# Lower Skeena Fish Passage Assessment
# Highway #16, #37S, & CN Rail

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## Summary

The purpose of this report is to present background information and survey results for the Lower Skeena fish passage assessment conducted along Highway #16, Highway #37South (#37S), and CN Rail. In 2005, the Skeena Fisheries Commission was retained by the Pacific Salmon Commission to conduct a Fish Passage and Culvert Inspection (FPCI) on all non-bridged stream crossings distinguished with fish presence along Highway #16 between Terrace and Prince Rupert, and along Highway #37 between Terrace and Kitimat. A FPCI was also conducted on CN Rail non-bridged stream crossings with fish presence between these three communities. The Lower Skeena fish passage assessment is part of a larger regional effort to improve fish passage limited by highways and secondary roads throughout northwest British Columbia.

The primary objective of this project was to focus on increasing the abundance of fish stocks by opening freshwater habitat to salmon spawning and rearing. This project will utilize the fish passage culvert inspection procedure that has been developed to evaluate one of the most easily addressed fish habitat constraints, access to existing habitat. The fish passage culvert inspection methodology is based on the BC Government fish passage protocol outlined in: *Fish Passage – Culvert Inspection Procedures,* Parker, 2000 (FPCI). Essentially, the FPCI fieldwork includes: measuring the stream and culvert characteristics, noting the fish bearing qualities and quantities, evaluating barriers, and taking upstream and downstream photographs from the culvert inlet and outlet. Office calculations are followed by prioritization of assessed culverts.

FPCI results in this report are structured into two parts: Highway #16 and CN Rail – Terrace to Prince Rupert, followed by Highway #37 South and CN Rail – Terrace to Kitimat. Twenty-eight fish bearing stream reaches crossed by Highway #16 and CN Rail are culverted. Of these twenty-eight stream reaches, ten are characterized as having fish passage issues, consisting of various types and degrees of barriers along with abundance and value of upstream fish habitat. Of these ten streams, three are rated as high priority.

The other seven streams are rated as low and medium priorities due to a lack of fish distribution, marginal to poor habitat conditions, or large capital restoration costs versus the amount of high and moderate fish habitat potentially gained. Most of the twenty-six fish bearing stream reaches crossed are culverted by both Highway #16 and CN Rail. However, some streams are only culverted at one right-of-way, and in other cases no culverts exist.

Fish passage surveys were conducted on Highway #37S and CN Rail Kitimat Subdivision show thirty-five fish bearing streams. Of these thirty-five stream reaches, one is characterized as having a fish passage issue and it is rated as high priority. Nine culverts need maintenance effort and the majority of these are beaver activity issues.

In general, streams crossed by Highway #37 and CN Rail through the Lakelse and Kitimat drainages exhibited relatively superior compliance with fish passage guidelines. This is evidenced by the numerous new culvert or bridge structures on streams crossed by Highway #37 and CN Rail. Powerline Creek, Cable Car Creek, and Scully Creek channels–north, central, and south have caused fish passage problems in the past, but recent rehabilitation efforts have ensured straightforward juvenile and adult migration. CN Rail has recently upgraded several culverts and has completed comprehensive revegetation activities.

Exchamsiks Backchannels (Map Culvert No.s 35, 36, 37, and 38) are the highest priority culverts to rehabilitate in this study. Support for moving forward with planning, restoration, and funding efforts has been verbally forthcoming from Department of Fisheries and Oceans and the B.C. Ministry of Highways.

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## Acknowledgements

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# Introduction

The purpose of this report is to present background information and survey results for the Lower Skeena fish passage assessment along Highway #16, Highway #37South (#37S), and CN Rail. In 2005, the Skeena Fisheries Commission was retained by the Pacific Salmon Commission to conduct a Fish Passage and Culvert Inspection (FPCI) on all non-bridged stream crossings distinguished with fish presence along Highway #16 between Terrace and Prince Rupert, and along Highway #37 between Terrace and Kitimat. A FPCI was also conducted on CN Rail non-bridged stream crossings with fish presence between these three communities. The Lower Skeena fish passage assessment is part of a larger regional effort to improve fish passage limited by highways and secondary roads throughout northwest British Columbia.

The maintenance of healthy fish populations requires that upstream components of streams crossed by roads permit the free migration of spawning adult fish and rearing juveniles. The purpose of this project is to serve as an initial program phase to restore fish passage to diverse fish habitats disconnected in the past by Highway #16 and Highway # 37S and CN Rail culvert installations.

Many kilometres of critical habitat that used to support salmonids are thought to be inaccessible due to improperly designed and installed fish passage structures along these transportation corridors. Stream crossings were assessed to determine the restoration feasibility, extent of, and applicable priority. Deliverables from this project include this narrative report, an updated database of all fish bearing streams crossed by culverts and bridges on Highways #16 and #37S and CN Rail, a map showing the highway, streams, fish resources, topography, and culvert locations, and a prioritized list showing stream crossings requiring restoration.

This report is structured into two parts: Highway #16 and CN Rail – Terrace to Prince Rupert, followed by Highway #37 South and CN Rail – Terrace to Kitimat.

## FISH PASSAGE

The movement of fish through culverts can be restricted by many factors including culvert length and gradient, stream levels and velocities, and inlet and outlet configurations. Improper culvert design and installation can block fish passage to spawning and rearing areas such as small streams, lakes, and wetlands.

When adult salmon enter freshwater, the maturing fish stop feeding and rely on energy reserves stored in body fat and protein to carry them through migration and spawning. The rate of sexual maturity is established by heredity and most often cannot adjust to delay (Powers and Orsborn 1985). Barriers that cause excessive delay and/or abnormal energy expenditures can result in mortality either during migration or in spawning areas.

The direction and length of migration varies with the fish species and life stage; consequently, the necessary timing, frequency, and duration for unimpeded access to required habitats also varies. On a finer scale, juvenile salmonids and resident freshwater species need to freely disperse to find optimal rearing conditions to ensure their survival: areas with reduced competition, high quality and low velocity refuge habitat, and fewer predators.

Restoring fish passage increases the amount of available habitat within a stream system. If habitat abundance is the limiting factor, fish populations will rise in response to increased access to additional habitat. However, the population response to habitat gain is also frequently dependent on numerous other factors, which may include the quality and quantity of new habitat, the nature and abundance of predators, and the presence of competitors.

When impassable culverts are replaced, restoring fish passage may change the transport of sediments, woody debris, and other materials to downstream reaches. This could change the slope or elevations of upstream or downstream channel reaches, as elevation differences are reconciled. These changes, which can lead to both positive and negative effects, can affect the aquatic environment by altering habitat preferences and characteristics affecting fish use and behavior.

Consideration of potential changes, especially by flood stage stream flows and sediment transport events, is necessary in the lower Skeena area due to the topographical and climatic conditions. If fishways are selected as restoration options, routine inspections and maintenance must be recognized as essential parts of the project in order to have success in passing fish over moderate to long time spans.

## Methods

### Pre-field Planning

In order to generate a list of stream crossings to assess in the field portion of the project, an office-based overview was compiled and reviewed to identify all non-bridged stream crossings. Data used included highway inventory data, GIS analysis of Terrain Resource Inventory Maps (TRIM), and a compilation of the existing fisheries information using the Fish Information Summary System (FISS). Traditional fisheries knowledge, other fisheries references, and anecdotal material regarding important fish streams in this section of Highway #16, #37S, and CN Rail were also rolled into the review. A GIS-based map series of lower Skeena tributaries crossed by Highway #16 and CN Rail between Terrace and Prince Rupert and streams crossed between Terrace and Kitimat by Highway #37S and CN Rail was created.

### Fieldwork

The fish passage culvert inspection methodology is based on the BC Government fish passage protocol outlined in Fish Passage–Culvert Inspection Procedures, (FPCI) (Parker 2000). Essentially, the FPCI fieldwork data collection includes: administrative categories such as stream name, location coordinates, and watershed code; measuring stream and culvert characteristics; noting the fish bearing qualities and quantities; evaluating barriers; and taking upstream and downstream photographs from the culvert inlet and outlet. Stream measurements were taken at distances of 25 m and 50 m so as to avoid the influence of the culvert on stream characteristics.

The following field gear was used to collect stream and culvert characteristic data:

- Culvert length was measured with a Bushnell Yardage Pro laser range finder.
- Culvert and stream widths and depths were measured with a meter stick or tape.
- Stream velocities were measured with a Swoffer 2100 Current Meter.
- Stream and culvert gradients were measured with a Suunto clinometer.
- Location coordinates were recorded with a Garmin eTrex Summit.
- Photographs were taken with a HP Photosmart R707, 5.1 MP digital camera.
- Stream lengths were measured with a hip chain.

### Post-Field

Following completion of the fieldwork, calculations were prepared for each barrier culvert site evaluating the type and degree of obstruction, stream length upstream of the barrier as well as overall length, and the Q100. These calculations were then scored using the criteria in the FPCI

(Parker 2000) followed by the prioritization of assessed culverts. Three primary report sections were prepared to describe all stream crossings in text format, in a database, and on 1:50,000 scale maps.

