Reconnaissance (1:20,000) Fish and Fish Habitat Inventory Re-sampling of Peter-Aleck Creek upstream of Owen Lake

Watershed Code: unknown (drainage pattern differs from watershed atlas)

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EXECUTIVE SUMMARY

Reconnaissance level fish and fish habitat inventory of streams in the upper Peter-Aleck watershed was initiated in 2001. Re-sampling of streams in the watershed in 2005 has concluded a broad scale fish inventory for the study area, based on 1:20,000 TRIM (Terrain Resource Information Management) map data. While stream classification of some sampled reaches remains uncertain, fish distribution in the upper Peter Aleck Creek mainstem and most of its tributaries is well understood. Future fish inventory efforts can therefore focus on isolated cases where fish distribution remains unclear, and on operational needs. This report summarizes past fish inventory efforts and results in context with data collected during re-sampling to present a comprehensive picture of fish distribution in the upper Peter-Aleck drainage.

The upper Peter-Aleck watershed is a fourth order system that drains into the south end of Owen Lake (Morice drainage). This drainage pattern is contrary to the drainage pattern of the system depicted on NTS (National Topographic Survey) and TRIM (Terrain Resource Information Management) mapsheets, and identified in the watershed atlas, where it is shown to drain into the Nadina River (Nechako watershed) via the lower Peter-Aleck system. The upper Peter-Aleck Creek, upstream of Owen Lake, actually drains through a large wetland at the south end of Owen Lake to the north into Owen Lake, rather than veering to the south into the Nadina River. The broad wetland located south of Owen Lake, between the Nadina River and Owen Creek watershed and surrounding the lower reaches of upper Peter-Aleck Creek, is a potential cross-over location for fish between the Morice (Skeena) and Nadina (Fraser) system.

Re-sampling was conducted to fulfill re-sampling requirements identified during initial reconnaissance level fish and fish habitat inventories conducted in 2001. Fish and fish habitat inventory and operational inventory in 2001 and 2005 has resulted in sampling of 31 reaches (21.1% of reaches in the study area), with information on three additional sample sites available from operational inventory conducted in 1997 and 1998. A total of 13 sites representing 11 reaches (35.5% of sampled reaches) in 10 streams were re-sampled in June 2005. The only fish species captured during resampling was Dolly Varden (*Salvelinus malma*). In addition to this species, rainbow trout (*Oncorhynchus mykiss*) were captured during previous fish sampling in the Peter-Aleck watershed. While several other species have been documented in the Owen watershed, none of these have been captured even though many of the mainstem reaches of Peter-Aleck Creek appear to have suitable spawning and overwintering habitat for anadromous fish (e.g. coho). The lower reach of Peter-Aleck Creek contains a series of beaver dam complexes and appears to be a significant obstruction to fish passage at many flows, but this reach has not been sampled and may be used by other species documented present in the Owen Creek watershed (e.g. coho, cutthroat, whitefish, burbot, ...).

Dolly Varden was the most widespread species captured in the Peter-Aleck watershed. This species was captured at 11 of the 28 sites sampled during the initial inventory effort in 2001, and was the only species captured during re-sampling. Dolly Varden are found throughout most of the mainstem, and lower reaches of higher order tributaries. This species has been confirmed present in the lower 23.76 km of the 24.49 km mainstem, extending almost to the headwaters of the system. Rainbow trout were captured upstream to reach 6 of the mainstem (13.79 km upstream of Owen Lake). Mainstem habitat appears to be the most important fluvial habitat for

Dolly Varden and rainbow trout in the system. Dolly Varden and rainbow trout captured in the lower reaches of Peter-Aleck Creek, near Owen Lake, are speculated to possibly have an adfluvial life history strategy, but appear to be partially isolated fluvial populations due to significant obstructions to fish passage in reach 1.

Results of this re-sampling project were combined with historical fish information to provide an overview of fish distribution based on stream size, gradient and elevation. All of the 3rd, and 4th order reaches in the upper Peter-Aleck watershed were found to be fish bearing. Typical to trends observed in other watershed in central BC, proportions of non-fish bearing and suspected non-fish bearing reaches increased in conjunction with smaller drainage size (as indicated by stream order), and higher gradients. This is speculated to be due to low summer flows and lack of overwintering habitat in smaller streams. Many lower order reaches (1st and 2nd order) were also found to be ephemeral, or to lack a defined channel in lower gradient and lower elevation zones. Interestingly, all fish bearing reaches where fish have been captured in the project area have been below 1200 metres in elevation, and had gradients less than 13%, and channel widths greater than 1.2 m. Not surprisingly, fish distribution appears to be strongly tied to the proximity to optimal perennial fish habitat (overwintering, spawning and rearing) in Owen Lake, and the mainstem valley bottom of Peter-Aleck Creek.

PROJECT SUMMARY SHEET

PROJECT REFERENCE INFORMATION

MSR Project #:	HFP-SKR-001-2005
FDIS Project #:	948 Resampling
MSR Region:	Prince Rupert Region (06)
MSR District:	not applicable
FW Management Unit:	06-09
Fisheries Planning Unit:	not applicable
DFO Subdistrict:	Prince George (1)
Forest Region:	Prince Rupert
Forest District:	Nadina Forest District
Forest Licensee & Tenure #:	Houston Forest Products, FLA – 16827
First Nations Claim Area:	Wet'suwet'en Nation, Carrier Sekani

WATERSHED INFORMATION

Watershed Group	MORR
Watershed Name	Morice River
Watershed Code	Unknown (portion of Peter-Aleck that drains into Owen Lake)
UTM at Mouth	9.649223.599231
Watershed Area	79.38 km^2 (study areas only)
Total of all stream lengths	118.28 km
Stream Order	4
NTS Maps (1:50,000)	93L/02 (study areas only)
TRIM Maps	093L.006, 093L.005 (study area only)
BEC Zone	SBSmc, SBSdk, ESSFmc
Air Photos	30BCC 96111 No. 88-89, 92-101 (study area only) 30BCC 96156 No. 46-47 (study area only) 30BCC 96138 No. 175-180 (study areas only)

SAMPLING DESIGN

Total # of Reaches	146 (in study area)
Sites sampled in 2001	28
Re- Sampling Sites	7 (7 proposed)
Added Value Sites	6 (3 discretionary)
Total Sample Sites	13 (10 proposed)
Field Sampling Dates	June 26 and 28, 2005
Fish Species in Watershed	RB, DV

CONTRACTOR INFORMATION

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DISCLAIMER

This product has been accepted as being in accordance with the approved standards within the limits of the Ministry quality assurance procedures.

ACKNOWLEDGEMENTS

Funding for this project was provided by Forest Investment Account (FIA) and Houston Forest Products Co. (HFP), Houston, B.C. The contract was administered and monitored by Jaret van der Giessen for HFP. Helicopter services were provided by Highland Helicopters, and the help and effort of Ryan Buchanan is greatly appreciated. Editorial comments on drafts of this report were provided by Jaret van der Giessen (HFP), and Ron Saimoto (SKR Consultants Ltd.).

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Appendix 2. Photodocumentation Forms 1 and 2.
Appendix 3. Watershed relationship summary table for the Peter-Aleck watershed, using criteria described in Witt and Giroux (1999).
Appendix 4. QA/QC
Appendix 5. 1:20,000 Fisheries Project/Interpretive Maps for Peter-Aleck Creek watershed.

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Digital Project Overview Map
Digital Fisheries Project and Interpretive Maps
ArcView shape files for sites, reach gradient, reach features, and historical information
Photograph CD
Digital reports
Digital FDIS database

1.0 INTRODUCTION

The upper portion of the Peter-Aleck Creek watershed, upstream of Owen Lake, was inventoried in August 2001 and June 2005 to assess fish habitat characteristics and to investigate the diversity, population characteristics, and distribution of fish in the study area. The lower portion of Peter-Aleck Creek (WSC 180-374000-95200-99500-2270) drains into the Nadina River. The creek has been mis-mapped upstream of Park Lake, since the upper portion of Peter-Aleck Creek does not drain into the Nadina River system (Nechako River system), but drains to the north into the southern end of Owen Lake (Morice River drainage, Bulkley River system). The portion of the Peter-Aleck Creek that connects to the Morice River system via Owen Lake was inventoried in 2001 and re-sampled in 2005. SKR Consultants Ltd. was retained by Houston Forest Products Co. (Houston, B.C.) to conduct these surveys. The initial sampling project was jointly funded by Forest Renewal B.C. (FRBC) and Houston Forest Products Co. (HFP), and re-sampling in 2005 was funded by the Forest Investment Account (FIA) and HFP. This report summarizes the results of the initial and follow up reconnaissance level stream inventory project that was conducted in the Peter-Aleck watershed.

1.1 OBJECTIVES

The main objectives of the 1:20,000 fish and fish habitat reconnaissance level stream inventory project in the Peter-Aleck watershed were:

- to review and summarize historical fisheries information for the study area,
- to describe fish distribution and diversity by conducting a 1:20,000 fish inventory,
- to document barriers to fish passage,
- to document fish habitat characteristics,
- to identify further sampling requirements, and
- to classify reaches sampled according to the B.C. Forest Practices Code Fish – Stream Identification guidebook (FPC 1998).

1.2 LOCATION

Peter-Aleck Creek is located in the Morice Forest District within the Prince Rupert Region (Ministry of Forests, Ministry of Sustainable Resources). The upper portion of Peter-Aleck Creek drains into the Morice River via Owen Lake and Owen Creek, and is not connected to the lower reaches of Peter-Aleck Creek (WSC 180-374000-95200-99500-2270), which drain into the Nadina River (Nechako River watershed).

