CHINOOK SALMON HABITAT ASSESSMENT AND RESTORATION ENHANCEMENT POSSIBILITIES FOR SELECTED TRIBUTARIES OF THE PELLY RIVER IN THE VICINITY OF PELLY CROSSING, 1998.

(Needlerock, Mica, Willow and Grayling Creeks)

Prepared for:

The Yukon River Panel

Prepared by:

Jane Wilson & Associates

with

Environmental & Administrative Services Yukon
Laberge Environmental Services & S.P. Withers

December, 1999

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RE-33-98

The Yukon River Salmon Restoration & Enhancement Fund

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ABSTRACT

Chinook habitat investigations were conducted on four major tributaries of the Pelly River downstream of Granite Canyon including: Needlerock, Mica, Willow and Grayling Creeks; between July 1998 and April 2, 1999. Detailed stream habitat surveys were conducted during critical low flow conditions in summer and winter to identify chinook restoration possibilities. Adult chinook enumeration was conducted August 26 by helicopter and obstructions and spawning areas identified and mapped.

Of the four tributaries investigated, only Needlerock and Mica Creeks supported a spawning population of adult chinook. A total of 26 chinook salmon was observed in Needlerock Creek below the reaches affected by a forest fire in 1995. Silt and sand deposition was high below observed spawning areas due to active sliding of sand and silt from abutting slopes. Above the upper limit of spawning, a forest fire burned a large area adjacent to the creek in 1995 resulting in: the loss of canopy cover, the formation of logjams as a result of fallen fire-killed trees and subsequent erosion of weakened banks. As a result, the stream morphology was greatly altered and appeared unsuitable for spawning. A total of 15 adult chinook was observed in Mica Creek. Unusually low water levels prevented chinook from migrating upstream until August 17, after some precipitation raised the water level. A beaver dam, located approximately 2 km upstream of the mouth, obstructed further migration and all spawning occurred below the dam. In the past, chinook salmon have been observed spawning further upstream; as far as the outlet of Towhata Lake. The low, marsh-like conditions and extensive beaver activity above Towhata Lake make this area at the present time unsuitable for spawning chinook salmon.

Chinook salmon fry were captured in all four tributaries investigated. Fry were captured below a high beaver dam near the mouth of Willow Creek. Extensive beaver activity in Willow Creek has made this creek unsuitable for spawning chinook at this time. However, water quality and habitat suitable for salmon spawning is found at sites below some of the beaver dams suggesting that this creek may have supported a spawning population at one time. Grayling Creek is a cold clear stream providing limited spawning habitat but excellent rearing habitat. The cold water temperatures suggest groundwater discharge which could be investigated for its potential in the establishment of an artificial streamside incubation facility to supply fry for out-planting to tributaries within the watershed. Winter stream flow and water quality indicate adequate over-wintering habitat for juvenile chinook salmon in all four tributaries investigated.

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INTRODUCTION

In the present study, four major tributaries of the Pelly River within the Traditional Territory of the Selkirk First Nation were investigated to determine the extent of utilization by chinook salmon and identify restoration potential. The tributaries investigated included: Needlerock, Mica, Willow and Grayling Creeks.

Sustaining a healthy population of chinook salmon in the Pelly River watershed is of great importance to a number of user groups along the Pelly River basin and along the Yukon River downstream of the Pelly River. Native food fishers and a domestic and commercial fisher presently rely on this resource in the study area. Selkirk First Nation members have long relied on chinook salmon to supplement their diets and members presently fish between Needlerock Canyon and Fort Selkirk.

It is generally felt among members of the Selkirk First Nation that chinook populations in the Yukon River have declined considerably from the past. Recent participation in enhancement feasibility studies have indicated a strong desire on the part of the Selkirk First Nation to develop enhancement programs in their traditional territory. Preliminary investigations conducted by the Selkirk First Nation and the Department of Fisheries & Oceans have been limited to assessing winter open water sites for the purpose of evaluating available and sensitive fish habitat as well as identifying possible streamside incubation sites for enhancement of chinook stocks in this area (DFO, 1995, Tanner 1990, Wilson , 1997). However, utilization of most of these tributaries by chinook salmon is undocumented and detailed investigations of chinook spawning and rearing habitat have not been conducted.

The general objective of this project was to provide the information necessary for resource managers and future land use developers to make informed decisions on habitat protection and restoration for the study area.

The specific objectives of the study were as follows:

1) To collect current and historical information on chinook salmon utilization in the four tributaries within the study area.
2) To inventory stream habitat in each tributary including physical and biological characteristics
3) To identify potential restoration options and report findings

This report presents the findings of these investigations. Funding for this project was provided by the Yukon River Panel Salmon Restoration & Enhancement Fund under the U.S./Canada Interim Agreement of the Pacific Salmon Treaty.

STUDY AREA

The lower Pelly River and its tributaries fall within the Central Yukon Plateau Ecoregion (Ecological Stratification Working Group, 1995). The region is characterized by rolling hills and plateaus separated by broad, deeply cut valleys. As a result of glacier retreat during the last glaciation, valleys downstream of lakes are bordered by glacio-lacustrine and fluvial depositional features. The most common forest types are white and black spruce. Black spruce is dominant in colder, poorly drained areas. As naturally recurring fires are frequent, serial vegetation communities are prevalent. Burnt-over areas are most commonly colonized by lodgepole pine and trembling aspen. Shrub birch and willow, with occasional paper birch and alpine fir, dominate the subalpine vegetation. Extensive grasslands occur on lower south-facing slopes. These grassland slopes are prominent features of the lower Pelly River Valley.

The cold, semiarid climate of the region has a mean annual temperature of approximately -3.5° C, with a summer mean of 12.0°C and a winter mean of -19°C. The lowest precipitation at the Pelly River Farm, for the period 1951 to 1997, occurs in April, with a monthly mean of 10.6 mm, and the highest occurs in July, with a monthly mean of 50.8 mm (Environment Canada unpublished data).

The Pelly River drains an area of approximately 51,000 square kilometers. It flows from its headwaters in the Selwyn Mountains to its confluence with the Pelly River at Fort Selkirk. The major tributaries of the Pelly River include the Hoole, Ketza, Ross, Lapie, Orchay, Glenlyon, Tay, Earn, Tummel, and Macmillan Rivers. The current study area includes the tributary streams downstream of the Macmillan River. They include Needlerock, Mica, Willow and Grayling Creeks (Fig. 1).

The monthly mean discharge of the Pelly River at Pelly Crossing for the period 1952 to 1996 ranges from a low of 50 m^3/sec in March to a high of 1382 m^3/sec in June. The minimum daily discharge (28 m^3/sec) was recorded on February 26, 1982, and the maximum daily discharge (4300 m^3/sec) was recorded on May 28, 1957.

The lower Pelly River and the tributaries included in the current study area are shown on National Topographic Series map sheets 105-L, 115-I and 115-P.

7 000 000mN 450 000mE

400 000mE

7 000 000mN

Woodburn Ck.

Crooked Creek

Summit Lake

Klondike Hwy.

Willow Lake

Willow Creek

Diamain Lake

MacMillan R.

RIVER

Needle

Lake Creek

Coldspring Ck.

Grayling Lakes

Grayling Ck.

PELLY

Ptarmigan Ck.

Tatlmain Lake

Pelly Crossing

Mica Creek

Towhata Lake

Tatlmain Ck.

Legar Lake

Legar Creek

Von Wilczek Lakes

400 000mE

6 950 000mN

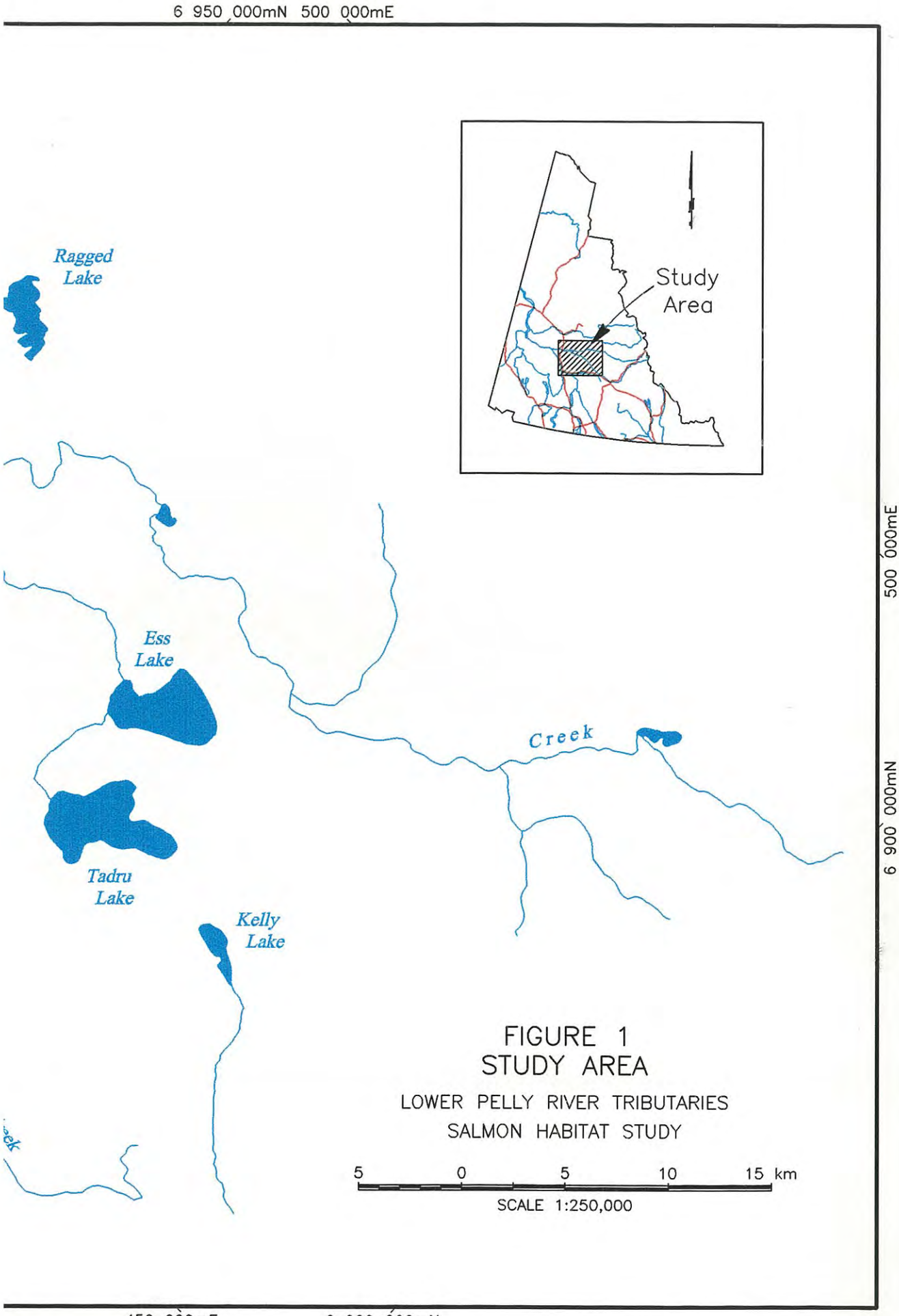

FIGURE 1
STUDY AREA

LOWER PELLY RIVER TRIBUTARIES
SALMON HABITAT STUDY

5 0 5 10 15 km

SCALE 1:250,000

METHODS:

Stream investigations were conducted at four levels including: 1) collection of historical traditional knowledge, 2) a preliminary examination of aerial and topographic maps to determine general reach breaks and access routes, 3) site specific physical and biophysical investigations at stream level and 4) an aerial overview to determine present utilization of each stream by chinook salmon and denote obstructions.

Site Determination:

Preliminary reach breaks were determined from aerial and topographic maps prior to field investigations. Access routes were determined from maps and from discussion with Selkirk First Nation members living in Pelly Crossing.

Field Investigations:

Summer Survey:

Summer stream surveys were conducted between July 29 and August 12, 1998. Sites on Grayling, Willow and Mica Creeks and upper reaches of Needlerock Creek were accessed by the use of ATV's or a 4X4 truck. A river boat owned and operated by Bob Curry of Pelly Crossing was used to access the lower reach of Needlerock Creek from the Pelly River. Aerial surveys were conducted on Mica and Needlerock Creeks, August 26, using a bell 206B Jet-ranger helicopter from Trans-North Air.

Habitat Description:

Stream habitat inventories were conducted on selected sites within delineated reaches for each tributary based on the methodology and description of characteristics in the Stream Survey Field Guide - Fish Habitat Inventory & Information Program (DFO, MOE/B.C.). Field inventory forms were developed based on the DFO/MOE Stream Survey Form and modified with consultations with DFO personnel (Yukon/NBC division) to make it comprehensive for all field assistants. Characteristics including: streambed material, composition, bank characteristics, riparian zone composition, and channel characteristics including: pool/riffle/run ratio, gradient, width and depth, were recorded. An Eagle Explorer hand held GPS was used to record UTM coordinates of survey sites, obstructions, spawning dunes, and other notable features.

Water Quality:

Basic water quality components including: temperature, pH, DO, conductivity, and turbidity, were measured in-situ using a multi-parameter probe (Horiba water quality checker model U-10); calibrated prior to field operations.

A temperature logger (Optic StowAway®Temp) was placed in each of the four major tributaries to record daily water temperatures for a year. Each logger, which measures 5 1/2" X 3/4", was attached to a 10 ' length of cable and inserted in a section of pvc pipe for protection. A cap with several drilled holes was glued to the top (upstream end) of the pvc pipe to allow water to flow through. The entire unit was then placed near the bottom of a deep pool where it would be less likely to freeze to the bottom and kept in place by driving a steel rod, fitted through holes drilled in the bottom (downstream) end of the pvc pipe, into the stream bed. The attached cable was extended and secured to a steel rod driven into the bank. An attached rope was tied off to a tree for added security. After a full year of recording temperatures, the logger will be removed and the data downloaded into a computer.

Water samples were taken from each tributary for analysis of nutrients, anions and metals. Samples were collected in clean new plastic bottles at a point upstream of any disturbance associated with other site investigations. All samples were stored and transported on ice and shipped to Norwest Laboratories in Burnaby B.C. for analysis.

Water Quantity:

Stream velocity was measured during the summer survey using a Price Flow Meter from Environment Canada. Discharge was determined using the standard velocity area method.

Juvenile Fish Assessment:

Gee-type minnow traps with 1/4" mesh were baited and set in a variety of habitat types to determine the presence of juvenile chinook salmon in each tributary, and the extent of upstream migration. The bait consisted of a walnut-sized portion of Yukon River salmon roe held in a perforated plastic sandwich bag and tied to the inside of each trap. The traps were kept closed using a "twist-tie" which would break apart in the event that a trap was lost thereby preventing the continuous capture of fish. Traps were set for a minimum 12 hour period up to a maximum of 24 hours whenever possible. Gee-type minnow traps baited and set in this fashion have been found to be highly effective for the capture of Yukon River chinook salmon fry.

All juvenile fish captured were identified, enumerated and released. A sub-sample of captured jcs were anaesthetized with a small portion of an "Alka Seltzer" tablet, measured for fork length to the nearest millimeter, weighed (using a digital scale accurate to $\pm$ 0.1) and released after full recovery from the anaesthetic.

Data Analysis:

To compare relative abundance of jcs between sites and tributaries, the results of the trapping program were expressed as the number of fish trapped per number of hours the trap was set (CPUE).

Biological data including: mean length, mean weight and mean condition factor; was determined for jcs captured per site in each tributary. The condition factor (K) was calculated for salmon fry using the formula: K = weight(grams) * 100/ length (centimeters).

Benthic Sampling:

Benthic invertebrate samples were collected using a 30 cm D-frame invertebrate kick net sampler with a 400 micron mesh. Whenever possible, samples were collected from shallow riffle areas. Invertebrates were dislodged from the substrate by kicking the substrate at various points in the riffle for a period of three minutes. Dislodged invertebrates and debris collected in the net held downstream of the disturbed substrate were then transferred to a one litre nalgene bottle and preserved in a 10% formalin solution.

The preserved samples were sorted, identified and enumerated by Laberge Environmental Services. The majority of benthos were identified to the family level. The number of organisms per sample were summed to give a total abundance value for that site. Diversity was calculated per reach by enumerating all the taxonomic groups identified from species to phylum.

The benthos data was further analyzed by determining the composition of the community at each reach. The community was divided into major taxonomic groups, usually orders, and the percentage of each determined. Any group(s) which formed 25% or more of the community was classified as dominant.

Winter Survey

Winter stream flow measurements and water quality samples were obtained from Needlerock, Mica and Grayling Creeks between March 31 and April 2, 1999. Sites were accessed by snowmobile.

Winter low flow measurements were determined using the salt slug injection method. This method involves injecting a slug of sodium chloride (NaCl) into the stream and monitoring the change in conductivity over time as the salt slug passes a point downstream.

RESULTS:

NEEDLEROCK CREEK

Area Description

Needlerock Creek flows in a north-westerly direction from the Tummel and Tatchun hills to the southeast entering the Pelly River on the left just below Granite canyon; draining a total area of approximately 1,025 km^2. The highest point in the drainage basin is 1,726 meters. There are no large lakes in the Needlerock Creek drainage.

The drainage area of Needlerock Creek remains in a relative pristine state with little human activity other than trapping and hunting. A winter cat road constructed from Pelly Crossing to Russel Creek in 1981-1982 to access placer gold exploration near Russel Creek crosses Needlerock creek approximately 2 km upstream of the mouth. However, the exploration activities have ceased and the road since abandoned for this purpose.

Four sites were investigated on Needlerock Creek between the mouth and the lower extent of a fire which occurred in 1995 (UTM 0461934E 6957252N)(Fig.'s 1 & 2). A site upstream of the mouth was accessed by boat from the Pelly River. Sites further upstream were accessed by ATV along the abandoned winter mining road. Sites above the fire kill area were inaccessible by ATV as fallen trees made passage through this area difficult.

Site Descriptions

Reach 1 - Site 1

This site was located near the mouth approximately 150 meters upstream from the confluence with the Pelly River and is generally representative of the lowest reach of the creek which extends to a point approximately 1.2 km upstream; the upstream extent denoted by an increase in elevation.

One of the characteristic features of this reach includes the frequent confinement of the stream channel by sandy slopes. The stream which meanders irregularly through this valley occasionally abuts unstable sandy slopes resulting in sand and silt deposition downstream. Although very little suspended solids were observed, sand and silt accumulations were evident in numerous areas and became entrapped in algal growth on gravel and cobble substrate.

Streambed material consisted of sand and silt (35%), gravel (35%), cobble (30%), and a few boulders. Substrate compaction was moderate.

Although conditions during the summer of 1998 were extremely dry, Needlerock Creek maintained a relatively moderate flow with the average wetted width of 11.5 meters being fairly consistent throughout the site surveyed and only a meter less than the channel width. The calculated discharge of 1.12 m^3/s, on August 4,was greater than all other tributaries investigated in the present study (Table 2). Since Needlerock Creek is not fed by any large lakes, it is likely that ground water input is substantial. The stream flowed over a moderate gradient of 1.0%, at an average velocity of 0.5 m/s, in a riffle/run sequence.

Approximately 35% of the total stream area provided some cover for fish. Overhanging willow and alder and streamside grasses provided approximately 50% of the available cover; the remainder being comprised of Large Organic Debris (LOD) (35%), boulders (5%) and cutbanks (10%).

Reach 2 -Site 1

This site, located above the winter mining road crossing approximately 2 km (straight line) upstream from the mouth was generally representative of a reach extending approximately 2 km (straight line) upstream from the lower reach; the upper limit denoted by a change in elevation. The stream flows through a narrow valley and is occasionally confined. The average channel width was 9.2 meters, the average wetted width, 9.0 meters and the average depth, 0.75 meters. The stream ran clear in a pool/riffle/run sequence over a moderate gradient of 1.0%, at an average velocity of 0.2 m/s.

Streambed material consisted of silt/sand (30%), gravel (20%) and cobble (50%). Sand and silt accumulations were greatest in pools particularly at bends in the river. A clean layer of cobble and larger sized gravel overlaid sand, cobble and gravel in areas of higher velocity. Medium to large sized boulders were scattered along the stream sides. Substrate material was free of algal and moss growth at this site.

Generally the stream banks were stabilized by cobble and boulder accumulations and a thick growth of willow, alder and spruce. A small segment of the left bank has slumped sometime in the past and signs of some present erosion are evident. Some stabilization of this bank area was provided by a growth of horsetail and mosses at the base.

Approximately 40 % of the total stream area provided cover for fish with vegetative overgrowth and deep pools making up 70 % of the cover. Some cover was also provided by boulders and cutbank.

Reach 3

Because of the difficulty in accessing sites within this reach from the ground, observations were made during an aerial survey and general characteristics recorded. The stream meandered tortuously through a wide valley which narrowed towards the upstream limit, approximately 16 km (straight line) upstream from the previous reach.

