Chinook Salmon Assessment and Restoration/Enhancement Options for Selected Tributaries of the Nisutlin River and Teslin Lake Drainages, 1998

White Mountain Environmental Consulting
in association with
The Teslin Tlingit Council
and
Laberge Environmental Services

Funding for this study was provided by the Yukon River Panel Restoration and Enhancement Fund, under the U.S./Canada Interim Agreement of the Pacific Salmon Treaty.

Project # RE-20-98

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Abstract

Field investigations and assessments to document chinook salmon (*Onchorhyncus tswatcha*) resources in the Nisutlin River drainage and major tributaries to the north-west arm of Teslin Lake, were conducted during July and August, 1998. Investigations included water quantity and quality assessments, benthic sampling, and fish habitat and utilization assessments.

This report constitutes part of an ongoing effort to document the salmon resources of the Teslin Drainage basin in order to allow for salmon management on a watershed basis. The Teslin drainage is within the Teslin Tlingit Traditional Territory of the south central Yukon.

The most significant observation of the hydrology component of this study was the extremely low discharge in many of the tributaries. In some cases the measured discharge approached or was lower than the estimated 7 day low flow extreme. These drought like conditions had direct effects on the chemistry as well as the biological and physical characteristics of the watercourses, which likely affected distribution and well being of juvenile salmon.

In general, relatively high numbers of salmon fry were captured in the Nisutlin drainage. All the major tributaries, and most of the smaller ones, supported rearing chinook to some degree. The Sidney Creek and Rose River drainages supported the highest numbers of rearing chinook fry documented in the study area. The very low water levels prevalent during the study likely resulted in a reduction of available habitat and so concentrated fry in the remaining habitats. This reduction of habitat was particularly evident in smaller tributaries. Combined with a relatively high escapement in the 1997 run, this may account for the large numbers of fry captured during the study. Nevertheless, this study indicates the Nisutlin sub-basin represents a very significant salmon resource in the upper Yukon River drainage, and may contain some of the most extensive rearing habitat in this area.

Much of the study area remains in a virtually pristine state, however access from the South Canol Road and Alaska Highway will likely lead to increases in human activity within the study area. Land and watershed management policies that protect the fisheries resource should be considered an important component of any land use planning process.

Several culverts at creek crossings along the South Canol Road represented an obstruction to fish passage at the water levels encountered. This report recommends these obstructions be addressed.

Potential sites for a salmon enumeration fence were assessed. The lower Wolf River near its outlet to the Nisutlin River was considered a suitable site for such a fence.

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1.0 INTRODUCTION

This report presents the findings of a study on chinook salmon resources in selected portions of the Teslin River drainage within the Teslin Tlingit Traditional Territory of south central Yukon (Figure 1). The study is part of an ongoing initiative by the Teslin Tlingit Council (TTC) to assess fisheries resources and management options within the Teslin River drainage. Fisheries and water investigations were conducted on a total of 7 tributaries to the north-west arm of Teslin Lake and 19 tributaries to the Nisutlin River. The Nisutlin mainstem was given a cursory overview, but was not a focus of this study. The Rose River and Sidney Creek were given more extensive investigations due to accessibility and the likely-hood of future development impacts.

This physical inventory was conducted in conjunction with a traditional knowledge survey of the Teslin Tlingit. The findings of the traditional knowledge survey have been presented in a separate report. The TTC is currently in the process of developing land management strategies within their traditional territory. Prior to this report, detailed information on the utilization of tributary streams by chinook salmon was lacking for much of the study area. Spawning populations in some tributaries were undocumented, and the importance of these drainages for rearing salmon was unknown. The purpose of this study was to address these data gaps and provide the information necessary for management of salmon stocks in the area. It is hoped that documenting salmon utilization and restoration/enhancement potential in the area will influence future land use decisions that might negatively impact the salmon resource. Recent proposals to significantly increase timber harvest in the Teslin area highlight the need to assess critical habitats for chinook salmon and ensure that future developments do not compromise this resource.

The specific objectives of this project were as follows:

- Conduct fisheries and waters investigations of selected tributaries to Teslin Lake and the Nisutlin River drainage.
- Prepare a report that would discuss restoration/enhancement options within the study area.
- Solicit support from local communities and other interested parties for possible future restoration/enhancement work resulting from the findings of these studies.
- Generate background data that can be used towards development of a strategy for managing chinook salmon in the Teslin Tlingit Traditional Territory in conjunction with other Yukon River strategies.

2.0 STUDY AREA

Physical investigations were conducted on tributaries of the Nisutlin River and major tributaries to the north-west arm of Teslin Lake. This study investigated 19 sub drainages entering the Nisutlin River and 7 tributary creeks to Teslin Lake (Figures 2,3 and 4). The study area, entirely within the traditional territory of the Teslin Tlingit First Nation, has supported subsistence harvest activities for generations.

Teslin Lake, 126 kilometers long and averaging 3.2 km wide with an average depth of 59 meters, is one of the principle headwaters of the Yukon River (Fisheries & Marine Services,1973). Teslin Lake has been designated as High Quality Waters for the purposes of fisheries management by the Yukon Territorial Government (YTG). The seven tributaries to Teslin Lake assessed were: Flat Creek, Grayling Creek, Fox Creek, Deadman Creek, Brooks Brook, Lone Tree Creek, and Ten Mile Creek. Five of the seven tributaries to Teslin Lake are crossed by the Alaska Highway. A list of sites investigated and the corresponding UTM coordinates are presented in Appendix 1.

The Nisutlin River is a sub-basin of the Teslin River watershed which flows into the Yukon River, eventually draining into the Bering sea. The Nisutlin River drains an area of approximately 11,984 square kilometers, in south central Yukon, Canada. The headwaters of the Nisutlin lie in the Pelly and St. Cyr mountain ranges. A number of lakes are located within this drainage including: Moss, Thirty Mile, Wolf, and Nisutlin lakes. The Nisutlin River flows generally west from Nisutlin Lake to its confluence with the Rose River before turning to flow south and eventually emptying into Nisutlin Bay on Teslin Lake. The study area encompassed 7 tributaries of Teslin Lake, greater than 2nd order and 68 tributaries of the Nisutlin River. Not all tributaries of the Nisutlin River were sampled. Tributaries to the Nisutlin River consist of 48- 1st order tributaries, one of which was investigated, 11- 2nd order tributaries, 10 of which were investigated, and 9-3rd order or greater tributaries all of which were investigated. The major sub-basins of the Nisutlin drainage include the Wolf River, McNeil River, McConnell River, Rose River, Thirty Mile Creek, Hundred Mile Creek, and Sidney Creek.

The Nisutlin River Delta is by far the most extensive delta in the Yukon south of the Beaufort Sea coast. Due to a constantly renewed supply of nutrients deposited by the river, the rich mudflats support thriving populations of invertebrates and aquatic plants which supports the aquatic food chain of the entire Teslin Lake system (CWS 1997). The majority of the Nisutlin drainage has a southerly aspect, unusual in the Yukon, where most rivers generally flow in a northerly direction. The primary tributaries of the Nisutlin River investigated are: Wolf River, Sidney Creek, Rose River, Thirty Mile River, McConnell River, McNeil River, Hundred Mile Creek and Cottonwood Creek. A total of 14 smaller (secondary) streams within the Nisutlin River drainage were also investigated. Numerous small creeks were not investigated due to time and budgetary constraints.

The South Canol Road runs parallel to the Nisutlin River and Rose River, for approximately 125 kilometers. Limited mining development and mineral exploration have occurred within the Nisutlin drainage, with activity in the vicinities of Iron Creek (a tributary of Sidney Creek), Seagull Creek, Groundhog Creek and Wolf Lake. Logging has occurred in some areas of the Nisutlin drainage, most notably near Sidney Creek. At the time of writing this report a controversial proposal to increase timber harvest in the Teslin area has been put forward. The Nisutlin River is a popular canoe route and receives a significant amount of hunting pressure both by TTC members and others. The Nisutlin River can be easily accessed from three locations along the South Canol Road, otherwise access into the study area is restricted to aircraft and boat. The Nisutlin River Delta has been designated a National Wildlife Area due to its importance as a waterfowl staging area during spring and fall migrations. Portions of the Nisutlin River drainage, centered around Wolf Lake, constitute a proposed area of interest for a National Park feasibility study.

The study area lies primarily within the Southern Lakes Ecoregion of south-central Yukon. This ecoregion is characterized by a cold continental climate modified slightly by marine influences from the Gulf of Alaska; however the coastal moderation is often realized more at higher elevations than on valley floors. The ecoregion is located in the scattered discontinuous permafrost region with permafrost commonly occurring on north aspects in fine textured lacustrine soils (Oswald and Brown, 1978).

Boreal forest predominates at lower elevations and alpine tundra at higher elevations. Willow, alder and in some areas dwarf birch, are common along creek banks. White and black spruce, balsam poplar, lodgepole pine, aspen, and sub-alpine fir comprise the dominant tree species in the area.

The Department of Fisheries and Oceans (DFO) conducts annual aerial surveys to count spawning salmon in two portions of the Nisutlin basin. One survey covers the Nisutlin River from Hundred Mile Creek to Sidney Creek. The other survey covers the Wolf River from the outlet of Wolf Lake to Fish Creek

Species of fish recorded in the study area include the following: lake (humpback) whitefish (*Coregonus clupeaformis*), broad whitefish (*C. nasus*), least cisco (*C. sardinella*), round whitefish (*Prosopium cylindraceum*), inconnu (*Stenodus leucichthys*), Arctic grayling (*Thymallus arcticus*), lake trout (*Salvelinus namaycush*), chinook salmon (*Oncorhynchus tshawytscha*), chum salmon (*O. keta*), longnose sucker (*Catostomus catostomus*), northern pike (*Esox lucius*), burbot (*Lota lota*), slimy sculpin (*Cottus cognatus*), lake chub (*Couesis plumbeus*), and Arctic lamprey (*Lampreta japonica)*.

3.0 STUDY METHODS

3.1 Field investigations

Physical investigations were undertaken during three field sessions, from July 15 - 17, July 22 - 31 and August 10 - 11, 1998. The July 22 - 31 field session consisted of two separate field crews each comprised of three people. One crew worked from access points along the South Canol Road while the other flew into Moss Lake and accessed tributaries from a zodiac boat traveling down the Nisutlin River. Aerial surveys of all the primary tributaries, and portions of the Nisutlin River within the study area, were conducted from a fixed wing aircraft on August 23, 1998.

Physical investigations were conducted on a total of 19 sub drainages entering the Nisutlin River and 7 tributary creeks entering Teslin Lake. Larger tributaries of the Nisutlin River were given a more detailed investigation where feasible, including assessments of their major tributaries. To this end, 6 sites were investigated in the Sidney Creek drainage (including Evelyn and Murphy Creeks), and 13 sites investigated in the Rose River drainage (including 7 tributaries to the Rose). Visual surveys, conducted from the ground, were made of all watercourses with the aid of polarized glasses.

Field investigations consisted of the following five components: 1) water quality and quantity assessments, 2) benthic invertebrate sampling, 3) habitat assessments, 4) fisheries assessments and 5) aerial surveys.

3.2 Hydrological Assessments

Basic hydrological information when available, was obtained for each of the streams surveyed to assess the seasonal variation and water quality parameters. Air photographs and topographic maps were interpreted to identify basin and stream characteristics such as drainage area, stream gradient variation and median elevation. During the fisheries assessments, one reach near the outlet of each stream was selected for a detailed survey. This survey consisted of accurate instantaneous discharge measurements and observations of channel geometry. Field measurements were used as a check against predicted average flows for the time period derived from regional estimation, as well as to verify the working observation that the 1998 summer season experienced extremely low flows. The D.I.A.N.D. Design Flood Estimating Guidelines and the paper " Regionalization of Low Flows in Yukon Territory" were used to give a gross estimate of the Mean Annual Flood (MAF) and 7 day low flow discharge for surveyed reaches. These estimates of average high and low water events combined with instantaneous discharge measurements, were intended to provide a basic snapshot of seasonal flow variation in the surveyed tributaries.

3.3 Water Quality

During July 1998, water samples were collected in clean new plastic bottles and analyzed for physical parameters, nutrients, anions and metals by Philip Analytical Services in Burnaby, BC. Collection and analyses were based on methods outlined in "Standard Methods for the Examination of Water and Wastewater, 19th Edition, published by the American Public Health Association. In-situ measurements of conductivity, pH, temperature and dissolved oxygen were determined using a Multiline F/set-3 multimeter or with Orion instruments.

3.4 Water Quantity

The hydrological record for the basins and sub basins covered in this study is very incomplete, with only partial records available for some streams. A partial record exists for the Nisutlin River above the Wolf River, discontinued in 1995. Four streams; Deadman Creek, Murphy Creek, Rose River, and Sidney Creek were monitored for a few years, all discontinued in 1980. Streamflow variation and extreme events, both flooding and drought, have direct effects on the quantity and quality of habitat available to chinook salmon. Since a detailed hydrological analysis was beyond the scope of this study, the mean annual flood, extreme low flow, and instantaneous flow measurements were noted for each tributary. These three discharges can be used as the basis for a rough snapshot of streamflow variation.

Where a record existed, reference to the streamflow variation during the period of record has been made.

The field work consisted of velocity and stream geometry measurements, instantaneous flow calculations, and miscellaneous observations. In most cases velocity was measured using Price type velocity meters, or was estimated by the floating object method. Flow calculations were by standard velocity - area method or by float - area method. Float -area estimates were corrected for drag using 0.8 as a coefficient. Both measuring techniques were applied on Cottonwood Creek and provided very similar discharge readings.

Field winter low flow assessments of fish habitat were removed from the study budget, and as a result, little can be said about the actual potential for overwintering habitat for chinook fry. Overwintering habitat potentials were estimated based on field investigations in July and on drainage basin size.

3.5 Benthic Invertebrate Sampling

Two methods were used to collect benthic invertebrates. Most of the collections were made with a Surber sampler (area = 0.02929 m^2) which had a 300 micron mesh. Benthic collection involved taking a composite of three samples. Each of the three samples were collected in different riffle areas at the site. The captured invertebrates and detritus were placed in one litre nalgene bottles, preserved with 10% formalin, and shipped to an entomologist for sorting, identification and enumeration.

Analysis of the benthic invertebrate samples was conducted by Charles J. Low, PhD, an invertebrate biologist in Victoria, BC. All samples were washed through two screens with mesh sizes 1 millimetre and 180 microns. All of the organisms retained by the coarse screen were counted and identified. The organisms on the 180 micron screen were sub-sampled using a Folsom plankton splitter. The majority of the benthos were identified to the genus level.

Six of the benthic invertebrate collections were made using a kick net sampler. This consisted of 30 cm wide D shaped net with a mesh size of 363 microns, attached to a four foot pole. The substrate was disturbed by kicking. The dislodged invertebrates and detritus were collected in the D net held directly downstream. A reach of ten metres was sampled in this fashion for a duration of three minutes. The captured organisms and detritus were transferred to a one litre nalgene bottle and preserved with 10% formalin. Invertebrates were washed through a series of screens, mesh sizes 4.7mm and 0.297mm. All invertebrates retained on each screen were identified to family level and enumerated by Bonnie Burns of Laberge Environmental Services.

3.6 Fish Habitat Assessments

Homogenous sections of stream were delineated on a reach basis. Individual sites within each reach were investigated and used to characterize the reach. Each site was given a site code and a general description form was completed. In some cases, more than one site exists within a given reach. Due to the scope of the study, only the lowest reach of some tributaries were investigated. Larger tributaries were given a more detailed investigation where access permitted.

Each site was assessed and described in terms of physical parameters and aquatic habitat including: average depth, average width, substrate, flow characteristics (pool, riffle, glide), available instream and overhead cover, channel and bank characteristics, and surrounding forest type. Temperatures were recorded using a digital thermometer or Multiline multimeter. Water velocities were estimated using the velocity-area method or the floating object method. A Magellan 2000 GPS was used at each site to determine UTM coordinates. Habitat mapping of the main tributaries was completed on a reach by reach basis and photographic documentation made. Surrounding vegetation was documented for portions of the Sidney and Rose drainages to provide an ecological context.

3.7 Fish Utilization Assessments

Several non destructive methods were used to capture fish. Capture effort was aimed at chinook salmon fry and other fish species captured were incidental. Each sample/capture method has biases and therefore a variety of methods were used, when feasible, to ensure accurate assessments of fish present. The limitations of each capture method are discussed later in this section. Assessments for the presence of chinook fry were conducted through the use of minnow traps, seine nets, electro-fishing and visual observations.

Minnow traps (Gee type, ¼" mesh) were the primary technique used to determine the presence of chinook salmon fry. Traps were baited with salmon roe (Yukon River origin) suspended in the trap in a perforated plastic bag and left overnight. Traps were placed in a variety of habitat types and were set following DFO's protocol for the baiting of G-type minnow traps. The range in size and species of fish that a Gee trap will capture are limited, but they have been shown to be highly effective for Yukon River chinook salmon fry (Hunka and Shuler, 1988, and Moody 1993). Effort extended for minnow trapping was expressed as number of fish caught per hour. Effort was made to have traps set for as close to a 24 hour period as possible, however time set ranged from 0.5 hours to 28 hours.

Electro-fishing was conducted using a Smith-Root type 12A POW battery powered backpack type electro-fisher, using a single pass technique. The operator of the electrofisher was accompanied by a person to net and record fish. Electrofishing was particularly effective in capturing smaller fish and in areas where fish could be corralled or cornered. Effort extended by electrofishing was expressed in seconds of shocking time.

Seine nets were pulled at suitable sites using a 7 m x 1.5m, 1/8 inch oval weave mesh pole seine. Seining was restricted to depths of 1.5 metres or less and to sites with a suitable seine landing area. Effort extended by seining was expressed in square meters of area seined. Seine netting and electro-fishing were used in areas where it was not feasible to return to a site to collect minnow traps.

Fish captured were handled delicately to allow for live release after sampling. Anesthetics were not used. All fish captured or observed were identified and recorded. A sub-sample of captured fish were sampled for fork length (+/- 1mm) and round weight (+/- 0.1 g). Weights were taken using a digital scale accurate to ± 0.1 gram.

3.8 Aerial Surveys.

An aerial survey within the Nisutlin River Drainage was conducted on August 23, 1998. The survey was performed from a single engine fixed wing aircraft equipped with wide windows designed for conducting aerial surveys. The objective of the aerial survey was to denote aggregations of spawning salmon, potential barriers to fish migration, and to clarify delineation of surrounding habitats. Reaches of the Nisutlin River below Rose River were not intensively investigated as this reach is surveyed by the DFO by helicopter. Tributaries to the Nisutlin River that were surveyed are as follows: McNeil River (from Moss Lake to its junction with the Nisutlin River), upper Nisutlin River and Nisutlin Lake, McConnell River, Rose River, Thirty Mile Creek, Hundred Mile Creek, Sidney Creek and Wolf River. The Wolf River was also assessed for suitable weir sites.

3.9 Data Analysis

Fisheries Data

Length frequency histograms based on a 5mm length interval were made for chinook salmon fry for all tributaries where a sample size of 20 or more chinook fry was available. A combined length frequency histogram for all chinook fry captured during July was made. Based on analysis of the combined length frequency histogram, length classes were broken out into representative age classes (0+ corresponding to fish that emerged in spring of 1998 and 1+ to fish older than 1 year). Biological data including mean length, mean weight, and mean condition factor was calculated for the respective age classes for each tributary where chinook fry were captured.

Relative condition factor (K) was calculated for salmon fry using the formula:

$K = W^* 10^5 / L^3$.

where W = round weight in grams

L = fork length in millimeters

The extent of chinook salmon utilization of each reach has been simplified to subjectively quantify descriptions in order to compare water courses. These descriptions consist of the following categories: absent, uncommon, common, abundant and prolific. Absent indicates no chinook fry were recorded, uncommon indicates chinook fry were present but not commonly caught or observed, common indicates significant numbers of fry were observed and recorded with all capture techniques, abundant indicates chinook fry were readily observed and easily caught with at least one of the following criteria being met; minnow trap CPUE's > 0.20 fry per hour, and/or electro-fishing CPUE > 0.50 fry per second of shocking time and/or seine CPUE > 1 chinook per square meter, prolific describes sites where average minnow trap CPUE's exceeded 2.0 fry per hour. A more precise record of utilization may be obtained from the catch records in the Results section of this report.

Weight at length and logarithmic comparisons were calculated for salmon fry captured on each of the primary tributaries.

Water Quality

The water quality data was examined and compared to the Canadian Council of Resources and Environment Ministers guidelines for the protection of freshwater aquatic life.

Water Quantity

The Mean Annual Flood (MAF) estimations were derived using the D.I.A.N.D. *Flood Estimating Guidelines* and the regional equations presented therein. Average low flow was estimated using an equation described in *Regionalization of Low Flows in Yukon Territory* J.R. Janowicz, D.I.A.N.D., 1990. Comments on stream flow variation were based on comparisons to gauged streams reported in *Yukon Water Resources Hydrometric Program Historical Summary 1975 – 1994*, D.I.A.N.D., 1995.

It is important to note that the high and low water estimates provided in this report are gross estimates at best, and actual stream flow variation and basin yield will vary significantly from stream to stream. In particular, the low flow estimate should be viewed with caution because little is known about this important stage and how it relates to the available habitat for over-wintering juvenile chinook salmon. The method used for estimating low flow was developed some years ago using various low flow parameters and air temperature. The component for investigating low flow was cut from the budget of this study, and severely limits the reliability of low flow estimates provided herein.

Benthic Invertebrates

The number of benthic organisms per sample were summed to give a total abundance for each sample. 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 for each sample. The community was divided into major taxonomic groups, usually orders, and the percentage of each was determined. Any group that formed 25% or more of the community was classified as dominant.

4.0 RESULTS

The UTM coordinates for sites investigated are presented in Appendix 1. Detailed descriptions of each tributary investigated have been presented in Appendix 2. The tributary descriptions detail the results of all investigations including; hydrology, water quality, benthic invertebrates and fisheries assessments

4.1 Hydrology

The most significant observation of the hydrology component of this study was the extremely low discharge in many of the tributaries. In some cases the measured discharge approached or was lower than the estimated 7 day low flow extreme. For example, Flat Creek, Sterlin Creek, and Seagull Creek all had measured discharges lower than or near the estimated 7 day low flow. These drought conditions likely had direct effects on the biological, chemical and physical characteristics of the watercourses. Such effects might include different water temperatures and chemistry, and differences in food and habitat availability which may have been reflected in the distribution and well being of juvenile salmon during the 1998 season.

Only Sidney Creek and the Rose River have any gauge records of stream flow. The flow measurement made on the Wolf River during this study appears to be the first one on record. Patterns observed in the two gauged streams indicate the sub basins likely experience peak flows between the last week of May and second week of June. Summer flows in all of the larger basins are expected to recede gently from the spring flood with the exception of occasional storm events.

The Nisutlin River main stem, gauged above the Wolf River from 1979 to1975, had a mean annual discharge of 90.9 m^3/sec and a maximum mean daily flow of 131 m^3/sec. Peak flows occurred between May 10 and June 19. The highest instantaneous flow during the period of record occurred on June 19, 1992. Mean discharge for the salmon migration season was 175, 87.9, 84.8, and 84.6 m^3/sec in June, July, August, and September respectively. The minimum daily low flow occurred on April 15, 1982 with an estimated discharge of only 9.75 m^3/sec. Extreme low flow occurred between February 13 and March 25 during the period of record. A summary of physical characteristics of watercourses investigated during this study is presented in Table 1.

The small drainages in this study will experience peak flows resulting from lower elevation snow melt slightly earlier than the larger basins. The degree to which habitat will be affected by water supply in these creeks is largely determined by the amount of wetland and lake storage in the watershed as well as the capacity of the drainage for underground water storage. It was noted that many of the small creeks had significant habitat alterations caused by flooding. Floods breached beaver dams and reconfigured channels in many cases.

All of the flow measurements taken reflect the fact that 1998 was an extremely dry year. Total annual precipitation in the study area was far less than the normal amount of 340 mm. It appeared as though the smaller drainages were most affected by the drought, with flow reduced to trickle in some cases.

4.2 Water Quality

Sixteen water samples were collected in July 1998 for water chemistry with the analysis of a wide suite of parameters. These sixteen samples were taken from the major reaches distributed throughout the study area. The results of water quality samples collected during this study are presented in Tables 2 and Appendix 3. Insitu water quality results are presented in Table 3.

Of the 34 metals analyzed, seventeen were below the method detection limit in each of the samples (aluminum, antimony, beryllium, boron, cadmium, lead, mercury, molybdenum, nickel, phosphorus, selenium, tellurium, thallium, tin, titanium, vanadium, zirconium) (Appendix 3).

The waters of the study area were near neutral to slightly alkaline. Overall, the surface water quality had very low concentrations of metals and nutrients, and all the applicable parameters met the guidelines for the protection of aquatic life (CCREM 1987).

4.3 Benthic Invertebrates

A total of nineteen sites were sampled for benthic invertebrates; thirteen sites using a Surber Sampler and six sites using a kick net. As the kick net method does not lend itself to quantifiable measurements, densities could not be calculated for all sites, and direct comparisons between the analysis of the two methods could not be employed. All benthos data have been summarized in Table 4 and the percent composition of different taxonomic groups is presented in Appendix 4.

All of the benthic communities were relatively similar with natural fluctuations in abundance and diversity. All of the benthic communities were dominated by the insect orders Diptera (true flies) and or Ephemeroptera (mayflies). Two sites had dominant groups; Cottonwood Creek at the South Canol Road and Evelyn Creek, where Trichoptera (caddisflies) and Plecoptera (stoneflies) respectively, shared dominance.

Young chinook in fresh water feed on insects, chironomid (a family of Diptera) larvae, pupae and adults, caddisflies, mites and others (Scott and Crossman, 1973). High proportions of these organisms in samples taken indicates a majority of the waters sampled during this study have potential food resources to support chinook fry.

4.4 Fish Utilization Assessments

During the course of this study, a total of 205 minnow traps were set, 42 seines were pulled and 3 electro-fishing runs conducted. A detailed break-down of where this effort was exerted and the Catch per Unit of Effort is presented in tables 5, 6 and 7 respectively. In total 3,189 chinook salmon fry were captured and of these a sub-sample of 1,128 were measured for either length or length and weight.

The combined length frequency histogram for all chinook fry captured ranged from 40 to 125 mm and shows 2 distinct length classes with no representation in the 90-100mm length classes (Figure 5). Based on previous studies (Moody 1993) and comparisons of weight at length, it was assumed the 40-90mm grouping corresponds to fry that emerged in 1998. The 100-125mm length class may represent 1+ year fish (fry that emerged in 1997) or they may be residuals, that is precocious males that never migrate to sea. The 1+ year fish were found in the Rose, Sidney and Thirty Mile drainages, implying that successful over-wintering by juvenile chinook likely occurs in these creeks. Length frequency histograms for other creeks in the study area are presented in figures 6 -21.

Catch per unit of effort (CPUE) results for minnow trapping, electro-fishing and seine netting are presented in Tables 5, 6 and 7 respectively. Sidney Creek had the highest CPUE for chinook fry. Reach #3 on Sidney Creek had the highest CPUE of any reach sampled, at an average of 31.8 chinook fry captured per hour. The number of chinook fry captured per hour (all traps combined) are as follows: 3.81 in Evelyn Creek, 2.89 in Sidney Creek, and 1.24 in Murphy Creek. Other drainages that showed a high catch per unit of effort include the following: Ten Mile Creek with a combined CPUE of 1.33 chinook fry per hour, Rose River with a combined CPUE of 1.32 chinook fry per hour, Deadman Creek with a combined CPUE of 1.03 chinook fry per hour, Thirty Creek with a combined CPUE of 0.83 chinook fry per hour, Unnamed Tributary #3 with a combined CPUE of 0.67 chinook fry per hour and the Nisutlin River with a combined CPUE of 0.61 chinook fry per hour. The following watercourses had a CPUE between 0.6 and 0.5 chinook fry per hour: Canol Creek, Hundred Mile Creek, Sterlin Creek, Grayling Creek and Fox Creek. Seine netting results show high CPUE's in the following creeks: Unnamed Tributary #9, Flat Creek and the Wolf River. Electro-fishing was conducted at Seagull Creek, Cottonwood Creek and Pony Creek.

In general, relatively high numbers of salmon fry were captured in the Nisutlin drainage. The minnow trap CPUE's from upper Sidney Creek are among the highest ever recorded in the Yukon River (A. von Finster, Per Com). The very low water levels prevalent during the study likely resulted in a reduction of available habitat and so concentrated fry in the remaining habitats (photo 1). This reduction of habitat was particularly evident in smaller tributaries. This combined with a relatively high escapement in the 1997 run, might account for the large numbers of fry captured during the study. Nevertheless, this study indicates the Nisutlin drainage is undoubtedly a very significant salmon resource in the upper Yukon drainage.

Chinook salmon fry were found to be abundant in several of the tributaries to Teslin Lake including Deadman Creek, Grayling Creek, Fox Creek, and Flat Creek. It was unclear, and of interest to speculate, where the fry in these tributaries were spawned, with the most logical location being the upper reaches of the Teslin River where large numbers of spawners were observed during August of 1997.

Large numbers of what appeared to be chinook fry were observed in Teslin Lake near the outlet of Grayling Creek. These fish were only visually identified and were not captured.