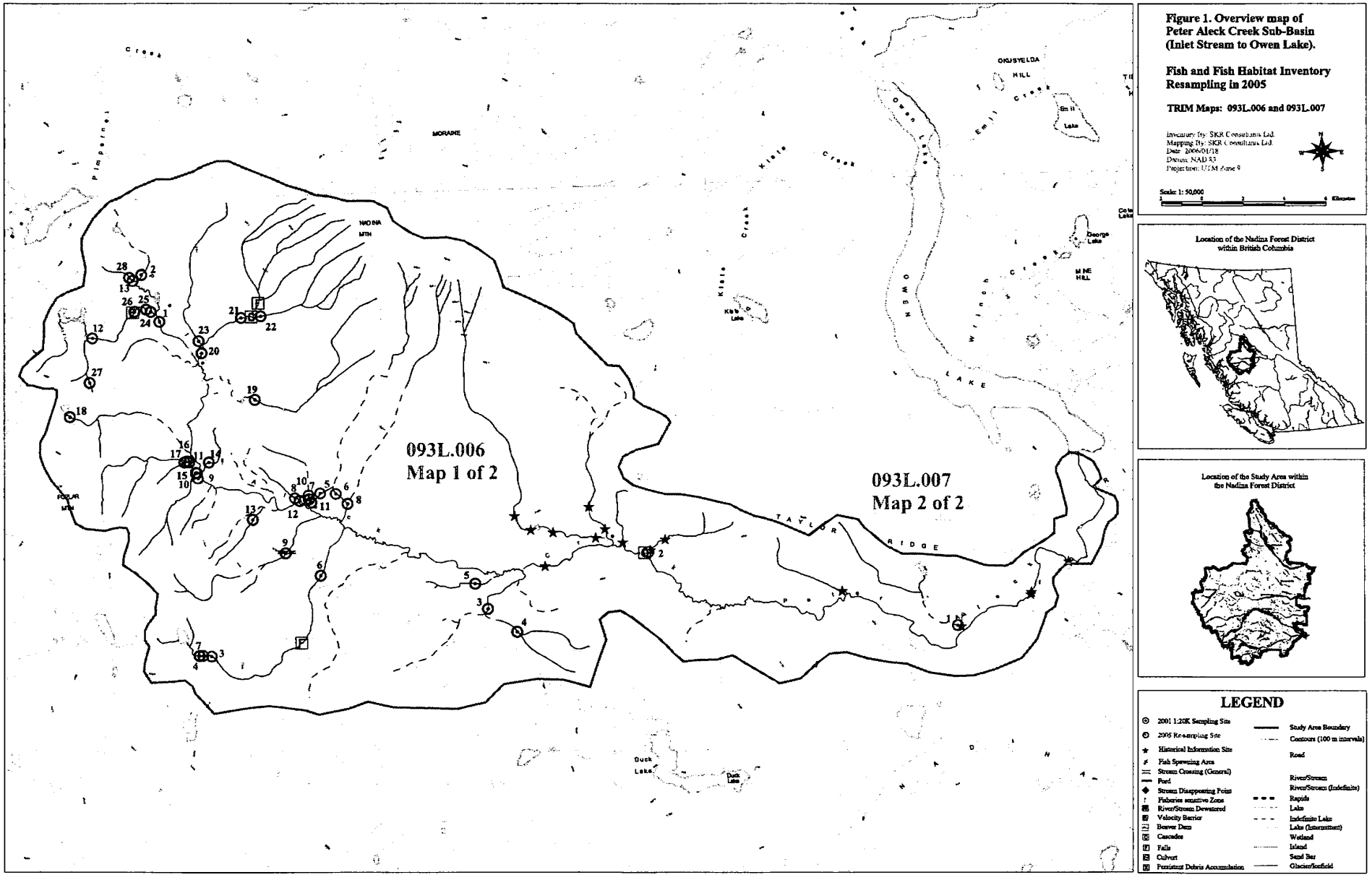

Figure 1. Overview map of Peter Aleck Creek Sub-Basin (Inlet Stream to Owen Lake).

Fish and Fish Habitat Inventory Resampling in 2005

TRIM Maps: 093L.006 and 093L.007

Inventory By: SKR Consultants Ltd.
Mapping By: SKR Consultants Ltd.
Date: 2006/01/18
Datum: NAD 83
Projection: UTM Zone 9

Scale: 1: 50,000

1.2.1 ACCESS

The study area was accessed by vehicle and helicopter. To access the area by vehicle, proceed west from the Houston town center along Highway 16 for approximately 5 km. Turn left onto the Morice River Forest Service Road (FSR). At 27 km the Morice River FSR veers to the right, and the Morice – Owen FSR continues straight. Take the Morice – Owen FSR past Owen Lake and the Owen Lake Resort. Turn left at 48 km onto the Morice – Tahtsa Road, and continue for 5.1 km. Turn right onto the road that is located along the north shore of Duck Lake. This road and associated spur roads can be used to access the study area.

1.3 HISTORICAL INFORMATION

The portion of Peter-Aleck Creek sampled in August 2001 and June 2005 drains into Owen Lake, rather than connecting to lower reaches of Peter-Aleck Creek. However, due to the mis-mapped drainage pattern, Peter-Aleck Creek was not included in previous inventories conducted in the Owen Creek watershed (Bustard 1999). Fish documented present in the Owen watershed include rainbow trout and steelhead (*Oncorhynchus mykiss*), coho (*O. kisutch*), cutthroat trout (*O. clarki*), Dolly Varden (*Salvelinus malma*), lake trout (*S. namaycush*), mountain whitefish (*Prosopium williamsoni*), burbot (*Lota lota*), pygmy whitefish (*Prosopium coulteri*), redside shiner (*Richardsonius balteatus*), largescale sucker (*Catostomus macrocheilus*), longnose sucker (*Catostomus catostomus*), northern pike minnow (*Ptychocheilus oregonensis*), longnose dace (*Rhinichthys cataractae*) and peamouth chub (*Mylocheilus caurinus*) (FISS, Bustard 1999, SKR 1998, 1999, 2001a, 2002). Operational inventory in Peter-Aleck Creek has resulted in the capture of Dolly Varden and rainbow trout in the mainstem of Peter-Aleck Creek, and some of its tributaries (SKR 1998, 1999, 2002).

2.0 RESOURCE USE

The Peter-Aleck Creek watershed consists of public and private land, and as such is utilized by several resource sectors.

1. First Nations issues and interests in the study area:
   - The Wet'suwet'en Nation has claimed a portion of the Nadina watershed as part of their traditional territories. The Wet'suwet'en Nation is in Stage 4 of the treaty process (B.C. Treaty Commission 2005).
2. Development and land use: forestry, mining, recreation:
   - The study area falls into forest license FLA-16827 (HFP) and harvesting and road building is in varying stages of planning and or development. Harvesting and road development in the area is proposed to 2007 (HFP 2001).
   - Owen Hill, an old fire lookout which provides extensive view of the Owen area and Peter-Aleck Creek system, is located to the north of the study area. The Nadina Mountain Trail runs approximately 2.5 to 3 km north of the proposed extension of the Peter Main Access road (MoF 1997).
   - A mineral tenure exists within the Peter-Aleck Creek watershed (adjacent to the east side of CP 364-2), and the Peter Main access road is planned to pass through this tenure (Ministry of Employment and Investment, 2000)
   - The guide outfitter territories in the study area are 609G004 and 609G006 and the trapline territory is 604T046. The Poplar Lake Range unit also exist within the study area (HFP 2001).
3. Impacts and uses by wildlife:
   - A comprehensive inventory of wildlife species does not exist for the Morice Forest District. However, several rare and endangered wildlife species are known or suspected to utilize habitat in the upper Peter-Aleck Creek and Owen watersheds, including Grizzly bear (*Ursus arctos*), wolverine (*Gulu gulu luscus*), and fisher (*Martes pennanti*) (Horn and Tamblyn 2000). Other wildlife species of interest include moose and deer.
   - Mountain goat winter range studies have been conducted on the south side of Nadina Mountain, which feeds the Peter-Aleck watershed (Turney personal communications).
4. Other developments, concerns or points of interest:
   - No Protected Areas Strategy (PAS) study sites are known to exist within the portion of the Peter – Aleck Creek watershed that drains into Owen Lake.
   - No water licences exist in the Peter-Aleck Creek watershed, and no community watersheds are located in the study area (Ministry of Sustainable Resources 2005).
5. Existing water quality data:
   - No existing water quality data was available at the time of survey.
6. Previous presence of fish in systems of interest:
   - Fish presence previously documented in the study area is summarized in table 1. The section of Peter-Aleck Creek included in table 1 is the section draining into Owen Lake, contrary to the drainage pattern indicated for this section of stream on the 1:50,000 NTS map. This section therefore forms a part of the Owen Creek watershed.

Table 1. Summary of fish species in the Owen Creek Watershed.

Fish Species	Location	Reference
Coho (*Oncorhynchus kisutch*)	Owen watershed	FISS, Bustard 1999
Steelhead (*O. mykiss*)	Owen watershed	FISS, Bustard 1999
Rainbow trout (*O. mykiss*)	Owen watershed, Peter-Aleck Creek	FISS, Bustard 1999 SKR 1998, 1999, 2002
Dolly Varden (*Salvelinus malma*)	Owen watershed Peter-Aleck Creek	FISS, Bustard 1999 SKR 1998, 1999, 2002
Lake trout (*S. namaycush*)	Owen watershed	FISS
Cutthroat trout (*O. clarki*)	Owen watershed	FISS
Mountain whitefish (*Prosopium williamsoni*)	Owen watershed	FISS, Bustard 1999
Pygmy whitefish (*Prosopium coulteri*)	Owen watershed	FISS
Burbot (*Lota lota*)	Owen watershed	FISS
longnose suckers (*Catostomus catostomus*)	Owen watershed	FISS
Largescale suckers (*C. macrocheilus*)	Owen watershed	FISS
Peamouth chub (*Couesius plumbeus*)	Owen watershed	FISS
Redside shiners (*Richardsonius balteatus*)	Owen watershed	FISS, Bustard 1999
Northern pike minnow (*Ptychocheilus oregonensis*)	Owen watershed	FISS
Longnose dace (*Rhinichthys cataractae*)	Owen watershed	FISS, Bustard 1999

3.0 METHODS

This project closely followed all applicable RIC standards (2001a) and the Forest Practice Code fish-stream identification guidebook (1998). Details on methodologies and value added attributes of sampling site selection, field assessments, and digital mapping are provided in the following sub-sections.

3.1 SAMPLE SITE SELECTION

Sample sites were selected during a detailed review of recommendations for additional sampling that were provided in the initial 1:20,000 reconnaissance fish and fish habitat inventory project (SKR 2002).

3.2 STREAM ASSESSMENT

All stream assessments were conducted in June 2005. Stream sites were accessed by four-wheel drive vehicle, on foot and helicopter. Stream sections of interest were assessed to determine fish distribution and habitat values. Fish Data Information System (FDIS) site cards and fish collection cards were completed at sample sites, following Resource Inventory Committee Standards (RIC 2001a), and data were entered into the FDIS database using the FDIS data entry tool.

All fish that were captured during this study were identified to species in the field or small sub-samples were preserved for confirmation using a dissecting microscope. Identification keys in McPhail and Carveth (1994) and Scott and Crossman (1973) were consulted for species identification. Fork lengths were recorded for fish captured, and fish were released. A list of sampling equipment used during this 1:20,000 reconnaissance level fish and fish habitat inventory project is presented in table 2.

Table 2. List of sampling equipment for stream reaches during the re-sampling of the Peter-Aleck watershed in June 2005.

Parameter	Sampling Intensity	Method
Date and time	each site	wrist watch
water temperature	each site	alcohol thermometer
Channel width	each site	meter stick, tape
PH	each site	Oaktron pHTestr2
Conductivity	each site	Oaktron TDSTestr 3
water clarity	each site	Visual
fish presence	as required to determine fish presence	Smith Root Model 12B
Photography	each site	Sony Cybershot DSC-S85
GPS	where available	Garmen eTrex Legend GPS
Gradient	each site	Enduro abney Level or Suunto clinometer

3.3 Statistical Analysis

Site and reach data were compared between various fish bearing, gradient, and stream order categories to evaluate if these factors are useful in identifying potential for fish presence for the entire watershed. Because of low sample size, and non-normal distribution of data, statistics that do not rely on normality were used for comparisons. To compare mean values (e.g. channel width) between categories, a Kruskal-Wallis and Kolmogornov-Smirnoff tests were used (Zar 1984, Sokal and Rohlf 1995). Frequencies between various categories were compared using a log-likelihood χ^2 tests. All analysis were conducted using the Systat 9 statistical package, and descriptive statistics were calculated in Excel.

