*e.g.* Nepopekum Creek), are also protected by the park, which extends eastward beyond the Skagit River watershed to the Similkameen River. E.C. Manning Provincial Park is one of the most popular outdoor recreation areas in the province, due to its diversity of recreational opportunities, scenery, and proximity to the lower mainland (BC Parks 2008a).

The headwaters of the Skaist River, upstream from the confluence of Grainger Creek, are within the Cascade Recreation Area, which also encompasses the headwaters of the Tulameen River (Similkameen River drainage; Columbia River Watershed) to the northwest. There are no developed roads, though a network of trails is popular with hikers and equestrians. Use of motorized vehicles (including helicopters) for recreation is prohibited in this park (BC Parks 2008a).

The lower portion of the watershed, below the confluence with the Sumallo River, is within Skagit Valley Provincial Park. The park extends to E.C. Manning Provincial Park to the east, the international border with the U.S.A. to the south, and the Skagit watershed boundary to the west, excluding the headwater areas of the Klesilkwa River upstream of and including Maselpanik Creek. The park is popular with hikers, and provides excellent fishing opportunities in the lower Skagit River. A large campground is located at Ross Lake, and boating is popular in Ross Lake. Across the international border, the watershed is within the North Cascades National Park and Ross Lake National Recreation Area (U.S. Department of the Interior 2008).

Since the Skagit River watershed encompasses both the coast and lee side of the Cascade Mountains and has a varied topography, a wide variety of habitats in close proximity to one another exist, and as such the watershed is home to several rare and unique species of plants and animals. There are four separate ecological reserves within Skagit Valley Provincial Park. Ross Lake Ecological Reserve preserves a stand of ponderosa pine (*Pinus ponderosa*) growing in an unusually moist area for this species, near its western range limits. Skagit River Rhododendrons Ecological Reserve protects a stand of Pacific rhododendrons (*Rhododendron macrophyllum*), which occur only in a few areas in Canada. Skagit River Forest Ecological Reserve preserves representative valley bottom forest in a transitional area between coastal and interior climates. Skagit River Cottonwoods Ecological Reserve preserves stands of black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) on an alluvial floodplain (BC Parks 2008a).

The Skagit River has also been given BC Heritage River status due to its rich diversity of natural, cultural, and recreational values (BC Parks 2008b).

2.2 Water

The Skagit River has been utilized for the production of hydroelectric power in the U.S. since 1924, when the Gorge Dam was completed. The Diablo Dam was completed in 1930, and the Ross Dam was completed in 1937 impounding the Skagit River and creating the Ross Lake Reservoir, which extends upstream and for 1 km north of the international border into Canada. The potential for small-scale power projects on Laforgue Creek and Maselpanik Creek was investigated in 2002 (Sigma Engineering Ltd. 2002), but no development on these streams has occurred to date.

Two community watersheds are present in the study area. Watershed code: 970-110000-90700-53200-0810, a 2nd order tributary to the Sumallo River, serves the community of Sunshine Valley. Watershed code 970-110000-93400, a small, 1st order tributary to the upper Skagit River mainstem, is also designated as a community watershed, although the purpose is unclear.

Hydrometric and water quality data for the Skagit River watershed is relatively abundant compared to other watersheds in British Columbia. Ten hydrometric stations are located within the Skagit River watershed, though only one, at Ross Lake, remains active. A summary of Environment Canada hydrometric stations is presented in Table 6.

Table 6. Summary of Environment Canada hydrometric Stations within the Skagit River watershed (Environment Canada 2008b).

Station Name	Station ID	Start Date (d/m/y)	End Date (d/m/y)	Type
Lightning Lake near Manning Park	08PA010	1/1/1973	31/12/1979	Level
Snass Creek at Highway 3	08PA011	1/1/1984	31/12/1986	Flow
Sumallo River at the mouth	08PA002	1/1/1914	31/12/1922	Flow
Sumallo River near Hope	08PA003	1/1/1914	31/12/1922	Flow
Skagit River near Hope	08PA001	1/1/1915	31/12/1955	Flow
Skagit River Gauge # 2	08PA005	1/1/1954	31/12/1955	Level
Skagit River Gauge # 3	08PA006	1/1/1954	31/12/1958	Flow
Skagit River Gauge # 4	08PA007	1/1/1954	31/12/1955	Level
Skagit River Gauge # 5	08PA008	1/1/1954	31/12/1955	Level
Skagit River at International Boundary	08PA004	1/1/1914	active	Level & Flow
Ross Reservoir near Newhalem*	08PA009	1946	2006	Level

* Located in the U.S.A.

Inactive provincial and federal water quality monitoring stations are located on the Skagit River 2 km north of the Canada/US border (Environment Canada Station BC08PA001) and the Westermore Bridge on Highway 3 (B.C. Ministry of Environment Stations 030049 and 030058). Selected data from the Environment Canada station is summarized in Table 7, and data from the BC Ministry of Environment station is summarized in Table 8.

Table 7. Water quality data from Environment Canada water quality station BC08PA001 on the Skagit River 2 km North of International Boundary (1979-1995).

Selected Parameters	# of Samples	Min	Max	Average	Standard Deviation
pH	100	6.20	8.16	7.52	0.390
Alkalinity total $CaCO_3$ (mg/L)	100	27.10	54.50	42.66	6.993
TDS (mg/L)	38	40.00	118.00	71.70	16.760
TSS (mg/L)	39	1.00	114.00	14.73	18.631
Specific conductance USIE/CM	100	67	138	107	16.787
Total $CaCO_3$ (mg/L)	62	31.70	62.50	50.12	8.760
Dissolved Silica (SiO_2) (mg/L)	19	2.75	4.97	3.80	0.531
Sulphate (SO_4^{2-}) (mg/L)	100	4.70	11.90	8.36	1.639
Nitrite (NO_2^-) & Nitrate (NO_3^-) (mg/L)	295	0.009	0.60	0.066	0.065
Total dissolved N (mg/L)	305	0.025	0.873	0.100	0.092
Total N (mg/L)	3	0.162	0.188	0.173	0.013
Total P (mg/L)	237	0.002	0.168	0.015	0.026
Water temperature (°C)	98	1	16	8	3.092
Turbidity (NTU)	100	0.11	36.00	2.00	4.730
Ammonia (NH_3; dissolved) (mg/L)	3	0.001	0.005	0.003	0.002

Table 8. Existing water quality data from historical provincial EMS Stations 030049 and 030058 on the Skagit River.

	EMS 030049 (1971-1977 & 1980)				EMS 030058 (1973-1977)			
Selected Parameters	**# of Samples**	**Min**	**Max**	**Average**	**# of Samples**	**Min**	**Max**	**Average**
pH	32	7	8.3	7.8	17	7.5	8.1	7.8
Alkalinity total (mg/L)	24	29.5	64.1	50.7	14	32.6	51.8	43.2
Specific conductance (µS/cm)	34	24	260	118	18	34	140	101
Ammonia (mg/L)	19	<0.005	0.04	<0.01	14	<0.005	0.06	<0.01
Nitrate (mg/L)	22	<0.02	0.04	<0.03	14	0.03	0.09	0.06
Nitrite (mg/L)	22	<0.005	0.021	<0.006	13	<0.005	<0.005	<0.005
total phosphorus (mg/L)	27	<0.003	0.045	<0.008	27	<0.003	0.018	<0.005
Ortho-P (mg/L)	17	<0.003	0.003	<0.003	12	<0.003	0.007	<0.004
Silica (mg/L)	6	5.8	8	7.3	3	6.3	7.7	7

2.2.1 Discussion of selected physical parameters

The average pH for the period of record (for all stations) ranged from 7.5 to 8.1 and was reflective of the 6.5-9.0 pH range preferred by juvenile salmonids. The average conductivity ranged from 101 to 118 µS/cm. The US Environmental Protection Agency (EPA) reports typical stream conductivity values ranging from 50 to 1,500 µS/cm, with studies of inland fresh waterbodies showing strong mixed fisheries in waters with conductivity ranging from 150 to 500 µS/ cm. The TDS data from the Environment Canada Station BC08PA001 averaged 71.7 mg/L. Reported TDS values for natural waters range from 1 mg/L to 1,000 mg/L, with interior stream concentrations reaching 750 mg/L (BC Ministry of Environment, Lands and Parks 1998a).

2.2.2 Discussion of selected nutrients

Ortho-P data from the 1970's EMS datasets indicated average concentrations in the Skagit River were above the <0.001 mg/L limiting concentration identified by McCusker *et al.* (2002). However, average concentrations at EMS 030049 were below the potentially limiting range of <0.003 to 0.005 mg/L identified by Ashley and Slaney (1997). The average concentration of nitrate (NO_3^-) + nitrite (NO_2^-) from the Environment Canada dataset was 0.066 mg/L, above the concentration of <0.045 mg/L, which is reflective of oligotrophic conditions (Wilson *et al.* 2003). Average nitrate concentrations from the 1970's EMS 030058 dataset were 0.06 mg/L, exceeding the <0.005 mg/L reflective of oligotrophic conditions described by Slaney *et al.* (1994).

2.3 Timber

Much of the watershed is located within Provincial Parks, and as such little to no timber extraction has occurred in those areas. However, due to the high quality of Douglas-fir (*Psudotsuga menziesii* ssp. *menziesii*), western red cedar (*Thuja plicata*), and western hemlock (*Tsuga heterophylla*) timber within the watershed, extensive harvesting has occurred in areas outside of the park, in particular the upper Klesilkwa and upper Sumallo River drainages. Extensive timber harvest in the upper Sumallo River and Maselpanik Creek watersheds has resulted in impacts to fish habitat in those watersheds (Clark 1994). Recent timber extraction has occurred in the Smitheram Creek drainage, which occurs in a pocket of unprotected land between E.C. Manning Provincial Park and Skagit Valley Provincial Park. Forest stewardship plan maps from BC Timber Sales indicate that harvesting is proposed or in various stages of development in most areas of the watershed outside of the park with productive timber (BC Timber Sales 2007). Cattermole Timber Ltd. had proposed cable and/or helicopter logging operations for 2006/07 in the Sumallo River Valley and Tearse Creek drainage (forest license A19202), and these activities were observed during the field program.

2.4 Residential/Development

The community of Sunshine Valley is the only residential area within the watershed. Sunshine Valley is described as a retirement/recreational property community, and currently there are no services. Sunshine Valley was originally called Tashme, a Japanese internment camp during World War II. The Manning Park Resort is located just outside of the watershed boundary at Lightning Lake, but the associated ski hill is located at Gibson Pass/Strawberry Flats, in the headwaters of Nepopekum Creek.

2.5 Recreation

Due to the watershed's scenery, diversity of wildlife, close proximity to the Lower Mainland and status as a provincial park over most of the watershed, recreational activities in the area are numerous (BC Parks 2008a). Manning Park Resort and campground is located just east of the watershed on the northern shore of Lightning Lake, though the associated ski hill is located in the headwaters of Nepopekum Creek. The resort also offers canoeing on Lightning Lake and Flash Lake, and a recreational trail provides access to most of Lightning Creek. A large provincial campground is also present at Ross Lake, and the Hozameen Campground is located just across the international border on Ross Lake. Numerous hiking trails are located throughout the watershed, and many trails permit horseback riding. There is an interpretive nature trail at Sumallo Grove, and interpretive programs are offered at E.C. Manning Provincial Park and Skagit Valley Provincial Park (BC Parks 2008a). The Skagit River is a renowned trout fishing destination, and there are ample fishing locations along the Skagit and Sumallo rivers, as well as in Ross Lake. All terrain vehicles may be used in those areas that are not protected by Provincial Parks.

2.6 Minerals / Petroleum

There are 163 mineral tenures covering portions of the Smitheram Creek, Norwegian Creek, Twentysix Mile Creek, and Silverdaisy Creek watersheds (Province of British Columbia 2007). Two mineral tenures are located in the headwaters of the Sumallo River, one is located on the Klesilkwa River just upstream from Maselpanik Creek, and eleven (part of a complex of 23, the others fall outside of the watershed boundary) are located on Manson Ridge in the Sumallo drainage at the northwest corner of the watershed. A list of the mineral tenures in the project area is included in the pre-field planning report (Attachment 1). No active placer or coal tenures are located in the project area, and no oil or gas tenures were located in the project area (Province of British Columbia 2007).

2.7 First Nations

The entire Skagit River watershed falls within the Statement of Intent boundaries for the Stó:lô Nation, who are currently at stage 4 of the BC Treaty Negotiation Process (BC Treaty Commission 2008). Eastern portions of E.C. Manning Provincial Park and the Cascade Recreation Area are within the traditional territory of the Upper Similkameen, who are part of the Okanagan Nation Alliance. The Okanagan Nation Alliance is not currently participating in the BC Treaty Negotiation process (BC Ministry of Aboriginal Relations and Reconciliation 2008). Western portions of the study area are within the traditional territory of the Nlaka'pamux Nation Tribal Council (BC Ministry of Environment, Lands, and Parks 1998b). The Nlaka'pamux Nation Tribal Council is also not currently participating in the BC Treaty Negotiation process (BC Ministry of Aboriginal Relations and Reconciliation 2008). No Indian Reserves are located within the project area.

2.8 Wildlife

Hunting is permitted in the Skagit watershed except for portions of E.C. Manning Provincial Park (the most current BC Hunting and Trapping synopsis should be consulted as regulations are subject to change). As of the 2007/2008 season, hunting for mule deer, black bear, coyote, raccoon, skunk, snowshoe hare, bobcat, cougar, upland game birds, and waterfowl was permitted. Hunting for white-tailed deer, moose, elk, and lynx is permitted only in management Unit 8-5, in the headwaters of the Skaist River, though there is no road or motorized vehicle access to this part of the watershed.

Areas of the watershed outside of E.C. Manning Provincial Park and Cascade Recreation Area fall within guide/outfitter territory 800753 (no guide outfitter territory is associated with E.C. Manning Provincial Park or Cascade Recreation Area). Trapline territory 202T001 encompasses the upper portion of the Klesilkwa River watershed outside of the Skagit Valley Provincial Park. Trapline territory 202T004 encompasses the upper portions of the Sumallo River watershed that fall outside of provincial park boundaries. Territory 202T002 encompasses a small area in the headwaters of Twentysix Mile Creek that fall outside of provincial park boundaries.

A total of eight provincially or federally listed animal species and six identified wildlife species are known to occur in the Skagit River watershed (Table 9). Fish species are not included in the table and are discussed below in section 2.9.

Wildlife Habitat Areas (WHAs) have been established in the upper Skagit watershed, between Rhododendron Flats and Norwegian Creek, and in the Potter Creek, upper Sumallo River, Maselpanik Creek and Twenty Six Mile Creek drainages (Table 10). The WHAs were created to protect spotted owl and grizzly bear habitats. Between four and seven spotted owl territories have been identified in the upper Skagit River, and one confirmed breeding pair has been identified in the watershed. The upper Skagit also provides an important corridor for grizzly bear, joining the US and Canadian populations (Environmental Law Centre Clinic 2005).

Table 9. Historical listed species or identified wildlife species in the upper Skagit River watershed.

CDC ID or Info Source	Common name	Scientific name	Classification (BC/SARA)	Location	Date observed
4512	Propertius duskywing	*Erynnis propertius*	Blue	Ross Lake, Skagit Valley	5/19/1974
19892	Mountain beaver, Rainieri subspecies	*Aplodontia rufa rainieri*	Blue/SC	Skaist River	7/2/1905
COSEWIC 2003	Keen's long eared bat	*Myotis keeni*	U (IDW)/SC	Skagit watershed	-
MELP 1998	Coastal tailed frog	*Ascaphus truei*	Blue (IDW)/SC	Skagit watershed	-
Keystone 2004	Spotted owl	*Strix occidentalis*	Red (IDW)/E	Skagit watershed	-
Keystone 2004	Grizzly bear	*Ursus arctos*	Blue (IDW)	Skagit watershed	-
Keystone 2004	Goshawk	*Accipiter gentilis*	Yellow (IDW)	Skagit watershed	-
Keystone 2004	Mountain goat	*Oreamnos americanus*	Yellow (IDW)	Skagit watershed	-
Env. Law Centre Clinic 2005	Pacific water shrew	*Sorex bendirii*	Red (IDW)/E	Skagit watershed	-
Env. Law Centre Clinic 2005	Pacific giant salamander	*Dicamptodon tenebrosus*	Red (IDW)/T	Skagit watershed	-

E: Endangered, IDW: Identified Wildlife, SC: Special Concern, T: Threatened, U: Status unknown.

Table 10. Wildlife habitat areas within the Skagit River study area.

WHA #	Location	Species	Forest District	Effective established date	Total area (ha)
2-317	Snass-Skagit	Spotted Owl	Chilliwack	28-Jun-06	813
2-318	Sumallo	Spotted Owl	Chilliwack	28-Jun-06	788
2-112	Sumallo 1	Grizzly Bear	Chilliwack	14-Apr-05	79
2-114	Sumallo 4	Grizzly Bear	Chilliwack	14-Apr-05	106
2-118	Maselpanik 2	Grizzly Bear	Chilliwack	14-Apr-05	112
2-119	Maselpanik 3	Grizzly Bear	Chilliwack	14-Apr-05	75
2-196	Sumallo Creek #5	Grizzly Bear	Chilliwack	14-Apr-05	52
2-197	Sumallo Creek #6	Grizzly Bear	Chilliwack	14-Apr-05	25
2-198	Sumallo Creek #7	Grizzly Bear	Chilliwack	14-Apr-05	34

2.9 Fisheries

The Skagit River is renown for its quality recreational fishing opportunities. Fisheries exist for rainbow trout throughout the Skagit River and Sumallo River mainstems, as well as many lakes throughout the watershed. The Sumallo River, as well as Clerf Lake, Poland Lake, Nicomen Lake, and the Ross Lake Reservoir have been stocked with rainbow trout of various strains (FISS 2007). Rainbow trout are present throughout the watershed, but angling opportunities are limited by the small size and limited access to most tributary streams. A few accessible locations exist on the Klesilkwa River, but thick riparian vegetation and large, slow moving glides make this river less popular with anglers. Bull trout are also caught in lower numbers throughout the lower Skagit River and Sumallo River, and in Ross Lake. Dolly Varden are present within the watershed, but are generally too small to be a target species of anglers, though some larger Dolly Varden can be taken in accessible streams throughout the project area. Eastern brook trout and westslope cutthroat trout have been stocked in Ross Lake, and are occasionally taken in the lower reaches of the Skagit River.

Due to the high amount of angler pressure on the lower Skagit River, the fishery is catch-and release only, to help conserve fish stocks. There is a retention fishery for trout in Ross lake, but char must be released. It is unclear if brook trout are included in this ban, as many anglers are unaware that brook trout are a species of char, and thus are probably subject to harvest. The Skagit River fishery (including Ross Lake) is closed from November 1st to June 30th to protect spawning rainbow trout in the spring and bull trout in the fall. A bait ban is in effect during the open fishing season (Province of British Columbia 2007).

3. METHODS

The methods employed for each phase of this project are consistent with the *Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures; Version 2.0* (BC Fisheries 2001a), which are described in 6 phases:

- existing data review;
- classification and sampling design;
- project plan;
- field data collection;
- data compilation; and
- reporting and mapping.

Milestone achievements, deviations or modifications from standard procedures, special considerations, and relevant details are documented for each of the identified project phases in the following sub-sections.

3.1 Phase 1: Existing Data Review

The collection and review of existing information was conducted in order to:

- determine the known fisheries values of the system;
- aid in reach break designations;
- locate potential obstructions to fish migration;
- determine areas of potentially sensitive habitat;
- determine areas for priority assessment; and
- select locations of suitable access points.

The review included, but was not limited to, the following information sources:

- provincial databases and online mapping tools (FISS, FishWizard, HabitatWizard, EcoCat);
- 1:50,000 scale NTS maps;
- 1:20,000 scale TRIM maps;
- provincial and licensee forest cover maps;
- forest development plan maps; and
- digital orthophotos.

An annotated bibliography and a contact list (*see* Triton 2007) was generated from the sources obtained and consulted for the overview. Relevant historic information regarding fish distributions and barriers has been included on the Interpretive/Project Maps included in Appendix 1.

Reaches at the 1:20,000 scale (TRIM I) that did not have a corresponding 1:50,000 scale watershed atlas stream for watershed code assignment, or in cases where the watershed atlas differed significantly from the 1:20,000 scale TRIM stream network, were assigned interim locational points (ILP's) starting at 10000. Submission of these ILP's for conversion to watershed codes is no longer a requirement of the fish and fish habitat inventory program (see *Errata 3, Fish and Fish Habitat Inventory Standards and Procedures, Version 2).* However, the ILP's must be collected in such fashion to facilitate their conversion to watershed codes when submitted to the ministry for uploading into the provincial database. As such, a database file with the UTM location of the mouth of each stream, as well as the ILP map number of the mouth, has been included in the digital deliverables to facilitate such conversion (Attachment 3). Other information, such as the UTM coordinates of additional upstream reaches and the associated map numbers, can be found in the reach table of the FDIS database.

A network of watershed codes based on the 1:20,000 TRIM network (known as the Corporate Watershed Base, or CWB) is now available. Unfortunately, this product was not available during the initial phase of the project when ILP's were being assigned. Conversion of the existing ILP numbers to watershed codes can be performed using standard Geographic Information System (GIS) software without submission to BC Fisheries. However, the FDIS database has not yet been configured for manual entry of watershed codes. Watershed codes for a project area are imported from an MOE-generated text file. To date, this utility has not been configured to provide CWB watershed codes. Conversion of ILP's to CWB watershed codes is beyond the scope of this project, thus ILP numbers remain in the FDIS database.

3.2 Phase 2: Classification and Sampling Design

Detailed analysis using digital TRIM map files and orthophotos was conducted in order to identify and classify sub-basins within the study area; to determine reach breaks; and to determine individual reach characteristics for all watercourses, lakes and wetlands. Where possible, GIS analysis was used to determine characteristics for reaches to reduce variability due to differences in judgment of personnel. Basin classification, stream order, magnitude, elevations, UTM coordinates, stream length, BEC zone, and mapsheet number were obtained using GIS functions. Disturbance indicators, setting, hillslope coupling, confinement, and channel pattern were determined through map and orthophoto interpretation by a qualified biologist.

All watercourses within the study area were divided into reaches based on several primary physical features including gradient, confinement, channel pattern and riparian vegetation. Stream reaches are characterized as relatively homogenous sections of streams having:

- a sequence of repeating structural characteristics (channel pattern, channel confinement, streambed substrates, and bank materials);
- similar gradient;
- similar processes (*e.g.* uniformity in discharge); and
- similar fish habitat types.

Marked changes in one or more of these parameters necessitate a reach break. Although barriers to fish migration often result in a change in stream classification (*i.e.* an obvious break between fish bearing and non-fish bearing sections of streams), they are not necessarily considered reach breaks.

A total of 112 reaches were randomly selected for sampling out of 4,095 available reaches (2.7%). Random selection was performed using the built-in random site selection function in the FDIS tool. Of the randomly selected reaches, 60 were removed from the sampling plan. This left 52 randomly selected sites, which were augmented with 18 biased sites to reach the target of 70 sites identified in the original contract. The rationale for removal of selected reaches, as well as the addition of biased sites, is included in the pre-field planning report (Triton 2007). No lake sampling was planned as part of this inventory.

A helicopter overflight was conducted on June 19th, 2007, in conjunction with MOE staff, to assist in refining the sampling plan. Potential barriers to fish migration, access limitations, and other notable watershed features were recorded. Video footage from the overflight is included in Attachment 2.

TRIM-based maps showing all reach breaks, ILP's or watershed codes, historic sampling information, and reaches selected for sampling were produced to guide the field crews during the field phase of the inventory.

3.3 Phase 3: Project Plan

The focus of Phase 3 was to determine the logistics of completing the work, develop the detailed budget, and produce the planning report. Other tasks associated with this phase included refining the specific requirements of the inventory project, including water quality sampling and testing, collecting genetic and aging structures, and collecting voucher specimens. In addition, a preliminary prioritization and scheduling of sampling effort was conducted in order to maximize the value of fish information collected with respect to fish distributions and timing.

3.4 Phase 4: Field Data Collection

The following provides an outline of the approach used in conducting the field work, as well as clarification of specific sampling methodologies.

3.4.1 Field Mobilization

Pre-field preparations included a crew talk and pre-field training. During the crew talk, safety issues and procedures were reviewed. Crew members who were not involved in the planning phases were informed about project specific logistics and requirements, and the latest developments in inventory procedure were reviewed and discussed. The crew talk provided a means to ensure that inventory cards were completed in a standardized manner by all crews and that crews were aware of QA/QC requirements.

Copies of the planning maps, orthophotos, and field/office supplies were provided to each crew. The required fish collection permits were obtained from the Ministry of Environment, Permit Authorization Service Bureau (fisheries inventory collection permit SU/PE07-36600 and SU/PE07-39323), and permission was obtained from BC Parks personnel to sample for fish within provincial park boundaries.

3.4.2 Stream Inventory

Field work was conducted by experienced two-person field crews. A list of field equipment is presented in Table 11. Details of the field data collection that are not specifically referred to in the RISC Standards are presented in the following subsections.

Table 11. Field sampling equipment and specifications used during the stream inventory.

Equipment	Make/model
Backpack Electrofisher	Smith-Root Model 12-A; Smith-Root Model 12-B; Smith-Root Model LR24
Minnow Traps	Standard Gee-type (baited with salmon roe or fish-based cat food)
Pole Seine	1.0 m × 3.0 m
Dipnet	1 m and 30 cm
Cameras	Olympus Stylus 760 7.1 MP Digital Camera Olympus Stylus 300 3.2 MP Digital Camera
Video Camera	Panasonic PV-GS320 Digital Video Camera
GPS	Garmin 12XL
Hip-chain	standard (avoided use where possible)
Metre stick	folding plastic (2 m)
Metre tape	30 m and 100 m (as required)
VHF radios	Icom IC-F50
Laser range finder	Bushnell Elite 1500
pH meter	Oakton pHTestr 2
Conductivity meter	Oakton TDSTestr
Clinometer	Suunto
Compass	Silva Ranger
Thermometer	alcohol
Angling gear	lightweight spinning rods and light tackle
Fish Identification, Morphometrics, DNA sampling, & age structure collection	• Hand lens (10X) • Small ruler (150 mm) • Fry board (300 mm) • Clove oil • Field guides (McPhail and Carveth 1994; McPhail and Taylor 1995, Pollard *et al.* 1997). • 40% buffered formalin (voucher specimen fixation) • 35% ethanol (voucher specimen preservation) • 95% Non-denatured ethanol (DNA sample preservation) • 1.5 mL centrifuge vials for DNA samples • Dissecting kit • Scale envelopes • Pesola 100 g scales • Sartorius digital balance

Site Data Collection
Non-differentially corrected field GPS coordinates were recorded at the downstream end of each of the sites visited during the field phase of the inventory. The site symbols, as displayed on the project/interpretive maps, are based on these site coordinates, but have been "snapped" to the TRIM stream lines to facilitate georeferencing with other provincial databases once the information is uploaded. The GIS UTM coordinates that appear in the FDIS database represent the corrected site locations. Site lengths and other linear measurements longer than 100 m were measured with the GPS where possible, instead of a hip chain, to avoid leaving hip chain thread. Photographs of representative site conditions and notable features were taken with digital cameras, generally at resolutions of 1600 × 1200 or better.

Fish Sampling
Fish sampling was conducted to determine fish presence, relative abundance and distribution. Fish sampling within stream reaches was conducted in all representative habitats using three primary sampling techniques: electrofishing, minnow trapping, and angling. Pole seining was employed in selected stream reaches with an appropriate substrate and discharge volume so as to be effective. Snorkel surveys were used on the Sumallo and Skagit rivers.

Electrofishing is the most efficient method of sampling in shallow stream habitats and was the preferred sampling method for all habitat types encountered in small streams and shallow water habitats. Electrofishing was the only fish sampling technique employed where the use of an additional sampling method would not have provided any additional information or where conditions were unsuitable (*e.g.* the pools were too shallow for minnow traps or the channel was too narrow to angle). A combination of techniques was employed where the use of only one method would not have effectively sampled all habitats and in areas that were not suited to electrofishing (*e.g.* deep pools and wetlands). Where appropriate, and where return visits were practical, minnow traps baited with salmon roe were set and allowed to soak for a 24-hour period.

Sixteen fish-only sites were completed at the discretion of the crew biologist to obtain additional information on the distribution of fish within the planning area. At fish-only sites no site card is completed and only fish sampling occurs. Fish-only sites can be located in a different part of a reach from which a site card was completed, or at a reach where no site card has been completed. Fish-only sites are distinguished on the map by an absence of site characteristics on the site summary symbol.