Examination of topographic maps indicate an increase in elevation. This entire area was generally characterized by dense stands of white spruce growing close to the stream banks. The stream flowed in a pool/riffle sequence.

Reach 4 -Site 1

This reach extends upstream to the lower extent of a large recent (1995) burn area. The stream flows through a wide valley with occasional confinement along the right. A site was surveyed below a sandy embankment approximately 18 km along the mining road from the stream crossing. The average channel width was 10.9 meters, the average wetted width, 9.3 meters and the average depth, 0.5 meters. The stream ran clear at an average velocity of 0.4 m/s over a moderate gradient of 1.0%, in a riffle/pool sequence.

Streambed material consisted of fines (30%) (mostly sand), gravel (65%), and small cobble (5%). The average sized gravel measured 3.0 cm in length. Compaction of gravel in riffle areas was low with a thin layer of gravel overlaying sand. Large masses of slimy brown algal growth were prevalent on gravel substrate particularly in sections where there was little crown cover. The stream was relatively shallow in riffle areas exposing small areas of gravel.

The stream was confined on the right by a steep sandy embankment which was partially stabilized by a thin growth of alder and willow shrubs along the base and occasional white spruce. The left bank was unconfined and stable with a lush growth of grasses, sedges, horsetail and mosses and a thick growth of alder and willow. Stands of young and mature spruce were more prevalent on the left bank upstream and downstream of the site surveyed.

Approximately 30% of the total stream area provided cover for fish. Most of the cover consisted of overhanging alder (40%) and pools (20%) in addition to some protection by LOD, cutbanks and instream vegetation. Although no juvenile fish were captured in minnow traps set overnight at this site, two grayling were observed in a pool.

Reach 5 - Site 1

This reach was affected by the fire in 1995 which burned a large area adjacent to Needlerock creek. Stream conditions have been altered as a result of logjams created by deadfall and from subsequent erosion of weakened banks. Hence, most of the reach was characterized by deep pools and runs formed by the holding back of water by logjams and large areas of deposited sand and silt throughout the streambed.

The representative site surveyed was accessed by travelling a further 9.5 km from the previous site on the winter road which runs along a high bench parallel to the creek. The channel width was 9.7 meters, the wetted width, 7.7 meters and the average depth, 1.0 meter. The stream was slow moving at an average velocity of 0.13 m/s. The site was

made up entirely of deep pools and runs over a low gradient of <1.0 %. Streambed material consisted of mostly sand and silt with a small percentage of gravel in shallower areas close to the left bank.

Riparian vegetation consisted primarily of grasses with some re-growth alder shrubs and an overstory of both fallen and standing fire-killed spruce.

Water Quality

At all four sites investigated in the summer, in-situ water quality measurements including: temperature, pH, dissolved oxygen and conductivity, were within the accepted water quality criteria for the protection of freshwater aquatic life as set out in the Canadian Council of Resources and Environment Ministers Guidelines (CREMM).

Water samples for laboratory analysis of metal, anions and nutrients were collected from Reach 1-site 1(near the mouth) and Reach 5-site 1 (in recent burn area), during the summer survey. Most metal concentrations were within acceptable levels recommended for salmonid hatcheries (DFO, 1983) with the exception of copper concentrations at Reach 1 which exceeded the recommended levels. Upstream at Reach 5, copper levels were only slightly above recommended levels. Nutrients at both sites were within recommended levels. A summary of water quality is given in Appendix 1.

A temperature logger was placed in a deep pool by the right bank at Reach 1-site 1 and will remain in the creek until August, 1999. A summary of daily water temperatures will be presented as an addendum to this report at that time.

Juvenile Chinook Capture

A total of 23 chinook salmon fry was captured in 15 gee-type minnow traps set overnight in Reach 1 and Reach 2. No jcs were caught in five traps set in Reach 4 and five traps set in Reach 5. Of the total jcs captured, 22 were caught in traps set near the.mouth in Reach 1. The remaining two jcs were captured in Reach 2. The fork length of jcs captured ranged between 58 and 75 mm and the weight, between 1.2 and 4.4 grams. It is assumed that jcs captured were all young-of-year (fry emerged in 1998). Although no scale samples were taken for age determination of jcs captured, weight at length comparisons of fry in Croucher Creek in the Upper Yukon River system (Moodie, 1993) indicate the general length range of young-of-year (0+) jcs to be between 40 - 90 mm.

The mean condition factor (K) for jcs captured in Needlerock Creek was 1.05; the condition factor being an indicator of the general health and condition of salmonids. Generally, a higher condition value is preferred to a lower value (Moodie, 1993), although no standards for comparison have yet been developed for the Yukon River system. A higher condition factor could mean greater over-wintering success. The mean condition factor for jcs captured in Needlerock Creek is slightly lower than the mean of jcs captured in Mica Creek, but higher than means in Willow and Grayling Creeks (Table 1).

Benthic Invertebrates

Benthic invertebrates were collected from Reaches 1, 2 and 3 on Needlerock Creek, in August 1998. The community at Reach 1 was the most diverse in the study area with 18 different taxonomic groups identified within the total population of 203. Dipterans (true flies) were dominant. The community at Reach 4 had the lowest population (8 individuals) and diversity in the study area. Gastropoda (snails) was the dominant group at this site. Gastropods generally inhabit sandy substrates, which formed 30% of the stream bottom in this reach. The remaining gravel substrate was covered with large masses of brown algae which may have restricted colonization of invertebrates. The community at Reach 5 had a low population but was fairly diverse. Amphipoda (scuds) shared dominance with Diptera reflecting the pool type habitat prevalent at this site. Data are summarized in Table 3.

Adult Chinook Salmon

A total of 26 adult chinook salmon and three carcasses was observed in Needlerock Creek during an aerial survey conducted on August 26, 1998; all within a 6 km (straight line) stretch above the winter road crossing (Fig. 3). During the ground survey, eight adult chinook were observed migrating upstream at the winter road crossing. A few small beaver dams were observed in this area, however they did not impede migration. No adult chinook were observed above a beaver dam located at GPS 6246952N 13602400W, however it is uncertain if it was a barrier to migration. In the area above this dam, fewer large spruce stands were noted adjacent to the creek and willow/alder shrubs generally predominated.

Winter Low Flow and Water Quality:

A winter low flow measurement was taken in an area of open water approximately 500 meters upstream of the confluence of Pelly River. A large quantity of water flowed swiftly through this open area. Using the salt dilution method, the discharge was determined as 1.71 m^3/s.

Frozen overflow or "glacier" ice was extensive on this creek. During a reconnaissance of the creek by snowmobile, overflow conditions were observed as far as a site investigated during the summer in Reach 4. It appeared that these conditions continued further upstream. During the summer survey, ground water was observed entering the creek from the embankment at this site in Reach 4. Since ground water outflows are usually several degrees warmer than surface flows it was thought that there might be open water in this area, however no open areas were observed there during the winter survey.

In-situ water quality measurements including: temperature, pH, dissolved oxygen and conductivity, were within the accepted water quality criteria for the protection of freshwater aquatic life (CREMM).

Water samples for laboratory analysis of metal, anions and nutrients were collected from the open area in Reach 1. All metal and nutrient concentrations were within acceptable levels recommended for salmonid hatcheries (DFO, 1983) including copper which had exceeded the recommended levels in a sample taken from the same location during the summer. It is likely that copper enters the stream through surface runoff during the summer. A summary of water quality is given in Appendix 1.

Discussion & Recommendations

Estimates of the overall number of chinook reaching spawning grounds in Canada in the Yukon River drainage were very low in 1998; approximately 44% below the recent 5 year cycle average (JTC report, 1998). Since this study reported the first documented sighting of chinook spawning activity in Needlerock Creek it is uncertain whether the return to this creek was lower than in previous years. It is possible that this creek once supported many more chinook according to observations by Johnson Edwards from Pelly Crossing who recalled seeing "100's" of chinook holding in pools in several locations in Needlerock in 1954 (Morrell, 1991). The amount of unutilized area in the reach where spawning chinook salmon were observed indicates that this area could probably support a higher population.

If the return of adult chinook salmon was much greater in the past, a number of factors may have affected spawning habitat thereby reducing the available area suitable for spawning, including:

1) Possible loss of habitat in Reach 5 as a result of the forest fire of 1995.
2) Increased sediment loads downstream of sand slides in Reach 1
3) Barriers to migration as a result of beaver dam construction

Recommendations:

To increase available habitat for spawning the following recommendations may be considered:

1) stabilization of banks in Reach 1

Unstabilized sandy slopes which abut the creek in Reach 1 contribute sand and silt downstream making this otherwise good habitat unsuitable for spawning chinook salmon. The stabilization of these slopes may increase the available area for spawning.

Due to the gradient of the slope and volume of sliding material, plants have not been able to take root on these slopes naturally. A stabilization project would therefore require the construction of a berm at the base. Indigenous plant species which are adapted to the soil conditions could then be planted. The Department of Fisheries and Oceans should be

consulted before commencing any stabilization project and a qualified professional should be consulted in all riparian planting projects.

Due to the limited area affected by unstable banks and the remoteness of the area, in reality, the costs associated with this restoration project may not be justifiable.

2) forest fire suppression along riparian zone of stream

Since naturally recurring fires are frequent in this area, the suppression of fires in remote unpopulated areas is generally not cost effective. Long term fire suppression can also have other effects on the ecosystem which should be considered. If feasible, fire control could be focused instead on protecting the riparian zone or the vegetation immediately adjacent to salmon bearing streams which directly effects the stream habitat by regulating water temperature, controlling erosion and providing fish with cover and food.

3) Breaching of beaver dams

Most beaver dams observed were low and did not present barriers to salmon migration. However, the beaver dam mentioned earlier may have presented a barrier as no adult chinook salmon were observed above it during an aerial survey. Beaver dams which are low may be breached naturally during spring freshet and therefore physical removal may not be necessary. The stream should be monitored, however, during summer low flow to determine if newly constructed beaver dams create an obstruction for upstream migration.

In a beaver control or beaver dam removal program consideration must also be given to the fact that beaver dams can have beneficial effects for fish life and can sometimes create conditions downstream that provide additional habitat for chinook salmon. Any beaver dam removal project should therefore be carefully considered and follow the guidelines laid out in DFO's " Guidelines for the Management of Beaver in Fish-Bearing Streams in the Yukon & NBC Division."

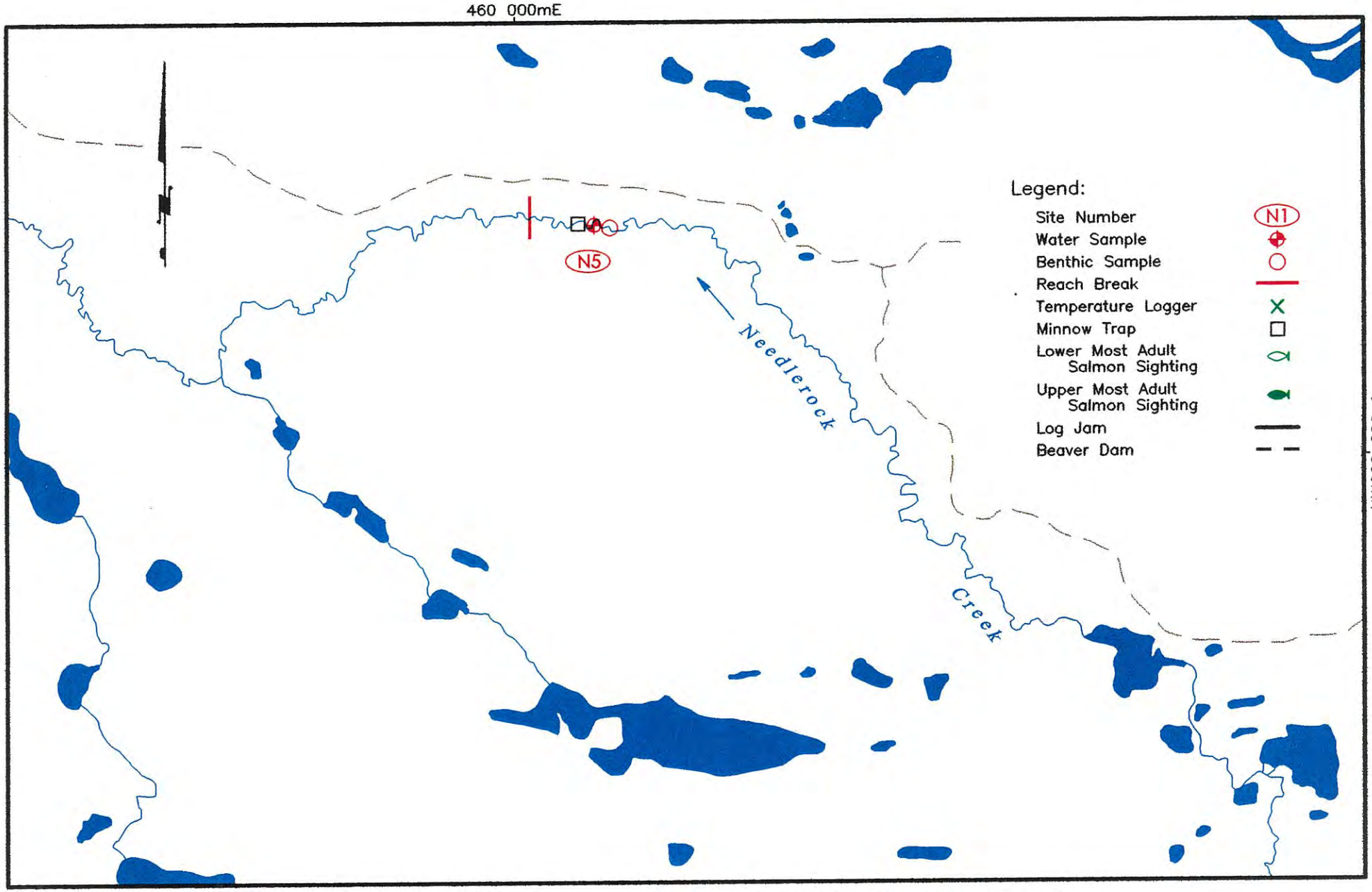

FIGURE 2 : UPPER REACHES OF NEEDLEROCK CREEK

LOWER PELLY RIVER TRIBUTARIES SALMON HABITAT STUDY

445 000mE

6 960 000mN

PELLY R.

WLF
WQ

N1

N2

Needlerock Creek

N3

N4

FIGURE 3
LOWER NEEDLEROCK CREEK
LOWER PELLY RIVER TRIBUTARIES
SALMON HABITAT STUDY

1 0 1 2 3 km

SCALE 1:50,000

Legend:

Site Number	N1
Water Sample	
Benthic Sample	
Reach Break	
Temperature Logger	X
Minnow Trap	
Lower Most Adult Salmon Sighting	
Upper Most Adult Salmon Sighting	
Log Jam	
Beaver Dam	
Water Low Flow Site	WLF
Water Quality Site	WQ

Photo 1. Viewing upstream in Reach 1, Needlerock Creek showing excellent habitat for Juvenile chinook salmon (August 4, 1998).

Photo 2. Reach 5 of Needlerock Creek. Note pool type habitat and deadfall across channel as a result of recent fire.

Photo 3. Reach 1 of Needlerock Creek. Note "glacier" ice conditions and unstabilized sandy slopes (April 1, 1999).

MICA CREEK

Area Description

Mica Creek flows into the Pelly River at the southeast edge of Pelly Crossing from its headwaters about 90 km to the southeast; draining an area of approximately 1,595 km^2. The highest point in the drainage is 1,297 meters. The larger lakes in the drainage include Tadru Lake, Ess Lake, Tatlmain Lake and Towhata Lake. In addition to Chinook salmon, several species of fish are found in either the lakes or creek including: grayling, burbot, pike, longnose suckers, humpback whitefish, least cisco, round whitefish, slimy sculpin and arctic lamprey (DFO stream files).

Six sites were investigated on Mica Creek between the mouth and the outlet of Tatlmain Lake (Fig.'s 4 & 5). Sites in the lower reaches were accessed from a firewood hauling road which runs along the right bank. A site on Ptarmigan Creek and a site at the outlet of Tatlmain Lake was accessed by ATV along a trail leading to the Selkirk First Nation camp facility located at the north end of Tatlmain Lake.

Site Description

Reach 1 -Site 1

This reach extends from the mouth approximately 0.7 km upstream. The stream meanders irregularly through an open valley.

A representative site was investigated above the bridge crossing on Mica Creek located approximately 400 meters upstream of the mouth. The water level was extremely low, with approximately 50 % of the streambed being exposed in many areas. The average channel width was 10.6, the average wetted width, 7.3 m and the average maximum depth, 0.49 m. Riffle areas were shallow with an average maximum depth of 10 cm. The stream flowed over a moderate gradient of 1.0% at an average velocity of 0.1 m/s. Discharge was determined as 0.09 m^3/s, on July 29.

Streambed material consisted of approximately 20 % fines (silt and sand), 60 % gravel, and 20 % larges. Larges were comprised entirely of small cobble. A deep layer of gravel, cobble and sand formed a v-shaped channel through which the stream flowed in a criss-cross fashion from one side of the stream channel to the other in a 1:1 pool/riffle pattern. Some sand and silt accumulations were evident in pools particularly at bends in the stream. A green slimy algae covered approximately 50 % of the wetted substrate.

This reach provided excellent rearing habitat for jcs with approximately 40 % of the stream area providing cover in the form of pools (30%), cutbanks (20%), LOD (20%) and overhanging vegetation of willow, alder and spruce (30 %). The amount of available habitat however was reduced due to the low water level. A side channel which was dry at the time of investigation, probably provides additional cover at higher water levels.

Reach 2 - Site 1

This reach extends approximately 2 km upstream from Reach 1. The stream meanders irregularly and is frequently confined by sand and gravel embankments.

The section of stream investigated in this reach was confined on the left by a five meter high embankment comprised of sand, gravel and cobble, and unconfined on the right. The water level was very low, with approximately 50 % of the active stream bed channel exposed in many areas. The average channel width was 12.8 m, the average wetted width, 8.3 m and the average depth, 0.23 m. The stream flowed in a 70 % riffle, 30% run sequence at a velocity of 0.13 m/s, over a gradient of approximately 1.3%. The streambed was relatively even from bank to bank; the wetted channel, at the time of survey, being only slightly lower in most areas. A small groundwater source entered the creek from the right embankment.

Streambed material consisted of approximately 10% fines (mostly sand), 45% gravel and 45% larges consisting of a mixture of small and large cobble and a few small boulders. No algal growth was observed on the wetted substrate, however some substrate was covered with moss. Compaction was moderate throughout the survey site.

The vegetation along this reach is comprised of mostly successional growth poplar species, which have grown after a forest fire that burned through this area in the 60's, and less than 5% live white spruce. Riparian vegetation consisted primarily of a thick growth of alder and willow shrub along unconfined banks and an understory of grasses and horsetail. The embankment was stabilized by accumulated cobble and gravel at the base and a sparse growth of grasses, alder and willow.

Approximately 30% of the total stream area provided some cover for juvenile fish. Most of the cover was provided by overhanging willow and alder (65%) and LOD (25%). At the low water level, large cobble and small boulders provided cover. A small side channel which was dry at the time of investigation likely provides cover at higher water levels.

Reach 3 - Site 1

This reach extends from Reach 2 to the outlet of Towhata Lake. The stream meanders irregularly and sometimes tortuously with occasional confinement.

A site investigated was accessed by driving about 7 km along the wood hauling road, then walking about 300 m along a game trail leading to the creek. Judging by the number of tracks, this trail is used extensively by bears.

The stream morphology at this site was altered by a large logjam at the downstream end of the site and a succession of three small beaver dams upstream of the logjam. As a result, this area was comprised almost entirely of deep pools and runs. The velocity was low at 0.05 m/s. The stream ran clear over a moderate gradient of 1.0%.

Silt and sand covered most of the streambed at this site with heavy accumulations in deep pools. Generally, sand overlaid gravel and cobble with some small to large cobble being exposed. What appeared to be an old spawning redd was barely discernable in a run above the second upstream beaver dam.

The beaver dams provided cover for fish in the form of pools and LOD. In addition, approximately 30 % of the total cover was provided by a thick layer of overhanging alder and willow shrubs. A small percentage of cover was also provided by boulders, instream vegetation and cutbanks.

The vegetation along this reach is comprised of mostly successional growth poplar species, which have grown after the forest fire which burned through this area in the 60's, and approximately 20% live white spruce. Riparian vegetation consisted primarily of a thick growth of alder and willow shrub along unconfined banks and an understory of grasses and horsetail.

Sites above the area surveyed were inaccessible from the wood cutting road, however, observations were made during an aerial overview. The stream meandered irregularly and sometimes tortuously with occasional confinement through a wide valley. Generally the stream flowed in a pool/riffle/run pattern. The substrate appeared to be primarily gravel and cobble. The vegetation along this stretch was comprised of mostly thick stands of white spruce which grew close to the stream sides. Old salmon spawning dunes were observed below the outlet of Ptarmigan creek.