3.4 Mapping

Mapping during phases I, II and III of the project were completed by SKR Consultants Ltd. using the Fish Inventory Mapping System extension for Arcview GIS software (Fish Map 1.2 Geosense Consulting Ltd. 2002), following applicable Resource Inventory Committee standards (RIC 2001b). Data presented on the maps included sub-basin boundaries, sample site locations, significant features, and historical information within the study area. In addition, SKR identified reaches with known fish presence, suspected fish presence, suspected fish absence, and known fish absence for presentation of fish distribution on the interpretive maps. The criteria used by SKR for determining fish presence and absence are presented in table 3.

Table 3. Criteria used to evaluate fish distribution for colour coded presentation on the Fisheries Project/Interpretive Hardcopy Maps (Appendix 5) of this study area.

Fish Present _____	• Stream reaches where fish have been captured or can be classified as fish bearing based on fish captured upstream. NOTE: fish distribution may not always extend to the upper limit of all reaches symbolized as fish bearing
Fish Suspected Present ----------	• Stream reaches with gradients less than 21% and with any potential for fish presence, excluding first order streams less than 1 km in length on 1:20000 TRIM (Terrestrial Resource Information Mangement) map
Fish Suspected Absent ----------	• First order streams less than 1 km in total length on 1:20000 TRIM map • Streams visited with limited potential for fish presence, but no definable barriers to fish passage following RIC standards, thus still requiring resampling
Fish Absent _____	• Reaches with no fish captured in two seasons upstream of natural obstructions to fish migration • Reaches upstream of identified natural barriers to fish migration following intensive sampling in one season • 1st and small 2nd order streams flowing into non fish bearing reaches • Reaches with gradients exceeding 20% (Note: the location of lower reach break is not defined until field sampling is conducted)

3.5 DATA COMPILATION

Since re-sampling in 2005 included re-sampling in the entire Peter-Aleck watershed upstream of Owen Lake, this report and accompanying final deliverables were designed to summarize re-sampling data and data collected during previous inventory projects. Historical information on the fisheries project/interpretive maps is coded to facilitate cross-referencing with data sources captured during the literature review. FDIS database tables for the re-sampling database (fdisdat.mdb) were populated so as to facilitate merging of the re-sampling database with the FDIS database produced for the initial sampling project (SKR 2002).

3.6 QUALITY ASSURANCE

While the Ministry of Sustainable Resource Management (MSRM), and the Ministry of Environment (MoE) previously conducted independent, third party quality assurance evaluations (QA) on 1:20,000 fish and fish habitat inventory (SKR 2002), third party QA was not mandatory for projects conducted in the 2005 field season. Similarly, while the Forest Ecosystem Specialist reviewed the non-fish bearing tables produced as a result of fish and fish habitat inventory in 2001 (SKR 2002), no government representative was available to review the non-fish bearing tables produced as a result of the 2005 re-sampling project. To assure that the re-sampling data, report, data base and map continued to be of high quality, SKR conducted internal QA evaluations using guidelines and standards as detailed in the reconnaissance (1:20,000) fish and fish habitat inventory quality assurance procedures (RIC 2000).

4.0 RESULTS AND DISCUSSION

Eleven stream reaches (13 sample sites) of the 147 stream reaches identified in portion of Peter-Aleck Creek that drains into Owen Lake were sampled in June 2005 to provide a more detailed assessment of fish presence or absence in accordance with the Fish/Stream Identification Guidebook (FPC 1998). Sites were selected for re-sampling based on recommendations in the initial stream inventory conducted in 2001 (SKR 2002), and previous operational sampling activities (*see* Methods section). Re-sampling in June 2005 resulted in the conclusive classification of 23 reaches for which fish bearing status was previously unclear (table 4).

Table 4. Summary of reaches with previously unknown fish distribution that could be conclusively classified following re-sampling in the Peter-Aleck watershed.

Sub-basin	Re-sampling intensity						# reaches conclusively classified following re-sampling	
	Re-sampling Dates	Total # of sites	# rec'd sites[1]	# extra sites	# reaches	# streams	Fish-bearing	Non-fish bearing
Peter-Aleck	June 2005	13	7	6	11	10	1	22

[1]Sites recommended for re-sampling during previous inventories (see SKR 2002)

4.1 LOGISTICS

Re-sampling was timed to coincide with spring/early summer high-flow condition as much as possible, to determine the seasonal utilization of fish habitat in the study area, and in order to determine the passability of obstructions which were identified during low discharge periods during initial sampling. Of the 13 sites sampled, no visible channel was identified at two sites, leaving 11 sample sites with relevant water quality and flow stage data. Most of the sites sampled (9 of 11; 81.8%) exhibited moderate flow stage, and one site (8.2%) exhibited low flow stage. Early summer sampling did not encompass the peak flow event that is characterized by low water temperature, and low conductivity due to the late onset of the project. Sampling during periods of peak flow generally coincides with lower water temperatures and conductivity (Dunne and Leopold 1978), all of which may affect sampling efficiency (Reynolds 1996). While spring sampling may be desirable in documenting seasonal fish use, sampling efficiency during peak flows may be significantly compromised. Water quality encountered during resampling in spring/ early summer conditions is summarized in table 5, and was within guidelines suggested for sampling with an electrofisher (RIC 2001a). Water was reported as clear at all sites sampled. Peak flow periods were not captured during re-sampling, however, sampling in 2005 was conducted during early summer conditions without reduced sampling efficiency generally encountered in early spring.

Table 5. Summary of water quality data collected during re-sampling of streams within the study area in 2005. The total number of sites sampled and the number of sites with water quality criteria under critical levels as identified in FDIS are also listed.

Stream Order	# sites with water quality data	Temperature (°C)		Conductivity (µS/cm)	
		range	# sites <4 °C	Range	# sites < 30µS/cm
1	1	8	0	30	0
2	10	6-12	0	30-150	0

A combination of vehicle, foot (for sites > 200 m from the nearest road), and helicopter were used to access sites in the study area. Eight of the 13 sites (61.5%) were accessed by helicopter, three (23.1%) were accessed on foot, and two sites (15.4%) were accessed by four-wheel drive vehicle. This is similar to access methods during initial sampling in 2001, where 42.9% of reaches were accessed by helicopter, 35.7% on foot, and 21.4% by vehicle. Difficulties with access increases the cost incurred, especially with methods requiring access on more than one occasion (e.g. minnow trapping), thus sampling methodologies were restricted to electrofishing at all sites, since this method does not require repeat access to sample sites.

The generally gentle terrain, coupled with extensive wetland areas in some locations, resulted in mismapping of some drainages on the 1:20,000 TRIM maps. Some of these mismapped systems were not identified until resampling of these systems. Initial sampling locations of three sites were misidentified as a different stream than the stream that was actually sampled. Comparisons of field notes, UTM coordinates and site photos, as well as more detailed ground truthing in 2005 identified several mapping and site location errors, as detailed in table 6 below.

Table 6. Summary of three sites where a mapping and site identification error for the initial sampling event (SKR 2002) was identified during resampling efforts.

2001 site identification			Actual location		2005 re-sample site #	Comments
Site #	ILP	Reach	ILP	Reach		
10	70029	1	70032	1	**7**	This reach was GPS'ed to confirm its drainage pattern (SKR 2002). Site 10 (SKR 2002) was confirmed to be near the confluence of ILP's 70029 and 70032 and represents the drainage from ILP 70032. The upper portion of ILP 70029 veers to the southwest and flows into ILP 70023 (see resample site 5). The lower portion ILP 70029 has no defined channel (see resample site 6).
15	70041	1	70041	1	**9**	This reach is actually a distributary to ILP 70041
16	70043	1	70041	1	**10**	The initial sample site 16 was mistakenly identified as ILP 70043 due to the presence of a defined distributary in reach 1of ILP 70041 (along an old fire track).
			70043	1	**11**	This reach was field identified incorrectly as site 16 in 2001 (SKR 2002). This reach was sampled and GPS'ed in 2005

4.2 SUMMARY OF BIOPHYSICAL INFORMATION

The portion of Peter-Aleck Creek sampled is a 4th order inlet stream to the southern tip of Owen Lake that drains an area of approximately 79.38 km^2 over a distance of 25 km. Very little glacial influence, a predominance of low gradient reaches, and a low proportion of lakes characterize the portion of the Peter-Aleck Creek watershed that drains into Owen Lake. The headwaters of this system are found at an elevation of 1500 meters, and the confluence of Peter-Aleck and Owen Lake is found at an elevation of 830 meters. The topography consists primarily of low gradient valley flat areas along the mainstem Peter-Aleck Creek, with steeper terrain along the south facing slopes of Nadina Mountain in the northern portion of the watershed, and the north facing slopes of Poplar Mountain in the southwest portion of the watershed. The Peter-Aleck sub-basin is of interest since it is a potential cross over point for fish populations from the Skeena and Nechako systems, separated from each other in a large wetland to the south of Owen Lake. The portion of Peter-Aleck Creek that drains into Owen Lake watershed falls within the Humid Continental Highlands Ecodivision of the Humid Temperate Ecodomain. Within the Central Interior Ecoprovince, the entire area is within the Fraser Plateau Ecoregion (Meidinger and Pojar 1991, MoF 2001). The lower and mid-elevation reaches are found within the Sub-Boreal Spruce biogeoclimatic zone, while the upper reaches extend into the Engelman Spruce-Sub Alpine fir biogeclimatic zone. Very small portions of the upper reaches of tributaries at the higher elevations of the south facing slopes of Nadina Mountain are characterized by Alpine Tundra Biogeoclimatic Zone. Table 7 provides a summary of watershed information for the Peter-Aleck Creek watershed.

Table 7. Summary of watershed information for in the Peter-Aleck Creek watershed.

Name	Watershed Code	Watershed Area (km^2)	Stream Length (km)	Stream Order	NTS map	BEC Zone	Wetland areas (km^2)
Peter-Aleck (inlet to Owen Lake) UTM: 9.649223.599231	Unknown	79.38	118.28	4	93L/02	SBSmc ESSFmc AT	1.63

4.2.1 WATER QUALITY

Water quality measurements were taken at 11 of the 13 sample sites. No visible channel was identified at the remaining two sites. Temperature ranged from 6 °C to 12 °C (mean = 8.6, SE = 0.62), pH ranged between 7.2 and 8.2 (mean = 7.85 SE = 0.094), and conductivity ranged between 30 and 150 µS/cm (mean = 85.5 µS/cm, SE = 11.93). The three sites with the highest conductivities (> 100 µS/cm) were located at or near wetlands, and we speculate that conductivity at these sites is influenced by the proximity to wetlands. Water was clear at all locations, reflecting a lack of glacial influence, and the generally pristine nature of the watershed.

4.3 Fish Habitat Characteristics

A number of factors can influence the capability of a stream to provide suitable habitat for fish. Several studies in recent years have shown that information easily obtained from TRIM maps and airphotos, or easily obtained field measurements, can provide good indicators of the likelihood of fish presence (e.g. Porter et al. 2000b, Latterell et al 2003, Triton 2003, SKR 2004a, 2004b). Average channel width is one such characteristic which influences fish presence (Rosenfeld et al. 2000, Triton 2003, SKR 2004a, 2004b). Stream gradient is another good indicator of the habitat value of streams for fish (FPC 1988). Using methods for estimating and categorizing streams by channel width (e.g. stream order) and gradient classes have been used to help develop a simpler indication of habitat value and fish distribution based on TRIM map interpretations (e.g. Witt and Giroux 1999).