Mean weights/lengths and condition factor (K) were calculated for both age classes in each of the tributaries sampled (Table 8). Condition factor (K) is a measure of the "plumpness" of the fish with a higher K value indicating a more plump fish. A higher condition factor implies a healthier fish with an increased ability to over-winter. Because fish are mobile between and within watercourses, care should be exercised when using condition factor as a measure of relative productivity of a site. The mean length for 0+ age fish ranged from a high of 69.94 mm in McNeil River to a low of 56.43 mm in Unnamed Tributary # 8. The length for 1+ age fish ranged from a high of 124 mm in Thirty Mile Creek to a low of 105 mm in Sidney Creek. The mean weight for 0+ age fish ranged from a high of 3.83g in the McNeil River to a low of 1.96 g in Ten Mile Creek. The weight for 1+ age fish ranged from a high of 21.1 g in Thirty Mile Creek to a low of 14.5 g in Sidney Creek. The mean K for 0+ age fish ranged from a high of 1.26 in Rose River to a low of 0.84 in Unnamed Tributary #10. A summary of biological data for chinook salmon fry is presented in Table 8. Weight at length relationships for chinook fry captured during the study is presented in Table 9.

The following watercourses in the study area have been denoted as supporting spawning chinook salmon by DFO: The Nisutlin River, Wolf River, Sidney Creek, Evelyn Creek, McNeil River and Rose River. While confirmed reports of spawning salmon were not found, the following watercourses were documented during this study as having the potential to support spawning salmon: Thirty Mile Creek, Hundred Mile Creek, Murphy Creek, Deadman Creek and the McConnell River. Spawning salmon were observed during this study on Sidney Creek, Wolf River and throughout the Nisutlin River below the outlet of the McConnell River.

4.5 Fish Habitat Assessments

The results of this study shows the Nisutlin drainage to have extensive rearing habitats for chinook fry. Within the Nisutlin drainage the following watercourses were determined to be the most important for rearing chinook: the Sidney Creek drainage (including Murphy and Evelyn creeks) and the Rose River drainage. Chinook rearing habitat was also abundant in the following drainages: Thirty Mile Creek, Wolf River, and Hundred Mile Creek. Other tributaries that showed relatively high catch per effort for chinook fry but were considered less significant due to their smaller size, include the following: Deadman Creek, Grayling Creek, Flat Creek, Unnamed Tributary #3, Unnamed Tributary #9 and Ten Mile Creek. The McConnell, and McNeil drainages while showing

relatively low catch per unit of efforts, are likely still significant for rearing salmon fry due to their large drainage size.

Surrounding vegetation documented for portions of the Sidney and Rose drainages to provide an ecological context, is presented in Appendix 5.

Active or historic beaver dams were observed on almost all the watercourses investigated, including the main tributaries and the Nisutlin itself. Smaller creeks can easily be spanned by a single beaver dam, thus closing off and altering upstream habitats. The larger tributaries to the Nisutlin River provide excellent chinook habitats partly because they are of a size beavers find difficult to span with a single dam. Sidney Creek, the Rose, McConnell, McNeil and Nisutlin Rivers (upper reaches) all fit this general description. These waters also have good velocities and aeration, provide some spawning habitats and likely provide good overwintering habitat because of their size.

4.6 Aerial Survey

An aerial survey covering the Nisutlin River Drainage was conducted on August 23, 1998. Light overcast skies and relatively clear water provided good visibility. Vision was enhanced with the aid of polarized sunglasses. Because of the nature of the survey, exact counts of the numbers of salmon in each drainage were not attempted. Observations of chinook and obvious redds were recorded on a 1:250,000 map sheet.

Chinook salmon adults were observed in several reaches of the Nisutlin River upstream of Rose River. The most notable was an aggregation of more than 30 chinook, upstream of the Rose River. Chinook were common from that point upstream to the outlet of the McConnell River and then became sporadic. A single carcass was seen at the outlet of Nisutlin Lake.

No chinook were observed in the McNeil, McConnell or Rose Rivers. None of these rivers had obstructions from beavers or other, and possess suitable spawning and rearing habitats. The Nisutlin River below Rose River was not surveyed during the aerial survey as spawning areas in this reach have been well documented during previous studies conducted by the DFO.

Two adult chinook were observed on Sidney Creek approximately 2 km downstream of the outlet of Iron Creek. Several adult chinook were observed on the Wolf River.

Beaver dams creating barriers to fish passage were observed on Hundred Mile Creek 5 km upstream of the Nisutlin River and upper Seagull Creek below the lakes. Non barrier beaver dams were observed on the McNeil River, Rose River and Sidney Creek.

5.0 DISCUSSION

5.1 Habitat Management

Most of the study area remains in a virtually pristine state, with developments limited to the Alaska Highway and South Canol Road crossings, limited mineral exploration and timber harvesting. Most of the creeks support intact ecosystems with healthy fish populations. Future encroachment upon fish habitats through development such as timber harvest, mining, agriculture, and residential development seems inevitable.

Adequate land and watershed management policies should be considered an important component of any fisheries management or enhancement strategy. Ensuring wise land use decisions for future developments may well be the most important fisheries management strategy in the study area. An overall land management strategy that takes an ecosystem/watershed approach is recommended. The authors hope that this report will contribute to a pro-active land management approach in the study area.

Recent proposals to significantly increase the annual allowable harvest of timber in the Teslin area point to the need to ensure that such developments do not compromise the fisheries resources of the area. The fisheries /salmon resource would benefit from enlightened forest management practices that would protect critical habitats such as spawning areas, rearing watersheds and riparian zones. Critical habitats could be protected through YTG protected areas strategy and/or under a TTC management plan. Drainages that are susceptible include Sidney Creek and the Rose River due to access and ongoing developments. In the Sidney Creek drainage, logging and mining has occurred in the recent past or is ongoing. The Rose River drainage contains the South Canol Road and historic mining development. Watercourses crossed by the Alaska Highway (Deadman, Ten Mile, Lone Tree, Fox, and Brook's Brook) are also susceptible to current and future developments.

Several culverts at creek crossings along the South Canol Road represented an obstruction to fish passage at the water levels encountered. Mean water velocities tend to be much greater in a culvert than in the natural stream channel. A velocity barrier occurs when the water velocities in the culvert exceed the swimming abilities of the fish. Water depths tend to be decreased through a culvert and this may also be a barrier to fish passage (Fisheries and Oceans, 1990). The drop distance between the outlet of the culverts and the surface of the creek, and the related high water velocities, restricted upstream movement of fish particularly during low water. Some of theses creeks provided rearing habitats for chinook salmon, particularly Murphy Creek where high concentrations of salmon fry were captured downstream of the culverts and very few upstream.

At Murphy Creek the two main culverts had drops at their outlets of 0.3 and 0.4 meters (photo 2). The drops and the associated water velocities were determined to be an obstruction to fish passage, particularly for smaller fish. This assessment was supported by the results of minnow trapping that found high concentrations of salmon fry downstream of the culverts and very few upstream of them. Because some fry were

captured upstream of this culvert it appears the culvert does allow some fish passage, likely restricted to periods of higher water levels.

The culverts at Cottonwood Creek were a barrier to fish passage at the water levels encountered (photo 3). Electro-fishing conducted on Cottonwood Creek found chinook fry downstream of the culverts with none found above it. Upstream fish migrations were limited by beaver dams above and below the road crossing.

The culvert at Tributary to Rose River #1 (RT1) had a drop on the downstream end that was an obvious barrier to fish passage. No fish were captured in this creek, and it is unclear if this creek constituted fish bearing waters.

Deer Creek had a 0.35 meter drop on downstream side of culvert. No fish were captured in this creek, and it is unclear if this creek constituted fish bearing waters.

The culvert at Tributary to Rose River #2 (RT2) had a drop on the downstream end that was an obvious barrier to fish passage. No fish were captured in this creek, and it is unclear if this creek constituted fish bearing waters.

The culvert at Dodge Creek had a drop on the downstream end that was an obvious barrier to fish passage. No fish were captured in this creek, and it is unclear if this portion of the creek constituted fish bearing waters.

The culverts on Pony Creek were a barrier to fish passage. Arctic grayling and burbot were captured in this creek downstream of the culverts.

Murphy Creek and Cottonwood Creek are the recommended priorities for addressing the culvert barriers on the South Canol Road due to the confirmed presence of chinook fry in these creeks. Although the culverts on Pony Creek are located above the present range of salmon, fish passage has been negatively affected. Culverts on Deer Creek, Tributary to Rose River #2 (RT2), and Dodge Creek are potential barriers to fish passage, however since no fish were recorded in these creeks they were given a lower priority. Future road work to upgrade fords on the Seagull Creek access road should consider impacts to fisheries.

Determining and implementing cost effective methods of alleviating the impediments to fish passage presented by the culverts is recommended. Possible solutions include replacing culverts, installing tail-water control structures and/or baffles in the culverts. Baffles are low weirs attached to the bottom of the culvert, and installed where water velocities are too great or depths are too shallow to permit passage of fish. Tail-water control structures (outlet pool) are constructed where an impassable drop exists at the outlet of the culvert. An outlet pool with a control weir will back-flood the culvert to provide an adequate depth of water for fish passage. The outlet pool also provides a resting area for fish (Fisheries and Oceans, 1990). A more detailed discussion on fish migration requirements and general design criteria for culverts is presented in Fish Habitat

Enhancement - A Manual for Freshwater, Estuarine and Marine Habitats, Fisheries and Oceans Canada 1990.

Beaver activity in the study area, while evident, was not as prevalent as in a previous study of the Teslin area (Connor et al, 1997). Some dams were acting to restrict fry movement as in Unnamed Tributary #3, Flat Creek, Deadman Creek and Cottonwood Creek.

The inter-relationships between salmon and beaver is both complex and dynamic and beaver can have both positive and negative effects on salmon. A comprehensive discussion of this subject is beyond the scope of this report. A more complete discussion is available from the Department of Fisheries and Oceans *Guidelines for the Management of Beaver in Fish Bearing Streams in the Yukon & NBC Division.*

Because beaver activity can have positive effects on salmon, any beaver control or dam removal should be assessed on a site basis with specific objectives outlined. It is important to assess the long-term likelihood of success for any beaver management plan. Beaver control should be accompanied with a monitoring program and should follow the guidelines laid out in DFO's *Guidelines for the Management of Beaver in Fish Bearing Streams in the Yukon & NBC Division*. The beaver dams on Cottonwood Creek and Deadman Creek are accessible and removing them would likely increase available rearing habitat for chinook fry, however the cost effectiveness of such a plan is questionable.

5.2 Population Management

An enumeration fence within the Nisutlin River drainage would be useful in determining a more precise estimate of adult salmon numbers utilizing this drainage. An enumeration fence in the Nisutlin drainage would provide educational and employment opportunities as well as important biological information to assist in fisheries management.

During the course of this study potential sites for a fence were assessed. The lower Wolf River near its outlet to the Nisutlin River was considered a preferable site for an enumeration weir (photo 4). This site has good access by boat from the Nisutlin River during open water, and a trail provides winter access for moving materials to the site.

Since 1970, the DFO has conducted aerial salmon counts of the upper Wolf River from the outlet of Fish Creek to the outlet of Wolf Lake. Establishing an enumeration fence near the outlet of the Wolf River would compliment existing information by providing a precise count of salmon utilizing the system and thereby provide an index by which to evaluate past aerial surveys. An enumeration fence would provide precise information regarding run timing as well as age, sex and length composition of the salmon population. The TTC has expressed interest in undertaking such a project. A fence would provide training and employment opportunities in fisheries management for the Teslin Tlingit people. Prior to the installation of such a fence, background work to determine the type of weir and the gathering of hydrological information would be undertaken. An enumeration fence on the Wolf River would contribute to the collection of base line data

associated with the proposed establishment of a National Park in the Wolf River Drainage area.

Deadman Creek has good potential as a community /educational enhancement project. The easy access from the Alaska Highway and significant numbers of chinook fry utilization make this a good candidate as a site for education of school kids in fish habitat assessment and enhancement techniques. Such a program might involve an annual minnow trapping program that could be used to evaluate and index salmon fry population trends over time. Other projects might include removing obstructions, building instream cover, habitat assessments and ecological studies.

Dropping water levels over the summer resulted in the stranding of chinook fry in side channels of the Wolf River. Many of these side channels eventually dried up with the fish presumably perishing. The cost efficiency of rescuing stranded chinook from side channels on the Wolf River is questionable. This stranding of fry occurs in many areas on other tributaries and on the Nisutlin mainstem. The extent to which this happens is likely a function of water levels.

Chinook fry stocking and other related methods of fry enhancement should be approached cautiously. Protocols to protect local genetic stocks and community acceptance of techniques to be used require further development. The protocols for direct manipulation (enhancement) of fry and rearing of eggs to the fry stage have not been succinctly developed in the Yukon. Development of such procedures in the Teslin drainage requires consultation with both the peoples of Teslin and the scientific community including the Yukon Salmon Committee and the Teslin Renewable Resource Council.

Several species of fish and avian predators prey on chinook fry and eggs. Belted kingfishers (*Ceryle alcyon*), Arctic terns (*Sterna paradisaea*) and mergansers (*Mergus* spp.) as well as several species of gull (*Larus* spp.) were observed feeding on small fish, presumably including chinook fry, throughout much of the study area. Northern pike, burbot and lake trout feed on chinook fry. Arctic grayling and slimy sculpin feed on chinook eggs. The majority of these species exist outside the parameters of management. However, northern pike, common near the Nisutlin delta, are voracious predators on fry, and a pike only fishing derby was suggested as a method to reduce pike predation.

6.0 RECOMMENDATIONS

The following is a summary of the major recommendations resulting from this study. A more detailed discussion of the rationale behind these recommendation is presented in the Discussion section of this report.

Recommendations are as follows:

- Land management practices that protect the fisheries resource with a pro-active approach is recommended. Critical habitats including: spawning sites, important rearing areas and riparian zones should be protected.

- Installation of a fish weir on the lower Wolf River to compliment existing information by providing a precise count of salmon utilizing the system and thereby provide an index by which to evaluate past aerial surveys.

- Culverts along the South Canol Road that are currently limiting fish movements should be addressed. Priorities include Murphy Creek and Cottonwood Creek due to confirmed chinook fry utilization of these creeks.

Acknowledgments

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Photo 1. Sidney Creek (site SDN1) note exposed gravel bars due to low water conditions.

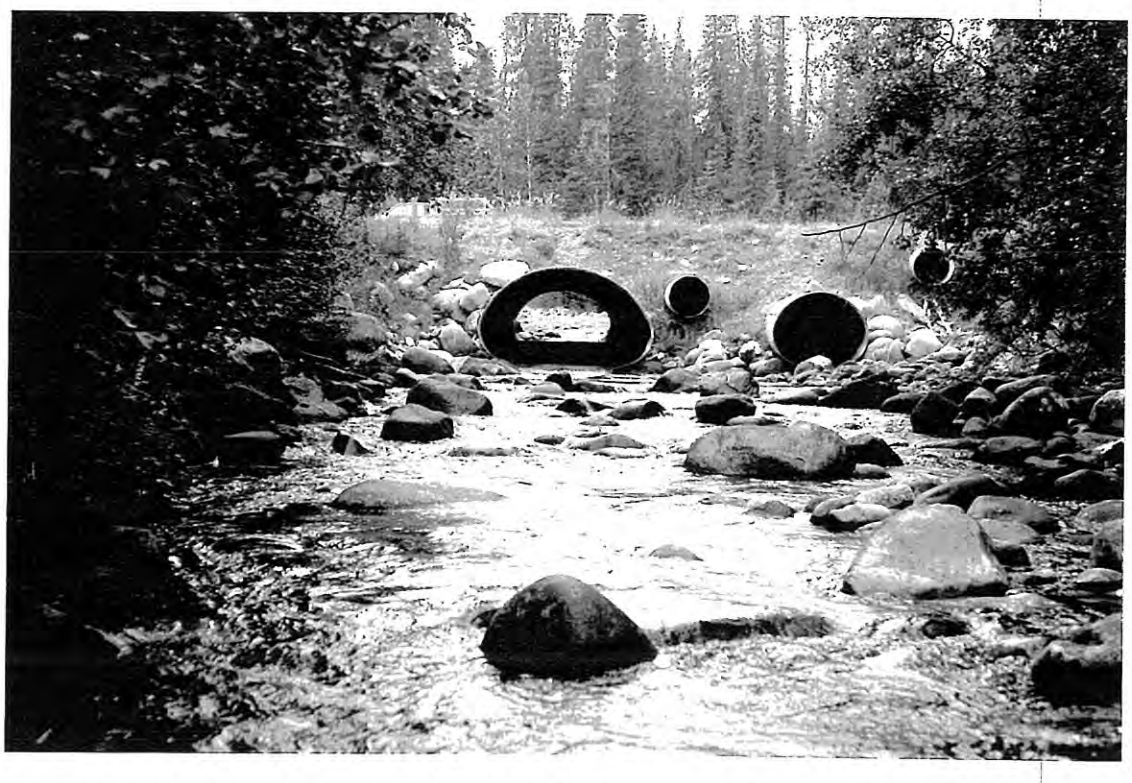

Photo 2. View looking upstream to culverts on Murphy Creek (site MPH). The culverts restricted fish passage at the water levels encountered during the study.

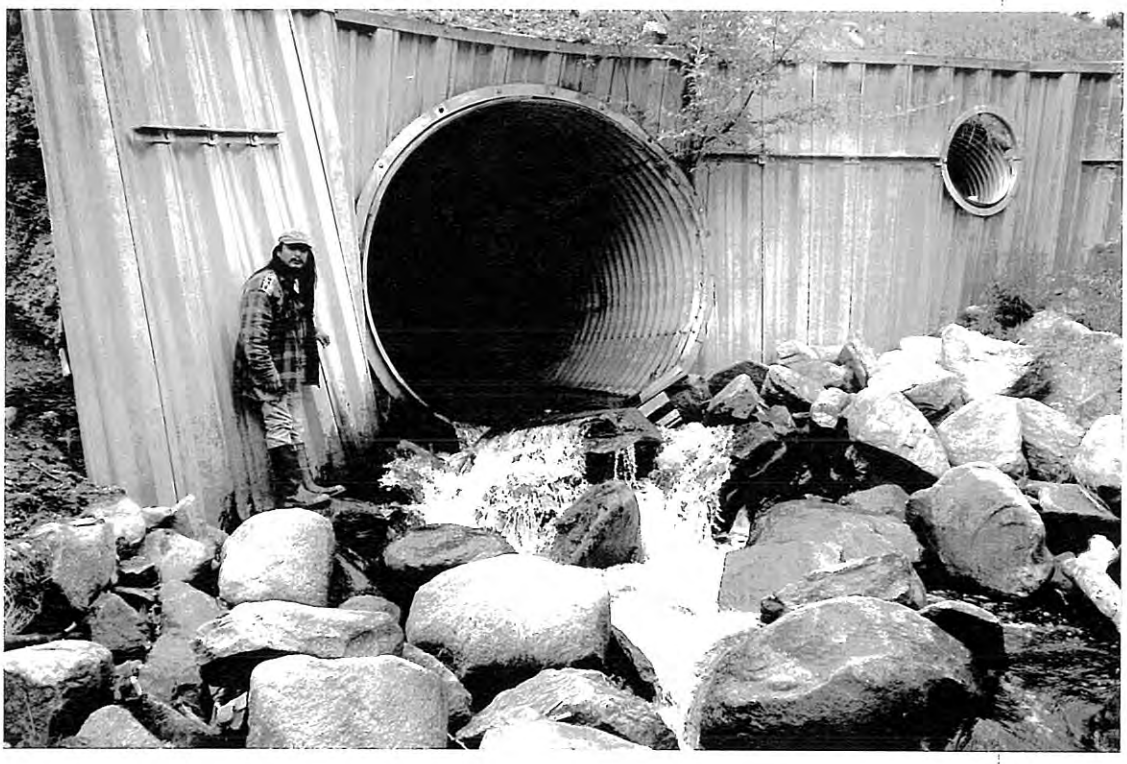

Photo 3. Outlet of culvert on Cottonwood Creek at the South Canol Road (site CTW). The culvert restricted fish passage at the water levels encountered during the study.

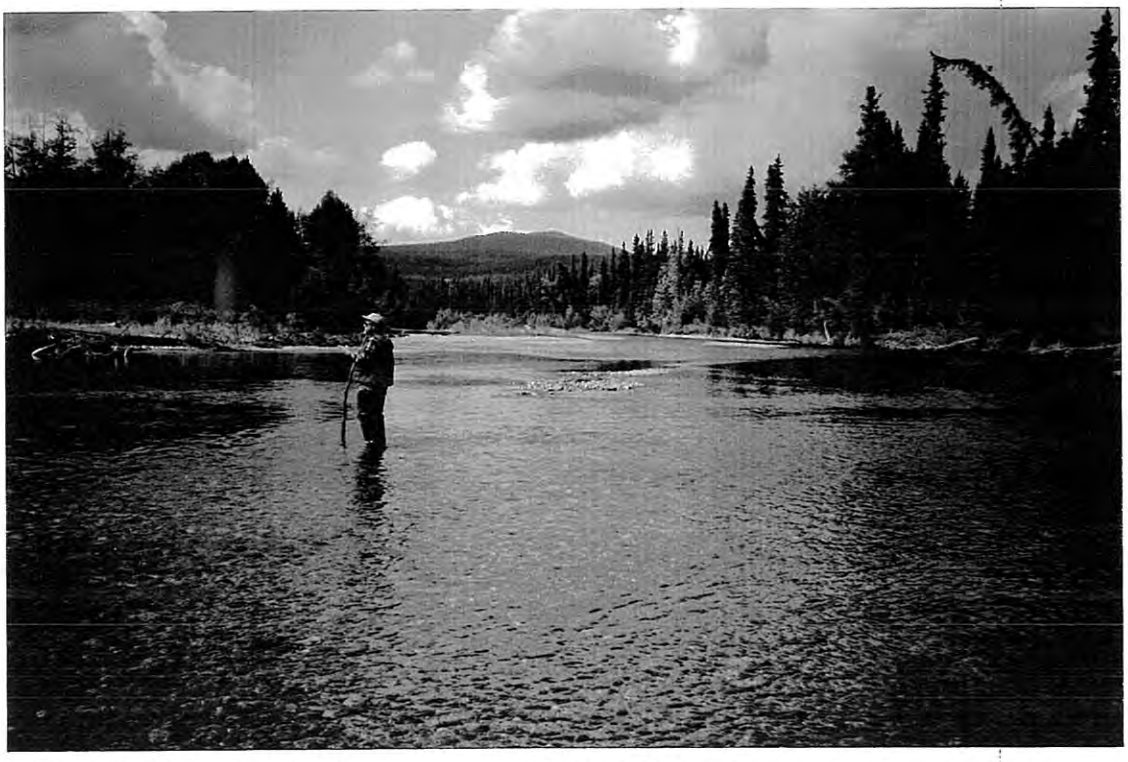

Photo 4. View looking downstream on the Wolf River from approximately 0.6 km upstream of the Nisutlin River (site WLF).

Table 1 . Summary of the physical characteristics for watercourses in the Teslin drainage, summer 1998.

Site	Site Code	Date (d/m/yr)	Site Description	Basin Area (km^2)	Discharge (m^3/sec)	Mean Annual Flood (m^3/sec)	Mean 7-Day Low Flow (m^3/sec)	Avg. Depth (m)	Avg. wetted Width (m)	Avg. Velocity (m/sec)
McNeil River reach 1	MCN1	22/07/98	at outlet of Moss Lake	n/a	n/a	n/a	n/a	>1	40	< 0.1
McNeil River reach 2	MCN2	22/07/98	below Moss Lake	n/a	n/a	n/a	n/a	1.0	25	> 1
McNeil River reach 3	MCN3	23/07/98	u/s confluence @ Nisutlin River	n/a	17.92 [f]	n/a	n/a	0.65	28	< 2
Unnamed Tributary to McNeil River	UMc1	22/07/98	outlet to McNeil River	n/a	n/a	n/a	n/a	0.3	7	< 1
Nisutlin River	NS1	23/07/98	u/s of confluence @ McNeil River	n/a	6.08 [f]	n/a	n/a		21	> 1
Nisutlin River	NS2	23/07/98	u/s of confluence @ McConnell R	n/a	n/a	n/a	n/a	0.7	25	>1
Nisutlin River	NS	25/07/98	u/s of Unnamed Tributary #3	n/a	n/a	n/a	n/a	1	50	0.7
McConnell River	MCC	24/07/98	@ outlet to Nisutlin River	1,052	7.68 [f]	68	1.1	0.45	30	1.0
Seagull Creek	SGC	27/07/98	d/s of Seagull Lake	446	0.49 [f]	30	0.44	0.35	3	0.5
Unnamed Tributary #1	UN1	24/07/98	@ outlet to Nisutlin River	137	n/a	10	0.12	0.35	4	<1
Unnamed Tributary #2	UN2	24/07/98	@ outlet to Nisutlin River	32	0.63 [f]	2.6	0.025	0.3	2.3	0.6
Wolf Creek	WC	24/07/98	@ outlet to Nisutlin River	95	2.38 [f]	7.1	0.08	0.6	4	1.25
Unnamed Tributary #3	UN3	25/07/98	@ outlet to Nisutlin River	38	0.012 [f]	3.0	0.03	0.25	3	0.4

NOTES: [m] = measured with price meter, velocity area method. [f] = velocity measured with float, Discharge by velocity area n/a= not available

Table 1 Continued. Summary of the Physical Characteristics for Watercourses in the Teslin Area, Summer 1998.

Site	Site Code	Date (d/m/yr)	Site Description	Basin Area (km^2)	Discharge (m^3/sec)	Mean Annual Flood (m^3/sec)	Mean 7-Day Low Flow (m^3/sec)	Avg. Depth (m)	Avg. wetted Width (m)	Avg. Velocity (m/sec)
Rose River	RSR1	25/07/98	@ outlet to Nisutlin River	942	n/a	61.4	0.948	0.6	30	0.7
Rose River reach 2	RSR2	27/07/98	bridge @ Canol Rd	n/a	n/a	n/a	n/a	0.6	12	> 1
Rose River reach 2	RSR???	27/07/98	@ outlet of Canol Creek	n/a	n/a	n/a	n/a	0.68	21.4	0.54
Rose River reach 3	RSR???	27/07/98	d/s of Rose Lake	n/a	n/a	n/a	n/a	0.5	6	< 0.3
Pony Creek	PNC	11/08/98	@ Canol Rd crossing	132	n/a	9.7	0.12	0.25	8	0.85
Unnamed Tributary #4	UN4	25/07/98	@ outlet to Nisutlin River	51.5	n/a	4.0	0.04	0.2	2.5	0.15'
Hundred Mile Creek	HM	26/07/98	@ outlet to Nisutlin River	586	2.9 [f]	39.3	0.59	n/a	8	n/a
Cottonwood Creek	CTW	24/07/98	@ Canol Rd crossing	75.6	0.231 [m]	5.7	0.06	0.14	4.5	0.35
Sidney Creek reach 1	SDN1	27/07/98	@ outlet to Nisutlin River	800	3.5 [f]	n/a	0.82	0.3	30	0.5
Sidney Creek reach 2	SDN2	23/07/98	@ Canol Rd crossing	368	1.82 [m]	n/a	n/a	0.28	13.4	0.48
Sidney Creek reach 3	SDN3	24/07/98	u/s Iron Cr.	n/a	0.76	n/a	n/a	0.49	7.4	0.22
Evelyn Creek	EV1	25/07/98	@ Canol Road crossing	175	0.91	12.6	0.16	0.29	10.4	0.285
Evelyn Creek	EV2	28/07/98	9 km u/s of Canol Rd crossing	n/a	n/a	n/a	n/a	0.4	5	>1

NOTES: [m] = measured with price meter, velocity area method. [f] = velocity measured with float, Discharge by velocity area n/a= not available

Table 1 Continued. Summary of the Physical Characteristics for Watercourses in the Teslin Area, Summer 1998.

Site	Site Code	Date (d/m/yr)	Site Description	Basin Area (km^2)	Discharge (m^3/sec)	Mean Annual Flood (m^3/sec)	Mean 7-Day Low Flow (m^3/sec)	Avg. Depth (m)	Avg. wetted Width (m)	Avg. Velocity (m/sec)
Murphy Creek	MPH	28/07/98	@ Canol Rd crossing	110 @ Canol Rd	1.25 [f]	11	0.09	0.3	6	>1
Unnamed Tributary #6	UN6	28/07/98	@ outlet to Nisutlin River	40	< 0.1 [f]	3.2	0.03	0.3	7	0.31
Unnamed Tributary #7	UN7	28/07/98	@ outlet to Nisutlin River	70	0.4 [f]	5.3	0.06	0.25	4.5	0.6
Thirty Mile River	30MI	29/07/98	@ outlet to Nisutlin River	384	1.55 [m]	26.4	0.37	0.4	16	0.66
Unnamed Tributary #8	UN8	28/07/98	@ outlet to Nisutlin River	78	0.32 [f]	5.9	0.06	0.25	2	0.3
Unnamed Tributary #9	UN9	29/07/98	@ outlet to Nisutlin River	106	0.18 [f]	7.9	0.09	0.2	5	0.5
Wolf River	WLFR	30/07/98	@ outlet to Nisutlin River	3,954	14.0 [m]	n/a	n/a	0.6	30	n/a
Unnamed Tributary #10	UN10	31/07/98	@ outlet to Nisutlin River	72	0.10 [f]	5.5	0.06	0.3	4	0.5
Brooks Brook reach 1	BRB1	08/07/98	@ outlet to Teslin Lake	60	0.204 [m]	4.6	0.05	0.15	7	0.45
Brooks Brook reach 2	BRB2	08/07/98	Between outlet and Alaska Hwy	n/a	n/a	n/a	n/a	0.45	3.5	0.51
Deadman Creek reach 1	DM1	08/07/98	Between outlet and Alaska Hwy	150	0.849 [m]	10.9	0.14	0.52	5	0.59

NOTES: [m] = measured with price meter, velocity area method. [f] = velocity measured with float, Discharge by velocity area n/a= not available

Table 1 Continued. Summary of the Physical Characteristics for Watercourses in the Teslin Area, Summer 1998.