Ptarmigan creek

Ptarmigan Creek flows in a westerly direction entering Mica Creek just downstream of the outlet of Towhata Lake (Fig. 5). A site was investigated where the trail to Tatlmain Lake crosses the creek approximately 1 km (straight line) upstream from the confluence of Mica Creek.

Although no juvenile fish were captured in minnow traps set at this site, observations indicate excellent rearing habitat for jcs. Although reaches downstream of the site investigated were not observed, it is possible that the low water level in this creek has created an environment for beaver dam construction downstream of this site which could prevent fry from migrating this far upstream.

Approximately 50 % of the stream area provided cover for fish in the form of: 40% overhanging vegetation of alder shrub and white spruce, grasses and horsetail, 20 % LOD, 20% pool and 20% cutbank.

The stream flowed from bank to bank through a v-shaped channel of cobble and gravel. Due to the low water level almost 70% of the streambed material, consisting of equal amounts of moderately compacted gravel and small cobble, was exposed. Some silt and

sand accumulated at bends in the stream. The active channel width was 7.0 m, the wetted width 2.4 m and the average depth, 3.3 cm. At the time of investigation the creek ran clear in a 1:1:1 pool/riffle/run ratio over a gradient of 1.2%.

The stream banks were low and stabilized by lush vegetative growth. White spruce and large poplar species grew close to the stream edge interspersed with alder shrub and an undergrowth of grasses and horsetail.

Reach 4 (between Towhata Lake and Tatlmain Lake)

Between Towhata Lake and Tatlmain Lake, Mica creek flowed almost slough-like through a flat wide valley bottom. Generally, conditions were marshy with extensive beaver activity evident in the form of dams and beaver lodges. The substrate was frequently muck in sites observed downstream of Tatlmain Lake where the stream was subject to flooding from beaver activity. Vegetation in the valley bottom was comprised mostly of poplar and sporatic patches of spruce and large open areas of small shrub.

Reach 5 - Site 1

A site was investigated at the outlet of Tatlmain Lake. Access was by ATV along the trail to the Selkirk First Nation camp located at Tatlmain Lake.

Only a trickle of water flowed through this area; some of it holding in stagnant pools. A low beaver dam spanned the outlet of Tatlmain Lake. The streambed was relatively wide and level with an even distribution of moderately compacted gravel and cobble. Three juvenile pike were observed in a deep slow moving pool located at the lower end of the site. Vegetation in this area was comprised of a dense growth of poplar, willow and alder and the occasional white spruce. A lush growth of tall grasses, horsetail and sedges grew along the stream edges. A small rust coloured groundwater source entered the stream on the left bank.

This reach is an important whitefish spawning area and according to Linch Curry of Pelly Crossing, who spent a number of childhood years travelling through this area, the stream in this area is normally much higher and very clear.

Water Quality

In-situ water quality measurements, including: temperature, pH, dissolved oxygen and conductivity, were within the accepted water quality parameters required for the protection of freshwater aquatic life (CREMM) at all sites except the reach below Tatlmain Lake where there was little dissolved oxygen in stagnant pools.

Water samples for laboratory analysis of metals, anions and nutrients were collected at Reach 3 (above large logjam). Most metal concentrations were within acceptable levels recommended for salmonid hatcheries with the exception of copper and cadmium which both exceeded the recommended levels. Nutrients were within recommended levels. A summary of water quality is given in Appendix 1.

A temperature logger was placed in a deep pool by the right bank at Reach 3 and will remain in the creek until August, 1999. A summary of daily water temperatures will be presented as an addendum to this report.

Juvenile Chinook Capture

A total of 51 chinook salmon fry was captured in eight gee-type minnow traps set overnight at Reaches 1 and 2. Although 10 traps were set, two were vandalized by wildlife at Reach 2. No jcs were caught in five traps set at Reach 3 and in traps set at remaining upstream sites. The fork length of jcs captured ranged between 51 and 80 mm and the weight between 1.4 and 5.5 grams. It is assumed that jcs captured in Mica Creek were all young-of-year (0+).

The mean condition factor (K) for jcs captured in Mica Creek was 1.09; the condition factor being an indicator of the general health and condition of salmonids. The mean condition factor for jcs captured in Mica Creek is slightly higher than the mean condition factor of jcs captured in Needlerock Creek (Table 1).

Incidental catches in traps set at Reaches 1 and 2 included a total of 15 longnose suckers and two slimy sculpins.

Benthic Invertebrates

Benthic invertebrates were collected from Reaches 1, 2 and 3, all downstream of Towhata Lake, in August 1998. The communities in Mica Creek were more diverse than others in the study area and population numbers were comparable (Table 3). All three sites were dominated by the insect order Diptera, however, there was good representation from the insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies), indicating good water quality.

Benthic invertebrates were collected from one site on Ptarmigan Creek approximately one kilometer upstream of the confluence with Mica Creek. The population was relatively diverse here with Dipterans forming the dominant group and Plecopterans forming the subdominant group. It would appear that habitat is excellent here for diverse healthy benthic invertebrate populations, but the low water levels may have inhibited productivity. Data are summarized in Table 3.

Adult Chinook Salmon

A total of 17 adult chinook salmon was observed in Mica Creek during an aerial survey conducted on August 26, 1998; all observed within a short distance below a beaver dam located approximately 1 km upstream of the mouth (Fig. 5).

Winter Low Flow and Water Quality

A winter low flow measurement were taken in an area of open water located in Reach 2 at a site investigated during the summer. A good quantity of water with moderate flow was observed here. Several deep pools in this area could provide habitat for over-wintering fish. Using the salt dilution method, the discharge was determined as 0.39 m^3/s. Groundwater intrusion is likely along the right embankment as numerous open water areas were observed in this reach.

In-situ water quality measurements, including: temperature, pH, dissolved oxygen and conductivity, were within the accepted water quality parameters required for the protection of freshwater aquatic life (CREMM).

Water samples for laboratory analysis of metal, anions and nutrients were collected from an open area in Reach 2. All metal and nutrient concentrations were within acceptable levels recommended for salmonid hatcheries (DFO, 1983) including copper and cadmium which had exceeded the recommended levels in a sample taken during the summer. It is likely that copper and cadmium enter the stream through surface runoff during the summer. A summary of water quality is given in Appendix 1.

Conclusions & Recommendations:

The beaver dam located in the lower reach of Mica Creek prevented adult chinook salmon from accessing a major portion of useable habitat below Towhata Lake, resulting in fish being forced to spawn in areas below the dam in perhaps less than ideal spawning habitat. In a previous aerial survey, conducted August 24, 1997, chinook were observed at sites above the present barrier; as far as the outlet of Towhata Lake (Wilson, 1997). Although the total count of adult chinook in 1998 was the same as the 1997 count, the egg to fry survival rate may be greatly reduced if spawning occurred in poorer habitat which in turn would reduce returns of this year class.

Stream habitat characteristics above Towhata lake generally appear to be unsuitable for salmon utilization. Chinook fry would likely be subject to heavy predation by pike which inhabit Tatlmain Lake. Restoration and monitoring efforts should hence be focused on reaches below Towhata lake.

Recommendations:

1) breaching of beaver dams and beaver control

The increase in beaver activity between the mouth and Towhata Lake was likely a result of the unusually low water level in Mica Creek necessitating the construction of numerous dams by beaver in order to provide sufficient reservoirs for over-wintering. The dams appeared to be relatively low and would probably be breached during spring freshet. The beaver dam which prevented chinook salmon from migrating upstream and newly constructed dams after freshet may need to be breached manually however. The proximity of Mica Creek to the village of Pelly Crossing and the ease of access to lower reaches would make the monitoring and lowering of beaver dams obstructing migration feasible for community members of Pelly Crossing.

In a beaver control or beaver dam removal program consideration must also be given to the fact that beaver dams can have beneficial effects for fish. Not only can the dam and associated debris provide protection for juvenile fish, but increased productivity in the reservoirs can provide habitat for insects and benthic organisms which contribute to the diet of fish. In many cases, since the water surface is raised above the dam an increased amount of water will go underground re-emerging downstream where it may enhance spawning habitats as observed during an aerial survey of Mica Creek in 1997 at which time spawning redds were observed downstream of beaver dams (Wilson, 1997). Any beaver dam removal or lowering project should therefore be carefully considered and follow the guidelines laid out in DFO's " Guidelines for the Management of Beaver in Fish-Bearing Streams in the Yukon & NBC Division."

2) removal of logjams

Two very large logjams were observed below Towhata Lake, during the aerial survey (Fig. 5). In the past these logjams have not obstructed migration of chinook salmon, however they could be cut through to allow easier passage for chinook spawning migrating to sites upstream. Care must be taken in the removal of any part of a logjam as large releases of water and displacement of logs could cause damage to the habitat downstream. The Department of Fisheries and Oceans should be consulted before a logjam removal project is initiated.

3) Fisheries investigation of Ptarmigan creek

Ptarmigan Creek is a major tributary of Mica Creek and probably provides rearing habitat for jcs. Although no fish were captured at an upstream site where the water level was very low, the quality of water and generally excellent rearing habitat suggests that jcs may utilize the creek during normal water levels. The possible utilization of this creek by jcs should be investigated in future studies to assist in management decisions for land use practices in this tributary.

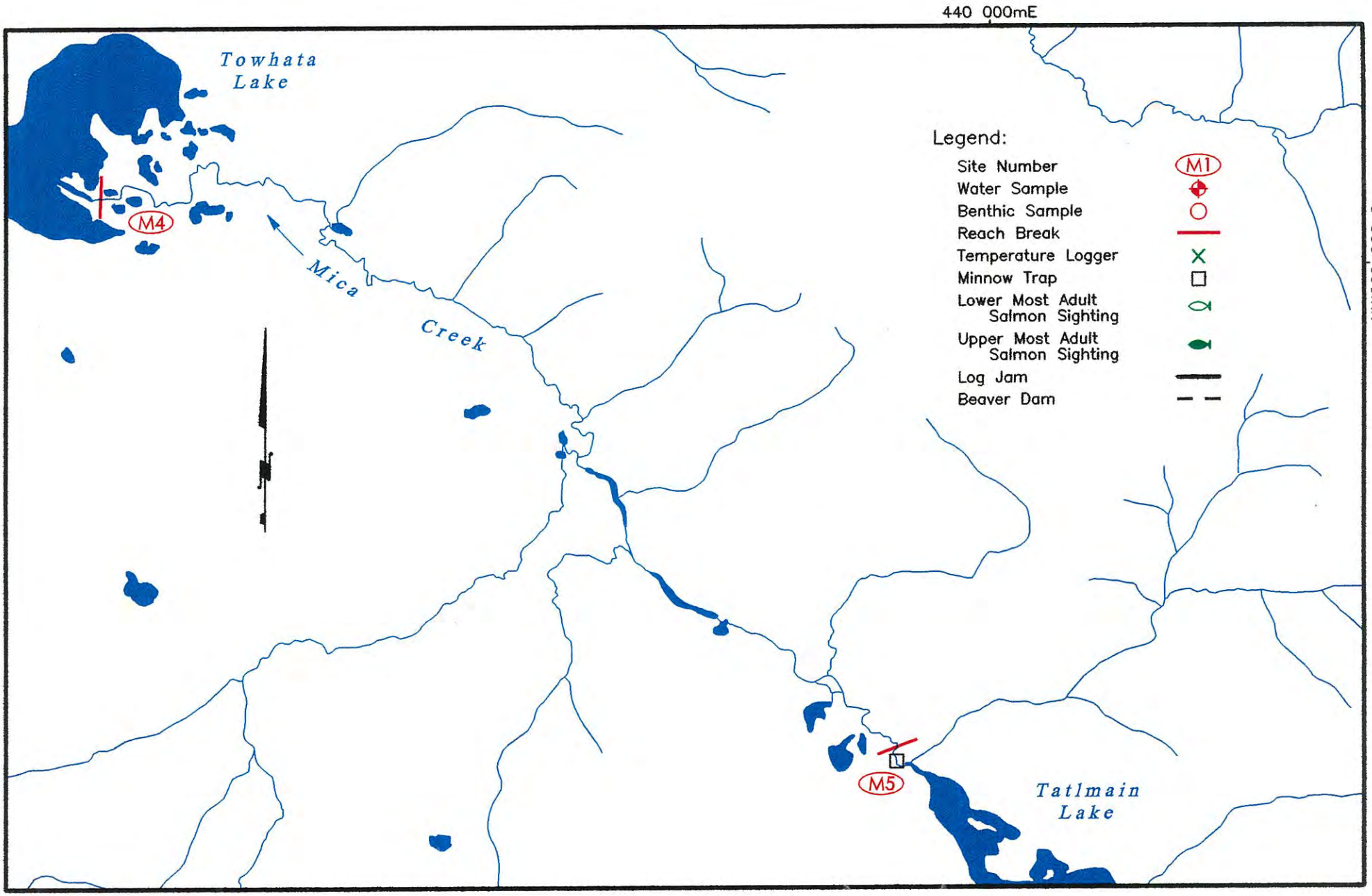

FIGURE 4 : UPPER REACHES OF MICA CREEK

LOWER PELLY RIVER TRIBUTARIES SALMON HABITAT STUDY

6 960 000mN

420000mE

PELLY RIVER

Ptarmigan Creek

Towhata Lake

Mica Creek

Klondike Highway

M1

M2

M3

WLF
WQ

FIGURE 5
LOWER MICA CREEK
LOWER PELLY RIVER TRIBUTARIES
SALMON HABITAT STUDY

1 0 1 2 3 km

SCALE 1:50,000

Legend:

Site Number	M1
Water Sample	
Benthic Sample	
Reach Break	
Temperature Logger	X
Minnow Trap	
Lower Most Adult Salmon Sighting	
Upper Most Adult Salmon Sighting	
Log Jam	
Beaver Dam	
Water Low Flow Site	WLF
Water Quality Site	WQ

Photo 4. Mica Creek, Reach 1, looking downstream at site 1. Note very low water level (July 29, 1998).

Photo 5. Ian Pumphrey instructing David Silas on water quality methods.

Photo 6. Ptarmigan Creek, a tributary of Mica Creek, near trail crossing, August 6, 1998. Note low water level and excellent habitat for juvenile chinook salmon.

Photo 7. Mica Creek, Reach 2, looking upstream at site 1. Note very low water level (July 29, 1998).

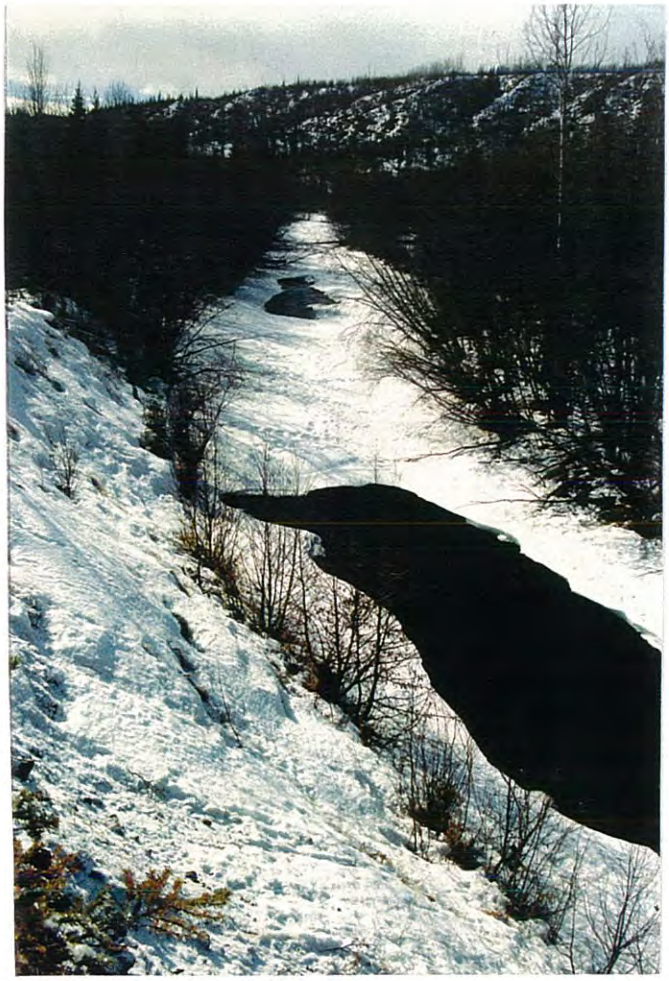

Photo 8. Mica Creek, Reach 2, looking upstream at site 1. Open water areas on April 2, 1999.

Photo 9. Aerial view of logjam in Reach 3 below site 1.

Photo 10. View of low flat valley above Towhata Lake. Mica Creek enters Towhata Lake upper right of photo.

Photo 11. View of Reach 4 below Tatlmain Lake. Note heavy sedimentation as a result of extensive beaver activity in this area.

Photo 12. Low beaver dam at outlet of Tatlmain Lake, August 6, 1998.

Photo 13. View of Reach 5, below Tatlmain Lake. Note flat streambed with very little water flow.

WILLOW CREEK

Area Description

Willow Creek flows south from Willow Lake along the west side of the Klondike Highway entering the Pelly River 2 km downstream from the community of Pelly Crossing. It drains approximately 615 km^2 of the low Willow Hills to the north. The highest point in the drainage basin is 1,386 meters.

Human activity in the Willow Creek drainage is minimal with hunting, sport fishing (primarily by local residents) and trapping being the main activities. A subdivision of the village of Pelly Crossing extends along the Pelly Farm Road and a number of residences are located near the lower reaches of the creek.

Three sites were investigated on the lower reaches of Willow Creek (Fig 6). Two of the sites were within close proximity to the bridge crossing on the Pelly Farm Road. An upstream site was accessed from a fire control road which extends from the Klondike Highway approximately 7 km from the village of Pelly Crossing.

Site Descriptions

Reach 1 - Site 1

This site was located just upstream from the mouth of Willow Creek. A large beaver dam over 1.0 meter high extended across the main channel and a side channel, flowing in along on the right, separated by a grass and willow covered island of alluvial silt and sand deposits. Below the dam, two channels were separated by a gravel bar; converging near the confluence of the Pelly River. Water from leaks in the dam pooled immediately below the dams then flowed with contributing groundwater in a riffle pattern to the confluence of Pelly River over a moderate gradient of 1.5%, at a velocity of 0.11 m/s. Discharge below the dam was determined as 0.46 m^3/s, on August 1.

The substrate was comprised of mostly silt/sand and gravels and a small percentage of small cobble. Alluvial silt and sand deposits were highest in pools and along the right bank. Compaction was moderate in riffles and high in pools.

Extensive undercutting of high banks on the left caused soils and large spruce trees to give away. The right bank was low and stabilized with grasses and sedges and a dense growth of willow and poplar. Cover was provided for fish below the dams in pools and by undercut banks and overhanging spruce and willow on the left bank.

Reach 2 -Site 1

A site was investigated which extended above and below the bridge crossing on the Pelly Farm Road. Beaver dams constructed both above and below this site have altered the stream habitat resulting in elevated water levels and sedimentation. The water level was either at or slightly above the channel width of 6.8 meters and averaged 1.2 meters in depth. Substrate consisted of mostly sand and silt laden gravel and cobble and a few boulders. The stream was very slow moving at an average velocity of 0.05 m/s.

The riparian zone consisted of a thick growth of alder and willow with an understory of grasses. The stream area became increasingly shaded upstream where overhanging willow and alder extended almost completely over the stream. Excellent cover for fish was provided by overhanging vegetation, cutbanks, pools and boulders.

Reach 3 - Site 1

This site was located upstream of the bridge in a recent burn area approximately 7 km following the Klondike Highway. A series of beaver dams, observed upstream of the site surveyed, caused extensive flooding. Water levels moderated in the area surveyed downstream of the flooded area; the average channel width being 7.4 meters, the average wetted width, 5.2 meters and the average depth, 0.55 meters. The stream flowed in a pool/riffle/run sequence over a moderate gradient of 1.0% at a velocity of 0.23 m/s.

The substrate was comprised of mostly gravel and cobble with a few boulders overlaying sand and silt. Cobble was generally more compacted than gravel. Algal growth was prevalent on larger cobble. The stream in this area has cut through a large deposit of gravels, sands and silts probably of glacial origin. The resultant cut banks have been stabilized with vegetative growth and boulders, cobbles and gravels which have collected at the base.

Vegetation was sparse in some areas and consisted primarily of willow and alder shrubs, poplar and the occasional live white spruce. Some overhanging vegetation and fallen debris provides cover for fish in addition to pools and small boulders.

Water Quality

The water was slightly turbid at the site investigated in Reach 3, with suspended white silt evident. In-situ water quality measurements, including: temperature, pH, dissolved oxygen and conductivity, were within the accepted water quality parameters required for the protection of freshwater aquatic life (CREMM) at all sites.