Fish Identification, Data Collection and Voucher Specimen Collection
All fish sampling data were recorded on RISC Fish Collection Forms. Fish species were identified in the field using the *Field key to freshwater fishes of British Columbia* (McPhail and Carveth 1994) and the *Field Identification of Coastal Juvenile Salmonids* (Pollard *et al.* 1997). For char, field crews used a key specific to the Skagit River watershed found in McPhail and Taylor (1995). Extensive morphometric data was

collected from a subsample of char at most sites, so that identification could be verified using the linear discrimination function (Equation 1) presented in Haas (1996).

Equation 1. $\mathrm{LDF} = (0.63 \times \text{total branchiostegal rays}) + (0.18 \times \text{total anal fin rays}) + (37.31 \times (\text{total upper jaw length} \div \text{standard length})) - 21.8$

LDF results >0 indicate that the species are bull trout, and <0 indicate Dolly Varden. The formula does not distinguish hybrids.

Fork lengths were measured to the nearest millimeter, and recorded for all fish species captured. Weights were recorded using Pesola spring scales, or a digital balance, for a sub-sample of the fish captured.

Scale samples were collected from 59 rainbow trout at 17 sites located throughout the watershed, and across the range of size classes encountered. For Dolly Varden/bull trout, the leading pelvic fin ray was collected for ageing. Ageing structures were collected from 35 Dolly Varden/bull trout at 10 sites across the watershed. All ageing structures were sent to North/South Consultants Inc. to be aged. Of the samples collected, 30 rainbow trout scales and 25 Dolly Varden/bull trout fin rays were submitted for ageing. Seven of the rainbow trout scales were determined to be un-ageable because of regenerated scales. Two of the Dolly Varden/bull trout fin rays were un-ageable, for unknown reasons.

The adipose fin was clipped from specimens selected for genetic analysis. Genetic samples were sent to Dr. Eric Taylor, Dept. of Zoology, University of British Columbia for analysis. The samples were analyzed for species identification only. Samples from 28 rainbow trout (11 sites) and 33 Dolly Varden/bull trout (14 sites) were submitted for analysis. Thirty five rainbow trout samples and 21 Dolly Varden/bull trout samples were collected, but not analyzed, due to cost limitations. These samples have been submitted to the MOE office in Surrey.

Two rainbow trout and two brook trout voucher specimens were collected from the Skagit River mainstem, and three char were collected, one from the Skagit River mainstem and two from the Klesilkwa River. All of these char are believed to be Dolly Varden based on morphometric characteristics, but no genetic tissue from these specimens was collected.

Fish Habitat Description

At each site location, an attempt to qualitatively describe the rearing, spawning, and overwintering habitat values, regardless of whether fish were present or not, was made. Features relevant to fish and fish habitat, such as barriers, partial obstructions, or habitat limitations were documented, geo-referenced, and photographed where encountered. The photographs taken at each reach include representative upstream and downstream views. Where appropriate, photographs of riparian conditions, barriers to fish migration, critical habitats (*e.g.* spawning habitat, off-channel habitat), upslope features that may affect the aquatic environment (*e.g.* eroding banks, clay deposits), and areas of concern regarding harvesting practices and road building, were also taken.

While the assessment is subjective and based on the judgment of a biologist experienced in assessing fish habitat, the guidelines presented in Table 12 are generally used to assign rankings of high, moderate, or low to each type of habitat. In some cases, intermediate values are assigned, especially when one ranking does not sufficiently describe a reach (for instance, spawning habitat is generally of low quality, but small pockets of high quality spawning gravels are present). If no habitat is present, a ranking of "none" is assigned. In all cases, a brief justification for the ranking is provided.

Water Quality Sampling

Although water quality sampling was originally part of the inventory plan, water sampling was conducted by Limnotek Research and Development Inc. concurrently with this project, and thus is not included here. However, the temperature, pH and conductivity were taken from all wetted stream reaches using field-quality handheld meters to indicate the general conditions in the watershed.

3.5 Phase 5: Data Compilation

Following the field program, data were entered into the FDIS inventory database (version 7.6). Data was entered by a biologist involved with the field data collection and having prior experience with the FDIS system so that minor corrections to cards could be completed when necessary (*i.e.,* missing ILP, WSC, or NID #'s, photo sequence out of order, measurement method code missing). Field coordinates for site locations were uploaded into the GIS, and "snapped" to the TRIM stream network to provide GIS coordinates to the FDIS database. The GIS coordinates are used for all future mapping to ensure that site data is properly georeferenced to the appropriate TRIM stream. In most cases field UTM's were within 25 m of the mapped TRIM stream.

Photographs were matched to the appropriate site using the roll and frame (image) number recorded on the site cards. Although the RISC standards indicate that .TIFF files should be submitted, the digital cameras used during the inventory recoded images as .JPEG files. Although .JPEGs use a lossy encoding scheme, while .TIFF files are lossless (preventing degradation of the file quality), conversion of the .JPEG files to .TIFF files would result in a loss of image quality, and there is no compelling reason to convert the files. As such, files submitted on the photo CD are .JPEGs.

Fish stage was recorded during post-field processing and assigned solely on the basis of fork length, to avoid variation between the judgments of field crews. Fish believed to be between ages 0+ and 1 based on fork length were recorded as fry, while older fish were recorded as juvenile. If the fish was believed to be sexually mature, it was recorded as an adult. The RISC standard definition for parr refers to pacific salmon, and thus no fish were recorded as parr during this inventory. No specimens were sacrificed during the inventory to determine the maturity of the fish, therefore all fish that were recorded as fry or juvenile, based on fork length, were recorded as immature, and adult fish were recorded as mature. Sex was not determined for any fish captured, except for one post-spawned Dolly Varden male from Nepopekum Creek.

Table 12. Guidelines used by field crews in assigning habitat values to stream reaches.

Habitat Type	High Value	Moderate Value	Low Value
Rearing habitat	• Abundance of cover (usually several types) • Perennial flows • Coarse substrates for juveniles • Moderate gradient (1-7% for RB, 5-12% for DV/BT) • Significant representation (>10% of the total habitat area) of both pool (>25 cm deep) and riffle habitats for RB, deep riffle and run habitats with relatively abundant boulders for BT, moderate gradient with adequate pools and large cobbles or boulders for DV.	• Moderate to abundant cover, (amount or variety may be lacking, generally not both) • Perennial flows or dry for only short periods • Predominantly course substrates • Moderate gradient (0.5-13% for RB, 3-15% for DV/BT) • Some representation of riffle and pool habitats (5-10% riffle and >10% pool) for RB and moderately abundant boulder and/or LWD cover for DV/BT	• Low amount of cover and/or diversity of types • Ephemeral discharge or low discharge volume • Predominantly fine substrates or high percentage of organics • High gradient (>13% for RB, >16% for DV/BT) • Poor channel definition • Shallow (<10 cm) average water depth, infrequent pools >15 cm deep • Poor water quality (high summer water temperature, or the potential for low oxygen due to high BOD or stagnant water)
Spawning habitat	• Presence of fairly clean, well-sorted gravels • Suitable substrate exists over at least 5% of the habitat area • Sufficient discharge during the spawning and incubating period • Suitable water velocity • Stable streambed • Holding pools for adults are present	• Suitable gravels present, but angular or not well sorted (mixed with cobbles or fines) • Suitable substrate exists over a small portion of the habitat area <5% • Sufficient discharge over the spawning and incubating period • Streambed substrates prone to mobilization during high-flow events (more limiting to RB than DV/BT) • Holding pools for adults may be rare	• Gravels are highly angular, compacted, or have high amount of fines. • Pockets of gravels are infrequent or very small • Marginal discharge volume • Flows become very turbulent and streambed prone to scour during high flow events • Lack of holding pools for adults
Overwintering habitat	• Residual pool depths of at least 40 cm are present • Sufficient discharge volume of a perennial basis • Adequate flow to keep water well oxygenated • If ponds are present, must be at least 0.25 ha and 2 m deep	• Residual pool depths of at least 40 cm are present, but rare • Sufficient discharge volume to keep pools from freezing • If ponds are present, must be at least 0.25 ha and 1.5 m deep	• Limited available pools over 40 cm deep • Marginal discharge volume • Ponds are present, but are less than 0.25 ha and are shallower than 1.5 m

Rainbow trout are reported to mature as early as age 1+ in small stream resident populations, at sizes as small as 150 mm (Scott and Crossman 1998; McPhail 2007). Our limited ageing data (23 fish, aged 0+ to 5) indicate that a 150 mm rainbow trout is likely age 2+, and thus fish greater than 150 mm were considered mature adults. This assumption seems reasonable for headwater areas in the Skagit Watershed, which remain cool year round and tend to be low in nutrients and somewhat unproductive, likely resulting reduced growth rates (*e.g.* Rosenau and Slaney 1991). Rainbow trout from the lower Skagit River and Ross Lake likely reach maturity at a larger size than is reported here. Our ageing data from North/South Consultants Inc. indicate that two age 0+ rainbow trout were captured, with fork lengths of 92 mm and 102 mm. Since these fish were captured in August, it is likely that they are actually age 1+. The fish were captured in cool, headwater tributaries (Silverdaisy Creek and Big Burn Creek), and probably had small annuli on the scales that were difficult to read. Based on growth rates for cool-water populations of rainbow trout reported in McPhail (2007), fish smaller than 50 mm were classified as fry.

Dolly Varden in the Finlay River watershed in north-central B.C. are reported to grow to lengths of up to 40 mm by the end of their first growing season (age 1), while coastal populations can reportedly reach 50 mm. The Finlay River population reaches lengths of about 60 mm at age 1+, 80 mm at 2+, and > 115 mm at 3+ (McPhail 2007). The limited data for Dolly Varden collected during this study (ages were obtained for six confirmed Dolly Varden, ages 2+ to 4+) indicate a higher growth rate for the Skagit River population. Mature Dolly Varden from the Klesilkwa River are reported to have an average fork length of 120 mm (McPhail and Taylor 1995), and this measurement was used to differentiate juvenile from adult Dolly Varden.

Bull trout in the Skagit River watershed are reported to have a lacustrine-adfluvial life history type (Nelson 2006). Bull trout of this type typically do not mature until age 5+ in males and 6+ in females (350-450 mm) in southern British Columbia (McPhail 2007). Bull trout larger than 350 mm are recorded as adults during this study, though McPhail and Taylor (1995) do not report bull trout smaller than 425 mm among spawning char in the Skagit River mainstem. McPhail and Taylor (1995) also indicate that young-of-the-year char in the Skagit watershed range in size from 35 mm to 80 mm by the end of their first growing season. For convenience, both Dolly Varden and bull trout less than 50 mm are reported as fry. Three confirmed Dolly Varden bull trout hybrids were captured, with fork lengths of 99 mm, 105 mm, and 142 mm. All of these fish are recorded as juveniles.

Aging structures for eastern brook trout were not collected, thus the size-at-maturity classes were developed entirely based on average size-at-age data presented in Scott and Crossman (1998), mostly on fish from eastern Canada. Male brook trout are reported to mature as early as age 1+ and females as early as 2+, though maturity is usually reached at age 2 or 3 (Ford *et al.* 1995). The age of maturity was calculated by taking the mean fork length of the reported age 2+ fish. Brook trout are reported to average about 40-50 mm by the end of their first growing season, but growth is negligible during the winter months, thus brook trout were considered to be fry if they were less than 50 mm (though no brook trout this small were captured). Fork lengths used to determine fish stage and maturity for each species captured is summarized in Table 13.

Table 13. Fork lengths used to determine fish stage and maturity for species captured in the Skagit River watershed.

		Fish Stage			Maturity	
Common Name	**Code**	**Fry**	**Juvenile**	**Adult**	**Immature**	**Mature**
Rainbow trout	RB	< 50 mm	50-150 mm	> 150 mm	< 150 mm	> 150 mm
Bull trout	BT	< 50 mm	50-350 mm	> 350 mm	< 350 mm	> 350 mm
Dolly Varden	DV	< 50 mm	50-120 mm	> 120 mm	< 120 mm	> 120 mm
Dolly Varden / bull trout hybrid	DV×BT	< 50 mm	50-150 mm	> 150 mm	< 150 mm	> 150 mm
Eastern brook trout	EB	< 50 mm	50-204 mm	> 204 mm	< 204 mm	> 204 mm

3.6 Phase 6: Reporting and Mapping

3.6.1 Data Organization

The data in the Appendices are organized according to watershed code, which represents the hierarchical position of the sites in the watershed, from lowest to highest. A site-watershed code/ILP index is included at the beginning of Appendix 2 to facilitate cross referencing of watershed code/ILP's and site numbers.

The data for each site are presented in the following order:

1. Reach card.
2. Site card.
3. Fish collection card(s), if the site was sampled for fish.
4. Non-Fish Bearing Status Reports (where applicable).

To reduce the volume of printed paper and reduce the file size of the electronic document (to accommodate downloading once the report is uploaded to the online provincial databases), photographs are not attached to the photodocumentation appendix (Appendix 3). Photographs are provided on the attached photodocumentation CD (Attachment 3), and are referenced to each site by roll and frame number, and CD image number.

3.6.2 Report

This report follows the outline provided in the inventory standards (BC Fisheries 2001a), and includes some data analyses not otherwise required by the standards. Stream classifications according to the *Forest and Range Practices Act*, for the purpose of riparian management for forestry road crossings and timber harvesting, are provided (Province of British Columbia 1998). Recommendations for future sampling are provided for streams where the presence or absence of fish could not conclusively be determined.

For all sampled reaches determined to be non-fish bearing, a written explanation supporting the classification is provided in the Non-Fish Bearing Status Report. The discussion sections of the non-fish bearing reports focus on sampling methods and effort, habitat conditions, barriers to fish passage, and water quality parameters (*i.e.* discharge volume, water temperature, pH, conductivity, turbidity).

Follow-up sampling is recommended (Province of British Columbia 1998) in order to establish fish presence or absence where it could not reliably be determined or inferred. The need for follow-up sampling was determined based on the results of the initial survey, and recommendations from the survey team.

3.6.3 Stream Classification for Determining Riparian Management Areas (RMAs)

There can be several sources of conflict with respect to completing accurate stream classifications for the purpose of defining RMA's. Where two sample sites are established within representative sections of a single reach and each sustains an average channel width that places them in conflicting RMA classifications, the average can be used to determine the appropriate class. There are cases where professional judgment may be used to change an RMA classification that is based solely on channel width or gradient. Some examples include:

1. Reaches with a gradient > 20% where it is suspected that fish migration occurs.
2. In reaches where the channel is excessively ponded, RMA classifications may be inferred from reaches immediately upstream and downstream.

Reaches categorized as non-classified drainages (NCD) are largely drainages that do not meet the definition of a stream provided in the *Fish-stream Identification Guidebook, 2nd edition, version 2.1* (Province of British Columbia 1998). These include, but are not limited to, drainages with no well defined channel or evidence of mineral alluvium, but which still convey water through seepage flows and/or discontinuous, poorly defined channels, snowmelt channels which are completed vegetated with annual and perennial vegetation, or linear sequences of disconnected, standing surface puddles. Although in most cases these drainages do not provide fish habitat, it is important to note that this is not always the case, and a classification of NCD does not inherently imply non-fish bearing status. For example, reaches with extensive ponding due to beaver dams, or flooded wetland reaches that do not possess stream channels or sustain properties of streams (such as a fluvial sediment bed or continuous definable channel banks) may contain important fish habitat, but retain a NCD classification.

Triton has developed a classification to accommodate stream reaches that are excessively ponded and channel widths, for the purpose of stream classification, can not be obtained. A classification of NVC-W (No Visible Channel – Wetland) is depicted on Fisheries Project/Interpretive maps and is used in the RMA table to refer to such reaches.

Where the fisheries project/interpretive maps indicate NVC, the field crew has assigned "No Visible Channel" status to the mapped reach. These differ from NCD's and NVC-W's in that no evidence of a stream or drainage was located, and no RMA protection is required.

It should be noted that the RMA classification of unsampled reaches cannot be determined from the data collected in this project, and require a site visit to collect channel widths.

3.6.4 Mapping

All mapping was completed using the *Fish Inventory Mapping System (FishMap) for BC Inventory data* utility (Geosense Consulting Ltd. 2002), which is an extension developed for use within ESRI® ArcView 3.2 GIS software. Mapping was completed to standards defined in the *Standards for Fish and Fish Habitat Maps* (BC Fisheries 2001b). Exceptions to the standards are summarized below:

- Reach number labels are not rotated with the reach breaks, which we find improves readability.
- Reach numbers are not placed along the map edges along the channel line to reduce clutter. Reach number is easily determined from the next downstream reach break.
- Reach data symbols are omitted. Watercourse type, confinement, and pattern are easily interpreted from the map, and if necessary, can be retrieved from the FDIS database. Reach data symbols are replaced with gradient-only symbols. Reach data symbols cause excessive clutter and reduce readability, especially in highly dendritic watersheds.
- Project and Interpretive maps are combined. The information from both map types can be effectively combined on one map type without degradation of readability.

Nine 1:20,000 scale fish and fish habitat project/interpretive maps have been produced as part of this project. In some cases, TRIM mapsheets have been combined where only a small amount of the watershed exists on a given mapsheet. Portions of mapsheet 092H.034 are included on mapsheet 092H.024; portions of mapsheet 092H.035 are included on mapsheet 092H.025; and portions of mapsheet 092H.036 and included on mapsheet 092H.036. All maps are in Universal Transverse Mercator (UTM) zone 10 projection, and based on the NAD83 datum.

As mentioned in section 3.1, submission of ILP numbers to the Ministry for conversion to watershed codes is no longer a requirement of the FFHI program. In fact, all TRIM streams have recently been assigned watershed codes, in a product known as the Corporate Watershed Base (CWB; ILMB 2008b). Conversion of ILP's used in this project to existing CWB watershed codes is possible, and would provide greater functionality of the end product; however the FDIS database utility is not currently designed to accept input of these CWB codes. Conversion of the ILP's to CWB watershed codes is beyond the scope of this project.

3.6.5 Fish Bearing Status Interpretations

Interpretive stream coding has been used on the project/interpretive maps which allow for quick identification of the fish-bearing status of a given stream reach. Five interpretive classifications are used as follows:

1. Fish-bearing (inferred) - dashed red line coding.
2. Fish-bearing (confirmed) - solid red line coding.
3. Non fish-bearing (inferred) - dashed blue line coding.
4. Non fish-bearing (confirmed) - solid blue line coding.
5. No visible channel - solid purple line coding.

A description of each fish-bearing code and the justifications used to determine the fish-bearing status are discussed in the following sections:

Fish-bearing (inferred)
All stream reaches are initially treated as inferred fish-bearing. The inferred fish-bearing status can be changed based on sampling results which confirm the presence or absence of fish, or which provide a reasonable indication that fish are not present within the reach. The fish-bearing status can also be downgraded based on map interpretation of watershed characteristics such as gradient, order, and catchment area, which are indicators of potential fish habitat.

Fish-bearing (confirmed)
Reaches receive solid red coding when fish are known to be present within the reach. Fish presence is most often determined through field sampling, but may also be indicated by historical fisheries information. Fish need not be captured in the reach if fish are known present upstream, even if they occur above barriers to fish migration. For instance, Nicomen Lake is known to have been previously stocked with rainbow trout (FISS 2007). Regardless of the results of any fish sampling downstream, and despite the presence of any potential barriers, all downstream reaches within the project area are automatically coded red due to the potential for downstream seeding of rainbow trout from this lake. This includes the unnamed outlet of the lake, reaches 1 and 2 of Grainger Creek, reaches 1 and 2 of the Skaist River, and reaches 1 to 5 of the Skagit River.

When fish are captured in a stream reach, the entire reach is automatically considered fish bearing, even if sampling occurred in the lower end, unless a known barrier to fish migration occurs upstream of the sample site.

Non-fish bearing (inferred)
Streams are downgraded from inferred fish-bearing to inferred non-fish bearing for a variety of reasons. Map interpretation indicating a low likelihood of fish presence is the most common reason. Small, 1^{st} order reaches are inferred non-fish bearing due to the low likelihood of sufficient discharge to provide fish habitat. Reaches with gradients exceeding 30%, with a low potential for perennial fish habitat to occur upstream (*i.e.* no lakes greater than 1 ha or significant amounts of low gradient, 3^{rd} order stream channel exist upstream) are also downgraded. Reaches can be downgraded if the reach was sampled for fish, but none were captured and the field crew suspects that none are present, but cannot be sure without additional sampling. In this case, inferred non-fish bearing status is occasionally projected downstream to a suspected barrier, though in most cases such a barrier would be investigated by the field crew. It is important to note that streams with inferred non-fish bearing status must be managed as fish-bearing until fish absence can be confirmed through sampling.

Non-fish bearing (confirmed)
This interpretation is only applied where the classification is supported by field data. This typically includes reaches where barriers to fish passage have been identified and confirmed on the ground and where no potential overwintering habitat exists upstream, or

fish presence has been ruled out through extensive sampling. If the barriers are not permanent (*i.e.,* beaver dams or log jams), or are anthropogenic (culverts or weirs) they are not used to justify non-fish bearing status upstream, and the reach would most likely retain inferred non-fish bearing status. In all cases, it is extremely important to provide accurate measurements of height and length of the obstruction, as well as mitigating factors such as the occurrence and depth of plunge pools and jump pools. In some cases, barriers are inaccessible, and are assessed from a helicopter or estimated from the ground. In these cases, the determination of full versus partial barrier is given extra consideration, taking estimation errors into account. In all cases photodocumentation provides essential supporting evidence.

No Visible Channel

Reaches classified as having no visible channel are considered barriers, unless they are ponded reaches within wetlands (NVC-W). This classification is only assigned to reaches that have been surveyed. All reaches upslope of an NVC reach are classified as non fish-bearing (confirmed) if no potential overwintering habitat occurs upstream. This is often the case where confinement and gradient lead to scour in an upper reach, and decreased gradient and confinement result in a lack of scour in a lower reach. Stream channels also frequently dissipate at the base of major slope breaks, particularly along large river valleys, due to the sharp decrease in gradient and degree of confinement, although infiltration associated with accumulations of porous fluvial materials also likely contributes to the lack of scour.

Another common occurrence is for stream channels to dissipate in the transition from confined upland forested swale or gully to wetland. This effect is typically associated with a combination of conditions including: loss of confinement at a slope break; sharp decrease in gradient to <3%; loss of energy due to groundwater meeting the water table of the wetland; and less significantly, dense shrubs, which often characterize transition zones and may act to interrupt or intercept and deflect surface flows. In most cases these are small, often ephemeral streams. Where continuous surface water is lacking, fish cannot access the stream and this can be used to support a non fish-bearing classification. In some cases it may be necessary to visit the site during peak flows to ensure fish passage is not possible, however, this is based on professional judgment.

When no visible channel is encountered in the field, the survey crew takes extra precautions to ensure their navigation to the site was precise. Additional ground-truthing is conducted to look for mapping errors or recent changes to the course of the stream. Additional survey notes are recorded on the site card when no visible channel is encountered.

4. RESULTS AND DISCUSSION

4.1 Achievement of Project Objectives

A total of 70 stream sites were selected for sampling, as identified in the planning report (Attachment 1). During the field work completed between August 14th to 20th and October 22nd to 23rd, 2007 a total of 77 sites were surveyed, and an additional 16 fish-only sites were completed to aid in determining fish distributions within the Skagit River watershed. A total of 79 individual reaches were surveyed within the watershed, representing 2.0% of all reaches identified in the Canadian portion of the Skagit River watershed (7.8% of all reaches with average gradients less than 30%).

4.2 Logistics

4.2.1 Problems Encountered

No significant problems were encountered during the completion of the field surveys. Several proposed helicopter access sites could not be completed due to a lack of available landing sites. These reaches, and their substitutions, are summarized in Table 14.

Table 14. Proposed sampling reaches not completed due to lack of helicopter access during the 2007 field sampling program, and their substitutes.

Deleted Reaches			**Replacement Reaches**		
Name	**Watershed Code or ILP**	**Reach**	**Name**	**Watershed Code or ILP**	**Reach**
Daynor Creek	970-110000-98800	2	Daynor Creek	970-110000-98800	1
Silverdaisy Creek	970-110000-90000	3	Silverdaisy Creek	970-110000-90000	1
Twenty Mile Creek	970-110000-90700-16500	3	Twenty Mile Creek	970-110000-90700-16500	1 & 2
unnamed 3rd order tributary to Laforgue Creek	970-110000-90700-22600-6850	1	Laforgue Creek	970-110000-90700-22600	3
unnamed 1st order Skaist River tributary	ILP 11851	1	unnamed 1st order Skaist River tributary	970-110000-94100-08100	1
unnamed 2nd order tributary to Silvertipped Creek	970-110000-86200-61800	1	Silvertipped Creek	970-110000-86200	1
Nepopekum Creek	970-110000-80900	6	Nepopekum Creek	970-110000-80900	3

A helicopter was used to access sites on August 15th and 16th, but low lying cloud cover and precipitation prevented helicopter use for the following three days. The sampling plan was flexible enough to accommodate re-scheduling without adversely affecting timelines and budgets. All remaining helicopter access sites were completed on August 20th.

A factory defect in a brand new electrofisher cause was the cause of low sampling effort at site 21 (Daynor Creek, reach 1), and no electrofishing at site 22. This malfunction did not affect the classifications of site 21, as fish were captured despite the low effort. Although no electrofishing occurred at site 22, it is directly connected to Daynor Creek and no barriers are present, thus fish-bearing status is inferred. The lack of sampling did not affect the interpretation of fish-bearing status in upstream reaches. The unit was promptly replaced with a spare, resulting in minimal downtime.

Field identification of char captured during the inventory was problematic, but did not affect the collection of data during the field component of the project, since morphological characteristics used to identify the char were recorded for later confirmation. Difficulties with the field identification are discussed below.

4.2.2 Char Identification Problems

Haas and McPhail (2001) report that mis-identification of Dolly Varden and bull trout, despite the use of the LDF formula (Equation 1), is very common, and is most often attributed to inaccurate branchiostegal ray counts. They found that bull trout were mis-identified nearly half of the time (48%) in a laboratory setting, while Dolly Varden were wrongly identified only 2.5% of the time. Data from specimens that had identifications confirmed by genetic analysis during this inventory strongly supports their conclusion, as all char that were field identified as bull were confirmed as bull trout, but 10 bull trout were field identified as Dolly Varden. In fact, at site 12 (Nepopekum Creek, reach 2), field crews had initially thought they had captured several bull trout based on the general appearance of the fish (head shape), but had later changed their identification to Dolly Varden once the branchiostegal rays were counted (counts were 20 and 21 for the specimens that had genetic samples taken). Genetic analysis later confirmed that the fish were indeed bull trout.

The fact that mis-identification of bull trout occurred 48% of the time (essentially the same success rate as would occur by chance), in a laboratory setting with professional fisheries biologists and university zoology students in Haas and McPhail's (1991) study provides little confidence that bull trout and Dolly Varden can be distinguished by anyone but char experts. This is particularly the case in the field where light conditions, time constraints, and specialized equipment (dissecting microscopes and accurate calipers) are not available, and especially if the specimens are not anesthetized.

Although Haas and McPhail (1991) suggest that increased training would alleviate the mis-identification problem, it seems possible that perhaps bull trout from the Skagit River watershed have an unusually low number of branchiostegal rays, thus confusing the FDF function (ignoring the unlikely possibility that genetic samples from this study were somehow mixed up, or provided anomalous results). Triton field crews conducting the Skagit inventory have past experience in collecting morphological data from both allopatric and sympatric populations of Dolly Varden and bull trout from elsewhere in the province. Furthermore, crews often double-checked branchiostegal ray counts by having both crew members count independently on fish that were suspected to be bull trout.

Branchiostegal rays were counted on 49 fish during the Skagit inventory. Counts ranged from 16 (likely a low count error) to 26, though only two fish had higher counts than 23 and both were correctly identified as bull trout. Among specimens field identified as Dolly Varden, the average branchiostegal ray count was 20.4 (std. dev. = 1.7), and the most common count was 21. This is a very similar distribution of counts that McPhail and Taylor (1995) reported in the Skagit River watershed, though their range extends to considerably higher counts (which includes bull trout).

Since three char voucher specimens had been collected during the inventory, morphological data was carefully collected using calipers and a magnification lens at the Triton office once the specimens had been fixed and preserved in alcohol. The results are presented in Table 15.

Table 15. Morphological identification of char voucher specimens.

Fork Length (cm)	# of Left Branch Rays	# of Right Branch Rays	Jaw Length (cm)	Standard Length (cm)	# of Anal Fin Rays	Anal Fin Base (cm)	Jaw Length to Anal Fin Base Length Ratio (result)	LDF (result)
7.4	11	10	0.55	6.4	7	0.75	0.73 (DV)	-4.1 (DV)
13.2	11	10	1.40	12.0	9	1.25	1.12 (DV)	-2.6 (DV)
9.3	11	10	0.95	8.3	9	0.9	1.06 (DV)	-2.7 (DV)

In order to determine the likelihood of error due to improper branchiostegal ray counts, the number of branchiostegal rays was increased to the point where the function predicted bull trout. The 7.4 cm fish needed a count of 28, while the other two fish needed counts of 26. Although it is possible that branchiostegal ray counts were not completely accurate (and in fact, field counts are likely to have some level of inaccuracy), it is unlikely that the degree of error is sufficient to result in a change of identification using the LDF method. Unfortunately, genetic samples were not submitted from these fish for genetic confirmation of identification, as they had been fixed in formalin when collected in the field, which degrades the DNA.