Site	Site Code	Date (d/m/yr)	Site Description	Basin Area (km^2)	Discharge (m^3/sec)	Mean Annual Flood (m^3/sec)	Mean 7-Day Low Flow (m^3/sec)	Avg. Depth (m)	Avg. wetted Width (m)	Avg. Velocity (m/sec)
Deadman Creek reach 2	DM2	08/07/98	u/s of Alaska Hwy (240m)	n/a	n/a	n/a	n/a	0.5	n/a	n/a
Deadman Creek reach 3	DM3	08/07/98	u/s of reach 2	n/a	n/a	n/a	n/a	0.65	n/a	n/a
Lone Tree Creek	LNT	09/07/98	d/s of Alaska Hwy	41	n/a	3.2	0.03	0.35	1.8	0.5
Grayling Creek	GRC1	09/07/98	@ outlet to Teslin Lake	83	0.086 [m]	6.3	0.07	0.15	4	0.25
Ten Mile Creek	10MI	09/07/98	Between outlet and Alaska Hwy	33	n/a	2.6	0.025	0.1	3	n/a
Flat Creek reach 1	FT1	09/07/98	Teslin Lk to Sterlin Ck	> 800 (est.)	0.479 [m]	>50	0.82	0.3	8	0.21
Flat Creek reach 2	FT2	09/07/98	Sterlin Ck to Flat Lake	n/a	n/a	n/a	n/a	0.25	7	0.2
Sterlin Creek	STRL	09/07/98	@ flat Ck confluence	81	0.2 [f]	6	0.07	0.2	4	0.35
Fox Creek	FX	09/07/98	vicinity of Alaska Hwy	56	n/a	4.3	0.05	0.2	2	0.2

NOTES: [m] = measured with price meter, velocity area method. [f] = velocity measured with float, Discharge by velocity area n/a= not available

Table 2 Results of water quality analysis for samples collected in the Teslin drainage, summer 1998.

Site	Site Code	Date (d/m/yr)	pH	TSS (mg/L)	Turbidity NTU	Hardness mg/L	Alkalinity mg/L	Ammonia mg/L	Nitrate mg/L
McConnell River	MCC	24/07/98	8.4	< 4	0.3	178	135	< 0.005	< 0.02
Unnamed Tributary #1	UN1	24/07/98	8.1	< 4	0.45	62.2	61.8	0.016	< 0.02
Wolf Creek	WC	24/07/98	7.7	< 4	0.22	30.2	31.7	0.011	< 0.02
Unnamed Tributary #3	UN3	24/07/98	8.3	< 4	1.03	147	143	0.01	< 0.02
Rose River	reach 2	24/07/98	8.1	< 4	0.44	72.1	63.7	0.016	< 0.02
Unnamed Tributary #4	UN4	24/07/98	8.3	< 4	0.88	146	143	0.008	< 0.02
Cottonwood Creek	CTW	24/07/98	8.2	4	3.02	100	100	0.009	< 0.02
Sidney Creek	SDN1	27/07/98	8.0	< 4	0.5	70.4	68.2	0.022	0.03
Thirty Mile Creek	30MI	28/07/98	8.4	< 4	0.35	144	136	0.077	< 0.02
Unnamed Tributary #9	UN9	29/07/98	8.3	< 4	0.16	119	122	< 0.005	< 0.02
Wolf River	WLF	30/07/98	8.2	< 4	0.34	95.5	93.4	< 0.005	< 0.02
Nisutlin River	n/a	31/07/98	8.2	< 4	0.42	122	108	0.005	0.02
Flat Creek	FT1	09/07/98	7.8	< 4	0.62	140	117	0.42	< 0.02
Grayling Creek	GRC1	09/07/98	7.9	< 4	0.17	137	120	< 0.005	< 0.02
Deadman Creek	DM1	08/07/98	7.7	< 4	0.22	53.3	50.1	0.22	< 0.02
Brooks Brook	BRB2	08/07/98	8.0	< 4	0.19	92.6	86.7	0.051	< 0.02

Table 3 . Summary of insitu water quality results for watercourses in the Teslin drainage, summer 1998.

Site	Site Code	Date (d/m/yr)	Water Temp. (°C)	D.O. (mg/L)	D.O. (%)	Conductivity (uS/cm)	pH
McNeil River reach 1	MCN1	22/07/98	15.4				
McNeil River reach 2	MCN2	22/07/98	15.4	7.29	82.9	284	8.48
McNeil River reach 2	MCN3	23/07/98	14.7	6.7	75.5	288	7.87
Unnamed Tributary to McNeil River	UMc1	22/07/98	13.6				
Nisutlin River	NS1	23/07/98	14.9	6.5	72.8	222	8.34
Nisutlin River	NS2	23/07/98	12.6	6.98	73.3	267	8.4
McConnell River	MCC	24/07/98	9.6	7.32	71.5	344	8.37
Seagull Creek	SGC	27/07/98	13.9	9.0	100	349	8.57
Unnamed Tributary #1	UN1	24/07/98	9.9	7.64	75.3	132	8.25
Unnamed Tributary #2	UN2	24/07/98	8.2	7.8	73.5	60	8.06
Wolf Creek	WC	24/07/98	11.2	7.92	73.8	73	7.15
Unnamed Tributary #3	UN3	25/07/98	9.5	6.96	66.7	275	8.02
Nisutlin River		25/07/98	11.9	7.26	73.1	278	8.37
Rose River reach 1	RSR1	25/07/98	11.8	8.11	81.9	150	8.21
Rose River reach 2	RSR2	27/07/98	15.5	9.1	100	135.2	8.16
Rose River reach 2	RSR6	27/07/98	11.5	10.3	105	126.8	8.01
Pony Creek	PNC	11/08/98					
Unnamed Tributary #4	UN4	25/07/98	12.8	7.01	71.3	305	8.25
Hundred Mile Creek	HM	26/07/98	13.2	6.39	66.9	280	8.34
Cottonwood Creek	CTW	24/07/98	11.7	10	103	177.6	8.1
Sidney Creek reach 1	SDN1	27/07/98	17	8	80	150	8.25
Sidney Creek reach 2	SDN2	23/07/98	11.5	10.1	102	150	7.79

Table 3 . Summary of insitu water quality results for watercourses in the Teslin drainage, summer 1998. Continued

Site	Site Code	Date (d/m/yr)	Water Temp. (°C)	D.O. (mg/L)	D.O. (%)	Conductivity (uS/cm)	pH
Sidney Creek reach 3	SDN3	24/07/98	8.8	10.5	101	118.6	7.6
Evelyn Creek	EV2	28/07/98	8.5				
Evelyn Creek	EV1	25/07/98	13.2	9.9	103	92.7	7.81
Murphy Creek	MPH	28/07/98	11.2	10	101	99.5	7.76
Unnamed Tributary #6	UN6	28/07/98	14.3	4.89	51.9	330	7.41
Unnamed Tributary #7	UN7	28/07/98	13.9	7.1	76	83	8.12
Thirty Mile Creek	30MI	29/07/98	12.8	10.0	104	267	8.49
Unnamed Tributary #8	UN8	28/07/98	12.8	9.64	99.2	112	8.03
Unnamed Tributary #9	UN9	29/07/98	11.2	9.2	94.6	238	8.22
Wolf River	WLFR	30/07/98	14.8	9.2	98.8	189	8.33
Unnamed Tributary #10	UN10	31/07/98	9.8	9.87	94.8	209	8.15
Brooks Brook reach 1	BRB1	08/07/98	9.7	11.3	108	160	8.07
Brooks Brook reach 2	BRB2	08/07/98	9.7				
Deadman Creek reach 1	DM1	08/07/98	12.7	10.2	104	93.6	7.6
Lone Tree Creek	LNT	09/07/98	8.3	11.2	103	196	8.08
Grayling Creek	GRC	09/07/98	12.2	10.5	107	230	8.17
Ten Mile Creek	10MI	09/07/98	10.3	10.8	105	235	8.28
Flat Creek reach 1	FT1	09/07/98	13.9	9.9	106	231	8.45
Flat Creek reach 2	FT2	09/07/98	18.4			305	
Sterlin Creek	STRL	09/07/98	10.1			165	
Fox Creek	FX	09/07/98	10.6	10.4	102	283	8.15

Table 4 . Summary of benthic samples collected in the Teslin drainage, summer 1998.

Site	Site Code	Date (d/m/yr)	Sampling Method *	Total Abundance	Taxonomic Richness	Dominant Taxa
Nisutlin River	NS1	23/07/98	SS	1637	51	Ephemeroptera
McNeil River	MCN2	22/07/98	SS	415	45	Diptera
McConnell River	MCC	24/07/98	SS	167	29	Diptera & Ephemeroptera
Unnamed Tributary #1	UN1	24/07/98	SS	507	41	Ephemeroptera & Diptera
Unnamed Tributary #2	UN2	24/07/98	SS	271	36	Diptera
Wolf Creek	WC	24/07/98	SS	1027	50	Ephemeroptera & Diptera
Rose River	reach 2	25/07/98	KN	75	9	Ephemeroptera & Diptera
Unnamed Tributary #4	UN4	24/07/98	SS	1117	64	Diptera
Cottonwood Creek	CTW	24/07/98	KN	142	9	Ephemeroptera, Diptera & Trichoptera
Sidney Creek	SDN3	24/07/98	KN	147	14	Diptera & Ephemeroptera
Sidney Creek	SDN2	24/07/98	KN	30	5	Ephemeroptera & Diptera
Sidney Creek	SDN1	27/07/98	SS	193	37	Diptera & Ephemeroptera
Evelyn Creek	EV1	24/07/98	KN	137	11	Plecoptera, Ephemeroptera & Diptera
Murphy Creek	MPH	28/07/98	KN	221	11	Diptera
Thirty Mile Creek	30MI	28/07/98	SS	329	37	Diptera & Ephemeroptera
Unnamed Tributary #9	UN9	29/07/98	SS	587	36	Diptera
Wolf River	WLFR	30/07/98	SS	323	45	Diptera & Ephemeroptera
Flat Creek	FT1	09/07/98	SS	4151	72	Diptera
Grayling Creek	GRC1	09/07/98	SS	988	32	Diptera

*SS = Surber sampler KN = kick net

Table 5 . Summary of minnow trap results showing effort, total catches and catch per unit of effort for chinook salmon fry (CH) in the Teslin drainage, summer 1998.

Location	Site	# Traps Set	Total Effort (hrs)	# CH Captured	CPUE (# fish/hour)	Other Species Captured *
McNeil River	MCN	15	269.25	18	0.07	SS,LNS
Nisutlin River	NS2	2	29	3	0.10	none
	NS3	6	101.5	79	0.78	none
	NS4	1	22.75	12	0.53	none
total		9	153.25	94	0.61	
McConnell River	MCC	17	252.4	49	0.19	SS
Seagull Creek	SGC	2	2	0	0.00	none
Unnamed Tributary # 3	UN3	5	138.75	93	0.67	SS
Rose River	RSR1	1	0.5	0	0.00	none
	RSR2	12	302.05	387	1.28	none
	RSR3	5	35	90	2.57	none
	RSR4	4	26.45	35	1.32	none
	RSR5	4	24	26	1.08	none
	RSR6	4	20.5	1	0.05	BB
total		30	408.5	539	1.32	
Canol Creek	CC	2	17	9	0.53	none
Coyote Creek	CYC	2	52.2	0	0.00	none
tributary to Rose River	RT1	1	23.17	0	0.00	none
tributary to Rose River	RT2	1	21.25	0	0.00	GR
Deer Creek	DRC	1	22.33	0	0.00	none
Dodge Creek	DDC	1	20.83	0	0.00	none
Pony Creek	PNC	2	36.66	0	0.00	BB
Hundred Mile Creek	HM	6	80.8	48	0.59	SS,LNS
Cottonwood Creek	CTW	9	163.84	0	0.00	SS

s code: SS=slimy sculpin, LNS=longnose sucker, BB=burbot, GR=Arctic grayling, NP= northern pike

Table 5 continued. Summary of minnow trap results showing effort, total catches and catch per unit of effort for chinook salmon (CH) in the Teslin drainage, summer 1998.

Location	Site	# Traps Set	Total Effort (hrs)	# CH Captured	CPUE (# fish/hour)	Other Species Captured *
Sidney Creek	SDN1	9	147	304	2.07	SS
	SDN2	4	83	121	1.46	SS
	SDN3	5	8.5	265	31.18	none
total		18	238.5	690	2.89	
Evelyn Creek	EV	5	91.6	349	3.81	SS
tributary to Evelyn Creek	TEV	2	4.6	0	0.00	none
Murphy Creek	MPH	10	146.31	181	1.24	SS
Thirty Mile Creek	30MI	9	156.6	130	0.83	SS
Wolf River	WLF	9	147.8	5	0.03	NP
Brooks Brook	BRB1	4	124.92	29	0.23	SS
	BRB2	3	90.49	1	0.01	none
	BRB3	2	59.5	0	0.00	none
total		9	274.91	30	0.11	
Deadman Creek	DM1	4	107.42	18	0.17	SS
	DM2	3	80.09	28	0.35	none
	DM3	4	107	257	2.40	none
total		11	294.51	303	1.03	
Flat Creek	FT1	4	96.25	4	0.04	SS,NP
	FT2	7	162.15	0	0.00	NP
total		11	258.4	4	0.02	
Sterlin Creek	STRL	1	23.25	12	0.52	
Grayling Creek	GRC1	5	117.5	85	0.72	SS
	GRC2	2	47	0	0.00	SS
total		7	164.5	85	0.52	
Fox Creek	FX	3	69	38	0.55	SS
Ten Mile Creek	10MI	4	86	114	1.33	none
Lone Tree Creek	LNT	3	67.5	0	0.00	none

Species code: SS=slimy sculpin, LNS=longnose sucker, BB=burbot, GR=Arctic grayling NP=northern pike

Table 6 . Summary of seine netting results showing catch per unit of effort (# chinook/total effort) for chinook salmon captured in the Teslin drainage, July 1998.

Location	Date	# seines	Total Effort (m sq)	# CH captured	CPUE (# CH/ m sq)	other species captured *
McNeil River	22/07/98	7	168	2	0.01	SS
Nisutlin @ McNiel (NS1)	23/07/98	5	134	50	0.37	GR
Unnamed Tributary # 1	22/07/98	9	189	1	0.01	GR
Hundred Mile Creek	25/07/98	6	205	28	0.14	SS
Unnamed Tributary # 8	27/07/98	1	70	23	0.33	SS, RWF
Unnamed Tributary # 9	29/07/98	1	17.5	35	2.00	SS
Thirty Mile Creek	28/07/98	3	133	9	0.07	GR,SS
Wolf River	30/07/98	4	94	69	0.73	GR, SS, RWF
Unnamed Tributary # 10	31/07/98	2	37.5	9	0.24	SS
Flat Creek	09/07/98	3	62	62	1.00	SS,LNS,GR,BWF,NP,US
Flat @ Sterlin	09/07/98	1	40	154	3.85	GR, NP, LNS,SS

Table 7 . Summary of electro-fishing results showing catch per unit of effort (# chinook/total effort) for chinook salmon (CH) captured in the Teslin drainage, July 1998.

Location	Date	# ELS	Total effort (sec)	# CH	CPUE	Other species captured*
Seagull Creek	27/07/98	1	465	0	n/a	GR
Cottonwood Creek	28/07/98	1	350	3	0.009	SS
Pony Creek	11/08/98	1	286	0	n/a	BB,GR

* Species code: SS = slimy sculpin, GR = Arctic grayling, RWF = round whitefish, NP = northern pike, LNS = longnose sucker, BB = burbot, BWF = broad whitefish, US = unidentified salmonid

Table 8 . Summary of biological data for chinook salmon fry captured in the Teslin drainage, July 1998.

Location	Date	age	Length (mm) N	Length (mm) mean	Length (mm) Range	Weight (g) N	Weight (g) mean	Weight (g) Range	Weight (g) SD	mean K
McNeil River	22/07/98	0+	16	69.94	(61 - 84)	14	3.83	(2.1 - 5.6)	1.24	1.08
Nisutlin River (N1-N4)	23-24/07/98	0+	94	62.16	(45 - 75)	74	2.44	(1.4 - 4.0)	0.63	1.02
McConnel River	23/07/98	0+	50	63.8	(52 - 73)	29	2.74	(1.4 - 3.9)	0.66	1.01
Unnamed Tributary # 3	24/07/98	0+	93	61.85	(46 - 78)	56	2.69	(1.2 - 4.7)	0.90	1.02
Rose River (RSR2-RSR6)	25-27/07/98	0+	179	68.97	(49 - 85)	23	3.54	(1.8 - 5.6)	0.96	1.26
	25-27/07/98	1+	3	111.00	(108 - 115)	0	n/a	n/a	n/a	n/a
Coyote Creek	27/07/98	0+	9	67.00	(61 - 75)	0	n/a	n/a	n/a	n/a
Hundred Mile Creek	25/07/98	0+	37	59.22	(45 - 67)	34	2.14	(1.2 - 3.2)	0.45	1.04
Sidney Creek (SDN1-SDN3)	23-27/07/98	0+	101	61.90	(49 - 90)	56	1.84	(1.2 - 3.0)	0.37	0.98
	23-27/07/98	1+	1	105	n/a	1	14.50	n/a	n/a	n/a
Evelyn Creek	25/07/98	0+	27	67.23	(58 - 76)	0	n/a	n/a	n/a	n/a
	25/07/98	1+	1	116	n/a	0	n/a	n/a	n/a	n/a
Murphy Creek	28/07/98	0+	54	65.02	(57 - 79)	11	3.23	(2.3 - 4.6)	0.67	1.17
Unnamed Tributary # 8	27/07/98	0+	23	56.43	(47 - 71)	0	n/a	n/a	n/a	n/a
Thirty Mile Creek	28/07/98	0+	48	60.34	(54 - 69)	47	2.07	(1.2 - 3.5)	0.50	0.94
	28/07/98	1+	1	124	n/a	1	21.10	n/a	n/a	1.11
Unnamed Tributary # 9	29/07/98	0+	31	57.48	(54 - 67)	0	n/a	n/a	n/a	n/a
Wolf River	30-29/07/98	0+	75	67.17	(54 - 83)	45	3.17	(1.5 - 5.9)	1.03	1.03
Unnamed Tributary # 10	31/07/98	0+	8	63.88	(61 - 71)	8	2.28	(1.5 - 4.3)	0.96	0.84
Brocks Brook (BRB1-BRB2)	08/07/98	0+	23	62.96	(52 - 76)	23	2.51	(1.4 - 4.2)	0.70	1.05
Deadman Creek (DM1-DM3)	08/07/98	0+	70	61.94	(51 - 77)	68	2.39	(1.3 - 4.2)	0.57	1.00
Grayling Creek	09/07/98	0+	49	59.63	(49 - 71)	48	2.09	(1.2 - 3.4)	0.42	0.99
Ten Mile Creek	09/07/98	0+	34	57.94	(51 - 69)	33	1.96	(1.4 - 3.1)	0.40	1.00
Flat Creek	09/07/98	0+	56	61.82	(49 - 71)	33	2.77	(1.3 - 4.4)	0.85	1.08
Sterlin Creek	09/07/98	0+	12	60.42	(51 - 68)	11	2.2	(1.7 - 3.0)	0.43	1.02
Fox Creek	09/07/98	0+	23	60.09	(54 - 74)	22	2.16	(1.6 - 3.8)	0.51	0.99

Table 9 . Summary of weight at length relationships for chinook salmon fry captured in the Teslin drainage, July 1998.

Site	Date	N	slope (b)	RSQ	Y intercept (a)
McNeil River	22/07/98	14	3.07	0.86	-5.09
Nisutlin River (NS1-NS4)	23-24/07/98	74	2.64	0.69	-4.36
McConnell River	23/07/98	29	2.68	0.73	-4.42
Unnamed Tributary # 3	24/07/98	56	2.99	0.89	-4.97
Rose River (RSR2-RSR6)	25-27/07/98	23	3.06	0.94	-5.01
Hundred Mile Creek	25/07/98	34	2.12	0.67	-3.43
Sidney Creek (SDN1-SDN3)	27/07/98	57	3.01	0.82	-5.02
Murphy Creek	28/07/98	11	2.72	0.89	-4.42
Thirty Mile Creek	28/07/98	48	3.29	0.88	-5.55
Wolf River	29-30/07/98	45	2.89	0.88	-4.78
Unnamed Tributary # 10	31/07/98	8	3.70	0.73	-6.34
Brooks Brook (BRB1-BRB2)	08/07/98	23	2.63	0.80	-4.35
Deadman Creek (DM1-DM3)	08/07/98	68	2.29	0.76	-3.74
Grayling Creek	09/07/98	48	2.49	0.66	-4.10
Ten Mile Creek	09/07/98	33	2.50	0.84	-4.12
Flat Creek	09-10/07/98	33	3.11	0.89	-5.17
Sterling Creek	09/07/98	11	1.84	0.77	-2.93
Fox Creek	09/07/98	22	2.82	0.93	-4.68

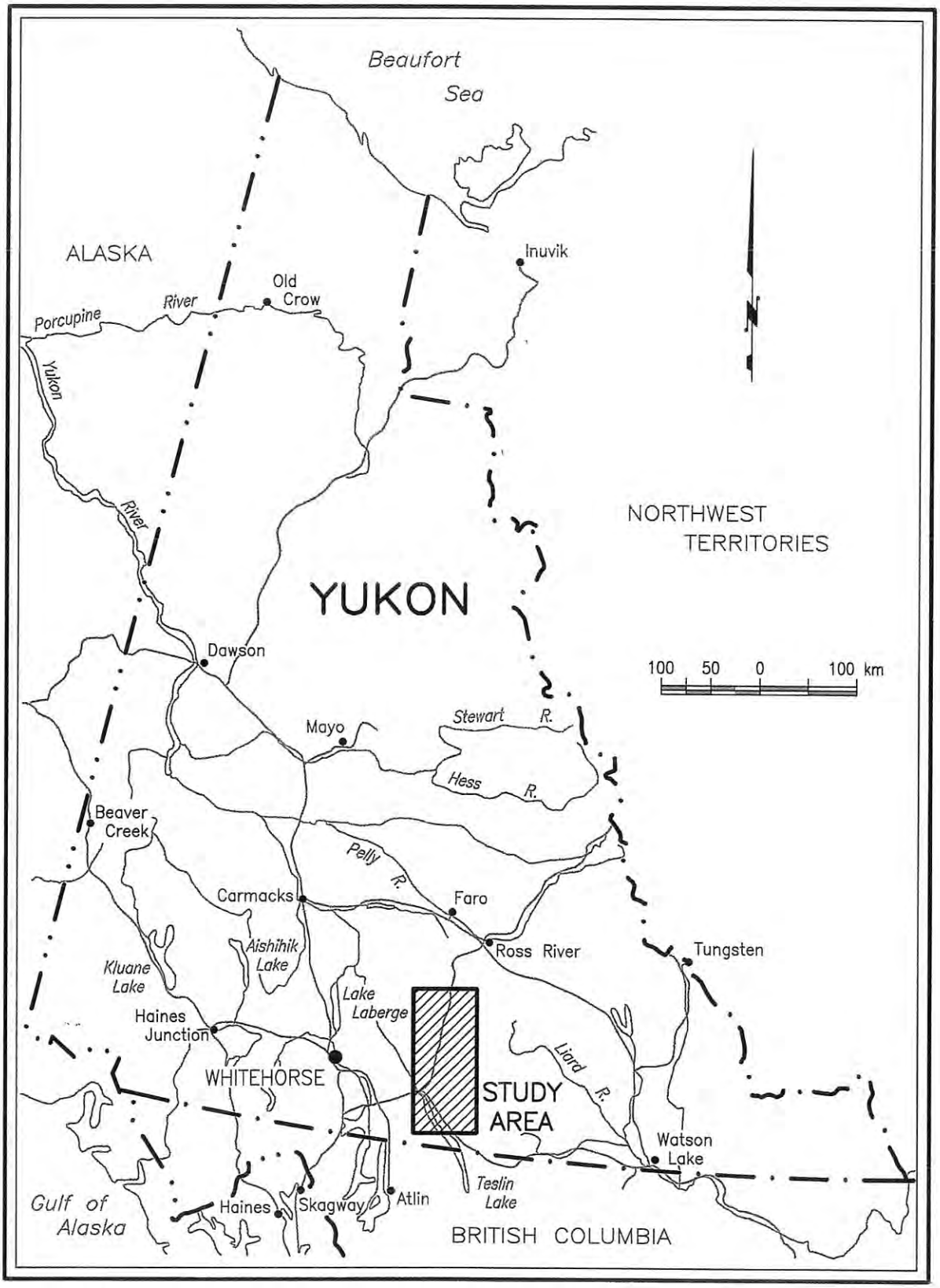

Figure 1 Map of the study area in relation to the Yukon Territory.

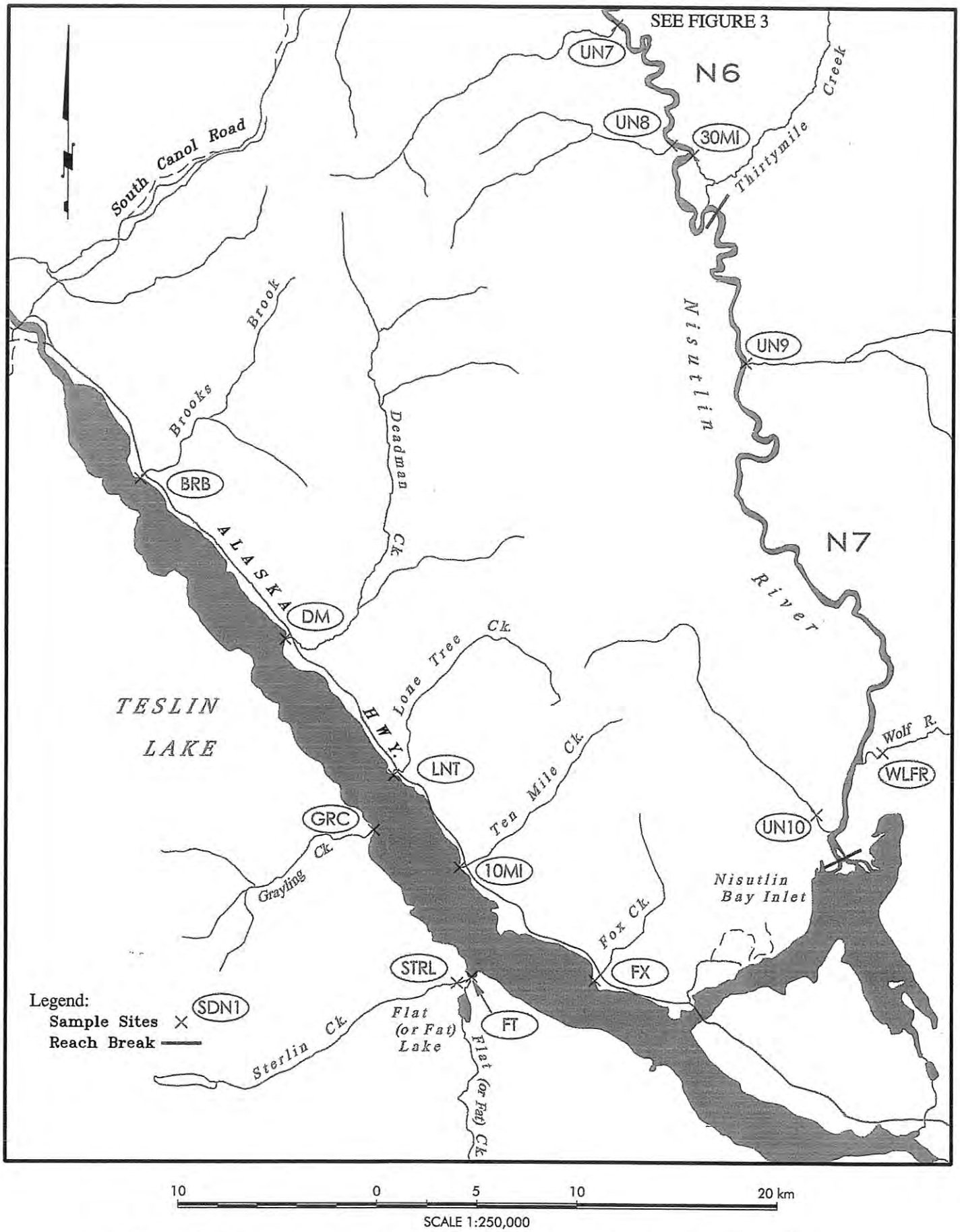

Figure 2. Teslin Lake and lower Nisutlin River showing sample site locations and other pertinent information.