Findings from a combination of initial sampling (SKR 2002) and resampling (2005) of streams in the Peter-Aleck watershed are used to describe fish habitat preferences based on channel width, stream order, and gradient classes. The following sections describe the characteristics of stream order and gradient classes and how different categorizations may be useful for estimating habitat value and the likelihood of fish presence based on future map interpretation or stream data models for this drainage.

4.3.1 CHANNEL WIDTHS AND GRADIENTS

Channel width and gradient have been shown to be correlated with the potential for fish presence in previous studies (SKR 2004a, 2004b). Channel width is a factor that directly affects habitat quantity, and in many cases, larger streams provide more and higher quality habitat than smaller streams. Gradient has been found to clearly effect both, habitat quality, and habitat accessibility. Steeper streams offer less valuable rearing and spawning habitat due to larger (Hunter 1991), and fish expend more energy moving or holding in higher gradient systems. Channel width and site gradients were summarized for fish bearing, non-fish bearing, suspected fish bearing and suspected non-fish bearing reaches that were sampled during this study (table 8). Since topographic barriers limit fish distribution regardless of upstream site characteristics, sites upstream of known barriers to fish passage (e.g. falls and cascades) were omitted from the summary. No fish were captured at sites where the channel width was less than 1.2 meters. There was significant overlap in the range of site gradients between the four fish bearing categories. This is largely due to the fact that most sites included in the analysis are located in the valley flat area surrounding the mainstem, since sites upstream of known barriers to fish passage were discarded from the analysis. The results from this study support previous findings from other fish and fish habitat inventory projects (e.g. SKR 2004a, 2004b) that fish are unlikely to use streams with average channel widths less than approximately 1metre (table 8). Dolly Varden were captured at one site with a gradient of 12% (site 9, ILP 70026 reach 2) in 2001 (SKR 2002). This site was located in a steeper section of the reach, which had an average reach gradient of only 2.5%. The remaining 10 sites where fish were captured had gradients less than or equal to 10%. This indicates that fish presence at sites with gradients greater than 12% in the Peter-Aleck watershed is unlikely, which is supported by findings from other inventory projects in the interior of BC that have documented that fish use of small streams is unlikely where gradients are greater than 12% in the central interior of British Columbia. Interestingly, there is also a high likelihood of natural barriers to fish migration (i.e. chutes, cascades or water falls) in streams with gradients more than 12%.

Table 8. Average channel widths (standard error) and range of channel widths for fish bearing, non-fish bearing, suspected fish bearing, and suspected non-fish bearing reaches in the study area. Non-classified drainages, and reaches upstream of known barriers to fish migration have been omitted from the analysis.

Fish Bearing Status	# sites in analysis	Site Gradient (%)		Channel width (m)	
		Mean (SE)	Range	Mean (SE)	Range
Fish Present	11	4.6 (1.07)	1.5-12	1.92 (0.139)	1.28-2.67
Suspect Fish Present	2	3.5	3.5	2.08 (0.148)	1.93-2.23
Fish Absent	4	4.1 (1.850)	0-9	0.95 (0.200)	0.6-1.5
Suspect Fish Absent	2	6.8 (2.75)	4-95	1.43 (0.117)	1.32-1.55

4.3.1.1 Relationship of Channel Widths to Stream Order

Stream order can easily be determined from map interpretation, while channel width requires field measurements. Stream order based on 1:20,000 scale TRIM streams has a general relationship to drainage basin area and is commonly used to categorize streams as an indicator of stream size. Streams with small drainage basins (e.g. 1st and 2nd order streams; see Glossary for a definition of stream order) carry a relatively low volume of water and are subject to seasonal changes in water levels that cause them to be intermittent and/or ephemeral (Ross 1997). Channel width categorized by stream order has been shown to be a useful for estimating the likelihood of fish presence in similar studies (Rosenfeld et al. 2000, Triton 2003). In fact, all nine sample sites where the reach was determined to be a non-classified drainage (NCD) during this study, were 1st or incorrectly mapped 2nd order reaches (table 9). For the Peter-Aleck watershed it appears that channel width categories (e.g. stream order) may be useful indicators of the potential for fish presence, as long as topographic or anthropogenic barriers that restrict or prevent fish passage to reaches upstream, regardless of stream order, are kept in mind.

Results from this study support that channel width is related to stream order. Channel widths were compared between sites representing different stream orders using a Kruskal-Wallis (H) test. Average channel widths for sampled reaches differ significantly with stream order (H = 10.645, p = 0.005). However, channel widths do not differ significantly between first and second order reaches (Kolmogornov Smirnoff (KS) statistic = 0.448, p = 0.198), but the proportion of non-classified drainages is greater for first order than for second order reaches (50% compared to 22.7% respectively). A relatively low number of first order reaches were sampled in the Peter-Aleck watershed, and many of these first order reaches drained relatively large basins (> 1 km^2) when compared to most first order streams in the study area. Channel width of third order reaches is significantly greater than channel with of second order reaches sampled in the Peter-Aleck watershed (KS = 0.750, p = 0.031). Overall, there is a significant relationship between stream order and channel size, though this relationship is less well defined between 1st and 2nd order reaches sampled in the study area, likely as a result of sample site selection, and sample size. We speculate that the relationship between channel width and basin size would be stronger than the relationship between stream order and channel width. Stream order appears to be a rough indicator for stream size in the Peter-Aleck watershed, and because stream order is easily determined for all reaches in the watershed, stream order was used for comparisons of fish bearing status between reaches in the study area.

Table 9. Number of reaches sampled, average channel widths, and number of non-classified drainages broken down by stream order. Non-classified drainages are included when calculating mean channel widths, or ranges in channel widths. Historical information was included, except for re-sampled sites where the most current information was used in calculating channel widths.

Stream Order	Number sampled	Channel Width (m)		NCD's (%)
		Range	Mean (SE)	
1	8	0 - 1.55	0.59 (0.281)	4 (50%)
2	22	0 - 2.35	1.25 (0.178)	5 (22.7%)
3	4	1.77-2.67	2.34 (0.197)	0 (0%)

4.3.1.2 Relationship of Stream Gradient to Stream Order

Stream gradient is a main determinant of fish distribution because gradient affects habitat types and quantity, as well as accessibility to fish (Ross 1997, FPC 1998). Reaches with low to moderate gradient are more likely to be fish bearing than reaches with higher gradients. The Fish Stream Identification Guidebook (1998) provides gradient ranges suitable for various salmonid species, and identifies a reach gradient of 20-25% as the limit to fish distribution depending on species and stream morphology. Steeper reaches are generally found in higher elevations within a watershed (Hunter 1991, Ross 1997). Figure 2 graphically illustrates that the average reach gradient decreases considerably and consistently as stream order increases. There is more variability in stream gradient among 1st and 2nd order reaches, and less variability for 3rd and 4th order reaches because all 3rd and 4th order reaches are located in, and surrounded by, valley flat areas along the mainstem, while many 1st and 2nd order reaches are located in the steeper and mountainous headwaters. For example, gradients of 1st order reaches range between 0.5% and 79.8%, while gradient of 3rd and 4th order reaches range between 0% and 8.5 % in the Peter-Aleck watershed. Overall, higher order reaches, which are generally found in the valley flat area associated with the mainstem of Peter-Aleck Creek are on average less steep than lower order reaches, which exhibit a much wider range in gradient (ranging from low gradients in the valley flat areas and mountain plateaus to high gradients in the steep lands, particularly the south southwest facing slopes of Nadina Mountain and the east northeast facing slopes of Poplar Mountain.

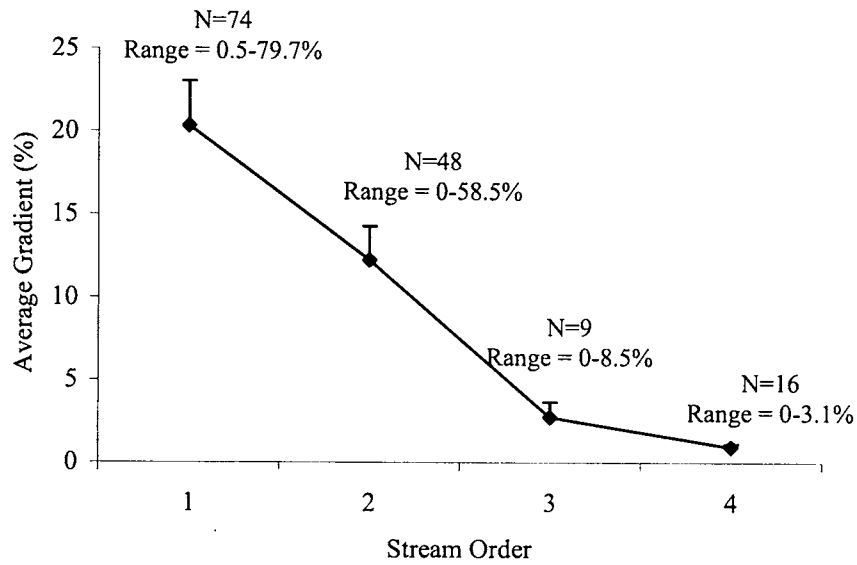

Figure 2. Average reach gradient of streams with varying stream order. Error bars indicate standard error.

4.3.2 Relationship of Stream Order to Fish Presence

Stream order and fish bearing status of reaches sampled in the Peter-Aleck watershed are summarized in table 10. Stream order differs significantly between fish bearing, non-fish bearing, suspected fish bearing and suspected non-fish bearing reaches (log likelihood χ^2 = 12.966, p = 0.044) . First order reaches that were found to be fish bearing have a relatively large basin, and are thus larger systems than most first order reaches in the watershed. The two first order sites where fish were captured (site 2, ILP 70001 (Peter-Aleck Creek), reach 25 and site 23, ILP 70059 Reach 1; SKR 2002) were located on or near the mainstem, and drained relatively large 1st order basins. Mean channel width differed significantly (H = 9.397, p = 0.024) between reaches of different fish bearing status (fish bearing, non-fish bearing, suspected fish bearing, suspected non-fish bearing) (table 8). In general, fish bearing and suspected fish bearing reaches tend to be wider and generally have higher stream order than non-fish bearing and suspected non-fish bearing reaches in the study area.

Information on fish presence and limits to fish distribution (i.e. barriers to fish migration) was used to help classify all reaches in the watershed as fish bearing, suspected fish bearing, suspected non-fish bearing and non-fish bearing (figure 3). All 3rd and 4th order reaches in the study area have been conclusively classified as fish bearing because fish were either captured in these reaches, or upstream. The proportion of reaches classified as fish bearing declines for 2nd order reaches (21%), and only 3% of 1st order reaches are known to be fish bearing. Conversely, the proportion of non-fish bearing reaches increases from 58% of second order reaches in the study area to 70% of first order reaches in the study area. The majority of these known non-fish bearing first and second order reaches have high gradients (50% of non-fish bearing 1st order reaches and 35.7% of non-fish bearing second order reaches had gradients greater than 20%), and were therefore classified as non-fish bearing by default.

Table 10. Summary of the number (percent) of sampled reaches of different stream order that were determined to be fish bearing, non-fish bearing, suspected fish bearing, and suspected non-fish bearing.