4.2.3 Weather

Weather conditions encountered during the field phase were appropriate for completing the work. Light rain and overcast, low cloud was encountered between August 17th to 20th, but in general the weather was partly to mostly clear with mild temperatures. Approximately 2 cm of fresh snow was encountered near Allison Pass on October 22nd, and water temperatures dipped to 3°C, which is below lower limit for electrofishing indicated on the MOE fish inventory sampling permit. In consultation with the MOE representative (Duane Jesson, Fisheries Biologist), who had accompanied the field crew on that day, electrofishing was allowed to continue. The cool water temperatures are not believed to have affected sampling efficiency at the site, and two rainbow trout were captured and released unharmed.

4.3 Fish Above 20%

Fish have been stocked in Poland Lake, though it is unknown if the lake was previously fish-bearing (a survey was conducted in 1953, but the results are not available on the provincial databases; FISS 2007). Reach 3 at the outlet of Poland Lake has an average gradient of 28%, and likely prevents upstream migration of fish into Poland Lake. Similarly, Clerf Lake was stocked with rainbow trout and is known fish-bearing, but reach 1 of its outlet stream has a gradient of 22% prior to discharging into the upper Klesilkwa River, and likely prevents upstream migration of native fish from the Klesilkwa River into the lake. Fish were observed rising in two unnamed lakes that are tributary to Maselpanik Creek (waterbody identifiers 00067SKGT and 00068SKGT) during a helicopter overflight on June 19th, 2007. The gradient of the mainstem between them is 29%, and reach 2, which occurs below the lower of the two lakes is has a gradient of 27%. Rainbow trout were captured in reach 1 above a waterfall barrier to fish migration, indicating that the fish were likely seeding down from these lakes (site 2). Due to the small size of the watershed above these barriers, the lakes are believed to have been stocked.

Fish populations believed to be native were captured above gradients of up to 12% to 14% (*e.g.* Tearse Creek reach 3, Ferguson Creek reach 7, reach 1 of Twentyeight Mile Creek and Silvertipped Creek, reaches 3-5 of Maselpanik Creek). Interestingly, rainbow trout were captured in most of the steeper fish-bearing reaches in the project area, though most of the current literature suggests that Dolly Varden and bull trout are more likely to be found in these habitats.

4.4 Fish Species

Historical information for the Skagit River watershed from FISS (2007), McPhail and Taylor (1995), Scott *et al.* (2003), and Griffith (1993), among other sources, indicate that rainbow trout, cutthroat trout (usually specified as the westslope subspecies), Dolly Varden, bull trout, and eastern brook trout are present within the Skagit River watershed. All of these species were captured during the field inventory in August and October, 2007, except for cutthroat trout. Records of cutthroat trout in the Canadian Skagit River watershed are somewhat rare, and appear to be limited to incidental angler catches of adults in the lower Skagit River mainstem and Ross Lake (Scott *et al.* 2003; Looff 1996). Westslope cutthroat trout have been stocked in the Skagit River watershed above Ross Dam in the U.S.A. Records of westslope cutthroat trout in the Canadian portion of the Skagit River are likely migrants from this stocking program. There is also some indication that native coastal cutthroat trout (*O. clakii clarkii*) are present in the Ross Lake watershed, at least in the American portion (Blakey *et al.* 2000), and spawning populations are recorded from Ruby Creek, Big Beaver Creek, Little Beaver Creek, and Lightning Creek below the confluence of Three Fools Creek. No records of coastal cutthroat trout were located for the Canadian portion of the Skagit River, though many of the occurrences are recorded simply as cutthroat trout, with no indication of the subspecies.

Additionally, there are reports that redside shiners have been introduced into the reservoir in the U.S.A. (D. Jesson, Fisheries Biologist, Ministry of Environment, pers. comm.), but no records of redside shiners in the Canadian portion of the Skagit River have been noted, and none were captured during the field sampling program.

4.4.1 Rainbow trout

Rainbow trout are among the most common game fish in British Columbia (McPhail 2007), and are distributed throughout the province with the exception of the northeast, east of the Rocky Mountains, where their distribution is much more restricted (Ford *et al.* 1995). Rainbow trout have also been widely introduced throughout North America, and all over the globe. Although native to the Skagit River watershed, introductions of rainbow trout in the Canadian Skagit River watershed are known to have occurred as early as 1923 (FISS 2007).

The species exhibits a high degree of phenotypic plasticity over its range, and specimens from different watersheds, and often within watersheds, can appear quite different (Scott and Crossman 1998). Many of the rainbow trout captured in the upper Skagit River Watershed during the inventory had some confusing diagnostic characteristics. Rainbow trout from the upper Skagit watershed, above the confluence of Snass Creek, as well as fish from the upper Sumallo River watershed above Sunshine Valley often had maxillaries that extended well beyond the hind margin of the eye, which is usually characteristic of cutthroat trout (Pollard *et al.* 1997, McPhail and Carveth 1994). Also, the melanophores on the caudal fin tended to form spots on fry, and the adipose fin tended to have breaks in the ring of pigment, and often spots, which is also characteristic of cutthroat trout (Figure 4). The pattern of spotting on the fish, and the slight golden or bronze hue, while not diagnostic, is also reminiscent of cutthroat trout that the field crew members had captured in other watersheds in coastal British Columbia.

Figure 4. Rainbow trout from the upper Skagit watershed with a large maxillary, heavy spotting, a broken ring of pigment on the adipose fin, and a bronze hue. Since the fish had no red slash and no hyoid teeth, it was field identified as a rainbow (instead of a cutthroat) trout. The identification was later confirmed by genetic analysis.

Figure 5. Rainbow trout from the lower Skagit watershed, with a more "typical" rainbow trout coloration, shorter maxillary, and unbroken ring of pigment on the adipose fin.

A record of golden trout in Nicomen Lake may, in fact, be due to the coloration of the rainbow trout in this part of the watershed. The captured trout closely resemble illustrations of "Little Kern River golden trout" (*O. mykiss gilberti*) presented in Behnke (1992), though a diagnostic key is not provided. Although it is unlikely that an unauthorized introduction of golden trout would successfully establish a self-sustaining population in the upper Skagit watershed, a definite barrier on the mainstem would prevent hybridization with native rainbow trout if the watershed was previously barren. The genetic analysis performed during this project is not able to differentiate golden trout from rainbow trout. Since suitable allelic markers are reported to exist that can differentiate golden trout from rainbow trout (Behnke 1992), a genetic analysis of upper Skagit River rainbow trout should be considered to conclusively rule out the possibility of the existence of this species in the watershed.

Rainbow trout were widely distributed throughout the watershed, and were the most common species captured during the inventory (305 specimens were captured from 47 sites, additional specimens were observed). Rainbow trout were the only species present in the Skagit River watershed upstream of a bedrock waterfall located just upstream of the Snass Creek confluence, and are also the only species in the Canadian portion of the Lightning Creek watershed. Rainbow trout were the only species captured in upper Maselpanik Creek (to reach 5, char were captured up to reach 3), and the upper Klesilkwa River (to reach 9, char were captured up to reach 7), though this may be due to stocking.

Rainbow trout were the only species captured in reach 3 of Tearse Creek, above reach 1 which has an average gradient of 14%, and were also the only species captured in St. Alice Creek, above an alluvial fan, though McPhail and Taylor (1995) report capturing Dolly Varden in St. Alice Creek.

4.4.2 Bull Trout

Both bull trout and Dolly Varden are known to be present in the Skagit River watershed, and both species were captured during the field inventory in 2007. Crews attempted to field-identify bull trout and Dolly Varden in the field using keys in McPhail and Taylor (1995), McPhail and Carveth (1994), and information from Haas (1996). Crews also collected morphological information from a sub-sample of char from each capture location to identify fish using the LDF method (Equation 1, see section 3.4.2). Initially, very few bull trout were reported. One 350 mm adult was observed near the confluence of the Klesilkwa River during a snorkel survey, and another was observed in reach 1 of the Sumallo River just upstream of the confluence with the Skagit River mainstem. Two fish captured from reach 1 of Nepopekum Creek were identified as bull trout based on branchiostegal ray counts (these fish had 25 and 26 total branchiostegal rays, respectively).

The results of the genetic analysis indicated that many of the fish identified as Dolly Varden were actually bull trout (see section 4.2.2). Other confirmed bull trout capture locations include reach 2 of Nepopekum Creek, reach 1 of Silverdaisy Creek, reach 1 of Twentyeight Mile Creek, reach 6 of the Sumallo River at Sunshine Valley, reach 3 of the Klesilkwa River at the Maselpanik FSR bridge, and reaches 1 and 3 of the Skagit River mainstem. Bull trout were also captured in Ferguson Creek upstream of the Highway 3 culvert, which likely forms a barrier to fish migration, but downstream of a long section of dewatered channel, which also appears to currently form a barrier to fish migration (a section of about 500 m; rainbow trout were captured both upstream and downstream of the dewatered channel). Another unlikely bull trout capture location was reach 3 of a low-gradient flood channel with mostly fine substrates that appears to form a watershed connection with Silverhope Creek (a Fraser River tributary). The habitats in this stream channel are atypical of preferred bull trout habitats, and the only other genetic sample submitted from this location turned out to be a hybrid. Fish from this location were strongly suspected to be Dolly Varden, as were 39 fish captured in minnow traps just downstream in reach 2 at the old Klesilkwa FSR bridge location.

Young-of-the-year fry captured at site 39 (reach 2 of the Klesilkwa River) were suspected to be bull trout, but were too small to collect morphological data, and no genetic samples were taken (as sampling is generally lethal for fish smaller than 50 mm). The species code for this site has been entered as BT/DV in the FDIS data base and on the fisheries project/interpretive maps, to indicate that the fish are suspected to be bull trout, but may be Dolly Varden.

4.4.3 Dolly Varden

As discusses in sections 4.2.2 and 4.4.2, field identification of Dolly Varden and bull trout was problematic during this study. Crews had initially identified the majority of char captured as Dolly Varden, but of 27 char samples submitted for genetic ID confirmation that were believed to be Dolly Varden, 10 were actually bull trout (and 8 were Dolly Varden / bull trout hybrids). Crew members had initially called some fish bull trout based on their general appearance, but changed to Dolly Varden based on low branchiostegal ray counts and LDF results. It appears that the identification of char in the watershed would have been more accurate had identifications been based on head shape alone. Figures 6, 7, and 8 show representative photos of bull trout, Dolly Varden, and hybrid fish captured in the watershed. Based on the photos, the more pointed snout of the bull trout is apparent. Bull trout also seemed to have less noticeable parr marks, though this is difficult to notice without specimens of both species side-by-side.

Nine confirmed Dolly Varden were captured at 6 sites in the watershed, in reach 1 of the Skagit River mainstem just downstream of the confluence of St. Alice Creek, reach 1 of Silverdaisy Creek, reach 1 of Twentyeight Mile Creek, reach 6 of the Sumallo River at Sunshine Valley, and reach 7 of Ferguson Creek, between the culvert at the Highway 3 culvert and a section of dewatered stream channel 500 m upstream. Bull trout were also captured in all of these locations. The only "pure" population of Dolly Varden was found in reach 1 of East Snass Creek. This population of Dolly Varden was also the only fish capture location where no rainbow trout were captured.

Figure 6. Genetically-confirmed bull trout from Nepopekum Creek. Note the pointed snout. This fish was initially field-identified as a bull trout, but was later changed to Dolly Varden because its branchiostegal ray count was 21.

Figure 7. Post-spawning male Dolly Varden from Nepopekum Creek. This fish was not genetically identified, but the small size at maturity conclusively indicates that it is not a bull trout (but may be a hybrid).

Figure 8. Genetically confirmed hybrid Dolly Varden / bull trout. In the field, the fish appeared to look more like a Dolly Varden to crew members.

Mature Dolly Varden (not genetically confirmed) were found in reaches 1 and 2 of Nepopekum Creek, and a 190 mm post-spawned male was captured in reach 1 on Oct. 23rd, 2007. The water temperature recorded at that site was 6.3˚C at approximately 2:30 pm. The timing and water temperature are consistent with reported Dolly Varden spawning in Nepopekum Creek reported by McPhail and Taylor (1995). Because genetic tissue from these fish was not analyzed, it is possible that they were hybrids. It is unlikely that they were bull trout based on their small size at maturity.

4.4.4 Dolly Varden / Bull Trout Hybrids

Eight genetically confirmed Dolly Varden/bull trout hybrids were captured at six sites. Hybrids represented 29.6% of the char samples submitted for genetic identification. Hybrids were captured in reach 1 of the Skagit mainstem downstream of the confluence of St. Alice Creek and in reach 2 at the Silver-Skagit Road bridge upstream of the confluence of the Klesilkwa River, in reach 6 of the Sumallo River at Sunshine Valley, in a low-gradient tributary to reach 7 of the Klesilkwa River that appears to be connected to Silverhope Creek, reach 1 of Marmotte Creek, and reach 1 of Silverdaisy Creek. Although hybridization has been reported in other sympatric populations of Dolly Varden and bull trout (*i.e.*, the upper Finlay River in north-central BC; Baxter *et al.* 1997), the extent of hybridization and widespread distribution of hybrids appears to be unique to the Skagit watershed, and has previously been reported in McPhail and Taylor (1995).

Based on our limited distribution data of native char in the Skagit watershed, the distribution patterns of bull trout and Dolly Varden generally agree with those reported in McPhail and Taylor (1995), though the distinction between "tributary" Dolly Varden populations and "mainstem" bull trout populations was not as clear-cut as was reported by McPhail and Taylor (1995). Relatively few populations of "pure" bull trout or Dolly Varden appear to exist. Headwater areas that can act as refuges for Dolly Varden alleles appear to be more often occupied by rainbow trout in the Skagit watershed. Dolly Varden were more often found in the larger tributaries and mainstems, and no isolated populations above barriers to fish migration were located. This distribution pattern more often puts them in contact with bull trout populations

4.4.5 Eastern Brook Trout

Four eastern brook trout were captured in on Oct. 23, 2007 at site 52, on reach 1 of the Skagit River mainstem just upstream of the Chittenden Foot Bridge, approximately 1.5 km upstream from Ross Lake. All were juveniles between 61 mm and 91 mm in fork length, and were captured from a complex of large woody debris. Historical records of brook trout in the Skagit River watershed are limited to the lower Skagit River mainstem and Ross Lake, and are mostly incidental angler catch reports (*e.g.* Scott *et al.* 2003). The presence of these juvenile fish may indicate that brook trout spawning occurs in the lower Skagit mainstem. McPhail and Taylor (1995) report finding ripe male brook trout in the Skagit mainstem and Nepopekum Creek. Also, they found two brook trout/Dolly Varden hybrids. No genetic material was submitted from the brook trout captured during the inventory, though the absence of any intermediate characteristics suggests that the specimens were not hybrids. A representative photo of one of the brook trout captured during the inventory is shown in Figure 9.

Figure 9. A 91 mm eastern brook trout captured in reach 1 of the Skagit River mainstem. Note the black spots on the dorsal fin which are absent from Dolly Varden and bull trout.

4.5 Summary of Biophysical Information

Fish habitat values are influenced by several primary physical characteristics of watercourses including gradient, channel confinement, side slope length and angle, streambed substrates, and channel morphology. In addition to physical characteristic, biological parameters such as riparian and instream vegetation, large woody debris and aquatic invertebrate production influence fish habitat values.

The Skagit River watershed is characterized by a broad, wide valley through the lower central portion of the watershed through which the Skagit River flows. The valley is flanked on either side by steep mountains, reaching up to over 2,500 m in elevation. A glacier is noted on the eastern face of Silvertip Mountain, though icefields which persist through the summer months are common in the upper elevations. There is 224 km^2 of alpine areas in the watershed, making up 21% of the entire land base. No fish were captured in alpine areas during the inventory, though rainbow trout have been stocked in Nicomen Lake, which occurs in the Interior Mountain Heather Alpine (IMA) BEC zone. All confirmed fish-bearing reaches occur below approximately 1,350 m elevation, except for Grainger Creek at the outlet of Nicomen Lake, which reaches up to 1,790 m elevation. Most of the fish bearing reaches occur below 1,000 m elevation.

Typical of mountainous areas, 82% of the reaches in the project area have average gradients greater than 20% (75% have average gradients in excess of 30%). Fish were captured in reaches with gradients of up to 12%, and rainbow trout were captured in reach 3 of Tearse Creek, which occurs above a reach with an average gradient of 14%. Other populations of fish above gradients greater than 15% occur due to stocking. The average gradients of sampled sites ranged from 0% to 53%, though the average gradient exceeded 20% at only 3 sites (24, 28, and 73).

The average channel widths of streams surveyed in the project area was 7.3 m (ranging from 0.39 m to 33.9 m, std. dev. = 6.3 m). The smallest stream found to contain fish had an average channel width of 4.3 m (Lightning Creek, reach 9), and the average fish-bearing stream had an average channel width of 10.7 m (std. dev. = 7.3). The large average channel size of fish-bearing streams in the Skagit watershed is reflective of the fact that drainages often become too steep or contain barriers to fish migration before they become smaller than 4 m wide. The average channel width at sites where no fish were captured was 4.1 m (range 0.39 m to 10.0 m, std. dev. = 2.2).

Cascade-pool morphology was the dominant channel morphology encountered within the watershed, and was assigned to 61% of stream sites. Riffle-pool morphology was the second most common morphology, occurring at 35% of the stream sites. Large-channel morphology was assigned at two sites, and step-pool morphology was noted at one site. Gravels were the dominant substrate at 38% of the sites visited, with cobbles dominant at 32%, boulders at 20%, and fines at 10%. Gravels and cobbles were also the most common subdominant types at 30.5% each, while fines made up 24%, boulders 12% and bedrock made up 2%. This distribution of substrates is consistent with the dominant channel types (cascade-pool and riffle-pool) that were most common in the watershed.

Stream channels in the project area were generally stable, with 88% of reaches classified as entrenched, confined, or frequently confined. Only 1.1% of the reaches were classified as unconfined, and 26 of these were classified as wetland reaches. Some minor bank erosion was noted at site 21 (Daynor Creek reach 1), but it appeared to be natural. An unnamed tributary to the Klesilkwa River (watershed code 970-110000-84800-31000) that crosses the Silver-Skagit Road appears to be moving a significant volume of bed material, causing excessive channel wandering and dewatering during low flow periods. This stream appears to have washed out the Silver-Skagit Road in the past. Timber harvesting upstream of the road crossing may have destabilized the banks, contributing to the problem. Past timber harvest also appears to be contributing to aggrading, multiple channels and lack of pools in reach 9 of the Sumallo River.

Several tributaries to reach 3 of the Skagit River had “blown-out” channels. Tributaries in this area drain the highest mountains in the project area, and have steep gradients. Windfall and other large woody debris cause small jams that are removed by high flow events, causing streambed erosion, and occasionally resulting in avulsions. Fish habitat in these reaches is typically limited by a lack of cover as the channels are over-widened. This type of channel was noted at sites 33 (Marmotte Creek), 34 (Twentyeight Mile Creek), and 75 (Silvertipped Creek). The instability of these channels is due to natural events.

Dewatering was noted at reach 1 of Twenty Mile Creek. This stream was completely dry during the August sampling period, though some flow was noted in October. Dewatering in reach 7 of Ferguson Creek may be partly due to past harvest activities. Ferguson Creek is confined by bedrock walls and the streambed features many large, non-movable lag boulders in this reach. Large woody debris (many pieces with machine-cut ends) appears to have been rafted down the channel during high flow events, eventually getting caught up in the boulders and bedrock walls. The woody debris then traps smaller streambed substrates, eventually building the streambed up higher than the water height at normal discharge levels. This dewatered section now appears to be forming at least a seasonal barrier to fish migration.

A large woody debris jam has formed in reach 2 of Nepopekum Creek. The jam spans the channel, and is made up of enough pieces of wood so as to be somewhat stable. The jam is not currently an obstruction to fish passage, but if enough bedload builds up behind it, it may eventually form a streambed drop. A footbridge is located 100 m downstream of the jam at the centennial trail crossing. This bridge may be damaged if the jam breaks up and woody debris becomes hung up on it. An unnamed tributary to reach 7 of the Klesilkwa River (watershed code 970-110000-84800-64930) was noted to have some excessively downcut sections, areas of over-abundant small woody debris, and multiple channels. It also appeared as though beaver dams were present in the past, but had been blown-out.

4.5.1 Connection to Adjacent Watersheds

During the overflight on June 19th, 2007, an alluvial fan at the height of land between Silverhope Creek, a Fraser River tributary (watershed code 100-112900), and the Klesilkwa River, was noted to have active channels that connect the two watersheds. Riedel *et al.* (2007) have suggested that the entire upper Skagit Watershed once drained into the Silverhope Creek watershed through the Klesilkwa Pass, when the lower Skagit Valley was blocked by large continental glaciers. At other times, flows had been reversed and Silverhope Creek drained into the Skagit River (Riedel *et al.* 2007). Bull trout, Dolly Varden (suspected), hybrids, and rainbow trout were captured in this reach, and may be able to cross into the Fraser River watershed via this connection. It is very likely that colonization / re-colonization of both the Silverhope Creek and Skagit River watersheds occurred through this pass, and may help explain the lack of coarse fish species in the watershed (since the connection occurred in a headwater, glacial area at the time that would be unsuitable for most coarse fish species).

Riedel have also suggested that the upper Skaist River and Snass Creek once flowed to the north and were connected to the Similkameen River watershed, and that Lightning Creek was blocked below Thunder Lake, and also flowed in the opposite direction, into the Similkameen Watershed. These connections may help explain the different appearance between the rainbow trout in the upper and lower parts of the watershed, if they have originated in different watersheds. It may also help explain the absence of bull trout and Dolly Varden in the upper Skagit and Lightning Creek watersheds, if these species are absent from the upper Similkameen River.

Currently, Lightning Lake drains both southwest into Lightning Creek, and east into the Similkameen River (*via* Little Muddy Creek) due to a concrete weir constructed at the east end of Lightning Lake. The weir is a barrier to juveniles, but may be passable to adult fish at high flows. Rainbow trout present in Lightning Lake can seed downstream into the Similkameen River watershed.

4.6 Water Quality Information

A detailed analysis of water quality was not conducted as part of this stream inventory; however *in situ* water quality information including temperature, pH, and electrical conductivity was collected using field-grade meters. Water temperatures ranged from 3°C to 18°C, with an average temperature of 9.7°C (std. dev. = 3.0). Water temperatures were suitable for electrofishing in all cases except one, though electrofishing was allowed to proceed and fish were captured from that site (see section 4.2.1). Conductivity measurements ranged from 10 µS/cm to 210 µS/cm, with an average of 95.6 µS/cm (std. dev = 51.1). Conductivity was below 30 µS/cm at three sites, but fish were captured at two of them. The average pH for streams in the area was 7.6 (std. dev. = 0.6) and ranged from 6.2 to 8.5. The majority of the streams had a slightly alkaline pH, but 17% had pH levels below 7.0. The turbidity was clear for all sites surveyed except for site 91, which had light turbidity. The water quality parameters recorded fall within guidelines for the protection of aquatic life in British Columbia (Fast 2006).

4.7 Distribution of Fish and Fish Habitat

A total of 465 fish of four different species were captured during the stream surveys of the Skagit river watershed in 2007. Additionally, hybrids of Dolly Varden and bull trout were captured. Fish were predominantly captured by electrofishing (81.9% of fish captures), but 71 (15.3%) were captured in minnow traps and 13 (2.8%) were captured by angling. Pole seining was also employed at a few sites, but was unsuccessful at capturing fish. Visual observations, both from shore and during snorkel surveys, also make 10.6% of the fish records in the FDIS database. Fish were captured at 66 of the 92 sites visited in 2007 (Table 16).

Table 16. Fish species captured in the Skagit River watershed (visual observations not included).

Species	# captured (% of total catch)	# sites where caught (% of fish-bearing sites)	Life stages captured
Rainbow trout	305 (65.6%)	38 (57.6%)	fry, juvenile, adult
Dolly Varden (confirmed)	9 (1.9%)	6 (9.1%)	juvenile, adult
Dolly Varden (suspected)	123 (26.5%)	16 (24.2%)	fry, juvenile, adult
Bull trout (confirmed)	13 (2.8%)	10 (15.2%)	juvenile
Bull trout (suspected)	3 (0.6%)	1 (1.5%)	fry
Dolly Varden / bull trout hybrids (confirmed)	8 (1.7%)	7 (10.6%)	juvenile
eastern brook trout	4 (0.9%)	1 (1.5%)	juvenile

Fish were relatively abundant where captured. The average catch-per-unit-effort (CPUE) by electrofishing at fish bearing sites was 2.81 fish per 100 electrofishing seconds (EF sec.). The highest electrofishing CPUE (34.1 fish/100 EF sec.) by far occurred at site 51 (reach 7 of Ferguson Creek). The lowest density (as determined by electrofishing CPUE) occurred at site 45 (Tearse Creek, reach 3), where only 1 rainbow trout was captured in 1,246 seconds of electrofishing (0.08 fish/100 EF sec.). Two other rainbow trout were observed at this site, but escaped capture. The efficiency of electrofishing at this site was somewhat low because it is a wetland reach with standing water and thick riparian vegetation. Table 17 shows the relative densities of fish, as determined by electrofishing, within the project area.

Table 17. Electrofishing catch-per-unit-effort of fish by species.

Site #	Rainbow Trout				Dolly Varden and Bull Trout				Eastern Brook Trout				Combined (all species)			
	Fry	Juveniles	Adults	TOTAL	Fry	Juveniles	Adults	TOTAL	Fry	Juveniles	Adults	TOTAL	Fry	Juveniles	Adults	TOTAL
2			0.84	0.84											0.84	0.84
3		0.20	0.10	0.30										0.20	0.10	0.30
5		1.51		1.51										1.51		1.51
8	0.35	0.58	0.46	1.39									0.35	0.58	0.46	1.39
12	**0.15**	0.76		0.92	0.15	0.61		0.76					0.31	1.37		1.68
15						**0.09**	0.18	0.27						**0.09**	0.18	0.27
18	1.56	0.99		2.55									1.56	0.99		2.55
19	**2.18**	1.96	0.22	4.36									**2.18**	1.96	0.22	4.36
21		3.62	1.11	4.74										3.62	1.11	4.74
23		0.92	0.46	1.38										0.92	0.46	1.38
25		3.26	0.93	4.19										3.26	0.93	4.19
26		1.40	0.86	2.27										1.40	0.86	2.27
29		0.92		0.92		1.69		1.69						2.61		2.61
33		0.27	0.27	0.53		0.27		0.27						0.53	0.27	0.80
34		**0.15**		0.15		0.15	0.15	0.30						0.30	0.15	0.45
39	0.20	0.20		0.4	**0.20**	0.20		0.40					0.40	0.40		0.81
43		0.20		0.2	**0.20**	**1.98**		2.18					**0.20**	2.18		2.38
45			**0.08**	**0.08**											**0.08**	**0.08**
50	0.21	1.23		1.44		0.41	0.21	0.62					0.21	1.65	0.21	2.06
51		**21.98**	**9.89**	**31.90**		1.10	**1.10**	2.20						**23.08**	**10.99**	**34.07**
52	0.35	0.23		0.58	**0.12**	0.35		0.46		**0.46**		**0.46**	0.46	1.04		1.50
58						**1.98**	0.45	**2.43**						1.98	0.45	2.43
59						0.87		0.87						0.87		0.87
66		0.23		0.23										0.23		0.23
67		2.38	1.27	3.65										2.38	1.27	3.65
75		0.18	0.18	0.35		0.18		**0.18**						0.35	0.18	0.53
85		0.62		0.62										0.62		0.62
86		1.66	1.47	3.13		0.37		0.37						2.03	1.47	3.50
87			0.13	0.13											0.13	0.13
89	2.09	0.56		2.65		0.42	**0.14**	0.42					2.09	0.98		3.07
92	0.29	0.29		0.57		0.86		1.00					0.29	1.15	0.14	1.58
93		0.35		0.35		1.75		1.75						2.10		2.10
Avg	**0.82**	**1.79**	**1.22**	**2.49**	**0.17**	**0.78**	**0.37**	**0.95**		**0.46**		**0.46**	**0.81**	**2.08**	**1.03**	**2.78**

Notes: 1. **Red** indicates highest values and **Blue** indicates lowest within each category.

2. Dolly Varden and bull trout are combined as the majority of these fish have not had genetic confirmation of identification.