Fish bearing streams receiving the fish passage culvert inspection were prioritized using the FPCI scoring matrix. The matrix considers fish species present, fish habitat values, barrier type, length of habitat upstream, proportion of stream habitat barred, and the presence of further upstream barriers. In short, prioritization is based on maximizing fish access to habitat segregated by a barrier culvert on Highways #16 and #37S, and CN Rail. The priorities do not take into account sediment movement or maintenance issues. The FPCI scoring matrix can be used to prioritize and to base restoration or rehabilitation efforts on funding availability or other considerations.

| **Fish species** | | **Habitat value** | | **Barrier** | | **Length of new habitat** | | **Stream barred %** | | **Limiting to upstream barrier** | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Multiple or significant | 10 | H | 10 | Full | 10 | ≥1 km | 10 | >70% | 10 | Yes | 5 |
| Single | 6 | M | 6 | Partial | 6 | <1 km | 6 | 51–70% | 6 | No | 0 |
| Other | 3 | L | 3 | Underter | 3 | <500 m | 3 | <50% | 3 | | |

**Table 1. FPCI scoring matrix.**

Fish species are classed as single, multiple, or significant, to note the degree of restorative benefits. Information in regard to fisheries values was generated through professional judgement by subjective analysis that included:

- Fish populations and habitat known to be conservation risks or concerns.
- Fish species of Provincial significance; these include species that have been identified provincially as being particularly sensitive to forest harvesting activities (Haas 1998). In this lower Skeena fish passage assessment, this mostly refers to bull trout (BT), Dolly Varden (DV), and/or cutthroat trout (CT).
- Fish populations and habitat identified by First Nations as being traditionally or contemporarily important.

Habitat value is a subjective rating based on the known value of the stream habitat to be gained and is based on complexity, productivity, and limiting habitats. Different values for different habitat types are based on species preference and known distributions. The barrier factor is used to give higher priority for sites with more severe obstructions to fish. Barriers are based on outfall drop, culvert water velocity, culvert gradient, and culvert length.

Length of new habitat is the length of potentially restored stream, measured on the 1:20,000 scale map, to the next known barrier using gradient classes to differentiate the fisheries values of different habitat types. Stream barred percent is the length of new habitat divided by the total fish bearing stream length. Limiting to upstream barrier is scored if there is another culvert upstream of the site that has been assessed as a full, partial, or undetermined barrier (Parker 2000).

The relative numerical scores associated with each category are then summed. The ranking of high, moderate, or low is given based on the scoring classes listed below.

- High ranking score 39–55
- Moderate ranking score 26–38
- Low ranking score 15–25

# INSERT MAP Figure 1

# Highway #16 and CN Rail – Terrace to Prince Rupert

## LOWER SKEENA RIVER BACKGROUND

### Location

Highway #16 and CN Rail parallel the Skeena River between Terrace and Prince Rupert in west central British Columbia. Highway #16 passes along the right bank or north side for approximately 106 km to Tyee before cutting westward 40.5 km across Tsimshean Peninsula and ending in Prince Rupert. CN Rail corresponds and for the most part is adjacent to Highway #16 from Terrace to Tyee, then continues alongside the Skeena River, Porpoise Harbour, and Prince Rupert Harbour before terminating in Prince Rupert. Tyee is situated approximately 12 km upstream of the river mouth.

### Lower Skeena River

The Skeena Watershed is the second largest watershed in British Columbia, draining 54,432 km$^2$. It is located in the northwestern portion of BC with its mouth at 54° N, just south of the Alaska panhandle. In its eastern headwaters the Skeena River extends through the Coast Ranges to drain part of the Nechako Plateau.

The Skeena River cuts through the Kitimat Range of the Coast Mountains, which are mostly composed of granite and granitoid rocks. The landscape is composed of a diverse assemblage of rugged, glaciated mountains with distinct U-shaped valleys. The valley walls are composed of steep bedrock locally covered with veneers of colluvium and till with interspersed tributary stream alluvial fans and debris cones (Clague 1984). The steep-sided former fiord has been filled with hundreds of meters of sediment carried by the river since deglaciation, 10,300 to 11,000 years ago.

Skeena River sediment deposition has formed a wide low-lying valley flat containing many islands and gravel bars, sizeable logjams, and extensive back channels and wetland areas. The lower Skeena River mainstem is divided into two distinct reaches (Resource Analysis Branch 1976). Reach 1 passes from the mouth upstream to Kwinitsa Creek, with a regular or continuous profile, an average gradient of 0.0 to 0.1 %, and channel movement is limited by the valley walls near the edge of the floodplain. Extensive major shoals and banks forming part of the Skeena River estuary characterize this reach. These floodplain and deltaic deposits are composed of silts and fine sands, except for some mid-channel deposits that are relatively coarser with scattered boulders. The reach is tidal influenced, which alongside lunar variations and seasonal flow conditions can produce river water attributes with different regimes of salinity, velocity, and temperature on a quickly changing basis.

Reach 2 extends upstream from Kwinitsa Creek to just above Ferry Island, which is adjacent to Terrace. This reach possesses an average gradient of 0.05%, or 0.4 to 0.5 m/km, and is an immense fluvial deposition zone bounded by the valley walls and the riprap related to the transportation corridor. Numerous divided channels, backwaters, and swampy areas resulting from shifting islands and gravel bars characterize the lower Skeena floodplain, which averages 2.5 km in width. In this section of the Skeena River, islands range in size up to 300 ha and continuously undergo substantial change, resulting in this being the most dynamic section of the entire river.

Reach 2 channel is characterized as a wandering gravel bed river with a straight and sinuous channel pattern. There are two or more river main flow branches separated by islands (Hogan and Schwab 1989). Most of the river channels have complex histories of abandonment, filling, re-excavation, and reuse. Sloughs are common, particularly between Kasiks River and Shames

River; the majority of sloughs have been created because of the highway and rail routes blocking channels. A small number of these sloughs are borrow pits associated with the highway and railroad construction and upgrades. The river slope decreases uniformly from Terrace to the estuary, as does the size of gravel in the river deposits. Gravels at Terrace are cobbles about 10 cm diameter, while most sediment below Kwinitsa Creek is sand-sized. Streamflow conditions in the Skeena River are highly variable over short time periods, and consequently, habitat attributes such as water velocity and depth have the potential to change rapidly.

A unique and conspicuous feature of this river section are the large logjams, which range from a few tree lengths to logs piled massively and continuously for up to a kilometer (Bustard 2002 pers comm). The larger logjams exceed 20,000 $m^3$ in volume. There is no other BC river entering the coast with this extent of logjams and log piles. These log piles are important structural features that promote sediment deposition when located on or adjacent to a mid-channel bar; if positioned at the mouth of a back channel, they stabilize and train the river channel. Unlike logjams elsewhere in the Skeena Watershed, these large logjams provide juvenile habitat at most discharge stages. Side channels regulated by logjams do not get scoured and provide important habitat for coho and chinook juveniles. The logjams provide the predominant all-season cover for fish in Reach 2. A notable feature of these myriad side and back channels are the very large amounts of stonefly larvae (Drewes 2002).

**Figure 2: Skeena River – View southwest across Hudson's Bay Flats**

Major tributaries entering the lower Skeena River from the mouth upstream include the Ecstall, Khyex, Scotia, Kasiks, Exchamsiks, Gitnadoix, Exstew, Lakelse, Zymagotitz, and Kitsumkalum Rivers. The Ecstall, Gitnadoix, Lakelse, and Kitsumkalum Watersheds are discussed in Gottesfeld *et al*. (2002). The majority of these single channel tributaries have been carved by glacial action into U-shaped valleys with oversteepened sidewalls and floors in-filled with sediment.

#### Hydrology

The lower Skeena River has a modified maritime climate that is controlled by the large-scale mid-latitude weather frontal pattern and the topography, particularly the Coast Mountains. There is considerable temperature and precipitation variation from the Skeena River mouth eastward to Terrace. On the coast there is abundant precipitation with cool summers and mild winters with average temperatures near 0°. Usually, precipitation reaches a maximum in the fall and early winter, generally in October and November (Environment Canada 1993), with intense cyclonic storms from the North Pacific moving across or stalling on the coast on an irregular basis.

The Coast Mountains, which trend northwesterly and parallel the coastline, cause uplift of the moisture-laden winds and augment the precipitation. The lower Skeena estuary (Prince Rupert Airport) receives 2450 mm of total precipitation per year, though significantly higher amounts occur in the mountains. The meteorological station at Prince Rupert Regional Park at the base of Mt. Hays, (at 91m elevation), receives over 3000 mm of precipitation. At Terrace Airport, the average total annual precipitation is 1322 mm, less than half that at the river mouth. The coastal portions and higher elevations of the lower Skeena drainage lack a dry season. Tributary valleys receive between 2000 to 4250 mm annual precipitation, with approximately 80% of it occurring between October and April. Moisture deficits seldom occur.

Determining the size and seasonal variation in the streamflow on the lower Skeena River is difficult. The furthest downstream hydrologic station with a long record (08EF001) is located at Usk, 18 km northeast of Terrace. The Skeena River above Usk has a drainage area of 42,200 $km^2$ (Remington 1996). The typical annual hydrograph shows an extended peak flow in May and June and one or more smaller storm flows in the fall. Nearly all of the annual floods have occurred in the spring snowmelt season. The peak flows typically occur between May 14 and July 2, except in 1974, 1978, and 1991, when fall rainstorms in October or early November produced the highest floods. Monthly mean discharge for the Skeena River at Usk, Station 08EF001, is 160 cms in March and 2,830 cms in June.

Considerable run-off is added to the Skeena River downstream of Usk from large tributary streams, which include the Khyex, Kasiks, Exstew, Exchamsiks, Ecstall, Gitnadoix, Kalum, Lakelse, Zymoetz, and the Zymagotitz. Hydrometric stations have been operated in the past on Exchamsiks River (Station 08G012), Zymagotitz River (08G011), and Khtada River (08EG003). Peak flows on lower Skeena tributaries usually occur during the autumn or early winter. In the 38 years of record (1962-1999) of the Exchamsiks River, all but one of the record annual floods (1970) were rainstorm flows. The Exchamsiks annual hydrograph is shown below.