Stream order	Fish present	Suspected Fish Present	Fish absent	Suspected fish absent	Total
1	2 (5.9)	0 (0.0)	5 (14.7)	1 (2.9)	8
2	5 (14.7)	2 (5.9)	14 (41.8)	1 (2.9)	22
3	4 (11.8)	0 (0.0)	0 (0.0)	0 (0.0)	4

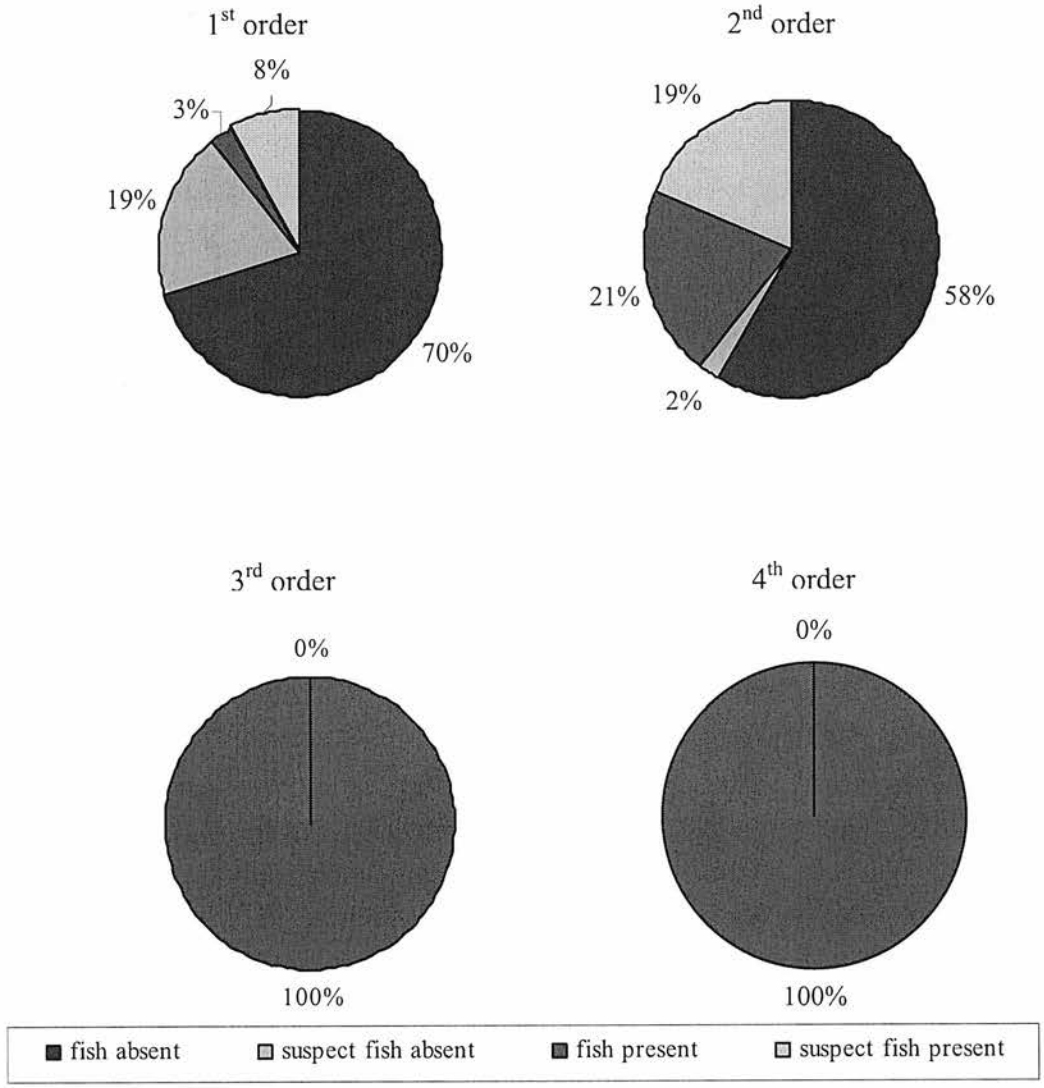

Figure 3. Percent fish bearing, suspected fish bearing, suspected non-fish bearing and non-fish bearing reaches with varying stream order.

4.3.3 Relationship of Stream Order and Gradient to Fish Presence

Easily determined reach characteristics including gradient and channel width, are interrelated, and appear to influence the likelihood of fish presence. Both gradient and channel width are related to stream order (table 9, figure 2). First and second order streams are more likely to have smaller channel width or be NCD (tables 9), and have higher average gradient (figure 2). Fish presence appears to be less likely in reaches with smaller channel widths (table 8), and steeper reaches (figure 4). Streams with lower stream order generally have smaller basin size, and basin size is strongly correlated with channel size. Thus stream order may be a suitable indicator of the likelihood of fish presence of reaches within the study area since it is an easily obtained measure that relates both these factors. However, the relationship between stream order and channel width is likely weaker than the relationship between basin size and channel width, particularly for lower order reaches. First order reaches that drain a relatively large basin are similar in channel width to second order reaches, and the fact that a disproportionate number of larger first order reaches was sampled may have resulted in the lack of a significant difference between channel widths and stream order. Basin size is likely a more accurate indicator of fish presence than stream order. Not surprisingly, the proportion of fish bearing reaches in the study area increases with stream order and a significant reduction in the proportion of fish bearing reaches is noted in 1st and 2nd order reaches.

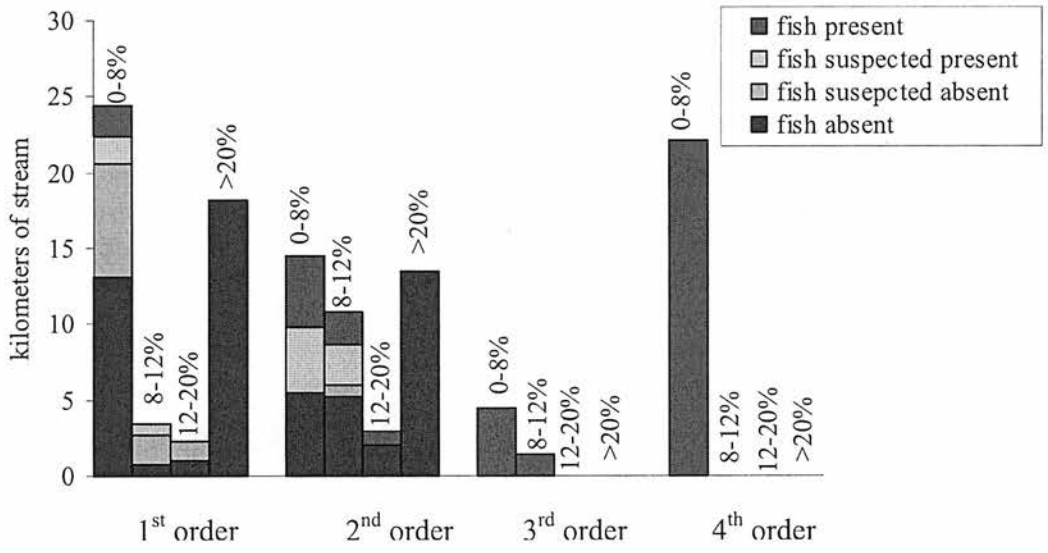

Figure 4. Distribution of fish presence and absence in different order and gradient classes of stream reaches in the study area as determined from 1: 20,000 TRIM maps. Data labels indicate gradient classes within each stream order.

Fish bearing status of 1st, 2nd, 3rd and 4th order stream was graphed by common gradient ranges provided for fish species distribution in the Fish-Stream Identification Guidebook (FPC 1998). Figure 4 illustrates that fish presence is strongly related to gradient, and stream order. Interestingly, no fish were captured in reaches with gradients greater than 13 % during any sampling event in the study area. In addition, all suspected fish bearing reaches in the study area have a gradient less than 12%. No fish were captured in any reach above 1200 meter elevation. Similar gradient limits (13.5%, 11% and 17%) have been documented in the Whitesail (SKR 2003a), Tahtsa Reach (SKR 2004a) and Nadina (SKR 2004b) watersheds. Elevation limits identified in the Peter-Aleck is somewhat lower than that identified for the Whitesail (1300 m), Tahtsa Reach (1225 m) and Nadina (1411 m) watersheds. However, the tendency of higher elevation reaches to be non-fish bearing is likely more related to the predominance of higher gradient in these headwater reaches, higher probability for natural barriers to fish distribution, and a high proportion of non-classified drainages due to their small drainage size.

4.3.4 WATERSHED RELATIONSHIP SUMMARY

Reach characteristics and sample site distribution in the study area was summarized by elevation, gradient, and stream order categories since these factors have been identified as influences on the potential for fish presence in previous studies (e.g. Witt and Giroux 1999). The number of reaches sampled across the entire study area and fish presence associated with those reaches is presented in table 11. Sample site distribution is divided into: elevation zones, as suggested by Witt and Giroux (1999); gradient classes, as identified in the Fish Stream Identification Guidebook (FPC 1998); and stream order. Reaches were not separated by channel pattern since most of the reaches (94.6%) in the project area were straight, sinuous or irregular (Appendix 3). Witt and Giroux (1999) suggest using gradient, channel pattern, and stream order classes generated by the FDIS database to create a watershed relationship table. The results of this grouping are presented in Appendix 3. Table 11 illustrates that the proportion of sampled reaches found to be fish bearing is lower for reaches at higher elevation, and with higher gradients, while a greater proportion of sites were found to be fish bearing at sites with higher stream order.

Table 11. Watershed relationship summary table for the Peter-Aleck watershed.

	Elevation Zone[1]					Gradient					Stream Order			
	1	2	3	4	5	0-8%	8-12%	12-16%	16-20%	≥20%	1st	2nd	3rd	4th
Total No. Reaches	**30**	**74**	**24**	**3**	**16**	**91**	**12**	**6**	**2**	**36**	**74**	**48**	**9**	**16**
No. Randomly selected reaches	0	12	2	0	0	8	3	1	0	2	6	5	3	0
No. Biases Selected Reaches	5	9	3	0	0	11	4	2	0	0	1	15	1	0
Total No. Sampled	**5**	**21**	**5**	**0**	**0**	**19**	**7**	**3**	**0**	**2**	**7**	**20**	**4**	**0**
% reaches sampled	16.7	28.4	20.8	0	0	20.9	58.3	50.0	0	5.6	9.5	41.7	44.4	0
No. with Fish (%of sampled reaches)	1 (20.0)	9 (42.9)	0 (0)	0 (0)	0 (0)	7 (36.8)	3 (42.9)	1 (33.3)	0 (0)	0 (0)	2 (2.9)	7 (35.0)	4 (100)	0 (0)
No. with suspected fish (% of sampled reaches)	0 (0)	2 (9.5)	1 (20.0)	0 (0)	0 (0)	2 (10.5)	1 (14.3)	0 (0)	0 (0)	0 (0)	0 (0)	3 (15.0)	0 (0)	0 (0)
No. with no fish (% of sampled reaches)	3 (60.0)	10 (47.6)	4 (80.0)	0 (0)	0 (0)	10 (52.6)	2 (28.6)	2 (66.7)	0 (0)	2 (100)	5 (71.4)	9 (45.0)	0 (0)	0 (0)
No. with suspected no fish (% of sampled reaches)	1 (20)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (14.3)	0 (0)	0 (0)	0 (0)	0 (0)	1 (5)	0 (0)	0 (0)