Water samples for laboratory analysis of metals, anions and nutrients were collected at Reach 2- Site 1 (below the bridge on Pelly Farm Road). Most metal concentrations were

Winter Low Flow and Water Quality

A winter low flow measurement and water quality sample was not taken from Willow Creek.

Discussion & Recommendations

The numerous beaver dams throughout Willow Creek have changed the morphology of the creek and created obstructions to upstream migration. The extent of beaver activity and the ample supply of successional growth aspen and other deciduous species which have grown since a fire in the 60's, would make a beaver control program at this time ineffectual unless an intense trapping or beaver reduction program were initiated. With the low prices of beaver pelts, there may be little monetary incentive for such a program.

It is possible that Willow Creek once supported a spawning population before the fires which burned through the lower reaches of the creek. Don Trudeau of Pelly Crossing observed an adult chinook salmon, in 1991, near the bridge on the Pelly Farm Road (pers. Comm.), perhaps a residual of a previous spawning population. The available area and suitable substrate, water quality and quantity in areas upstream of the bridge indicate that Willow Creek could support a spawning population.

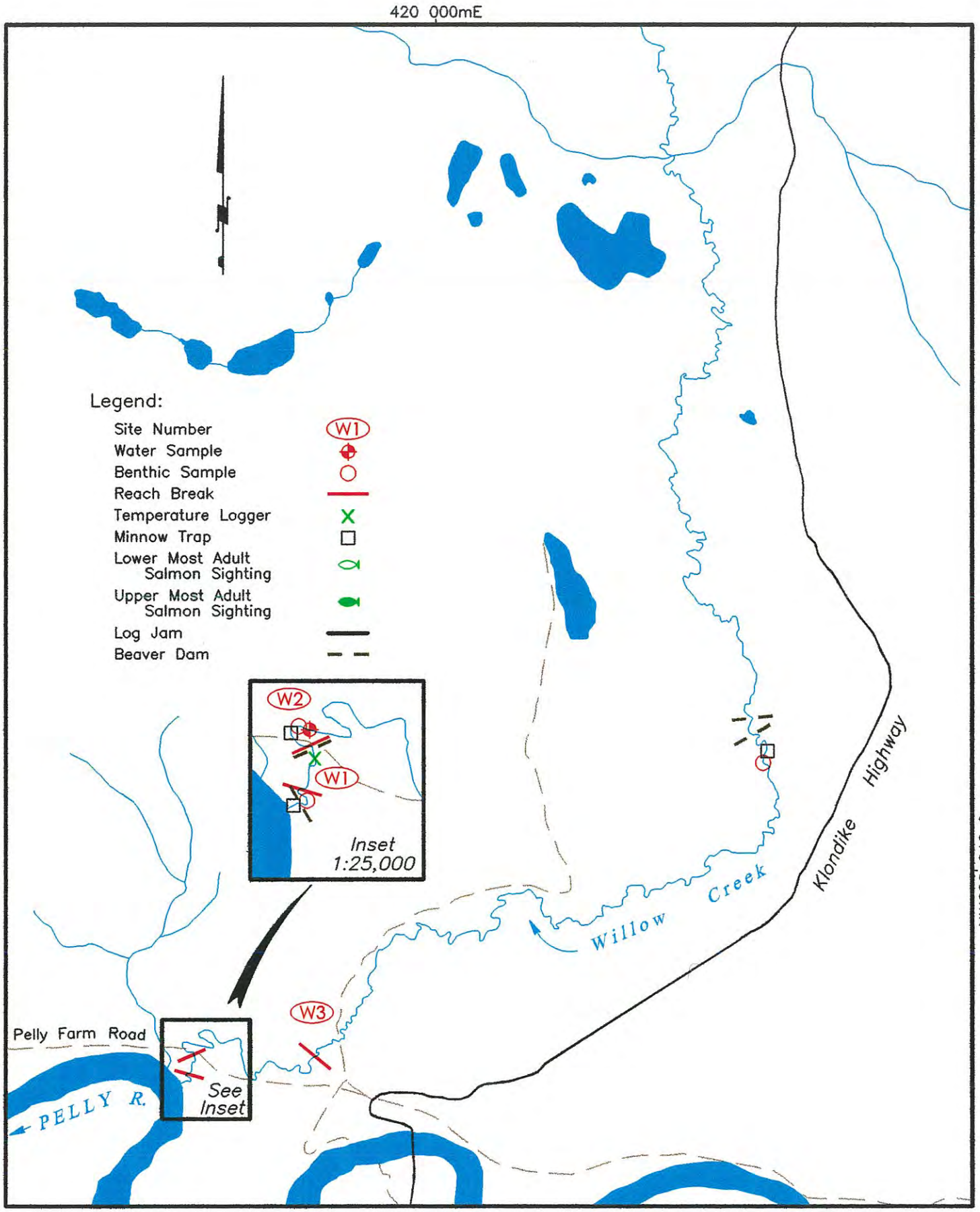

FIGURE 6 : WILLOW CREEK

LOWER PELLY RIVER TRIBUTARIES SALMON HABITAT STUDY

1 0 1 2 3 km

SCALE 1:50,000

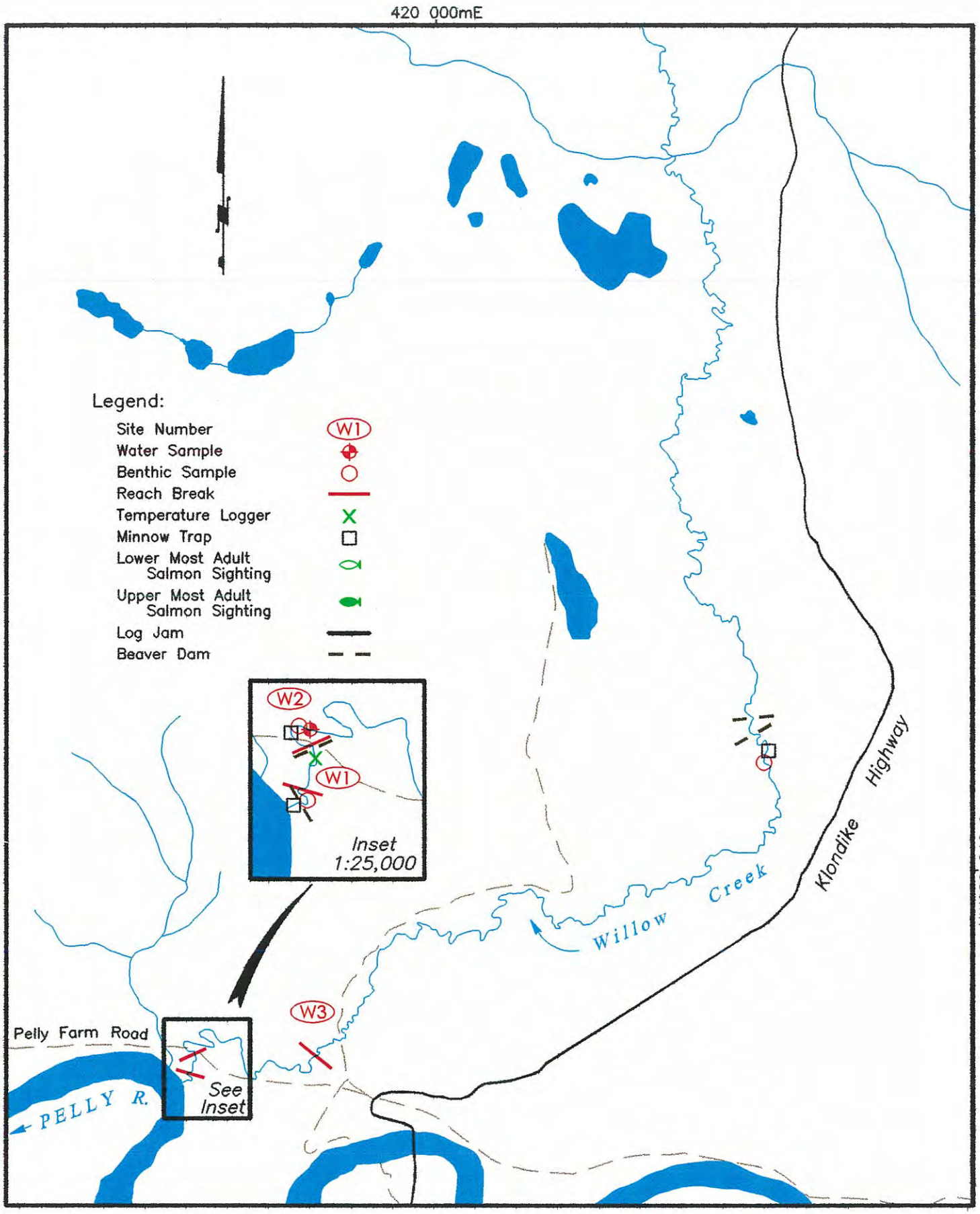

FIGURE 6 : WILLOW CREEK

LOWER PELLY RIVER TRIBUTARIES SALMON HABITAT STUDY

1 0 1 2 3 km

SCALE 1:50,000

Photo 14. Beaver dam near mouth of Willow Creek, August 1, 1998. Dam would be a barrier to salmon migrating upstream.

Photo 15. View of potential chinook spawning habitat in Reach 3, Willow Creek. Extensive beaver Activity was observed both above and below this site.

GRAYLING CREEK

Area Description

Grayling Creek is a small stream which enters the Pelly River approximately 10 km downstream from the community of Pelly Crossing. The creek flows in a southeast direction from Grayling Lakes, located about 15 km to the northwest of the confluence, through a narrow valley of dense spruce and willow. The highest point in the drainage basin is 1,290 meters.

Three sites were investigated on the lower reaches of Grayling Creek (Fig. 7). A site near the mouth was accessed from a dirt road which runs south of the Pelly Farm Road following along the top of a bench on the west side of the creek. Sites were investigated above and below the bridge crossing on the Pelly Farm Road approximately 10 km from the Klondike Highway. Above the bridge, access was gained by a dirt road which follows along the west side of the creek.

Site Descriptions

Reach 1 - Site 1

A site was investigated approximately 250 m upstream of the confluence with the Pelly River in the first reach. The stream meanders irregularly with occasional confinement by a bench which ascends to the Pelly River. The stream ran very clear over a moderate gradient of 1.0% in a pool/riffle/run pattern at an average velocity of 0.27 m/s. Discharge at this site, on August 1, was determined as 0.29 m^3/s. Deep clear pools were more prevalent at the upstream end of the site; the lower part being mainly riffle/run. The average channel width was 8.4 meters, the wetted width, 5.6 meters, and the average depth, 0.3 meters.

Streambed material in the wetted channel consisted primarily of clean gravel and a small percentage of cobble. Compaction was low in riffles and moderate in runs. Alluvial deposits of sand and silt formed banks at bends in the creek.

Excellent cover was provided for fish in the form of deep pools, cutbanks, LOD and overhanging vegetation of primarily willow with some alder, white spruce, grasses and sedges.

Reach 2 - Site 1

This reach extends upstream to the bridge on the Pelly Farm Road. The stream channel becomes narrow and very shaded with the low crown cover of willow and alder extending completely over the stream channel. At a representative site below the bridge on the Pelly Farm Road, the average channel width was 5.8 meters, the average wetted

width, 5.3 meters and the average depth, 0.35 meters. The stream ran very clear over a moderate gradient of 1.0% in a predominantly riffle pattern. Substrate was mostly small to large cobble with a few small boulders and some gravel and a small percentage of silt and sand. Banks were low and well stabilized by cobble and boulders and a thick growth of alder and willow.

Reach 3 - Site 1

This reach extends approximately 0.5 km upstream from the bridge on the Pelly Farm Road and meanders through a narrow valley with occasional confinement. A representative site was investigated approximately 0.4 km upstream of the bridge. The stream ran very clear at an average velocity of 0.2 m/s over a gradient of 1.3% in a riffle/run/pool pattern. Pools were generally found at bends in the creek. The average channel width was 4.7 meters, the average wetted width, 3.6 meters and the average depth, 0.5 meters. The substrate was comprised of mostly gravel and small cobble with silt and sand accumulations in pools. Banks were low and well stabilized by shrub roots, grasses and horsetail.

The riparian zone was comprised predominantly of alder with some willow and white spruce and a dense undergrowth of horsetail and mosses. The stream area was mostly shaded with overhanging alder and tall stands of spruce.

Water Quality

The water in Grayling Creek was relatively cold and very clear. In-situ water quality measurements, including: temperature, pH, dissolved oxygen and conductivity, were within the accepted water quality parameters required for the protection of freshwater aquatic life (CREMM) at all sites.

Water samples for laboratory analysis of metals, anions and nutrients were collected at Reach 3 -Site 1 (above the bridge on Pelly Farm Road). Most metal concentrations were within acceptable levels recommended for salmonid hatcheries with the exception of copper which exceeded the recommended levels. Nutrients were all within recommended levels. A summary of water quality data is given in Appendix 1.

A temperature logger was placed in a deep pool by the right bank in Reach 3 - Site 1 and will remain in the creek until August, 1999. A summary of daily water temperatures will be presented as an addendum to this report.

Juvenile Chinook Salmon

A total of eight chinook salmon fry was captured in five gee-type minnow traps set overnight at Reach 1 - Site 1, upstream from the mouth. No jcs were caught in five traps

set in Reach 2 and in five traps set in Reach 3. The fork length of jcs captured ranged between 64 and 78 mm and the weight between 2.5 and 4.3 grams. It is assumed that jcs captured in Grayling Creek were all young-of-year (0+).

The average condition factor (K) for jcs captured in Grayling Creek was 1.00; the condition factor being an indicator of the general health and condition of salmonids. The mean condition factor for jcs captured in Grayling Creek is slightly lower than the mean condition factor of jcs captured in other tributaries investigated in the present study (Table 1).

Incidental catches included slimy sculpins which were caught in traps set at all three locations surveyed.

Benthic Invertebrates

Benthic invertebrates were collected from Reaches 1 and 3, in August 1998. The highest population in the study area was recorded at Reach 1. The diversity was very low however, and the majority of the invertebrates (92%) were chironomid (a family of Diptera) larvae. The population at Reach 3 was lower but slightly more diverse and evenly distributed. Dipterans were also the dominant group at Reach 3 and Plecopterans were subdominant. Data are summarized in Table 3.

Adult Chinook Salmon

No adult chinook salmon were observed in Grayling Creek.

Winter low flow and water quality

A winter low flow measurement was taken in an area above and below the bridge on the Pelly Farm Road. Using the salt dilution method, the discharge was determined as 0.28 m^3/s. The stream flowed freely approximately 25 cm below a layer of ice which was covered with approximately 15 cm of hardpack snow.

Numerous open water areas were observed approximately 0.5 km upstream of the bridge in Reach 3 where ground water intrusion is likely.

In-situ water quality measurements including: temperature, pH, dissolved oxygen and conductivity, were within the accepted water quality criteria for the protection of freshwater aquatic life (CREMM).

Water samples for laboratory analysis of metal, anions and nutrients were collected from Reach 2 below the bridge. All metal and nutrient concentrations were within acceptable levels recommended for salmonid hatcheries (DFO, 1983) including copper which had exceeded the recommended levels in a sample taken during the summer. It is likely that copper enters the stream through surface runoff during the summer. A summary of water

quality is given in Appendix 1.

Discussion & Recommendations

Grayling Creek provides limited area for a spawning chinook population but excellent habitat for juvenile salmon. Protection of this important habitat needs to be considered in management decisions involving future land use practices which could effect the habitat quality in this stream.

The cold summer water temperatures in Grayling Creek suggest a groundwater source which could possibly be suitable for a ground water fed incubation facility for producing juvenile chinook salmon. Groundwater is almost always cooler than surface flows during the summer and warmer during the winter (von Finster, 1994). If a suitable groundwater discharge site was located with sufficient flow and water quality the resultant fry could be outplanted to spawning streams throughout the drainage basin. The proximity of this stream to the village of Pelly Crossing and relative ease of access could make the operation and maintenance of such a facility feasible.

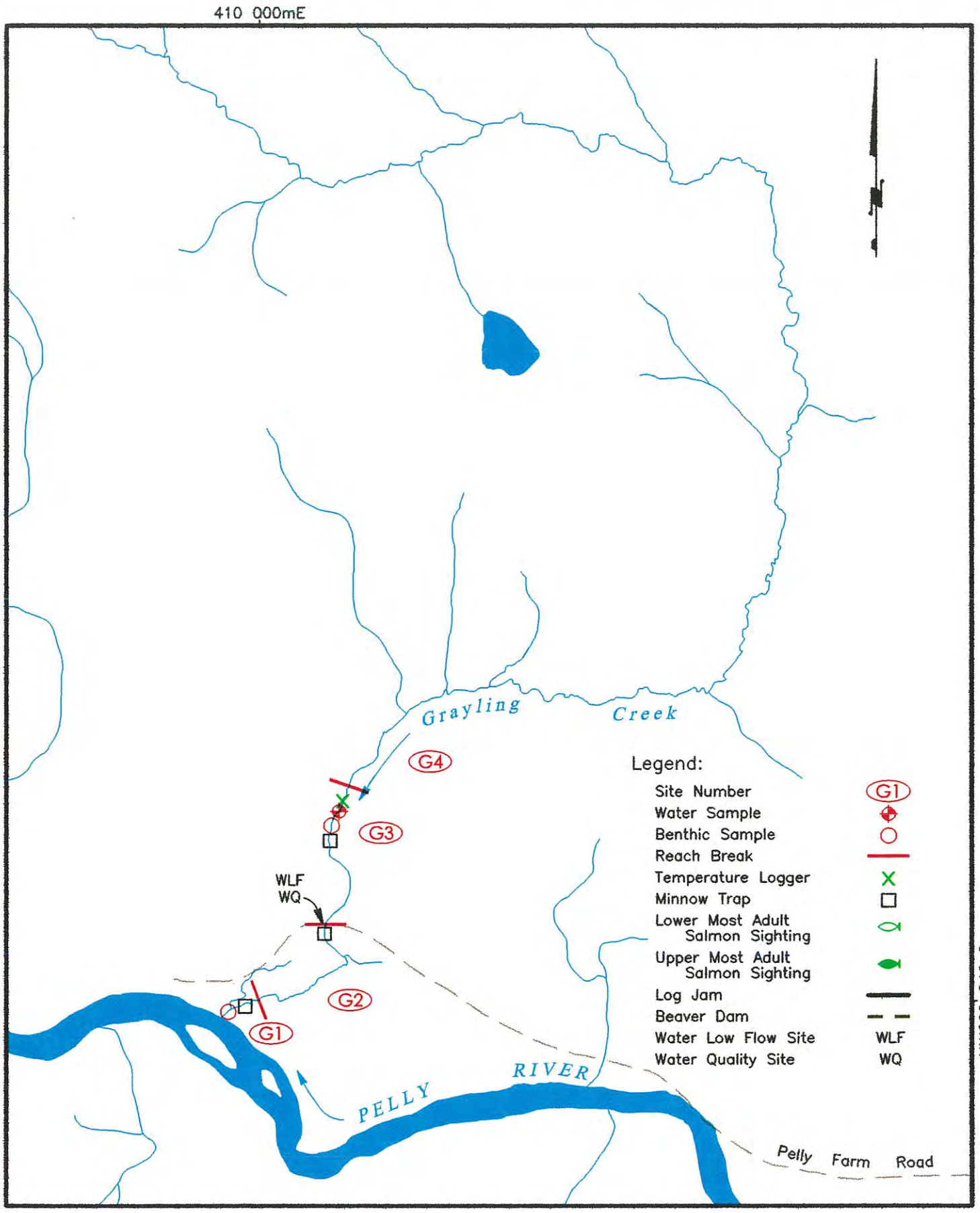

FIGURE 7 : GRAYLING CREEK

LOWER PELLY RIVER TRIBUTARIES SALMON HABITAT STUDY

1 0 1 2 3 km

SCALE 1:50,000

Photo 16. View of Grayling Creek downstream of bridge on Pelly Farm Road. Note stable banks and complete crown cover.

Photo 17. View looking upstream in Reach 1 near the outlet of Grayling Creek. Note cutbanks and LOD providing good cover for juvenile chinook salmon.

SUMMARY

Needlerock, Mica, Willow and Grayling Creeks all provide critical habitat for either natal or non-natal juvenile chinook salmon. Juvenile salmon from natal streams (spawning streams) may remain and over-winter in the same stream or move out and ascend non-natal (non-spawning) tributaries of main migration routes during their downstream migration to avoid predation by birds or fish such as pike, inconnu and burbot, as well as take advantage of the more favourable feeding conditions in the clear waters of the tributaries (von Finster, 1994). Young chinook in fresh water feed on insects, Chironomid larvae, pupae and adults, caddisflies, mites and others (Scott and Crossman, 1973). Based on the high proportions of these various organisms, especially Chironomids, throughout the study area, it is suspected, and apparent in many cases, that the reaches sampled could support young chinook populations. Excellent water quality and adequate protective cover for juvenile salmon was observed in all tributaries investigated. Hence, careful consideration should be given to land use practices which could have potential deleterious effects on the habitat of these tributaries.