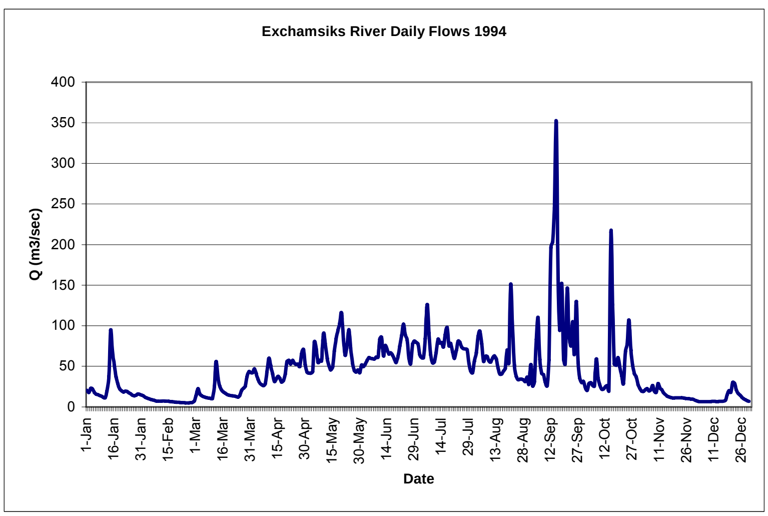


**Figure 3. Annual hydrograph for Exchamsiks River.**

## LOWER SKEENA RIVER FISHERIES VALUES

The lower Skeena River and its tributary streams have high fish values; the Skeena River is the second most important salmon producer in BC, with annual escapements of over two million fish. Pink and sockeye salmon are the leading species utilizing the system and account for approximately 95% of the spawning salmon. The Skeena River mainstem and adjacent channels from Kasiks River upstream to Shames are extremely important to pink and chum salmon, which spawn in large numbers.

All species of salmon, as well as steelhead and cutthroat trout, and Dolly Varden char, are present in this section of river for some period of their life histories. Some species, such as sockeye, mostly migrate through the area, though river-type spawner progeny may spend rearing time there. The tributaries support many life stages for anadromous and freshwater species. Adult enumerations often tend to be difficult due to turbid water conditions that can persist from May through early winter.

Juvenile fish migrating downstream to saltwater feed and rear along the extensive network of logjams, side channels, and wetlands, as well as the diverse and fertile estuary. Dependent on the species, anadromous juveniles spend time ranging from days to months in the estuary undergoing the physiological adaptation from their natal stream life to sea life. Salinity regime variations in the estuary facilitate this adaptation, but the juveniles also encounter differences in topography, turbidity, sea temperatures, tides and currents, food abundance, and predator populations (Burgner 1991).

The lower Skeena is productive due to the outstanding spawning and rearing habitat that yields anadromous and resident fish abundance. Despite the high fisheries values and ease of access to the lower Skeena River and its tributaries, adult and juvenile salmonid abundance and habitat use are relatively poorly understood due to the lack of observations. Adult enumeration is difficult due to high amounts of turbidity that often continue from May through September, and that in some years persist until November.

Fisheries escapement values for all systems in this study are from the Salmon Escapement Database System (SEDS), which is the DFO Pacific salmon escapement database (DFO 2001).

### Chinook

Chinook spawning in the lower Skeena River area occurs in the mainstem and adjacent channels, Khyex River, Kasiks River, Exchamsiks River, Exstew River, and Zymacord River. All populations are relatively small and essentially possess the same run timing.

### Sockeye

A small population of sockeye spawn in Esker's Slough. Recorded escapements from the 1980s were 10 to 25 fish. This stock is noteworthy because it is one of the rare river type stocks in the Skeena Watershed. Sockeye with river type life histories are better known in the Nass and Stikine Rivers, where some successful stocks rear in habitat similar to the Skeena River backchannels. Sockeye spawners have been recorded from one to several times in the Kasiks, Exchamsiks, and Exstew drainages, but these are not typical occurrences.

### Pink

Pink salmon spawning is widespread throughout the mainstem and sub-channel gravel bars, including back channels. Pink salmon are the most abundant species of salmon spawning in the Skeena River West area, centered between Kasiks and Shames Rivers. It is probable that spawning locations vary, ranging from an annual to decadal basis depending on discharge levels and the shifting river channels (Bustard 1991). Typically, pink spawning peaks the first week of September and is usually finished by late September to early October, though some stream runs occur slightly later.

**Chum**

Chum salmon are relatively common in the lower Skeena River and its tributaries. The most important spawning areas are located in the Ecstall River and in the multi-channelled reach of the Skeena River situated downstream of Terrace to the Kasiks known as Skeena West. These two areas contain the only strong stocks in the Skeena Watershed, and generally account for approximately 80% of the total chum spawners. Fluctuating escapements to these areas averaged between 8,700 in the 1950s, to 20,000 in the 1980s, and 8,500 in the 1990s. Lower Skeena tributaries supporting small spawning populations include Khyex, Kasiks, Exchamsiks, Exstew, Shames, and Zymagotitz Rivers.

**Coho**

Coho are widely distributed throughout the lower Skeena River area, though data concerning escapement, distribution, life history variations, and habitat use is scant. Coho do not generally spawn in the Skeena River mainstem channel; however, Bustard (1991) did observe limited spawning in the mainstream. Kasiks Channel, Shames Slough, Exstew Slough, Esker Slough, Andesite Backchannel, and many un-named back channels are important coho spawning grounds. As well, tributaries supporting major amounts of coho spawning include Ecstall, Khyex, Exstew, Exchamsiks, Gitnadoix, Kasiks, and Zymagotitz. Juvenile coho surveys typically suggest that they access backchannels and sloughs with fall high flows, overwinter, and depart as smolts with the spring-early summer snowmelt floods (Hartman and Brown 1988, Brown 2002).

**Steelhead**

Lower Skeena watershed streams support both sea-going and resident populations of Oncorhynchus *mykiss*. The anadromous populations are known as steelhead, while residents are known as rainbow trout. There are both summer run and winter run populations of steelhead in the Skeena. Summer run steelhead return in July and August while winter run steelhead return from November to March. Summer run steelhead are more numerous and found throughout the watershed; winter run steelhead are limited to the coastal portions of the Skeena, usually from the Terrace area downstream.

**Eulachon**

Four smelt species are found in the Skeena Estuary; the best known and highly prized by First Nations is the eulachon (*Thaleichthys pacificus*), sometimes spelled oolichan. Eulachons are small (<25cm) anadromous fish that spawn in the lower main channel and tidal portions of coastal tributaries of the Skeena River. Spawning occurs in the spring, usually between mid-March and mid-May (Hart 1973), from the Kasiks River downstream to the Ecstall and Kyhex River, with some years of great abundance. The eggs adhere to the surface of the sand or fine gravel substrate for six weeks before hatching in May–June. The larvae average 4 mm in length and move to the sea immediately upon hatching (Lewis 1998).

## FISHERIES

### First Nations Traditional Use

The lower Skeena River area has long been the traditional homeland of coastal Tsimshian peoples. First Nations traditional use and occupancy of the lower Skeena areas was extensive and is well documented by oral history and early Euro−Canadian visitors. The Tsimshian culture had integral connections to the environment they inhabited. Salmon are an integral part of the Tsimshian culture and a principal food source.

Following the establishment of Fort Simpson in 1834, many of the lower Skeena First Nation groups moved to the area surrounding the fort and are now located in Lax Kw'alaams. Other lower Skeena Tsimshian reside in Kitsumkalum Village and continue to use the lower Skeena River area for traditional activities.

Nine distinct groups hold territories from Lakelse River downstream to the Skeena mouth. Tsimshian groups within the area include the Gitziis, Gitwilgiots, Ginaxangiik, Gitandoh, Gitlan, Gitlutzau, Gitzaklalth (Gitzaxlaal), Gitnadoix, and the Gitwilksabe (thought to be extinct). These groups were centered in villages typically located close to the Skeena River and used traditional territories owned by various lineage heads (Inglis and MacDonald 1979).

### Recreational Fisheries

The sports fishery in the lower Skeena River area provides important recreation and aesthetic values for the public. Salmon fishing draws local residents from northwest BC and non-resident tourists into the lower Skeena area with its extraordinary angling opportunities. Easy access to gravel bars and boat launch sites is afforded from Highway #16. The most popular boat launch sites are located at the mouth of the Kitsumkalum River, Andesite Sidechannel, near the mouth of the Exchamsiks River, close to Kwinitsa, and the launch site near the mouth of the Exstew River.

The guided and unguided sport fishery targets chinook, coho, pink, steelhead, and chum salmon. The one commercial fishing lodge on the lower Skeena is located close to Shames River and accommodates 35 angling enthusiasts. Anecdotal information suggests that intense angling pressure, particularly near the mouths of Kasiks, Exchamsiks, and Exstew Rivers, may be detrimental to chinook salmon populations at (Kofoed 2002).

### Enhancement Activities

The only known enhancement activity was at Andesite Sidechannel where DFO developed a small groundwater-fed channel for chum salmon enhancement. Foreshore fish habitat replacement projects have occurred in conjunction with three transportation projects including: habitat compensation due to realignment and widening of Highway #16 at the Khyex to Tyee section (White 1988, 1990); establishment of foreshore vegetation following the construction of the Ayton Mainline on the south bank of the Skeena River between Scotia and Ayton Creeks (White 1997); and the reclaimed Esker Gravel Pit (Bustard 1993a).

## DEVELOPMENT ACTIVITIES

The dominant development activities in the lower Skeena River area revolve around logging, transportation, and utilities. Mineral exploration and development have been slight and peripheral to the area of interest. Population and settlement other than by First Nations in the past have been very limited, except in the estuary where historic seasonal settlements were associated with the fish canneries.