NOTE: Spawning locations listed here include only reaches assessed during aerial survey. See text for details.

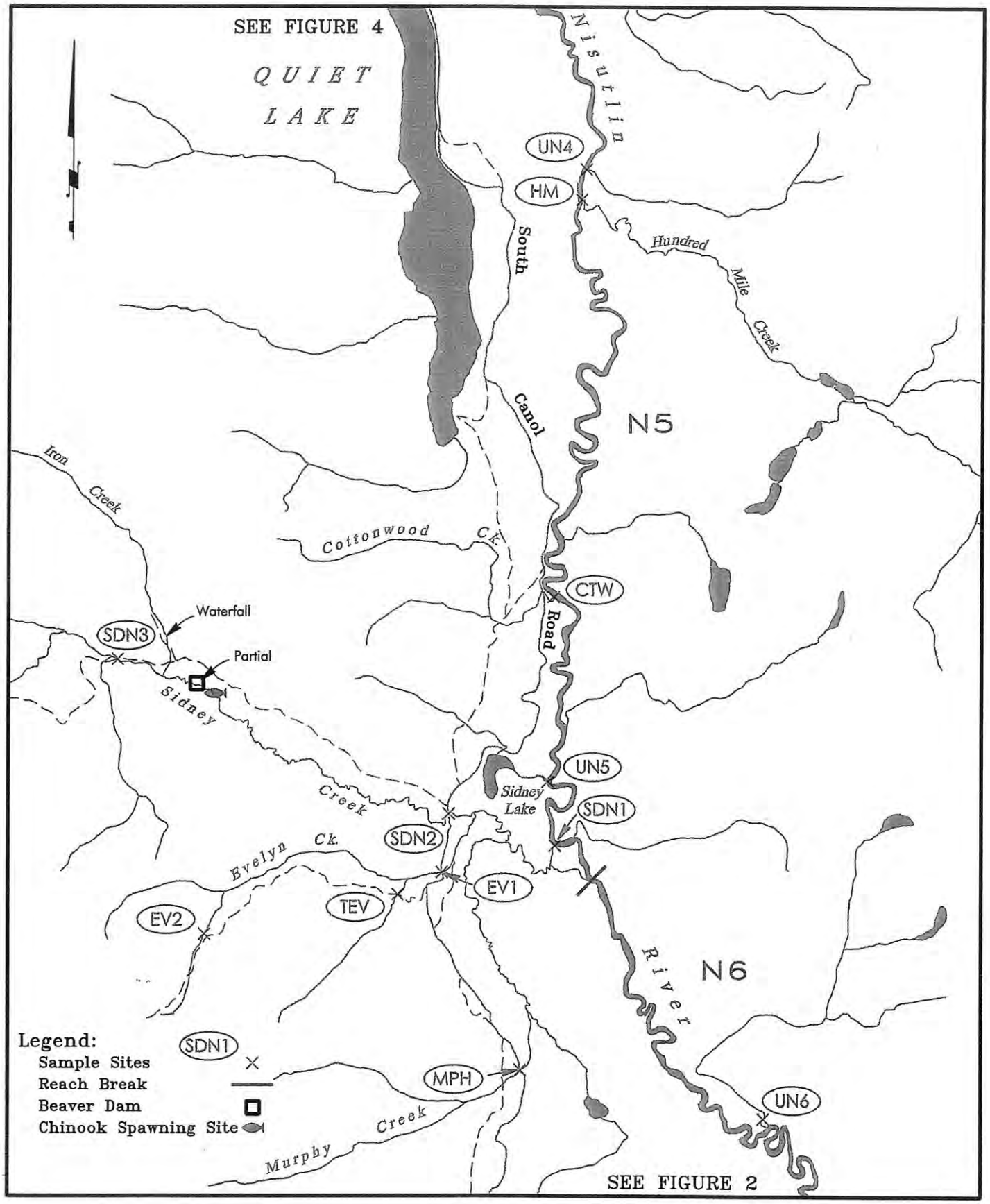

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Figure 3. Mid reaches of the Nisutlin River and Sidney Creek drainage showing sample site locations and other pertinent information.

NOTE: Spawning locations listed here include only reaches assessed during aerial survey. See text for details.

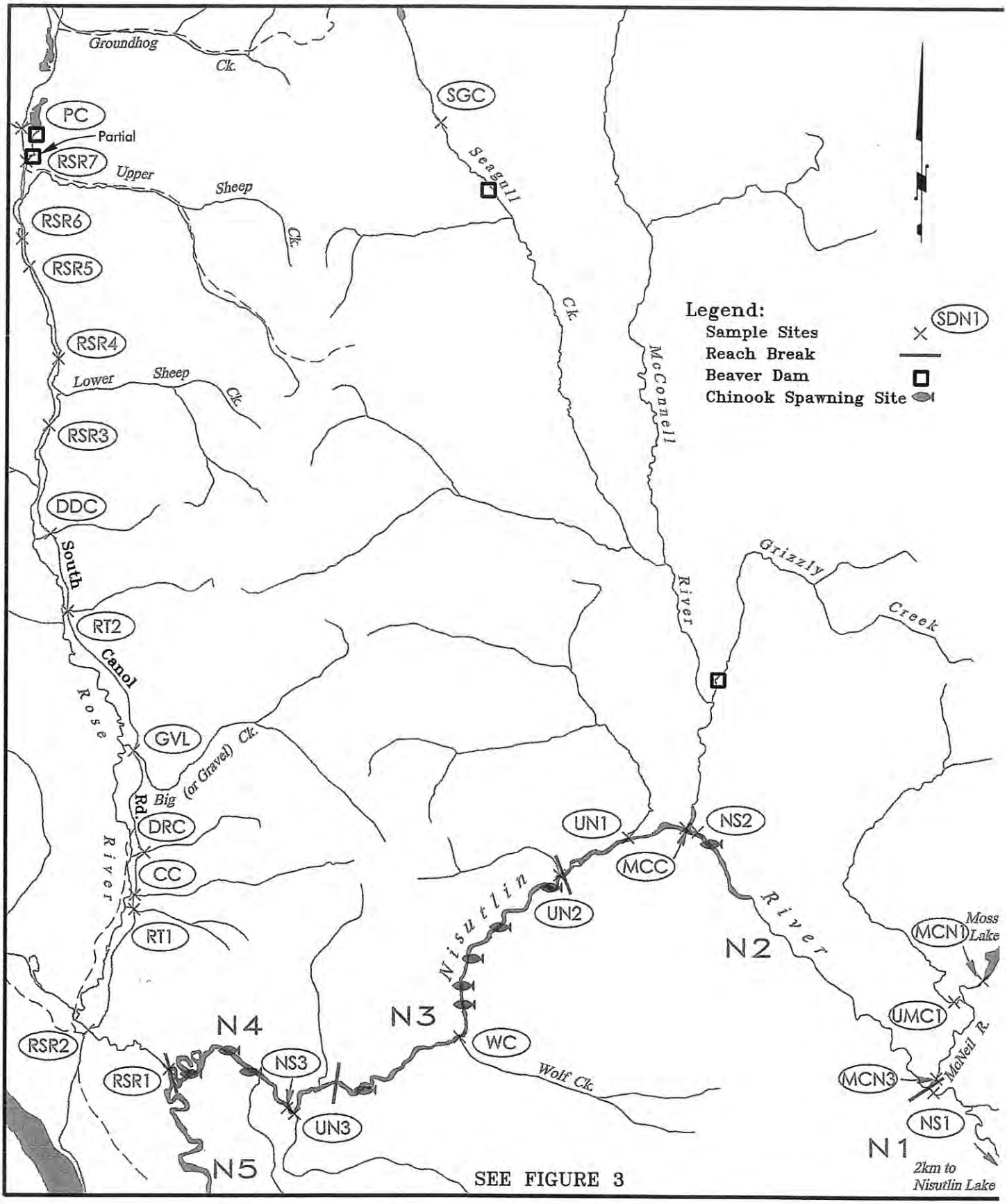

Figure 4. Upper Nisutlin River and tributaries showing sample site locations and other pertinent information.

NOTE: Spawning locations listed here include only reaches assessed during aerial survey. See text for details.

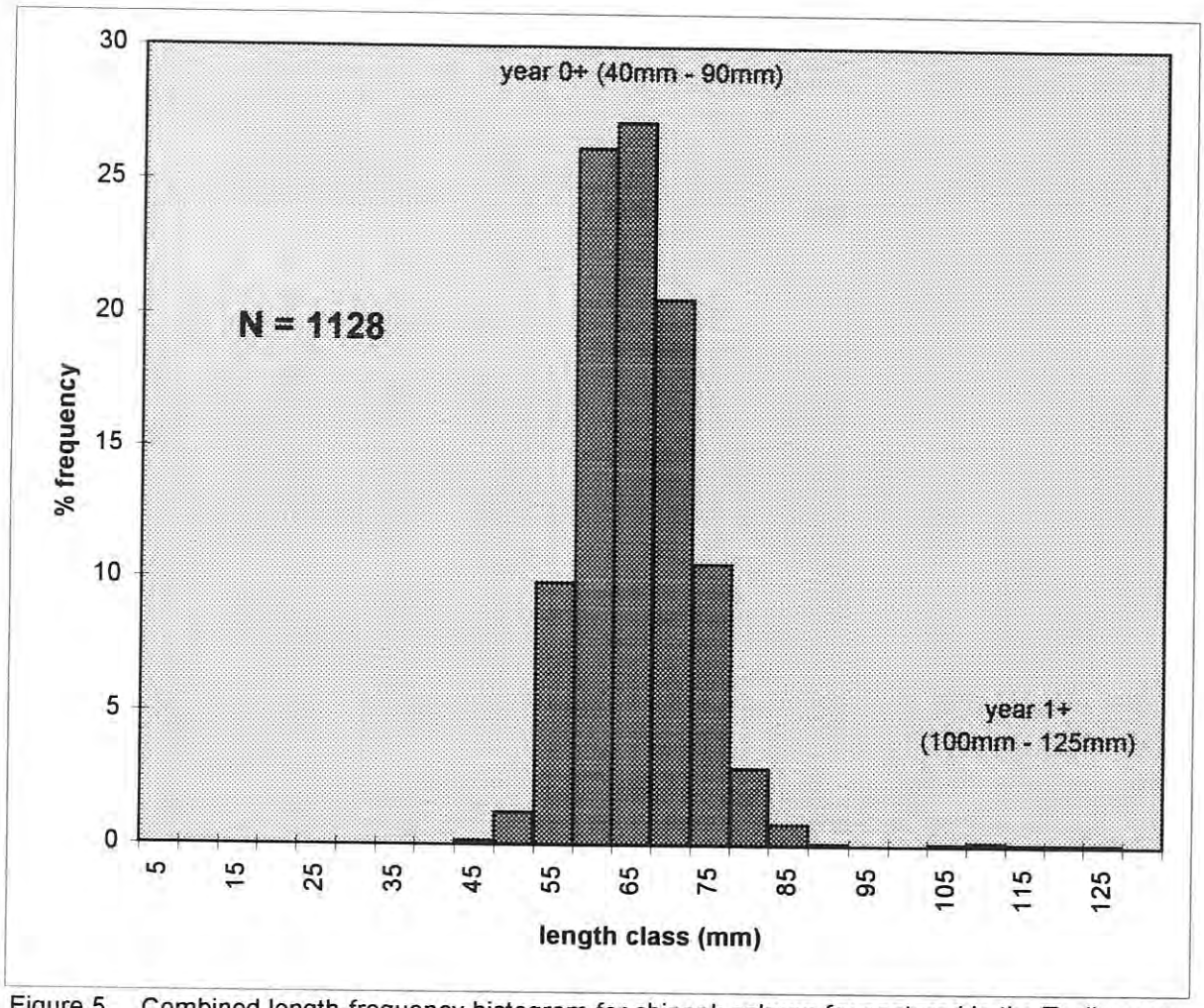

Figure 5. Combined length-frequency histogram for chinook salmon fry captured in the Teslin area, Yukon, July , 1998.

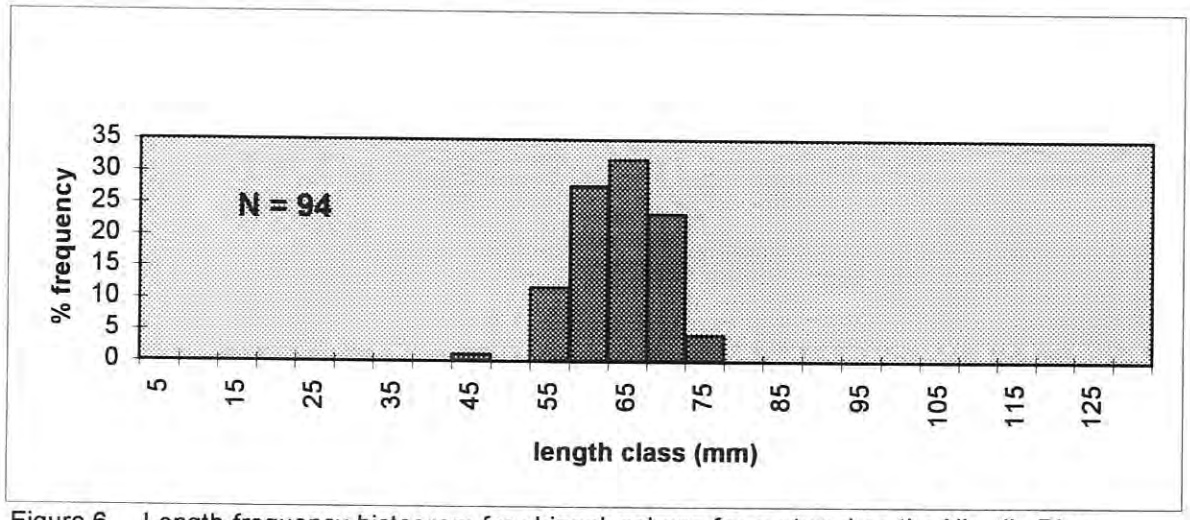

Figure 6. Length-frequency histogram for chinook salmon fry captured on the Nisutlin River, Yukon, July 23-24, 1998.

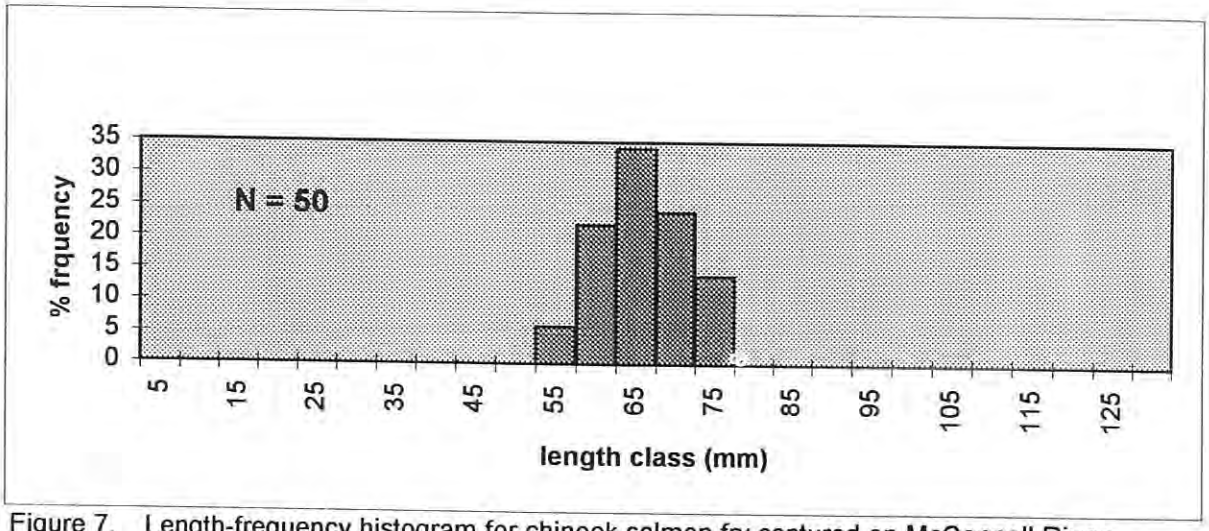

Figure 7. Length-frequency histogram for chinook salmon fry captured on McConnell River, Yukon, July 23, 1998.

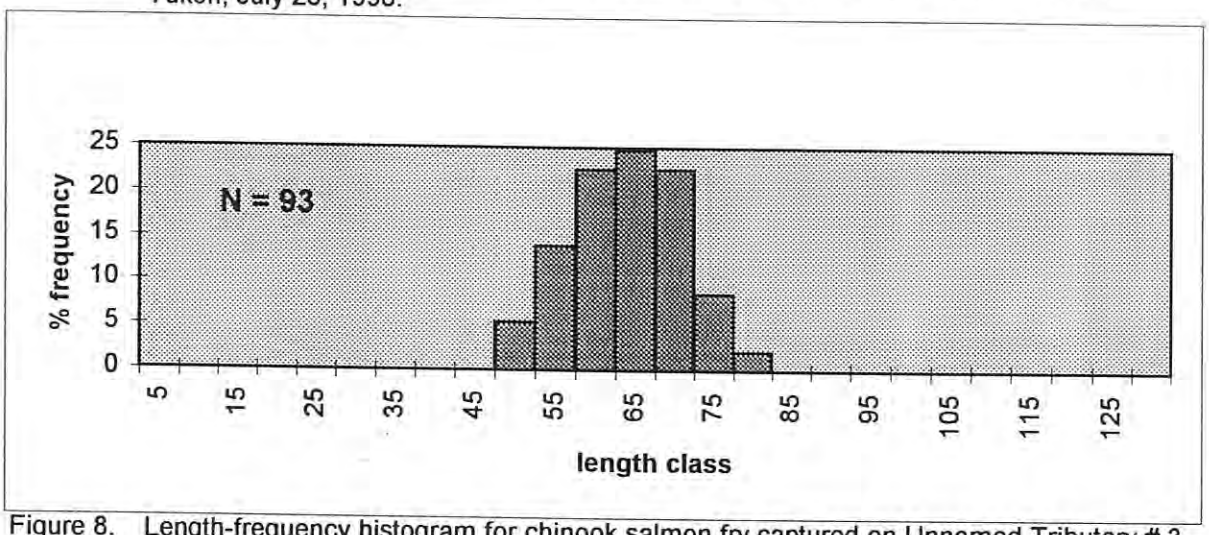

Figure 8. Length-frequency histogram for chinook salmon fry captured on Unnamed Tributary # 3, Yukon, July 24, 1998.

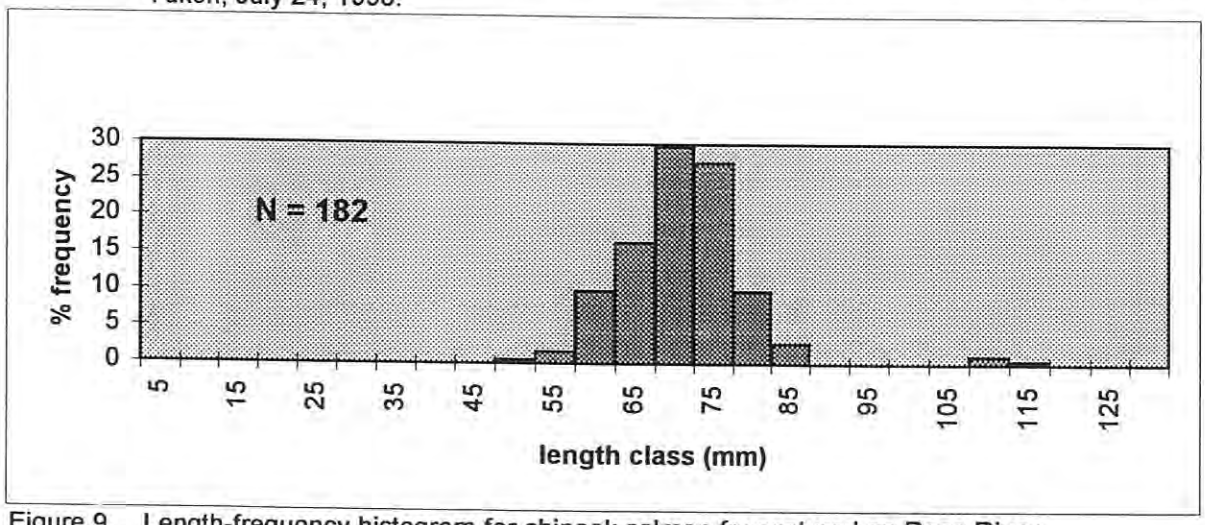

Figure 9. Length-frequency histogram for chinook salmon fry captured on Rose River, Yukon, July 25-27, 1998.

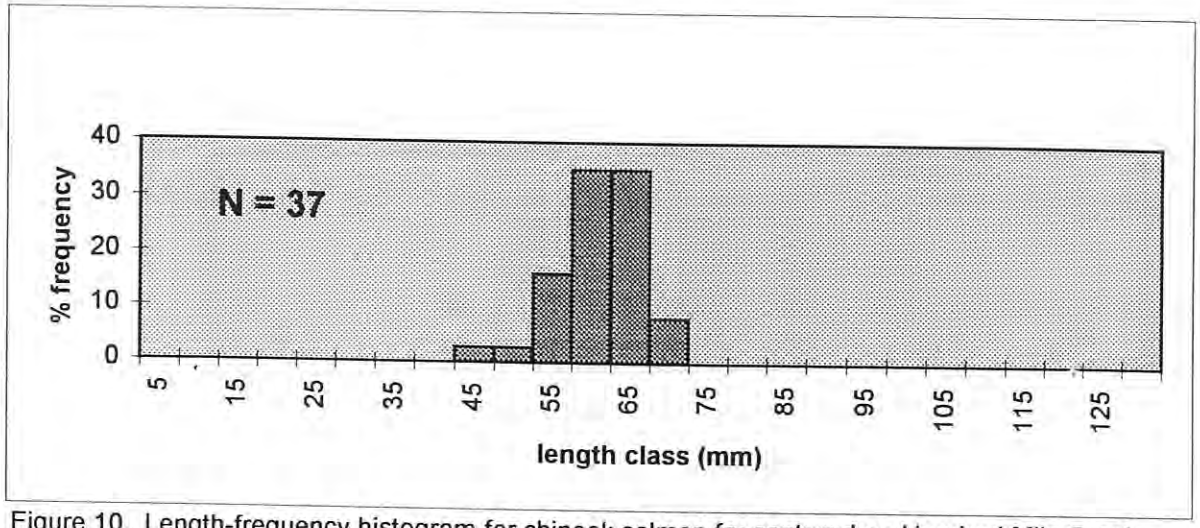

Figure 10. Length-frequency histogram for chinook salmon fry captured on Hundred Mile Creek, Yukon, July 25, 1998.

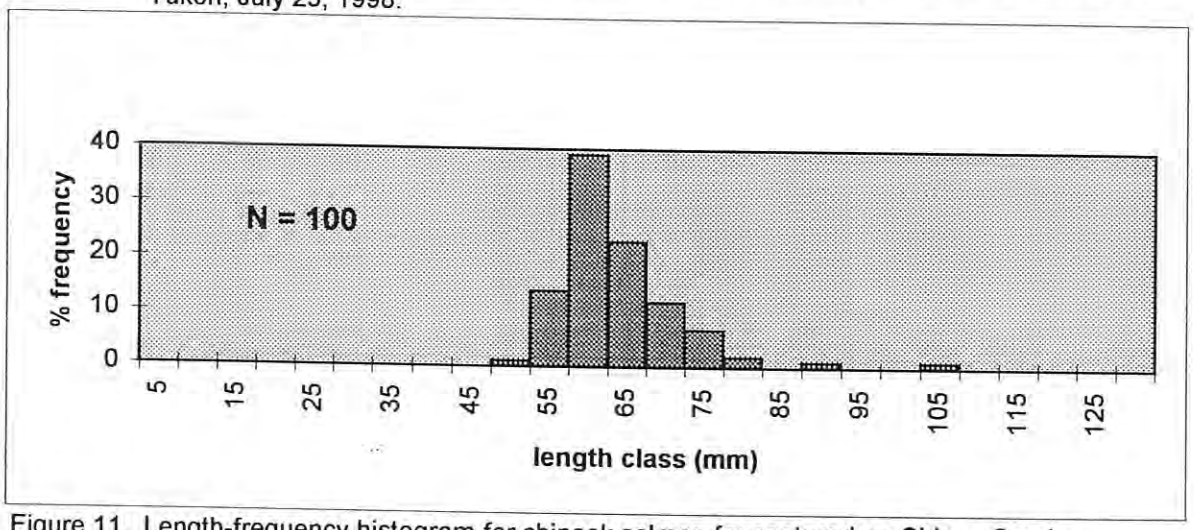

Figure 11. Length-frequency histogram for chinook salmon fry captured on Sidney Creek, Yukon, July 23-27, 1998.

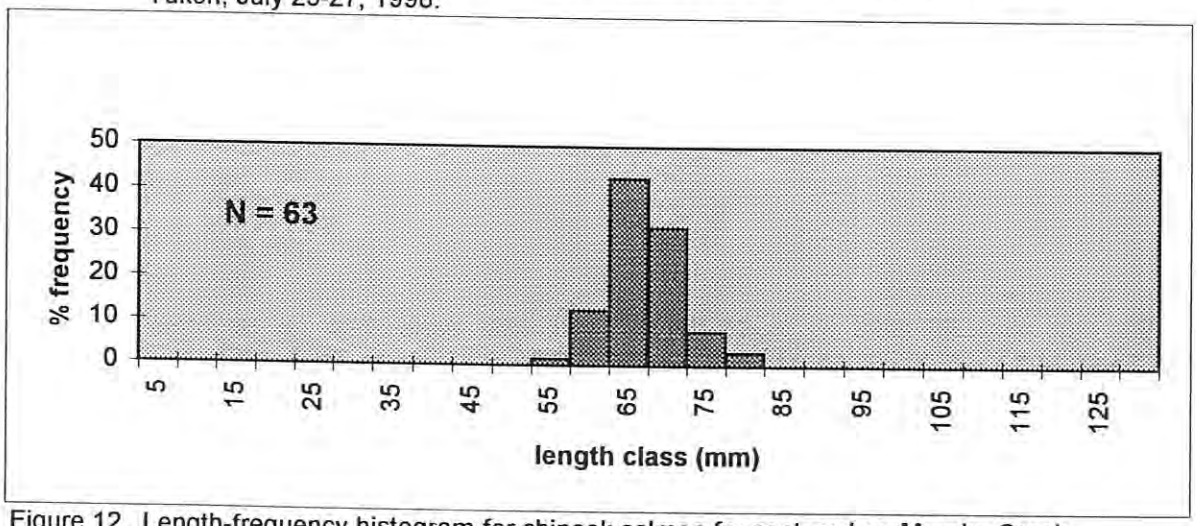

Figure 12. Length-frequency histogram for chinook salmon fry captured on Murphy Creek, Yukon, July 28, 1998.

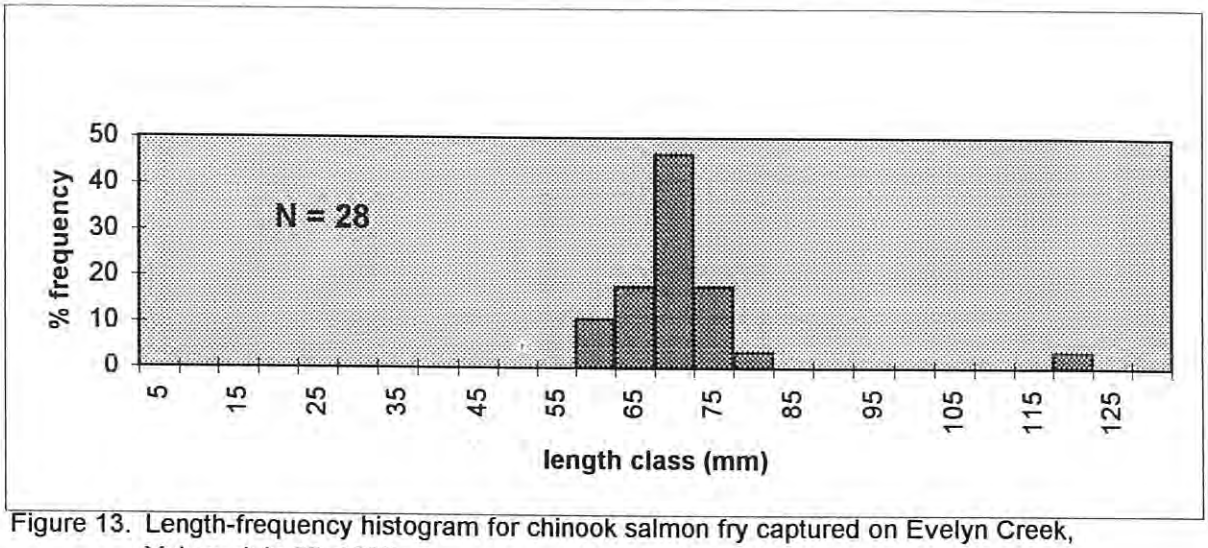

Figure 13. Length-frequency histogram for chinook salmon fry captured on Evelyn Creek, Yukon, July 25, 1998.