Tributaries with present chinook salmon spawning populations including: Needlerock and Mica Creeks, should be monitored to locate obstructions which could prevent adult chinook from reaching preferred spawning areas. The population size and spawning locations should be monitored yearly and obstructions to upstream migration such as beaver dams or logjams removed or breached.

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TABLES

Table 1. Summary of Juvenile Chinook Salmon Catch Data

Location	Site	# traps	Total CH Captured	CPUE	Length Range (mm)	Weight Range (g)	Mean K
MICA CREEK							
(below Towhata Lake)	M1-1	5	20	0.19	66 - 76	3.1 - 5.2	1.12
	M2-1	3	31	0.52	51 - 80	1.4 - 5.5	1.06
	M3-1	5	0	0	--	--	--
(Below Tatlmain Lake)	M5-1	3	0	0	--	--	--
PTARMIGAN CREEK	PT-1	5	0	0	--	--	--
GRAYLING CREEK							
(below bridge)	G1-1	5	8	0.1	64 - 78	2.5 - 4.3	1.00
	G2-1	5	0	0	--	--	--
	G3-1	5	0	0	--	--	--
WILLOW CREEK	W1-1	5	4	0.04	63 - 76	2.4 - 4.0	1.03
	W2-1	5	0	0	--	--	--
	W3-1	5	0	0	--	--	--
NEEDLEROCK CREEK	NR1-1	5	11	0.11	58 -74	2.0 - 4.4	1.13
	NR1-2	5	11	0.13	54 - 68	1.2 - 2.9	0.97
	NR2-1	5	2	0.03	68 - 75	3.4 - 4.2	1.03
	NR3-1	5	0	0	--	--	--
	NR5-1	5	0	0	--	--	--

Table 2. Summer and Winter Water Quality Parameters and Flow Measurements for Needlerock, Mica, Willow and Grayling Creeks.

Location	Site	Date	Temp.(C)	DO (mg/l)	Cond. (uS/cm)	pH	Ave. Velocity (m/s)	Discharge (m3/s)
NEEDLEROCK CK.								
summer	NR1-1	4/8/98	14.7	11.6	315	8.5	0.47	1.12
winter	NR1-1	1/4/99	0.1	9.8	218	7.7	--	1.71
summer	NR2-1	11/8/98	10.9	11.1	300	8.4	0.18	0.77
summer	NR4-1	9/8/98	11.9	10.6	288	8.8	0.42	0.71
summer	NR5-1	10/8/98	13.2	8.7	285	8.2	0.13	0.55
MICA CK.								
summer	M1-1	29/7/98	11.8	11.1	288	8.1	0.10	0.09
summer	M2-1	29/7/98	15.1	11.8	292	8.4	0.13	0.21
winter	M2-1	2/4/99	0.8	14.3	208	7.9	--	0.39
summer	M3-1	30/7/98	14.9	11.1	307	8.2	0.05	0.20
Ptarmigan Ck.	PT-1	6/8/98	12.4	11.3	249	8.5	--	--
outlet of Tatlmain Lk.	TL5-1	6/8/98	11.2	5.4	315	8.4	--	--
WILLOW CK.								
summer	W1-1	1/8/98	13.7	11.6	285	8.2	0.11	0.46
summer	W2-1	5/8/98	13.6	11.2	294	8.3	0.05	0.26
summer	W3-1	12/8/98	9.4	11	261	*	0.23	0.46
GRAYLING CK.								
summer	G1-1	1/8/98	7.9	13.7	279	8.3	0.27	0.29
summer	G2-1	31/7/98	7.4	13.7	279	8.1	--	--
winter	G2-1	31/3/99	0.5	15.3	171	7.7	--	0.28
summer	G3-1	31/7/98	6.1	13.2	285	8	0.20	0.35

* pH calibration faulty -- reading inaccurate

Table 3. Benthic Invertebrate Data in Needlerock, Mica, Ptarmigan, Willow and Grayling Creeks, August, 1998

Location	Site	Abundance	Diversity	Dominant Taxa (>25% of pop.)
NEEDLEROCK CREEK				
	N1-1	203	18	Diptera (67.5%)
	N4-1	8	3	Diptera (87.5%)
	N5-1	84	13	Diptera (36.9%) & Amphiboda (28.6%)
MICA CREEK				
	M1-1	768	17	Diptera (76.8%)
	M2-1	611	15	Diptera (83.6%)
	M3-1	125	15	Diptera (59.2%)
PTARMIGAN CREEK				
	P1-1	142	10	Diptera (58.4%)
WILLOW CREEK				
	W1-1	724	15	Diptera (74.6%)
	W2-1	19	5	Diptera (63.2%)
	W3-1	431	16	Trichoptera (48.5%) & Diptera (44.8%)
GRAYLING CREEK				
	G1-1	904	8	Diptera (94%)
	G3-1	550	10	Diptera (46%)

APPENDIX

1. *Dissolved Metals and Nutrients Concentration*
2. *Juvenile Fish Collection Data*
3. *Benthic Invertebrates*
4. *Field Inventory Descriptions*

Appendix 1. Dissolved Metals and Nutrient Concentrations in Needlerock, Mica, Willow and Grayling Creeks.

Dissolved Metals Concentration in **Needlerock Creek -- Summer** low flow. Sample taken from NR2-1 on August 4, 1998.

Metal	Level (mg/l)	Metal	Level (mg/l)	Metal	Level (mg/l)
Aluminum	0.0332	**Cobalt**	<0.00003	**Potassium**	3.8
Antimony	<0.005	**Copper**	0.00527	**Selenium**	<0.004
Arsenic	<0.01	**Iron**	0.061	**Silicon**	4.35
Barium	0.124	**Lead**	<0.0003	**Silver**	<0.00005
Beryllium	<0.00001	**Lithium**	0.007	**Sodium**	3.2
Bismuth	<0.0004	**Magnesium**	12.6	**Strontium**	0.249
Boron	<0.002	**Manganese**	0.121	**Sulphur**	4.5
Cadmium	<0.00006	**Molybdenum**	0.00219	**Thallium**	<0.001
Calcium	56.8	**Nickel**	0.002	**Titanium**	0.00046
Chromium	0.00141	**Phosphorus**	<0.03	**Vanadium**	0.00014
				Zinc	<0.0021

Nutrients Concentration in **Needlerock Creek -- Summer** Low Flow. Sample taken from NR2-1 on August 4, 1998.

Nutrient	Concentration (mg/l)	Nutrient	Concentration (mg/l)
Total Alkalinity (mg $CaCO_3$/L)	201	**Nitrite-N**	<0.003
Chloride	0.8	**Phosphorus-Orthophosphate**	<0.005
Fluoride	< 0.5	**Sulphate**	12.7
Hardness ($CaCO_3$ equiv.)	194	**Total Suspended Solids**	<5.0
Nitrate-N	<0.05		

Dissolved Metals Concentration in **Needlerock Creek -- Summer** low flow. Sample taken from NR5-1, on August 8, 1998.

Metal	Level (mg/l)	Metal	Level (mg/l)	Metal	Level (mg/l)
Aluminum	0.0447	**Cobalt**	<0.00003	**Potassium**	2.8
Antimony	0.005	**Copper**	0.00092	**Selenium**	<0.004
Arsenic	<0.01	**Iron**	0.147	**Silicon**	6.9
Barium	0.143	**Lead**	<0.0003	**Silver**	<0.00005
Beryllium	<0.00001	**Lithium**	0.004	**Sodium**	5.0
Bismuth	<0.0004	**Magnesium**	17.4	**Strontium**	0.299
Boron	<0.002	**Manganese**	0.0314	**Sulphur**	7.37
Cadmium	<0.00006	**Molybdenum**	0.00196	**Thallium**	<0.001
Calcium	70.6	**Nickel**	0.0008	**Titanium**	0.00152
Chromium	0.00022	**Phosphorus**	<0.03	**Vanadium**	<0.00003
				Zinc	0.0018

Nutrients Concentration in **Needlerock Creek -- Summer** low flow. Sample taken from NR5-1 on August 8, 1998.

Nutrient	Concentration (mg/l)	Nutrient	Concentration (mg/l)
Total Alkalinity (mg $CaCO_3$/L)	229	**Nitrite-N**	<0.003
Chloride	0.6	**Phosphorus-Orthophosphate**	0.005
Fluoride	< 0.5	**Sulphate**	21.6
Hardness ($CaCO_3$ equiv.)	246	**Total Suspended Solids**	<5.0
Nitrate-N	<0.05		

Dissolved Metals Concentration in **Needlerock Creek -- Winter** low flow. Sample taken from NR1-1, on April 1, 1999.

Metal	Level (mg/l)	Metal	Level (mg/l)	Metal	Level (mg/l)
Aluminum	0.0336	**Cobalt**	<0.00003	**Potassium**	5.0
Antimony	<0.005	**Copper**	0.00288	**Selenium**	<0.004
Arsenic	<0.01	**Iron**	0.274	**Silicon**	4.75
Barium	0.111	**Lead**	<0.0003	**Silver**	<0.00005
Beryllium	<0.00001	**Lithium**	0.013	**Sodium**	3.2
Bismuth	<0.0004	**Magnesium**	12.7	**Strontium**	0.265
Boron	<0.002	**Manganese**	0.0297	**Sulphur**	3.61
Cadmium	<0.00006	**Molybdenum**	0.00266	**Thallium**	<0.001
Calcium	55.6	**Nickel**	0.0005	**Titanium**	0.00073
Chromium	0.00048	**Phosphorus**	<0.03	**Vanadium**	0.00011
				Zinc	<0.0002

Nutrients Concentration in **Needlerock Creek -- Winter** low flow. Sample taken from NR1-1 on April 1, 1999.

Nutrient	Concentration (mg/l)	Nutrient	Concentration (mg/l)
Total Alkalinity (mg $CaCO_3$/L)	196	**Nitrite-N**	<0.003
Chloride	0.8	**Phosphorus-Orthophosphate**	<0.005
Fluoride	< 0.5	**Sulphate**	10.3
Hardness ($CaCO_3$ equiv.)	191	**Total Suspended Solids**	<5.0
Nitrate-N	<0.05		

Dissolved Metals Concentration in **Mica Creek -- Summer** low flow. Sample taken above log-jam approx. 5 km along firewood hauling road upstream of bridge (M3-1), on July 30 1998.

Metal	Level (mg/l)	Metal	Level (mg/l)	Metal	Level (mg/l)
Aluminum	0.083	**Cobalt**	<0.00003	**Potassium**	3.1
Antimony	<0.005	**Copper**	0.00419	**Selenium**	0.006
Arsenic	<0.01	**Iron**	0.197	**Silicon**	4.02
Barium	0.0881	**Lead**	<0.0003	**Silver**	<0.00005
Beryllium	<0.00001	**Lithium**	0.006	**Sodium**	5.1
Bismuth	<0.0004	**Magnesium**	13.6	**Strontium**	0.284
Boron	0.003	**Manganese**	0.054	**Sulphur**	9.25
Cadmium	0.00318	**Molybdenum**	0.00164	**Thallium**	<0.001
Calcium	53.2	**Nickel**	0.0021	**Titanium**	0.00201
Chromium	0.00119	**Phosphorus**	<0.03	**Vanadium**	0.00031
				Zinc	<0.0002

Nutrients Concentration in **Mica Creek -- Summer** low flow. Sample taken above log-jam approx. 5 km along firewood hauling road upstream of bridge (M3-1), on July 30, 1998.

Nutrient	Concentration (mg/l)	Nutrient	Concentration (mg/l)
Total Alkalinity (mg $CaCO_3$/L)	173	**Nitrite-N**	<0.003
Chloride	0.96	**Phosphorus-Orthophosphate**	0.01
Fluoride	< 0.5	**Sulphate**	26.6
Hardness ($CaCO_3$ equiv.)	181	**Total Suspended Solids**	<5
Nitrate-N	<0.05		

Dissolved Metals Concentration in **Mica Creek --Winter** low flow. Sample taken at M2-1 on April 2, 1999.

Metal	Level (mg/l)	Metal	Level (mg/l)	Metal	Level (mg/l)
Aluminum	0.0046	**Cobalt**	<0.00003	**Potassium**	3.6
Antimony	<0.005	**Copper**	0.00097	**Selenium**	<0.004
Arsenic	<0.01	**Iron**	0.151	**Silicon**	6.7
Barium	0.089	**Lead**	<0.0003	**Silver**	<0.00005
Beryllium	<0.00001	**Lithium**	0.005	**Sodium**	6.8
Bismuth	<0.0004	**Magnesium**	0.0314	**Strontium**	0.346
Boron	<0.002	**Manganese**	17.9	**Sulphur**	12.8
Cadmium	<0.00006	**Molybdenum**	0.00147	**Thallium**	<0.001
Calcium	62.8	**Nickel**	0.0011	**Titanium**	0.00027
Chromium	<0.00006	**Phosphorus**	<0.03	**Vanadium**	0.00003
				Zinc	<0.0002

Nutrients Concentration in **Mica Creek -- Winter** low flow. Sample taken at M2-1,on April 2, 1999.

Nutrient	Concentration (mg/l)	Nutrient	Concentration (mg/l)
Total Alkalinity (mg $CaCO_3$/L)	203	**Nitrite-N**	0.004
Chloride	0.6	**Phosphorus-Orthophosphate**	0.006
Fluoride	< 0.5	**Sulphate**	38.5
Hardness ($CaCO_3$ equiv.)	227	**Total Suspended Solids**	<5
Nitrate-N	<0.05		

Dissolved Metals Concentration in **Willow Creek--Summer** low flow. Sample taken at Pelly Farm road bridge Crossing (W2-1), on August 5, 1998.

Metal	Level (mg/l)	Metal	Level (mg/l)	Metal	Level (mg/l)
Aluminum	0.001	**Cobalt**	<0.00003	**Potassium**	6.5
Antimony	<0.005	**Copper**	0.00268	**Selenium**	0.01
Arsenic	<0.01	**Iron**	0.08	**Silicon**	5.01
Barium	0.111	**Lead**	<0.0003	**Silver**	<0.00005
Beryllium	<0.00001	**Lithium**	0.006	**Sodium**	3.8
Bismuth	<0.0004	**Magnesium**	13.5	**Strontium**	0.266
Boron	0.003	**Manganese**	0.0317	**Sulphur**	5.42
Cadmium	<0.00006	**Molybdenum**	0.00276	**Thallium**	<0.001
Calcium	47.4	**Nickel**	0.0005	**Titanium**	<0.00002
Chromium	0.00069	**Phosphorus**	<0.03	**Vanadium**	<0.00003
				Zinc	0.001

Nutrients Concentration in **Willow Creek--Summer** low flow . Sample taken at Pelly Farm Road bridge crossing (W2-1), on August 5, 1998.

Nutrient	Concentration (mg/l)	Nutrient	Concentration (mg/l)
Total Alkalinity (mg $CaCO_3$/L)	178	**Nitrite-N**	<0.003
Chloride	1.0	**Phosphorus-Orthophosphate**	0.005
Fluoride	< 0.5	**Sulphate**	15.6
Hardness ($CaCO_3$ equiv.)	174	**Total Suspended Solids**	<5
Nitrate-N	<0.05		

Dissolved Metals Concentration in **Grayling Creek -- Summer** low flow. Sample taken above Pelly Farm Road bridge crossing (G3-1) on July 31, 1998.

Metal	Level (mg/l)	Metal	Level (mg/l)	Metal	Level (mg/l)
Aluminum	0.0352	**Cobalt**	<0.00003	**Potassium**	2.1
Antimony	<0.005	**Copper**	0.00373	**Selenium**	0.007
Arsenic	<0.01	**Iron**	0.211	**Silicon**	5.45
Barium	0.103	**Lead**	<0.0003	**Silver**	<0.00005
Beryllium	<0.00001	**Lithium**	0.01	**Sodium**	3.2
Bismuth	<0.0004	**Magnesium**	13.6	**Strontium**	0.229
Boron	<0.002	**Manganese**	0.0876	**Sulphur**	5.15
Cadmium	<0.00006	**Molybdenum**	0.00236	**Thallium**	<0.001
Calcium	49.3	**Nickel**	0.0215	**Titanium**	0.00129
Chromium	0.00113	**Phosphorus**	<0.03	**Vanadium**	0.00012
				Zinc	<0.0002

Nutrients concentration in **Grayling Creek -- Summer** low flow. Sample taken above Pelly Farm Road bridge crossing (G3-1), on July 31, 1998.

Nutrient	Concentration (mg/l)	Nutrient	Concentration (mg/l)
Total Alkalinity (mg $CaCO_3$/L)	172	**Nitrite-N**	<0.003
Chloride	0.7	**Phosphorus-Orthophosphate**	0.01
Fluoride	< 0.5	**Sulphate**	13.9
Hardness ($CaCO_3$ equiv.)	168	**Total Suspended Solids**	<5
Nitrate-N	0.05		

Dissolved Metals Concentration in **Grayling Creek -- Winter** low flow. Sample taken at Pelly Farm Road bridge crossing (G2-1), on March 31, 1999.

Metal	Level (mg/l)	Metal	Level (mg/l)	Metal	Level (mg/l)
Aluminum	0.0225	**Cobalt**	<0.00003	**Potassium**	2.3
Antimony	<0.005	**Copper**	0.00063	**Selenium**	0.005
Arsenic	<0.01	**Iron**	0.075	**Silicon**	6.65
Barium	0.0932	**Lead**	<0.0003	**Silver**	<0.00005
Beryllium	<0.00001	**Lithium**	0.006	**Sodium**	3.7
Bismuth	<0.0004	**Magnesium**	15.0	**Strontium**	0.256
Boron	0.006	**Manganese**	0.0527	**Sulphur**	5.78
Cadmium	<0.00006	**Molybdenum**	0.00233	**Thallium**	<0.001
Calcium	53.5	**Nickel**	0.0007	**Titanium**	0.00046
Chromium	0.00067	**Phosphorus**	<0.03	**Vanadium**	<0.00003
				Zinc	<0.0016

Nutrients concentration in **Grayling Creek -- Winter** low flow. Sample taken at Pelly Farm Road bridge crossing (G2-1), on March 31, 1999.

Nutrient	Concentration (mg/l)	Nutrient	Concentration (mg/l)
Total Alkalinity (mg $CaCO_3$/L)	183	**Nitrite-N**	0.003
Chloride	0.3	**Phosphorus-Orthophosphate**	0.006
Fluoride	< 0.5	**Sulphate**	17.2
Hardness ($CaCO_3$ equiv.)	190	**Total Suspended Solids**	<5
Nitrate-N	<0.05		

Appendix 2. Juvenile Fish Collection Data from Needlerock, Mica, Willow and Grayling Creeks

Juvenile Fish Collection Data, **NEEDLEROCK CREEK**, 1998

(Reach 1, Site 1)

Date	Trap #	Species	# Hours Set	Total CH Captured	Length (mm)	Weight (g)	Condition factor (k)	Other Species *
5-Aug	1	CH	19.25	1	64	2.3	0.88	
5-Aug	2	CH	19.25	3	58	2.0	1.03	
5-Aug	2	CH	19.25		65	3.9	1.42	
5-Aug	2	CH	19.25		68	3.8	1.21	
5-Aug	3	CH	19.50	3	58	2.6	1.33	
5-Aug	3	CH	19.50		63	2.5	1.00	
5-Aug	3	CH	19.50		63	3.5	1.40	
5-Aug	4	CH	19.17	2	74	4.4	1.09	
5-Aug	4	CH	19.17		65	2.5	0.91	
5-Aug	5	CH	19.50	2	63	3.0	1.20	
5-Aug	5	CH	19.50		66	2.9	1.01	
5-Aug	6	CH	17.00	1	65	2.8	1.02	
5-Aug	7	CH	17.17	3	58	1.7	0.87	
5-Aug	7	CH	17.17		60	2.2	1.02	
5-Aug	7	CH	17.17		57	2.0	1.08	
5-Aug	8	CH	17.50	4	66	2.7	0.94	
5-Aug	8	CH	17.50		68	2.7	0.86	
5-Aug	8	CH	17.50		54	1.9	1.21	
5-Aug	8	CH	17.50		64	2.9	1.11	
5-Aug	9	CH	17.50	3	61	1.2	0.53	
5-Aug	9	CH	17.50		56	1.8	1.02	
5-Aug	9	CH **	17.50		--	--	--	
5-Aug	10	--	17.00	0	--	--	--	
(Reach 2, Site 1)								
11-Aug	3	CH	13.75	2	75	4.2		
11-Aug	3	CH			68	3.4		
11-Aug	1	CH		0	--	--	--	
11-Aug	2	CH		0	--	--	--	
11-Aug	4	CH		0	--	--	--	
11-Aug	5	CH		0	--	--	--	
(Reach 3, Site 1)								
10-Aug	1	CH		0	--	--	--	
10-Aug	2	CH		0	--	--	--	
10-Aug	3	CH		0	--	--	--	
10-Aug	4	CH		0	--	--	--	
10-Aug	5	CH		0	--	--	--	
(Reach 4, Site 1)								
10-Aug	1	CH		0	--	--	--	
10-Aug	2	CH		0	--	--	--	
10-Aug	3	CH		0	--	--	--	
10-Aug	4	CH		0	--	--	--	
10-Aug	5	CH		0	--	--	--	

* Species code: CH = chinook salmon, LNS = longnose sucker, SS = slimy sculpin

Juvenile Fish Collection Data, Mica Creek, 1998.