### Forest Resource Development

The rich forest resources of the lower Skeena area have always been important to the native Tsimshian and in more recent times to Euro-Canadians. The early Tsimshian culture made extensive use of red and yellow cedar for their longhouses, canoes, poles and crests, cookware, and clothing. Other trees, such as spruce, alder, birch, and juniper, were carved or woven.

Commercial forest exploitation did not begin until the early 1890s, when large quantities of firewood were cut for steam-driven paddle wheelers, which regularly traveled the Skeena River. The construction of the railway from 1910 to 1914 necessitated clearing the right-of-way, which was subsequently widened during WWII to complete the highway from Terrace to Prince Rupert (Kerby 1984).

Selective logging of spruce occurred in the 1940s. In the early 1950s, clearcut logging of the high value Sitka spruce stands commenced on the lower Skeena River floodplain sites and islands. By the late 1960s, the floodplain Sitka spruce stands were nearly eliminated. Enormous Sitka spruce logs were skidded with Cats and dumped into the river where they were boomed and towed to the Port Edward pulp mill to be pulped (Waldie and van Heek 1969). Some of the skid trails, which were often deeply engraved into the floodplain, are currently used by coho for rearing habitat.

In the late 1950s and early 1960s, forest harvesting activities began in the lower reaches of the Shames, Exstew, Exchamsiks, and Kasiks River valleys; most logging occurred on the floodplain or the toe of the slopes. At this time, the lower reaches of Zymagotitz River and the lower Erlandsen were partial and clearcut logged. In the early to mid-1970s, extensive clearcutting occurred in the Zymagotitz drainage along the steep mountainsides and over alluvial fans. In the late 1960s and into the 1970s various lower Skeena areas including McNeil River, Little Windsor, and Big Windsor saw the initiation of industrial logging.

Logging in Kwinitsa Creek drainage was initiated in 1978 and continued into 1991 with approximately 64% of the operable area logged. In Scotia River drainage, forest development started in 1980 and has continued into the present. Recent logging, particularly in the Shames, Exstew, and Scotia drainages, has been restricted to upland areas utilizing conventional and helicopter logging methods.

**Figure 4: Mouth of Scotia River showing logged areas.**

In the mid-1950s through until the early 1960s, Columbia Cellulose dumped logs into the Skeena River from approximately half of its Terrace operations, as well as from logging operations downstream from Terrace. These logs were boomed, held in storage grounds, and towed down the Skeena to the pulp mill at Port Edward.

**Transportation & Utilities Development**

The Skeena River has been used for thousands of years as a transportation waterway, primarily by canoes. In the early 1890s, steam-powered paddle wheelers began regular, seasonal use that continued until the Grand Trunk Pacific (GTP) Railway was completed in 1912. Paddlewheel use in this section of the Skeena River did not require any rock-removal or channel alterations.

At present, there is intensive linear development on the northern bank of the Skeena River with CN Rail and Highway #16 situated on the northern floodplain for much of their length. The Grand Trunk Pacific Railway (the predecessor to CN Rail) was constructed in the 1910 to 1914 period on the north bank of the Skeena River. Construction practices (rip-rapping) effectively reduced the lateral movement of the river in some floodplain areas, blocking off some of the floodplain and many side and back channels.

Completion of Highway #16, linking Prince Rupert and Terrace in 1944 saw the use of roadbuilding practices that restricted fish passage and floodplain lateral movement. Numerous back channels and side channels were cut off to returning adults, and abutments of some tributary streams bridges aggravated natural sediment deposition in fans; this necessitates frequent channel dredging to avoid washouts. Railroad and highway upgrading in the late 1970s and early 1980s further restricted river movement and prevented the rejuvenation of channels behind the transportation corridor.

**Figure 5: Shames River aggradation sediment accumulated under and upstream of the CN Rail Bridge.**

Secondary roads off the highway to side drainages include access to McNeil (Green) River, to Work Channel via Lachmach River, and logging roads accessing the lower and mid-portions of Exstew, Shames, and Zymagotitz drainages. South of the Skeena River, resource road access from Old Remo extends west through White Bottom to past Dasque Creek. Highway #16 access provides major boat launch options at Kwinitsa, Andesite Side Channel, and at the mouth of the Kitsumkalum, Exstew, Exchamsiks, and Kasiks Rivers, as well as many other smaller, less-known sites.

On the south side of the Skeena River, linear development consists of the BC Hydro 287 kV transmission line and the Pacific Northern Gas (PNG) pipeline, both terminating in Prince Rupert. This utility corridor is serviced by road to a point opposite Salvus, where the natural gas pipeline crosses the Skeena River and passes up the Kasiks River valley. The PNG pipeline was built in the 1960s; in 1993, the pipeline across Skeena River broke due to river scour and was re-installed under the river by directional drilling (Powell 1995). Maintenance problems on the BC Hydro transmission line have been minimal, primarily consisting of tower base erosion problems, which have been mitigated with rip-rap.

## Highway #16 & CN Rail – Prince Rupert to Terrace FPCI Results

Twenty-eight fish bearing stream reaches crossed by Highway #16 and CN Rail are culverted. Of these twenty-eight stream reaches, ten are characterized as having fish passage issues, consisting of various types and degrees of barriers along with abundance and value of upstream fish habitat. Of these ten streams, three are rated as high priority. The fish passage surveys were carried out in early to mid September 2005; this period co-relates to late summer low flows.

The other seven streams are rated low and medium priorities due to a lack of fish distribution, marginal to poor habitat conditions, or large capital restoration costs versus the amount of high and moderate fish habitat potentially gained. Most of the twenty-six fish bearing stream reaches crossed are culverted by both Highway #16 and CN Rail. However, some streams are only culverted at one right-of-way, and in other cases no culverts exist.

Due to past surveys, third order and larger streams at the 1:50,000 scale in the surveyed areas have a relatively complete inventory of fish species presence and at least some general habitat values. Information for first and second order creeks is limited and marginal in nature. Many first order unnamed tributary streams to Skeena River that are crossed by Highway #16 are not mapped at the 1:50,00 scale.

### LOWER SKEENA RIVER

From the mouth upstream to Kwinitsa River, the north bank of the Skeena River (Reach 1) has marginal or no floodplain area. The northern valley wall for the most part is composed of steep gradient-bedrock, which is locally covered with veneers of colluvium and till. Highway #16 and CN Rail follow the toe of steep, avalanche prone bedrock slopes and much of their right-of-way encroach into the Skeena River. Right-of-way encroachments built into the river are composed of coarse (>2 m) and medium (1-2 m) riprap; this material provides a stable sub-grade base and controls potential damage from river erosion.

From Kwinitsa River upstream to Terrace, the Skeena River has formed a wide low-lying valley flat, which contains numerous islands and gravel bars, sizeable logjams, and extensive backchannel or wetland areas. In some places the valley wall has caused Highway #16 and CN Rail to encroach into the Skeena River. A number of sizeable debris fans and debris cones occur along the valley wall edge. The highway and rail line also pass through many active snow avalanche paths. As in Reach 1, right-of-way encroachments built into the river and sections overlying wetlands and backchannels are composed of coarse and medium riprap.

From the CN Station in Prince Rupert to Tyee, there are no CN Rail culverts impeding fish passage. This is mostly due to the steep hillside adjacent to the rail line and to the tidal backwatering of culverts. Many streams in the lower Skeena crossed by Highway #16 and/or CN Rail do not have moderate and large quantities of habitat upstream of the transportation corridor. Inflow streams that dry up or do not exist feed many of these small units of habitat, which often have water quality problems that include excessive warm temperatures, low dissolved oxygen, and stagnant water seasonally or perpetually posing limiting factors for salmonid use. The majority of fish bearing streams are bridged. The notable sections of habitat cut off by the transportation corridors are backchannels of the Skeena River floodplain; these are principally located between Exchamsiks and Shames Rivers. Stream orders documented in this study are based on 1:20,000 scale mapping.

| Map Culvert No. | Stream Name | Comment | Fish Species | Fish Passage Issue | Restoration Site Priority |
|---|---|---|---|---|---|
| 35 | Exchamsiks Backchannel | Culvert is 20cm above water surface and is roughly 10 m away. No drainage between highway and railroad. Culvert may become critical component of the restoration plan. | CO and CT | Barrier at all but highest flows | High. Elevations surveyed then restoration workplan needs to organized with partners |
| 36 | Exchamsiks Backchannel | Culvert may need to be modified once restoration plan is determined | CO and CT | Barrier at low to high flows | High. Elevations surveyed then restoration workplan needs to organized with partners |
| 37 | Backchannel #1 | Exchamsiks Backchannel and Backchannel #1 will possibly be linked together to increase flows | CO and CT | Culvert inlet and outlet are buried | High. Elevations surveyed then restoration workplan needs to organized with partners |
| 38 | Unnamed channel | This channel links Skeena River to Map Culvert No. 37 outlet area | CO and CT | Likely that this channel will be a critical component in the above backchannels restoration plan | High. Elevations surveyed then restoration workplan needs to organized with partners |
| 39 | Carwash Backchannel | Culvert is elevated 2.25 m at inlet and 2.1 m at outlet above backchannel and Skeena River respectively | CO | Inlet and outlet are elevated | Medium due to habitat value and potential gain, fish species, and partial barrier |
| 50 | Unnamed Pond | There is no culvert evident providing fish access to/from the Skeena River | Unknown | Barrier at all flows. | Medium. Fish and fish habitat assessment required. |
| 51 | Shames River | Channel is actively unstable and aggrading with displacement of spawning gravels. | PK, CO, CM, CH, DV, CT | No, but could mitigate degraded spawning and rearing habitat | Medium. Large off-channel rehab opportunity is present |
| 61 | Amsbury Creek | Sediment traps have filled and present 2.4 m vertical barrier | PK, ST, CT, DV | Yes. Outfall and velocity barriers | Medium. Low cost effective rehabilitation |
| 47 | Unnamed backchannel | Full barrier due to no culvert placements on the highway and CN Rail | Unknown | Yes. Backchannel is fully cut-off from Skeena River | Low. Connect to backchannel complex 80 m to the north |
| 52 & 53 | Unnamed stream | Highway culvert is dysfunctional and CN Rail culvert is non-existent | Unknown | Yes. Stream is fully disconnected from Skeena River | Low. Habitat quality issues upstream of highway. |
| 83 | Howe Creek | CN Rail culvert has 4.75 outfall drop to Skeena River on coarse riprap | Suspect CO and CT | Yes, outfall barrier at all flows | Low. Restoration options are not easy or cost effective |