The average electrofishing effort at sites where no fish were captured was 645 seconds (std. dev. = 154), with a total of 13,541 EF sec. of effort expended. At the 21 sites where no fish were captured, the average length of stream sampled was 181 m, while at fish-bearing sites the average sampled length was 123 m. The effort expended per metre was lower at the non-fish bearing sites (3.6 seconds per lineal metre, compared to 5.6 seconds per lineal metre at fish-bearing sites), which is reflective of the fact that crews usually attempt to cover more habitat when they are not catching fish, to ensure that fish are not present in low densities. When fish are captured, crews can afford to expend more effort to chase fish that escape during the first pass with the electrofisher anode.

Electrofishing at night was completed at two sites (site 50, site 93), as this method was found to be highly effective at capturing a greater number of fish and a greater range in size class of fish during previously conducted inventories (Triton 2005, Triton 2006). Results were not so conclusive in the Skagit River watershed, largely due to the limited number of species present (including a lack of non-game fish). It is felt that sampling during the day or night will capture the range of species present at a site, as long as effort is sufficient. CPUE at mainstem sites with limited cover is likely higher at night, although the additional effort and safety considerations needed for working at night likely outweigh the benefits of capturing a few more fish. There were no additional species or size classes of fish captured during night electrofishing.

Fish distribution within the Skagit River watershed is primarily limited by gradient. Tributary streams often become steep quickly upstream of the mainstem reaches, forming barriers to fish passage. Approximately 220 km of stream are classified as confirmed fish-bearing in the project area, representing 7.2% of all mapped stream length within the project area. Fish-bearing reaches represent 45.3% of all reaches with gradients of 15% or less. Reaches which retain an inferred fish-bearing status comprise 8.6% (263 km) of the total stream length. Confirmed non-fish bearing reaches comprise 8.1% of the total stream length (246 km), while inferred non-fish bearing reaches make up the bulk of the streams in the project area, at 75.6% (2,306 km). Reaches confirmed as having no visible channel make up 0.4 % (13 km).

A series of bedrock-controlled waterfalls occur on the Skagit River mainstem just upstream of the Snass Creek confluence. These falls formed the upper distribution limit of all species except rainbow trout. The rainbow trout above the falls are isolated, and likely have a different life-history strategy compared to those downstream of the falls. Previous studies have suggested that rainbow trout that support the recreational fishery in the lower Skagit exhibit a lacustrine-adfluvial life history, utilizing habitats in Ross Lake as rearing adults (Griffith and Greiner 1983 *In* Scott *et al.* 2003). Rainbow trout in the upper Skagit River watershed do not have access to any significant lacustrine habitats. Nicomen Lake is the largest that occurs upstream of these falls (6.0 ha), and is known to contain a stocked population of rainbow trout, but steep gradients downstream in Grainger Creek may limit access to this lake from native populations. Rainbow trout in the upper Skagit watershed are permanent stream-residents by necessity.

Rainbow trout were also the only species captured throughout the Lightning Creek watershed, though bull trout are known to utilize habitats in the lower portion of the watershed south of the international border (Nelson 2006). Bull trout are known from Lightning Creek upstream at least as far as Three Fools Creek in the U.S.A. (U.S. Fish and Wildlife Service 2004), and several documents indicate that critical bull trout habitat is present throughout the American portion of the watershed. Since no bull trout or Dolly Varden were captured during this inventory, and none have been captured in several previous inventories of the lakes within the Canadian portion of the Lightning Creek drainage (FISS 2007), it is reasonable to suspect that a barrier to fish passage exists between the international border and the confluence of Three Fools Creek.

4.7.1 Lake Habitats

Lakes make up a relatively small proportion of the available fish habitat in the Skagit River watershed. Most of the lakes are small; of 102 identified on the TRIM map base, only 33 are larger than 1 ha. Nearly half (45%) are located in the alpine. Lacustrine habitat appears to have low potential to provide significant habitats for fish in the watershed, other than the lakes of the Lightning Creek chain, and Ross Lake. Most are above barriers to fish passage and are barren. The small size of most may indicate that the depth may not be sufficient to provide overwintering habitat for fish. The shoreline development score (D_L) is low for most of the lakes in the watershed. The shoreline development score is a measure of the length of shoreline (L) to the circumference of a circle with an area equal to that of the lake (A_0), and is described by the formula (from Wetzel 1983):

Equation 2.

$$D_L = \frac{L}{2\sqrt{\pi A_0}}$$

Shoreline development can be important as is reflects the potential for littoral communities to develop in greater proportion to pelagic areas. Littoral communities are often associated with increased production of invertebrates and other food sources for fish, and can affect the productivity of a lacustrine ecosystem. Lakes with a score close to 1 are nearly circular and have the minimum possible shoreline area. The average shoreline development score for lakes in the watershed is 1.22 (range 1.02 to 3.19; std. dev. = 0.25). Only five lakes have a score greater than 2.0, a common value for sub-circular or elliptical lakes (Wetzel 1983). Highly irregular lakes typically have much greater shoreline development scores.

4.8 Fish Age, Size and Life History

Ageing structures were collected from 94 fish, including 8 bull trout, 7 Dolly Varden, 17 unconfirmed Dolly Varden / bull trout, 3 Dolly Varden / bull trout hybrids, and 59 rainbow trout. Due to budget constraints, only 55 of the samples were submitted to North/South Consultants Inc. to be aged. Samples not submitted included 1 bull trout, 1 Dolly Varden, 8 Dolly Varden / bull trout, and 29 rainbow trout. Two of the Dolly Varden bull trout specimens submitted were unageable, as were 7 of the rainbow trout samples. Both the aged and un-aged samples have been submitted to the BC Ministry of Environment, Fish and Wildlife Section, Surrey, BC.

De Leeuw (1991) found that the uniformity of ages obtained for Dolly Varden from the Skeena River and cutthroat trout from the Queen Charlotte Islands was poor, and the ages obtained were dependent upon the person aging the fish, and the structure used (fin rays and otoliths, and scales for the cutthroat trout samples). In Dolly Varden, fin rays tended to produce younger and a slightly wider range of estimates than did otoliths. In cutthroat trout, fin rays produced a slightly older, but again slightly wider, range of estimates. Scale samples for cutthroat produced considerably younger age estimates, but the narrowest range. No validation of the actual ages of the structures was conducted, and therefore no comment as to which structure produced the most accurate results was made.

Ageing structures collected during this project were processed by an independent, reputable laboratory (North/South Consultants Inc.). We consistently collected scales for rainbow trout (although one pair of otoliths was collected from an accidental mortality) and fin rays for Dolly Varden and bull trout, thereby reducing the variability associated with using different structures.

Bull trout captured during the inventory from which age data was collected ranged from 93 mm to 206 mm, and were between ages 1 and 4. Based on the reported size at maturity (McPhail 2007; McPhail and Baxter 1996), these fish were classified as juveniles. The reported size at age for these fish is consistent with growth rates reported in McPhail and Baxter (1996). Figure 10 presents length at age data for bull trout from the Skagit River compared to bull trout captured during several other inventories completed by Triton as well as data from other sources. Bull trout from the Skagit River are on the low end of the growth range, and are most similar with Line Creek fish and 4-year old samples from the Fox River (both are more northern systems). The short length at age of Skagit River bull trout may indicate low productivity, marginal rearing conditions for juveniles, or may just be due to the small sample size.

Dolly Varden were between 91 mm and 200 mm, with ages between 2 and 4. Two of the fish were smaller than 120 mm and were classified as juveniles. Both of these fish were 2 years old. Three of the adults were age 3, and one 189 mm fish was age 4. Dolly Varden in the Skagit River watershed appear to have similar growth rates to populations from Coastal British Columbia, and appear to grow slightly faster than those from the interior of the province (McPhail 2007).

Char that did not have their species identification confirmed by genetic analysis (not including brook trout), that had ageing structures collected, ranged from 72 mm to 212 mm. Ages ranged from 1 to 4, and corresponded from youngest to oldest with increasing fork length, with no exceptions. The stage and maturity of these fish was assigned based on their field identification (Dolly Varden), and as such, fish larger than 120 mm (aged 2 and up) were classified as adults. If the fish are actually bull trout, all would be classified as juveniles, since the two species mature at vastly different sizes. All of the hybrid fish captured were between 99 mm and 142 mm, and were classified as juveniles. All were age 2.

Ageing structures that were submitted from rainbow trout ranged in size from 58 mm to 363 mm. Ages ranged from 0+ to 5+. There were two fish reported to be aged 0+ (first growing season), with lengths of 93 mm and 102 mm. Although rainbow trout can grow to lengths of up to 120 mm by the end of their first growing season (McPhail 2007), it is unlikely that these specimens could have attained these sizes by the time of their capture (August 14th and 17th), and are more likely to be aged 1+. Four of the age 1+ fish were smaller than 100 mm. The largest specimen (363 mm, age 5+) was captured from the Skagit River mainstem.

Our limited age data indicate that rainbow trout have the highest growth rates in the Skagit River watershed, which is consistent with reported growth rates between trout and char species (McPhail 2007; Scott and Crossman 1998). Our data also show that bull trout are the fastest growing char, followed by hybrids, then Dolly Varden. This interpretation is based on a very small number of sampled, but is consistent with the available literature. The average sizes at the ages reported for fish in the Skagit River watershed is shown in Figure 11.

A length-frequency diagram for fish captured in the Skagit River watershed is presented in Figure 12. The distribution of size classes should be interpreted with caution, as data is more a reflection of sampling location than of the actual distribution of size classes in the watershed. For example, crews are likely to avoid sampling large schools of fry, as they are more sensitive to handling (though observations would be made on the fish collection form). Also, electrofishing effectively samples small to medium sized streams, but is not effective in large rivers. Angling (used more often in the Skagit River mainstem) catch per unit effort is always much lower than electrofishing, therefore, direct comparisons to the number of small fish captured in streams to the number of adults captured in the larger mainstems is not possible with the data collected. The data does indicate the size classes of fish most likely to be encountered in the main fish-bearing tributaries to the Skagit River. For example, fish of all species appear to begin moving out of the smaller tributaries by the time they reach 200 mm.

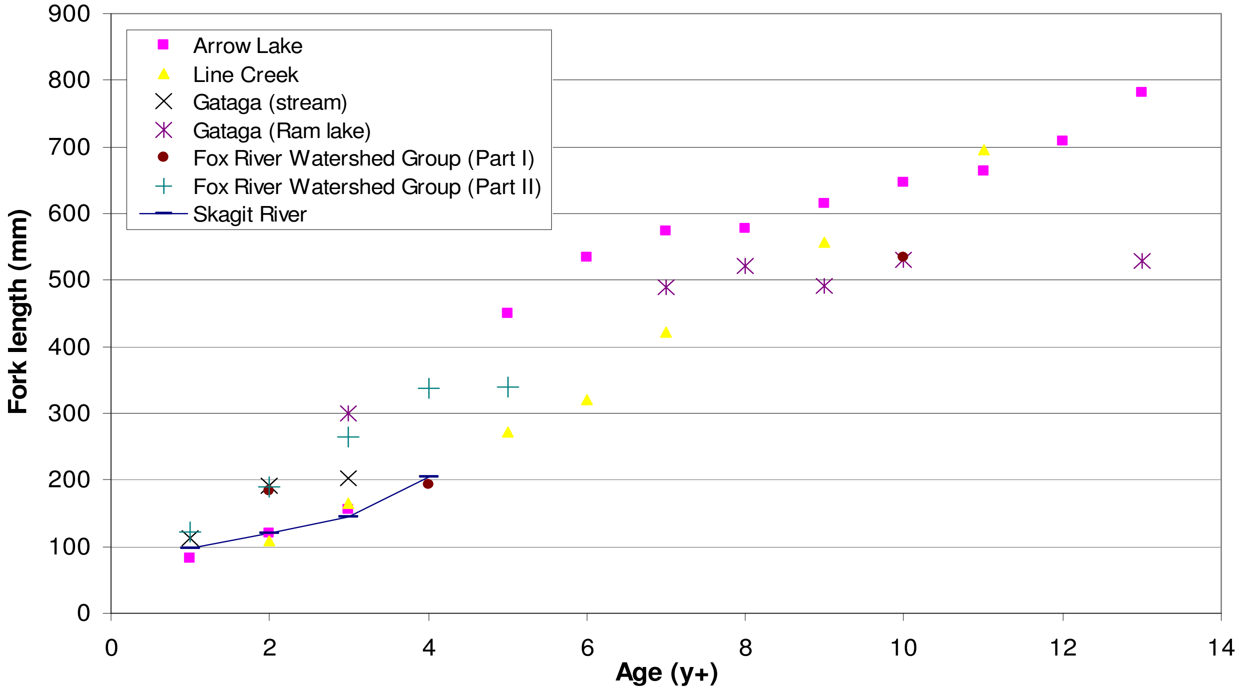


Figure 10. Mean length-at-age for bull trout from various locations, including the Skagit River watershed (n=8, series connected by a line). Data from the Fox River watershed group are taken from Triton 2005 and Triton 2006, data from the Gataga River watershed are taken from Triton 2004. Data from the Libby Reservoir (Montana), Arrow Lake (southeast BC) and Line Creek (Clearwater River, Alberta) are taken from Table 9 in Ford *et al.* (1995).

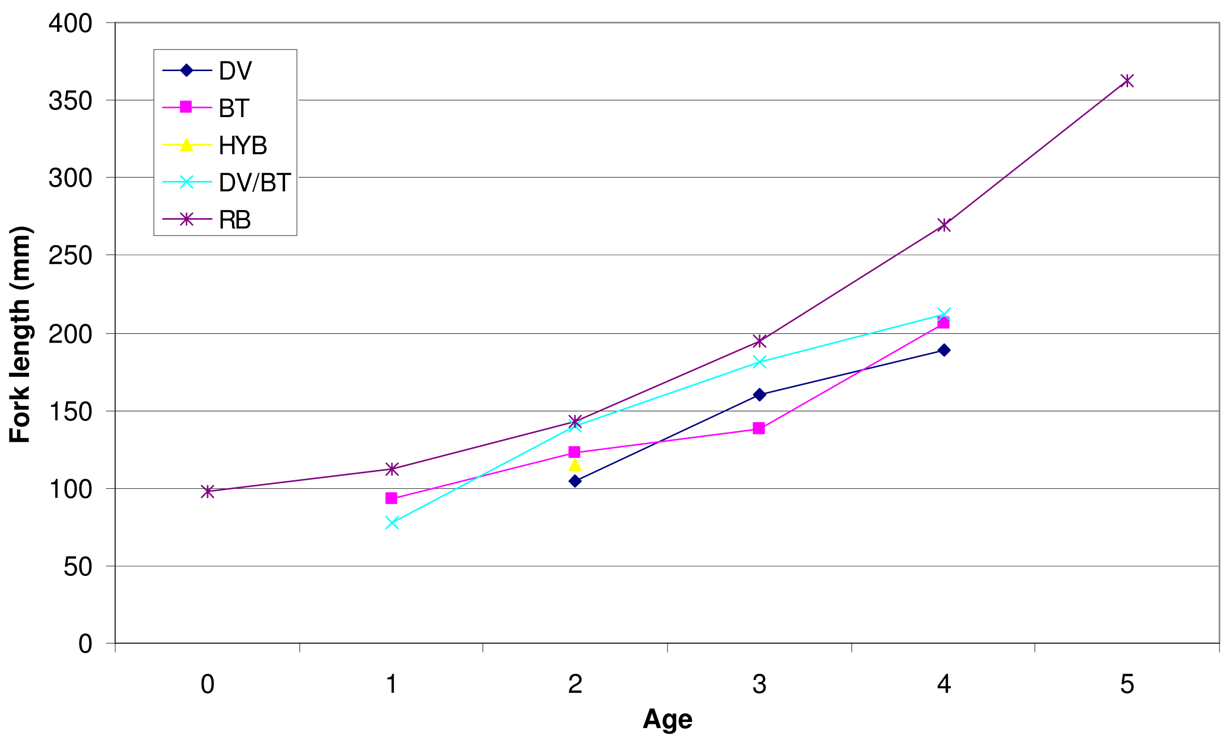


Figure 11. Average size of each species of fish at each age class for specimens from the Skagit River Watershed.

4.9 Significant Features and Fisheries Observations

A total of 33 features which impact fish and fish habitat were noted during the field inventory in 2007, and are recorded in the FDIS database. Several of the features were inaccessible, and were noted during aerial surveys from a helicopter. Some historic features were known prior to the inventory (FISS 2007), and have been entered in the "historical features" table of the FDIS database. All of the historic features were visited during the inventory, and additional comments were made. A summary of significant features is presented in Table 18.

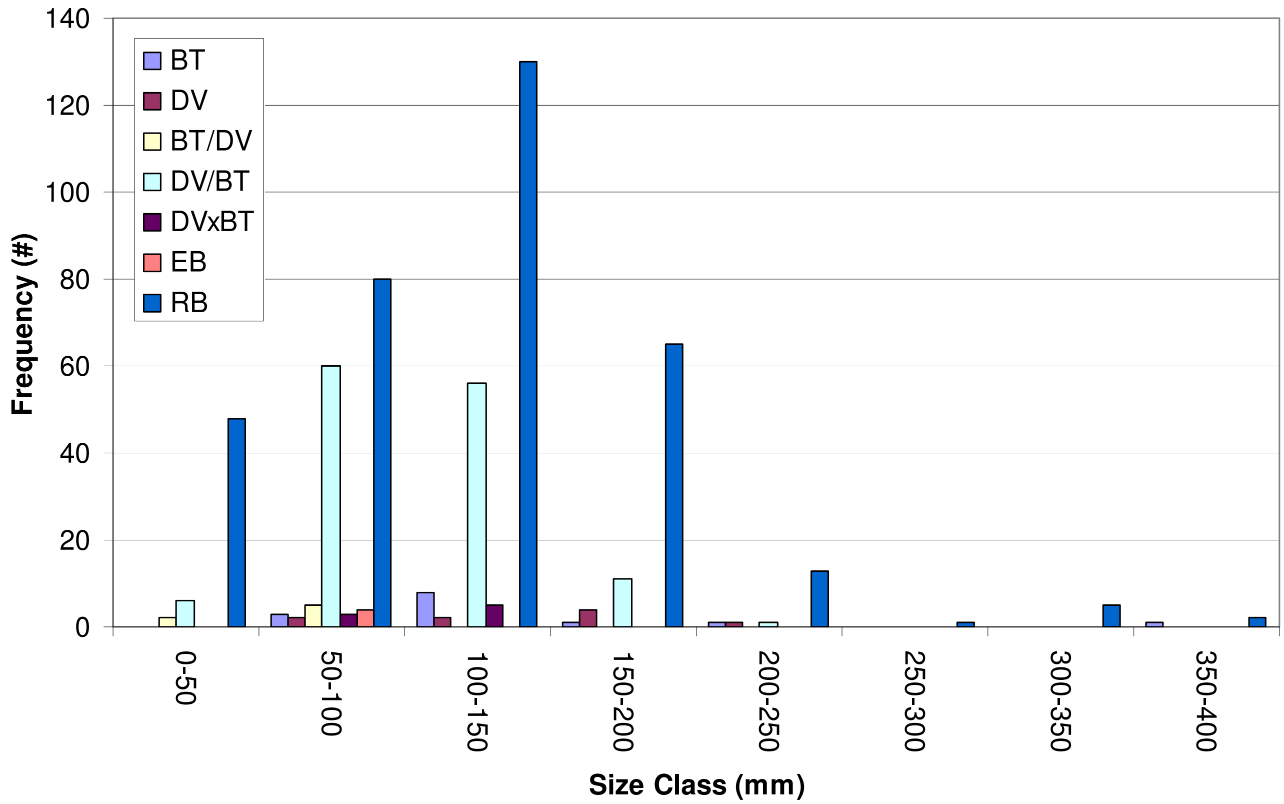


Figure 12. Length-frequency diagram for fish species captured in the Skagit River watershed.

Table 18. Features identified during the field inventory in 2007 (organized by watershed code).

Watershed Code	Site	Type	Height (m)	Length (m)	Field UTM Coordinates	Description
970-110000	90	F	7.5	1.0	10.641250.5453940	Bedrock-controlled waterfall on the mainstem Skagit River upstream of the confluence with Snass Creek. Height is estimated due to access limitations. Additional falls were noted upstream from the helicopter. Forms a definite barrier to upstream fish migration, and limit of char distribution in the watershed (RB are present upstream).
970-110000-70500	19	D	1.0	3.0	10.656991.5434759	Rock weir at the outlet of Lightning Lake (south end) to control water levels is a barrier to young-of-year RB. A log fish-way on the right margin was not functioning properly (dry). This feature is historic (known in FISS).
970-110000-70500	19	D	1.0	0.9	10.658898.5436649	Concrete weir at the north outlet of Lightning Lake (into Little Muddy Creek, Similkameen Watershed). May be a barrier to juvenile fish.
970-11000070500-83500	17	C	6.0	20.0	10.653890.5433425	This bedrock cascade on Passage Creek forms a definite barrier to upstream fish migration. This cascade is the furthest downstream in a series. NFC above.
970-110000-80300	6	BMA			10.638833.5434333 (GIS)	Reach 1 of Galene Creek flow significantly north of its mapped location, potentially due to an avulsion upstream (the channel was dry at the time of survey, and appeared to be recently formed).
970-110000-80900	12	X	3.0	15.0	10.639489.5437069	A large log / woody debris jam in Nepopekum Creek is currently stable and not restricting fish passage, but may endanger the Centennial Trail footbridge 100 m downstream if it washed out.
970-110000-80900-78900	16	F	1.9	0.1	10.651036.5434979	This bedrock falls forms a definite barrier to upstream fish migration, but additional barriers are located downstream (Nepopekum Falls).
970-110000-81700	7	C	0.8	0.3	10.632819.5431521	This small cascade forms a barrier to juvenile salmonids, and is at least seasonal barrier to adults. Many similar features were noted further downstream, and cumulatively appear to block fish passage to upper portions of McNaught Creek.
970-110000-82500	9	BMA			10.637288.5441009	Reach 2 of Shawatum Creek veers to the north of its mapped location just downstream of the Centennial Trail crossing near the reach 2 / 3 break.
970-110000-82500	9	DW			10.637001.5440881	Reach 2 of Shawatum Creek becomes dewatered at the gradient eases and it loses confinement at the edge of an alluvial fan.
970-110000-82500	9	FAN			10.636949.5440817	Historic alluvial fan on Shawatum Creek was surveyed during field inventory in 2007. All flows dissipate into permanent fan (mature cedar trees are growing on the fan). Flows dissipate enough that no culvert is present at Silver-Skagit Road despite a 6 m wide stream channel present in reach 3. No channel is present below the fan.

BMA = Base Mapping Anomaly C = Cascade CV = Culvert D = Dam DW = Dewatered Channel F = Falls FAN = Alluvial Fan (entered as FLD in FDIS) FSB = Subsurface Flow X = Debris Jam XW = Debris Wedge

Table 18 (Continued). Features identified during the field inventory in 2007 (organized by watershed code).

Watershed Code	Site	Type	Height (m)	Length (m)	Field UTM Coordinates	Description
970-110000-82500	80	X	1.1	0.1	10.637391.5441300	Largest of many log drops noted throughout the reach which form obstructions, but not full barriers to fish passage. No fish present due to alluvial fan downstream.
970-110000-84800	5	X	1.5	0.1	10.623269.5439767	This large woody debris jam is a non-permanent barrier to upstream fish migration. RB captured upstream.
970-110000-84800-31000	91	CV	0.2		10.628890.5443901	1.8 m wide by 1.2 m high flat bottomed culvert appears new, but was installed at a steep gradient and has already formed an outlet pool and associated drop. Will likely become a barrier, but conditions are reflective of a larger problem on this blown-out stream that appears to wash out the road on occasion.
970-110000-84800-33200-4180	2	F	1.2		10.626923.5437131 (GIS)	Several log / boulder drops which obstruct fish passage are present throughout the reach, this 1.2 m high falls is the 1st permanent barrier, located 270 m upstream of Maselpanik Creek. RB upstream seem to be from lake stocking.
970-110000-84800-33200-6380	4	C	6.0	12.0	10.626470.5433716	This boulder cascade/chute is a definite barrier to upstream fish migration. NFC upstream.
970-110000-87700	33	X	2.0	20.0	10.636470.5446970	Debris jams caused by torrents during spring high flows. Non-permanent features that may cumulatively obstruct fish passage.
970-110000-87700	33	X	4.0	20.0	10.636398.5447057	Debris jams caused by torrents during spring high flows. Non-permanent features that may cumulatively obstruct fish passage.
970-110000-90000	29	F	20.0		10.640180.5451122	20 m high waterfalls occur just upstream of the Skagit River trail, at the reach 1 / 2 break, and form a definite barrier to upstream fish migration. No sampling occurred upstream of the falls.
970-110000-90700-21000	60	C	3.5	11.0	10.635766.5455758	30% gradient cascade barrier just upstream of Highway 3. Forms a definite barrier, but only very poor quality fish habitat is present upstream.
970-110000-90700-53200	51	DW		114.0	10.626330.5461017	Dewatered section forms a definite seasonal and potentially permanent barrier to fish migration. BT, DV, and RB present below, only RB above.
970-110000-90700-63200	48	F	6.0	0.5	10.627555.5456935	Bedrock falls that forms a definite barrier to fish migration.
970-110000-91600	63	F	2.3	0.3	10.644106.5461964	Waterfall likely forms a barrier, but no fish are present downstream due to underground flows.
970-110000-91600	63	FSB			10.644050.5461849	Snass Creek flows underground from the UTM indicated downstream to below Dry Lake. No fish habitat is present within this section.
970-110000-94100-43500	64	F	1.3		10.650396.5457964	Waterfalls observed from the helicopter. Not ground-truthed, but no fish captured upstream in good quality habitat. Likely form barriers to fish migration.

BMA = Base Mapping Anomaly C = Cascade CV = Culvert D = Dam DW = Dewatered Channel F = Falls FAN = Alluvial Fan (entered as FLD in FDIS) FSB = Subsurface Flow X = Debris Jam XW = Debris Wedge

Table 18 (Continued). Features identified during the field inventory in 2007 (organized by watershed code).

Watershed Code	Site	Type	Height (m)	Length (m)	Field UTM Coordinates	Description
970-110000-94100-43500	64	F	1.0		10.650276.5457960 (GIS)	Waterfalls observed from the helicopter. Not ground-truthed, but no fish captured upstream in good quality habitat. Likely form barriers to fish migration.
970-110000-95300	27	C	2	5	10.647868.5450217 (GIS)	Bedrock-controlled cascade barrier to fish migration occurs 25 m upstream of the confluence with the Skagit River.
970-110000-95300	27	F	1.5		10.647845.5450208 (GIS)	1.5 m high waterfall located at the top of a cascade. These features form definite barriers to upstream fish migration.
970-110000-95300	70	F	20.0		10.645345.5448705	20 m high waterfall observed from the helicopter. Occurs immediately upstream of an old mine site. Additional barriers to fish are located further downstream.
970-110000-96800	25	CV	1.7		10.650153.5447617	Flat-bottomed culvert at highway 3 crossing is hanging 1.7 m, and discharges onto riprap. This culvert currently forms a barrier to fish. RB are present upstream.
970-110000-96800	25	CV	1.0		10.650203.5447673	1,600 mm CMP culvert at an old gravel pit access road is hanging 1.0 m and forms a barrier to fish migration. RB were captured upstream.

BMA = Base Mapping Anomaly C = Cascade CV = Culvert D = Dam DW = Dewatered Channel F = Falls FAN = Alluvial Fan (entered as FLD in FDIS) FSB = Subsurface Flow X = Debris Jam XW = Debris Wedge

4.9.1 Fish and Fish Habitat

The data collected demonstrates the occurrence, relative abundance and distribution of fish species within the Skagit River watershed. Definitive limits of sport fish for many streams are known, often associated with the identification of permanent barriers.

Sport fish – general habitat values

Of the of 60 stream sites assessed for rearing habitat values (*i.e.* not including NVC sites or fish-only sites), 30 were assessed as having high rearing habitat values for sport fish. High value rearing habitat was widely distributed throughout the watershed. Despite high value habitats at sites 48 (Potter Creek) and 64 (Turnbull Creek), no fish were captured, and barriers to fish migration are suspected downstream. Sites 4 (unnamed tributary to Maselpanik Creek), 7 (upper McNaught Creek), 17 (Passage Creek), 31 (Twentysix Mile Creek), and 70 (Smitheram Creek) all had high rearing habitat values, but occur above barriers to fish migration and are barren.