[1]Elevation zones are: Zone 1 = 740–971m, Zone 2 = 972-1203m, Zone 3 = 1204-1435m, Zone 4 = 1436 – 1667m, Zone 5 = 1668-1900m for upstream reach elevations (see Witt and Giroux 1999)

4.3.5 FISH HABITAT

Fish and fish habitat inventory data collected in the Peter-Aleck watershed in this and in previous studies illustrates that lower order streams are less likely to be fish bearing, and that reaches above 1200 meters elevation, sites with gradients greater than 13%, or reaches greater than 12% are not fish bearing and not suspected to be fish bearing. These factors are interrelated, however, and should not be viewed in isolation. For example, the lack of fish presence in reaches with gradients greater than 12% may be due to the fact that there were no 3rd or 4th order reaches in the study area that had gradients greater than 9%. The relationships between elevation, stream order, and especially gradient and channel width in the Peter-Aleck watershed can guide future inventory efforts in refining limits of fish distribution, and in focusing re-sampling efforts where fish distribution limits are less clearly defined. However, the general lack of fish in reaches with relatively steep gradients and at high elevation, as well as in lower order reaches (of which a high proportion exhibit higher gradient and elevation) does not imply that these reaches are unimportant in maintaining the physical and biological attributes of stream habitat in the Peter-Aleck watershed. The potential detrimental effect of forestry activities on stream habitat has been well documented (e.g. Murphy and Meehan 1991). These include changes in stream hydrology (increased peak flows, lower low flows), reduction of stream bank stability (results in degrading and aggrading of stream channels), increased sedimentation, reduced organic input (e.g. leaf litter, terrestrial insects), reduced shading resulting in changes in temperature regime, loss of recruitable large woody debris for channel complexity and stabilization, reduced cover, and obstructions to fish passage (e.g. improperly placed and/or installed culverts). While some fish species are less susceptible to these impacts than others, several of the species in the study area, including Dolly Varden and rainbow trout, are highly sensitive to forestry related impacts (Porter et al. 2000). Land-use, including forestry and road building in smaller, headwater systems can have downstream and cumulative impacts on fish habitat, thus the cumulative impact of riparian and upslope management over the entire watershed should be considered when planning land-use activities.

4.4 FISH DISTRIBUTION

The Peter-Aleck watershed is characterized by a predominance of valley flat areas, with some steeper gradient terrain in its headwaters, lower order reaches draining the northeast facing slopes of Poplar Mountain, and the southwest facing slopes of Nadina Mountain. The watershed is not influenced by glaciers. No large or moderate sized lakes are found in this portion of Peter-Aleck Creek, which drains into Owen Lake. Much of the watershed is accessible to fish, as a result of generally gentle terrain which is dominated by the valley flat area associated with the mainstem of Peter-Aleck Creek.

Fish were confirmed present in approximately 38 km (32.2%) of all stream lengths in the Peter-Aleck watershed. In total, 2.04 km of first order reaches, 7.86 km of second order reaches, 5.76 km of third order reaches and 53.43 km of fourth order reaches were found to be fish bearing (figure 4). First order reaches directly connected to higher order systems may provide refuge habitat during periods of high discharge, and are important in maintaining fish habitat and water quality downstream. In addition, 2.47 km of first order reaches and 7.02 km of second order reaches are suspected to be fish bearing. No third or fourth order reaches remain unclassified, since all of these reaches have been conclusively classified as fish bearing. Fish are suspected or confirmed to be absent from 43.7 km of first order reaches and 26.86 km of second order reaches. Table 12 summarizes the relative amounts of fish habitat found within each stream order category.

Fish distribution is limited in some tributaries to Peter-Aleck Creek by the presence of natural and anthropogenic barriers or obstructions (table 13). The majority of these obstructions are natural, since the road network in the watershed does not extend into the upper portion of the mainstem, or tributaries. No topographical or anthropogenic barriers were identified on the mainstem Peter-Aleck Creek, where 23.76 km of the 24.49 km long mainstem were found to be fish bearing.

Table 12. Percent of reaches with known fish bearing status, and kilometers of each stream classification within reaches of different stream order.

Stream Order	% of reaches with confirmed presence/absence after re-sampling	% of confirmed reaches which have fish present	Kilometers of Stream				% of reaches with fish present/suspected fish present
			Fish Present	Suspected Fish Present	Fish Absent	Suspected Fish Absent	
1	73	3.1	2.04	2.47	32.97	10.73	11
2	81	25.6	7.86	7.02	26.05	0.81	40
3	100	100	5.76	0	0	0	100
4	100	100	22.11	0	0	0	100
Total	82.8	42.1	37.77	9.49	59.83	10.73	43.8

Table 13. Summary of historic and new barriers and obstructions to fish migration found in Peter-Aleck Creek upstream of Owen Lake (sorted by ILP and reach number).

ILP	TRIM map #	Reach	Barrier			
			Type	Height (m)	Verified in field	Description
70004	093L.007	1	GR		Y	30 m long section of 30% gradient with SP morphology at mouth of stream (SKR 1999)
70006	093L.006	1	C	6	Y	20 m long, 22% gradient cascade with 0.5 m steps (no pools) at confluence with Peter-Aleck Creek.
70021	093L.006	2.2	F	2.5	Y	Bedrock falls in a 50 m long cascade
70026	093L.006	2	FD		Y	Ford where culvert has been removed; this site is not a barrier to fish passage
70054	093L.006	2	F	1.1	Y	In high gradient section with smaller falls.
70056	093L.006	1	C	26	Y	cascade 85 m upstream of confluence with mainstem.
70060	093L.006	3	F	3	Y	Observed during helicopter overflight

[1] GR = gradient barrier, F = falls, C = cascade, FD = ford

Species captured during the initial reconnaissance inventory in 2001, and during re-sampling in 2005 were limited to rainbow trout and Dolly Varden, though other species have been documented further downstream in Owen Creek. Fish distribution of these species, including burbot, mountain whitefish, pygmy whitefish, redside shiner, largescale sucker, longnose sucker, northern pikeminnow, longnose dace and peamouth chub may be restricted to Owen Lake and downstream reaches of Owen Creek, as well as the lower wetland reach of Peter-Aleck Creek which was not sampled. Rainbow trout were captured upstream to reach 6 (13.79 km upstream of Owen Lake) of Peter-Aleck Creek, while Dolly Varden were found almost to the very upper reaches of the mainstem (confirmed presence of Dolly Varden to 23.76 km of the 24.49 km long mainstem). Dolly Varden were also captured in lower reaches of tributaries to Peter-Aleck Creek, primarily with the valley flat area of the mainstem, and in close proximity to the mainstem. In higher order systems (2nd and 3rd order), Dolly Varden were found in reaches with gradients up to 12%. All fourth and third order reaches in the watershed were found to be fish bearing, and a significant proportion of second order reaches were also found to be fish bearing. Overall, the Peter-Aleck watershed upstream of Owen Lake contains a relatively high amount of suitable and accessible fish habitat, particularly for Dolly Varden. Suitable spawning habitat was noted for some species, including coho, which are known to be present in Owen Creek and lake, but which have not been documented in Peter-Aleck Creek, and we speculate that the lack of these species from Peter-Aleck Creek is more likely due to difficult fish passage in reach 1 of Peter-Aleck Creek, which is located in an extensive wetland complex with beaver activity, than the lack of suitable fish habitat.

4.5 FISH AGE, SIZE AND LIFE HISTORY

Dolly Varden was the only species captured in the sites sampled in the Peter-Aleck watershed in August 2001 and June 2005. Although rainbow trout were captured during previous inventory projects (Bustard 1999, SKR 1998, 1999), no rainbow trout were captured at sites sampled in 2001 or 2005. The following sub-sections summarize the acquired fish data and provide interpretations and discussions of fish size and age distributions, and species life histories.

4.5.1 DOLLY VARDEN

Dolly Varden were wide spread throughout the Peter-Aleck watershed, and the species was captured at 11 of the 28 sites sampled for fish in August 2001 and June 2005. Three juvenile Dolly Varden were captured at a resample site in 2005 (site 11 ILP 70043, reach 1), and 44 Dolly Varden were captured over 10 sites sampled in August 2001. The three Dolly Varden captured at site 11 ranged in length between 74 and 79 mm, and are speculated to be age 1+ based on length frequency analysis conducted on length data obtained in August 2001 (SKR 2002). Initial sampling resulted in the capture of 44 Dolly Varden, which were estimated to represent five distinct age groups, ranging from 0+ to 4+. Age at maturity for Dolly Varden reported by Scott and Crossman (1973), and for Dolly Varden in the Nadina watershed (SKR 2001c, 2004a) is generally between ages 3 and 4, with males frequently maturing one year earlier than females, which corresponds to the age at sexual maturity found in the scales collected from the Peter-Aleck watershed.

Dolly Varden were captured throughout many of the stream reaches in Peter-Aleck watershed sampled. These populations may exhibit an adfluvial or fluvial life history, with Dolly Varden captured in proximity to Owen Lake suspected to have an adfluvial life history. Dolly Varden captured in some of the higher elevation reaches in the watershed are suspected to have a fluvial life history, due to the low abundance of lakes in the system (6 lakes ranging between 0.4 and 2.8 ha, and covering a total of 8.8 ha).

4.5.2 RAINBOW TROUT

Rainbow trout were not captured during re-sampling in 2005, or during initial reconnaissance level inventory conducted in 2001. However, rainbow trout were captured at two sites in the Peter-Aleck watershed upstream of Owen Lake during previous fish sampling projects. Rainbow trout were captured in reaches 2 and 6 of Peter-Aleck Creek (ILP 70001), and in reach 1 of ILP 70010. All of these sites are within the lower half of the Peter-Aleck watershed, and all of these reaches exhibit relatively low gradient (2.11%, 0.84% and 7.96% respectively). Rainbow trout captured during operational inventories ranged in length between 41 and 104 mm, and were speculated to represent two age classes (0+ and 1+) (SKR 1999). Due to the proximity of these capture locations to Owen Lake, rainbow trout previously captured in the lower Peter-Aleck system are speculated to have an adfluvial life history.

4.5 SIGNIFICANT FEATURES AND FISHERIES OBSERVATIONS

Overall, the Peter-Aleck watershed offers accessible and suitable habitat for resident char and trout populations throughout most of the mainstem reaches, and lower reaches of tributaries, located within the Peter-Aleck valley flat area. While rainbow trout have only been captured in the mainstem and larger tributaries draining into the lower twelve reaches of Peter-Aleck Creek (Bustard 1999, SKR 1998, 1999), Dolly Varden are found throughout lower and mid elevation reaches, and their distribution extends into the headwaters of the system. The Peter-Aleck watershed is of interest since it is a potential cross over location for fish between the Nadina River (Nechako) and Owen Creek (Skeena) drainages. The mainstem of Peter-Aleck Creek is mis-mapped to drain into the Nadina River, through a wetland complex, which covers most of the area between Owen Lake (Skeena) and Park Lake (Nechako). Movement of the channel within the wetland, and/or periodic flooding make this area a likely location for past or future cross-overs of species between the two drainages. The following sections describe interesting features related to fish, fish habitat, and habitat protection concerns in the Peter-Aleck watershed based on historical information and the findings from this study.