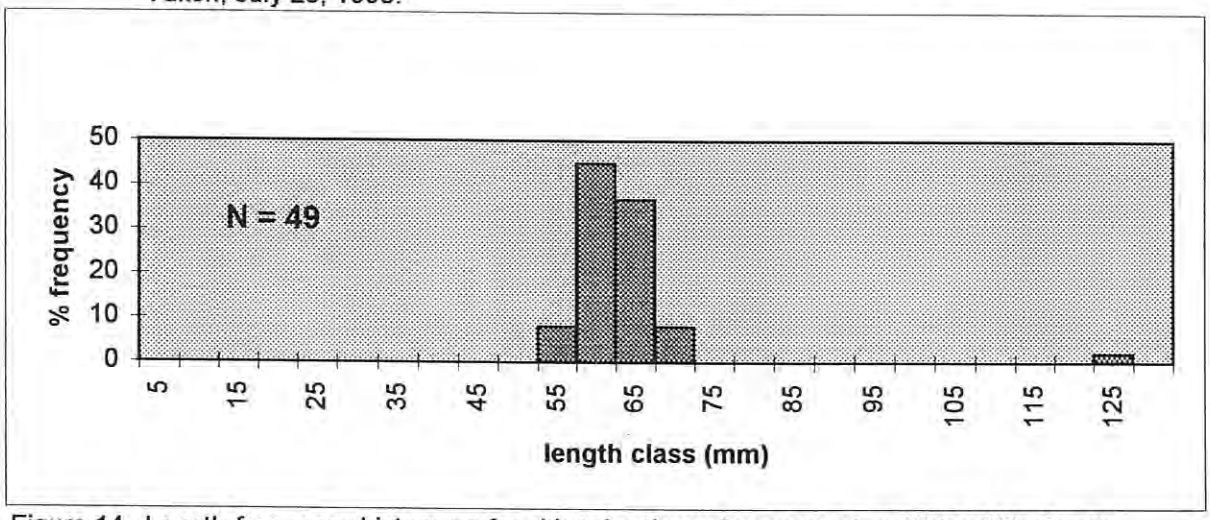

Figure 14. Length-frequency histogram for chinook salmon fry captured on Thirty Mile Creek, Yukon, July 28, 1998.

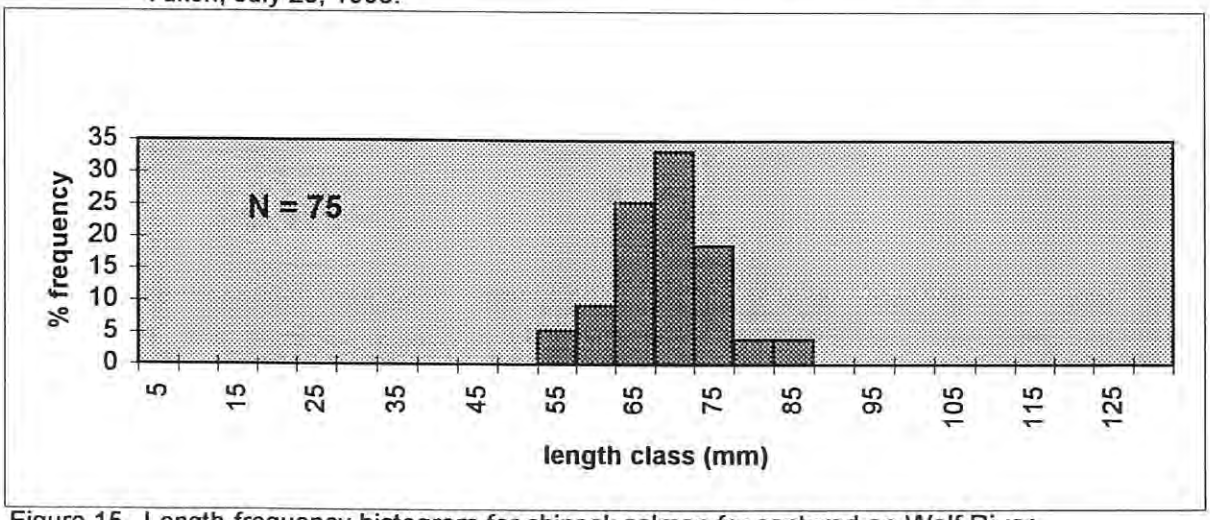

Figure 15. Length-frequency histogram for chinook salmon fry captured on Wolf River, Yukon, July 29-30, 1998.

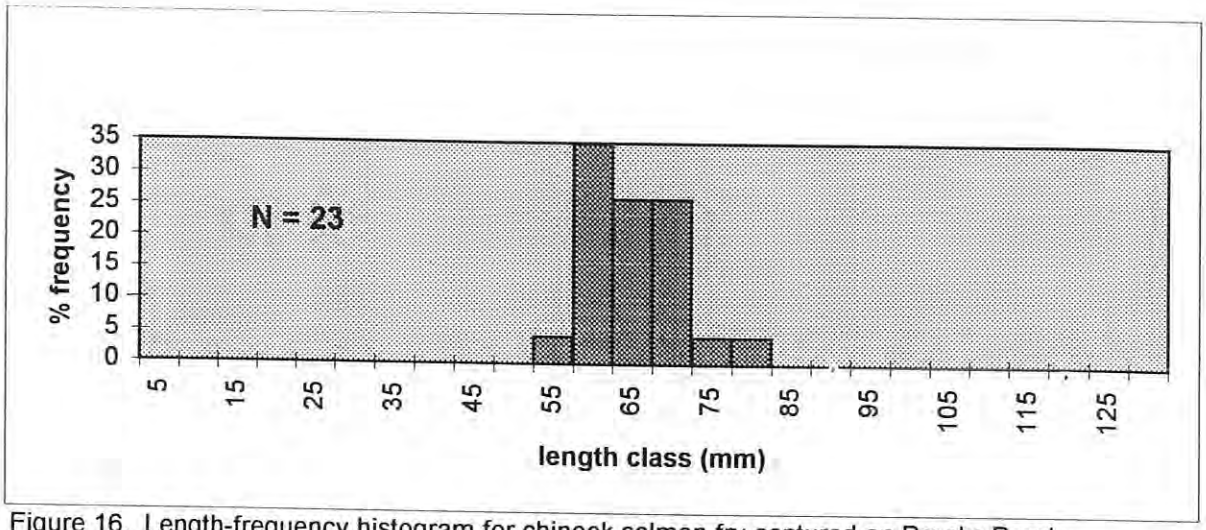

Figure 16. Length-frequency histogram for chinook salmon fry captured on Brooks Brook, Yukon, July 8, 1998.

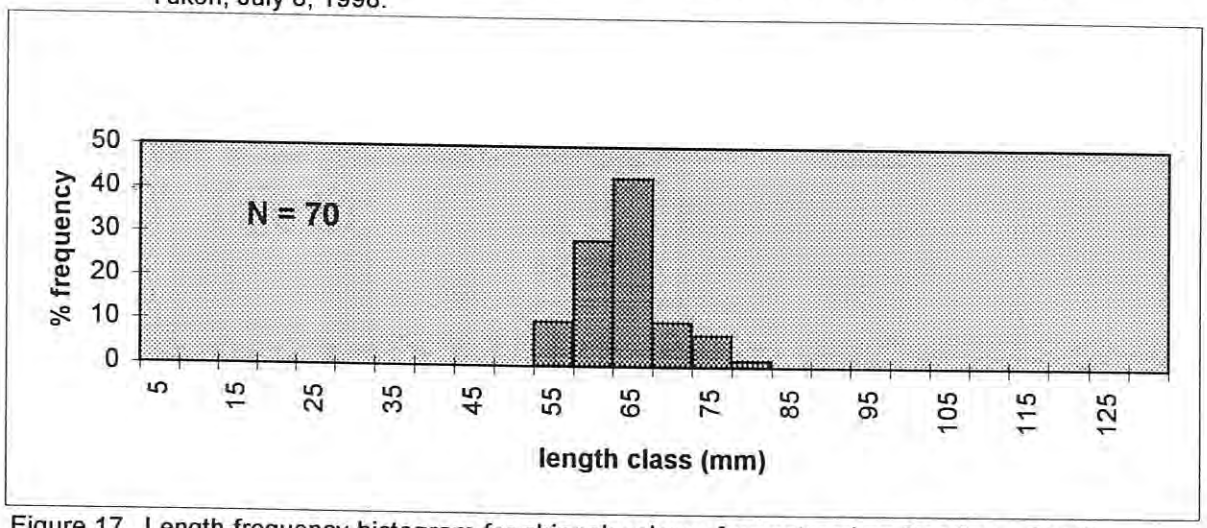

Figure 17. Length-frequency histogram for chinook salmon fry captured on Deadman Creek, Yukon, July 8, 1998.

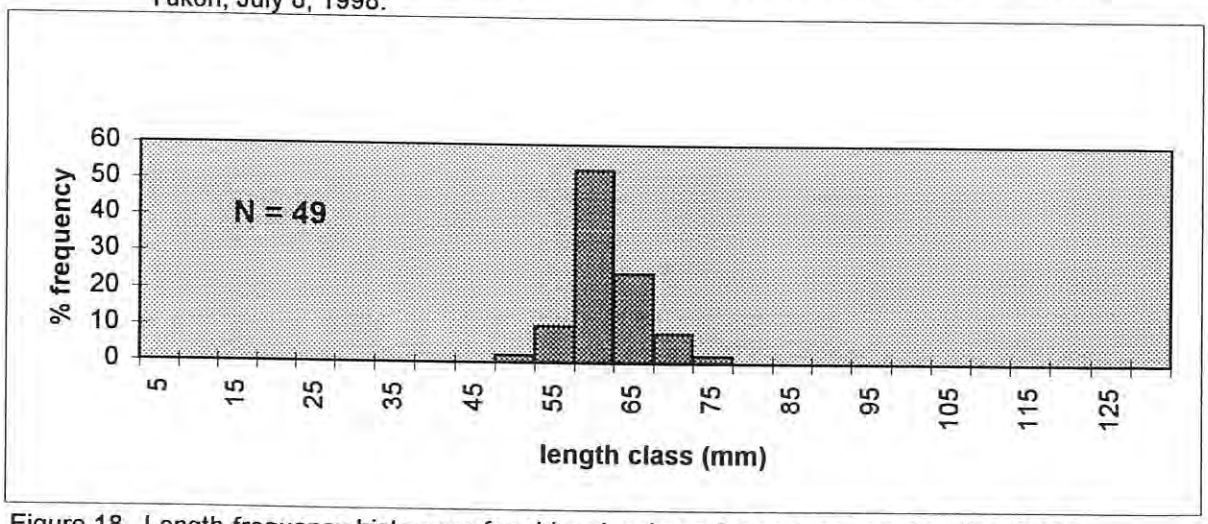

Figure 18. Length-frequency histogram for chinook salmon fry captured on Grayling Creek, Yukon, July 9, 1998.

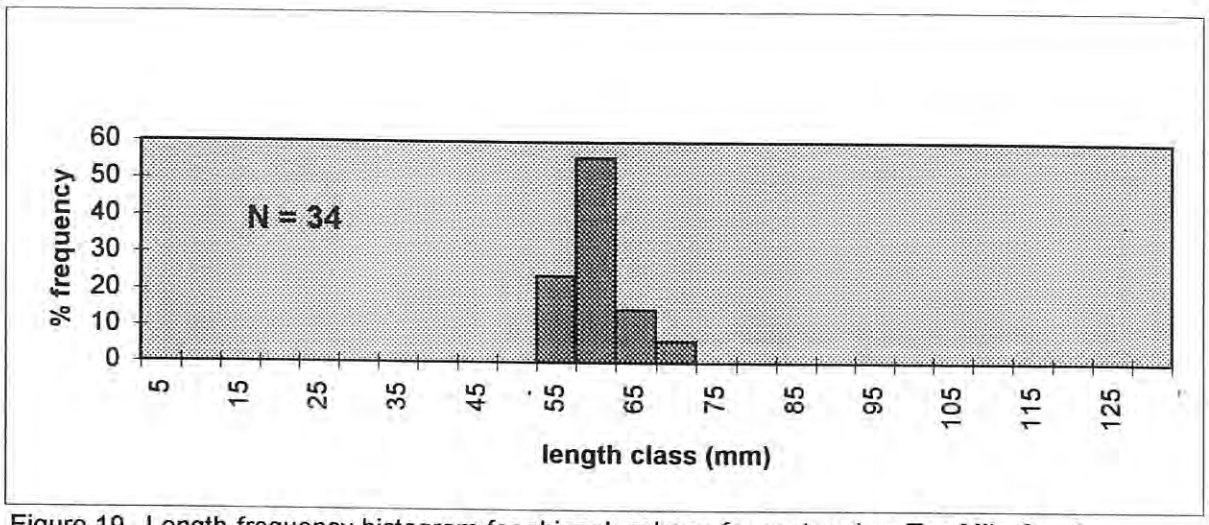

Figure 19. Length-frequency histogram for chinook salmon fry captured on Ten Mile Creek, Yukon, July 9, 1998.

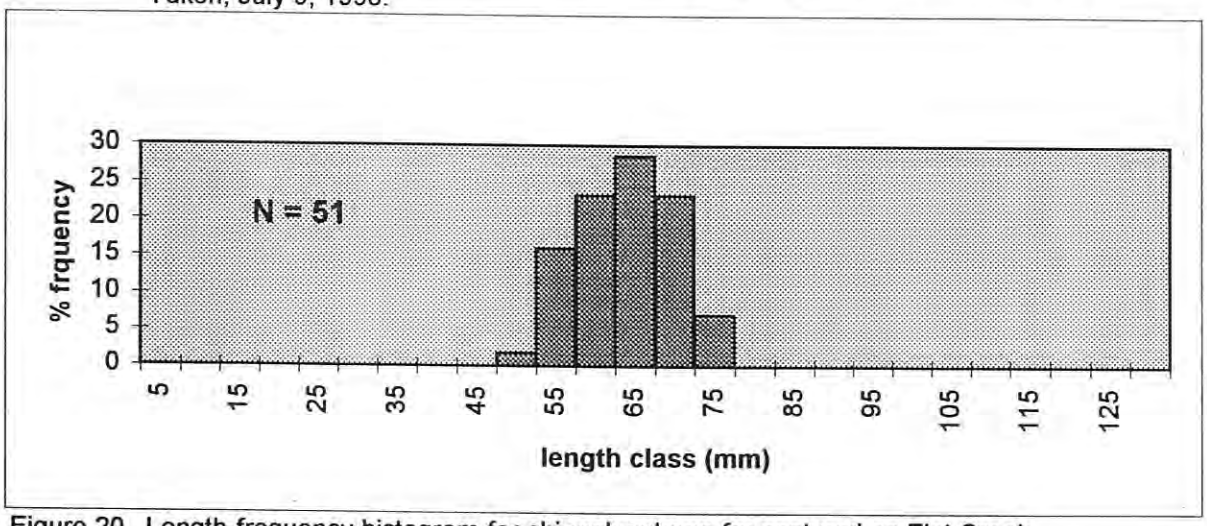

Figure 20. Length-frequency histogram for chinook salmon fry captured on Flat Creek, Yukon, July 9-10, 1998.

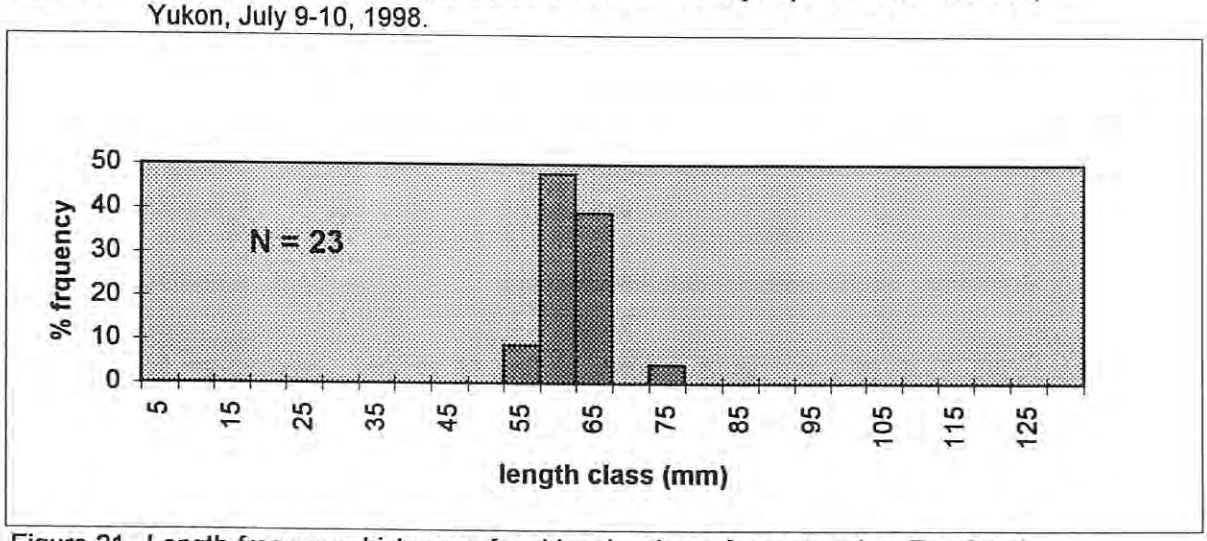

Figure 21. Length-frequency histogram for chinook salmon fry captured on Fox Creek, Yukon, July 9, 1998.

APPENDIX 1

Sample sites in the Teslin drainage, summer 1998.

SITE CODE	LOCATION	UTM
BRB1	Brooks Brook @ outlet to Teslin Lake	599400mE, 6698750mN
BRB2	Brooks Brook d/s of the Alaska Highway	599550mE, 6699000mN
BRB3	Brooks Brook u/s of the Alaska Highway	599550mE, 6699000mN
DM 1	Deadman Creek @ outlet to Teslin Lake	606700mE, 6690750mN
DM2	Deadman Creek @ Alaska Highway	606900mE, 6690750mN
DM3	Deadman Creek u/s of the Alaska Highway	606900mE, 6690750mN
FT1	Flat (Fat) Creek @ outlet to Teslin Lake	616150mE, 6673400mN
FT2	Flat (Fat) Creek u/s of Sterlin Creek	616000mE, 6673150mN
STRL	Sterlin Creek @ outlet to Flat Creek	616000mE, 6673400mN
GRC1	Grayling Creek @ outlet to Teslin Lake	611400mE, 6681050mN
GRC2	Grayling Creek reach2	611050mE, 6680750mN
FX	Fox Creek @ Alaska Highway	622600mE, 6673650mN
10MI	Ten Mile Creek @ Alaska Highway	615800mE, 6679100mN
LNT	Lone Tree Creek @ Alaska Highway	612500mE, 6683900mN
MCN1	McNeil River @ outlet of Moss Lake	648750mE, 6789300mN
MCN2	McNeil River @ camp 1	648000mE, 6788650mN
MCN3	McNeil River @ outlet to Nisutlin River	645900mE, 6783750mN
NS1	Nisutlin River @ outlet to McNeil River	646000mE, 6783650mN
NS2	Nisutlin River @ outlet to McConnell River	634050mE, 6796350mN
NS3	Nisutlin River d/s of Unnamed Tributary #3	678210mE, 6149500mN
NS4	Nisutlin River @ portage (government campground)	611010mE, 6755650mN
MCC	McConnell River @ outlet to Nisutlin River	633950mE, 6796400mN
CTW	Cottonwood Creek @ South Canol Road	609900mE, 6751450mN
SDN1	Sidney Creek @ outlet to the Nisutlin River	612650mE, 6737000mN
SDN2	Sidney Creek @ South Canol Road	605400mE, 6740400mN
SDN3	Sidney Creek u/s of Iron Creek	589200mE, 6748100mN
MPH	Murphy Creek @ South Canol Road	608150mE, 6728100mN
EV1	Evelyn Creek @ South Canol Road	605050mE, 6737300mN
EV2	Evelyn Creek 9km u/s of South Canol Road	597250mE, 6737950mN
TEV	tributary to Evelyn Creek in vicinity of ford	603200mE, 6736750mN
RSR1	Rose River @ outlet to the Nisutlin River	608800mE, 6784500mN
RSR2	Rose River @ South Canol Road bridge (Rose #1)	605018mE, 6786749mN
RSR3	Rose River @ South Canol Rd crossing (Rose #2)	602783mE, 6815775mN
RSR4	Rose River @ South Canol Rd crossing (Rose #3)	603350mE, 6819800mN
RSR5	Rose River @ South Canol Rd crossing (Rose #4)	602650mE, 6822126mN
RSR6	Rose River @ South Canol Rd crossing (Rose #5)	601336mE, 6825258mN
RSR7	Rose River @ South Canol Rd crossing (Rose #6)	601608mE, 6828982mN
CC	Canol Creek @ outlet to Rose River	606952mE, 6793408mN
PNC	Pony Creek @ South Canol Road	601450mE, 6830500mN
DDC	Dodge Creek @ South Canol Road	602646mE, 6810984mN
RT1	Tributary to Rose River #1@ South Canol Road	606924mE, 6792676mN
RT2	Tributary to Rose River #2@ South Canol Road	603806mE, 6807412mN
DRC	Deer Creek @ South Canol Road	607443mE, 6795449mN
CYC	Coyote Creek @ South Canol Road	610019mE, 6748248mN

APPENDIX 1 Continued
Sample Sites in the Teslin Area, Summer 1998.

SITE CODE	LOCATION	UTM
GVL	Gravel Creek @ South Canol Road	606971mE, 6800486mN
HM	Hundred Mile Creek @ outlet to Nisutlin River	611850mE, 6770400mN
30MI	Thirty Mile Creek @ outlet to Nisutlin River	626900mE, 6715100mN
WLFR	Wolf River @ outlet to Nisutlin River	635450mE, 6684500mN
UN1	Unnamed Tributary # 1 @ outlet to Nisutlin River	631350mE, 6795950mN
UN2	Unnamed Tributary # 2 @ outlet to Nisutlin River	628300mE, 6794200mN
UN3	Unnamed Tributary # 3 @ outlet to Nisutlin River	615100mE, 6782100mN
UN4	Unnamed Tributary # 4 @ outlet to Nisutlin River	612100mE, 6771950mN
UN5	Unnamed Tributary # 5 @ outlet to Nisutlin River	610200mE, 6742150mN
UN6	Unnamed Tributary # 6 @ outlet to Nisutlin River	620850mE, 6725000mN
UN7	Unnamed Tributary # 7 @ outlet to Nisutlin River	623200mE, 6721650mN
UN8	Unnamed Tributary # 8 @ outlet to Nisutlin River	626000mE, 6715250mN
UN9	Unnamed Tributary # 9 @ outlet to Nisutlin River	629700mE, 6704450mN
UN10	Unnamed Tributary # 10 @ outlet to Nisutlin River	634200mE, 6680950mN
WC	Wolf Creek @ outlet to Nisutlin River	622850mE, 6786150mN
SGC	Seagull Creek d/s of Seagull Lake	621800mE, 6830400mN

APPENDIX 2 Stream Descriptions

Nisutlin River

Efforts to assess chinook fry distribution in the Nisutlin drainage was directed to tributaries of the Nisutlin River rather than in the mainstem itself. It was beyond the scope of this study to adequately assess the extent of chinook salmon fry utilization on the Nisutlin River mainstem. Because of this, it was not possible to determine the relative importance of tributaries for rearing relative to the overall population in the Nisutlin mainstem. However, the study showed that where suitable available habitats occurred they were extensively utilized by chinook fry. Based on habitat and fish observations made during the float survey of the Nisutlin, and minnow trapping results, it is evident that the Nisutlin mainstem has extensive chinook fry habitat throughout. These habitats are unevenly distributed and occur more often in certain reaches.

Variations in habitats in the Nisutlin River main stem were documented during the course of this investigation and seven distinctly different reaches were identified. Benthic samples and water quality and chemistry samples were not taken from the Nisutlin River mainstem during this study.

The seven reaches identified above are as follows:

1) Between Nisutlin Lake and the confluence with the McNeil River.

This reach was not investigated from the ground but was viewed from the air. The reach consists mainly of a gentle meandering glide with gravel substrates only in the main thalwag areas. Extensive wetlands are associated with the upper reaches below Nisutlin Lake. A single chinook carcass was observed at the outlet of Nisutlin Lake.

2) Between the confluence of the McNeil and Nisutlin Rivers and Unnamed Tributary #2.

This reach has extensive boulder runs with cobbles, gravel and sand substrates. Rapids become more common. The channel is confined by long flat benches, likely of glacial origin with very limited grassy vegetation. The high velocities throughout most of this reach preclude chinook rearing in all but side areas and pools. No adult chinook were observed in this reach, although a Bald Eagle was observed possibly with a chinook carcass.

3) From Unnamed Tributary #2 through a canyon and rapids to a point 6 kms downstream of Wolf Creek.

This reach provides many chinook habitats. Bedrock approaches the surface throughout and large boulders are common. The reach flows as rapids interspersed with wide, deep, gentle glides and deep eddy and side pools. This reach provides excellent fish habitats in the glides and pools and likely has high oxygen levels due to the high extent of white water. Numerous fish were seen consistently in all glide and pool areas. Chinook fry, perhaps 1+yr. chinook and Arctic grayling of all age classes were observed rising and holding in pools. Two adult spawners were observed in the lower end of this reach.

4) From a point 6 kms downstream of Wolf Creek to the confluence with the Rose River.

This reach flows through an open valley with gently sloping banks and has a wide channel with extensive meanders as it nears the confluence with the Rose River. Substrates consist of even mixes of boulder, cobble gravel and sand, with shallow undercut banks common. Chinook habitats are abundant throughout this reach and good numbers of both fry and adult chinook were observed throughout. The largest aggregation of adult chinook observed was in the extensively meandering and braided reach close to Rose River.

5) From the Rose River to the confluence with Sidney Creek.

This reach has wide meanders in an open channel. The River is shallow with many gravel and silt point bars along the banks. Some undercutting occurs and the main thalwag is characterized by clean cobble/ boulder substrates. A well developed pool riffle sequence occurs in many parts of the reach. Chinook habitats are dispersed throughout this reach, including many previously documented spawning areas.

6) From Sidney Creek to Thirty Mile Creek.

The channel through this reach is wide and flat in an open valley. Riffles decrease and substrates become finer with silts and sand predominating. Gravel patches occur in shallow riffle areas and gravel bars are common at bends. Adult chinook were observed throughout this reach, most notably below the outlet of Sidney Creek.

7) From Thirty Mile Creek to the Nisutlin Delta.

This reach flows through a wide open valley before reaching the Nisutlin delta. Substrates are fine and the channel wide and flat. The reach below Wolf Lake has coarser substrates with gravel and cobbles becoming common and the occasional outcrop of bedrock and boulders. Log debris piles are common. Good habitats exist due to the size of the river and large instream debris. The extent of chinook utilization is likely good although dispersed.

All of the reaches described have available chinook salmon spawning and rearing habitats, although the extent and quality of those habitats varies. The low returns of adult chinook throughout the Yukon drainage in 1998, coupled with high returns during 1997, produced significant variations in utilization. Fry were recorded throughout the reaches, while adult utilization diminished further up the drainage. The observed presence of old redds in the upper reaches indicates that chinook likely do disperse further up into the drainage in years of high returns, however the extent of prime spawning habitat becomes more limited in the upper reaches.

Chinook fry combined from all four sample sites on the Nisutlin River, had a modal length group of 65 mm (Figure 6) and had a length frequency distribution similar to that of all fry captured during the investigation (Figure 5). Lengths ranged from 45-75 mm with a mean of 62.16 mm, mean weight was 2.44 g with a range of 1.4-4.0 g, and the mean K value was 1.02 (Table 8).

McNeil River

The McNeil River is a major headwater tributary of the Nisutlin River with its head waters in the St Cyr Range of the Pelly Mountains. Several lakes are located along the McNeil including Moss and Contour Lakes. Extensive wetlands are associated with the river, particularly upstream of Moss Lake. The River flows in a generally south /westerly direction to its confluence with the Nisutlin River at UTM 645900mE, 6783750mN (Figure 4). An historic skin boat frame was found near the outlet of Moss Lake.

Discharge of the McNeil River immediately upstream of its confluence with the Nisutlin River was assessed using the floating object method, at 17.92 m^3/sec.

The waters of the McNeil River were slightly alkaline and conductivity was relatively high, similar to other headwater reaches of the Nisutlin drainage (Table 3). Water chemistry samples were not taken from the McNeil River.

Investigations on the McNeil River were conducted at 3 locations between July 22 and 23, 1998. These sites were: the outlet of Moss Lake (site MCN1), the confluence of the McNeil and Nisutlin Rivers (site MCN3) and at a point midway between (site MCN2). An aerial survey was made of the reach from Moss Lake to the Nisutlin River. The outlet of Moss Lake is a long narrowing bay that flows into a tightly confined river channel. The river remains tightly confined until shortly before entering the Nisutlin River where it becomes more open. Abrupt cliffs are common and the occasional boxed canyon occurs. Substrates near the outlet consist of cobbles (90%) and boulders (10%) imbedded in a thick clay layer in a flat open channel. This reach has little cover and flows as a gentle glide with an average depth of 1 meter The average wetted width at the lake outlet is 40 meters, the depth is >1 meter and velocity <0.1m/sec (Table 1). What appeared to be two old/ historic redds exist at the point were the velocity increases, immediately above the point where the lake ends and the river begins. Moving downstream and into the more confined reaches, the substrates consist of much coarser loosely compacted material, cobbles 55%, boulders 40% and coarse gravel 5%. Velocities increase to maximums of > 2m/sec. and an average of 1 m/sec with a pool riffle glide ratio of 2:5:3. Several deep pools associated with cliff banks occur. Channel configuration changes within 1 km of the confluence with the Nisutlin River with the channel becoming less confined and flattening. Substrates were 95% cobble tightly compacted into coarse sands. The average depth was 0.3 meters with an average wetted width of 7 meters. Abrupt banks rise up to 2 meters. The riffle to glide ratio was 17:3 and virtually no pools existed.