Moderate quality rearing habitat was found at 16 sites. Moderate quality rearing habitats were often downgraded from "high" due to steep gradients or somewhat low channel complexity. Fourteen of the sites were assessed as providing low quality rearing habitat, for a variety of reasons. Most of the sites with low value rearing habitat are suspected non-fish bearing, except for two. Site 50, which occurs in reach 6 of the Sumallo River near Sunshine Valley, is limited by a lack of cover – the site encompasses a long riffle with very few boulders, no woody debris, and no overhanging vegetation. Site 75 occurs on Silvertipped Creek, which was also limited by a lack of cover on long sections of riffle habitat. Despite the presence of a defined stream channel, the ephemeral flows and steep gradient in reach 2 of Twenty Mile Creek prompted the field crew to indicate that no potential rearing habitat was present.

High value spawning habitat was observed at 5 sites including Reach 1 of East Snass Creek, the Skagit River just downstream of the Skaist River confluence, reach 1 of the Sumallo River, reach 1 of Daynor Creek, and Lightning Creek at the outlet of Flash Lake. Eighteen sites had moderate spawning habitat potential. Moderate value spawning habitat was located throughout the watershed, but usually associated with larger, named tributaries and mainstems. The moderate value spawning habitat noted at sites 17 (Passage Creek), 27 (Smitheram Creek), and 31 (Twentysix Mile Creek) occurs above barriers and is not available for use by fish. Moderate value spawning habitat also occurs at site 38 in the upper Sumallo River drainage, above a suspected barrier to fish. Low value spawning habitat was noted at 31 sites, and a rating of "none" was assigned to 7 sites.

Overwintering Assessment

High value overwintering habitat was identified at nine sites. Not surprisingly, the majority of the overwintering habitat identified was associated with the mainstem Skagit, Sumallo, and Klesilkwa rivers. The lower reaches of Ferguson Creek (upstream of a dewatered section of channel that forms at least a seasonal barrier to fish migration) were noted as good overwintering habitat. The lower reach of East Snass Creek provides good overwintering habitat for a population of Dolly Varden, the only one in the watershed that was found without bull trout hybrids. High value overwintering habitat was also noted in Nepopekum Creek and Maselpanik Creek. High value overwintering habitat potential was noted in Smitheram Creek, though the watershed is barren of fish.

Eleven sites were rated as having moderate quality overwintering habitat. The rating was most often attributed to streams that had pools greater than 40 cm depth, but the areal extent of the habitat could support only a limited number of fish. These moderate-quality habitats mostly occur in 3rd and 4th order tributaries. Twenty of the streams assessed had overwintering habitat rated as low value, usually associated with marginal discharge volumes or a very low frequency of pools greater than 40 cm deep. Twenty-one of the reaches examined provided no available overwintering habitat.

Field surveys in October confirmed some of the overwintering habitat assessments completed in the summer. For example, a snorkel survey in reach 1 of the Sumallo River (site 57) in August did not result in the observation of any fish, although the reach was assessed as having high value overwintering habitat. A re-survey of the same section in October resulted in the observation of 8 fish (including 5 large adults), confirming the movement of fish into this reach for overwintering.

The survey of reach 7 of the upper Skagit River (site 23) in August and October gives an idea of the minimum requirements that fish need for overwintering in the system. The site was assessed as having no overwintering habitat in August as the maximum residual pool depth was measured to be 0.28 m. Extensive electrofishing the reach in October did not result in the capture of any fish, with the exception of two rainbow trout that were captured in the same scour pool that had a residual depth of 0.50 m. This pool was not part of the surveyed length in the summer, and was the only habitat surveyed that appeared to be suitable and used for overwintering.

4.9.2 Rare/Sensitive Species

Dolly Varden and bull trout are blue-listed[1] within British Columbia, as they are sensitive to development pressures, habitat loss, and over fishing (BC Ecosystem Explorer 2008). Both were captured in the Canadian portion of the Skagit River watershed during the field inventory in 2007. Both westslope and coastal cutthroat trout are also a blue-listed species in British Columbia (BC Ecosystem Explorer 2008). Although not captured during the inventory, migrant westslope cutthroat trout from a stocking program in the U.S.A. are occasionally captured by anglers in Ross Lake and the lower Skagit River by anglers (Scott *et al*. 2003).

4.9.3 Habitat Protection Concerns

In general, the majority of the watershed in both Canada and the U.S.A. upstream from the Ross Dam are protected by Provincial and National Parks. Headwater areas of the Klesilkwa and Sumallo rivers fall outside of Provincial Park boundaries and have been subject to intensive logging in the past. Despite the protected status of most of the

[1] Species considered to be of Special Concern (formerly Vulnerable) in British Columbia. Blue-listed taxa are at risk, but are not Extirpated, Endangered or Threatened.

watershed, the parks are very popular recreation destinations, and habitats within the watershed receive a significant amount of fishing pressure. Catch and release regulations and seasonal fishing closures have been implemented on both sides of the border to protect stocks from overfishing. Additional protection concerns are documented below.

4.9.3.1 Fisheries Sensitive Zones

No fisheries sensitive zones were surveyed or specifically identified in the watershed. However, active and abandoned side-channels and back-channels are present along the Skagit River, and many are seasonally accessible to fish, providing refuge habitat during high flows. These off-channel habitats are also present, in lower abundance, on the Klesilkwa and Sumallo rivers and likely provide critical rearing habitat for juvenile fish. These off-channel areas are also important food production sources.

Significant wetland areas exist in reaches 2, 4, and 6 of the Klesilkwa River, and some smaller wetlands and sloughs exist adjacent to the lower Sumallo River. These areas may provide important refuge habitat during freshet, and also contribute to channel stability by providing floodwater storage that might otherwise cause downstream bank erosion.

4.9.3.2 Important Habitats

The Skagit River mainstem has previously been identified as critical spawning and juvenile rearing habitat for Ross Lake rainbow trout and bull trout populations (Griffith and Greiner 1983). In particular, the Skagit River mainstem between St. Alice Creek and the 26 Mile Bridge just upstream of the confluence with the Klesilkwa River has been reported as the main spawning area for bull trout (McPhail and Taylor 1995). Spawning activity has also been reported in Nepopekum Creek, and a post-spawning male Dolly Varden was captured in reach 1 in 2007.

Very high densities of Dolly Varden, bull trout, and rainbow trout were captured in Ferguson Creek upstream of the Highway 3 crossing. Deep pools and large boulder cover provide excellent fish rearing habitat. An aggrading channel upstream has caused a section of channel to become dewatered, which forms a barrier to upstream fish migration. The aggraded channel may actually contribute to maintaining cooler water temperatures in this tributary during the summer, by keeping a large proportion of the flows below the surface of the gravels.

Very deep, bedrock-controlled pools in the Skagit River mainstem between the confluence of Snass Creek and a series of waterfalls a few hundred metres upstream would provide excellent quality overwintering habitat for adult fish.

Rainbow trout in the upper portion of the Skagit River watershed, above the barriers that occur in the lower portion of reach 5, are isolated and dependent on a relatively small watershed area. No significant accessible lakes occur in the upper watershed, and the Skagit River is much smaller than it is below the confluence of the Sumallo River. As such, overwintering habitat in this part of the watershed is likely critical in sustaining rainbow trout populations. In particular, the mainstem below the confluence of the Skaist River, as well as deep pools throughout the mainstem and in the lower Skaist River, Big Burn Creek, and Daynor Creek may be limited and are of critical importance. Reasonable amounts of suitable spawning sites were noted in the upper portion of the watershed, particularly in Daynor Creek

4.9.3.3 Restoration and Rehabilitation Opportunities

Both the upper portions of the Klesilkwa River (including Maselpanik Creek) and the Sumallo River upstream of Sunshine Valley have had a significant amount of past logging activity, and impacts have previously been noted (Clark 1994). In particular, aggrading channels were noted in the upper Sumallo River and in Ferguson Creek. Woody debris, much of which is sourced from logging activity (noted by machine-cut butts) has become lodged in a bedrock canyon in Ferguson Creek just upstream of Highway 3. The wood traps streambed particles mobilized during floods (including an abundance of small boulders and large cobble), raising the height of the streambed. A 114 m long section of dewatered channel has developed as a result, which forms a definite barrier to fish on a seasonal basis, and probably perennially. No bull trout or Dolly Varden were captured upstream of the barrier, though rainbow trout were.

A 2.3 m high by 2.8 m wide, flat bottomed culvert at which conveys unnamed creek (970-110000-96800) under Highway 3 is perched 1.7 m at the outlet, and the discharge falls onto riprap armouring the bank of the Skagit River. A 1,600 mm corrugated metal pipe (CMP) round culvert is located 50 m further upstream on an old road used to access a gravel pit which appears to be deactivated. Both of these culverts are full barriers to all life stages of fish, though the highway culvert may be passable during extreme high flows in the Skagit River. Rainbow trout were captured upstream of the culverts, and the creek provides high value rearing habitat. Some moderate potential overwintering, and low value spawning habitat was noted, though the capture of a 69 mm juvenile suggests that spawning does occur above the culverts. Removal and/or replacement of the gravel pit access road culvert would be relatively straight-forward, but replacement of the highway culvert would necessitate traffic control, and ultimately may require a different structure (*e.g.,* an open-bottomed structure) to make the crossing passable to fish.

A 1.2 m high by 1.8 m wide, flat-bottomed culvert was installed in an unnamed tributary (970-110000-84800-31000) to the Klesilkwa River at the edge of Skagit Valley Provincial Park recently, but the culvert was installed with a 1% gradient, and has already developed a 20 cm outlet drop. This drop is likely to become larger over time as high velocity flows from the culvert scour a deeper outlet pool. This creek appears to have washed out the Silver-Skagit Road in the past, and has an unstable channel.

4.10 Fish-Bearing Status

The fish-bearing status of a stream may be directly supported by sampling data or indirectly inferred based on fish captured in associated reaches, or habitat quality and the occurrence or lack of barriers to fish passage. For example, if the habitats within a given reach are suitable for rearing and/or spawning but no fish were captured and no barriers were observed, the reach would be classed as fish-bearing. If the habitats were inadequate to provide suitable rearing habitat, or where barriers prevent fish from accessing and utilizing the reach, it would be classified as non-fish bearing. Where supporting evidence is inconclusive, the reach would have a preliminary classification pending additional sampling.

4.10.1 Riparian Management Area Classifications

RMA classifications were completed for all 77 sites surveyed (fish-only sites are not assigned a RMA classification, since channel widths are not available). A total of 30 stream sites were classified as fish-bearing (five S1, twenty-two S2, three S3, no S4's). Seventeen sited received default fish-bearing status (four S2 default, twelve S3 default, one S4 default). Twelve sites were designated as non-fish bearing (eight S5 and four S6). One reach was classified as a non-classified drainage (NCD), and one other was classified as a ponded wetland reach (NCD-W, default fish-bearing status). Sixteen of the reaches were found to have no visible channel and do not require RMA classifications. RMA classifications for each sample reach are provided in Table 19.

4.11 Recommendations for Future Work

Fish distributions within the watershed are fairly well known following the inventory program in 2007. Since one of the goals of this inventory was to document where fish are present, rather than absent, the definitive limits are unknown in many watersheds. Follow-up sampling in several watersheds (St. Alice Creek, McNaught Creek, Twentysix Mile Creek) may help to define the upper limits of fish distribution. Re-sampling in Nepopekum Creek above Derek Falls, and in an unnamed lake (00028SKGT) which is tributary to Twenty Mile Creek is needed to confirm fish absence in those systems.

Although the presence of golden trout in the watershed is extremely unlikely, genetic samples of rainbow trout in the upper Skagit River watershed above Snass Creek (particularly from Nicomen Lake) could be analyzed to definitively rule out the presence of golden trout from the watershed. Samples from this part of the watershed could also undergo a more in-depth analysis to compare them to samples from the upper Similkameen and Tulameen watersheds, and to the lower Skagit River, to determine their origin. An analysis of allelic drift may also be able to indicate how long the fish in the upper part of the watershed have been isolated for.

Similarly, samples of rainbow trout, bull trout, and Dolly Varden from the upper Klesilkwa River and upper Silverhope Creek may be able to indicate if recent exchanges of genetic material have occurred. If so, this may have management implications for stocking programs in the Skagit River, if it is desirable to keep certain strains of rainbow trout (or potentially other species if stocked) out of the Fraser River watershed.

Table 19. Riparian Management Area classifications.

Watershed Code / ILP	Reach #	Site #	Average Gradient (%)	Average Channel Width	Sampling Results	RMA Class
10854	1	42	5.0	NVC	NS	NVC
11097	1	30	9.7	NVC	NS	NVC
11424	1	54	1.0	NVC	NS	NVC
11692	1	61	3.5	NVC	NS	NVC
11970	1	68	7.5	0.39	NS	S6
970-110000	7	23	5.5	4.38	RB	S3
970-110000	2	83	0.2	33.87	BT RB	S1
970-110000	5	85	0.4	21.67	RB	S1
970-110000	5	90	2.0	13.10	NS	S1
970-110000-70500	7	18	3.0	8.88	RB	S2
970-110000-70500	9	19	1.5	4.30	RB	S3
970-110000-70500-83500	3	17	1.5	6.57	NFC	S5
970-110000-70500-95300	1	20	8.5	2.47	NS-DRY	S3 default
970-110000-78000	1	13	2.0	NVC	NS	NVC
970-110000-80300	1	6	8.7	4.13	NS-DRY	S3 default
970-110000-80900	2	12	2.3	14.45	BT DV/BT RB	S2
970-110000-80900	4	15	3.0	11.35	DV/BT	S2
970-110000-80900-39000	1	32	10.3	4.68	NFC	S3 default
970-110000-80900-78900	2	16	5.5	4.41	NFC	S5
970-110000-80900-90300	1	14	1.7	0.73	NS-DRY	S4 default
970-110000-81700	4	7	8.0	8.88	NFC	S2 default
970-110000-82400	2	11	0.0	NVC	NFC	NCD-W
970-110000-82500	2	9	4.0	NCD	NS	NCD
970-110000-82500	3	80	10.5	6.88	NFC	S5
970-110000-82700	2	8	7.0	8.83	RB	S2
970-110000-84000	2	10	11.0	NVC	NS	NVC
970-110000-84800	9	5	5.0	7.12	RB	S2

NFC – No Fish Captured NVC – No Visible Channel NS – Not Sampled BT = Bull Trout DV = Dolly Varden DV/BT = suspected Dolly Varden BT/DV = suspected Bull Trout DV×BT = Dolly Varden/Bull Trout Hybrid RB = Rainbow Trout

Table 19 (Continued). Riparian Management Area classifications.

Watershed Code / ILP	Reach #	Site #	Average Gradient (%)	Average Channel Width	Sampling Results	RMA Class
970-110000-84800	2	39	1.0	15.23	DV/BT RB	S2
970-110000-84800-18600	1	40	3.5	3.58	NS-DRY	S3 default
970-110000-84800-31000	1	91	4.5	3.73	NFC	S3 default
970-110000-84800-33200	5	3	4.5	11.55	RB	S2
970-110000-84800-33200-3440	1	1	14.0	NVC	NS	NVC
970-110000-84800-33200-4180	1	2	13.3	5.02	RB	S2
970-110000-84800-33200-6380	2	4	1.5	4.93	NFC	S5
970-110000-84800-52800	1	41	5.5	NVC	NS	NVC
970-110000-84800-64930	3	43	0.8	5.25	DV/BT	S2
970-110000-85900	1	37	3.0	NVC	NS	NVC
970-110000-86200	1	75	3.5		BT RB	S2
970-110000-87100	1	35	17.0	NVC	NS	NVC
970-110000-87300	1	34	17.3	7.12	BT DV RB	S2
970-110000-87700	1	33	7.0	8.97	DV/BT DV×BT RB	S2
970-110000-89000	4	31	3.5	5.13	NFC	S2 Default
970-110000-89500	1	28	22.0	NVC	NS	NVC
970-110000-90000	1	29	7.0	5.57	BT DV DV/BT DV×BT RB	S2
970-110000-90700	9	38	3.5	3.94	NFC	S3 default
970-110000-90700	6	50	1.3	22.78	BT DV DV/BT DV×BT RB	S1
970-110000-90700	1	57	0.5	26.27	BT DV/BT RB	S1
970-110000-90700-16500	1	56	9.5	4.83	NS-DRY	S3 default
970-110000-90700-16500	2	73	53.3	4.82	NS	S3 default
970-110000-90700-21000	1	60	4.0	1.10	NFC	S6
970-110000-90700-22600	3	62	3.5	9.97	NFC	S2 default
970-110000-90700-28900	3	55	14.0	2.93	NFC	S3 default

NFC – No Fish Captured NVC – No Visible Channel NS – Not Sampled BT = Bull Trout DV = Dolly Varden DV/BT = suspected Dolly Varden BT/DV = suspected Bull Trout DV×BT = Dolly Varden/Bull Trout Hybrid RB = Rainbow Trout

Table 19 (Continued). Riparian Management Area classifications.

Watershed Code / ILP	Reach #	Site #	Average Gradient (%)	Average Channel Width	Sampling Results	RMA Class
970-110000-90700-43200	1	49	0.0	NVC	NS	NVC
970-110000-90700-53200	7	51	7.8	9.77	BT, DV DV×BT DV/BT RB	S2
970-110000-90700-53200-7950	3	53	0.7	2.82	NFC	S6
970-110000-90700-63200	1	48	7.0	5.97	NFC	S2 default
970-110000-90700-70800	3	47	8.0	4.68	NFC	S5
970-110000-90700-72300	3	45	1.0	4.72	RB	S3
970-110000-90700-76400	1	44	9.0	NVC	NS	NVC
970-110000-90700-76400	1	46	11.0	NVC	NS	NVC
970-110000-91600	2	59	9.5	6.37	DV/BT	S2
970-110000-91600	5	63	12.3	3.96	NFC	S5
970-110000-91600	2	71	4.0	NVC	NS	NVC
970-110000-91600-29000	1	58	9.5	6.33	DV DV/BT	S2
970-110000-94100	3	66	2.5	9.00	RB	S2
970-110000-94100	4	67	4.5	8.88	RB	S2
970-110000-94100	1	87	3.5	13.73	RB	S2
970-110000-94100-08100	1	65	10.0	NVC	NS	NVC
970-110000-94100-43500	2	64	7.3	4.07	NFC	S3 default
970-110000-94100-92600	1	69	3.5	1.55	NFC	S3 default
970-110000-95300	1	27	14.5	5.30	NFC	S5
970-110000-95300	3	70	1.0	2.78	NFC	S5
970-110000-96700	2	26	8.0	5.78	RB	S2
970-110000-96800	1	25	4.0	5.95	RB	S2
970-110000-97000	1	24	28.3	1.80	NS-DRY	S6
970-110000-98800	1	21	2.5	6.07	RB	S2
970-110000-98800-24900	1	22	8.0	2.10	NFC	S3 default

NFC – No Fish Captured NVC – No Visible Channel NS – Not Sampled BT = Bull Trout DV = Dolly Varden DV/BT = suspected Dolly Varden BT/DV = suspected Bull Trout DV×BT = Dolly Varden/Bull Trout Hybrid RB = Rainbow Trout

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Appendix 1.

Fisheries Project/Interpretive Maps.

Appendix 2.

FDIS summary reports.

Sample Site Index

Organized by Site

Watershed Code	ILP	Reach	Site #	Mapsheet	Fish Card
970-110000-84800-33200-3440		1	1	092H.004	
970-110000-84800-33200-4180		1	2	092H.004	Yes
970-110000-84800-33200		5	3	092H.004	Yes
970-110000-84800-33200-6380		2	4	092H.004	Yes
970-110000-84800		9	5	092H.014	Yes
970-110000-80300		1	6	092H.005	
970-110000-81700		4	7	092H.005	Yes
970-110000-82700		2	8	092H.005	Yes
970-110000-82500		2	9	092H.015	
970-110000-84000		2	10	092H.015	
970-110000-82400		2	11	092H.005	Yes
970-110000-80900		2	12	092H.005	Yes
970-110000-78000		1	13	092H.005	
970-110000-80900-90300		1	14	092H.006	
970-110000-80900		4	15	092H.005	Yes
970-110000-80900-78900		2	16	092H.006	Yes
970-110000-70500-83500		3	17	092H.006	Yes
970-110000-705000		7	18	092H.006	Yes
970-110000-705000		9	19	092H.006	Yes
970-110000-70500-95300		1	20	092H.006	
970-110000-988000		1	21	092H.016	Yes
970-110000-98800-24900		1	22	092H.016	Yes
970-11000000		7	23	092H.016	Yes
970-110000-970000		1	24	092H.016	
970-110000-968000		1	25	092H.016	Yes
970-110000-967000		2	26	092H.016	Yes
970-110000-953000		1	27	092H.016	Yes
970-110000-895000		1	28	092H.015	
970-110000-900000		1	29	092H.015	Yes
	11097	1	30	092H.015	
970-110000-890000		4	31	092H.015	Yes
970-110000-80900-39000		1	32	092H.015	Yes
970-110000-877000		1	33	092H.015	Yes
970-110000-873000		1	34	092H.015	Yes
970-110000-871000		1	35	092H.015	
970-110000		1	36	092H.005	Fish-only
970-110000-859000		1	37	092H.015	
970-110000-907000		9	38	092H.015	Yes
970-110000-848000		2	39	092H.014	Yes
970-110000-84800-18600		1	40	092H.014	

Watershed Code	ILP	Reach	Site #	Mapsheet	Fish Card
970-110000-84800-52800		1	41	092H.014	
	10854	1	42	092H.014	
970-110000-84800-64930		3	43	092H.014	Yes
970-110000-90700-72300-4720		1	44	092H.024	
970-110000-90700-72300		3	45	092H.024	Yes
970-110000-90700-76400		1	46	092H.014	
970-110000-90700-70800		3	47	092H.024	Yes
970-110000-90700-63200		2	48	092H.024	Yes
970-110000-90700-43200		1	49	092H.025	
970-110000-907000		6	50	092H.024	Yes
970-110000-90700-53200		7	51	092H.025	Yes
970-110000		1	52	092H.005	Fish-only
970-110000-90700-53200-7950		3	53	092H.024	Yes
	11424	1	54	092H.024	
970-110000-90700-28900		3	55	092H.025	Yes
970-110000-90700-16500		1	56	092H.025	
970-110000-907000		1	57	092H.025	Yes
970-110000-91600-29000		1	58	092H.025	Yes
970-110000-916000		2	59	092H.025	Yes
970-110000-90700-21000		1	60	092H.025	Yes
	11692	1	61	092H.025	
970-110000-90700-22600		3	62	092H.025	Yes
970-110000-916000		5	63	092H.025	Yes
970-110000-94100-43500		2	64	092H.026	Yes
970-110000-94100-08100		1	65	092H.026	
970-110000-941000		3	66	092H.026	Yes
970-110000-941000		4	67	092H.026	Yes
	11970	1	68	092H.026	
970-110000-94100-92600		1	69	092H.026	Yes
970-110000-953000		3	70	092H.015	Yes
970-110000-916000		2	71	092H.025	
970-110000-90700-53200		6	72	092H.024	Fish-only
970-110000-90700-16500		2	73	092H.015	
970-110000-90700-53200		3	74	092H.025	Fish-only
970-110000-862000		1	75	092H.015	Yes
970-110000		3	76	092H.015	Fish-only
970-110000		3	77	092H.015	Fish-only
970-110000		3	78	092H.015	Fish-only
970-110000		3	79	092H.015	Fish-only
970-110000-825000		3	80	092H.015	Yes
970-110000-84800-33200		3	81	092H.014	Fish-only
970-110000-84800-64930		2	82	092H.014	Fish-only
970-11000000		2	83	092H.015	Yes

Watershed Code	ILP	Reach	Site #	Mapsheet	Fish Card
970-110000-84800		3	84	092H.014	Fish-only
970-11000000		5	85	092H.026	Yes
970-110000-90700		8	86	092H.024	Fish-only
970-110000-941000		1	87	092H.026	Yes
970-110000		0	88	092H.005	Fish-only
970-110000		1	89	092H.005	Fish-only
970-11000000		5	90	092H.025	
970-110000-84800-31000		1	91	092H.014	Yes
970-110000-80900		1	92	092H.005	Fish-only
970-110000		2	93	092H.015	Fish-only

Sample Site Index

Organized by Watershed Code / ILP

Watershed Code	ILP	Reach	Site #	Mapsheet	Fish Card
970-110000		0	88	092H.005	Fish-only
970-110000		1	36	092H.005	Fish-only
970-110000		1	52	092H.005	Fish-only
970-110000		1	89	092H.005	Fish-only
970-110000		2	93	092H.015	c
970-110000		3	76	092H.015	Fish-only
970-110000		3	77	092H.015	Fish-only
970-110000		3	78	092H.015	Fish-only
970-110000		3	79	092H.015	Fish-only
970-11000000		2	83	092H.015	Yes
970-11000000		5	85	092H.026	Yes
970-11000000		5	90	092H.025	
970-11000000		7	23	092H.016	Yes
970-110000-705000		7	18	092H.006	Yes
970-110000-705000		9	19	092H.006	Yes
970-110000-70500-83500		3	17	092H.006	Yes
970-110000-70500-95300		1	20	092H.006	
970-110000-78000		1	13	092H.005	
970-110000-80300		1	6	092H.005	
970-110000-80900		1	92	092H.005	Fish-only
970-110000-80900		2	12	092H.005	Yes
970-110000-80900		4	15	092H.005	Yes
970-110000-80900-39000		1	32	092H.015	Yes
970-110000-80900-78900		2	16	092H.006	Yes
970-110000-80900-90300		1	14	092H.006	
970-110000-81700		4	7	092H.005	Yes
970-110000-82400		2	11	092H.005	Yes
970-110000-82500		2	9	092H.015	
970-110000-825000		3	80	092H.015	Yes
970-110000-82700		2	8	092H.005	Yes
970-110000-84000		2	10	092H.015	
970-110000-84800		3	84	092H.014	Fish-only
970-110000-84800		9	5	092H.014	Yes
970-110000-848000		2	39	092H.014	Yes
970-110000-84800-18600		1	40	092H.014	
970-110000-84800-31000		1	91	092H.014	Yes
970-110000-84800-33200		3	81	092H.014	Fish-only
970-110000-84800-33200		5	3	092H.004	Yes
970-110000-84800-33200-3440		1	1	092H.004	
970-110000-84800-33200-4180		1	2	092H.004	Yes

Watershed Code	ILP	Reach	Site #	Mapsheet	Fish Card
970-110000-84800-33200-6380		2	4	092H.004	Yes
970-110000-84800-52800		1	41	092H.014	
970-110000-84800-64930		2	82	092H.014	Fish-only
970-110000-84800-64930		3	43	092H.014	Yes
970-110000-859000		1	37	092H.015	
970-110000-862000		1	75	092H.015	Yes
970-110000-871000		1	35	092H.015	
970-110000-873000		1	34	092H.015	Yes
970-110000-877000		1	33	092H.015	Yes
970-110000-890000		4	31	092H.015	Yes
970-110000-895000		1	28	092H.015	
970-110000-900000		1	29	092H.015	Yes
970-110000-90700		8	86	092H.024	Fish-only
970-110000-907000		1	57	092H.025	Yes
970-110000-907000		6	50	092H.024	Yes
970-110000-907000		9	38	092H.015	Yes
970-110000-90700-16500		1	56	092H.025	
970-110000-90700-16500		2	73	092H.015	
970-110000-90700-21000		1	60	092H.025	Yes
970-110000-90700-22600		3	62	092H.025	Yes
970-110000-90700-28900		3	55	092H.025	Yes
970-110000-90700-43200		1	49	092H.025	
970-110000-90700-53200		3	74	092H.025	Fish-only
970-110000-90700-53200		6	72	092H.024	Fish-only
970-110000-90700-53200		7	51	092H.025	Yes
970-110000-90700-53200-7950		3	53	092H.024	Yes
970-110000-90700-63200		2	48	092H.024	Yes
970-110000-90700-70800		3	47	092H.024	Yes
970-110000-90700-72300		3	45	092H.024	Yes
970-110000-90700-72300-4720		1	44	092H.024	
970-110000-90700-76400		1	46	092H.014	
970-110000-916000		2	59	092H.025	Yes
970-110000-916000		2	71	092H.025	
970-110000-916000		5	63	092H.025	Yes
970-110000-91600-29000		1	58	092H.025	Yes
970-110000-941000		1	87	092H.026	Yes
970-110000-941000		3	66	092H.026	Yes
970-110000-941000		4	67	092H.026	Yes
970-110000-94100-08100		1	65	092H.026	
970-110000-94100-43500		2	64	092H.026	Yes
970-110000-94100-92600		1	69	092H.026	Yes
970-110000-953000		1	27	092H.016	Yes
970-110000-953000		3	70	092H.015	Yes
970-110000-967000		2	26	092H.016	Yes
970-110000-968000		1	25	092H.016	Yes

Watershed Code	ILP	Reach	Site #	Mapsheet	Fish Card
970-110000-970000		1	24	092H.016	
970-110000-988000		1	21	092H.016	Yes
970-110000-98800-24900		1	22	092H.016	Yes
	10854	1	42	092H.014	
	11097	1	30	092H.015	
	11424	1	54	092H.024	
	11692	1	61	092H.025	
	11970	1	68	092H.026	

Appendix 3.