4.5.1 FISH AND FISH HABITAT

The higher order and moderate to low gradient reaches of mainstem and larger (third order) tributaries within the study area appear to offer the most suitable and abundant fish spawning, rearing and overwintering habitat. Overwintering and rearing habitat is also provided by a few of the moderate and small sized wetlands, and the few small sized lakes in the systems. In addition to Dolly Varden captured and observed during the inventory conducted in August 2001 and June 2005, rainbow trout have been documented in the lower reaches of the mainstem, and larger order tributaries that drain into the lower reaches of the mainstem (e.g. ILP 70010, a second order tributary to reach 5 of Peter-Aleck Creek).

4.5.2 HABITAT PROTECTION CONCERNS

4.5.2.1 Fisheries Sensitive Zones

One fisheries sensitive zone was identified in reach 1 of ILP 70002 during a previous inventory (SKR 1998). Multiple side channels around debris in the lower portion of this reach were noted during sampling on October 20th, 1997.

4.5.2.2 Fish above 20% gradient

No reaches with gradients greater than 20% were sampled in 2001 (SKR 2002) or in 2005.

4.5.2.3 Rare and Endangered Species

Dolly Varden, a blue listed species (B.C. Environment 2001) were present throughout the Peter-Aleck watershed.

4.5.2.4 High Value Sport Fishing

While sportfishing opportunities exist at Owen Lake and Owen Creek (e.g. for bull trout, Dolly Varden, rainbow trout), sportfishing opportunities in the Peter- Aleck Creek drainage upstream of Owen Lake appear to include only rainbow trout and Dolly Varden. No notably high value sport fishing opportunities were noted in the study area.

4.5.2.5 Restoration and Rehabilitation Opportunities

No restoration or rehabilitation opportunities were identified in the Peter-Aleck watershed during re-sampling, however, one site was identified during initial sampling where restoration opportunities exist:

- Two culverts in reach 2 of ILP 70026 have been washed out from the road crossing, and a ford is currently present at this stream. Dolly Varden of three life stages (fry, juvenile and adult) were captured in this reach. One of the culverts remains partly in the stream channel downstream of the road crossing, and the second culvert remains under the road, but appears partly crushed. The road should be deactivated, or the crossing should be replaced with a structure that will minimize impacts on fish and fish habitat in this reach. The reach is located in a harvested area, with no riparian retention. The riparian vegetation has re-established since harvesting, and provides some shading for the stream.

4.6 FISH BEARING STATUS

Fish distribution in the study area is limited by a combination of gradient barriers to fish migration, and intermittent channels. Fish bearing reaches are summarized in table 14, while proposed non-fish bearing reaches are summarized in table 15. Reaches upstream of barriers to fish migration where no fish were captured, or where no perennial fish habitat was identified, are classified as non-fish bearing based on one season of sampling. Some reaches where no fish were captured, but no definite barrier to fish migration were observed, were noted to require further sampling to conclusively establish fish presence or absence (table 16).

4.6.1 FISH BEARING REACHES

Fish bearing status was assigned to all reaches in which species listed in the Forest Practices Code Fish Stream Identification guidebook were captured (FPC 1998). In addition, reaches in which no fish were captured, but where fish presence has been documented upstream, and where no barriers to fish migration have been identified were defaulted as fish bearing. Table 14 summarizes reaches that were documented to be fish bearing during this study. Of the eleven reaches sampled in June 2005, fish were captured in one stream reach (table 14). Other potential fish bearing reaches are indicated on the Fisheries Project/Interpretive Map (Appendix 5).

4.6.2 NON - FISH BEARING REACHES

Non-fish bearing status was assigned to ten reaches sampled upstream of barriers to fish migration in which no fish were captured in one season of sampling or which did not offer perennial fish habitat (table 15). This indicates a lack of resident fish upstream of these barriers.

4.6.3 FOLLOW – UP SAMPLING REQUIRED

Fish presence or absence was not conclusively determined for two reaches sampled in the Peter-Aleck watershed during the re-sampling program in June 2005 (table 16). Reaches, which could not be conclusively classified, require re-sampling to indicate if seasonal fish use is present and to confirm fish absence as described under Forest Practices Code standards (FPC 1998).

Table 14. Summary of data from one fish bearing reach (sorted by site number) in the Peter-Aleck Creek watershed sampled in 2005 (*for details see* Appendix 1).

Site #	Alias Stream name	ILP/ Watershed Code	TRIM map	Reach	Species	Channel		Proposed Riparian Class	Comments
						Width (m)	Site gradient (%)		
11	Unnamed	70043	093L.006	1	DV	1.50	2.50	**S3**	This reach provides excellent spawning habitat, and may provide suitable overwintering habitat. Three juvenile Dolly Varden were captured in 420 seconds of electrofishing. Initial sampling conducted in 2001 did not include sampling of this stream. Initial sample site 16 (SKR 2002), which was mistakenly identified as a site on ILP 70043 reach 1 was actually sampled in reach 1 of ILP 70041 (see tables 6 and 15).

Table 15. Summary of data from nine non-fish bearing reaches (sorted by site number) in the Peter-Aleck watershed sampled in 2005 (*for details see* Appendix 1). Site data pertaining to the resample events are listed first, with initial sampling data listed second for all re-sampled sites.

Site # *	ILP/ Watershed Code	Reach	TRIM map	Electrofishing specifications								Secondary Method	Date (2005)	Proposed Riparian Class	Comments
				Gradient (%)	Channel Width (m)	Dist. (m)	Time (s)	Cond. (µS)	Temp.	Stage	Turbidity				
2	70006	1	93L.006	2.5	1.00	110	451	90	10	M	C	EF	06/28	**S6**	This reach was initially sampled on June 26th, 1998 (SKR 1999); the reach provided fair rearing habitat and poor spawning habitat. During re-sampling, an 18 m long, 22% gradient cascade with 0.5 m steps (no plunge pools) was identified as a barrier to fish passage at the confluence with the mainstem. No fish were captured upstream of the cascade in two seasons of sampling.
				1.8	1.21	100	535	59	9	M	C				
3	70021	2-2	93L.006	12.0	1.53	100	368	70	11	M	C		06/28	**S6**	A 2.5 m falls over bedrock in an ~ 50 m long cascade onto rock (minimal plunge pool) was identified at the lower reach break as a barrier to fish passage. Dolly Varden were captured downstream (Site 6, SKR 2002), but no fish were captured upstream of the falls in this reach, or in reach 3 in two seasons of sampling (see site 4). A small lake (surface area ~2.4 ha) was examined by helicopter and appeared too shallow to provide suitable perennial habitat.
6															
4	70021	3	93L.006	0.3	2.35	140	720	70	11	M	C	EF	06/28	**S6**	This reach was initially sampled on August 22, 2001 (SKR 2002); the reach offered good rearing habitat, but no fish were captured. During re-sampling, a 2.5 m waterfall was identified as a barrier to fish passage in reach 2-2 (see site 3). No fish were captured in one season of sampling in reach 2-2 or in two seasons of sampling in reach 3.
7				0.5	2.25	120	721	100	7	M	C				

* italic site number indicates site number for site sampled in 2001 (SKR 2002)

Table 14. Summary of data from nine non-fish bearing reaches (sorted by site number) in the Peter-Aleck Creek watershed sampled in 2005 (*for details see* Appendix 1). Site data pertaining to the resample events are listed first, with initial sampling data listed second for all re-sampled sites.

Site # *	ILP/ Watershed Code	Reach	TRIM map	Electrofishing specifications								Secondary Method	Date (2005)	Proposed Riparian Class	Comments
				Gradient (%)	Channel Width (m)	Dist. (m)	Time (s)	Cond. (µS)	Temp.	Stage	Turbidity				
5	70029	1	93L.006	4	---	---	---	---	---	---	---		06/28	**NCD**	This reach was sampled about 250 m upstream of the mapped confluence with Peter-Aleck Creek. The reach is located in a 15 m wide riparian band with SW/NE aspect. No fish habitat was present, and no defined, continuous channel was identified. The drainage pattern of this system is mis-mapped; the upper reaches connect to Peter-Aleck Creek via ILP 70023 (see site 6). The initial sample site 10 (SKR 2002) was mistakenly identified as being located in reach 1 of ILP 70029 (table 7), but comparisons of field notes and photos indicate that this initial sample site was actually located in reach 1 of ILP 70032.
8 *12*	70033	1	93L.006	1	--- 1.50	--- 0.45	--- ---	--- Dry					06/28	**S4/ NCD**	Sections of defined channel were identified in the lower 50 meters of this system, which connects directly to Peter-Aleck Creek (fish bearing waterbody), but the channel is ephemeral, and the reach is NCD upstream. The lower 50 meters of the reach were dry during initial sampling on August 15, 2001 (SKR 2002). The lower 50 meters should be managed as fish bearing by default due to the lack of barriers, and direct connectivity with the fish-bearing mainstem.

* italic site number indicates site number for site sampled in 2001 (SKR 2002)

Table 14. Summary of data from nine non-fish bearing reaches (sorted by site number) in the Peter-Aleck Creek watershed sampled in 2005 (*for details see* Appendix 1). Site data pertaining to the resample events are listed first, with initial sampling data listed second for all re-sampled sites..

Site # *	ILP/ Watershed Code	Reach	TRIM map	Electrofishing specifications								Secondary Method	Date (2005)	Proposed Riparian Class	Comments
				Gradient (%)	Channel Width (m)	Dist. (m)	Time (s)	Cond. (µS)	Temp.	Stage	Turbidity				
9 *15*	70041	1	93L.006	9 9.25	0.60 0.55	100 100	312 442	90 130	7 11	M M	C C	EF	06/26	**S6**	This reach was initially sampled on August 10, 2001 (SKR 2002), when the initial sample site 15 was mapped on the mainstem of ILP 70041 reach 1 (see table 7). This reach is actually a distributary of ILP 70041, where water flows down a fire track or an old road. Comparisons of field notes and photos indicate that the initial sample site 15 was actually located on this distributary, and not on the mapped mainstem. The reach provides only marginal fish habitat as it consists largely of a road drainage ditch. A 20 meter section of seepage flow was identified as a potential barrier to fish passage during initial sampling, and was confirmed to obstruct fish passage during re-sampling. No fish were captured in this reach in two seasons of sampling.
10 *16*	70041	1	93L.006	4.5 5.0	0.72 0.52	100 100	327 522	130 130	6 10	M M	C C	EF	06/26	**S6**	This reach was initially sampled on August 10, 2001 (site 16, SKR 2002). The initial sample site was mistakenly identified as being located on ILP 70043 (see table 7). This reach provides only poor fish habitat. No suitable overwintering habitat (no deep pools), poor to no spawning habitat (very occasional presence of marginally sized gravels with lots of fines), and fair rearing habitat were identified in this reach. The reach may be ephemeral. No fish were captured in two seasons of sampling.

* italic site number indicates site number for site sampled in 2001 (SKR 2002)

Table 14. Summary of data from nine non-fish bearing reaches (sorted by site number) in the Peter-Aleck Creek watershed sampled in 2005 (*for details see* Appendix 1). Site data pertaining to the resample events are listed first, with initial sampling data listed second for all re-sampled sites.