**Table 2. Highway #16 and CN Rail culverts with fish passage issues.**

## HIGH PRIORITY FISH PASSAGE SITES

### Exchamsiks Backchannels Culverts

**Map Culvert No.s 35, 37, 38.**

The Exchamsiks Backchannels are composed of two relatively large backchannels located on the Skeena River floodplain, east of Exchamsiks River. From west to east the backchannels have been named Exchamsiks Backchannel and Backchannel #1. Highway #16 and CN Rail largely cut them off from the Skeena River. The highway and CN Rail culverts associated with the three backchannels are Culvert Map No.s 35, 36, 37, and 38.

**Map Culvert No. 35** is situated at the western margin of Exchamsiks Backchannel and passes under Highway #16. There is no corresponding culvert under CN Rail. The 2600 mm round, multiplate culvert was elevated 0.2 m above the water surface. Coarse riprap allows water to flow out of the backchannel through both the highway and rail subgrades. Inflow into Exchamsiks Backchannel is from the Skeena River at high water as well as five first order creeks and two, second order creeks draining the mountainside; these have total stream length of 10.45 km. This culvert corresponds with CN Rail Mile Post 33.6 and with B.C. Ministry of Highways RIMS 195.81.

**Figure 6: Map Culvert No. 35**
**Inlet looking upstream into Exchamsiks Backchannel**

**Figure 7: Map Culvert No. 35**
**Looking downstream from Exchamsiks Backchannel to inlet**

**Figure 8: Map Culvert No. 35**
**Looking downstream from outlet into drainage area between the highway and rail line.**

| | | | |
|---|---|---|---|
| Date | Sept 13 06 | Stream Name | Exchamsiks Backchannel |
| Road Name | Highway #16 | Watershed Code | Unknown |
| UTM/GPS Location | 09 481576 6020886 | Recorders Name | LW/KR |
| 1:20 000 Map Sheet | 103I 034 | | |
| Site Number | 035 | | |

| **Culvert Characteristics** | |
|---|---|
| Culvert Diameter (mm) | 2600 mm |
| Culvert Length (m) | 41 m |
| Culvert Slope (%) | 0.5% |
| Culvert Material | Multi Plate |
| Culvert Water Velocity | N/A |
| Culvert Shape | Round |
| Culvert Wetted Width | N/A |
| High Water Mark | 100 cm |
| Culvert Water Depth | 00 cm |
| Culvert Outfall Drop | 210 cm |
| Culvert Maintenance | Yes, LWD at Inlet |
| Comment | Culvert elevated 25 cm above backchannel water surface |

| **Stream Characteristics** | | |
|---|---|---|
| Pool Depth at Outfall | 0 | |
| Measure | Below Culvert Average | Above Culvert Average |
| Wetted Width avg | 0 | 0 |
| Bankfull Width avg | 0 | 0 |
| Water Depth avg | 0 | 0 |
| Bankfull Depth (cm) | 0 | 0 |
| Stream Velocity avg | 0 | 0 |
| Stream Gradient (%) | 0 % | N/A |
| Substrate | N/A | N/A |
| Fish Habitat Quality | N/A | High |
| Beaver Activity/Type | None observed | None observed |
| Barrier Evaluation: | Full | |
| Barrier Type | Inlet height and outfall drop at low to high water levels | |
| Prescription | To be determined | |
| Comment | Culvert overdue for rehab | |

| | |
|---|---|
| Q100 Estimate | N/A |
| Stream Length Above Barrier | 800 m |
| % Stream Barred | 100 % |

| **Fish species** | | **Habitat value** | | **Barrier** | | **Length of new habitat** | | **Stream barred %** | | **Score** |
|---|---|---|---|---|---|---|---|---|---|---|
| Multiple and Significant | 10 | H | 10 | Full | 10 | ≥1 km | 6 | >70% | 10 | **46** |

**Table 3: Map Culvert No. 35**

**Map Culvert No. 36** is situated approximately 800 m to the east of the western end of Exchamsiks Backchannel and consists of a culvert crossing under Highway#16 and CN Rail. Both culverts are 2000 mm, round multiplate structures. There is no discernible channel for the approximately 54 m section between the highways and CN's culverts. Downstream of the CN Rail culvert, drainage dissipates in a wetland area; there is no discernible channel for approximately 50 m where a backwater then drains to the west (shown in Figure 15). This culvert corresponds with CN Rail Mile Post 34.0 and with B.C. Ministry of Highways RIMS 196.400.

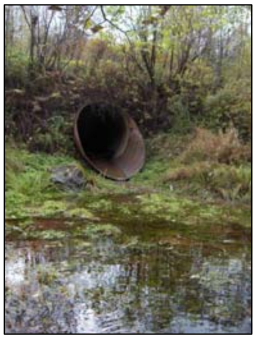

**Figure 9: Map Culvert No. 36**
**Looking downstream from Exchamsiks Backchannel to highways culvert inlet**

**Figure 10: Map Culvert No. 36**
**View east upstream on Exchamsiks Backchannel**

**Figure 11: Map Culvert No. 36**
**View west downstream on Exchamsiks Backchannel**

**Figure 12: Map Culvert No. 36**
View upstream of highways culvert outlet

**Figure 13: Map Culvert No. 36**
**View from highways culvert outlet to CN Rail culvert inlet**

**Figure 14: Map Culvert No. 36**
**CN Rail culvert inlet, view downstream**

**Figure 15: Map Culvert No. 36**
**CN Rail culvert outlet, view upstream**

**Figure 16: Map Culvert No. 36**
**View west of backwater approximately 50 m south of CN Rail culvert.**

| | | | |
|---|---|---|---|
| Date | Sept 13 06 | Stream Name | Exchamsiks Backchannel |
| Road Name | Highway #16 & CN Rail | Watershed Code | Unknown |
| UTM/GPS Location | 09 482375 6020898 | Recorders Name | LW/KR |
| 1:20 000 Map Sheet | 103I 034 | | |
| Site Number | 036 | | |

| **Culvert Characteristics** | |
|---|---|
| Culvert Diameter (mm) | 2000 mm |
| Culvert Length (m) | 22 m |
| Culvert Slope (%) | 0.5% |
| Culvert Material | Multi Plate |
| Culvert Water Velocity | N/A |
| Culvert Shape | Round |
| Culvert Wetted Width | 1540 cm |
| High Water Mark | 62 cm |
| Culvert Water Depth | 10.5 cm |
| Culvert Outfall Drop | 0 cm |
| Culvert Maintenance | No |
| Comment | |

| **Stream Characteristics** | | |
|---|---|---|
| Pool Depth at Outfall | 0 | |
| Measure | Below Culvert Average | Above Culvert Average |
| Wetted Width avg | 0 | 0 |
| Bankfull Width avg | 0 | 0 |
| Water Depth avg | 0 | 0 |
| Bankfull Depth (cm) | 0 | 0 |
| Stream Velocity avg | 0 | 0 |
| Stream Gradient (%) | 0 % | N/A |
| Substrate | N/A | N/A |
| Fish Habitat Quality | N/A | High |
| Beaver Activity/Type | None observed | None observed |
| Barrier Evaluation: | Barrier at low to high flows | |
| Barrier Type | | |
| Prescription | To be determined | |
| Comment | | |

| | |
|---|---|
| Q100 Estimate | N/A |
| Stream Length Above Barrier | 1200 m |
| % Stream Barred | 100 % |

| **Fish species** | | **Habitat value** | | **Barrier** | | **Length of new habitat** | | **Stream barred %** | | **Score** |
|---|---|---|---|---|---|---|---|---|---|---|
| Multiple and Significant | 10 | H | 10 | Full | 10 | ≥1 km | 6 | >70% | 10 | **46** |

**Table 4: Map Culvert No. 36**

**Map Culvert No. 37** is situated at the western end of Backchannel #1 and passes under Highway #16; however, the inlet is buried under LWD and the outlet is buried under riprap. It is the only drainage structure for Backchannel #1 into the Skeena River. This culvert corresponds with CN Rail Mile Post 31.7 and an unknown point with Ministry of Highways RIMS. The coarse riprap is similar to Exchamsiks Backchannel in that it allows water to flow through the highway and rail subgrades. In high flows, Backchannel #1 receives flow from the Skeena River, and at low flows there is drainage through the highway and the rail riprap to the adjacent Skeena River. Terrestrial inflow is from three second order creeks that have a total stream length of 10.9 km. A typical stream flowing into Backchannel #1 is shown in Figure19.