Photodocumentation.

PHOTO SURVEY FORM 1 - EQUIPMENT DETAILS

Survey start date (yyyymmdd): 2007 | 08 | 14 **Agency:** | C044 |
Survey end date: 2007 | 08 | 20 **Crew:** NF | ML |

CAMERA #1

Make & Model:	**Olympus Stylus 760**		**Lenses:**	**A** B C D E F
Format:	135mm film	Other film: ________	**Digital**	Still video
Resolution (for digital and video cameras):	144 dpi			
Output file type (for digital and video cameras):	.JPEG			

CAMERA #2

Make & Model:	**Olympus Stylus 300**		**Lenses:**	A **B** C D E F
Format:	135mm film	Other film: ________	**Digital**	Still video
Resolution (for digital and video cameras):	72 dpi			
Output file type (for digital and video cameras):	.JPEG			

LENSES

	Focal length (mm)		Focal length (mm)
A	**Fixed 6.5-19.5 mm***	**D**	
B	**Fixed 5.5-17.4 mm****	**E**	
C		**F**	

ROLL AND/OR BATCH DETAILS

Roll# or Batch#	Camera #	Output medium	For film cameras: Film type	ISO
1	1	neg slide **file**	color B&W other: ________	
2	2	neg slide **file**	color B&W other: ________	
3	1	neg slide **file**	color B&W other: ________	
4	1	neg slide **file**	color B&W other: ________	
5	1	neg slide **file**	color B&W other: ________	
6	1	neg slide **file**	color B&W other: ________	
7	1	neg slide **file**	color B&W other: ________	
		neg slide file	color B&W other: ________	
		neg slide file	color B&W other: ________	
		neg slide file	color B&W other: ________	
		neg slide file	color B&W other: ________	
		neg slide file	color B&W other: ________	
		neg slide file	color B&W other: ________	

* Equivalent to a 37 mm - 111 mm lens on a 35 mm camera.
**Equivalent to a 35 mm - 105 mm lens on a 35 mm camera

PHOTO SURVEY FORM 1 - EQUIPMENT DETAILS

Survey start date (yyyymmdd): 2007 | 08 | 14 **Agency:** | C044 |
Survey end date: 2007 | 08 | 20 **Crew:** RL | JH |

CAMERA #1

Make & Model:	**Olympus Stylus 300**	**Lenses:**	**A** B C D E F
Format:	135mm film	Other film: ________	**Digital** Still video
Resolution (for digital and video cameras):	144 dpi		
Output file type (for digital and video cameras):	.JPEG		

CAMERA #2

Make & Model:	**Olympus Stylus 300**	**Lenses:**	**A** B C D E F
Format:	135mm film	Other film: ________	**Digital** Still video
Resolution (for digital and video cameras):	144 dpi		
Output file type (for digital and video cameras):	.JPEG		

LENSES

	Focal length (mm)		**Focal length (mm)**
A	**Fixed 5.5-17.4 mm***	**D**	
B		**E**	
C		**F**	

ROLL AND/OR BATCH DETAILS

Roll# or Batch#	**Camera #**	**Output medium**	**For film cameras: Film type**	**ISO**
8	**1**	neg slide **file**	color B&W other: ________	
9	**1**	neg slide **file**	color B&W other: ________	
10	**1**	neg slide **file**	color B&W other: ________	
11	**1**	neg slide **file**	color B&W other: ________	
12	**1**	neg slide **file**	color B&W other: ________	
13	**1**	neg slide **file**	color B&W other: ________	
14	**1**	neg slide **file**	color B&W other: ________	
JH	**2**	neg slide **file**	color B&W other: ________	
		neg slide file	color B&W other: ________	
		neg slide file	color B&W other: ________	
		neg slide file	color B&W other: ________	
		neg slide file	color B&W other: ________	
		neg slide file	color B&W other: ________	

*Equivalent to a 35 mm - 105 mm lens on a 35 mm camera

PHOTO SURVEY FORM 1 - EQUIPMENT DETAILS

Survey start date (yyyymmdd): 2007 | 06 | 19 **Agency:** | C044 |

Survey end date: 2007 | 06 | 19 **Crew:** NF | RL |

CAMERA #1

Make & Model:	**Olympus Stylus 760**	**Lenses:** <u>A</u> B C D E F	
Format:	135mm film	Other film: _________ **<u>Digital</u>**	Still video
Resolution (for digital and video cameras):	144 dpi		
Output file type (for digital and video cameras):	.JPEG		

CAMERA #2

Make & Model:	**N/A**	**Lenses:** A B C D E F	
Format:	135mm film	Other film: _________ Digital	Still video
Resolution (for digital and video cameras):			
Output file type (for digital and video cameras):			

LENSES

	Focal length (mm)		Focal length (mm)
A	**Fixed 6.5-19.5 mm***	**D**	
B		**E**	
C		**F**	

ROLL AND/OR BATCH DETAILS

Roll# or Batch#	Camera #	Output medium	For film cameras: Film type	ISO
Overflight	**1**	neg slide **<u>file</u>**	color B&W other: _________	
		neg slide file	color B&W other: _________	
		neg slide file	color B&W other: _________	
		neg slide file	color B&W other: _________	
		neg slide file	color B&W other: _________	
		neg slide file	color B&W other: _________	
		neg slide file	color B&W other: _________	
		neg slide file	color B&W other: _________	
		neg slide file	color B&W other: _________	
		neg slide file	color B&W other: _________	
		neg slide file	color B&W other: _________	
		neg slide file	color B&W other: _________	
		neg slide file	color B&W other: _________	

* Equivalent to a 37 mm - 111 mm lens on a 35 mm camera.

PHOTO SURVEY FORM 1 - EQUIPMENT DETAILS

Survey start date (yyyymmdd): 2007 | 10 | 22 **Agency:** | C044 |
Survey end date: 2007 | 10 | 23 **Crew:** NF | RL |

CAMERA #1

Make & Model:	**Olympus Stylus 760**	**Lenses:**	**A** B C D E F
Format:	135mm film	Other film: ________	**Digital** Still video
Resolution (for digital and video cameras):	144 dpi		
Output file type (for digital and video cameras):	.JPEG		

CAMERA #2

Make & Model:	**Olympus Stylus 300**	**Lenses:**	A **B** C D E F
Format:	135mm film	Other film: ________	**Digital** Still video
Resolution (for digital and video cameras):	144 dpi		
Output file type (for digital and video cameras):	.JPEG		

LENSES

	Focal length (mm)		Focal length (mm)
A	Fixed 6.5-19.5 mm*	D	
B	Fixed 5.5-17.4 mm**	E	
C		F	

ROLL AND/OR BATCH DETAILS

Roll# or Batch#	Camera #	Output medium	For film cameras: Film type	ISO
15	2	neg slide **file**	color B&W other: ________	
16	1	neg slide **file**	color B&W other: ________	
		neg slide file	color B&W other: ________	
		neg slide file	color B&W other: ________	
		neg slide file	color B&W other: ________	
		neg slide file	color B&W other: ________	
		neg slide file	color B&W other: ________	
		neg slide file	color B&W other: ________	
		neg slide file	color B&W other: ________	
		neg slide file	color B&W other: ________	
		neg slide file	color B&W other: ________	
		neg slide file	color B&W other: ________	
		neg slide file	color B&W other: ________	

* Equivalent to a 37 mm - 111 mm lens on a 35 mm camera.
**Equivalent to a 35 mm - 105 mm lens on a 35 mm camera

FDIS Photo Documentation

Skagit River 1:20,000 FFHI

Project Watershed Code: 970-110000-00000-00000-0000-0000-000-000-000-000-000-000

WS Code	ILP MAP #	NID MAP #	Photo Roll	Photo Frame	Photo CD CD #	Photo CD Image #	Reach	Site	UTM(Zone/East/North)	Date	Type	Foc Len	Foc Dir
Waterbody ID	ILP #	NID #					Comment						
000-000000-00000-00000-0000-0000-000-000-000-000-000-000	092H.014		13	11	1	207	1.0	42	..	2007/08/19	SITE	STD	U
	10854						Upstream view showing the lack of a defined stream channel (camera case for scale).						
000-000000-00000-00000-0000-0000-000-000-000-000-000-000	092H.014		13	12	1	208	1.0	42	..	2007/08/19	SITE	STD	D
	10854						Upstream view showing the lack of a defined stream channel (radio for scale).						
000-000000-00000-00000-0000-0000-000-000-000-000-000-000	092H.015		10	12	1	152	1.0	30	..	2007/08/16	SITE	STD	D
	11097						A shallow depression with rooted vegetation across the basin floor (field book for scale).						
000-000000-00000-00000-0000-0000-000-000-000-000-000-000	092H.015		10	13	1	153	1.0	30	..	2007/08/16	SITE	STD	U
	11097						A short (1 m) section of scour where the stream gradient and confinement increase (cruiser vest for scale).						
000-000000-00000-00000-0000-0000-000-000-000-000-000-000	092H.024		2	27	1	37	1.0	54	..	2007/08/15	SITE	STD	U
	11424						Thick shrubby vegetation through swale (boots for scale).						
000-000000-00000-00000-0000-0000-000-000-000-000-000-000	092H.024		2	28	1	38	1.0	54	..	2007/08/15	SITE	STD	D
	11424						Thick vegetation (note size of hemlock trunk) and eveidence of historic scour (camera case for scale).						
000-000000-00000-00000-0000-0000-000-000-000-000-000-000	092H.025		9	14	1	139	1.0	61	..	2007/08/15	SITE	STD	U
	11692						Dry depression with rooted vegetation across the basin floor (camera case for scale).						
000-000000-00000-00000-0000-0000-000-000-000-000-000-000	092H.025		9	15	1	140	1.0	61	..	2007/08/15	SITE	STD	D
	11692						Dry depression with rooted vegetation across the basin floor (RL and hat for scale).						
000-000000-00000-00000-0000-0000-000-000-000-000-000-000	092H.026		9	6	1	131	1.0	68	..	2007/08/15	SITE	STD	U
	11970						Narrow channel with a trickle of flow over gravels and fines (camera case for scale).						
000-000000-00000-00000-0000-0000-000-000-000-000-000-000	092H.026		9	7	1	132	1.0	68	..	2007/08/15	SITE	STD	D
	11970						Narrow channel with a trickle of flow over gravels and fines (RL for scale).						
970-110000-00000-00000-0000-0000-000-000-000-000-000-000			12	19	1	191	3.0		..	2007/08/18	FISH		
							334 mm rainbow trout						
970-110000-00000-00000-0000-0000-000-000-000-000-000-000			12	22	1	194	3.0		..	2007/08/18	FISH		
							363 mm rainbow trout						
970-110000-00000-00000-0000-0000-000-000-000-000-000-000			7	1	1	107	2.0	83	..	2007/08/20	SITE	STD	X
	0						ML snorkelling in a glide below the Silver-Skagit Road bridge.						
970-110000-00000-00000-0000-0000-000-000-000-000-000-000			7	2	1	108	2.0	83	..	2007/08/20	SITE	STD	U
	0						Upstream view of the bottom of the reach at the confluence with the Klesilkwa River.						

Project Watershed Code: 970-110000-00000-00000-0000-0000-000-000-000-000-000-000

WS Code	ILP MAP #	NID MAP #	Photo		Photo CD		Reach	Site	UTM(Zone/East/North)	Date	Type	Foc Len	Foc Dir
Waterbody ID	ILP #	NID #	Roll	Frame	CD #	Image #	Comment						
970-110000-00000-00000-0000-0000-000-000-000-000-000-000			7	3	1	109	2.0	83	..	2007/08/20	SITE	STD	D
	0						A typical riffle-pool sequence with side and diagonal gravel bars.						
970-110000-00000-00000-0000-0000-000-000-000-000-000-000			16	1	1	234	5.0	85	..	2007/10/22	SITE	STD	U
	0						Upstream view, looking towrds the confluence with the Skaist River.						
970-110000-00000-00000-0000-0000-000-000-000-000-000-000			16	2	1	235	5.0	85	..	2007/10/22	SITE	STD	D
	0						Looking downstream towards a bridge over the Skagit River (bridge is on an unnamed forestry road used to access cutblocks and mines in the upper Smitheram Creek drainage; RL and SP on bridge for scale).						
970-110000-00000-00000-0000-0000-000-000-000-000-000-000			16	3	1	236	5.0	90	..	2007/10/22	SITE	STD	U
	0						Upstream view of the bedrock confinement and angular boulders in a section of 2% gradient just upstream from the confluence with Snass Creek.						
970-110000-00000-00000-0000-0000-000-000-000-000-000-000			16	4	1	237	5.0	90	..	2007/10/22	SITE	STD	U
	0						7.5 m high bedrock controlled waterfall (lowermost in a series of definite barriers to fish migration).						
970-110000-00000-00000-0000-0000-000-000-000-000-000-000			16	5	1	238	5.0	90	..	2007/10/22	SITE	STD	U
	0						7.5 m high, bedrock-controlled waterfall.						
970-110000-00000-00000-0000-0000-000-000-000-000-000-000			16	6	1	239	5.0	90	..	2007/10/22	SITE	STD	U
	0						Showing the deep bedrock walls that entrench the Skagit River near the 7.5 m falls.						
970-110000-00000-00000-0000-0000-000-000-000-000-000-000			16	7	1	240	5.0	90	..	2007/10/22	SITE	STD	U
	0						Showing the deep bedrock walls that entrench the Skagit River near the 7.5 m falls.						
970-110000-00000-00000-0000-0000-000-000-000-000-000-000			16	8	1	241	5.0	90	..	2007/10/22	SITE	STD	D
	0						Looking downstream just below the falls. DJ and IL are in the photo for scale.						
970-110000-00000-00000-0000-0000-000-000-000-000-000-000			23	4	1		5.0		..	2007/05/16	REACH	STD	U
	0												
970-110000-00000-00000-0000-0000-000-000-000-000-000-000			11	15	1	172	7.0	23	..	2007/08/17	SITE	STD	U
	0						Upstream view showing flows over cobble and gravel (cruiser vest for scale).						
970-110000-00000-00000-0000-0000-000-000-000-000-000-000			11	16	1	173	7.0	23	..	2007/08/17	SITE	STD	D
	0						Showing functional and non-functional large woody debris and flow over gravel, cobble, and boulder (hat for scale).						
970-110000-00000-00000-0000-0000-000-000-000-000-000-000			11	17	1	174	7.0		..	2007/10/22	FISH		
	0						134 mm rainbow trout						
970-110000-00000-00000-0000-0000-000-000-000-000-000-000			15	1	1	225	7.0	23	..	2007/08/17	SITE	STD	U
	0						Upstream view showing the headwaters of the Skagit River alongside Highway 3, Oct. 22, 2007.						
970-110000-00000-00000-0000-0000-000-000-000-000-000-000			15	2	1	226	7.0	23	..	2007/08/17	SITE	STD	D
	0						Downstream view showing the headwaters of the Skagit River alongside Highway 3, Oct. 22, 2007.						
970-110000-70500-00000-0000-0000-000-000-000-000-000-000			11	5	1	162	7.0	18	..	2007/08/17	SITE	STD	U
	0						Scour pool created by a root wad and large woody debris drop (JH in photo for scale).						

Project Watershed Code: 970-110000-00000-00000-0000-0000-000-000-000-000-000-000

WS Code / Waterbody ID	ILP MAP # / ILP #	NID MAP # / NID #	Photo: Roll	Photo: Frame	Photo CD: CD #	Photo CD: Image #	Reach / Comment	Site	UTM(Zone/East/North)	Date	Type	Foc Len	Foc Dir
970-110000-70500-00000-0000-0000-000-000-000-000-000-000			11	6	1	163	7.0	18	..	2007/08/17	SITE	STD	D
	0						Riffle-pool morphology with flow over gravels, cobbles, and fines (JH in photo for scale).						
970-110000-70500-00000-0000-0000-000-000-000-000-000-000			11	7	1	164	7.0	18	..	2007/08/17	SITE	STD	D
	0						Showing good channel complexity created by large woody debris (hat for scale).						
970-110000-70500-00000-0000-0000-000-000-000-000-000-000			11	8	1	165	7.0		..	2007/08/16	FISH		
	0						128 mm rainbow trout						
970-110000-70500-00000-0000-0000-000-000-000-000-000-000			11	9	1	166	9.0	19	..	2007/08/17	SITE	STD	D
	0						Riffle-pool morphology, with shallow flows over gravel (JH in photo for scale).						
970-110000-70500-00000-0000-0000-000-000-000-000-000-000			11	10	1	167	9.0	19	..	2007/08/17	SITE	STD	U
	0						Overhanging riparian vegetation and undercut banks providing good cover (pack and map for scale).						
970-110000-70500-00000-0000-0000-000-000-000-000-000-000			11	11	1	168	9.0	19	..	2007/08/17	SITE	STD	U
	0						Clump of large woody debris and thick, overhanging willow vegetation.						
970-110000-70500-00000-0000-0000-000-000-000-000-000-000			11	12	1	169	9.0	19	..	2007/08/17	SITE	STD	U
	0						Rock weir at the outlet of Lightning Lake, at the head of Lightning Creek.						
970-110000-70500-00000-0000-0000-000-000-000-000-000-000			11	13	1	170	9.0	19	..	2007/08/17	SITE	STD	U
	0						Concrete spillway at the north end of Lightning Lake, forming part of the Little Muddy Creek drainage (Similkameen River watershed).						
970-110000-70500-00000-0000-0000-000-000-000-000-000-000			11	14	1	171	9.0		..	2007/08/17	FISH		
	0						99 mm rainbow trout						
970-110000-70500-83500-0000-0000-000-000-000-000-000-000			3	1	1	39	3.0	17	..	2007/08/16	SITE	STD	U
	0						Upstream view of a riffle-pool sequence typical of the reach (ML electrofishing for scale).						
970-110000-70500-83500-0000-0000-000-000-000-000-000-000			3	2	1	40	3.0	17	..	2007/08/16	SITE	STD	D
	0						Showing fish cover typical of the reach; a large woody debris pile with a scour pool (dipnet for scale).						
970-110000-70500-83500-0000-0000-000-000-000-000-000-000			3	3	1	41	3.0	17	..	2007/08/16	SITE	STD	BD
	0						Aerial view of a 6 m high by 20 m long (estimated) bedrock cascade near the bottom of reach 2.						
970-110000-70500-95300-0000-0000-000-000-000-000-000-000			11	3	1	160	1.0	20	..	2007/08/17	SITE	STD	U
	0						Showing the dry, downcut channel with cobble and gravel substrate and abundant large woody debris (field book for scale).						
970-110000-70500-95300-0000-0000-000-000-000-000-000-000			11	4	1	161	1.0	20	..	2007/08/17	SITE	STD	D
	0						Steeper section of the site with boulders present (cruiser vest for scale).						
970-110000-78000-00000-0000-0000-000-000-000-000-000-000			5	1	1	75	1.0	13	..	2007/08/18	SITE	STD	U
	0						Cedar/hemlock/Douglas-fir forest at the mapped stream location (handheld vhf radio for scale).						
970-110000-78000-00000-0000-0000-000-000-000-000-000-000			5	2	1	76	1.0	13	..	2007/08/18	SITE	STD	D
	0						Cedar/hemlock/Douglas-fir forest at the mapped stream location (NF for scale).						

Project Watershed Code: 970-110000-00000-00000-0000-0000-000-000-000-000-000-000

WS Code	ILP MAP #	NID MAP #	Photo		Photo CD		Reach		Site	UTM(Zone/East/North)	Date	Type	Foc Len	Foc Dir
Waterbody ID	ILP #	NID #	Roll	Frame	CD #	Image #	Comment							
970-110000-80300-00000-0000-0000-000-000-000-000-000-000			5	5	1	77	1.0		6	..	2007/08/18	SITE	STD	U
	0						Upstream view showing the dry channel with recently fallen trees (2 m ruler on fallen log for scale).							
970-110000-80300-00000-0000-0000-000-000-000-000-000-000			5	6	1	78	1.0		6	..	2007/08/18	SITE	STD	D
	0						Downstream view of the dry channel with miore fallen riparian vegetation (NF filling out card for scale).							
970-110000-80900-00000-0000-0000-000-000-000-000-000-000			15	15	1	232	1.0			..	2007/10/23	FISH		
							190 mm Dolly Varden or bull trout (not verified)							
970-110000-80900-00000-0000-0000-000-000-000-000-000-000			15	16	1	233	1.0			..	2007/10/23	FISH		
							121 mm bull trout							
970-110000-80900-00000-0000-0000-000-000-000-000-000-000			5	7	1	79	2.0		12	..	2007/08/18	SITE	STD	U
	0						A typical riffle-pool section (dipnet for scale).							
970-110000-80900-00000-0000-0000-000-000-000-000-000-000			5	8	1	80	2.0		12	..	2007/08/18	SITE	STD	D
	0						Showing some non-functional large woody debris (NF in photo for scale).							
970-110000-80900-00000-0000-0000-000-000-000-000-000-000			5	9	1	81	2.0		12	..	2007/08/18	SITE	STD	D
	0						Showing the large log/woody debris jam just upstream of the Centennial Trail crossing.							
970-110000-80900-00000-0000-0000-000-000-000-000-000-000			5	10	1	82	2.0		12	..	2007/08/18	SITE	STD	D
	0						The Centennial Trail footbridge (ML in photo for scale).							
970-110000-80900-00000-0000-0000-000-000-000-000-000-000			10	5	1	145	4.0		15	..	2007/08/16	SITE	STD	D
	0						Riffle-pool morphology flowing over cobble and gravel substrates (JH for scale).							
970-110000-80900-00000-0000-0000-000-000-000-000-000-000			10	6	1	146	4.0		15	..	2007/08/16	SITE	STD	U
	0						Scour pool associated with a piece of functional large woody debris (cruiser vest for scale).							
970-110000-80900-00000-0000-0000-000-000-000-000-000-000			10	7	1	147	4.0		15	..	2007/08/16	SITE	STD	NS
	0						184 mm Dolly Varden captured at the site.							
970-110000-80900-39000-0000-0000-000-000-000-000-000-000			10	8	1	148	1.0		32	..	2007/08/16	SITE	STD	U
	0						Cascade-pool morphology with flows over boulders and cobbles. Also showing the numerous large woody debris and associated bed drops (cruiser vest for scale).							
970-110000-80900-39000-0000-0000-000-000-000-000-000-000			10	9	1	149	1.0		32	..	2007/08/16	SITE	STD	U
	0						A section of 14% gradient through the middle portion of the reach (JH in photo for scale).							
970-110000-80900-39000-0000-0000-000-000-000-000-000-000			10	10	1	150	1.0		32	..	2007/08/16	SITE	STD	D
	0						Cascade-pool morphology in the 14% gradient section of the reach (metre tape for scale).							
970-110000-80900-39000-0000-0000-000-000-000-000-000-000			10	11	1	151	1.0		32	..	2007/08/16	SITE	STD	U
	0						Showing the lower gradient section at the upstream end of the site.							
970-110000-80900-78900-0000-0000-000-000-000-000-000-000			10	1	1	141	2.0		16	..	2007/08/16	SITE	STD	U
	0						Cascade-pool morphology with flows over boulder, cobble, and bedrock (JH in photo for scale).							

Project Watershed Code: 970-110000-00000-00000-0000-0000-000-000-000-000-000-000

WS Code	ILP MAP #	NID MAP #	Photo		Photo CD		Reach	Site	UTM(Zone/East/North)	Date	Type	Foc Len	Foc Dir
Waterbody ID	ILP #	NID #	Roll	Frame	CD #	Image #	Comment						
970-110000-80900-78900-0000-0000-000-000-000-000-000-000			10	2	1	142	2.0	16	..	2007/08/16	SITE	STD	D
	0						Cascade-pool morphology with flows over boulder, cobble, and bedrock (camera case for scale).						
970-110000-80900-78900-0000-0000-000-000-000-000-000-000			10	3	1	143	2.0	16	..	2007/08/16	SITE	STD	NS
	0						Transforming tailed frog captured at the site.						
970-110000-80900-78900-0000-0000-000-000-000-000-000-000			10	4	1	144	2.0	16	..	2007/08/16	SITE	STD	U
	0						1.9 m high bedrock-controlled waterfall at the upper end of the site.						
970-110000-80900-90300-0000-0000-000-000-000-000-000-000			11	1	1	158	1.0	14	..	2007/08/16	SITE	STD	U
	0						Showing the narrow, dry channel with gravel and fine substrates (hat for scale).						
970-110000-80900-90300-0000-0000-000-000-000-000-000-000			11	2	1	159	1.0	14	..	2007/08/16	SITE	STD	D
	0						Showing the narrow, dry channel with gravel and fine substrates (field book for scale).						
970-110000-81700-00000-0000-0000-000-000-000-000-000-000			14	14	1	222	4.0	7	..	2007/08/20	SITE	STD	D
	0						Showing a 1.1 m deep scour pool downstream of a section of bedrock confinement (camera case for scale).						
970-110000-81700-00000-0000-0000-000-000-000-000-000-000			14	15	1	223	4.0	7	..	2007/08/20	SITE	STD	U
	0						Cascade-pool morphology with flows over boulder and cobble.						
970-110000-81700-00000-0000-0000-000-000-000-000-000-000			14	16	1	224	4.0	7	..	2007/08/20	SITE	STD	U
	0						Small cascade						
970-110000-82400-00000-0000-0000-000-000-000-000-000-000			5	11	1	83	2.0	11	..	2007/08/18	SITE	STD	U
	0						Showing the flooded wetland just upstream of the Silver-Skagit road crossing (ML electrofishing for scale).						
970-110000-82400-00000-0000-0000-000-000-000-000-000-000			5	12	1	84	2.0	11	..	2007/08/18	SITE	STD	D
	0						Showing the flooded wetland with abundant instream vegetation. Mark can just be seen on the far right against the left bank.						
970-110000-82400-00000-0000-0000-000-000-000-000-000-000			5	13	1	85	2.0	11	..	2007/08/18	SITE	STD	BD
	0						Close-up view of the water surface with thick floating vegetation (camera case for scale).						
970-110000-82500-00000-0000-0000-000-000-000-000-000-000			5	14	1	86	2.0	9	..	2007/08/18	SITE	STD	U
	0						Upstream view of the channel at the bootom of reach 3, at the Centennial Trail footbridge.						
970-110000-82500-00000-0000-0000-000-000-000-000-000-000			5	16	1	88	2.0	9	..	2007/08/18	SITE	STD	U
	0						Showing the excessive bed scour and downcutting at the bottom of reach 3, below the Centennial Trail crossing.						
970-110000-82500-00000-0000-0000-000-000-000-000-000-000			5	17	1	89	2.0	9	..	2007/08/18	SITE	STD	U
	0						Showing the excessive bed scour and downcutting at the bottom of reach 3, below the Centennial Trail crossing.						
970-110000-82500-00000-0000-0000-000-000-000-000-000-000			5	18	1	90	2.0	9	..	2007/08/18	SITE	STD	U
	0						Showing the excessive bed scour and downcutting at the bottom of reach 3, below the Centennial Trail crossing.						