(Reach 1 - Site 1)

Date	Trap #	Species*	# Hours Set	Total CH Captured	Length (mm)	Weight (g)	Condition factor (k)	Other Species *
30-Jul	2	CH	21.25	9	75	4.3	1.02	14 LNS
30-Jul	2	CH	21.25		76	4.9	1.12	
30-Jul	2	CH	21.25		70	4.0	1.17	
30-Jul	2	CH	21.25		69	4.4	1.34	
30-Jul	1	CH	21.50	2	66	3.2	1.11	
30-Jul	1	CH	21.50		74	4.0	0.99	
30-Jul	3	CH	21.50	2	68	3.3	1.05	1 SS
30-Jul	3	CH	21.50		72	4.1	1.10	
30-Jul	4	CH	21.50	3	67	3.1	1.03	
30-Jul	4	CH	21.50		76	4.8	1.09	
30-Jul	4	CH	21.50		66	3.2	1.11	
30-Jul	5	CH	21.50	7	69	3.7	1.13	
30-Jul	5	CH	21.50		74	5.2	1.28	
30-Jul	5	CH	21.50		73	4.6	1.18	
30-Jul	5	CH	21.50		70	3.5	1.02	
(Reach 2 - Site 1)								
30-Jul	3	CH	19.50	10	63	2.4	0.96	
30-Jul	3	CH	19.50		66	3.2	1.11	
30-Jul	3	CH	19.50		60	2.2	1.02	
30-Jul	3	CH	19.50		60	2.2	1.02	
30-Jul	3	CH	19.50		60	2.6	1.20	
30-Jul	4	CH	19.75	11	60	2.2	1.02	1 SS
30-Jul	4	CH	19.75		56	1.7	0.97	
30-Jul	4	CH	19.75		52	1.4	1.00	
30-Jul	4	CH	19.75		67	3.6	1.20	
30-Jul	4	CH	19.75		68	3.7	1.18	
30-Jul	5	CH	20.00	10	71	3.7	1.03	1 mort LNS
30-Jul	5	CH	20.00		74	4.5	1.11	
30-Jul	5	CH	20.00		80	5.5	1.07	
30-Jul	5	CH	20.00		66	2.7	0.94	
30-Jul	5	CH	20.00		51	1.4	1.06	

Note: *Traps #1 and #2 set in Reach 2 - Site 1 were vandalized by wildlife*

(Outlet of Tatlmain Lake)								
7-Aug	1	CH		0	--	--	--	
7-Aug	2	CH		0	--	--	--	
7-Aug	3	CH		0	--	--	--	
(Ptarmigan Creek)								
7-Aug	1	CH		0	--	--	--	
7-Aug	2	CH		0	--	--	--	
7-Aug	3	CH		0	--	--	--	
7-Aug	4	CH		0	--	--	--	
7-Aug	5	CH		0	--	--	--	

* Species code: CH = chinook salmon, LNS = longnose sucker, SS = slimy sculpin

Juvenile Fish Collection Data, **WILLOW CREEK**, 1998

Date	Trap #	Species	# Hours Set	Total CH Captured	Length (mm)	Weight (g)	Condition factor (k)	Other Species *
1-Aug	1	--	18.25	0	--	--	--	1 SS
1-Aug	2	CH	18.17	2	63	2.7	1.08	1 SS
1-Aug	2	CH	18.17		76	4.0	0.91	
1-Aug	3	--	18.25	0	--	--	--	1 SS
1-Aug	4	CH	18.08	2	63	2.4	0.96	
1-Aug	4	CH	18.08		66	3.4	1.18	
1-Aug	5	--	18.25	0	--	--	--	
(Reach 2, Site 1)								
6-Aug	1	--		0	--	--	--	
6-Aug	2	--		0	--	--	--	
6-Aug	3	--		0	--	--	--	1 BB
6-Aug	4	--		0	--	--	--	1 SS
6-Aug	5	--		0	--	--	--	
(Reach 3, Site 1)								
13-Aug	1	--		0	--	--	--	1 SS
13-Aug	2	--		0	--	--	--	1 SS
13-Aug	3	--		0	--	--	--	1 SS
13-Aug	4	--		0	--	--	--	
13-Aug	5	--		0	--	--	--	

Juvenile Fish Collection Data, **GRAYLING CREEK**, 1998

(Reach 1, Site 1)

Date	Trap #	Species	# Hours Set	Total CH Captured	Length (mm)	Weight (g)	Condition factor (k)	Other Species *
1-Aug	1	CH	15.50	2	75	4.1	0.97	1 SS
1-Aug	1	CH	15.50		70	3.5	1.02	
1-Aug	3	CH	15.25	2	68	3.4	1.08	
1-Aug	3	CH	15.25		78	4.3	0.91	
1-Aug	5	CH	15.75	4	75	3.9	0.92	
1-Aug	5	CH	15.75		64	2.5	0.95	
1-Aug	5	CH	15.75		65	3.2	1.17	
1-Aug	5	CH	15.75		64	2.5	0.95	
1-Aug	2	--	15.50	0	--	--	--	1 SS
1-Aug	4	--	15.50	0	--	--	--	
(Reach 2, Site 1)								
31-Jul	1	--		0	--	--	--	1 SS
31-Jul	2	--		0	--	--	--	
31-Jul	3	--		0	--	--	--	
31-Jul	4	--		0	--	--	--	
31-Jul	5	--		0	--	--	--	
(Reach 4, Site 1)								
31-Jul	1	--		0	--	--	--	1 SS
31-Jul	2	--		0	--	--	--	1 SS
31-Jul	3	--		0	--	--	--	1 SS
31-Jul	4	--		0	--	--	--	
31-Jul	5	--		0	--	--	--	

* Species code: CH = chinook salmon, LNS = longnose sucker, SS = slimy sculpin, BB = burbot

APPENDIX 3

BENTHIC INVERTEBRATE DATA FOR TRIBUTARIES TO PELLY RIVER, 1998

	Willow Creek			Mica Creek			Ptarmigan	Grayling Creek		Needlerock Creek		
	W1-1	W2-1	W3-1	M1-1	M2-1	M3-1	Creek	G1-1	G3-1	NR1-1	NR4-1	NR5-1
PHYLUM ARTHROPODA												
Class Insecta												
Unidentified insect pupae								12				
Order Ephemeroptera												
Ephemeroptera - unid larvae			1	8	5	10	2	4				4
Family Siphlonuridae	80							13	41	4		3
Family Baetidae	84		15	5	4	3			30	4		
Family Heptagenilidae	1		2	8	3	1			32	8		2
Family Ephemerellidae							2					
Order Plecoptera												
Plecoptera - unid larvae	7	1	4		26	2	29		119	19		1
Family Capniidae												
Family Perlidae				6	1	13						2
Family Chloroperlidae	9		5	22		5		22	1	6		
Order Trichoptera												
Trichoptera Unid larvae				1	12					1		1
Family Brachycentridae			175	103	34	1				4		
Family Hydropsychidae			6		2				32	9		
Family Limnephilidae			1				1					1
Family Glossosmatidae			22	2						1		
Family Rhyacophilidae			5	1	1	1		1	42	8		
Family Lepidoidae				8								
Order Diptera												
Diptera Unid pupae	7	3	1	13			9			2	1	1
Diptera Unid Adult	2					1						
Diptera Unid larvae					2							
Family Blephariceridae										1		
Family Culicidae								5		1		
Family Chironomidae, larvae	457	3	173	525	473	62	72	834	235	22		23
Family Chironomidae, pupae	18		1	17	18	2		13	6			1
Family Simulidae	52		16	19	4	1			12	109		
Family Tipulidae	6	6	2	16	14	8	2			2		6
Order Coleoptera										1		
Order Hemiptera												
Family Corixidae							8					
Family Mesoveliidae							1					
Araneae				4								
Class Crustacea												
Order Amphipoda												
Hyalella azteca												24
PHYLUM MOLLUSCA												
Class Pelecypoda						12						
Class Gastropoda												
Family Lymnaeidae						3					2	
Family Valvatidae											5	
PHYLUM ANNELIDA												
Class Hirudinea										1		
Class Oligochaeta	3	8	2	10	12		16					15
Total per Sample	724	19	431	768	611	125	142	904	550	203	8	84
Total per Creek	1174			1504				1454		295		
Taxonomic Richness per Sample	12	5	16	17	15	15	10	8	10	18	3	13

Unid = unidentified

EACH SURVEY FORM

DATE: July 29 Page # 1 of 2 **TIME:** Start: 10:10 Finish: 12:00

REACH #: M1 SITE #: 1 **U.T.M.:** 0419963 E 6965795 N

LOCATION: above first bridge on **MICA CREEK**

Surveyors: LC, DS, IP, JW

PHOTOS

	ROLL #	FRAME #	FL(mm)	NOTES:
Reference site		**2**		
Downstream		**4**		
Upstream		**3**		
		5		**Instruction on water quality meter**

STREAMBED MATERIAL

Fines: (< *size of ladybug*) % of total: 20 % clay: silt: 50 % sand: 50 %

Gravel: (*ladybug to Tennis ball*) % of total: 60% small: 50 % large: 50 %

Larges: (*Tennis ball to basketball*) % of total: 20% sm.cobble: 100 % lge.cobble:

boulder: 0 % Bedrock: (> 4 m) 0

D90 : 15 cm **Compaction** (Low, Mod, High): moderate

NOTES: algal slime on substrate prevalent (approx. 50 % of wetted substrate covered)
Water level very low -- large areas of exposed substrate

BANKS

Confinement: **E** **C** **FC** **OC** **UC** **NA** **Ave. height: (*bankfull depth*):** 0.82 m

Composition: primarily silt and gravel, organics

Slopes %: 70 % **Stability %**: 60 %

FLOOD STAGE **Dry** _____ **Low** X **Moderate** **High**_____ **Flood** _____(check one)

Flood signs height (M): 1.8 m

NOTES: some banks vertical with some undercutting -- other areas unconfined. Water level extremely low

VEGETATION/COVER

Cover: total (%): 40 % % Dp Pool: 30 % % L.O.D.: 20 % % boulder: 0 % % In veg.: 0 %

% over veg.: 30 % % Cutbank: 20 %

Crown closure (%): 20 %

Riparian vegetation: shrub layer primarily of willow (Silex sp.) and alder (Alnus sp.) -- highbush cranberry (Viburnum edule), rose (Rosa sp.) and dogwood (Cornus stolonifera), grasses, horsetail (equisetum sp.), sedges (Carex sp.), white spruce (Picea glauca) and poplar (Populus balsamifera)

CHANNEL CHARACTERISTICS

Average **Channel Width**: 10.6 m Average **Wetted Width**: 7.3 m

Ave. max. **Pool depth**: 106 cm Ave. max. **riffle depth**: 10 cm Avg. max **Run depth**: 30 cm

Surveyed **length**: 111 m **Gradient** (%): 1.0 % **Aspect**: North east

% Pool 5 % **% Riffle** 30 % **% Run**: 65 %

Side channel % 10 % * **Braided**: Yes No gravel **Bars** %: 10 %

NOTES: water very low with large areas of exposed gravel and cobble.
* dry side channel with small stagnant pool -- no water flowing back into creek

WATER QUALITY (In situ)

Temp (° C): 11.8 **pH:** 8.1 **DO** (mg/l): 11.1 **Cond.** (*u*S/cm): 288

Turbidity: 1 **Benthic sample #** M1 - 1 **Lab Sample #** N/A

Notes: sculpins present indicating good water quality
Water tannic colour

DISCHARGE

Ave. wetted width: 7.3 m **Ave. depth:** 0.22 m **Ave. velocity:** 0.10 m/s **Discharge**: 0.093 m^3/s

Notes shallow water made measuring flow difficult

WildLife Observations

2 live & 1 dead slimy sculpin observed in stream. Juvenile chinook, longnose sucker and slimy sculpin in traps

Enhancement & Restoration Opportunities

Good rearing habitat

EACH SURVEY FORM

DATE: July 29 Page # 1 of 2 **TIME**: Start: 14:50 Finish: 15:20

REACH #: M2 SITE #: 1 **U.T.M.**: 0420428 E 6962820 N

LOCATION: **MICA CREEK** next to steep embankment approx. 3 km upstream of bridge along firewood hauling road

Surveyors: DS, IP, JW

PHOTOS

	ROLL #	FRAME #	FL(mm)	NOTES:
Reference site		8		From embankment
Downstream		9		Downstream
Upstream		7		Upstream
		10		From stream level - ref site
		11		Upstream
		12		Downstream
		13		Substrate

STREAMBED MATERIAL

Fines: (< *size of ladybug*) % of total: 10 % clay: silt: 10 % sand: 90 %

Gravel: (*ladybug to Tennis ball*) % of total: 45% small: 50 % large: 50 %

Larges: (*Tennis ball to basketball*) % of total: 45% sm.cobble: 45 % lge.cobble: 50 %

boulder: 5 % Bedrock: (> 4 m) _____

D90 : 26 cm **Compaction** (Low, Mod, High): moderate

NOTES: algal slime not as prevalent at this site -- some substrate covered with moss. Water level very low with much of substrate exposed.

BANKS

Confinement: **E** **C** **FC** **OC** **UC** **NA** **Ave. height: (*bankfull depth*)**: 0.7 m

Composition: sand, silt,larges, gravel

Slopes %: 70 % (right bank) 90 % (left bank) **Stability %**: 30 %

FLOOD STAGE **Dry** _____ **Low** X **Moderate** **High**_____ **Flood** _____(check one)

Flood signs height (M): 1.2 m

NOTES: stream confined by embankment on right. Some sliding of sand from embankment on right -- stabilized somewhat by gravel and larges at base -- some shrub and grasses stabilizing although sparse. Left bank low and unconfined

MICA CREEK (M2-1)

VEGETATION/COVER

Cover: total (%): 30 % % Dp Pool: 0 % % L.O.D.: 25 % % boulder: 5% % In veg.: 0 %

% over veg.: 65 % % Cutbank: 5 %

Crown closure (%): 10 - 20 %

Riparian vegetation: shrub layer of alder (Alnus sp.) and willow (Silex sp.). Less than 5 % white spruce (Picea glauca). Poplar (Populus balsamifera) stand on right bank at downstream end of site surveyed. An old burn in this area, ground cover of of grasses, horsetail (Equisetum sp.) other: dogwood (Cornus stolonifera), water hemlock (Cicuta sp.), sedges (Carex spl) mosses, rose (Rosa sp.)

CHANNEL CHARACTERISTICS

Average **Channel Width**: 12.8 m Average **Wetted Width**: 8.3 m

Ave. max. **Pool depth**: 0 cm Ave. max. **riffle depth**: 19 cm Avg. max **Run depth**: 26 cm

Surveyed **length**: 119 m **Gradient** (%): 1.3 % **Aspect**: North

% Pool 0 % **% Riffle** 70 % **% Run**: 30 %

Side channel % 40 % **Braided**: Yes No gravel **Bars** %: 0 %

NOTES: large areas of exposed substrate -- no pools - groundwater source from right bank (below embankment) small trickle

WATER QUALITY (In situ)

Temp (° C): 15.1 **pH:** 8.4 **DO** (mg/l): 11.8 **Cond.** (*u*S/cm): 292

Turbidity: 20 **Benthic sample #** M2 - 1 **Lab Sample #** N/A

Notes: water organic or tannic colour

DISCHARGE

Ave. wetted width: 8.2 m **Ave. depth:** 0.21 m **Ave. velocity:** 0.13 m/s **Discharge**: 0.21 m^3/s

Notes

WildLife Observations

One dead slimy sculpin and one partially decomposed small fish (perhaps grayling)
Juvenile chinook and slimy sculpins in traps
2 traps vandalized by wildlife (possibly bear)

Enhancement & Restoration Opportunities

Small groundwater discharge from right embankment. Flow and winter temperatures should be monitored as possible site for incubation box

EACH SURVEY FORM

DATE: July 30 **Page #** 1 of 2 **TIME:** Start: 15:00 Finish: 17:00

REACH #: M3 **SITE #:** 1 **U.T.M.:** 0420896 E 6961698 N

LOCATION: **MICA CREEK** above first major logjam approx. 5 km upstream of bridge along firewood hauling road

Surveyors: LC, DS, IP, JW

PHOTOS

	ROLL #	FRAME #	FL(mm)	NOTES:
Reference site		21		Downstream & reference site
Downstream				
Upstream		19 & 20		Upstream - beaver dams
		15		Temp logger - log jam
		16		Log jam
		17		
		18		

STREAMBED MATERIAL

Fines: (< *size of ladybug*) % of total: 75 % clay: silt: 40 % sand: 60 %

Gravel: (*ladybug to Tennis ball*) % of total: 5% small: 50 % large: 50 %

Larges: (*Tennis ball to basketball*) % of total: 20% sm.cobble: 20 % lge.cobble: 75 %

boulder: 5 % Bedrock: (> 4 m) 0

D90 : 43 cm **Compaction** (Low, Mod, High): high in pools -- moderate in riffles.

NOTES: Three low beaver dams observed above logjam at this site-- accumulations of sand with scattered cobble in pools - one bar with cobble predominant

BANKS

Confinement: **E** **C** **FC** **OC** **UC** **NA** **Ave. height:** (***bankfull depth***): 0.8 m

Composition: silt, organics, some boulders

Slopes %: 90 % **Stability %**: 50 %

FLOOD STAGE **Dry** _____ **Low** X **Moderate** **High**_____ **Flood** _____(check one)

Flood signs height (M): 1.4 m

NOTES: large logjam located at downstream end of survey site. Three beaver dams in survey site located upstream of logjam.

VEGETATION/COVER

Cover: total (%): 60 % % Dp Pool: 30 % % L.O.D.: 30 % % boulder: 5% % In veg.: < 5 %

% over veg.: 30 % % Cutbank: 5 %

Crown closure (%): 40 %

Riparian vegetation: shrub layer primarily of alder (Alnus sp.) with some willow (Silex sp.). Approx. 20 % of riparian comprised of white spruce(Picea glauca). An old burn in this area, ground cover of grasses, horsetail (equisetum sp.). other: dogwood (Cornus stolonifera)

CHANNEL CHARACTERISTICS

Average **Channel Width**: 13.3 m Average **Wetted Width**: 11.5 m

Ave. max. **Pool depth**: 87 cm Ave. max. **riffle depth**: 6.5 cm Avg. max **Run depth**: 48 cm

Surveyed **length**: 110 m **Gradient** (%): 1.0 % **Aspect**: North to North west

% Pool 75 % **% Riffle** 5 % **% Run**: 20 %

Side channel % 0 % **Braided**: Yes No gravel **Bars** %: 5 %

NOTES: site consists of beaver dams & a log jam -- primarily pools and runs (one small riffle downstream of beaver dam on left. Approx. 75% pool at survey site caused by beaver dams & logjam.