**Figure 17: Map Culvert No. 37**
**View from inlet looking upstream into Backchannel #1**

**Figure 18: Map Culvert No. 37**
**View downstream at buried inlet from Backchannel #1**

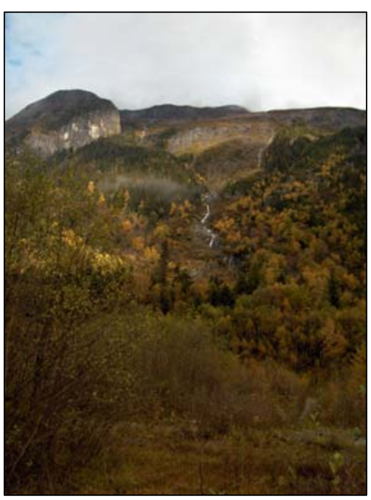

**Figure 19: Map Culvert No. 37**
**View northward to typical creek flowing into Backchannel #1**

**Map Culvert No. 38** is not a culvert location, but a 200 m in length channel that provides a direct linkage from Map Culvert No. 37, approximately 200 m downstream to a large secondary Skeena River channel. Inflows to this channel are from Backwater #1 either through Culvert No. 38 (the outlet is buried in the riprap) or the riprap is visible as the flow enters the channel. Figure 20 shows a portion of this channel.

**Figure 20: Backchannel #1 outflow channel**

**Exchamsiks Backchannels Fish Values**

In the early 1990s, a proposed upgrade to highway #16 in the vicinity of Exchamsiks River initiated environmental studies to determine the fisheries values (Bonwick *et al*. 1992). Of interest to this study are the fisheries studies, particularly the juvenile rearing and habitat assessments undertaken on the Exchamsiks Backchannels and reported in Bustard (1991) and Bustard (1993b).

Due to fish passage access difficulties, adult salmonids, other than cutthroat trout, were never captured or observed in the Exchamsiks Backchannels. In 1989 and 1990, a total of 4,727 juvenile fish were sampled during three sample periods. The catch composition included threespine stickle back (87.3%), juvenile coho (9.4%), and Dolly Varden char (1.5%). Cutthroat and rainbow trout comprised only 0.3% of the overall catch. The remaining 1.4% was comprised of redside shiners, peamouth chub, and sculpins. The CPUE of coho juveniles was consistently higher in Backchannel #1 (1.6 coho/trap) than in Exchamsiks Backchannel, which had 0.4 coho/trap. Catch composition in late fall sampling indicated a slightly higher percentage of coho (14.3%).

In 1992, sampling was conducted at a mix of sites to provide an index of relative abundance and species composition. The data indicates that coho catches increased significantly in 1992 compared to earlier years. The results show juvenile coho comprised 75.2% of the catch with a CPUE of 8.4 coho/trap.

It is assumed that all coho recruitment into the backchannel sites is from fry that have been spawned elsewhere in the Skeena and enter the backchannels during high conditions. In 1992, a juvenile coho population estimate was conducted in Backchannel #1. A total of 2,522 marked coho were released and 2,813 recaptured the following week. Of the recaptures, 585 were marked, yielding an estimated population of 12,092 coho (95% confidence intervals 11,3134 to

12,871 fish). This is considered a minimum because approximately 20% of Backchannel #1 was not sampled due to difficult access.

During tests conducted in 1990 to determine coho smolt movement out of Backchannel #1 through the coarse riprap, mark recapture estimates indicated that up to 18,700 coho smolts may have been produced in Backchannel #1 during that year (Bustard 1991). Scale samples taken from smolts captured in Backchannel #1 outlet in May 1990 indicated that most fish leave the backchannels as age 1+ fish and that only a few fish remain for a second year. These ages probably vary from year-to-year depending on the time of juvenile recruitment into the backchannels.

**Exchamsiks Backchannels Habitat Values**

Exchamsiks Backchannel and Backchannel #1 during the high water flood in the early summer consists of 13-14 ha each of wetted areas. These observations, taken from air photo measurements should be considered the maximum wetted areas (26.7 ha), due to substantial reduction in wetted area on all channels during late summer low flows. Maximum depths were taken during the late summer low flow period.

| Exchamsiks Backchannels | Area sq km | Perimeter m | Max Depth m | Water Level Fluctuations m | 1st and 2nd Order Inflow Stream Lengths m |
|---|---|---|---|---|---|
| Exchamsiks Backchannel | 13 | 11,000 | 1 | 3.4 | 2,450 |
| Backchannel #1 | 13.7 | 8,000 | 3.5 | 2.7 | 8,000 |
| Water level fluctuations refer to June and September staff gauge readings | | | | | Total 21,350 |

**Table 5: Physical habitat attributes of the three backchannels.** Modified from Bustard 1991.

Dissolved oxygen (DO) measurements and temperature profiles were conducted at a number of sites in August, September, and November 1992 (Bustard 1993b). Sites of concern were noted where DO levels dropped below 5 ppm or where water temperatures exceeded 20$^{o}$ C. In Exchamsiks Backchannel, dissolved oxygen and/or temperature in the upper surface layers was a concern at all sites in August and 50% of the sites in September. From April 1993 to May 1996, B.C. Ministry of Highways and Transportation positioned various dataloggers that sampled stage height, water temperatures at depths, and surface air temperatures in the backchannels and in the adjacent Skeena River. Sub-surface water temperature versus depth is shown in Figure 21.

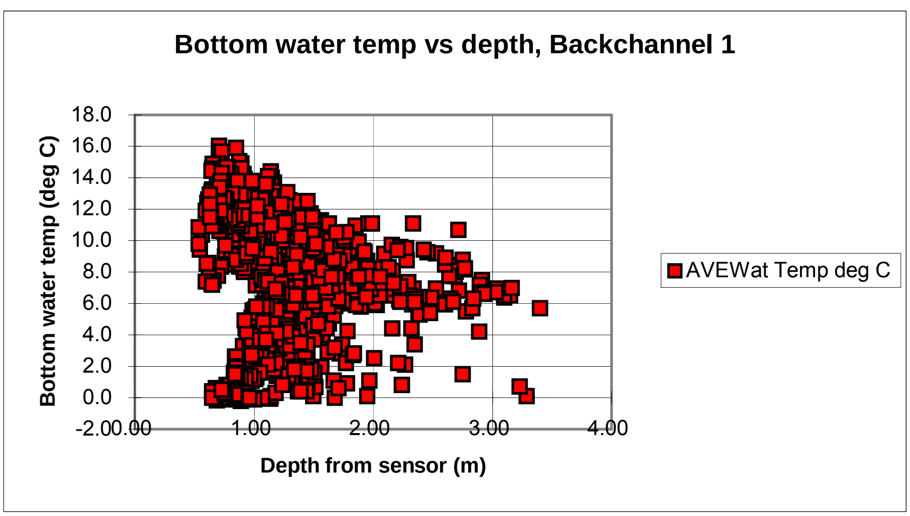


**Figure 21: Sub-surface temperatures compared to depths in Backchannel #1**

Bustard (1993) concluded that conditions in Exchamsiks Backchannel are marginal to intolerable for salmonids during extended dry periods such as those experienced in the late summer of 1992. There may be isolated pockets suitable for coho survival in portions of the backchannel, but generally conditions are poor. Bustard (1991) reported that DO and water temperatures improved by the late fall and remained stable through the winter. In Backchannel #1, high water temperatures (20-22°C) and low DO levels occurred in shallow sections in two out of five sites during August.

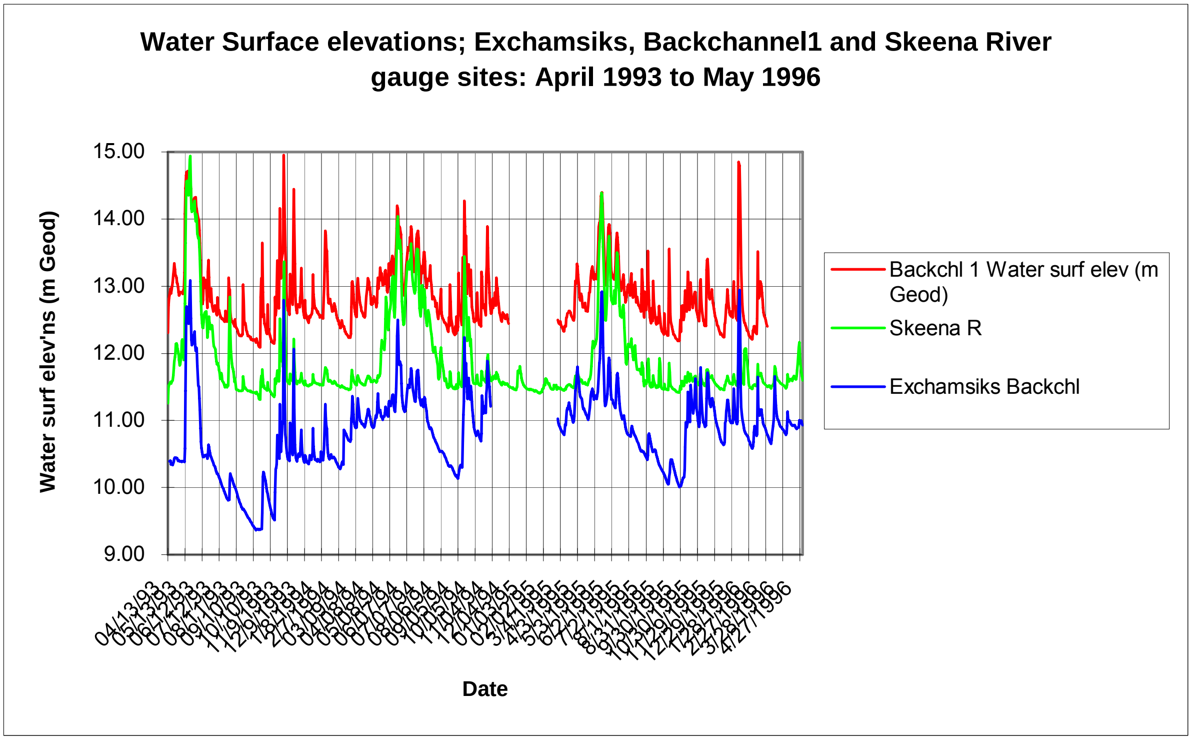


**Figure 22: Water surface elevations in Exchamsiks Backchannel, Backchannel #1, and the Skeena River, April 1993 to May 1996**

**Exchamsiks Backchannels Restoration Priority**

Exchamsiks backchannels are the highest priority culverts to rehabilitate in this study. The amount of habitat gained and therefore the potential coho production are significant. Previous studies such as Bustard's (1991, 1993b) have established background information on species composition, juvenile coho recruitment, habitat values, and factors limiting production. It is also known that emergence coho fry disperse downstream along the margins of the Skeena River and move into backchannels and wetlands that are accessible from the main river for overwintering (Bustard 1984, Finnegan 1991). Observations suggest that the rearing limitations to juvenile fish, particularly raised temperatures and DO, occur during the low-water periods in the late summer, and that overwinter survival in these backchannels is probably quite high when considering the two population estimates conducted in 1990 and 1992.