Site # *	ILP/ Watershed Code	Reach	TRIM map	Electrofishing specifications								Secondary Method	Date (2005)	Proposed Riparian Class	Comments
				Gradient (%)	Channel Width (m)	Dist. (m)	Time (s)	Cond. (µS)	Temp.	Stage	Turbidity				
12 *26*	70060	3	93L.006	11.0	1.87	110	821	60	12	M	C	---	06/28	**S6**	This reach provides some suitable rearing habitat, but no suitable spawning habitat due to the moderate gradient. A 3 meter waterfall was identified in reach 2 of this system, and the waterfall is a barrier to fish passage. No fish were captured upstream of the falls in one season of sampling, in the best available habitat. The small lake located upstream (ILP 70066) is not likely to provide suitable overwintering habitat due to the shallow water depth, small surface area (~3.4 ha), high elevation (1192 m) and extensive littoral area (about 80% of surface water was covered by water lilies). This reach can be managed as non-fish bearing due to the lack of perennial fish habitat, and the lack of fish captured upstream of a barrier to fish passage.

* italic site number indicates site number for site sampled in 2001 (SKR 2002)

Table 14. Summary of data from nine non-fish bearing reaches (sorted by site number) in the Peter-Aleck Creek watershed sampled in 2005 (*for details see* Appendix 1). Site data pertaining to the resample events are listed first, with initial sampling data listed second for all re-sampled sites.

Site # *	ILP/ Watershed Code	Reach	TRIM map	Electrofishing specifications								Secondary Method	Date (2005)	Proposed Riparian Class	Comments
				Gradient (%)	Channel Width (m)	Dist. (m)	Time (s)	Cond. (µS)	Temp.	Stage	Turbidity				
13	70063	1	93L.006	3.5	0.98	120	321	150	8	M	C	EF	06/28	**S6**	This reach was initially sampled on August 22nd, 2001 (SKR 2002). Fish habitat was rated as marginal due to the lack of suitable spawning habitat (no appropriate gravels), lack of suitable overwintering habitat (no deep pools), and poor rearing habitat (lack of pools and low discharge). Some seepage sections and underground flow approximately 100 m upstream of the mainstem were identified as potential obstructions to fish passage during initial sampling. The channel consists of 5 – 15 m long piped underground sections, and becomes less well defined 150 meters upstream of the mainstem. The wetland at the confluence with Peter-Aleck Creek was flooded at the time of re-sampling. The seepage sections, and extensive underground flow in this reach obstruct fish passage to very marginal fish habitat in this reach. No fish were captured in two seasons of sampling.
28				7.0	0.98	100	320	160	5	M	C				

* italic site number indicates site number for site sampled in 2001 (SKR 2002)

Table 16. Follow - up sampling requirements for three reaches (sorted by Site number) in the Peter-Aleck Creek watershed that were sampled in 2005 (*for details see* Appendix 1).

Site # *	ILP/Stream name	Reach	TRIM map	Channel Width (m)	Timing	Methods	Proposed Riparian Class	Comments
1	70002	1	93L.007	1.55	---	---	**S3**	This reach was initially sampled on October 20th, 1997 (SKR 1998); the lower 20 meters of this reach did not exhibit surface flow. The lower 25 meters of the reach were noted to lack surface flow or a defined channel during re-sampling. In addition, 0.3 m high steps in a 14% gradient, 40 m long cascade section restrict access. No suitable spawning habitat (substrate primarily cobbles and fines), no suitable overwintering habitat (no deep pools) and limited rearing habitat were noted in the reach. No fish were captured upstream of the lower 25 meter seepage section in two seasons of sampling. This reach should be managed as fish bearing by default due to the lack of definite obstructions to fish passage, but upstream reaches can be managed as non-fish bearing due to the lack of fish in two seasons of sampling in this reach, and poor habitat upstream.
6 *8*	70029	1	093L.006	1.93	---	---	**S3**	ILP 70029 is a mismapped drainage. This reach, located about 200 meters SE of the mapped location of the stream, connects the upper portion of ILP 70029 to ILP 70023 (see site 5). Dolly Varden were captured in ILP 70023 (Site 8, SKR 2002), and no barriers to fish passage were observed in the 400 meter section of this reach surveyed. This reach should be managed as fish bearing by default. Re-sampling upstream of the mapping error, in the upper portion of mapped reach 1 of ILP 70029 may provide information that would help assist conclusively classify upstream portions of the drainage.

* italic site number indicates site number for site sampled in 2001 (SKR 2002)

Table 16. Follow - up sampling requirements for three reaches (sorted by Site number) in the Peter-Aleck Creek watershed that were sampled in 2005 (*for details see* Appendix 1).

Site #	ILP/Stream name	Reach	TRIM map	Channel Width (m)	Timing	Methods	Proposed Riparian Class	Comments
7 *10*	70032	1	093L.006	1.28 1.32	---	---	**S4**	This reach was initially sampled on August 15th, 2001 (SKR 2001). During initial sampling, the site (site 10, SKR 2002) was mistakenly identified as being located on ILP 70029, since the site was completed at the confluence of ILP 70029 and 70032. Site 10 in SKR 2002 is actually located on ILP 70032. No fish were captured at this site by electrofishing during initial sampling, or during re-sampling. This reach provides some limited rearing habitat, no suitable overwintering habitat (no deep pools) and no spawning habitat (no suitable substrate, except possibly in the lower 50 meters). Fish presence in this reach is unlikely due to the limited quality of fish habitat.

* italic site number indicates site number for site sampled in 2001 (SKR 2002)

5.0 GLOSSARY OF ABBREVATIONS AND TERMS

Adfluvial	Referring to both lake (lacustrine) and stream (fluvial) habitat
BEC Zone	Biogeoclimatic Ecosystem Classification zone. A system used by the B.C Ministry of Forests, and others, to describe terrestrial ecosystems based on vegetation, geography, and climate (see Meidinger and Pojar 1991)
CMP	Corrugated metal pipe (culvert)
FDIS	Field Data Information System. A standardized MS Access database developed by B.C. Fisheries used to input field data collected during the reconnaissance (1:20,000) fish and fish habitat inventory
FFHI	Fish and fish habitat inventory
FIA	Forest Investment Account
FISS	Fisheries Information Summary System
FPC	Forest Practices Code of British Columbia
FSR	Forest Service Road
H	Kruskal-Wallis test statistic. The Kruskal Wallis test is the non-parametric analog to the one-way analysis of variance.
HFP	Houston Forest Products Co.
ILP	Interim Locational Point
KS	Kolmogornov-Smirnoff test statistic. The Kolmogornov-Smirnoff test tests whether independent samples come form the same distribution.
MSRM	B.C. Ministry of Sustainable Resource Management
NCD	Non-classified Drainage
NVC	No Visible Channel
Stream Order	Stream order is a method used to describe the relative size and topology of a stream in a network. Order is determined from TRIM map interpretation. Streams with no tributaries are 1st order, and order increases by one unit where streams of the same order join (e.g. two 2nd order streams make a 3rd order stream).
TRIM	Map products produced as a result of the provincial government's Terrain Resource Information Management program
WBID	Waterbody Identifier. A unique alpha-numeric code given to each waterbody within a watershed group (e.g., 00825UNRS). Acquired from the B.C. Watershed Atlas.
WSC	Watershed Code. Obtained from the B.C. Watershed Atlas.

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Appendix 1. Sample Site Information including FDIS Site Cards, Fish Forms, and Site Photographs (sorted by site number).

SITE CARD INDEX

ILP	TRIM Map #	Reach #	Site #	Page #
70002	093L.007	1.0	1	S-1
70006	093L.006	1.0	2	S-2
70021	093L.006	2.2	3	S-3
70021	093L.006	3.0	4	S-4
70029	093L.006	1.0	5	S-5
70029	093L.006	1.0	6	S-6
70032	093L.006	1.0	7	S-7
70033	093L.006	1.0	8	S-8
70041	093L.006	1.0	9	S-9
70041	093L.006	1.0	10	S-10
70043	093L.006	1.0	11	S-11
70060	093L.006	3.0	12	S-12
70063	093L.006	1.0	13	S-13

Appendix 2. Photodocumentation Forms 1 and 2.

Photodocumentation Form 1 – Equipment Details

Survey Start Date: June 26, 2005 Survey End Date: June 28, 2005
Agency: C141
Crew: RS/RS

Camera #1:
Make and Model: Sony Cybershot DSC-S85
Lense: 35 mm
Format: JPEG files

Roll and or Batches Detail:

Roll #	CD #	Camera	Output Medium	Film Type	ISO
1	1	1	CD Rom	digital	NA
2	1	1	CD Rom	digital	NA

Appendix 3. Watershed relationship summary table for the Peter-Aleck watershed, using criteria described in Witt and Giroux (1999).

	Elevation Zones[1]					Gradient (from FDIS)					Channel Pattern			Size		
	1	2	3	4	5	Class 1	Class 2	Class 3	Class 4	Class 5	ST/SI	IM/ME	AN/BR	Small	Med.	Large
Total No. Reaches	**30**	**74**	**24**	**3**	**16**	**61**	**29**	**21**	**9**	**27**	**139**	**8**	**0**	**74**	**57**	**16**
No. Randomly selected reaches	0	12	2	0	0	4	4	4	2	0	14	0	0	6	8	0
No. Biases Selected Reaches	5	9	3	0	0	5	5	7	0	0	16	1	0	1	16	0
Total No. Sampled	**5**	**21**	**5**	**0**	**0**	**9**	**9**	**11**	**2**	**0**	**30**	**1**	**0**	**7**	**24**	**0**
% reaches sampled	16.7	28.4	20.8	0	0	14.8	31.0	52.8	22.2	0	21.6	12.5	0	9.5	42.1	0
No. with Fish (%of sampled reaches)	1 (20.0)	9 (42.9)	0 (0)	0 (0)	0 (0)	3 (33.3)	4 (44.4)	3 (27.3)	0 (0)	0 (0)	10 (33.3)	0 (0)	0 (0)	2 (28.6)	8 (33.3)	0 (0)
No. with suspected fish (% of sampled reaches)	0 (0)	2 (9.5)	1 (20.0)	0 (0)	0 (0)	1 (11.1)	0 (0)	2 (18.2)	0 (0)	0 (0)	2 (6.7)	1 (100)	0 (0)	0 (0)	3 (12.5)	0 (0)
No. with no fish (% of sampled reaches)	3 (20.0)	10 (47.6)	4 (80.0)	0 (0)	0 (0)	5 (55.6)	5 (55.6)	5 (45.5)	2 (100)	0 (0)	17 (56.7)	0 (0)	0 (0)	5 (71.4)	12 (50.0)	0 (0)
No. with suspected no fish (% of sampled reaches	1 (20)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (9.1)	0 (0)	0 (0)	1 (3.3)	0 (0)	0 (0)	0 (0)	1 (4.2)	0 (0)

[1]Elevation zones are: Zone 1 = 740–971m, Zone 2 = 972-1203m, Zone 3 = 1204-1435m, Zone 4 = 1436 – 1667m, Zone 5 = 1668-1900m for upstream reach elevations (see Witt and Giroux 1999)

Appendix 4. QA/QC

Appendix 5. 1:20,000 Fisheries Project/Interpretive Maps for Peter-Aleck Creek watershed.

Fisheries Project/Interpretive Maps:
093L.006
093L.007