WATER QUALITY (In situ)

Temp (° C): 14.9 **pH:** 8.2 **DO** (mg/l): 11.1 **Cond.** (μS/cm): 307

Turbidity: 1 **Benthic sample #** M3 - 1 **Lab Sample #** M3 - 1

Notes: temperature logger set near bear trail above logjam in pool next to right bank

DISCHARGE

Ave. wetted width: 11.5 m **Ave. depth:** 0.35 m **Ave. velocity:** 0.05 m/s **Discharge**: 0.2 m^3/s

Notes low flow due to series of beaver dams and a logjam

WildLife Observations

Bear trail to site -- fresh tracks . beaver , kingfisher , small fish jumping above beaver dams

Enhancement & Restoration Opportunities

Area known to support spawning chinook in past. Major logjam not an obstruction in past however removal may allow for easier passage. Beaver dams appear to be recent and not very high (average 35 cm in height above water level) and probably removed during spring freshet. Fresh beaver cuttings. One possible spawning redd above 2nd beaver dam upstream of logjam mostly silted over -- water slow moving

EACH SURVEY FORM

DATE: Aug 6 **Page #** 1 of 2 **TIME:** Start: 15:30 Finish: 16:15

REACH #: PT **SITE #:** 1 **U.T.M.:** 0429798 E 6953708 N

LOCATION: **PTARMIGAN CREEK** at trail crossing

Surveyors: LC, IP, JW

PHOTOS

	ROLL #	FRAME #	FL(mm)	NOTES:
Reference site		**16**		
Downstream		**17**		
Upstream		**18**		

STREAMBED MATERIAL

Fines: (< ***size of ladybug***) % of total: 20 % clay: silt: 50 % sand: 50 %

Gravel: (***ladybug to Tennis ball***) % of total: 40% small: 50 % large: 50 %

Larges: (***Tennis ball to basketball***) % of total: 40% sm.cobble: 100 % lge.cobble:

boulder: 0 % Bedrock: (> 4 m) 0

D90 : 25 cm **Compaction** (Low, Mod, High): moderate

NOTES: even distribution of gravel & cobble throughout site

BANKS

Confinement: **E** **C** **FC** **OC** **UC** **NA** **Ave. height:** (***bankfull depth***): 0.38 m

Composition: sand, silt, organics

Slopes %: 70 % **Stability %**: 80 %

FLOOD STAGE **Dry** _____ **Low** X **Moderate** **High**_____ **Flood** _____(check one)

Flood signs height (M): 1.2 m

NOTES: banks low and stabilized by lush vegetative growth. Very little water flow

VEGETATION/COVER

Cover: total (%): 50 % * % Dp Pool: 20 % % L.O.D.: 20 % % boulder: 0 % % In veg.: 0 %

% over veg.: 40 % % Cutbank: 20 %

* estimated at normal (higher) water level

Crown closure (%): 70 - 80 %

Riparian vegetation: shrub alder (Alnus sp.) interspersed with tall stands of poplar (Populus balsamifera). White spruce (Picea glauca) (growing close to stream edge) Tall poplar stands predominant. Undergrowth of grasses, horsetail (Equisetum sp.) with some rose (Rosa sp.), high bush cranberry (Viburnum edule) and Hedysarum sp.

CHANNEL CHARACTERISTICS

Average **Channel Width**: 7.0 m Average **Wetted Width**: 2.4 m

Ave. max. **Pool depth**: 7.0 cm Ave. max. **riffle depth**: 1.0 cm Avg. max **Run depth**: 2.0 cm

Surveyed **length**: 85 m **Gradient** (%): 1.2 % **Aspect**: South west

% Pool 30 % **% Riffle** 30 % **% Run**: 40 %

Side channel % 50 % **Braided**: Yes No gravel **Bars** %: 0 %

NOTES: water very low with large areas of exposed gravel and cobble.

WATER QUALITY (In situ)

Temp (° C): 12.4 **pH**: 8.5 **DO** (mg/l): 11.3 **Cond**. (*u*S/cm): 249

Turbidity: 28 **Benthic sample #** PT - 1 **Lab Sample #** N/A

Notes: water very clear

DISCHARGE

Ave. wetted width: _____ **Ave. depth**: _____ **Ave. velocity**: _____ **Discharge** (m 3/s): _____

Notes No flow measurement taken

WildLife Observations

Enhancement & Restoration Opportunities

good rearing habitat -- winter water flow would be critical

EACH SURVEY FORM

DATE: Aug 6 Page # 1 of 2 **TIME:** Start: 20:10 Finish: 21:30

REACH #: TL 5 SITE #: 1 **U.T.M.:** 043917 E 694520 N

LOCATION: approx. 200 m downstream from **OUTLET OF TATLMAIN LAKE**

Surveyors: LC, IP, JW

PHOTOS

	ROLL #	FRAME #	FL(mm)	NOTES:
Reference site		**8**		
Downstream		**5 & 6 & 9**		
Upstream		**7**		
		3 & 4		**Outlet of Tatlmain Lake**

STREAMBED MATERIAL

Fines: (< ***size of ladybug***) % of total: 10% clay: silt: 20 % sand: 80 %

Gravel: (***ladybug to Tennis ball***) % of total: 80% small: 50 % large: 50 %

Larges: (***Tennis ball to basketball***) % of total: 10% sm.cobble: 95 % lge.cobble: 5 %

boulder: 0 % Bedrock: (> 4 m) 0

D90 : 20 cm **Compaction** (Low, Mod, High): low to moderate

NOTES: substrate evenly distributed (above noted percentages) throughout site surveyed (from outlet to approx. 300 m downstream). Most gravel and cobble exposed due to extremely low water level. Streambed quite level from bank to bank with current wetted channel only slightly lower.

BANKS

Confinement: **E** **C** **FC** **OC** **UC** **NA** **Ave. height:** (***bankfull depth***): 0.27 m

Composition: sand, silt, organics

Slopes %: 70 % **Stability %**: 80 %

FLOOD STAGE **Dry** _____ **Low** X **Moderate** **High**_____ **Flood** _____(check one)

Flood signs height (M): 0.64 m

NOTES: banks at stream edge very low. water level extremely low (creek bed almost dry). Small groundwater source from left bank. Banks stabilized by lush vegetation and roots.

OUTLET OF TATLMAIN LAKE (TL5-1)

VEGETATION/COVER

Cover: total (%): 30 % * % Dp Pool: 0 % % L.O.D.: 20 % % boulder: 5 % % In veg.: 5 %

% over veg.: 50 % % Cutbank: 20 %

* estimated at normal water level

Crown closure (%): 20 %

Riparian vegetation: dense growth of willow (Silex sp.) and alder (Alnus sp.) at stream sides. Poplar (Populus balsamifera) stands close to stream side on left bank and white spruce (Picea glauca) to bank on right. Thick growth of grasses in exposed areas. Other -- high bush cranberry (Viburnum edule), rose (Rosa sp.), colts foot, horsetail (Equisetum sp.), sedges (Carex sp.), mosses (very lush growth)

CHANNEL CHARACTERISTICS

Average **Channel Width**: 13.5 m Average **Wetted Width**: 0.53 m

Ave. max. **Pool depth**: 56 cm Ave. max. **riffle depth**: N/A Avg. max **Run depth**: 7 cm

Surveyed **length**: 110 m **Gradient** (%): 0.5 % **Aspect**: North west

% Pool * **% Riffle** * **% Run**: *

Side channel % 0 % **Braided**: Yes No gravel **Bars** %: 0 %

NOTES: small tributary entering from right bank (only a trickle of water) ground water source from left bank rust coloured (mineral)
Very low gradient. * Actual pool/riffle/run ratio can't be determined -- very little water flow

WATER QUALITY (In situ)

Temp (° C): 11.2 **pH**: 8.4 **DO** (mg/l): 5.4 **Cond**. (*u*S/cm): 315

Turbidity: **Benthic sample #** N/A **Lab Sample #** N/A

Notes: very little water flow -- stagnant -- green algal growth throughout

DISCHARGE

Ave. wetted width: _____ **Ave. depth**: _____ **Ave. velocity**: _____ **Discharge** (m 3/s): _____

Notes no flow measurement taken

WildLife Observations

Ducks, bald eagle, kingfisher
3 juvenile pike in pool

Enhancement & Restoration Opportunities

Important whitefish spawning area. Linch Curry recalled this area with much more water -- running clear

REACH SURVEY FORM

DATE: Aug. 1 Page # 1 of 2 **TIME:** Start: 14:10 Finish: 15:35

REACH #: W1 SITE #: 1 **U.T.M.:** 041758 E 696792 N

LOCATION: mouth of **Willow Creek** (between beaver dams and confluence of Pelly River)

Surveyors: LC, IP, JW

PHOTOS

	ROLL #	FRAME #	FL(mm)	NOTES:
Reference site		**19**		
downstream		**18 & 21**		
upstream		**15 & 16**		
		17		**Beaver dam**

STREAMBED MATERIAL

Fines: (< *size of ladybug*) % of total: 40 % clay: silt: 50 % sand: 50 %

Gravel: (*ladybug to Tennis ball*) % of total: 50 % small: 50 % large: 50 %

Larges: (*Tennis ball to basketball*) % of total: 10 % sm.cobble: 100 % lge.cobble:

boulder:_____ Bedrock: (> 4 m) _____

D90: 13 cm **Compaction** (Low, Mod, High): moderate

NOTES: gravel layer overlaying silt and sand. Silt and sand depositions along stream banks where banks eroded Silt and sand deposition at confluence of Pelly River in alluvial fan

BANKS

Confinement: **E** **C** **FC** **OC** **UC** **NA** **Ave. height: (*bankfull depth*):** 0.9 m

Composition: silt, sand and organics

Slopes %: 70 % **Stability %**: 20 % stable

FLOOD STAGE **Dry** _____ **Low** X **Moderate** _____ **High**_____ **Flood** _____(check one)

Flood signs height (M): 2.8 m

NOTES: Majority of bank with some erosion due to spring flooding and possible backing up of water from the Pelly River Some spruce leaning over water as a result of bank erosion. Grasses stabilizing more exposed banks.

WILLOW CREEK (W1 - 1)

VEGETATION/COVER

Cover: total (%): 60 % % Dp Pool: 20 % % L.O.D.: 30 % % boulder: 0 % % In veg.: 0 %

% over veg.: 20 % % Cutbank: 30 %

Crown closure (%): 10 %

Riparian vegetation: predominantly willow (Silex sp.) grasses and sedges (Carex sp.), poplar (Populus balsamifera), and some white spruce (Picea glauca) on higher banks, dogwood (Cornus stolonifera), horsetail (Equisetum sp.), mosses, rose (Rosa sp.). white spruce group on high left bank overhanging as result of erosion

CHANNEL CHARACTERISTICS

Average **Channel Width**: 12.4 m Average **Wetted Width**: 9.9 m

Ave. max. **Pool depth**: 70 cm Ave. max. **riffle depth**: 18 cm Ave. max **Run depth**: 36 cm

Surveyed **length**: 84 m **Gradient** (%): 1.5 **Aspect**: south west

% Pool 10 % **% Riffle** 50 % **% Run**: 40 %

Side channel % 70 % **Braided**: Yes No gravel **Bars** %: 10 %

NOTES: side channel flows along right bank -- adjacent beaver dams on side channel and main channel (barriers to salmon migration)

WATER QUALITY (In situ)

Temp (° C): 13.7 **pH**: 8.2 **DO** (mg/l): 11.6 **Cond.** (*u*S/cm): 285

Turbidity: 115 **Benthic sample #** W1 - 1 **Lab Sample #** N/A

Notes: water very clear

DISCHARGE

Ave. wetted width: 9.9 m **Ave. depth**: 0.32 m **Ave. velocity**: 0.11 m/s **Discharge**: 0.46 m^3/s

Notes_____

WildLife Observations

Frogs in side channel, Black bear tracks, mink tracks

Enhancement & Restoration Opportunities

Possible removal of beaver dams

REACH SURVEY FORM

DATE: Aug 5 Page# 1 of 2 **TIME:** Start: 17:00 Finish: 18:30

REACH #: W 2 SITE #: 1 **U.T.M.:** _____

LOCATION: **Willow Creek**, area upstream and downstream of bridge on Pelly Farm road

Surveyors: IP, JW

PHOTOS

	ROLL #	FRAME #	FL(mm)	NOTES:
Reference site		**25**		
Downstream		**24**		
Upstream		**21**		

STREAMBED MATERIAL

Fines: (< *size of ladybug*) % of total: 50 % clay: 0 silt: 40 % sand: 60 %

Gravel: (*ladybug to Tennis ball*) % of total: 30 % small: 50% large: 50%

Larges: (*Tennis ball to basketball*) % of total: 20 % sm.cobble: 45% lge.cobble: 50%

boulder: 5 % Bedrock: (> 4 m) 0

D90 : 30 cm **Compaction** (Low, Mod, High): high

NOTES: silt and sand accumulated around larges – much of gravel covered with sand

BANKS

Confinement: **E** **C** **FC** **OC** **UC** **NA** **Ave. height**: (***bankfull depth***): 0.44 m

Composition: mostly sand and silt. Most of bank stabilized by grasses and shrub alder and willow.

Slopes %: 80% **Stability %**: 80 % stable

FLOOD STAGE **Dry** _____ **Low** _____**Moderate** **High** X **Flood** _____(check one)

Flood signs height (M): 1.2 m

NOTES: water level is actually higher than normal due to effect of beaver dams downstream of survey site

VEGETATION/COVER

Cover: total (%): 50% % Dp Pool: 40% % L.O.D.: 10% % boulder: 5 % % In veg.: _____

% over veg.: 40% % Cutbank: 5%

Crown closure (%): 60 % cover of willow and alder

Riparian vegetation: vegetation comprised of alder (Alnus sp.), grasses, horsetail (Equisetum sp.)
Few interspersed poplar (Populus balsamifera) and white spruce (Picea glauca)

CHANNEL CHARACTERISTICS

Average **Channel Width**: 6.8 m Average **Wetted Width**: 6.8 m (channel flooded due to beaver dam)

Ave. max. **Pool depth**: 134 cm Ave. max. **riffle depth**: N/A Avg. max **Run depth**: 110 cm

Surveyed **length**: 70 m **Gradient** (%): < 1.0% **Aspect**: West

% Pool 70% **% Riffle** _____ **% Run**: 30%

Side channel % 0 % **Braided**: Yes No gravel **Bars** %: 0%

NOTES: average channel width and wetted width essentially the same due to flooding created by beaver dam downstream

WATER QUALITY (In situ)

Temp (° C): 13.6 **pH**: 8.3 **DO** (mg/l): 11.2 **Cond.** (*u*S/cm): 294

Turbidity: 41 **Benthic sample #** W2-1 **Lab Sample #** W2-1

Notes: Temperature logger placed next to right bank below beaver dam which is located approximately 100 m downstream of bridge

DISCHARGE

Ave. wetted width: 6.8 m **Ave. depth**: 0.66 m **Ave. velocity**: 0.052 m/s **Discharge**: 0.26 m^3/s
Notes_____

WildLife Observations

Beaver observed

Enhancement & Restoration Opportunities

Possible removal of beaver dam located approximately 100 m downstream of bridge

REACH SURVEY FORM

DATE: Aug 12 **Page #** 1 **TIME:** Start: 11:15 Finish: 13:30

REACH #: W 3 **SITE #:** 1 **U.T.M.:** 423304 E 6971268 N

LOCATION: WILLOW CREEK, site accessed from fire road off of Klondike Highway approx. 13 km north of Village of Pelly

Surveyors: LC, IP, JW

PHOTOS

	ROLL #	FRAME #	FL(mm)	NOTES:
Reference site		**19 & 20**		
downstream		**18**		
upstream		**21**		

STREAMBED MATERIAL

Fines: (< *size of ladybug*) % of total: 30 % clay: _____ silt: 30 % sand: 70 %

Gravel: (*ladybug to Tennis ball*) % of total: 30 % small: 30 % large: 70 %

Larges: (*Tennis ball to basketball*) % of total: 40 % sm.cobble: 50 % lge.cobble: 50 %

boulder: 5 % Bedrock: (> 4 m) 0

D90 : 26 cm **Compaction** (Low, Mod, High): moderate to high

NOTES: High compaction of larges and moderate compaction of gravels. Extensive green algal growth on larges

BANKS

Confinement: E C FC OC UC NA **Ave. height: (*bankfull depth*):** 0.29 m

Composition: sand, boulders & gravel

Slopes %: 70 – 80 % **Stability %:** 50 %

FLOOD STAGE **Dry** _____ **Low** _____ **Moderate** X **High**_____ **Flood** _____(check one)

Flood signs height (M): 1.15 m

NOTES: somewhat unstable bank on left -- willow and alder growth and accumulated boulders stabilizing part of it.

WILLOW CREEK (W3 - 1)

VEGETATION/COVER

Cover: total (%): 30 % % Dp Pool: 30 % % L.O.D.: 20 % % boulder: 20% % In veg.: 0

% over veg.: 20 % % Cutbank: 10 %

Crown closure (%): 20 %

Riparian vegetation: predominantly willow (Silex sp.) and alder shrub (Alnus sp.)with understory of grasses, dogwood (Cornus stolonifera), highbush cranberry (Viburnum edule), hedesarum sp., rose (Rosa sp.), soapberry (Shepherdia canadensis), horsetail (Equisetum sp.) and mosses. Both firekill and live poplar sp. and white spruce (Picea glauca) interspersed.

CHANNEL CHARACTERISTICS

Average **Channel Width**: 7.4 m Average **Wetted Width**: 5.2 m

Ave. max. **Pool depth**: 80 cm Ave. max. **riffle depth**: 26 cm Avg. max **Run depth**: 60 cm

Surveyed **length**: 104 m **Gradient** (%): 1.0 % **Aspect**: South east

% Pool 30 % **% Riffle** 30 % **% Run**: 40 %

Side channel % 0 **Braided**: Yes No gravel **Bars** %: <1%

NOTES: _____

_____

_____

WATER QUALITY (In situ)

Temp (° C): 9.4 **pH:** * **DO** (mg/l): 11.0 **Cond.** (μS/cm): 261

Turbidity: 2 **Benthic sample #** W3 - 1 **Lab Sample #** N/A

Notes: * pH calibration faulty -- reading inaccurate

Water turbid – whitish silt suspended

DISCHARGE

Ave. wetted width: 5.2 m **Ave. depth:** 0.41 m **Ave. velocity:** 0.23 m/s **Discharge:** 0.460 m^3/s

Notes_____

WildLife Observations

Black bear tracks, mink tracks

Enhancement & Restoration Opportunities

Beaver dam located above survey site could be breached, however until area regenerates after fire this area may experience siltation and sand deposition until banks upstream are stabilized.

REACH SURVEY FORM

DATE: Aug 1 Page # 1 of 2 **TIME:** Start: 10:30 Finish: 12:00

REACH #: G1 SITE #: 1 **U.T.M.:** 0410733 E 6970517 N

LOCATION: upstream of mouth of **GRAYLING CREEK**

Surveyors: LC, IP, JW

PHOTOS

	ROLL #	FRAME #	FL(mm)	NOTES:
Reference site		**9 &11**		
Downstream		**10 & 14**		
upstream		**12 & 13**		
		7		**Mouth of Grayling – Pelly River**

STREAMBED MATERIAL

Fines: (< *size of ladybug*) % of total: 30% clay: silt: 30 % sand: 70 %

Gravel: (*ladybug to Tennis ball*) % of total: 60% small: 50 % large: 50 %

Larges: (*Tennis ball to basketball*) % of total: 10 % sm.cobble: 50 % lge.cobble: 50 %

boulder: 0 % Bedrock: (> 4 m) 0

D90 : 23 cm **Compaction** (Low, Mod, High): low in riffles, moderate in runs

NOTES: sand & silt deposition at stream bends

BANKS

Confinement: **E** **C** **FC** **OC** **UC** **NA** **Ave. height: (*bankfull depth*)**: 0.9 m

Composition: silt, sand, organics

Slopes %: from 40 % to 90 % **Stability %**: 60 %

FLOOD STAGE **Dry** _____ **Low** X **Moderate** X **High**_____ **Flood** _____(check one)

Flood signs height (M): 1.8 m

NOTES: Flood stage low to moderate

VEGETATION/COVER

Cover: total (%): 40 % % Dp Pool: 25 % % L.O.D.: 25 % % boulder: 0 % % In veg.: 0 %

% over veg.: 25 % % Cutbank: 25 %

Crown closure (%): ranges from 15 % to 40 %

Riparian vegetation: predominantly willow (Silex sp.) with some alder (Alnus sp.), white spruce (Picea glauca) and poplar (Populus balsamifera). Ground cover of grasses, horsetail (equisetum sp.) , sedges (Carex sp.) yarrow (Achillea sp.)

CHANNEL CHARACTERISTICS

Average **Channel Width**: 8.4 m Average **Wetted Width**: 5.6 m

Ave. max. **Pool depth**: 56 cm Ave. max. **riffle depth**: 12 cm Avg. max **Run depth**: 21 cm

Surveyed **length**: 110 m **Gradient** (%): 1.0% **Aspect**: south west

% Pool 10 % **% Riffle** 50 % **% Run**: 40%

Side channel % 0 **Braided**: Yes No gravel **Bars** %: 0

NOTES: pools more prevalent at upstream limit of site surveyed – more riffle/ run in site surveyed.

WATER QUALITY (In situ)

Temp (° C): 7.9 **pH**: 8.3 **DO** (mg/l): 13.7 **Cond.** (*u*S/cm): 279

Turbidity: 95 **Benthic sample #** G1 - 1 **Lab Sample #** N/A

Notes: very clear cold stream

DISCHARGE

Ave. wetted width: 5.6 m **Ave. depth**: 0.19 m **Ave. velocity**: 0.27 m/s **Discharge**: 0.29 m^3/s

Notes_____

WildLife Observations

Kingfishers and an owl observed, approx. 20 adult grayling observed in deep pool at upper limit of survey site.

Enhancement & Restoration Opportunities

Good chinook rearing habitat. Cold water temps indicate possible groundwater source. Could be potential for streamside incubation box if temperature of water warm enough throughout winter.