Efforts to improve access into and out of these backchannels, and to stabilize water levels in them offer interesting means of enhancing productive fish habitat that is under utilized. A variety of possible options exist that may enhance coho rearing and spawning and therefore increase recruitment. Backchannel #1 offers the best opportunity to develop enhanced habitat and fish production. Linking the two backchannels together will most likely improve the water quality in Exchamsiks Backchannel. Increasing inflow from the Skeena River at the eastern end could provide a flushing action or influence that would also be helpful to water quality factors.

**Figure 23: Aerial view to the west showing Backchannel #1, Highway #16, CN Rail, the Skeena River, and the borrow pit to the far right**

Sealing the upstream side of the riprap berm that the highway and CN Rail are situated on, in the places where the backchannels come against it, would help to stabilize the backchannels water levels. Sealing the riprap could include using an impermeable layer, or possibly using material excavated when creating deep-water pockets, or material available in the nearby gravel pit. It is probable that all sites would benefit from increased backwater water levels either by excavation or by preventing leakage through the riprap by an impermeable berm, or sealing, or a combination of the two methods.

Until the current on-going elevation surveys are completed and the data is analyzed, positioning and placement of new culverts cannot be determined. As well, it is unknown whether the current locations and elevations of Culvert No.s 35, 36, 37, and the outflow channel at No. 38 will need to be modified and to what degree. This survey is a component of the conceptual restoration design that is appended to this report as Appendix 3.

Support for moving forward with restoration efforts has been verbally forthcoming from Department of Fisheries and Oceans and the B.C. Ministry of Highways. The next step includes a meeting of partners and stakeholders to discuss and consider survey results and the conceptual restoration plan, then to provide consensus for a work plan direction that outlines information gaps and assumptions in regard to:

- Restoration cost, funding sources, and risks to investment if any,
- Fish species life histories,
- Limiting habitat factors,
- Engineering hypothesis such as water flushing volumes and terms, water supply alternatives, and natural variability; for example, detrimental outcomes from large flood events depositing high silt loads.
- Further site assessments needed.

## MEDIUM PRIORITY FISH PASSAGE SITES

**Map Culvert No. 39** passes under Highway #16 and CN Rail to drain a 4.9 ha backchannel that is informally known as 'Carwash Backchannel'. This location correlates to CN Rail Mile Post 29.25 and Ministry of Highways RIMS 202.700. The highway and rail line are located on an outside bend of the Skeena River, which is immediately adjacent. The only culvert is elevated 2.25 m above the backchannel water surface. Terrestrial inflow is from two first order creeks with a total stream length of 0.9 km and one second order creek that has 1.9 km of total stream length. There is no spawning habitat associated with these streams. Maximum depth of 5 m (Bustard 1991) was recorded during the late summer low-flow period. The highway and rail line has isolated Carwash Backchannel.

The presence of coho juveniles, threespine stickleback, redside shiners, and peamouth chub is known from trapping efforts. Trapping effort with 15 traps averaged 0.40 coho/trap. It is not clear whether the fish are accessing the culvert at high water, or whether access is by passing through the coarse riprap berm, or a combination of these methods.

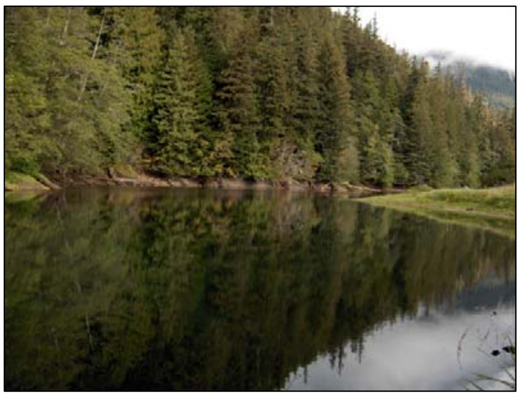

**Figure 24: Map Culvert No. 39**
**View from inlet looking upstream into Carwash Backchannel**

**Figure 25: Map Culvert No. 39**
**View from Carwash Backchannel looking downstream to inlet**

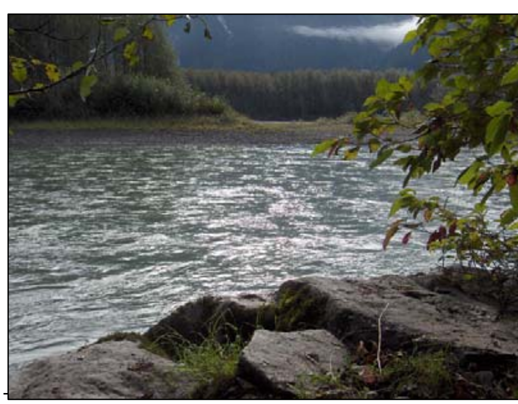

**Figure 26: Map Culvert No. 39**
**View from culvert outlet downstream to Skeena River**

| | | | |
|---|---|---|---|
| Date | Sept 15 06 | Stream Name | Unnamed |
| Road Name | Highway #16/CN Rail | Watershed Code | Unknown |
| UTM/GPS Location | 09 488015 6022059 | Recorders Name | LW/KR |
| 1:20 000 Map Sheet | 103I 035 | | |
| Site Number | 039 | | |

| **Culvert Characteristics** | |
|---|---|
| Culvert Diameter (mm) | 600 mm |
| Culvert Length (m) | 25.6 m |
| Culvert Slope (%) | 0.5% |
| Culvert Material | CMP |
| Culvert Water Velocity | N/A |
| Culvert Shape | Round |
| Culvert Wetted Width | N/A |
| High Water Mark | 42 cm |
| Culvert Water Depth | 00 cm |
| Culvert Outfall Drop | 210 cm |
| Culvert Maintenance | Yes |
| Comment | Culvert elevated 2.25 m above backchannel water surface |

| **Stream Characteristics** | | |
|---|---|---|
| Pool Depth at Outfall | 0 | |
| Measure | Below Culvert Average | Above Culvert Average |
| Wetted Width avg | 0 | 0 |
| Bankfull Width avg | 0 | 0 |
| Water Depth avg | 0 | 0 |
| Bankfull Depth (cm) | 0 | 0 |
| Stream Velocity avg | 0 | 0 |
| Stream Gradient (%) | 0 % | N/A |
| Substrate | N/A | N/A |
| Fish Habitat Quality | Medium | High |
| Beaver Activity/Type | None observed | None observed |
| Barrier Evaluation: | Full | |
| Barrier Type | Inlet height and outfall drop at low to high water levels | |
| Prescription | Open bottom structure | |
| Comment | Culvert overdue for rehab | |

| | |
|---|---|
| Q100 Estimate | N/A |
| Stream Length Above Barrier | 580 m |
| % Stream Barred | 100 % |

| **Fish species** | | **Habitat value** | | **Barrier** | | **Length of new habitat** | | **Stream barred %** | | **Score** |
|---|---|---|---|---|---|---|---|---|---|---|
| Multiple and Significant | 10 | H | 10 | Full | 10 | ≥1 km | 6 | >70% | 10 | **46** |

**Table 6: Culvert Map No. 39**

Map Culvert No. 39 is rated moderate priority due to fish species, habitat value, barrier type, and amount of habitat gained.

**Map Culvert No. 50** represents a small backwater pond (0.5 ha) that is cut off by Highway #16 and CN Rail. There are no culverts evident under Highway #16 or CN Rail. There are no inflow streams, and groundwater likely maintains water levels. The pond is situated approximately 800 m west of Shames River, and the location correlates to CN Rail Mile Post 16.2 and Ministry of Highways RIMS 224.1. The Skeena River is 85 m downstream from the rail line.

Fish species and presence is unknown, but from all appearances productive overwintering habitat is indicated. This type of floodplain habitat is preferred by juvenile coho and cutthroat trout for overwintering. Map Culvert No.50 is rated as medium priority; however, species and habitat use assessments and topographical elevation surveys should be completed before the type and amount of restoration efforts are prescribed.

**Figure 27: Map Culvert No. 50 Upstream view of isolated pond**

**Map Culvert No. 51** represents the Shames River crossed by Highway #16 and CN Rail, both of which are located on the lowest portion of Shames River alluvial fan, which is 1.8 km in length and crosses the Skeena River floodplain. Shames River Reach 1 bankfull width is approximately 80 m with an average gradient of 1.9% and a riffle-pool type morphology that is dominated by gravel and fine substrates. The channel is relatively unconfined with multiple flow channels with elevated mid channel bars. The channel is actively aggrading and unstable with shifts across its floodplain. The CN Rail Bridge is a bottleneck constricting flows and causing relatively moderate to large-scale deposition. A large abandoned right bank channel one km in length is situated 400 m upstream of the highway bridge.