Benthic samples collected at McNeil River had a population of 415 individuals and a diversity of 45 different taxonomic groups. Dipterans (61%) formed the majority of the community (Table 4 and Appendix 4).

Chinook fry from McNeil River ranged in length from 61-84 mm with a mean of 69.94 mm. Mean weight was 3.83 g with a range of 2.1-5.6 g, and the mean K value was 1.08 (Table 8). A length frequency histogram was not calculated for the McNeil River due to the small sample size.

Sampling efforts were restricted to areas near the banks due to depth and velocity and it is quite likely that deeper areas had more chinook fry than the areas sampled. Pockets of chinook fry were observed throughout the river and usually associated with large piles of organic debris. No adult salmon were observed spawning in the McNeil River during 1998 although suitable habitats were observed during field investigations and the aerial survey. Historic redds were observed at the outlet of Moss Lake.

Species of fish recorded in the McNeil River during this study include chinook salmon fry (common in suitable habitat areas) (Tables 5 and 6), Arctic grayling, longnose sucker, and slimy sculpin.

McConnell River

The head waters of the McConnell River lie in the St Cyr Range of the Pelly Mountains. The McConnell River flows in a southerly direction to its confluence with the Nisutlin River at UTM 633950mE, 6796400mN. Major tributaries of the McConnell include Grizzly Creek, Sleep Creek, White Creek, and Seagull Creek (Figure 4).

The McConnell is a major sub basin of the Nisutlin, draining an area of 1,052 km^2, resulting in a MAF of 68 m^3/sec. Average low flow is estimated to be about 1.1 m^3/sec.

The waters of the McConnell River were slightly alkaline, clear and hard and had the highest sulphate concentration. All other metal levels were very low where they were detected (Tables 2 and 3, Appendix 3).

The McConnell River was investigated from its confluence with the Nisutlin River upstream for 600 meters on July 24 and 25,1998 (site MCC). The river braids into three channels 200 meters upstream of the confluence with the Nisutlin. The eastern most channel was not flowing at the time of investigation, however it did have water backed up from the Nisutlin River. The wetted width of the river above the braided section averaged 30 meters. The average depth was 0.45 meters and the average velocity 1.0 m/sec (Table 1). Substrates were a mixture of flat to round cobbles (70%), gravel (15%) and boulders (15%). Boulders become more prevalent moving upstream. The river channel is occasionally confined by high clay cliffs and banks are often abrupt, rising to 1.8 meters. The creek flows as a fast glide (70%) interspersed with riffles (30%) with average velocities of 1 m/sec. Stream cover was limited in this reach to the interstitial spaces of boulder and cobble. Above this lower reach water velocities increase in a tightly confined channel comprised of rapids and riffles. The headwater tributaries all flow down steep entrenched valleys and the only headwater lakes exist at the top of Seagull Creek (Seagull Lakes). A short swampy reach on Seagull Creek in an open valley is the only exception to the steep incline followed by the tributaries and the only location that beaver activity was observed on the river or any of its major tributaries.

Benthic samples collected at McConnell River had a very low population of 167 individuals and a diversity of 29 different taxonomic groups. Diptera (41.9%) and Ephemeroptera (27.5%) shared dominance (Table 4 and Appendix 4).

Some mineral exploration activity has occurred in the upper reaches of Seagull Creek, and an extensive net-work of trails crosses the head water creeks starting in the upper Seagull Creek area and moving east and south east.

Chinook fry were common and well dispersed in the lower reaches of the McConnell River. The modal length group was 65 mm (Figure 7). Lengths ranged from 52-73 mm with a mean of 63.8 mm. Mean weight was 2.74g with a range of 1.4-3.9 g and the mean K value was 1.01 (Table 8). No adult chinook were observed in the river during aerial surveys, although suitable habitat was observed during field investigations and the aerial survey. Extensive over-wintering habitat is expected.

Species of fish recorded in the McConnell River during this study include: chinook salmon (fry, common to abundant), Arctic grayling and slimy sculpin (Table 5).

Seagull Creek

Seagull Creek is a major tributary of the McConnell River. The head waters of Seagull Creek lie in the St Cyr Range of the Pelly Mountains. Seagull Creek flows in a south/ south-easterly direction to it's confluence with the McConnell River. There are several small lakes in the upper reaches of Seagull Creek (Figure 4).

Seagull Creek drains an area of 446 km^2, resulting in a MAF of 30 m^3/sec. Average low flow in Seagull Creek is estimated to be about 0.44 m^3/sec. Discharge of Seagull Creek was estimated using the floating object method in the upper reaches below Seagull Lake. Discharge was estimated at 0.49 m^3/sec, on July 2,1998 (Table 1).

Seagull Creek was investigated approximately 3 km downstream of the outlet of Seagull Lake on July 27,1998 (site SGC). The average wetted width of the creek was 3 meters, average dry width 5 meters, average depth was 0.35 meters, and the average velocity 0.5 m/sec (Table 1). Substrates consist of loosely compacted cobble (40%), gravel (30%), boulder (20%), and sand (10%). Stream banks are partially confining and gentle. The creek is 70% riffle, 20% glide and 10% pool. Stream-side vegetation consists of willow and dwarf birch and cover consists of 10% overhanging vegetation and 5% instream woody debris. Good instream cover is provided by clean, large substrates with good interstitial spacing.

Water chemistry and benthic samples were not taken at Seagull Creek.

Fish species recorded in Seagull Creek during this investigation were Arctic grayling (2 or 3 year classes of fry) and slimy sculpin (Table 7). An active beaver dam was noted 2 km downstream of the sample site during the aerial survey.

Unnamed Tributary #1

The head waters of the Unnamed Tributary #1 lie in the Pelly Mountains. This tributary flows in a southerly direction to its confluence with the Nisutlin River approximately 3km downstream of the outlet of the McConnell River at UTM 631350mE, 6795950mN (Figure 4).

This creek drains an area of 137 km^2, resulting in a MAF of 10 m^3/sec. Average low flow is estimated to be about 0.12 m^3/sec (Table 1).

The waters of Unnamed Tributary #1 were slightly alkaline and clear. The water chemistry analysis showed no anomalies and most parameters were below the method detection limit (Tables 2 and 3).

The lower 400 meters of this creek was investigated on July 24, 1998 (site UN1). The average wetted width of the creek was 4 meters, average depth was 0.35 meters and average velocity <1 m/sec (Table 1). Substrates consist of cobble (40%), gravel (35%), sand (25%), and boulder (5%). The stream channel composition was 80% glide, 15% riffle and 5% pool. The creek had the occasional cut bank and instream woody debris (<5%) offering limited cover. Riparian vegetation was mature spruce forest with some poplar. Above the reach investigated, the adjacent forest had been burned by a forest fire within the last several years.

Benthic samples collected at this tributary had a total abundance value of 507 individuals and a diversity of 41 different taxonomic groups. Ephemeroptera and Diptera were the dominant groups (Table 4 and Appendix 4).

Species of fish recorded in Unnamed Tributary #1 during this study include chinook salmon (fry, uncommon) and Arctic grayling (adult) (Table 6).

Unnamed Tributary #2

The head waters of the Unnamed Tributary #2 lie in the Pelly Mountains. This tributary flows in a generally easterly direction before turning to flow south to its confluence with the Nisutlin River in a side bay at UTM 628300mE, 6794200mN (Figure 4).

This Creek drains an area of only 32 km^2, resulting in a MAF of 2.6 m^3/sec. Average low flow is estimated to be 0.025 m^3/sec.

The waters of this tributary were slightly alkaline. This site had the lowest conductance of all the reaches surveyed with a conductivity of 60 uS/cm, indicating the probability of soft water (Table 1). No water chemistry sample was taken from this creek.

The creek was investigated from its outlet at the Nisutlin upstream for 300 meters on July 24, 1998 (site UN2). The average wetted width of the creek was 2.5 meters with a dry width of 8 meters, average depth was 0.3 meters, and the average velocity 0.6 m/sec

(Table 1). Substrates consisted of cobble (30%), gravel (30%), sand (30%), boulder (5%), and organic debris (5%). Cover was limited to overhanging vegetation (5%). The creek flows predominantly as a glide (75%), with occasional riffles (20%), and corner pools (5%). Adjacent vegetation was spruce/poplar forest with willow and alder. Recent and historic beaver activity was in evidence in the form of an abandoned lodge and an active small dam.

No chinook were recorded in this creek and it does not appear likely that any significant over-wintering habitat is available. Species of fish recorded in the Unnamed Tributary #2 during this study was limited to Arctic grayling (adult).

Wolf Creek

The head waters of Wolf Creek lie in the high country of the Yukon Plateau centered around Indian Mountain. Wolf Creek flows in a north-easterly direction to enter the Nisutlin River at UTM 622850mE, 6786150mN (Figure 4).

Wolf Creek drains an area of 446 km^2, resulting in a MAF of 7.1 m^3/sec. Average low flow in Wolf Creek is estimated to be about 0.08 m^3/sec (Table 1). Over-wintering habitat potential is very low due to steep gradient however the boulder delta complex may offer some overwintering habitat.

The waters of Wolf Creek were neutral and very soft (Table 2). All metal and nutrient concentrations were low when detected (Table 3 and Appendix 3).

Wolf Creek was investigated from its outlet at the Nisutlin River upstream for 540 meters on July 24, 1998 (site WC). The average wetted width of Wolf Creek was 4 meters, average depth was 0.6 meters, and the average velocity 1.25 m/sec (Table 1). Substrates consisted of boulders (90%), cobble (5%), and sand (5%). The creek flows as a high velocity rapid (100%) in this reach with the occasional side and boulder pool. Creek banks rise abruptly 3 to 8 meters and the channel is confined and becomes entrenched above the reach investigated. Cover is limited to boulder pools, interstitial spacing among the boulders and over-hanging vegetation. Stream-side vegetation is dominated by alders. At the outlet area the creek fans out to 60 meters wide and flows through a boulder field before emptying into the Nisutlin River.

Benthic samples collected at Wolf Creek found a relatively high abundance with a population of 1027 individuals and a diversity of 50 different taxonomic groups. Ephemeroptera and Diptera shared dominance (Table 4 and Appendix 4).

Species of fish recorded in Wolf Creek during this study was limited to visual observations of chinook salmon (fry, common) in the pools created between boulders in an open area near the outlet.

Unnamed Tributary #3

The head waters of the Unnamed Tributary #3 lie in the high country of the Yukon Plateau south of the Nisutlin River. This tributary flows in a generally westerly direction before turning to flow north to its confluence with the Nisutlin River at UTM 615100mE, 6782100mN (Figure 4). Evidence of an historic camp including remains of a gaff pole and skin stretchers were found near the outlet of this creek.

This is a small creek, draining an area of 38 km^2, resulting in a MAF of 3.0 m^3/sec. Average low flow in the creek is estimated to be about 0.03 m^3/sec. The waters of Unnamed Tributary #3 were slightly alkaline, hard and clear. Metal levels were low when detected (Tables 2 and 3).

The reach surveyed extended from the creek outlet at the Nisutlin River upstream for 140 meters and was surveyed on July 25, 1998 (site UN3). The wetted width of the creek was 3 meters, average depth was 0.25 meters, and the average velocity 0.4 m/sec (Table 1). Substrates consisted of firmly compacted gravel (60%), cobble (20%), and sand (20%) with some silting. Cover was in the form of undercut banks (5%) and overhanging vegetation (35%). The creek was 45% glide, 25% riffle, and 20% pool. Stream banks rise to 2 meters with active slumping on the east side in a partially confined channel. At the outlet to the Nisutlin River the creek flows over a wide cobble beach for 12 meters with the creek widening to 12 meters. Riparian vegetation is dominated by a dense alder under-story with adjacent mature spruce forest. An active beaver dam and associated pond is located approximately 140 meters upstream of the Nisutlin River. This dam was 1.8 meters high and was a barrier to fry at the time of the survey; however chinook fry were captured upstream of this dam indicating the dam had either been recently constructed, or was not a barrier in the recent past.

Chinook fry from Unnamed Tributary #3 had strong representation in most length classes with the modal length group of 65 mm (Figure 8). Lengths ranged from 46-78 mm with a mean of 61.8 mm, mean weight was 2.69 g with a range of 1.2-4.7 g, and the mean K value was 1.02 (Table 8).

Species of fish recorded in the Unnamed Tributary #3 during this study include chinook salmon (fry, abundant both above and below the beaver dam) and slimy sculpin (Table 5). Over-wintering habitat potential may be limited to the lowest reach below the beaver dam. Flow patterns above the beaver dam are unknown.

Rose River

The Rose River is a major tributary of the Nisutlin River. The head waters of the Rose River lie in the St Cyr Range of the Pelly Mountains. The river flows in a southerly direction to its confluence with the Nisutlin River at UTM 608800mE, 6784500mN. The South Canol Road parallels the Rose River for most of its length and crosses the river at 6 locations, the first crossing occurring 6 km from the Nisutlin River. Major tributaries of the Rose include: Fish Creek, Lower Sheep Creek, Upper Sheep Creek, Weasel Creek, and Pony Creek (Figure 4).

The Rose River drains an area of 942 km^2 at the point where it crosses the South Canol Road at Rose #1 (site RSR2). This crossing was gauged from 1976 to 1980, with peak flood occurring between May 25 and June 24 during this period. The calculated MAF is 61.4 m^3/sec. Flow of the Rose River at Canol Creek, as measured on July 24 using a price meter, was 7.40 m^3/sec. A discharge of 9.96 m^3/sec was estimated immediately upstream of the outlet to the Nisutlin River using the floating object method on July 25. Average low flow for the basin is estimated to be about 0.948 m^3/sec.

The waters of Rose River were slightly alkaline and well aerated. A water chemistry sample was collected at the mouth and indicated that the Rose River had moderately soft waters with little to no nutrients or metals in the water column (Tables 2 and 3).

Over-wintering habitat potential for Rose River is very high, with significant habitat to be found in pools.

Most of the tributaries entering the Rose River from the east are crossed by the South Canol Road. Several of these culvert crossings present a barrier to fish passage and therefore restrict chinook fry movements.

Some mineral exploration has occurred on both Groundhog and Upper Sheep Creek, the result being that non-maintained roads parallel both creeks for most of their respective lengths.

The Rose River was sampled for benthics upstream of its confluence with Canol Creek, using the kick net method. Only 75 individuals were captured at this site with a diversity of 9 different taxonomic groups. Because the invertebrates collected by the kick net were identified to the family level and most of the invertebrates collected with the Surber Sampler were analyzed to the genus level, this partially accounts for the lower diversity value. Ephemeroptera and Diptera were the dominant orders (Table 4 and Appendix 4).

Chinook salmon fry from Rose River fell into two distinct length classes, indicating two year classes, and that successful over-wintering of chinook fry likely occurs in Rose River. The modal length was 70 mm (Figure 9). Lengths ranged from 49-85 mm with a mean length of 68.97 mm, mean weight was 3.54 g with a range of 1.8-5.6 g, and a mean K value of 1.26 (Table 8). The mean K value recorded for Rose River chinook fry was considerably higher than at any other location for which K values were calculated. Fry from Rose River were, on average, generally larger than from other watercourses.

Species of fish recorded in the Rose River during this study include the following: chinook salmon (fry, common at RSR1&5,abundant at RSR 2,4&5, prolific at RSR 3), chinook salmon (1+yr, uncommon), slimy sculpin, Arctic grayling and burbot (Table 5). No adult chinook were observed in Rose River during the aerial survey in 1998. Documents obtained from DFO Stream Files indicates that adult chinook do spawn in the

Rose River and have been observed near the outlet of Fish Creek (a tributary to Rose River several hundred meters upstream of the first crossing by the Canol Road)(DFO Stream file, 1996).

For the purposes of this investigation, Rose River was divided into 3 distinct reaches that were surveyed on July 24, 25 and 27,1998. Because of the proximity of the Canol Road, access was feasible throughout the entire length of the river. Sampling was conducted at the confluence of the Rose River with the Nisutlin (site RSR1), and at each of the six highway crossings (sites RSR2-RSR7). Rose River was included in the aerial survey conducted in late August to look for spawning adult chinook.

Reach R#1 extends from the Nisutlin River (site RSR1) to the first crossing of the Canol Road (site RSR2)and consists of a flat open channel with fine substrates consisting of shifting silty sand and large organic debris. Reach R#2 starts above the first road crossing (site RSR2) where the channel configuration changes to a steeper grade with cobble, boulder and gravel substrates. This configuration remains basically consistent throughout the rest of the river (including sites RSR3-RSR6) with areas of steeper gradient occurring. Reach R#3 starts at the 6th and last road crossing (site RSR7) and continues to Rose Lake. The channel becomes less steep and flow becomes a gentle glide over silted substrates. Beaver activity was in evidence in all the reaches, however other than RSR#3 the river has too great a flow regime to allow beavers to effectively block the entire channel. Channel-wide beaver dams exist immediately below Rose Lake.

REACH R1. This reach extends from the confluence with the Nisutlin River to the first crossing by the Canol Road. The portion of this reach investigated extends from the outlet upstream for 350 meters. The average wetted width in this reach was 30 meters, with an average depth of 0.6 meters and the average velocity was 0.7 m/sec (Table 1). Substrates consist primarily of sand (80%) and silt (20%). The stream channel is straight and banks were cut on both sides with an abrupt rise to 2.5 meters, confining the channel. Cover (10%) consisted of instream woody debris. The creek flows primarily as a glide (90%) with the occasional pool (10%) in side areas and usually associated with large instream woody debris. Above the portion investigated, the remainder of this reach meanders through a mature spruce forest and maintains much the same channel configuration with the inclusion of the occasional gravel riffle.

REACH R2. This reach extends from the first crossing of the Canol Road (site RSR2) to the last road crossing (site RSR7). A physical evaluation of the Rose was conducted at 2 locations within the reach, at site RSR2 and at the confluence of Canol Creek. A summary of those descriptions is as follows. Wetted width varies from 12 to 24 meters, with an average depth of 0.65 meters and average velocity of < 1 m/sec (Table 1). Substrates consist predominantly of moderately compacted mixes of boulders and cobbles (70-90%) with gravel and sand occurring in between larger substrates and on point bars. The river flows mostly as a riffle/ rapid (85%) with the occasional pool and glide area occurring. The river banks rise abruptly up to 2 meters and the channel is confined and in places entrenched. Willow and alder commonly line the banks, with a mature spruce

poplar forest adjacent. At higher altitudes, the riparian vegetation gradually changes to scrub spruce mixed with willow and dwarf birch.

REACH R3. This reach extends from site RSR7 to Rose Lake. The average wetted width was 6 meters with an average depth of 0.5 meters (Table 1). Substrates consist of a homogeneous organic silt layer. The entire reach flows as an even glide with velocities <0.3 m/sec through an open channel across an alpine meadow. Banks rise unevenly up to 1 meter. Vegetation consists of scrub willow and dwarf birch with the occasional stunted spruce.

This was the only reach of the Rose River where chinook salmon were not recorded during this investigation. Arctic grayling fry were observed near the culvert above the Canol Road. Considerable recent beaver activity was in evidence and a series of dams are located immediately below the outlet of Rose Lake

Pony Creek

Pony Creek is a headwater tributary to the Rose River. A lake exists in the upper reach of this creek. Pony creek flows in a generally south-easterly direction to enter Rose Lake (Figure 4).

Pony Creek has a drainage area of 132 km^2, resulting in a MAF of 9.7 m^3/sec. Average low flow in the creek is estimated to be about 0.12 m^3/sec. Water chemistry and benthic invertebrate samples were not taken from Pony Creek.

Pony Creek was surveyed for 200 meters on either side of the South Canol Road crossing on August 11, 1998 (site PNC). Pony creek is a high velocity creek with an average wetted width of 8 meters. Average depth was 0.25 meters and average velocity was 0.85 m/sec (Table 1). Substrates consist of loosely compacted cobble (65%), boulder (20%) and gravel (15%). Stream banks consisting of boulders rise up to 1 meter. The creek is virtually all (99%) riffle, with the only pool observed being at the outlet of the culvert at the Canol Road. This culvert represented a barrier to fish passage at the time of investigations with a drop of 0.5 meters. The creek flows through an open gravel plain with vegetation comprised of willow and the occasional spruce grove.

Over-wintering habitat will likely be very limited with the possible exception of the lake in the headwaters.

Fish recorded in Pony Creek during this investigation were Arctic grayling and burbot (Table 7).

Unnamed Tributary #4

This tributary has been improperly labeled as Hundred Mile Creek on topographic maps. Hundred Mile Creek enters the Nisutlin 1.2 km downstream of the outlet of Unnamed Tributary #4. The head waters of Unnamed Tributary #4 lie in the high country of the Yukon Plateau east of the Nisutlin River. This tributary flows in a generally

westerly direction to its confluence with the Nisutlin River at UTM 612100mE, 6771950mN (Figure 3).

Unnamed Tributary #4 has a small basin, draining an area of 51.5 km^2, resulting in a MAF of 4.0 m^3/sec. Average low flow in the creek is estimated to be about 0.04 m^3/sec.

Unnamed Tributary #4 was investigated from the confluence with the Nisutlin River upstream for 200 meters on July 25, 1998 (site UN4). The average wetted width of this creek was 2.5 meters, average depth was 0.2 meters, and the average velocity 0.15 m/sec (Table 1). Substrates consist of a thick layer of organic silt 1 cm thick over sand/silt. The creek flows as a glide/pool (100%) with velocities near 0.2 m/sec. Cover was abundant (40%) with large amounts of instream woody debris. Stream banks are gently sloped rising to 2 meters. Riparian vegetation is comprised of sedges, willow and alders with adjacent mature white spruce forest. A history of beaver activity was much in evidence including an abandoned lodge located 50 meters upstream of the creek outlet. Signs of past flooding by beaver extended to the edge of the Nisutlin River.

Over-wintering habitat is probably limited to the last few meters of the stream upstream of its confluence with the Nisutlin River.

Species of fish recorded in Unnamed Tributary #4 during this study was limited to visual observations of chinook salmon (fry, common).

Hundred Mile Creek

The headwaters of Hundred Mile Creek lie in the high country of the Yukon Plateau east of the Nisutlin River. This Creek flows in a generally north-westerly direction to its confluence with the Nisutlin River at UTM 611850mE, 6770400mN. Several lakes exist in the upper reaches of this creek (Figure 3).

A legal land survey had been completed at the outlet of the creek. This block of land is a personal land claims selection and a historic camp site.

Hundred Mile Creek is a significant tributary, draining an area of 586 km^2, resulting in a MAF of 39.3 m^3/sec (Table 1). Average low flow in the creek is estimated to be about 0.59 m^3/sec.

Hundred Mile Creek was investigated from the confluence with the Nisutlin River upstream for 1 kilometer on July 25 and 26,1998 (site HM). The average wetted width of the creek was 8 meters, the average depth 0.25 meters, and the average velocity > 0.5 m/sec. Substrates consist of loosely compacted gravel (50%), sand (30%), cobble (15%), and silt (5%). The stream channel is partly confined with some braiding. Near the creek outlet, stream banks rise abruptly to 10 meters for long stretches. A 15 meter high cut face occurs on the last bend before the creek joins the Nisutlin River. Further upstream, banks become more gentle rising to 4.5 meters. Instream cover (40%) consists of

overhanging vegetation and root wads. The creek flows mainly as a glide (60%) interspersed with riffles (25%) and pools (15%). Stream-side vegetation consists of alder, willow and sedges, the adjacent vegetation is white spruce and lodgepole pine forest.

Evidence of past beaver activity exists in the form of an abandoned beaver dam, located 400 meters upstream of the creek outlet. A series of beaver dams starting approximately 3 kms upstream of the Nisutlin were observed during the aerial survey.

Over-wintering habitat potential is high for the lower reaches due to lake storage and a significant water supply. Potential for chinook spawning exists in Hundred Mile Creek although no adult chinook were observed in the creek during the aerial survey.

Chinook fry from Hundred Mile Creek had a modal length group of 60 mm (Figure 10). Length ranged from 45-67 mm with a mean of 59 mm, mean weight was 2.14 g with a range of 1.2-3.2 g, and the mean K value was 1.04 (Table 8).

Species of fish recorded in Hundred Mile Creek during this study include chinook salmon (fry, abundant), longnose sucker, and slimy sculpin (Table 5).

Cottonwood Creek

The head waters of Cottonwood Creek lie in the Big salmon Range of the Pelly Mountains to the west of the Nisutlin River. This Creek flows in a generally easterly direction before turning south and eventually circling back to flow north to the confluence with the Nisutlin River at UTM 609900mE, 6751450mN. The South Canol Road crosses Cottonwood Creek approximately 1 km upstream of its confluence with the Nisutlin River (Figure 3).

Cottonwood Creek drains an area of 75.6 km^2, resulting in a MAF of 5.7 m^3/sec. The flow was measured at the Canol Road crossing at 0.231 m^3/sec on July 24 using a price meter, and 0.2304 m^3/sec on July 28 using the floating object method. This was the only site where both methods of calculating discharge where applied to the same reach. Average low flow for the basin is estimated to be about 0.06 m^3/sec (Table 1).

The waters of Cottonwood Creek were slightly alkaline, clear and well aerated. A water chemistry sample was collected at the mouth. Of all the reaches tested, Cottonwood had the highest concentration of iron, however, this level was very low at 0.17 mg/L and was well below the guidelines for the protection of aquatic life. Concentrations of other parameters were low when detected (Tables 2 and 3).

Cottonwood Creek was surveyed for 150 meters above the Canol Road crossing and downstream of the road to the creek outlet at the Nisutlin River on July 24, 25 and 28, 1998 (site CTW). The average wetted width of the creek was 5 meters, average depth was 0.14 meters and the average velocity was 0.35 m/sec (Table 1). Substrates were a mix of cobble and gravel with the occasional boulder, alternating with log debris and associated organic debris and silts. The stream channel is 40% pool, 30% riffle and 30%

glide and flows very confined through a deep valley with banks rising to 6 meters. Extensive instream woody debris and associated pools occur in over 50% of the reach. Riparian vegetation is dominated by alder and poplar with the adjacent forest mature white spruce and pine. A series of beaver dams begins 500 meters downstream of the road crossing and beaver dams spaced 50 meters apart continue to the confluence with the Nisutlin. Recent beaver activity was also in evidence 150 meters upstream of the highway crossing.

The culvert at the South Canol Road crossing was an obvious barrier to fish movements at the time of investigations. Over-wintering habitat potential is likely limited to the lowest reach near the Nisutlin River.

Benthic invertebrates were collected from Cottonwood Creek just downstream of the South Canol Road using the kick net method. The sample consisted of 142 individuals of 9 different taxonomic groups. Three insect orders were dominant, which is unusual. These orders were: Ephemeroptera, Diptera and Trichoptera (Table 4 and Appendix 4).

Species of fish recorded in Cottonwood Creek during this study were chinook salmon (fry,) (Tables 5 and 7) and slimy sculpin. Chinook fry were abundant below the lower beaver dams and became common moving upstream; they were uncommon in the reach between the road and the first downstream beaver dam; and they were not found upstream of the South Canol Road.

Unnamed Tributary #5

The head waters of the Unnamed Tributary #5 flow from Sidney Lake. This small tributary flows in a generally easterly direction to its apparent confluence with the Nisutlin River at UTM 610200mE, 6742150mN (Figure 3).

The outlet area of this tributary was not located during the field assessment, rendering it impossible to conduct any sampling. A small flow area thought to be the outlet was found and deemed inconsequential in terms of fish habitat. It is possible that the true outlet of the creek now flows into a side channel of the Nisutlin River.

Sidney Creek

Sidney Creek is a major tributary of the Nisutlin River. The head waters of Sidney Creek lie in the Big salmon Range of the Pelly Mountains to the west of the Nisutlin River. This Creek flows in a generally south-easterly direction to its confluence with the Nisutlin River at UTM 612650mE, 6737000mN. Major tributaries of Sidney Creek include Murphy Creek, Evelyn Creek, Iron Creek, Twin Creek, and Flat Creek (Figure 3).

Sidney Creek drains an area of 800 km^2 at the mouth, and 368 km^2 at the point it crosses the South Canol Road (site SDN2). The Creek was gauged from 1976 to 1980. During the period of record, annual peak flood occurred on average in mid June and was in the order of 35 m^3/sec. The flow was measured at the Canol Road crossing at 1.82 m^3/sec at the time of the survey, which is slightly lower than the lowest recorded summer

flow during the period of record. Average winter low flow for the basin is estimated to be about 0.82 m^3/sec, and about 0.36 m^3/sec at the Canol Road.

The slightly alkaline waters of Sidney Creek increase in pH from upstream to downstream ranging from 7.68 to 8.25. Conductivity also increased downstream. A water chemistry sample was collected at the mouth. Of the sites analyzed, Sidney Creek was the only site which all of the nutrients were detected. The water was moderately soft with low concentrations of metals detected. (Tables 2 and 3).