REACH SURVEY FORM

DATE: July 31 **Page #** 1 of 2 **TIME:** Start: 13:50 Finish: 15:00

REACH #: G2 **SITE #:** 1 **U.T.M.:** 0410776 E 6971250 N

LOCATION: **GRAYLING CREEK**, below the bridge on Pelly Farm Road

Surveyors: LC, IP, JW

PHOTOS

	ROLL #	FRAME #	FL(mm)	NOTES:
Reference site		**5**		
Downstream		**6**		
upstream		**7**		

STREAMBED MATERIAL

Fines: (< *size of ladybug*) % of total: 10% clay: silt: 50 % sand: 50 %

Gravel: (*ladybug to Tennis ball*) % of total: 30% small: 50 % large: 50 %

Larges: (*Tennis ball to basketball*) % of total: 60 % sm.cobble: 30 % lge.cobble: 35 %

boulder: 30 % Bedrock: (> 4 m) 0

D90 : 45 cm **Compaction** (Low, Mod, High): moderate to high

NOTES: _____

BANKS

Confinement: **E** **C** **FC** **OC** **UC** **NA** **Ave. height: (*bankfull depth*):** 0.35 m

Composition: silt, large cobble, organics

Slopes %: 80 % **Stability %:** 95 %

FLOOD STAGE **Dry** _____ **Low** _____ **Moderate** **X** **High** _____ **Flood** _____ (check one)

Flood signs height (M): 1.5m

NOTES: low banks stabilized by thick willow shrub & roots, horsetail, large cobble and boulders.

VEGETATION/COVER

Cover: total (%): 60 % % Dp Pool: 0 % L.O.D.: 25 % % boulder: 25 % % In veg.: _____

% over veg.: 25 % % Cutbank: 25 %

Crown closure (%): 100 %

Riparian vegetation: predominantly alder (Alnus sp.) and willow (Silex sp.) with intermittent poplar (Populus balsamifera). ground cover of primarily horsetail (equisetum sp.) some grasses, monkshood (Aconitum sp.), rose (Rosa sp.) and mosses on river fringes.

CHANNEL CHARACTERISTICS

Average **Channel Width**: 5.8 m Average **Wetted Width**: 5.3 m

Ave. max. **Pool depth**: 45 cm Ave. max. **riffle depth**: 25 cm Avg. max **Run depth**: N/A

Surveyed **length**: 76 m **Gradient** (%): 1.0 % **Aspect**: southwest

% Pool 15 % **% Riffle** 85 % **% Run**: 0%

Side channel % 0 **Braided**: Yes No gravel **Bars** %: 0

NOTES: predominantly riffle

WATER QUALITY (In situ)

Temp (° C): 7.4 **pH**: 8.1 **DO** (mg/l): 13.7 **Cond.** (μS/cm): 279

Turbidity: 28 **Benthic sample #** N/A **Lab Sample #** N/A

Notes: very clear cold creek

DISCHARGE

Ave. wetted width: _____ **Ave. depth**: _____ **Ave. velocity**: _____ **Discharge** (m 3/s): _____

Notes flow measurements not taken

WildLife Observations

Enhancement & Restoration Opportunities

REACH SURVEY FORM

DATE: July 31 Page # 1 of 2 **TIME:** Start: 10:45 Finish: 12:15

REACH #: G – 3 SITE #: 1 **U.T.M.:** 0410624 E 6971087 N

LOCATION: GRAYLING CREEK, upstream of Bridge on Pelly Farm Road

Surveyors: LC, IP, JW

PHOTOS

	ROLL #	FRAME #	FL(mm)	NOTES:
Reference site		25		
Downstream		1		
Upstream		3		
		22		Fry sampling (Linch Curry)
		23		Temperature logger (Linch Curry)
	LC photo	3		Placement of Temp logger (JW)

STREAMBED MATERIAL

Fines: (< *size of ladybug*) % of total: 30 % clay: silt: 60 % sand: 40 %

Gravel: (*ladybug to Tennis ball*) % of total: 40 % small: 30 % large: 70 %

Larges: (*Tennis ball to basketball*) % of total: 30 % sm.cobble: 95 % lge.cobble: 5 %

boulder: 0 Bedrock: (> 4 m) 0

D90 : 20 cm **Compaction** (Low, Mod, High): low to moderate on riffles
Moderate to high on runs

NOTES: sand/silt deposits at river bends

BANKS

Confinement: **E** **C** **FC** **OC** **UC** **NA** **Ave. height: (*bankfull depth*):** 0.65 m

Composition: silt/sand organics mosses equisetum

Slopes %: 80 % **Stability %:** 95 %

FLOOD STAGE **Dry** _____ **Low** _____ **Moderate** **X** **High**_____ **Flood** _____(check one)

Flood signs height (M): 1.8 m

NOTES: flood stage low to moderate. Banks stabilized by lush growth of shrub/roots & grasses & equisetum

GRAYLING CREEK (G3-1)

VEGETATION/COVER

Cover: total (%): 50 % % Dp Pool: 15 % % L.O.D.: 20 % % boulder: 0 % In veg.: 0

% over veg.: 35 % % Cutbank: 30 %

Crown closure (%): 95 %

Riparian vegetation: predominantly alder (Alnus sp.) with some willow (Silex spp.) and intermittent white spruce (Picea glauca). Under cover of dense horsetail (equisetum sp.) with moss on river fringes.

CHANNEL CHARACTERISTICS

Average **Channel Width**: 4.7 m Average **Wetted Width**: 3.6 m

Ave. max. **Pool depth**: 88 cm Ave. max. **riffle depth**: 23 cm Avg. max **Run depth**: 39 cm

Surveyed **length**: 68 m **Gradient** (%): 1.3 % **Aspect**: SW

% Pool 10 **% Riffle** 75 % **% Run**: 20 %

Side channel % 0 **Braided**: Yes No gravel **Bars** %: 5 %

NOTES: irregular meandering creek

WATER QUALITY (In situ)

Temp (° C): 6.1 **pH:** 8.0 **DO** (mg/l): 13.2 **Cond.** (*u*S/cm): 285

Turbidity: very clear **Benthic sample #** G3 - 1 **Lab Sample #** G3 -1

Notes: very clear and cold stream

Temperature logger set in pool by right bank at this survey site

DISCHARGE

Ave. wetted width : 3.55 m **Ave. depth**: 0.47 m **Ave. velocity:** 0.20 m/s **Discharge**: 0.35 m^3/s

Notes

WildLife Observations

Enhancement & Restoration Opportunities

cold and clear stream -- very shaded -- possibly good habitat for juvenile fish depending on benthic biomass

cold water may indicate ground water source which should be investigated in winter to determine if temperature warm enough for streamside incubation box operation.

REACH SURVEY FORM

DATE: Aug 4 Page # 1 of 2 **TIME:** Start: 14:00 Finish: 15:40

REACH #: NR 1 SITE #: 1 **U.T.M.:** 0506581 E 6718558 N

LOCATION: upstream of mouth of **NEEDLEROCK CREEK**

Surveyors: LC, IP, JW

PHOTOS

	ROLL #	FRAME #	FL(mm)	NOTES:
Reference site		7		
Downstream		8		
Upstream		9		
		10		View from cliffs – right bank
		11		Mouth of Needlerock -- conflu Pelly R.)
		12		View of valley from cliffs looking upstream
		16,13,18		Minnow trap site upstream of site 1

STREAMBED MATERIAL

Fines: (< *size of ladybug*) % of total: 35% clay: silt: 50 % sand: 50 %

Gravel: (*ladybug to Tennis ball*) % of total: 35% small: 10 % large: 80 %

Larges: (*Tennis ball to basketball*) % of total: 30% sm.cobble: 70 % lge.cobble: 30 %

boulder: 5 % Bedrock: (> 4 m) 0

D90 : 30 cm **Compaction** (Low, Mod, High): moderate

NOTES: large % of gravel & cobble covered with moss and algae -- silt/sand collected on moss & algae

BANKS

Confinement: **E** **C** **FC** **OC** **UC** **NA** **Ave. height**: (***bankfull depth***): 0.45 m

Composition: silt, sand, organics

Slopes %: 70 – 80 % **Stability %**: 70 %

FLOOD STAGE **Dry** _____ **Low** **Moderate** **X** **High**_____ **Flood** _____(check one)

Flood signs height (M): 3.1 m

NOTES: Occasional confinement at this site close to mouth. Further upstream, stream frequently confined.

NEEDLEROCK CREEK (NR-1)

VEGETATION/COVER

Cover: total (%): 35 % % Dp Pool: 0 % % L.O.D.: 35 % % boulder: 5 % % In veg.: 0 %

% over veg.: 50 % % Cutbank: 10 %

Crown closure (%): 15 %

Riparian vegetation: grasses, horsetail (Equisetum sp.), high bush cranberry (Viburnum edule), Hedysarum sp., dogwood (Cornus stolonifera) ,predominantly alder (Alnus sp.) with some willow (Silex sp.) along with white spruce (Picea glauca) and poplar (Populus balsamifera).

CHANNEL CHARACTERISTICS

Average **Channel Width**: 12.8 m Average **Wetted Width**: 11.5 m

Ave. max. **Pool depth**: N/A Ave. max. **riffle depth**: 25 cm Avg. max **Run depth**: 63 cm

Surveyed **length**: 141 m **Gradient** (%): 1.0 % **Aspect**: South

% Pool 0 % **% Riffle** 80 % **% Run**: 20%

Side channel % 0 **Braided**: Yes No gravel **Bars** %: 10 %

NOTES:

WATER QUALITY (In situ)

Temp (° C): 14.7 **pH**: 8.5 **DO** (mg/l): 11.6 **Cond.** (*u*S/cm): 315

Turbidity: 15 **Benthic sample #** NR1 - 1 **Lab Sample #** NR1 - 1

Notes: clear stream

DISCHARGE

Ave. wetted width: 7.5 m **Ave. depth:** 0.29 m **Ave. velocity:** 0.5 m/s **Discharge**: 1.12 m^3/s

Notes_____

WildLife Observations

Moose tracks, black bear (adult & cub) tracks, black bear & cub siting on ridge, bald eagle

Enhancement & Restoration Opportunities

Siltation would be problem in this area for adult chinook spawning. Good rearing habitat

REACH SURVEY FORM

DATE: Aug 9 **Page #** 1 **TIME:** Start: 15:00 Finish: 16:15

REACH #: NR 4 **SITE #:** 1 **U.T.M.:** 045908 E 6953780N

LOCATION: **NEEDLEROCK CREEK** approx. 18 km upstream of foot bridge -- site accessed from winter road following right bank.

Surveyors: IP, JW

PHOTOS

	ROLL #	FRAME #	FL(mm)	NOTES:
Reference site		3		
Downstream		4 & 8		
Upstream		5 & 7 & 9		
		5 & 6		Brown algae on substrate

STREAMBED MATERIAL

Fines: (< *size of ladybug*) % of total: 30% clay: silt: 10 % sand: 90 %

Gravel: (*ladybug to Tennis ball*) % of total: 65% small: 50 % large: 50 %

Larges: (*Tennis ball to basketball*) % of total: 5% sm.cobble: 100 % lge.cobble: 0 %

boulder: 0 % Bedrock: (> 4 m) 0

D90 : 5.0 cm **Compaction** (Low, Mod, High): low in riffles

NOTES: average gravel size 3.0 cm. Thin layer of gravel over sand. Large masses of slimy algal growth on gravel throughout survey site -- green algae on substrate adjacent to left bank. Gravel with black colouration -- coating.

BANKS

Confinement: **E** **C** **FC** **OC** **UC** **NA** **Ave. height:** (*bankfull depth*): 0.57 m

Composition: sand and organics (right bank mostly sand)

Slopes %: 70 – 80 % **Stability %**: 50 %

FLOOD STAGE **Dry** _____ **Low** X **Moderate** **High**_____ **Flood** _____(check one)

Flood signs height (M): 1.15 m

NOTES: sandy embankment along right bank partially stabilized by thin growth of alder/willow shrubs and sporatic white spruce. Left bank unconfined and stable with layer of grasses, sedges, equisetum and mosses and thick growth of primarily alder and some willow. Embankment on right follows contour of river along entire length of site surveyed.

NEEDLEROCK CREEK (NR4-1)

VEGETATION/COVER

Cover: total (%): 30 % % Dp Pool: 20 % % L.O.D.: 20 % % boulder: 0 % % In veg.: 10 %

% over veg.: 40% % Cutbank: 10 %

Crown closure (%): ranges from 20 to 40 %

Riparian vegetation: stream edges with grasses, sedges (carex sp.), horsetail (Equisetum sp.) and mosses – shrub primarily alder (Alnus sp.) with some willow (Silex sp)– high bush cranberry (Viburnum edule), rose (Rosa sp.). White spruce (Picea glauca) distributed sporatically along right embankment. Denser stands of spruce on left bank downstream of survey site. Young growth of spruce on left bank behind shrub layer

CHANNEL CHARACTERISTICS

Average **Channel Width**: 10.9 m Average **Wetted Width**: 9.3 m

Ave. max. **Pool depth**: 90 cm Ave. max. **riffle depth**: 24 cm Avg. max **Run depth**: 36 cm

Surveyed **length**: 110 m **Gradient** (%): 1.0 % **Aspect**: North west & South west

% Pool 30 % **% Riffle** 40 % **% Run**: 30%

Side channel % 0 **Braided**: Yes No gravel **Bars** %: < 5 %

NOTES: meandering section confined on right by sandy embankment

WATER QUALITY (In situ)

Temp (° C): 11.9 **pH**: 8.8 **DO** (mg/l): 10.6 **Cond**. (*u*S/cm): 288

Turbidity: 70 **Benthic sample #** NR4-1 **Lab Sample #** N/A

Notes: water tannic colour but clear to bottom. Water level very low -- area with little crown closure with extensive algal growth on gravel

DISCHARGE

Ave. wetted width: 9.25 m **Ave. depth**: 0.17 m **Ave. velocity**: 0.42 m/s **Discharge**: 0.712 m^3/s

Notes rain the previous day

WildLife Observations

Moose tracks on left bank, 2 small adult fish observed in pool (possibly grayling)

Enhancement & Restoration Opportunities

Possible suitable habitat for juvenile and adult chinook under normal conditions. Summer low water flow & overwintering conditons may be limiting factor

EACH SURVEY FORM

DATE: Aug 10 **Page #** 1 of 2 **TIME:** Start: 12:00 Finish: 13:15

REACH #: NR5 **SITE #:** 1 **U.T.M.:** 0461934 E 6957252 N

LOCATION: **NEEDLEROCK CREEK,** approx. 30 km upstream of bridge crossing -- in firekill area

Surveyors: IP, JW

PHOTOS

	ROLL #	FRAME #	FL(mm)	NOTES:
Reference site		**10**		
Downstream		**12**		
Upstream		**11**		

STREAMBED MATERIAL

Fines: (< *size of ladybug*) % of total: 90% clay: silt: 50 % sand: 50 %

Gravel: (*ladybug to Tennis ball*) % of total: 10% small: 50 % large: 50 %

Larges: (*Tennis ball to basketball*) % of total: 0% sm.cobble: 0 % lge.cobble: 0 %

boulder: 0 % Bedrock: (> 4 m) 0

D90 : 5.0 cm **Compaction** (Low, Mod, High): low to moderate

NOTES: thin layer of gravel underlain by sand in some areas -- substrate predominantly sand/silt

BANKS

Confinement: **E** **C** **FC** **OC** **UC** **NA** **Ave. height: (*bankfull depth*):** 0.80 m

Composition: sand and organics

Slopes %: 70 – 80 % **Stability %:** 60 %

FLOOD STAGE **Dry** _____ **Low** X **Moderate** **High**_____ **Flood** _____(check one)

Flood signs height (M): 1.4 m

NOTES: left stream side with exposed sand/silt deposits

NEEDLEROCK CREEK, (NR5-1)

VEGETATION/COVER

Cover: total (%): 70 % % Dp Pool: 40 % % L.O.D.: 40 % % boulder: 0 % % In veg.: 10 %

% over veg.: 5% % Cutbank: 5 %

Crown closure (%): 10 % in areas of regrowth alder and willow

Riparian vegetation: predominantly thick grass growth, with some fireweed (Epilobium angustifolium), horsetail (Equisetum sp.), water hemlock, curly dock (Rumex crispus) and mosses. some alder (Alnus sp.). Some live spruce and much standing and fallen firekilled spruce -- fallen dead spruce in creek causing log jams

CHANNEL CHARACTERISTICS

Average **Channel Width**: 9.7 m Average **Wetted Width**: 7.7 m

Ave. max. **Pool depth**: 106 cm Ave. max. **riffle depth**: N/A Avg. max **Run depth**: 95 cm

Surveyed **length**: 130 m **Gradient** (%): <1.0 % **Aspect**: North west

% Pool 50 % **% Riffle** 0 % **% Run**: 50%

Side channel % 5 % (dry at this time) **Braided**: Yes No gravel **Bars %**: 0 %

NOTES: predominantly deep pools and deep runs

WATER QUALITY (In situ)

Temp (° C): 13.2 **pH**: 8.2 **DO** (mg/l): 8.73 **Cond.** (*u*S/cm): 285

Turbidity: 1 **Benthic sample #** NR5 **Lab Sample #** NR5

Notes: water tannic colour

DISCHARGE

Ave. wetted width: 7.7 m **Ave. depth**: 0.58 m **Ave. velocity**: 0.13 m/s **Discharge**: 0.545 m^3/s

Notes slow moving water -- mostly deep pools and runs

WildLife Observations

Numerous small birds -- warblers etc.

Enhancement & Restoration Opportunities

Habitat is poor -- fire has made this site unsuitable for salmon spawning

REACH SURVEY FORM

DATE: Aug 11 Page # 1 of 2 **TIME:** Start: 10:20 Finish: 11:15

REACH #: NR 2 SITE #: 1 **U.T.M.:** 0439808 E 6963870 N

LOCATION: upstream of foot bridge located approx. 2 km upstream of mouth of **NEEDLEROCK CREEK**

Surveyors: IP, JW

PHOTOS

	ROLL #	FRAME #	FL(mm)	NOTES:
Reference site				
Downstream		14		
Upstream		15		
		13		Unstable Bank (left bank)
		23		Chinook salmon at foot crossing
		24		
		25		

STREAMBED MATERIAL

Fines: (< *size of ladybug*) % of total: 30% clay: silt: 20 % sand: 80 %

Gravel: (*ladybug to Tennis ball*) % of total: 20% small: 20 % large: 80 %

Larges: (*Tennis ball to basketball*) % of total: 50 % sm.cobble: 40 % lge.cobble: 40 %

boulder: 20 % Bedrock: (> 4 m) 0

D90 : 37 cm **Compaction** (Low, Mod, High): moderate

NOTES: gravel and larges clean (i.e. no algal or moss growth)

BANKS

Confinement: **E** **C** **FC** **OC** **UC** **NA** **Ave. height:** (***bankfull depth***): 0.69 m

Composition: silt, sand, organics

Slopes %: 40 – 80 % **Stability %**: 70 %

FLOOD STAGE **Dry** _____ **Low** **Moderate** **X** **High**_____ **Flood** _____(check one)

Flood signs height (M): 1.6 m

NOTES: high bank on left with some erosion -- stabilized at base with growth of equisetum and mosses.

VEGETATION/COVER

Cover: total (%): 40 % % Dp Pool: 30 % % L.O.D.: 10 % % boulder: 10 % % In veg.: 0 %

% over veg.: 40% % Cutbank: 10 %

Crown closure (%): 20 - 30 %

Riparian vegetation: stream edges with grasses, sedges (Carex sp.), horsetail (Equisetum sp.) and mossess – shrub primarily alder (Alnus sp.) with some willow (Silex sp.)– high bush cranberry (Viburnum edule), rose (Rosa sp.). Dense white spruce (Picea glauca)

CHANNEL CHARACTERISTICS

Average **Channel Width**: 9.2 m Average **Wetted Width**: 9.0 m

Ave. max. **Pool depth**: 130 cm Ave. max. **riffle depth**: 23 cm Avg. max **Run depth**: 73 cm

Surveyed **length**: 120 m **Gradient** (%): 1.0 % **Aspect**: South

% Pool 40 % **% Riffle** 30 % **% Run**: 30%

Side channel % 0 **Braided**: Yes No gravel **Bars** %: < 5 %

NOTES: irregular to tortuous meanders in this reach

WATER QUALITY (In situ)

Temp (° C): 10.9 **pH**: 8.4 **DO** (mg/l): 11.1 **Cond.** (*u*S/cm): 300

Turbidity: 2 **Benthic sample #** N/A **Lab Sample #** N/A

Notes: water very clear

DISCHARGE

Ave. wetted width: 6.5 m **Ave. depth**: 0.6 m **Ave. velocity**: 0.2 m/s **Discharge**: 0.77 m^3/s

Notes_____

WildLife Observations

Short eared owl, wolf tracks on left bank, 8 adult chinook salmon, beaver

Enhancement & Restoration Opportunities