Project Watershed Code: 970-110000-00000-00000-0000-0000-000-000-000-000-000-000

WS Code	ILP MAP #	NID MAP #	Photo		Photo CD		Reach	Site	UTM(Zone/East/North)	Date	Type	Foc Len	Foc Dir
Waterbody ID	ILP #	NID #	Roll	Frame	CD #	Image #	Comment						
970-110000-82500-00000-0000-0000-000-000-000-000-000-000			5	19	1	91	2.0	9	..	2007/08/18	SITE	STD	D
	0						Showing the aggrading channel near the top of the reach, which causes dewatering and the loss of channelization downstream.						
970-110000-82500-00000-0000-0000-000-000-000-000-000-000			5	20	1	92	2.0	9	..	2007/08/18	SITE	STD	D
	0						Showing a portion of the alluvial fan, where all channelization is lost and surface water is distributed across the forest floor in a wide swath.						
970-110000-82500-00000-0000-0000-000-000-000-000-000-000			5	21	1	93	2.0	9	..	2007/08/18	SITE	STD	D
	0						Downstream view of the forest where all remaining signs of surface water dissipate. No evidence of channelization or surface flow exist downstream from this point.						
970-110000-82500-00000-0000-0000-000-000-000-000-000-000			5	15	1	87	3.0	80	..	2007/08/19	SITE	STD	U
	0						Footbridge at Centennial Trail Crossing						
970-110000-82500-00000-0000-0000-000-000-000-000-000-000			13	1	1	197	3.0	80	..	2007/08/19	SITE	STD	D
	0						Showing the downcut channel with cascade-pool morphology (cruiser vest for scale).						
970-110000-82500-00000-0000-0000-000-000-000-000-000-000			13	2	1	198	3.0	80	..	2007/08/19	SITE	STD	U
	0						The 1.1 m high log drop with an 0.8 m deep plunge pool which has been mapped as a feature (cruiser vest for scale).						
970-110000-82500-00000-0000-0000-000-000-000-000-000-000			13	3	1	199	3.0	80	..	2007/08/19	SITE	STD	D
	0						Typical channel substrates consisting of cobbles, boulders, and gravels.						
970-110000-82700-00000-0000-0000-000-000-000-000-000-000			14	10	1	218	2.0	8	..	2007/08/20	SITE	STD	U
	0						Cascade-pool morphology over boulder, cobble, and gravel substrates (metre tape for scale).						
970-110000-82700-00000-0000-0000-000-000-000-000-000-000			14	11	1	219	2.0	8	..	2007/08/20	SITE	STD	U
	0						Cascade-pool morphology over boulder, cobble, and gravel substrates (hat for scale).						
970-110000-82700-00000-0000-0000-000-000-000-000-000-000			14	12	1	220	2.0	8	..	2007/08/20	SITE	STD	D
	0						Cascade-pool morphology over boulder, cobble, and gravel substrates (camera case for scale).						
970-110000-82700-00000-0000-0000-000-000-000-000-000-000			14	13	1	221	2.0		..	2007/08/20	FISH		
	0						188 mm rainbow trout						
970-110000-84000-00000-0000-0000-000-000-000-000-000-000			13	4	1	200	2.0	10	..	2007/08/19	SITE	STD	D
	0						Rooted vegetation across the basin floor (cruiser vest for scale).						
970-110000-84000-00000-0000-0000-000-000-000-000-000-000			13	5	1	201	2.0	10	..	2007/08/19	SITE	STD	U
	0						Rooted vegetation across the basin floor (hat for scale).						
970-110000-84800-00000-0000-0000-000-000-000-000-000-000			7	9	1	110	3.0		..	2007/10/23	FISH		
							147 mm Dolly Varden or bull trout (not verified)						
970-110000-84800-00000-0000-0000-000-000-000-000-000-000			13	6	1	202	2.0	39	..	2007/08/19	SITE	STD	D
	0						Large-channel morphology with flows over fines and gravels (JH for scale).						
970-110000-84800-00000-0000-0000-000-000-000-000-000-000			13	7	1	203	2.0	39	..	2007/08/19	SITE	STD	U
	0						Showing the low channel complexity.						

Project Watershed Code: 970-110000-00000-00000-0000-0000-000-000-000-000-000-000

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Waterbody ID	ILP #	NID #	Roll	Frame	CD #	Image #	Comment						
970-110000-84800-00000-0000-0000-000-000-000-000-000-000			13	8	1	204	2.0		..	2007/08/19	FISH		
	0						94 mm rainbow trout						
970-110000-84800-00000-0000-0000-000-000-000-000-000-000			14	1	1	209	9.0	5	..	2007/08/20	SITE	STD	D
	0						Typical cascade-pool morphology with flow over boulders, cobbles, and gravels (camera case for scale).						
970-110000-84800-00000-0000-0000-000-000-000-000-000-000			14	2	1	210	9.0	5	..	2007/08/20	SITE	STD	U
	0						Typical cascade-pool morphology with flow over boulders, cobbles, and gravels (hat for scale).						
970-110000-84800-00000-0000-0000-000-000-000-000-000-000			14	3	1	211	9.0	5	..	2007/08/20	SITE	STD	D
	0						Showing a 70 cm deep scour pool associated with large woody debris.						
970-110000-84800-00000-0000-0000-000-000-000-000-000-000			14	4	1	212	9.0	5	..	2007/08/20	SITE	STD	U
	0						Upstream view of a 1.5 m high debris jam which forms a non-permanent obstruction to fish migration (packboard for scale).						
970-110000-84800-00000-0000-0000-000-000-000-000-000-000			14	5	1	213	9.0	5	..	2007/08/20	SITE	STD	U
	0						Showing the ponded water extending for 20 m upstream from the debris jam shown in photo 4.						
970-110000-84800-00000-0000-0000-000-000-000-000-000-000			14	6	1	214	9.0		..	2007/08/20	FISH		
	0						115 mm rainbow trout						
970-110000-84800-18600-0000-0000-000-000-000-000-000-000			13	9	1	205	1.0	40	..	2007/08/19	SITE	STD	D
	0						Gravel, fine, and cobble substrates on the dry streambed (field book for scale).						
970-110000-84800-18600-0000-0000-000-000-000-000-000-000			13	10	1	206	1.0	40	..	2007/08/19	SITE	STD	U
	0						Showing the vertical banks along the dry channel (cruiser vest for scale).						
970-110000-84800-31000-0000-0000-000-000-000-000-000-000			15	12	1	229	1.0	91	..	2007/10/23	SITE	STD	U
	0						Upstream view looking towards the culvert at the road crossing, showing the wide, braided channel (cruiser vest for scale).						
970-110000-84800-31000-0000-0000-000-000-000-000-000-000			15	13	1	230	1.0	91	..	2007/10/23	SITE	STD	D
	0						Showing the main channel recently cut into the forest floor downstream of an avulsion (field book for scale).						
970-110000-84800-31000-0000-0000-000-000-000-000-000-000			15	14	1	231	1.0	91	..	2007/10/23	SITE	STD	U
	0						1.8 m wide by 1.2 m high flat bottomed culvert with a 1% gradient at the Silver-Skagit Road crossing						
970-110000-84800-33200-0000-0000-000-000-000-000-000-000			6	10	1	102	3.0		..	2007/05/23	REACH	STD	U
	0						2.9 m high semi-permanent falls formed by log/boulder wedge.						
970-110000-84800-33200-0000-0000-000-000-000-000-000-000			6	6	1	98	5.0	3	..	2007/08/19	SITE	STD	U
	0						Upstream view showing a typical section of channel (ML for scale).						
970-110000-84800-33200-0000-0000-000-000-000-000-000-000			6	7	1	99	5.0	3	..	2007/08/19	SITE	STD	D
	0						Downstream view showing a typical section of channel (electrofisher for scale).						
970-110000-84800-33200-3440-0000-000-000-000-000-000-000			6	8	1	100	1.0	1	..	2007/08/19	SITE	STD	D
	0						Non-classified drainage conditions in the thick brush immediately downstream of the road crossing.						

Project Watershed Code: 970-110000-00000-00000-0000-0000-000-000-000-000-000-000

WS Code	ILP MAP #	NID MAP #	Photo		Photo CD		Reach	Site	UTM(Zone/East/North)	Date	Type	Foc Len	Foc Dir
Waterbody ID	ILP #	NID #	Roll	Frame	CD #	Image #	Comment						
970-110000-84800-33200-3440-0000-000-000-000-000-000-000			6	9	1	101	1.0	1	..	2007/08/19	SITE	STD	U
	0						Showing the drainage seeping into a water bar at the road crossing.						
970-110000-84800-33200-4180-0000-000-000-000-000-000-000			6	2	1	94	1.0		..	2007/08/19	FISH		
	0						200 mm rainbow trout						
970-110000-84800-33200-4180-0000-000-000-000-000-000-000			6	3	1	95	1.0	2	..	2007/08/19	SITE	STD	U
	0						Showing a steep wood/boulder drop, common throughout the reach (dipnet for scale).						
970-110000-84800-33200-4180-0000-000-000-000-000-000-000			6	4	1	96	1.0	2	..	2007/08/19	SITE	STD	D
	0						Showing a typical section of cascade-pool morphology.						
970-110000-84800-33200-4180-0000-000-000-000-000-000-000			6	5	1	97	1.0	2	..	2007/08/19	SITE	STD	U
	0						Showing falls, located 270 m upstream of the confluence with the mainstem.						
970-110000-84800-33200-6380-0000-000-000-000-000-000-000			14	7	1	215	2.0	4	..	2007/08/20	SITE	STD	D
	0						Showing a section of riffle-pool morphology, with flow over gravel (camera case for scale).						
970-110000-84800-33200-6380-0000-000-000-000-000-000-000			14	8	1	216	2.0	4	..	2007/08/20	SITE	STD	U
	0						showing abundant large woody debris (hat for scale).						
970-110000-84800-33200-6380-0000-000-000-000-000-000-000			14	9	1	217	2.0	4	..	2007/08/20	SITE	STD	U
	0						cascade/chute barrier in reach 1 (aerial view from helicopter).						
970-110000-84800-52800-0000-0000-000-000-000-000-000-000			6	12	1	103	1.0	41	..	2007/08/19	SITE	STD	U
	0						Upstream view showing the thick, shrubby vegetation at the site location with no evidence of channelization (hanging thermometer for scale).						
970-110000-84800-52800-0000-0000-000-000-000-000-000-000			6	13	1	104	1.0	41	..	2007/08/19	SITE	STD	D
	0						Downstream view showing the forest floor (with lady fern, skunk cabbage, and twinberry) with no sign of scour from flowing surface water.						
970-110000-84800-64930-0000-0000-000-000-000-000-000-000			6	14	1	105	3.0	43	..	2007/08/19	SITE	STD	U
	0						Showing the channel with abundant large and small woody debris (ML for scale).						
970-110000-84800-64930-0000-0000-000-000-000-000-000-000			6	15	1	106	3.0	43	..	2007/08/19	SITE	STD	D
	0						Showing the channel with abundant large and small woody debris (camera for scale).						
970-110000-85900-00000-0000-0000-000-000-000-000-000-000			12	24	1	195	1.0	37	..	2007/08/18	SITE	STD	U
	0						Showing rooted vegetation across a dry depression (RL for scale).						
970-110000-85900-00000-0000-0000-000-000-000-000-000-000			12	25	1	196	1.0	37	..	2007/08/18	SITE	STD	D
	0						Showing rooted vegetation across a dry depression (camera case for scale).						
970-110000-86200-00000-0000-0000-000-000-000-000-000-000			12	1	1	175	1.0	75	..	2007/08/18	SITE	STD	D
	0						Showing an avulsion through the forest (JH for scale).						
970-110000-86200-00000-0000-0000-000-000-000-000-000-000			12	2	1	176	1.0	75	..	2007/08/18	SITE	STD	U
	0						A rare scour pool created by a large Douglas-fir tree (cruiser vest for scale).						
970-110000-86200-00000-0000-0000-000-000-000-000-000-000			12	3	1	177	1.0		..	2007/08/18	FISH		
	0						155mm rainbow trout						

Project Watershed Code: 970-110000-00000-00000-0000-0000-000-000-000-000-000-000

WS Code	ILP MAP #	NID MAP #	Photo		Photo CD		Reach	Site	UTM(Zone/East/North)	Date	Type	Foc Len	Foc Dir
Waterbody ID	ILP #	NID #	Roll	Frame	CD #	Image #	Comment						
970-110000-86200-00000-0000-0000-000-000-000-000-000-000			12	4	1	178	1.0		..	2007/08/18	FISH		
	0						137 mm bull trout						
970-110000-87100-00000-0000-0000-000-000-000-000-000-000			12	20	1	192	1.0	35	..	2007/08/18	SITE	STD	U
	0						Showing the shallow gully with no sign of scour or deposition of mineral alluvium (hat for scale).						
970-110000-87100-00000-0000-0000-000-000-000-000-000-000			12	21	1	193	1.0	35	..	2007/08/18	SITE	STD	D
	0						Showing the shallow gully with no sign of scour or deposition of mineral alluvium (camera case for scale).						
970-110000-87300-00000-0000-0000-000-000-000-000-000-000			12	12	1	185	1.0	34	..	2007/08/18	SITE	STD	D
	0						Cascade-pool morphology with flows over boulder and cobble (cruiser vest for scale).						
970-110000-87300-00000-0000-0000-000-000-000-000-000-000			12	13	1	186	1.0	34	..	2007/08/18	SITE	STD	U
	0						Upstream view of a 19% gradient cascade approximately 75 m upstream from the confluence with the Skagit River (hat for scale).						
970-110000-87300-00000-0000-0000-000-000-000-000-000-000			12	14	1	187	1.0	34	..	2007/08/18	SITE	STD	U
	0						Step-pool morphology at the top end of the site, where the gradient is 18%.						
970-110000-87300-00000-0000-0000-000-000-000-000-000-000			12	15	1	188	1.0		..	2007/08/18	FISH		
	0						149 mm Dolly Varden						
970-110000-87300-00000-0000-0000-000-000-000-000-000-000			12	16	1	189	1.0		..	2007/08/18	FISH		
	0						97 mm rainbow trout						
970-110000-87300-00000-0000-0000-000-000-000-000-000-000			12	17	1	190	1.0	34	..	2007/08/18	SITE	STD	U
	0						Showing the confluence of Twentyeight Mile Creek and the Skagit River.						
970-110000-87700-00000-0000-0000-000-000-000-000-000-000			12	6	1	179	1.0	33	..	2007/08/18	SITE	STD	U
	0						2 m high, 20 m long woody debris jam.						
970-110000-87700-00000-0000-0000-000-000-000-000-000-000			12	7	1	180	1.0	33	..	2007/08/18	SITE	STD	U
	0						Cascade-pool morphology with flows over boulder, cobble, and gravel (hat for scale).						
970-110000-87700-00000-0000-0000-000-000-000-000-000-000			12	8	1	181	1.0	33	..	2007/08/18	SITE	STD	D
	0						Cascade-pool morphology with flows over boulder, cobble, and gravel (camera case for scale).						
970-110000-87700-00000-0000-0000-000-000-000-000-000-000			12	9	1	182	1.0	33	..	2007/08/18	SITE	STD	U
	0						4 m high, 20 m long woody debris jam resulting from windfall. Scour caused by the jam is eroding the streambanks.						
970-110000-87700-00000-0000-0000-000-000-000-000-000-000			12	10	1	183	1.0		..	2007/08/18	FISH		
	0						111 mm hybrid dolly varden/ bull trout						
970-110000-87700-00000-0000-0000-000-000-000-000-000-000			12	11	1	184	1.0	33	..	2007/08/18	SITE	STD	NS
	0						111 mm hybrid Dolly Varden / bull trout captured at the site (confirmed by genetic analysis).						
970-110000-89000-00000-0000-0000-000-000-000-000-000-000			10	14	1	154	4.0	31	..	2007/08/16	SITE	STD	U
	0						Riffle-pool morphology with flows over gravel, and thick willow overhanging vegetation (cruiser vest for scale).						

Project Watershed Code: 970-110000-00000-00000-0000-0000-000-000-000-000-000-000

WS Code / Waterbody ID	ILP MAP # / ILP #	NID MAP # / NID #	Photo Roll	Photo Frame	Photo CD CD #	Photo CD Image #	Reach		Site	UTM(Zone/East/North)	Date	Type	Foc Len	Foc Dir
970-110000-89000-00000-0000-0000-000-000-000-000-000-000			10	15	1	155	4.0		31	..	2007/08/16	SITE	STD	D
	0						Large woody debris and flows over gravel.							
970-110000-89500-00000-0000-0000-000-000-000-000-000-000			4	7	1	63	1.0		28	..	2007/08/17	SITE	STD	U
	0						Showing the potential drianage in a moss-covered gully downstream of the trail crossing (Field book for scale).							
970-110000-89500-00000-0000-0000-000-000-000-000-000-000			4	8	1	64	1.0		28	..	2007/08/17	SITE	STD	D
	0						Showing the potential drianage in a moss-covered gully upstream of the trail crossing (pants for scale).							
970-110000-90000-00000-0000-0000-000-000-000-000-000-000			4	9	1	65	1.0			..	2007/08/17	FISH		
	0						122 mm bull trout							
970-110000-90000-00000-0000-0000-000-000-000-000-000-000			4	10	1	66	1.0		29	..	2007/08/17	SITE	STD	U
	0						Looking upstream towards the Skagit River Trail crossing (dry bag for scale).							
970-110000-90000-00000-0000-0000-000-000-000-000-000-000			4	11	1	67	1.0		29	..	2007/08/17	SITE	STD	D
	0						Showing a typical section of the reach below the Skagit River Trail crossing.							
970-110000-90000-00000-0000-0000-000-000-000-000-000-000			4	12	1	68	1.0		29	..	2007/08/17	SITE	STD	U
	0						20 m high bedrock controlled waterfall just upstream of the Skagit River Trail crossing, at the reach 1 / 2 break.							
970-110000-90000-00000-0000-0000-000-000-000-000-000-000			4	13	1	69	1.0		29	..	2007/08/17	SITE	STD	NS
	0						Abandoned mineshaft adjacent to the waterfall.							
970-110000-90700-00000-0000-0000-000-000-000-000-000-000			4	14	1	70	1.0		57	..	2007/08/17	SITE	STD	D
	0						Downstream view towards the confluence of the Sumallo River with the Skagit River (ML for scale).							
970-110000-90700-00000-0000-0000-000-000-000-000-000-000			4	15	1	71	1.0		57	..	2007/08/17	SITE	STD	U
	0						Showing a long glide approximately 300 m upstream from the confluence with the Skagit River (NF for scale; note the depth of the glide).							
970-110000-90700-00000-0000-0000-000-000-000-000-000-000			8	1	1	111	9.0		38	..	2007/08/14	SITE	STD	D
	0						Showing the aggrading channel with multiple braids through the forest (JH for scale).							
970-110000-90700-00000-0000-0000-000-000-000-000-000-000			8	2	1	112	9.0		38	..	2007/08/14	SITE	STD	U
	0						Riffle-pool morphology with functional large woody debris from a root wad (fish bucket for scale).							
970-110000-90700-16500-0000-0000-000-000-000-000-000-000			4	16	1	72	1.0		56	..	2007/08/17	SITE	STD	U
	0						Dry channel immediately upstream of the Highway 3 bridge (JH for scale).							
970-110000-90700-16500-0000-0000-000-000-000-000-000-000			4	17	1	73	1.0		56	..	2007/08/17	SITE	STD	D
	0						Looking towards the confluence with the Sumallo River, downstream of the Highway 3 bridge.							
970-110000-90700-16500-0000-0000-000-000-000-000-000-000			4	18	1	74	1.0		56	..	2007/08/17	SITE	STD	U
	0						Looking upstream from the confluence with the Sumallo River showing the elevated, dry channel.							

Project Watershed Code: 970-110000-00000-00000-0000-0000-000-000-000-000-000-000

WS Code	ILP MAP #	NID MAP #	Photo		Photo CD		Reach	Site	UTM(Zone/East/North)	Date	Type	Foc Len	Foc Dir
Waterbody ID	ILP #	NID #	Roll	Frame	CD #	Image #	Comment						
970-110000-90700-16500-0000-0000-000-000-000-000-000-000			0	1	1	242	2.0	73	..	2007/08/17	SITE	STD	U
	0						View of the boulder-strewn gully through which this creek flows (field book for scale).						
970-110000-90700-16500-0000-0000-000-000-000-000-000-000			0	2	1	243	2.0	73	..	2007/08/17	SITE	STD	D
	0						Minimal flow over bedrock between large boulders (camera case for scale).						
970-110000-90700-21000-0000-0000-000-000-000-000-000-000			2	20	1	30	1.0	60	..	2007/08/15	SITE	STD	D
	0						View of a small wetland adjacent to the Sumallo River downstream of highway 3.						
970-110000-90700-21000-0000-0000-000-000-000-000-000-000			2	21	1	31	1.0	60	..	2007/08/15	SITE	STD	U
	0						Outlet of the 24" corrugated metal pipe culvert, partially obstructed with small woddy debris, at the Highway 3 crossing (map case for scale).						
970-110000-90700-21000-0000-0000-000-000-000-000-000-000			2	22	1	32	1.0	60	..	2007/08/15	SITE	STD	U
	0						View of the channel between the cascade and Highway 3, with gravel substrates (hat for scale).						
970-110000-90700-21000-0000-0000-000-000-000-000-000-000			2	23	1	33	1.0	60	..	2007/08/15	SITE	STD	U
	0						showing the 11 m long section of 30% gradient upstream of the Highway 3 crossing (ML for scale).						
970-110000-90700-21000-0000-0000-000-000-000-000-000-000			2	24	1	34	1.0	60	..	2007/08/15	SITE	STD	U
	0						A typical section of channel upstream of the cascade (map case for scale).						
970-110000-90700-22600-0000-0000-000-000-000-000-000-000			10	16	1	156	3.0	62	..	2007/08/16	SITE	STD	U
	0						Riffle-pool morphology with flows over cobble and gravel (JH for scale).						
970-110000-90700-22600-0000-0000-000-000-000-000-000-000			10	17	1	157	3.0	62	..	2007/08/16	SITE	STD	D
	0						Riffle-pool morphology with large woody debris (cruiser vest for scale).						
970-110000-90700-28900-0000-0000-000-000-000-000-000-000			9	12	1	137	3.0	55	..	2007/08/15	SITE	STD	U
	0						Showing frequent bed drops associated with large woody debris (JH for scale).						
970-110000-90700-28900-0000-0000-000-000-000-000-000-000			9	13	1	138	3.0	55	..	2007/08/15	SITE	STD	D
	0						Showing frequent bed drops associated with large woody debris.						
970-110000-90700-43200-0000-0000-000-000-000-000-000-000			2	25	1	35	1.0	49	..	2007/08/15	SITE	STD	D
	0						Showing the thick, shrubby wetland downstream of the highway.						
970-110000-90700-43200-0000-0000-000-000-000-000-000-000			2	26	1	36	1.0	49	..	2007/08/15	SITE	STD	U
	0						Looking upstream across the small access road adjecent to the highway (formerly used to access a gas station)towards a small gully that likely represents the draiange (NF for scale).						
970-110000-90700-53200-0000-0000-000-000-000-000-000-000			3	16	1	53	7.0		..	2007/08/16	FISH		
	0						205 mm rainbow trout						
970-110000-90700-53200-0000-0000-000-000-000-000-000-000			3	17	1	54	7.0	51	..	2007/08/16	SITE	STD	U
	0						Showing a portion of the 114 m long dewatered section of channel with buried large woody debris (ML for scale).						
970-110000-90700-53200-0000-0000-000-000-000-000-000-000			3	18	1	55	7.0	51	..	2007/08/16	SITE	STD	U
	0						Showing a typical section of channel upstream of the dewatered section (camera case for scale).						

Project Watershed Code: 970-110000-00000-00000-0000-0000-000-000-000-000-000-000

WS Code	ILP MAP #	NID MAP #	Photo		Photo CD		Reach	Site	UTM(Zone/East/North)	Date	Type	Foc Len	Foc Dir
Waterbody ID	ILP #	NID #	Roll	Frame	CD #	Image #	Comment						
970-110000-90700-53200-0000-0000-000-000-000-000-000-000			3	19	1	56	7.0	51	..	2007/08/16	SITE	STD	D
	0						Looking downstream towards the dewatered section. Note the bedrock entrenchment.						
970-110000-90700-53200-7950-0000-000-000-000-000-000-000			3	12	1	50	3.0	53	..	2007/08/16	SITE	STD	U
	0						View of the channel which is dominated by willow overstream vegetation (taken from an open section, 2 m ruler for scale).						
970-110000-90700-53200-7950-0000-000-000-000-000-000-000			3	13	1	51	3.0	53	..	2007/08/16	SITE	STD	D
	0						View of the channel which is dominated by willow overstream vegetation.						
970-110000-90700-53200-7950-0000-000-000-000-000-000-000			3	15	1	52	3.0	53	..	2007/08/16	SITE	STD	U
	0						Aerial view of the upper portion of reach 2. Note the steep gradient and abundance of fallen large woody debris.						
970-110000-90700-63200-0000-0000-000-000-000-000-000-000			8	13	1	123	2.0	48	..	2007/08/16	SITE	STD	D
	0						Cascade-pool morphology with flows over boulder and cobble. Justin can be seen electrofishing under an old forestry bridge.						
970-110000-90700-63200-0000-0000-000-000-000-000-000-000			8	14	1	124	2.0	48	..	2007/08/16	SITE	STD	U
	0						Cascade-pool morphology with flows over boulder and cobble.						
970-110000-90700-63200-0000-0000-000-000-000-000-000-000			8	15	1	125	2.0	48	..	2007/08/16	SITE	STD	U
	0						6 m high waterfall located downstream in reach 1.						
970-110000-90700-70800-0000-0000-000-000-000-000-000-000			8	5	1	115	3.0	47	..	2007/08/14	SITE	STD	U
	0						Flows over cobble and boulder substrates with functional large woody debris (cruiser vest for scale).						
970-110000-90700-70800-0000-0000-000-000-000-000-000-000			8	6	1	116	3.0	47	..	2007/08/14	SITE	STD	D
	0						Scour pool below a bed drop assocatiated with a piece of large woody debris.						
970-110000-90700-70800-0000-0000-000-000-000-000-000-000			8	7	1	117	3.0	47	..	2007/08/14	SITE	STD	U
	0						Short section of cascade-pool morphology associated with boulder substrates near the upper end of the site (metre tape for scale).						
970-110000-90700-72300-0000-0000-000-000-000-000-000-000			8	10	1	120	3.0	45	..	2007/08/14	SITE	STD	U
	0						Large-channel morphology with fine and gravel substrates, and abundant instream vegetation (JH electrofishing for scale).						
970-110000-90700-72300-0000-0000-000-000-000-000-000-000			8	11	1	121	3.0	45	..	2007/08/14	SITE	STD	D
	0						Showing a pool with gravel substrates (JH electrofishing for scale).						
970-110000-90700-72300-0000-0000-000-000-000-000-000-000			8	12	1	122	3.0		..	2007/08/14	FISH		
	0						153 mm rainbow trout						
970-110000-90700-72300-4720-0000-000-000-000-000-000-000			8	8	1	118	1.0	44	..	2007/08/14	SITE	STD	U
	0						Showing no visible stream channel at the mapped location (JH for scale).						
970-110000-90700-72300-4720-0000-000-000-000-000-000-000			8	9	1	119	1.0	44	..	2007/08/14	SITE	STD	D
	0						Rooted vegetation across the basin floor (map for scale).						
970-110000-90700-76400-0000-0000-000-000-000-000-000-000			8	3	1	113	1.0	46	..	2007/08/14	SITE	STD	BD
	0						saturated soils along the basin floor (camera case for scale).						

Project Watershed Code: 970-110000-00000-00000-0000-0000-000-000-000-000-000-000

WS Code / Waterbody ID	ILP MAP # / ILP #	NID MAP # / NID #	Photo Roll	Photo Frame	Photo CD: CD #	Photo CD: Image #	Reach		Site	UTM(Zone/East/North)	Date	Type	Foc Len	Foc Dir
970-110000-90700-76400-0000-0000-000-000-000-000-000-000			8	4	1	114	1.0		46	..	2007/08/14	SITE	STD	U
	0						Shallow draw with rooted vegetation across the basin floor.							
970-110000-91600-00000-0000-0000-000-000-000-000-000-000			2	10	1	20	2.0	2	71	..	2007/08/15	SITE	STD	D
							Showing no visible channel at the mapped inlet to Dry Lake (reach 4).							
970-110000-91600-00000-0000-0000-000-000-000-000-000-000			2	19	1	29	2.0	2	71	..	2007/08/15	SITE	STD	D
							Aerial view of the outlet of Dry Lake. Note that the lake would need to be several metres higher for it to discharge.							
970-110000-91600-00000-0000-0000-000-000-000-000-000-000			2	15	1	25	2.0	1	59	..	2007/08/15	SITE	STD	D
	0						Wetted channel in the lower 30 m if the reach (NF electrofishing for scale).							
970-110000-91600-00000-0000-0000-000-000-000-000-000-000			2	16	1	26	2.0	1	59	..	2007/08/15	SITE	STD	U
	0						Showing the dry channel representative of the majority of the reach (dipnet for scale).							
970-110000-91600-00000-0000-0000-000-000-000-000-000-000			2	17	1	27	2.0	1	59	..	2007/08/15	SITE	STD	U
	0						Showing the confluence of tributary 970-110000-91600-31600, which appears to contribute a significant portion of the surface flows when wetted.							
970-110000-91600-00000-0000-0000-000-000-000-000-000-000			2	18	1	28	2.0	1	59	..	2007/08/15	SITE	STD	D
	0						Showing the confluence of tributary 970-110000-91600-31600, which appears to contribute a significant portion of the surface flows when wetted.							
970-110000-91600-00000-0000-0000-000-000-000-000-000-000			9	8	1	133	5.0		63	..	2007/08/15	SITE	STD	U
	0						Typical cascade-pool morphology with a rock-controlled bed drop (field book for scale).							
970-110000-91600-00000-0000-0000-000-000-000-000-000-000			9	9	1	134	5.0		63	..	2007/08/15	SITE	STD	D
	0						A lower gradient section of the site with large woody debris and flows over cobble and gravel (cruiser vest for scale).							
970-110000-91600-00000-0000-0000-000-000-000-000-000-000			9	10	1	135	5.0		63	..	2007/08/15	SITE	STD	U
	0						2.3 m high bedrock-controlled falls.							
970-110000-91600-00000-0000-0000-000-000-000-000-000-000			9	11	1	136	5.0		63	..	2007/08/15	SITE	STD	D
	0						Showing the dry, dewatered channel that extends downstream to Dry Lake.							
970-110000-91600-29000-0000-0000-000-000-000-000-000-000			2	11	1	21	1.0			..	2007/08/15	FISH		
	0						189 mm Dolly Varden							
970-110000-91600-29000-0000-0000-000-000-000-000-000-000			2	12	1	22	1.0			..	2007/08/15	FISH		
	0						212 mm Dolly Varden or bull trout (not verified)							
970-110000-91600-29000-0000-0000-000-000-000-000-000-000			2	13	1	23	1.0		58	..	2007/08/15	SITE	STD	U
	0						Showing a small bed drop over a piece of large woody debris (NF for scale).							
970-110000-91600-29000-0000-0000-000-000-000-000-000-000			2	14	1	24	1.0		58	..	2007/08/15	SITE	STD	D
	0						Looking towards the confluence with Snass Creek. Note the large Douglas-fir tree, common in the adjacent forest (NF for scale).							
970-110000-94100-00000-0000-0000-000-000-000-000-000-000			15	3	1	227	1.0		87	..	2007/10/22	SITE	STD	U
	0						Showing an undercut bank.							