The South Canol Road crosses Sidney Creek approximately 10 km above the confluence with the Nisutlin River. Logging and mining activity has occurred in the drainage basin with a small scale mining operation ongoing on Iron Creek. Sidney Creek was divided into 3 distinct reaches for the purpose of this investigation. The first reach (reach S1) covers the lower 10 kms below the Canol Road crossing; a relatively flat area with an open channel as the creek crosses the Nisutlin River flood plain. The second reach (reach S2) starts at the Canol Road crossing and continues upstream to Iron Creek. The third reach (reach S3) extends from Iron Creek and up through the alpine headwaters. Sidney Creek was surveyed July on 23, 24 and 27, 1998. A waterfall that presents an obvious barrier to the upstream migration of fish is located on Iron Creek upstream of the road ford.

Benthic invertebrate samples were collected from three sites on the main stem of Sidney Creek; all were dominated by Diptera and Ephemeroptera. The sample from the mouth was collected using a Surber Sampler and the diversity was significantly greater here than the two sites where a kick net was used. The sample taken downstream of the Canol Road had the lowest population in the study area with 30 individuals. The substrate was composed mainly of sand at this site, which may have limited the colonization of invertebrates (Table 4 and Appendix 4).

Chinook fry from Sidney Creek had good length distribution and a modal length of 60mm (Figure 11). Lengths ranged from 49-90 mm with a mean of 61.9 mm, mean weight was 1.84 g with a range of 1.2-3.2 g, and the K value was 0.98 (Table 8). A single fry at 108 mm and 14.5 g was captured upstream of Iron Creek. It was assumed this fish was a 1+ year fry, indicating some over-wintering by chinook fry likely occurs in Sidney Creek. Over-wintering habitat potential is likely to be good especially from the Nisutlin to the Canol Road.

During the aerial survey of Sidney Creek, 2 adult chinook salmon were observed approximately 2 km downstream of Iron Creek. Past references to chinook spawning in Sidney Creek have been anecdotal.

Species of fish recorded in Sidney Creek during this study include: chinook salmon (fry, 1+, and adult) (fry abundant to prolific throughout with a very high average of 31.2 chinook fry per hour, in SDN3) and slimy sculpin (Table 5).

REACH S1. The portion of this reach investigated extends from the creek outlet at the Nisutlin River (site SDN1) upstream for 1 kilometer. The creek was uniform throughout this reach and had an east/south-east aspect. The wetted width of the creek in this reach ranged from 25 to 35 meters with the dry width to 50 meters, average depth was 0.3 meters, and average velocity was 0.5 m/sec (Table 1). Discharge was calculated at 3.5 m^3/sec. Substrates were predominately gravel (80%) with sand/silt (20%). The creek flowed as a shallow glide (90%) with the occasional riffle (10%), pools were rare. Stream cover was very limited, consisting of occasional undercut banks, instream root wads, or overhead vegetation (2%). Large exposed gravel bars were found throughout this reach. Riparian vegetation was dominated by alder and willow with surrounding forest consisting of poplar and white spruce. Chinook fry were common to abundant throughout this reach.

REACH S2. This reach was investigated in the vicinity of the crossing of the South Canol Road (site SDN2). The average wetted width of the creek was 13.4 meters and the discharge was calculated at 1.82 m^3/sec, average depth was 0.28 meters, and average velocity 0.48 m/sec (Table 1). Substrates consist of moderately compacted gravel (45%), fines (45%) and cobble (10%). The creek is 70% glide , 15% riffle and 15% pool. The channel follows a pattern of point bars and cut banks on opposing shores. Cut banks rise up to 3 meters in a confined channel. The channel becomes increasingly more confined and entrenched in places moving upstream towards Iron Creek. Good instream cover exists in the form of corner pools, large organic debris and root wads. Areas of coarse substrate also provide good bottom cover in places.

REACH S3. This reach is located upstream of the confluence of Iron Creek (site SDN3). The average wetted width of the creek was 7.4 meters, average depth was 0.49 meters, and average velocity 0.22 m/sec (Table 1). Substrates consist of cobble (60%), gravel (35%), and fines (5%). Cover consists of overhanging vegetation (35% crown closure), large instream woody debris (35%), deep pools (10%), and undercut banks (20%). This reach has 65% riffle, 20% glide, and 15% pool and the channel is partially confined. This reach had the highest numbers of chinook fry captured in minnow traps within the study with an average CPUE of 31.18 fry/hour for a total of 5 traps (Table 5). This CPUE is likely the highest ever recorded in the upper Yukon Drainage.

Murphy Creek

Murphy Creek is a major tributary of Sidney creek. The head waters of Murphy Creek lie in the Big salmon Range of the Pelly Mountains to the west of the Nisutlin River. This Creek flows in a generally north/easterly direction to where it crosses the Canol Road, then turns to parallel the road flowing north to its confluence with Sidney Creek approximately 6 km upstream of the Nisutlin River at UTM 608150mE, 6728100mN (Figure 3).

Murphy Creek drains an area of 210 km^2 at the mouth, and 110 km^2 at the Canol Road crossing. The Creek was gauged with a continuous water level recorder from 1977 to 1980. During the period of record, annual peak flood occurred on average in the first

week of June and was in the order of 11 m^3/sec. Average low flow for the basin is estimated to be about 0.19 m^3/sec, and about 0.09 m^3/sec at the Canol Road.

The waters of Murphy Creek were slightly alkaline, well aerated and had a low conductivity, similar to Evelyn Creek (Table 1).

Murphy Creek was investigated in the vicinity of the South Canol Road on July 28 and 29,1998 (site MPH). The average wetted width of the creek was 6 meters, with substrates consisting of loosely compacted boulders (55%), cobble (40%), and gravel/sand (5%). Average depth was 0.3 meters and average velocity >1 m/sec (Table 1). Stream banks are gentle to abrupt rising to 2.5 meters. The creek flows primarily as a riffle with instream pools created by large boulders. Stream-side vegetation was dominated by alder and willow. Adjacent vegetation consisted of mature white spruce with some under-story alpine fir.

Murphy Creek was sampled for benthics using the kick net method. The benthic samples consisted of 221 individuals with a diversity of 11 different taxonomic groups and was dominated by the order Diptera (Table 4 and Appendix 4).

Chinook fry from Murphy Creek had a modal length of 65mm (Figure 12). Lengths ranged from 57-79 mm with a mean of 65.02 mm, mean weight was 3.23 g with a range of 2.3-4.6 g, and the mean K value was 1.17 (Table 8).

Species of fish recorded in Murphy Creek during this study include: chinook salmon (fry, abundant) and slimy sculpin (Table 5). Chinook fry were much more abundant downstream of the culvert at the Canol Road than upstream, and at the time of investigations the culvert was acting as a barrier to fish passage. Suitable summer chinook fry habitat exists throughout and over-wintering habitat potential is likely to exist below the culvert.

Evelyn Creek

Evelyn Creek is a major tributary of Sidney Creek. The head waters of Evelyn Creek lie in the Big Salmon Range of the Pelly Mountains to the west of the Nisutlin River. This Creek flows in a generally easterly direction to where it crosses the South Canol Road, then turns north to flow to its confluence with Sidney Creek at UTM 606450nE, 6740600mN (Figure 3).

Evelyn Creek drains an area of 210 km^2 at the mouth, resulting in a MAF of 12.6 m^3/sec. Average low flow in the creek is estimated to be about 0.16 m^3/sec.

The waters of Evelyn Creek were slightly alkaline and had a low conductivity, similar to Murphy Creek (Table 1).

Evelyn Creek was investigated upstream and downstream of the Canol Road crossing on July 25 and 26,1998 (site EV1). An evaluation of Evelyn Creek in the upper

reaches (9 km upstream of the road) and a small tributary (TEV) was conducted on July 27 (site EV2).

In the vicinity of the Canol Road crossing, the average wetted width was 10.4 meters, average depth was 0.29 meters, and average velocity was 0.285 m/sec (Table 1). Substrates consisted of well compacted cobble (60%), gravel (30%), and fines (10%). The channel is confined with steep unstable banks and flows as 80% riffle, 15% run and 5% pool. Cut banks, instream large organic debris and 30% canopy cover provide good to excellent cover in the creek. Vegetation consists of willows and alders with adjacent large mature spruce.

The average wetted width of Evelyn Creek in the upper reach was 5 meters and the dry width was 10 meters; average depth was 0.4 meters and average velocity > 1 m/sec (Table 1). Substrates consist of boulder (50%), cobble (20%), gravel (15%), bedrock (10%), and sand (5%). Stream banks were entrenched with some exposed bedrock. Cover was primarily in the form of large instream boulders and associated pools. The creek was mostly riffle (90%) with the occasional pool (10%). Riparian vegetation was alpine fir and alder. A beaver dam exists just below the tributary that drains Grayling Lake.

Evelyn Creek was sampled for benthics using the kick net method at a site near the Canol Road. The benthic samples had a population of 137 individuals representing 11 different taxonomic groups. This site was dominated by three orders, Plecoptera, Ephemeroptera and Diptera (Table 4 and Appendix 4).

Chinook fry from Evelyn Creek occurred in two distinct length classes with a comparatively long modal length group of 70 mm (Figure 13). Length ranged from 58-76 mm, with a mean length of 67 mm. A single fish from the larger (1+yr) length class was recorded at 116 mm (Table 8).

Species of fish recorded in Evelyn Creek during this study include: chinook salmon (fry, prolific, 1+yr uncommon) near the Canol Road Crossing, and slimy sculpin (Table 5). In one minnow trap alone, 217 fry were captured in a 18.5 hour set in Evelyn Creek. This appears to be a Yukon record for the number of fry captured in one trap (al von Finster per. com.). Over-wintering habitat is probably limited to the area near the confluence of Sidney Creek as the stream is rocky with a high gradient closer to the Canol road. Chinook fry were not found in the upper reaches of Evelyn Creek. A single round whitefish was observed in the small tributary entering Evelyn Creek from the south, 2 km upstream of the South Canol Road.

Unnamed Tributary #6

The head waters of Unnamed Tributary #6 lie in the high country of the Yukon Plateau east of the Nisutlin River. This tributary flows in a generally south/southwesterly direction before turning to flow south-easterly and parallel to the Nisutlin River. The

confluence of this tributary and the Nisutlin River is located at UTM 620850mE, 6725000mN (Figure 3). Several lakes are located in the upper reaches of the creek.

Unnamed Tributary #6 has a small basin, draining an area of 40 km^2, resulting in a MAF of 3.0 m^3/sec. Flow was estimated at less than 0.1 m^3/sec during the survey. Average low flow in the creek is estimated to be about 0.03 m^3/sec (Table 1).

Water chemistry and benthic samples were not taken from Unnamed Tributary #6.

Unnamed Tributary #6 was investigated near the outlet to the Nisutlin River on July 28, 1998 (site UN6). The wetted width of the creek ranged from 6 to 8 meters, average depth was 0.3 meters, and average velocity 0.31 m/sec (Table 1). Stream discharge was assessed at <0.1 m^3/sec. Substrates consist predominantly of mud (95%) with occasional gravel patches (5%). Substrates and algae exhibit an orange tinge likely resulting from the presence of iron reducing bacteria. The creek is predominantly glide (90%), and the few riffles that exist are located directly below a beaver dam approximately 55 meters upstream of the creek outlet. The creek meanders through the mud showing evidence of recent erosion. Stream banks are abrupt rising to 0.5 meters. Cover is limited in this reach to instream woody debris (10%) and aquatic grasses (3%). Stream side vegetation is grass and sedges with some equisetum. The surrounding vegetation is mixed white spruce and poplar forest with grasses and willow under-story.

The reach of this creek investigated was assessed to have low potential as fish habitat. The only species of fish recorded in Unnamed Tributary #6 during this study was northern pike (fry) observed in aquatic grass areas near the creek outlet. There is not likely to be any over-wintering habitat due to low flows.

Unnamed Tributary #7

The head waters of the Unnamed Tributary #7 lie in the Big Salmon Range of the Pelly Mountains west of the Nisutlin River. This tributary flows in a generally north/easterly direction to its confluence with the Nisutlin River at UTM 623200mE, 6721650mN (Figure 2).

Unnamed Tributary #7 drains an area of 70 km^2, resulting in a MAF of 5.3 m^3/sec. Flow was measured at 0.4 m^3/sec during the survey. Average low flow in the creek is estimated to be about 0.06 m^3/sec (Table 1).

The creek was investigated from its outlet at the Nisutlin River upstream for 150 meters on July 28,1998 (site UN7). The average wetted width was 4.5 meters and substrates were gravel (75%), cobble (15%) and sand (10%). The lower portion of the creek flows over a gravel bar at its confluence with the Nisutlin River. The creek was composed primarily of riffle (95%) with what little pool-glide (5%) present, located immediately below a beaver dam 90 meters upstream of the creek outlet. The lower 75 meters of the creek had virtually no cover, but increased to 30 % further upstream in the

form of woody debris and undercut banks. Stream banks were steep and grassy surrounded by mixed spruce and poplar forest.

Water chemistry and benthic samples were not taken from Unnamed Tributary #7.

Species of fish recorded in the Unnamed Tributary #7 during this study was limited to chinook salmon (fry, common) above and below the beaver dam (Table 5). Northern pike were observed in the creek's zone of influence in the Nisutlin River. Over-wintering habitat likely does not exist in this creek due to shallows and upstream barriers.

Unnamed Tributary #8

The head waters of Unnamed Tributary #8 lie in the Big Salmon Range of the Pelly Mountains west of the Nisutlin River. This tributary flows in an easterly direction to its confluence with the Nisutlin River at UTM 626000mE, 6715250mN (Figure 2).

Unnamed Tributary #8 drains an area of 78 km^2, resulting in a MAF of 5.9 m^3/sec. Flow was measured at 0.32 m^3/sec during the survey. Average low flow in the creek is estimated to be about 0.06 m^3/sec (Table 1).

Water chemistry and benthic surveys were not conducted on Unnamed Tributary #8.

This creek was investigated from its outlet to the Nisutlin River upstream for 500 meters on July 28,1998 (site UN8). The wetted width of the creek was 2 meters and the channel width was 5 meters; average depth was 0.25 meters and average velocity 0.3 m/sec (Table 1). Substrates were predominantly gravel (85%) with some sand (15%). The lower 45 meters of the creek flowed over a gravel bar at the confluence with the Nisutlin River. The creek showed a well developed pool:riffle ratio at 1:1 with the occasional deep pool (> 1 meter) associated with spruce deadfall. Glides comprised 35% of the stream. The creek has a high degree of cover (60%) primarily in the form of instream woody debris, undercut banks and overhanging vegetation. Creek banks were steep and abrupt rising to 2 meters. The creek had grassy banks with willow and alder common. Surrounding vegetation is mature white spruce forest.

Chinook fry from Unnamed Tributary #8 ranged in length from 47-71 mm with a mean of 56.43 mm, (Table 8).

Although relatively small, this creek provided excellent fish habitats. Species of fish recorded in Unnamed Tributary #8 during this study include chinook salmon (fry, common), Arctic grayling (fry), slimy sculpin, and round whitefish (Table 6). Over-wintering potential exists in the surveyed reach in the form of deep channels and pools.

Thirty Mile Creek

The head waters of Thirty Mile Creek lie in the high country of the Yukon Plateau east of the Nisutlin River. Thirty Mile Lake is located in the upper reaches of this creek from which it flows in a southerly direction draining the north and west sides of the Thirty Mile Range before turning to flow in a south-westerly direction to its confluence with the Nisutlin River at UTM 626900mE, 6715100mN (Figure 2).

Thirty Mile Creek is a significant tributary, draining an area of 384 km^2, resulting in a MAF of 26.4 m^3/sec. Flow was measured at 1.55 m^3/sec during the survey. Average low flow in the creek is estimated to be about 0.59 m^3/sec.

The waters of Thirty Mile Creek were the most alkaline of those tested, with a pH of 8.49. The waters were hard. No nutrients and very few metals were detected (Table 1). Benthic samples collected at Thirty Mile Creek had a population of 329 individuals representing 37 different taxonomic groups (Table 4 and Appendix 4).

Thirty Mile Creek was investigated from its outlet upstream for 500 meters on July 29, 1998 (site 30MI). Stream discharge was calculated at 1.55 m^3/sec. Substrates were primarily cobble/gravel with some sand. Pool:riffle ratio was estimated at 1:2 with 15% of the stream flowing as a glide. Pools were common at the outside bends of the creek often associated with instream woody debris. Several pools were deeper than 1 meter. Cover was abundant in the form of instream woody debris and over-hanging vegetation. Surrounding vegetation consisted of alder and willow at the stream banks surrounded by mature spruce forest.

Thirty Mile Creek provides excellent habitat for rearing chinook salmon and chinook fry from both age classes were found. A single 1+ year fry at 124 mm and 21.1 g was captured. Fry had a modal length group of 60 mm (Figure 14). The mean length was 60.3 mm with a range of 54-69 mm, the mean weight was 2.07 g with a range of 1.2-3.5 g, and the mean K value was 1.11 (Table 8). Over-wintering habitat potential is high for the surveyed reaches due to significant water supply and depth.

Species of fish recorded in Thirty Mile Creek during this study include chinook salmon (fry, uncommon) and slimy sculpin (Table 5).

Unnamed Tributary #9

The head waters of Unnamed Tributary #9 lie in the high country of the Yukon Plateau east of the Nisutlin River. This tributary flows in a generally westerly direction to its confluence with the Nisutlin River at UTM 629700mE, 6704450mN (Figure 2).

Unnamed Tributary #9 drains an area of 106 km^2, resulting in a MAF of 7.9 m^3/sec. Flow was measured at 0.18 m^3/sec during the survey. Average low flow in the creek is estimated to be about 0.09 m^3/sec.

The waters of Unnamed Tributary #9 were slightly alkaline, clear and moderately hard. Generally the only metals detected where those that are constituents of hardness (Tables 1 and 2).

Unnamed Tributary #9 was investigated near the outlet to the Nisutlin River and upstream for a distance of 250 meters on July 29,1998 (site UN9). The wetted stream width was 5 meters with a dry width of 15 meters; average depth was 0.2 meters and average velocity 0.5 m/sec (Table 1). The creek has abandoned an old channel and cut a new one approximately 50 meters upstream of the outlet. The new channel flows over a drop creating a small a pool. At the time of investigations, this drop represented a barrier to fish passage. Substrates consisted of gravel (80%), sand/silt (15%) and cobble (5%). The pool:riffle ratio was 1:5 with 50% of the creek a glide. Stream cover was at 50% composed of over-hanging alder, undercut banks, and instream woody debris. Stream-side vegetation consists of alder and grasses with some willow, surrounding vegetation is willow and alder with the occasional white spruce.

Benthic samples collected at Unnamed Tributary #9 had a population of 587 individuals and a diversity of 36 different taxonomic groups. Just over half of the community were Dipterans (Table 4 and Appendix 4).

Chinook fry from this tributary ranged in length from 54-67 mm with a mean length of 57.5 mm (Table 8).

Species of fish recorded in Unnamed Tributary #9 during this study include chinook salmon (fry, abundant) and slimy sculpin (Table 6). Chinook fry were abundant in a pool below the drop in the creek. Above this barrier, fry of undetermined species were occasionally observed, but rarely. Over-wintering habitat will be confined to the lower 50 m, with none expected above the steep drop.

Wolf River

The Wolf River is a major sub-basin of the Nisutlin River with its head waters in the Yukon Plateau east of the Nisutlin River. Wolf Lake is located in the upper reaches of this river which has several major tributaries. The Wolf River flows in a generally south/westerly direction to its confluence with the Nisutlin River at UTM 635450mE, 6684500mN (Figure 2). The Wolf River marks part of the north boundary of the Nisutlin River National Wildlife Area.

The Wolf River drains an area of approximately 3,954 km^2, resulting in a MAF of 236.19 m^3/sec. The flow in the Wolf River was measured at 14.0 m^3/sec with a Price type velocity meter using the velocity – area method by wading. This was apparently the first ever flow measurement on this river.

The waters of the Wolf River were slightly alkaline, moderately soft and clear. Orthophosphate was the only nutrient detected. Metal concentrations were low where detected (Tables 1 and 2).

The Wolf River was investigated from its outlet upstream for approximately 1.2 kilometers on July 30, 1998 (site WLFR). Within this reach, the river is braided with numerous gravel bars and islands. The average wetted width was 30 meters, the average depth 0.6 meters, and the average velocity 0.8 m/sec (Table 1). There were many dry side channels as well as channels with slack water, in some cases cut off from the river. Substrates consisted of moderately compacted gravel (90%) with some cobble (10%). Pool:riffle ratio was 1:5 with 60% of the river flowing as a glide. Cover was limited to the occasional undercut bank and overhanging vegetation. Poplar and willow predominated in riparian areas and on islands.

Benthic samples collected at Wolf River had a population of 323 individuals and a diversity of 45 different taxonomic groups. Diptera and Ephemeroptera were the dominant orders (Table 4 and Appendix 4).

Chinook fry from the Wolf River had a modal length group of 70 mm (Figure 15). Lengths ranged from 54-83 mm, with a mean of 67.17 mm, mean weight was 3.17 g with a range of 1.5-5.9 g, and the mean K value was 1.03 (Table 8).

Species of fish recorded in Wolf River during this study include chinook salmon (fry, abundant to common), northern pike, Arctic grayling, round whitefish, longnose sucker and slimy sculpin (Tables 5 and 6). Slack water areas were utilized by chinook, longnose sucker, and northern pike fry. Chinook and round whitefish fry were found in riffle areas. Small numbers of chinook fry, northern pike fry and longnose sucker fry were observed stranded in small side pools that had become isolated from the main river flow.

Unnamed Tributary #10

The head waters of Unnamed Tributary #10 lie in the Big Salmon Range of the Pelly Mountains west of the Nisutlin River. This tributary flows in a generally south/easterly direction to its confluence with the Nisutlin River just upstream of the Nisutlin Delta at UTM 634200mE, 6680950mN (Figure 2).

Unnamed Tributary #10 drains an area of 72 km^2, resulting in a MAF of 5.5 m^3/sec. Flow was measured at 0.10 m^3/sec during the survey. Average low flow in the creek is estimated to be about 0.06 m^3/sec (Table 1).

Water chemistry and benthic samples were not taken from Unnamed Tributary #10.

This creek was investigated from its outlet at the Nisutlin River upstream for 200 meters on July 31,1998 (site UN10). The average wetted width of the creek was 2.5 meters with an average dry width of 8 meters; average depth was 0.3 meters and average velocity 0.5 m/sec (Table 1). Discharge was determined to be 0.1 m^3/sec. Substrates were primarily gravel (75%), cobble (23%) with the occasional boulder (2%), and organic fines settled in pool areas. The creek has excellent cover in the form of instream woody debris, overhanging vegetation, and small undercut banks. The pool:riffle ratio was well

developed at 1:1, with pools often associated with instream woody debris. Approximately 50% of the creek flowed as a glide. The banks of the creek were generally abrupt rising to 2 meters. A high (15m) clay cut bank is located on the south side of the creek 30 meters upstream of the Nisutlin. A breached beaver dam is located about 150 meters from the creek outlet. Riparian vegetation consists of willow and alder and the surrounding forest is comprised of mature white spruce with the occasional poplar.

Chinook fry from Unnamed Tributary #10 had a mean length of 59.6 mm and ranged from 61-71 mm, mean weight was 2.28 g with a range of 1.5-4.3 g. Fry from this creek had the lowest mean condition factor (K) for chinook of any of the creeks investigated with a value of 0.84 (Table 8).

Species of fish recorded in the Unnamed Tributary #10 during this study include chinook salmon (fry, common) (Table 6) and slimy sculpin. Over-wintering habitat seems to be confined to the lower 150 m, as a breached beaver dam likely restricts use of upstream habitats.

Tributaries to Teslin Lake:

Flat Creek

Flat Creek, named as Fat Creek on some topographic map sheets, is locally known as Flat Creek, and will be referred to in this report as such. The head waters of Flat Creek lie in the low hills to the south west of Teslin Lake, due south of Bryde Mountain. Several head water tributaries, most originating from small lakes, converge to form the creek, which flows in a northerly direction for more than 40 kms through extensive wetlands to Flat Lake before descending the final 2 kms into Teslin Lake at UTM 616150mE, 6673400mN (Figure 2).

The Flat Creek watershed is approximately 800 km^2 in area, resulting in a Mean Annual Flood (MAF) of over 50 m^3/sec. Both flooding and winter low flow will be attenuated by lakes and wetlands in the upper part of the basin. Minimum flow is estimated to be in the order of 0.8 m^3/sec on average. Flow was measured with a price meter at only 0.479 m^3/sec during the survey. This corresponds to the 5 Year Low Flow event, indicative of a very dry year.

The waters of Flat Creek were alkaline (pH 8.45), hard, well aerated and clear. Of the waters tested, Flat Creek had the highest concentrations of ammonia, nitrate, arsenic, and manganese, however, levels were low and below applicable guidelines (Tables 2 and 3).

Flat Creek was divided into 2 distinct reaches for the purposes of investigations conducted on July 9,1998. Reach F1 (site FT1) extends from the creek outlet at Teslin Lake upstream for 350 meters to the confluence of Sterlin Creek. Reach F2 (site FT2) extends from the confluence of Sterlin Creek upstream to the outlet of Flat Lake.

Reach #1 flows over an open delta vegetated with sedges. The creek braids into 2 channels near the lake, and substrates consisted primarily of gravel/cobble mixes with some boulders and sand. The creek's channel comes close to bedrock upstream of Sterlin Creek and then follows a steep and confining bench which runs along the south bank and extends well out into Teslin Lake.

Bedrock comes to surface in the creek immediately upstream of the outlet of Sterlin Creek in a reach with many angular boulders, both large and small, and some deep pools formed adjacent to the outlet of Sterlin Creek. Several deep pools with thick aquatic vegetation occur on the north bank adjacent to a sedge meadow. This reach had abundant levels of fish utilization by several species.

Substrates had a higher degree of fines above the confluence of Sterlin Creek with shifting silts and sands becoming the dominant substrate closer to Flat Lake. Signs of historic beaver activity were visible throughout and an active dam was located at the outlet of Flat Lake.

Water temperatures became progressively warmer moving upstream towards Flat Lake for a total difference of 5°C.

Benthic samples collected at Flat Creek were the most abundant and diverse of the creeks assessed, with a population of 4,151 and a diversity of 72. Diptera was the dominant order forming 82.3% of the community (Table 4 and Appendix 4).

Chinook fry from Flat Creek had a modal length group of 65 mm (Figure 20) with a mean of 61.8 mm and ranged from 49-71 mm, mean weight was 2.8 g with a range of 1.3-4.4 g, and the mean K value was 1.1 (Table 8). No chinook were captured in reach F2, however several were observed. Over-wintering habitat exists in the form of deep pools.

Species of fish recorded in Flat Creek during this study include the following: chinook salmon (fry, abundant FT1,uncommon FT2)(Tables 5 and 6), longnose sucker (juv., abundant), Arctic grayling (fry, abundant, adult, juv., common), slimy sculpin (abundant), northern pike (fry, juv. and adults, common), and broad whitefish (fry, uncommon.

REACH F1 (site FT1). The average wetted width of the creek in this reach was 8 meters (Table 1). Substrates consisted of loosely compacted cobble (60%), sand (30%) and gravel (10%). The lower portion of this reach flows through an open flood plain in sedge meadow. Willows become more common upstream. The creek is 80% glide 15% riffle and 5% pool. Several deep pools occur near the outlet of Sterlin Creek in an area of large boulders. Below this, cover is limited to pools in the main flow and some instream woody debris. Chinook fry were abundant throughout this reach.

REACH F2 (site FT2). The creek in this reach is generally shallow, wide and slow with abundant aquatic vegetation. The average width of the creek narrows to 7 meters. Immediately upstream of the confluence with Sterlin Creek is a short reach composed of 80% angular boulders filled with gravel sand mixes. Upstream of this reach substrates consisted of a mix with 10% boulder 20% cobble, 30% gravel, and 40% sandy silts. The sandy silt reaches are loosely compacted and become more common closer to Flat Lake. Banks are generally open with some confining on the south side. This reach is 80% glide, 18% riffle, and 2% pool. An active beaver dam exists 20 meters downstream of the outlet of Flat Lake. Cover exists in the form of aquatic vegetation (35%), boulders (5%), over-hanging vegetation (10%),and the occasional undercut bank (3%). Riparian vegetation is sedge and willow with adjacent mature spruce. Chinook fry were less common in this reach than in reach 1.

Sterlin Creek

Sterlin Creek is a major tributary of Flat Creek. The head waters of Sterlin Creek lie on the north side of Mount Bryde west of Teslin Lake. Sterlin Lake is located in the upper reaches, from which Sterlin Creek flows in a east/ north-easterly direction to its confluence with Flat Creek at UTM 616000mE, 6673400mN (Figure 2).

Sterlin Creek drains an area of 81 km^2, resulting in a MAF of about 6 m^3/sec. Flow was estimated at 0.2 m^3/sec at the time of the survey. Note that the basin yield in Sterlin Creek is more than twice that of Grayling Creek with a similar drainage area. Winter low flow may be higher than the predicted average low flow of about 0.07 m^3/sec.

Sterlin Creek was investigated from the confluence at Flat Creek upstream for 320 meters on July 9,1998 (site STRL). The average wetted width of this creek was 4 meters, with and an average depth of 0.2 meters and velocity of 0.35 m^3/sec (Table 1). Substrates consisted of loosely compacted cobble (75%), sand (20%) and gravel (5%). Stream banks are abrupt rising to 1.3 meters. Cover consists of undercut banks, corner pools, instream woody debris and overhanging vegetation. The stream is 60% glide, 30% riffle, and 10% pool. Riparian vegetation is predominantly willow with mature spruce. Recent and historic beaver activity was in evidence. Over-wintering habitat should exist in the surveyed reach because of lake attenuation.

Water chemistry and benthic samples were not taken at Sterlin Creek.

Fish species recorded in Sterlin Creek during this study include chinook salmon (fry, common), Arctic grayling (fry and adult), and slimy sculpin (Tables 5 and 6).

Grayling Creek.

The head waters of Grayling Creek lie in the high country of the Yukon Plateau to the west side of Teslin Lake. The creek flows in a generally east /north-easterly direction to enter the west side of Teslin Lake at UTM 08611 201mE/ 6681006mN (Figure 2).

Grayling Creek drains an area of 83 km^2, resulting in a MAF of just over 6 m^3/sec. Flow was measured at 0.086 m^3/sec. Flooding has resulted in significant channel reconfiguration. There is a gravel delta at the outlet to Teslin Lake. The average low flow is estimated to be about 0.07 m^3/sec.

Grayling Creek was surveyed from it's outlet at Teslin Lake upstream for 625 meters to the site of a large active beaver dam on July 9,1998 (site GRC1 and GRC2). The average creek wetted width was 4 meters, average depth was 0.15 meters and average velocity was 0.25 m^3/sec (Table 1). The average dry width of the creek was 8 meters. Substrates were loosely compacted cobble (30%), gravel (30%) and sand (30%), and exhibited a layer of algae growth. Stream banks were abrupt rising to 1 meter in a confined channel. The creek was 50% glide, 45% riffle, and 5 % pool. Good instream cover exits in the form of submerged vegetation and undercut banks. Overhead cover was provided by mature spruce / poplar forest with willow and alder adjacent to the creek. The lower 50 meters of the creek flows over an exposed gravel beach prior to emptying into Teslin Lake. A beaver dam 1.8 meters in height marks the top of this reach. Above this dam, the creek channel is flooded, and has silt substrates. No fish were captured above this dam.

Water chemistry and benthic samples were not taken at Grayling Creek.

Chinook fry from Grayling Creek had a modal length group of 60 mm (Figure18) with a mean of 59.63 mm and ranged from 49-71 mm. Mean weight was 2.1 g with a range of 1.2-3.4 g, and the mean K value was 0.99 (Table 8). Over half of the fry sampled fell within the modal length group. Over-wintering habitat is expected to be very limited.

Species of fish recorded in Grayling Creek during this study include chinook salmon (fry, abundant), slimy sculpin and Arctic grayling (juv.) (Table 5). Large numbers of fry were observed in Teslin Lake near the outlet of Grayling Creek. Although none of these fry were captured for a positive identification they did appear to be chinook fry.

Brooks Brook (Gantiyakw)

Brooks Brook is also known by its Tlingit name as Gantiyakw. The head waters of Brooks Brook lie in the Big Salmon Range of the Pelly Mountains on the east side of Teslin Lake. The creek flows in a generally south-west direction to enter the east side of Teslin Lake at UTM 599400mE, 6698750mN (Figure 2). A First Nations cultural camp, known as Brooks Camp and maintained by the TTC, is located near the outlet of the creek on Teslin Lake.

Brooks Brook drains an area of 60 km^2, resulting in a MAF of 4.6 m^3/sec. Flow was measured at 0.204 m^3/sec. A few deep pools between the Highway and Teslin Lake will likely be available as over-wintering habitat. Low flow is estimated to average 0.05 m^3/sec.

The waters of Brooks Brook were slightly alkaline, well aerated, moderately soft and clear (Table 3). Both Brooks Brook and Deadman Creek had the highest concentration of zinc in the water column, although the value of 0.02 mg/l is below the guidelines for the protection of aquatic life (Table 2, Appendix 3).

Brooks Brook was investigated from its outlet at Teslin Lake upstream for 450 meters to the Alaska Highway crossing, and immediately upstream of the culvert, on July 8, 1998. The creek was divided into 2 distinct reaches for the purposes of this study. ReachB1 (site BRB1) extends from Teslin Lake upstream for 135 meters to the first beaver dam and consists of an open delta area for the first 65 meters before entering a confined channel with gentle banks. Reach B2(sites BRB2 and BRB3) extends from the beaver dam, upstream for 325 meters to the culvert at the Alaska Highway crossing and includes the upstream side of the culvert.

Chinook fry from Brooks Brook had a modal length class of 60 mm with both the 65 and 70mm classes well represented (Figure 16). They had a mean length of 62.96 mm and ranged from 57-76 mm, mean weight was 2.51 g with a range of 1.4-4.2 g, and the mean K value was 1.05 (Table 8).

Species of fish recorded in Brooks Brook during this study include chinook salmon (fry, abundant BRB1, uncommon BRB2, common BRB3) and slimy sculpin (Table 5). Northern pike (adults and juv.)were observed in adjacent side channels near the creek outlet to Teslin Lake. No fish were captured on the upstream side of the Alaska Highway.

REACH B1. This reach had an average wetted width of 7 meters, average depth of 0.15 meters and an average velocity of 0.45 m^3/sec (Table 1). Substrates consisted of moderately compacted cobble (60%) and gravel (35%), with some silting (fines<5%) and the occasional boulder. Stream banks have a gentle rise to a maximum of 1 meter and the open channel near the lake becomes confined moving upstream. The lower 65 meters of the creek flows over a gravel beach exposed due to low water levels in Teslin Lake. Limited cover occurs in this reach which is predominantly riffle with a pool:riffle ratio of 1:10. Riparian vegetation consists of some sedge at the waterline with willow adjacent. An active beaver dam 0.65 meters in height marks the upper boundary of this reach.

REACH B2. The creek narrows in this reach to an average wetted width of 3.5meters, an average depth of 0.45 meters, and an average velocity of 0.51 m^3/sec (Table 1). Substrates consisted of gravel (50%) and cobble (50%) with the occasional boulder. Stream banks rise abruptly from 0.5 to 2.5 meters and the channel is confined. The creek has some cut banks and instream woody debris with a high degree of crown closure (80-100%) consisting of willow and alder. The lower portion of the reach consisted of 80% pool and 20% riffle. In the upper portion of the reach riffles become predominant. A large pool (12m x 10m) is located immediately downstream of the culvert at the Alaska Highway. Upstream of the culvert, the creek is deeply confined and flows as a fast riffle with few large pools. No fish were captured upstream of the culvert.

Deadman Creek

The head waters of Deadman Creek lie in the Big Salmon Range of the Pelly Mountains on the east side of Teslin Lake. The creek flows in a generally south/south-west direction to enter the east side of Teslin Lake near the Alaska Highway at UTM 606700mE, 6690750mN (Figure 2).

Deadman Creek is a significant tributary, draining an area of 150 km^2 at the point it crosses the Alaska Highway. This creek was gauged from 1978 to 1982. Peak flood occurred between May 10 and June 20 during the period of record. The calculated MAF was 10.9 m^3/sec. Flow was measured at 0.849 m^3/sec, comparable to the lowest recorded discharge on record for the summer months. The average low flow is estimated to be about 0.14 m^3/sec.

The waters of Deadman Creek were very slightly alkaline, well aerated and soft (Table 2). All metal concentrations were low except zinc. Both Deadman Creek and Brooks Brook had the highest concentrations of zinc in the water column, although the value of 0.02 mg/L is below the guideline for the protection of aquatic life (Table 3, Appendix 3).

Deadman Creek was divided into 3 distinct reaches for the purpose of this study, conducted on July 8,1998. Reach D1(site DM1) extends from the creek outlet at Teslin Lake upstream for 305 meters to the bridge at the Alaska highway crossing. Reach D2 (site DM2) extends from the bridge at the Alaska highway upstream for 240 meters, runs parallel to the Alaska highway and has blast-rock from highway construction lining the west bank. The blast rock and adjacent highway distinguishes this reach from reach D1. Reach 3(site DM3) extends away from the highway influence, upstream for 270 to a large log jam log jam >1 meter high. This dam fills a reach of creek more than 10 meters long. The log jam is associated with historic beaver activity and appeared to be a barrier to fish passage. Recent flooding and several breached beaver dams were in evidence immediately upstream of the log jam.

Chinook fry from Deadman Creek had a modal length group of 65 mm with shorter length classes better represented than longer length classes (Figure 17). The mean length was 61.94 mm and ranged from 51-77 mm, mean weight was 2.39 g with a range of 1.3-4.2 g, and the mean K value was 1.0 (Table 8).

The woody debris area downstream of the log jam had prolific numbers of chinook fry. The first three reaches above Teslin Lake will likely provide significant over-wintering habitat in the form of deep pools.

The extent of chinook fry utilization was also assessed during 1997 under the Aboriginal Fisheries Strategy coordinated by DFO and the TTC. A healthy population of chinook fry were recorded during that survey as well (Wilson, 1997). At this point it is unknown if chinook spawn in this creek, however there is suitable habitat and there have been unconfirmed reports of adult chinook in the creek.

Cursory investigations upstream of the log jam showed no chinook fry, however Arctic grayling fry were observed.

Benthic invertebrate samples were not taken at Deadman Creek.

Species of fish recorded in Deadman Creek during this study include chinook salmon (fry, abundant DM1&2, prolific DM3), Arctic grayling and slimy sculpin (Table 5).

REACH D1. The average wetted width of this reach was 5 meters, average depth was 0.52 meters, and the average velocity was 0.59 m^3/sec (Table 1). Substrates consisted of moderately compacted gravel (60%) and cobble (40%) with areas of sand deposition on point bars. Cover was limited and consisted of instream woody debris (8%) and undercut banks (4%). Stream-side vegetation is comprised of willow and sedge, with mature Spruce adjacent on the north side and cleared agricultural within 50 meters of the south bank. The reach is 35% pool, 35% riffle, and 30% glide. The lower 105 meters crosses a cobble beach, exposed due to low water levels in Teslin Lake.

REACH D2. The average wetted width was 4 meters and average depth was 0.5 meters (Table 1) and substrates consisted of gravel (40%), cobble (40%), and blast rock (20%). Cover consists of overhead vegetation (20%), instream vegetation (15%), the occasional undercut bank, and angular blast rock lining the west bank. The creek in this reach is 40% pool, 40% riffle, and 20% glide.

REACH D3. The average wetted width in this reach was 4.5 meters and the average depth was 0.65 meters (Table 1). Substrates consisted of gravel (50%) and cobble (50%) with occasional areas of sand deposition. Creek banks are unconfined and abrupt rising to 2.5 meters. The pool:riffle ratio is 2:1 with few glide areas. Riparian vegetation consists of willow with mature spruce and poplar. Chinook fry were aggregated in abundance immediately below the dam at the upper end of this reach.

Lone Tree Creek

The head waters of Lone Tree Creek lie in the Big Salmon Range of the Pelly Mountains on the east side of Teslin Lake. The creek flows in a generally south/south-west direction to enter the east side of Teslin Lake after crossing the Alaska Highway at UTM 612500mE, 6683900mN (Figure 2).

Lone Tree Creek is a small tributary, draining 41 km^2, resulting in a MAF of 3.2 m^3/sec. There is not likely to be any over-wintering habitat in this creek, with an average low flow of only 0.03 m^3/sec.

Lone Tree Creek was investigated in the vicinity of the Alaska Highway crossing on July 9,1998 (site LNT). The average wetted width at the time of this study was 1.8 meters and the dry width of the creek was 3 meters. Substrates consisted of loosely compacted cobble (50%), gravel (40%), and sand (10%). Stream banks have a gentle rise of up to 4 meters and the channel becomes increasingly confined above the highway

Appendix 3

Analytical water quality results from the Teslin drainage, July 1998.

Total Metals

	Nitrite mg/L	Ortho-P mg/L	Sulfate mg/L	Aluminum mg/L	Antimony mg/L	Arsenic mg/L	Barium mg/L	Beryllium mg/L	Bismuth mg/L	Boron mg/L	Cadmium mg/L	Calcium mg/L	Chromium mg/L	Cobalt mg/L
Minimum Detection Limit	0.005	0.005	1	0.06	0.02	0.04	0.001	0.0002	0.02	0.04	0.0001	0.05	0.002	0.004
MCCONNEL RIVER	< 0.005	< 0.005	48.5	< 0.06	< 0.02	< 0.04	0.039	< 0.0002	< 0.02	< 0.04	< 0.0001	49.8	0.002	< 0.004
UNNAMED TRIB #1	< 0.005	< 0.005	5.6	< 0.06	< 0.02	< 0.04	0.008	< 0.0002	< 0.02	< 0.04	< 0.0001	22.5	0.002	< 0.004
WOLF CREEK	< 0.005	< 0.005	5.8	< 0.06	< 0.02	< 0.04	0.023	< 0.0002	< 0.02	< 0.04	< 0.0001	9.47	< 0.002	< 0.004
UNNAMED TRIB #3	< 0.005	< 0.005	5.9	< 0.06	< 0.02	< 0.04	0.106	< 0.0002	< 0.02	< 0.04	< 0.0001	39.9	0.002	0.004
ROSE RIVER	< 0.005	< 0.005	12.9	< 0.06	< 0.02	< 0.04	0.019	< 0.0002	< 0.02	< 0.04	< 0.0001	23.4	0.004	0.005
UNNAMED TRIB #4	< 0.005	< 0.005	8.3	< 0.06	< 0.02	< 0.04	0.086	< 0.0002	< 0.02	< 0.04	< 0.0001	37.7	0.002	< 0.004
COTTONWOOD CREEK	< 0.005	< 0.005	7.2	< 0.06	< 0.02	< 0.04	0.046	< 0.0002	< 0.02	< 0.04	< 0.0001	28.6	0.002	0.005
SIDNEY CREEK	0.005	0.006	7.8	<0.06	<0.02	<0.04	0.041	<0.0002	0.03	<0.04	<0.0001	20.3	<0.002	<0.004
THIRTY MILE CREEK	0.005	0.006	< 1.0	<0.06	<0.02	<0.04	0.042	<0.0002	<0.02	<0.04	<0.0001	43.1	<0.002	<0.004
UNNAMED TRIB #9	< 0.005	0.006	4.1	<0.06	<0.02	<0.04	0.050	<0.0002	<0.02	<0.04	<0.0001	36.2	<0.002	<0.004
WOLF RIVER	< 0.005	0.005	5.1	<0.06	<0.02	<0.04	0.049	<0.0002	<0.02	<0.04	<0.0001	27.5	<0.002	<0.004
NISUTLIN RIVER	< 0.005	< 0.005	14.4	<0.06	<0.02	<0.04	0.060	<0.0002	<0.02	<0.04	<0.0001	34.7	<0.002	<0.004
FAT CREEK	0.006	< 0.005	18.4	< 0.06	< 0.02	0.04	0.056	< 0.0002	< 0.02	< 0.04	< 0.0001	32.2	< 0.002	< 0.004
GRAYLING CREEK	< 0.005	< 0.005	12.6	< 0.06	< 0.02	< 0.04	0.058	< 0.0002	< 0.02	< 0.04	< 0.0001	33.3	< 0.002	< 0.004
DEADMAN CREEK	< 0.005	< 0.005	2.6	< 0.06	< 0.02	< 0.04	0.02	< 0.0002	< 0.02	< 0.04	< 0.0001	13.2	< 0.002	< 0.004
BROOKS BROOK	< 0.005	0.007	4.6	< 0.06	< 0.02	< 0.04	0.026	< 0.0002	< 0.02	< 0.04	< 0.0001	24.8	< 0.002	< 0.004

Appendix 3 Continued

Total Metals

	Copper mg/L	Iron mg/L	Lead mg/L	Magnesium mg/L	Manganese mg/L	Mercury mg/L	Molybdenu mg/L	Nickel mg/L	Phosphorus mg/L	Potassium mg/L	Selenium mg/L	Silicon mg/L	Silver mg/L	Sodium mg/L
Minimum Detection Limit	0.003	0.05	0.03	0.05	0.002	0.00005	0.005	0.01	0.04	0.5	0.001	0.8	0.0001	0.5
MCCONNEL RIVER	< 0.003	< 0.05	< 0.03	13.4	< 0.002	< 0.00005	< 0.005	< 0.01	< 0.04	1	< 0.001	1.6	< 0.0001	1.1
UNNAMED TRIB #1	< 0.003	< 0.05	< 0.03	2.06	< 0.002	< 0.00005	< 0.005	< 0.01	< 0.04	1.1	< 0.001	2	< 0.0001	1.3
WOLF CREEK	< 0.003	< 0.05	< 0.03	2.41	< 0.002	< 0.00005	< 0.005	< 0.01	< 0.04	< 0.5	< 0.001	2.7	0.0001	1.4
UNNAMED TRIB #3	< 0.003	0.17	< 0.03	10.7	0.029	< 0.00005	< 0.005	< 0.01	< 0.04	1.4	< 0.001	2.1	< 0.0001	1.5
ROSE RIVER	< 0.003	0.07	< 0.03	3.89	0.005	< 0.00005	< 0.005	< 0.01	< 0.04	1.6	< 0.001	1.8	< 0.0001	1.6
UNNAMED TRIB #4	< 0.003	0.07	< 0.03	11.0	0.022	< 0.00005	< 0.005	< 0.01	< 0.04	1.5	< 0.001	2	< 0.0001	3.3
COTTONWOOD CREEK	< 0.003	0.17	< 0.03	8.12	0.031	< 0.00005	< 0.005	< 0.01	< 0.04	1.4	< 0.001	1.7	< 0.0001	1.6
SIDNEY CREEK	<0.003	0.06	<0.03	4.98	0.002	< 0.00005	<0.005	<0.01	<0.04	0.7	<0.001	1.4	<0.0001	2.3
THIRTY MILE CREEK	<0.003	<0.05	<0.03	9.18	0.003	< 0.00005	<0.005	<0.01	<0.04	0.5	<0.001	1.6	<0.0001	1.9
UNNAMED TRIB #9	<0.003	<0.05	<0.03	8.38	0.003	< 0.00005	<0.005	<0.01	<0.04	0.8	<0.001	1.6	<0.0001	3.1
WOLF RIVER	<0.003	<0.05	<0.03	6.74	0.003	< 0.00005	<0.005	<0.01	<0.04	<0.5	<0.001	1.3	<0.0001	2.2
NISUTLIN RIVER	<0.003	0.06	<0.03	8.89	0.006	< 0.00005	<0.005	<0.01	<0.04	<0.5	<0.001	1.3	<0.0001	1.9
FAT CREEK	< 0.003	0.08	< 0.03	13.1	0.056	< 0.00005	< 0.005	< 0.01	< 0.04	0.8	< 0.001	2.2	< 0.0001	3.4
GRAYLING CREEK	0.003	< 0.05	< 0.03	11.5	0.003	< 0.00005	< 0.005	< 0.01	< 0.04	0.9	< 0.001	2.7	< 0.0001	4.2
DEADMAN CREEK	< 0.003	0.07	< 0.03	4.22	0.01	< 0.00005	< 0.005	< 0.01	< 0.04	0.8	< 0.001	2.8	< 0.0001	2.2
BROOKS BROOK	< 0.003	0.06	< 0.03	6.82	0.006	< 0.00005	< 0.005	< 0.01	< 0.04	0.8	< 0.001	2.8	< 0.0001	2.9

Appendix 3 Continued

	Total Metals								Dissolved Metals		
	Strontium mg/L	Sulphur mg/L	Tellurium mg/L	Thallium mg/L	Tin mg/L	Titanium mg/L	Vanadium mg/L	Zinc mg/L	Zirconium mg/L	Calcium disolved mg/L	Magnesium mg/L
Minimum Detection Limit	0.001	0.1	0.02	0.002	0.02	0.003	0.003	0.01	0.003	0.01	0.02
MCCONNEL RIVER	0.149	15.1	< 0.02	< 0.002	< 0.02	< 0.003	< 0.003	< 0.01	< 0.003	49.1	13.4
UNNAMED TRIB #1	0.095	1.7	< 0.02	< 0.002	< 0.02	< 0.003	< 0.003	< 0.01	< 0.003	21.6	2.01
WOLF CREEK	0.024	1.9	< 0.02	< 0.002	< 0.02	< 0.003	< 0.003	< 0.01	< 0.003	8.46	2.2
UNNAMED TRIB #3	0.111	1.9	< 0.02	< 0.002	< 0.02	< 0.003	< 0.003	< 0.01	< 0.003	40.6	11
ROSE RIVER	0.09	4	< 0.02	< 0.002	< 0.02	< 0.003	< 0.003	< 0.01	< 0.003	22.6	3.81
UNNAMED TRIB #4	0.143	2.6	< 0.02	< 0.002	< 0.02	< 0.003	< 0.003	< 0.01	< 0.003	39.2	11.6
COTTONWOOD CREEK	0.068	1.5	< 0.02	< 0.002	< 0.02	< 0.003	< 0.003	< 0.01	< 0.003	27.2	7.78
SIDNEY CREEK	0.074	2.7	<0.02	<0.002	<0.02	<0.003	<0.003	<0.01	<0.003	19.9	5.02
THIRTY MILE CREEK	0.146	2.7	<0.02	<0.002	<0.02	<0.003	<0.003	<0.01	<0.003	42.4	9.3
UNNAMED TRIB #9	0.110	1.5	<0.02	<0.002	<0.02	<0.003	<0.003	<0.01	<0.003	34.2	8.12
WOLF RIVER	0.100	1.8	<0.02	<0.002	<0.02	<0.003	<0.003	<0.01	<0.003	27	6.83
NISUTLIN RIVER	0.119	5.1	<0.02	<0.002	<0.02	<0.003	<0.003	<0.01	<0.003	33.9	8.97
FAT CREEK	0.172	6.5	< 0.02	< 0.002	< 0.02	< 0.003	< 0.003	0.01	< 0.003	33.0	14.0
GRAYLING CREEK	0.184	4.7	< 0.02	< 0.002	< 0.02	< 0.003	< 0.003	0.01	< 0.003	34.5	12.4
DEADMAN CREEK	0.054	1.3	< 0.02	< 0.002	< 0.02	< 0.003	< 0.003	0.02	< 0.003	13.9	4.52
BROOKS BROOK	0.094	2.1	< 0.02	< 0.002	< 0.02	< 0.003	< 0.003	0.02	< 0.003	25.2	7.21

Appendix 4

Percent composition for benthic taxonomic groups collected in the Teslin drainage, summer 1998.

SITE	Ephemeroptera	Plecoptera	Trichoptera	Diptera	Hydracarina	Other
Nisutlin R u/s McNeil R	49	4.6	13.1	22.4	5.7	5.1
McNeil R	15.4	7.5	3.8	61	8.7	3.5
McConnel R	27.5'	10.8	0.6	41.9	16.2	3
Unnamed Tributary #1	43.6	13.6	5.7	32.1	3.3	1.6
Unnamed Tributary #2	13.6	14	3	63.4	1.5	4.5
Wolf Creek	40	11.6	5.6	33.8	1	8.2
Rose R u/s Canol Cr	46.6	5.3	1.3	36	0	10.6
Unnamed Tributary #4	3.3	5.6	1.3	59.4	7.8	22.3
Cottonwood d/s S. Canol Rd	37.3	7.7	25.3	29.5	0	1.4
Sidney Cr u/s Iron Cr	30.6	7.4	17.6	42.8	0	1.3
Sidney Cr d/s S. Canol Rd	43.3	0	20	36.6	0	0
Sidney Cr @ mouth	38.9	6.2	2.1	42.5	8.3	2
Evelyn Cr	32.8	33.5	6.5	27	0	0
Murphy Cr	18.5	4	8.1	67.4	0	1.3
Thirty Mile Cr	28.6	9.1	2.7	53.5	2.4	3.6
Unnamed Tributary #9	13.6	21	0.8	60.8	2.7	1
Wolf R	31.9	16.1	6.2	38.1	5.9	1.8
Flat Cr	5.2	3.8	0.4	82.3	0.3	7.7
Grayling Cr	26	1.6	0.1	69.7	1.8	0.7

Appendix 5

Riparian vegetation for several Nisutlin River tributaries

Sidney Creek u/s Iron Creek (Site SDN 3) July 24 / 98
Overstorey - white spruce dominant with balsam poplar
Streambank vegetation - dense mix of alder and willow
High ridge on left bank has overstorey of *Pinus contorta* with *Populus tremuloides*

Riparian species observed:

Picea glauca	*Rhinanthus ninor*
Salix spp.	*Arctostaphylos uva-ursi*
Populus balsamifera	*Erigeron* sp.
Alnus incana	graminoids
Carex sp.	*Gentianella propinqua*
Sanguisorba canadensis	*Galium boreale*
Equisetum arvense	*Aster sibiricus*
Achillea millefolium	*Potentilla fruticosa*
Parnassia sp.	*Juncus* sp.
Epilobium latifolium	*Epilobium angustifolium*

Sidney Creek @ Canol Road (Site SDN2) July 24 / 98
Overstorey - mature white spruce with some balsam poplar
Streambank vegetation - tall alders and willows

Riparian species observed:

Picea glauca	feathermoss
Salix spp.	*Erigeron* sp.
Populus balsamifera	*Lupinus arcticus*
Alnus incana	*Juncus* sp.
Rubus idaeus	graminoids
Achillea millefolium	*Equisetum arvense*
Solidago simplex	*Parnassia* sp.
Aster sibiricus	*Rosa acicularis*
Carex sp.	*Potentilla fruticosa*
Epilobium latifolium	

On disturbed area near road:

Epilobium angustifolium	*Matricaria matricarioides*
Potentilla anserina	
Taraxacum officinale	
Plantago major	

Appendix 5 continued

Evelyn Creek @ Canol Road (Site EV1) July 25 / 98

Overstorey - white spruce with some balsam poplar
Streambank vegetation - tall willows and alders

Riparian species observed:

Populus tremuloides
Alnus incana
Rubus idaeus
Taraxacum officionale
Juncus sp.
Carex sp.
Picea glauca
Salix spp.
Equisetum arvense
Achillea millefolium
Potentilla diversifolia

Additional species noted in adjacent uplands:
Epilobium angustifolium
Shepherdia canadensis
graminoids

Cottonwood Creek @ Canol Road (Site CTW) July 24 / 98

Overstorey - over mature white spruce with some balsam poplar
Streambank vegetation - alders

Riparian species observed:

Picea glauca
Alnus incana
Populus balsamifera
Salix spp.
Equisetum arvense
Ribes triste
Ribes hudsonianum
Rosa acicularis
Shepherdia canadensis
Delphinium glaucum
Parnassia sp.
Aster sibiricus
Erigeron sp.
Epilobium angustifolium
Galium boreale
Pyrola asarifolia
Geocaulon lividum
Lupinus arcticus
Ledum groenlandicum
Vaccinium vitus-idaea
Cornus canadensis
Empetrum nigrum
Mertensia paniculata
Viburnum edule
Aconitum delphinium
Hedysarum alpinum
Potentilla fruticosa
Vaccinium uliginosum
Penstemon acutiflorum
Anemone richardsonii
Carex sp.
graminoids
Rubus arcticus
Rubus idaeus

Appendix 5 continued

Rose River @ Canol Road (Site RSR2) July 25 / 98

Overstorey - mature white spruce with balsam poplar and occasional lodgepole pine

Streambank - vegetation - willows except for alders in disturbed areas near road

Riparian species observed:

Picea glauca	*Hedysarum alpinum*
Pinus contorta	*Aster sibiricus*
Alnus incana	*Tofieldia pusilla*
Salix spp.	*Arnica* sp.
Populus balsamifera	*Platanthera hyperborea*
Potentilla fruticosa	*Carex* sp.
Epilobium latifolium	*Antennaria* sp.
Achillea millefolium	*Sanguisorba canadensis*
Parnassia sp.	*Equisetum arvense*
Galium boreale	*Solidago multiradiata*
Erigeron sp.	graminoids

Additional species noted in adjacent uplands:

Ledum groenlandicum	*Lupinus arcticus*
Vaccinium uliginosum	*Empetrum nigrum*
Shepherdia canadensis	*Epilobium angustifolium*
Astragalus sp.	*Oxytropis* sp.
Geocaulon lividum	*Mertensia paniculata*
Arctostaphylos uva-ursi	*Betula glandulosa*

Seagull Creek d/s Seagull Lake (Site SGC) July 27 / 98

No overstorey (occasional white spruce and alpine fir)

Streambank vegetation - thick cover of willow and shrub birch

Riparian species observed:

Picea glauca	*Betula glandulosa*
Abies lasiocarpa	*Carex* sp.
Salix reticulata	*Salix* spp.
Salix glauca	*Antennaria* sp.
Achillea millefolium	*Arctostaphylos uva-ursi*
Solidago sp.	*Arctostaphylos rubra*
Erigeron sp.	*Hedysarum alpinum*
Mertensia paniculata	*Castilleja* sp.
Epilobium angustifolium	*Rubus arcticus*
Epilobium latifolium	*Aster sibiricus*
Petasites sagittatus	*Pedicularis* sp.
Delphinium glaucum	graminoids