Project Watershed Code: 970-110000-00000-00000-0000-0000-000-000-000-000-000-000

WS Code	ILP MAP #	NID MAP #	Photo		Photo CD		Reach	Site	UTM(Zone/East/North)	Date	Type	Foc Len	Foc Dir
Waterbody ID	ILP #	NID #	Roll	Frame	CD #	Image #	Comment						
970-110000-94100-00000-0000-0000-000-000-000-000-000-000			15	4	1	228	1.0	87	..	2007/10/22	SITE	STD	D
	0						Large woody debris and associated scour pool.						
970-110000-94100-00000-0000-0000-000-000-000-000-000-000			2	1	1	12	3.0	66	..	2007/08/15	SITE	STD	U
	0						Showing a 0.4 m deep pool behind a large boulder (field book for scale).						
970-110000-94100-00000-0000-0000-000-000-000-000-000-000			2	2	1	13	3.0	66	..	2007/08/15	SITE	STD	D
	0						Showing a representative riffle section at the lower end of the site (NF angling for scale).						
970-110000-94100-00000-0000-0000-000-000-000-000-000-000			9	3	1	128	4.0	67	..	2007/08/15	SITE	STD	U
	0						Typical channel with flows over cobble and boulder (JH for scale).						
970-110000-94100-00000-0000-0000-000-000-000-000-000-000			9	4	1	129	4.0	67	..	2007/08/15	SITE	STD	D
	0						cascade-pool morphology with flows over cobble and boulder (backpack for scale).						
970-110000-94100-00000-0000-0000-000-000-000-000-000-000			9	5	1	130	4.0		..	2007/08/15	FISH		
	0						172 mm rainbow trout						
970-110000-94100-08100-0000-0000-000-000-000-000-000-000			4	5	1	61	1.0	65	..	2007/08/17	SITE	STD	U
	0						Showing the thick alder / fir / cedar forest at the mapped stream location (cruiser vest for scale).						
970-110000-94100-08100-0000-0000-000-000-000-000-000-000			4	6	1	62	1.0	65	..	2007/08/17	SITE	STD	D
	0						Showing the thick alder / fir / cedar forest at the mapped stream location.						
970-110000-94100-43500-0000-0000-000-000-000-000-000-000			2	3	1	14	2.0	64	..	2007/08/15	SITE	STD	BD
	0						Aerial view of the 1.3 m high (estimated) falls downstream in reach 1.						
970-110000-94100-43500-0000-0000-000-000-000-000-000-000			2	4	1	15	2.0	64	..	2007/08/15	SITE	STD	BD
	0						Aerial view of the 1.0 m high (estimated) falls downstream in reach 1.						
970-110000-94100-43500-0000-0000-000-000-000-000-000-000			2	5	1	16	2.0	64	..	2007/08/15	SITE	STD	D
	0						Downstream view of a wide, shallow cobble and boulder riffle (NF electrofishing for scale).						
970-110000-94100-43500-0000-0000-000-000-000-000-000-000			2	6	1	17	2.0	64	..	2007/08/15	SITE	STD	NS
	0						Tailed frog captured at the site.						
970-110000-94100-43500-0000-0000-000-000-000-000-000-000			2	7	1	18	2.0	64	..	2007/08/15	SITE	STD	NS
	0						Tailed frog adjacent to the stream.						
970-110000-94100-43500-0000-0000-000-000-000-000-000-000			2	9	1	19	2.0	64	..	2007/08/15	SITE	STD	U
	0						1.0 m high large woody debris / boulder streambed drop (dipnet for scale).						
970-110000-94100-92600-0000-0000-000-000-000-000-000-000			9	1	1	126	1.0	69	..	2007/08/15	SITE	STD	U
	0						Showing the narrow sub-alpine channel with a trickle of flow over gravel and moss (field book for scale).						
970-110000-94100-92600-0000-0000-000-000-000-000-000-000			9	2	1	127	1.0	69	..	2007/08/15	SITE	STD	D
	0						Showing the narrow sub-alpine channel with a trickle of flow over gravel and moss (camera case for scale).						

Project Watershed Code: 970-110000-00000-00000-0000-0000-000-000-000-000-000-000

WS Code	ILP MAP #	NID MAP #	Photo		Photo CD		Reach		Site	UTM(Zone/East/North)	Date	Type	Foc Len	Foc Dir
Waterbody ID	ILP #	NID #	Roll	Frame	CD #	Image #	Comment							
970-110000-95300-00000-0000-0000-000-000-000-000-000-000			4	1	1	57	1.0		27	..	2007/08/17	SITE	STD	D
	0						Downstream view of the channel 25 m upstream from the confluence with the Skagit River (camera case for scale).							
970-110000-95300-00000-0000-0000-000-000-000-000-000-000			4	2	1	58	1.0		27	..	2007/08/17	SITE	STD	U
	0						2 m high by 5 m long bedrock-controlled caccade, with a 1.5 m falls at the top (field book for scale).							
970-110000-95300-00000-0000-0000-000-000-000-000-000-000			4	3	1	59	1.0		27	..	2007/08/17	SITE	STD	NS
	0						Transforming tailed frog larvae.							
970-110000-95300-00000-0000-0000-000-000-000-000-000-000			4	4	1	60	1.0		27	..	2007/08/17	SITE	STD	BD
	0						Transforming tailed frog larvae.							
970-110000-95300-00000-0000-0000-000-000-000-000-000-000			3	9	1	47	3.0		70	..	2007/08/16	SITE	STD	U
	0						Showing a section of typical riffle-pool channel with lots of large and small woody debris (field book for scale).							
970-110000-95300-00000-0000-0000-000-000-000-000-000-000			3	10	1	48	3.0		70	..	2007/08/16	SITE	STD	D
	0						Riffle-pool channel with willow overstream vegetation (2 m ruler for scale).							
970-110000-95300-00000-0000-0000-000-000-000-000-000-000			3	11	1	49	3.0		70	..	2007/08/16	SITE	STD	U
	0						Aerial view of the 20 m high (estimated) waterfall above the old mine in reach 2.							
970-110000-96700-00000-0000-0000-000-000-000-000-000-000			1	2	1	1	2.0			..	2007/08/14	FISH		
	0						173 mm rainbow trout							
970-110000-96700-00000-0000-0000-000-000-000-000-000-000			1	3	1	2	2.0		26	..	2007/08/14	SITE	STD	U
	0						Upstream view showing the channel with good fish habitat from large woody debris and small boulders, and Devil's club overstream vegetation (ML for scale).							
970-110000-96700-00000-0000-0000-000-000-000-000-000-000			1	4	1	3	2.0		26	..	2007/08/14	SITE	STD	D
	0						Downstream view showing a clump of large woody debris which provides good cover for fish.							
970-110000-96800-00000-0000-0000-000-000-000-000-000-000			1	5	1	4	1.0		25	..	2007/08/14	SITE	STD	U
	0						Outlet of the hanging flat-bottomed culvert conveying flows under Highway 3 (ML and 2 m ruler for scale).							
970-110000-96800-00000-0000-0000-000-000-000-000-000-000			1	6	1	5	1.0		25	..	2007/08/14	SITE	STD	U
	0						Outlet of the hanging 1600 mm CMP culvert under the old gravel pit access road, visible from Highway 3 (ML and electrofisher anode for scale).							
970-110000-96800-00000-0000-0000-000-000-000-000-000-000			1	7	1	6	1.0		25	..	2007/08/14	SITE	STD	U
	0						Representative section of the reach, showing the borderline riffle-pool to cascade-pool morphology.							
970-110000-96800-00000-0000-0000-000-000-000-000-000-000			1	8	1	7	1.0			..	2007/08/14	FISH		
	0						151 mm rainbow trout							
970-110000-96800-00000-0000-0000-000-000-000-000-000-000			1	9	1	8	1.0		25	..	2007/08/14	SITE	STD	NS
	0						151 mm rainbow trout captured at the site.							
970-110000-96800-00000-0000-0000-000-000-000-000-000-000			1	10	1	9	1.0		25	..	2007/08/14	SITE	STD	D
	0						Downstream view showing an accumulation of large and small woody debris.							

Project Watershed Code: 970-110000-00000-00000-0000-0000-000-000-000-000-000-000

WS Code	ILP MAP #	NID MAP #	Photo		Photo CD		Reach		Site	UTM(Zone/East/North)	Date	Type	Foc Len	Foc Dir
Waterbody ID	ILP #	NID #	Roll	Frame	CD #	Image #	Comment							
970-110000-97000-00000-0000-0000-000-000-000-000-000-000			1	11	1	10	1.0		24	..	2007/08/14	SITE	STD	U
	0						Step-pool morphology typical of the reach, with angular boulder, cobble, and gravel substrates.							
970-110000-97000-00000-0000-0000-000-000-000-000-000-000			1	12	1	11	1.0		24	..	2007/08/14	SITE	STD	D
	0						Showing a section of interstitial flow between large cobble and boulder, opening into a gravel-dominated section.							
970-110000-98800-00000-0000-0000-000-000-000-000-000-000			3	4	1	42	1.0		21	..	2007/08/16	SITE	STD	U
	0						Typical riffle-pool sequence, with gravel riffles and alder riparian vegetation.							
970-110000-98800-00000-0000-0000-000-000-000-000-000-000			3	5	1	43	1.0		21	..	2007/08/16	SITE	STD	D
	0						Showing a section with an abundance of functional large woody debris.							
970-110000-98800-00000-0000-0000-000-000-000-000-000-000			3	6	1	44	1.0			..	2007/08/16	FISH		
	0						199 mm rainbow trout							
970-110000-98800-24900-0000-0000-000-000-000-000-000-000			3	7	1	45	1.0		22	..	2007/08/16	SITE	STD	U
	0						1.3 m high wedge formed behind an old piece of large woody debris, which forms a non-permanent barrier to upstream fish migration (handheld VHF radio for scale).							
970-110000-98800-24900-0000-0000-000-000-000-000-000-000			3	8	1	46	1.0		22	..	2007/08/16	SITE	STD	D
	0						typical section of channel (camera case for scale).							

Appendix 4.

Non-fish bearing status reports.

NON-FISH BEARING STATUS REPORT

Administrative:

Site:	4	
WSC:	970-110000-84800-33200-6380	**Reach:** 2
Date Surveyed:	August 20^{th}, 2007	
Sample Method(s):	Electrofishing	
Sampling Effort:	752 seconds	
Length surveyed:	200 m	

Stream Conditions:

Flow Stage:	Moderate
Conductivity:	30 μS/cm
Water Temperature:	6.1˚C
Turbidity:	Clear

Habitat Conditions:

Average Channel Width:	4.9 m
Average Site Gradient:	1.5%
Comments:	Good quality fish rearing habitat was noted, with moderate spawning habitat potential.

Supporting Evidence:

Upstream / Downstream Fish: This stream discharges into the top of reach 5 of Maselpanik Creek, which is suspected fish bearing. Rainbow trout were captured at the bottom of reach 5 of Maselpanik Creek, 3.9 km downstream of the confluence with this stream, and no barriers are believed to be present. Limited potential fish habitat exists in upstream reaches and tributaries, as all except reach 3 have average gradients exceeding 30%.

Availability of Overwintering Habitat: Overwintering habitat within the surveyed section was limited, though the occasional pool may have sufficient depth for juvenile fish. No lakes or ponds are present in upstream reaches or tributaries.

Barriers: A 6 m high, 12 m long (estimated from a helicopter) bedrock cascade / chute located downstream in reach 1 forms a definite barrier to upstream fish migration.

Comments: Due to the lack of fish captured by electrofishing in good quality fish rearing habitat above a definite barrier to fish migration, and the lack of potentially suitable habitats in upstream reaches and tributaries, this stream can be considered non-fish bearing upstream of the bedrock cascade barrier located downstream in reach 1.

NON-FISH BEARING STATUS REPORT

Administrative:

Site:	16	
WSC:	970-110000-80900-78900	**Reach:** 2
Date Surveyed:	August 16th, 2007	
Sample Method(s):	Electrofishing	
Sampling Effort:	697 seconds	
Length surveyed:	175 m	

Stream Conditions:

Flow Stage:	Moderate
Conductivity:	90 µS/cm
Water Temperature:	9.1˚C
Turbidity:	Clear

Habitat Conditions:

Average Channel Width:	4.4 m
Average Site Gradient:	5.5%
Comments:	Rearing habitat quality for bull trout and/or Dolly Varden was determined to be moderate, but low spawning habitat potential was noted.

Supporting Evidence:

Upstream / Downstream Fish: The stream eventually discharges into reach 7 of Nepopekum Creek, between Derek and Shadow Falls. No fish have been captured above these falls, though their presence cannot be conclusively ruled out. No additional sample sites are located upstream.

Availability of Overwintering Habitat: Overwintering habitat within the surveyed section was limited, though the occasional pool may have sufficient depth for juvenile fish. A small, 0.5 ha lake is located at the headwaters of a small tributary upstream of the sample site.

Barriers: Nepopekum Falls is located downstream at the reach 1 / 2 break, and forms a definite barrier to upstream fish migration. A 1.9 m high falls was found at the top of the surveyed section, which also forms a barrier to fish.

Comments: Due to the lack of fish captured by electrofishing in moderate quality fish rearing habitat above a definite barrier to fish migration, and the lack of potentially suitable habitats in upstream reaches and tributaries, this stream can be considered non-fish bearing upstream of Nepopekum Falls.

NON-FISH BEARING STATUS REPORT

<u>**Administrative:**</u>

Site:	17		
WSC:	970-110000-70500-83500	**Reach:**	3
Date Surveyed:	August 16th, 2007		
Sample Method(s):	Electrofishing		
Sampling Effort:	661 seconds		
Length surveyed:	150 m		

<u>**Stream Conditions**</u>:

Flow Stage:	Moderate
Conductivity:	30 μS/cm
Water Temperature:	7.0˚C
Turbidity:	Clear

<u>**Habitat Conditions:**</u>

Average Channel Width:	6.6 m
Average Site Gradient:	1.5%
Comments:	Good quality fish rearing habitat was noted, and moderate quality spawning habitat was also observed.

<u>**Supporting Evidence:**</u>

Upstream / Downstream Fish: This stream discharges into reach 3 of Lightning Creek, a known fish bearing watercourse. Upstream reaches and tributaries have high gradients and many are unlikely to contain suitable fish habitat.

Availability of Overwintering Habitat: Moderate value overwintering habitat was noted in the section surveyed, associated with deep scour pools under LWD piles.

Barriers: A 6 m high, 20 m long (estimated from a helicopter) bedrock cascade located downstream at the reach 1 / 2 break forms a definite barrier to upstream fish migration.

Comments: Due to the lack of fish captured by electrofishing in good quality fish rearing habitat above a definite barrier to fish migration, and the lack of potentially suitable habitats in upstream reaches and tributaries, this stream can be considered non-fish bearing upstream of the bedrock cascade barrier located downstream at the bottom of reach 2.

NON-FISH BEARING STATUS REPORT

Administrative:

Site:	24	
WSC:	970-110000-97000	**Reach:** 1
Date Surveyed:	August 14th, 2007	
Sample Method(s):	Not sampled	
Sampling Effort:	n/a	
Length surveyed:	150 m	

Stream Conditions:

Flow Stage:	Intermittent
Conductivity:	120 µS/cm
Water Temperature:	10.0˚C
Turbidity:	Clear

Habitat Conditions:

Average Channel Width:	1.8 m
Average Site Gradient:	28.3%
Comments:	Fish rearing habitat is of low value due to the steep gradient and limited stream discharge volume.

Supporting Evidence:

Upstream / Downstream Fish: Discharges directly into the Skagit River. The reach has a small upslope catchment area, and upstream reaches and tributaries are too steep to provide suitable fish habitat.

Availability of Overwintering Habitat: None available. The stream has insufficient discharge volume and inadequate residual pool depths.

Barriers: This reach maintains a gradient of over 20% over the entire surveyed section, which forms a definite barrier to upstream fish migration.

Comments: Due to the steep gradient, intermittent flow, poor overall quality of fish habitat, and lack of potential perennial fish habitat in this reach or in upstream reaches and tributaries, the reach can be managed as non-fish bearing.

NON-FISH BEARING STATUS REPORT

Administrative:

Site:	27, 70	
WSC:	970-110000-95300	**Reach:** 1
Date Surveyed:	August 16th-17th, 2007	
Sample Method(s):	Electrofishing	
Sampling Effort:	748 seconds (reach 1), 574 seconds (reach 3)	
Length surveyed:	200 m (reach 1), 150 m (reach 3)	

Stream Conditions (reach 1):

Flow Stage:	Moderate
Conductivity:	130 µS/cm
Water Temperature:	9.0˚C
Turbidity:	Clear

Habitat Conditions (reach 1):

Average Channel Width:	5.3 m
Average Site Gradient:	14.5%
Comments:	Good quality fish rearing habitat is present, and pockets of suitable spawning substrates were noted at pool tail-outs.

Supporting Evidence:

Upstream / Downstream Fish: This stream discharges directly into the Skagit River, a known fish-bearing watercourse. Additional barriers to fish migration are located 3 km upstream.

Availability of Overwintering Habitat: Overwintering habitat within the section surveyed in reach 1 was good, due to the abundance of deep, rock-controlled pools and the good discharge volume. No overwintering habitat was identified in reach 3.

Barriers: A 2 m high, 5 m long bedrock cascade is located 25 m upstream from the confluence with the Skagit River, and forms a definite barrier to upstream fish migration. Additionally, a 1.5 m high falls is located just upstream of the cascade. A 20 m high falls is located in reach 2 above an abandoned mine site.

Comments: Due to the lack of fish captured in 748 seconds of electrofishing upstream of the barrier in high value fish rearing habitat, this reach (upstream of the lower 25 m), and all upstream reaches and tributaries, can be considered non-fish bearing.

NON-FISH BEARING STATUS REPORT

<u>Administrative:</u>

Site:	47	
WSC:	970-110000-90700-70800	**Reach:** 3
Date Surveyed:	August 14th, 2007	
Sample Method(s):	Electrofishing	
Sampling Effort:	719 seconds	
Length surveyed:	160 m	

<u>Stream Conditions</u>:

Flow Stage:	Moderate
Conductivity:	70 μS/cm
Water Temperature:	9.1˚C
Turbidity:	Clear

<u>Habitat Conditions:</u>

Average Channel Width:	4.7 m
Average Site Gradient:	8.0%
Comments:	High value fish rearing habitat is present throughout the section surveyed. Spawning habitat value was assessed as low.

<u>Supporting Evidence:</u>

Upstream / Downstream Fish: This stream discharges into reach 8 of the Sumallo River, a known fish bearing watercourse. Upstream reaches and tributaries are steep and are unlikely to provide significant fish rearing habitats.

Availability of Overwintering Habitat: Overwintering habitat value was low overall in the section surveyed, though a few pools may have sufficient depth. No ponds or lakes are located upstream.

Barriers: The average gradient of reach 2 downstream is 21%, and was observed from the helicopter to have several steeper chutes and bed drops which impede fish passage. A section of bedrock confinement at the downstream end of the survey site also had numerous chutes and bed drops that cumulatively form a barrier to fish passage.

Comments: Due to the lack of fish captured in 719 seconds of electrofishing in high value fish rearing habitat above a reach with an average gradient > 20%, where several small chutes and bed drops were noted that form a cumulative barrier to fish migration, this reach and all upstream reaches and tributaries can be managed as non-fish bearing.

NON-FISH BEARING STATUS REPORT

<u>Administrative:</u>

Site:	53		
WSC:	970-110000-90700-53200-7950	**Reach:**	3
Date Surveyed:	August 16^{th}, 2007		
Sample Method(s):	Electrofishing		
Sampling Effort:	462 seconds		
Length surveyed:	150 m		

<u>Stream Conditions</u>:

Flow Stage:	Moderate
Conductivity:	60 µS/cm
Water Temperature:	8.0˚C
Turbidity:	Clear

<u>Habitat Conditions:</u>

Average Channel Width:	2.8 m
Average Site Gradient:	0.7%
Comments:	Moderate to low rearing habitat quality was observed in this wetland reach with thick willow overstream vegetation. Substrates were exclusively fines, and therefore no spawning habitat exists.

<u>Supporting Evidence:</u>

Upstream / Downstream Fish: This stream is a tributary to reach 8 of Ferguson Creek, which is suspected to be fish bearing. Fish were captured in the lower portion of reach 7 of Ferguson Creek. The watershed has a small upslope catchment area and all tributaries are too steep to provide potential fish habitat.

Availability of Overwintering Habitat: None. No suitably deep pools were observed and the discharge volume is insufficient.

Barriers: Reach 2 downstream has an average gradient of 28%, and was observed from the helicopter to have significant vertical drops and bedrock chutes which form a definite barrier to fish migration.

Comments: Due to the lack of significant fish habitat, lack of fish captured in 462 seconds of electrofishing, and presence of a definite barrier to fish migration downstream in reach 2, this reach and all upstream reaches and tributaries can be considered non-fish bearing.

NON-FISH BEARING STATUS REPORT

Administrative:

Site:	60	
WSC:	970-110000-90700-21000	**Reach:** 1
Date Surveyed:	August 15th, 2007	
Sample Method(s):	Electrofishing	
Sampling Effort:	259 seconds	
Length surveyed:	100 m	

Stream Conditions:

Flow Stage:	Moderate
Conductivity:	210 µS/cm
Water Temperature:	10.0˚C
Turbidity:	Clear

Habitat Conditions:

Average Channel Width:	1.1 m
Average Site Gradient:	4.0%
Comments:	Only very poor quality fish rearing habitat is present due to the small stream size and low discharge volume. Spawning habitat potential is also poor, despite the presence of gravels, due to the small stream size.

Supporting Evidence:

Upstream / Downstream Fish: This stream is a direct tributary to the Sumallo River, a known fish bearing watercourse. The stream is 1st order (no tributaries), and reach 2 upstream has an average gradient of 50% and is unlikely to contain any suitable fish habitat.

Availability of Overwintering Habitat: None, the stream is too small, and lacks sufficient pool depths and discharge volume.

Barriers: An 11 m long 30% gradient cascade barrier is present just upstream of the Highway 3 crossing which forms a definite barrier to upstream fish migration.

Comments: This stream veers to the east of its mapped location, crossing highway 3 approximately 150 m east of the mapped crossing. Downstream of the highway, the stream enters a marsh surrounding the Sumallo River, where the channel becomes poorly defined (though fish passage may be possible during high flow events in the Sumallo River). The 24” culvert at the highway crossing is partially obstructed with small woody debris at the inlet, and may form a non-permanent obstruction to fish passage. Sampling both upstream and downstream of the short, 30% gradient cascade barrier did not result in the capture of any fish, thus the stream can be managed as non-fish bearing upstream from the cascade.

NON-FISH BEARING STATUS REPORT

Administrative:

Site:	63	
WSC:	970-110000-91600	**Reach:** 5
Date Surveyed:	August 15th, 2007	
Sample Method(s):	Electrofishing	
Sampling Effort:	658 seconds	
Length surveyed:	650 m	

Stream Conditions:

Flow Stage:	Moderate
Conductivity:	120 µS/cm
Water Temperature:	10.5˚C
Turbidity:	Clear

Habitat Conditions:

Average Channel Width:	4.0 m
Average Site Gradient:	12.3%
Comments:	Moderate rearing habitat for bull trout and/or Dolly Varden was noted throughout the surveyed section, but spawning habitat value was assessed as low.

Supporting Evidence:

Upstream / Downstream Fish: Fish are known to be present downstream in reach 2-1. No additional sampling occurred in upstream reaches or tributaries, though the entire watercourse was surveyed by helicopter.

Availability of Overwintering Habitat: No overwintering habitat was identified as pools did not have sufficient depth.

Barriers: Snass Creek flows subsurface downstream through reach 4, and does not emerge until the reach 2-1 / 2-2 break, a distance of 2.9 km. This section of underground flow, which may be piped but likely filters through course substrates, is a barrier to all upstream fish migration. A 2.3 m high waterfall in this reach also forms a barrier, though no fish are present downstream of it.

Comments: Due to the lack of fish captured in 658 seconds of electrofishing above a long section of underground flow which forms a definite barrier to fish migration, and the presence of barriers in this reach which occurs upstream of the underground flow, Snass Creek can be considered non-fish bearing upstream of reach 3 (Dry Lake), including all tributary reaches.

NON-FISH BEARING STATUS REPORT

<u>Administrative:</u>

Site:	68	
ILP:	11970	**Reach:** 1
Date Surveyed:	August 15th, 2007	
Sample Method(s):	Not Sampled	
Sampling Effort:	n/a	
Length surveyed:	125 m	

<u>Stream Conditions</u>:

Flow Stage:	Moderate
Conductivity:	110 µS/cm
Water Temperature:	11.2˚C
Turbidity:	Clear

<u>Habitat Conditions:</u>

Average Channel Width:	0.39 m
Average Site Gradient:	7.5%
Comments:	Only very poor quality juvenile rainbow trout rearing habitat is present due to the very small steam size and low discharge volume. No potential spawning habitat is present.

<u>Supporting Evidence:</u>

Upstream / Downstream Fish: The nearest confirmed fish presence is 2.3 km downstream in reach 4 of the Skaist River. This stream is a short, 1st order reach.

Availability of Overwintering Habitat: No overwintering habitat is present due to the very small stream size and lack of pools. The stream discharges into a small, 1.7 ha lake which may provide suitable overwintering habitat.

Barriers: No definite barriers to upstream fish migration were identified, though fish passage through sections of poor channel definition and very shallow flows is unlikely.

Comments: Due to the presence of only very poor quality fish rearing habitat, and the small stream size with insufficient discharge volume to sample with an electrofisher, the steep gradients that occur downstream prior to any connection with a fish bearing watercourse, this short, 1st order stream can be managed as non-fish bearing.

NON-FISH BEARING STATUS REPORT

<u>Administrative:</u>

Site:	80	
WSC:	970-110000-82500	**Reach:** 3
Date Surveyed:	August 19th, 2007	
Sample Method(s):	Electrofishing	
Sampling Effort:	717 seconds	
Length surveyed:	120 m	

<u>Stream Conditions</u>:

Flow Stage:	Moderate
Conductivity:	50 μS/cm
Water Temperature:	9.6˚C
Turbidity:	Clear

<u>Habitat Conditions:</u>

Average Channel Width:	6.9 m
Average Site Gradient:	10.5%
Comments:	Moderate rearing habitat was noted, but may be limited by frequent log drops that would impede fish passage. Low spawning habitat potential was identified.

<u>Supporting Evidence:</u>

Upstream / Downstream Fish: Shawatum Creek discharges into the Skagit River, a known fish bearing watercourse. No additional upstream sampling was conducted.

Availability of Overwintering Habitat: Overwintering habitat potential was identified as low in the sections surveyed, though the occasional pool may have sufficient depth. Two small lakes occur upstream (2.5 ha and 1.2 ha) in reaches 7 and 9 which may be suitable, but these lakes occur upstream of very steep gradient reaches (> 50%).

Barriers: Reach 2 of Shawatum Creek occurs on an alluvial fan, and all surface discharge seeps into the coarse fan substrates, and channel definition is eventually lost (see site 9). No sign of any significant surface water occurs at the Silver-Skagit Road crossing, and in fact, no culvert was located, indicating that the flows are widely dissipated and/or are deep underground. This lack of any defined channel forms a definite barrier to upstream fish migration.

Comments: Since the alluvial fan in reach 2 forms a definite barrier to upstream fish migration, and no fish were captured in reach 3 in moderate quality fish habitat in 717 seconds of electrofishing, Shawatum Creek upstream of reach 2, including all tributaries, can be considered non-fish bearing.

Attachment 1.

Pre-field Planning Report.

Attachment 2.

Edited Overflight Video Footage.

Attachment 3.

Digital Deliverables.

Attachment 4.

Original RISC Field Cards.