**Figure 28: Map Culvert No. 51**
**Elevated mid channel bar constricting flow under CN Rail Bridge. Sediment spoil dredged from the channel is visible on both banks. View from Highway #16 Bridge**

Records for Shames River, Reach 1, indicate the presence of coho, chum, chinook, and pink salmon, cutthroat trout and Dolly Varden char. Principal spawners in Reach 1 are pink, chum, and chinook respectively, with escapement data being insufficient to establish abundance trends.

The reach has been impacted by the extensive forest harvesting in the valley upstream, resulting in uncommon hydrological cycle variations and increased peak flow events. Increased peak flows have caused extraordinary bedload and debris movements resulting in channel instability and shifting, erosion in higher gradient reaches and subsequent deposition on the fan, and displacement of spawning gravels.

**Figure 29: Map Culvert No. 51**
**View upstream from Highway #16 Bridge**

Restoration effort is rated a medium priority. Channel assessment and restoration are not recommended for the main channel. The foremost restoration option is to develop the large abandoned right bank side channel that is situated 400 m upstream of the highway bridge. The purpose would be to improve and extend spawning, rearing, and overwintering opportunities for coho salmon, improve spawning circumstances for pink and chum salmon, and improve rearing habitat for cutthroat trout. Recommended rehabilitation should include: initial field habitat assessment and monitoring, detailed field assessment and planning, and development of the side channel. Detailed off-channel development planning is described in Lister and Finnigan (1997): *Fish Habitat Rehabilitation Procedures, WRTC #9, Chapter 7: Rehabilitating Off-channel Habitat.*

**Map Culvert No. 61** represents the three sediment traps installed by CN Rail that are up to 90 m upstream of the Amsbury Creek Bridge. The sediment traps were built in 1984 following the rail bridge washout in 1983. The washout was due to a debris torrent initiated from a logging road related landslide, which deposited significant quantities of sediment and debris to Amsbury Creek (R. Cote pers. Comm.). The sediment traps, built from vertical 30 cm steel piles and 60 cm sheet piling crosswise up to 2.4 m in height, effectively straddle the stream channel. The upper sediment trap is filled to capacity and subsequently acts as a 2.4 m vertical barrier to fish passage.

The creek downstream of the sediment traps has stabilized and continues to support a fluctuating abundance of pink salmon and typically less than a dozen pairs of steelhead spawners. These fish currently spawn as far upstream as the bridge to the point where the substrate gets coarser and the channel shifts to a steeper gradient. There is no documented juvenile rearing activity. Riffle-pool complexes characterize the creek channel morphology upstream of the sediment traps for 400 m to the highway culvert.

Map Culvert No.61 is rated as medium restoration priority. The principal restoration objective is to restore Amsbury Creek channel to its original condition upstream to the Highway #16 culvert by removing the sediment traps and the debris. Due to road access to the site, this procedure could be a low cost, effective rehabilitation.

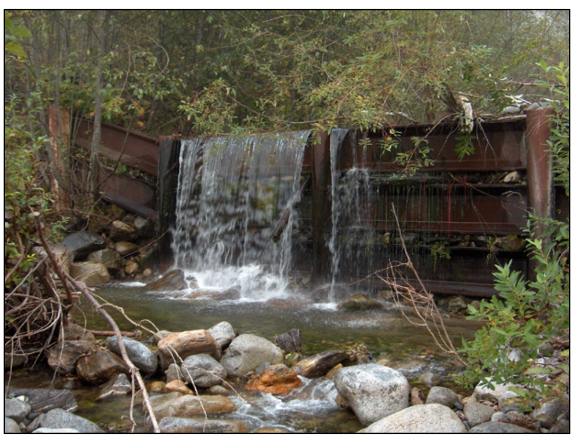

**Figure 30: Map Culvert No.61**
**View shows upper sediment trap**

**Figure 31: Map Culvert No.61**
View upstream from CN bridge shows lower two sediment traps

**Figure 32: Map Culvert No.61**
**View downstream to CN Rail's Amsbury Creek Bridge**

**Figure 33: Map Culvert No.61**
**View downstream of Amsbury Creek from CN Rail's Bridge**

## LOW PRIORITY FISH PASSAGE SITES

**Map Culvert No. 47** is an approximately 2 ha (500 m X 40 m wide) backchannel that has no culvert or drainage structure under Highway #16 or CN Rail. The backchannel is located 650 m east of Exstew River and is locally known as 'Exstew Backchannel'. This location correlates to CN Rail Mile Post 22.3 and Ministry of Highways RIMS 214.580.

Inflow streams are not present and the water is brackish with the surface covered with algae and aquatic vegetation growth. The backchannel likely has poor water quality and fish rearing characteristics. Trapping efforts captured no salmonids, and given that the rail and road berms have similar porosity to other sites, poor water quality is suggested as a limiting factor. The site is rated as low for restoration effort. If restoration is desired by DFO, B.C. Ministry of Environment, CN Rail, or the B.C. Ministry of Transportation, it is recommended that fish access for this backchannel be connected to the backchannel complex located approximately 80 m to the north.

**Figure 34: Map Culvert No. 47**
**View upstream from highway**

**Map Culvert No. 52 and 53** correlate to a 3.1 km long second order stream that is crossed by Highway #16 with a 1500 mm dysfunctional culvert, and there is no apparent CN Rail culvert or drainage structure. This unnamed stream is located about 460 m east of Shames River. Stream flow appears to pass through the riprap supporting the highway and CN Rail. Low gradient habitat upstream of the highway is approximately 780 m in length.

**Figure 35: Map Culvert No. 52**
**Unnamed stream upstream of CN Rail grade**

**Figure 36: Map Culvert No. 53**
**Unnamed stream upstream from highway culvert inlet**

**Figure 37: Map Culvert No. 53**
**View of highway inlet downstream that is largely blocked by LWD and sediment**

**Figure 38: Map Culvert No. 53**
**View of highway outlet downstream**

**Figure 39: Map Culvert No. 53**
View of highway outlet upstream

Map Culvert No. 52 and 53 sites are rated as low for restoration effort due to the small amount of moderate value habitat upstream of the highway that will be gained at a large capital expense. As well, rehabilitation measures are needed for the approximately 110 m channel between CN Rail and the Skeena River.

**Table 7: Map Culvert No. 53**

| | | | |
|---|---|---|---|
| Date | Sept 15 06 | Stream Name | Unnamed |
| Road Name | Highway #16 | Watershed Code | Unknown |
| UTM/GPS Location | 09 507782 6029743 | Recorders Name | LW/KR |
| 1:20 000 Map Sheet | 103I 046 | | |
| Site Number | 053 | | |

| **Culvert Characteristics** | |
|---|---|
| Culvert Diameter (mm) | 1500 mm |
| Culvert Length (m) | 26 m |
| Culvert Slope (%) | 0.5% |
| Culvert Material | CMP |
| Culvert Water Velocity | N/A |
| Culvert Shape | Round |
| Culvert Wetted Width | N/A |
| High Water Mark | 610 cm |
| Culvert Water Depth | 00 cm |
| Culvert Outfall Drop | 0 cm |
| Culvert Maintenance | Yes, LWD and sediment at Inlet |

**Map Culvert No. 83** is a culvert passing Howe Creek under CN Rail approximately 900 m east of Kalum River and within Terrace city limits. From its headwaters, Howe Creek runs approximately 2.4 km through residential and industrial areas of Terrace before passing through 0.8 km of culvert under Skeena Sawmill's site, then runs between Highway #16 and CN Rail until discharging into the Skeena River. The Eby Street Fish Hatchery is located at the spring fed headwaters, and the upper reach of the creek is an important community greenbelt and trail area. Community support to re-establish fish access has been voiced on several occasions.

Howe Creek culvert under the CN Rail line is a barrier to fish migration, and the first 1.6 km of habitat upstream of the rail line is seriously compromised. Water quality problems related to urban and industrial land use are unknown. This culvert corresponds with CN Rail Mile Post 2.6.

The outfall drop onto the coarse riprap is 4.75 m to the Skeena, and the final 5.0 m of the culvert is a steep 13.5% grade. Current conditions in the Skeena River at the culvert outlet are fast in most flows as it is on an inside bend. Restoration options include establishing a concrete fish ladder, but the position within the river channel and high flow conditions likely pose significant maintenance problems or failure. Re-positioning the creek outlet eastward to a more suitable site in regard to discharge and gradient is complicated due to private property concerns. This culvert restoration priority is rated low.

**Figure 40: Map Culvert No. 83**
**View from inlet upstream**

**Figure 41: Map Culvert No. 83**
**View of inlet downstream**

**Figure 42: Map Culvert No. 83**
**View of outlet downstream to Skeena River**

**Figure 43: Map Culvert No. 83**
**View of outlet upstream**

| | | | |
|---|---|---|---|
| Date | Sept 21 06 | Stream Name | Howe Creek |
| Road Name | CN Rail | Watershed Code | Unknown |
| UTM/GPS Location | 09 522795 6041269 | Recorders Name | LW/KR |
| 1:20 000 Map Sheet | 103I 057 | | |
| Site Number | 083 | | |

| **Culvert Characteristics** | |
|---|---|
| Culvert Diameter (mm) | 1200 mm |
| Culvert Length (m) | 21 m |
| Culvert Slope (%) | 2.5% then 13.5% |
| Culvert Material | CMP |
| Culvert Water Velocity | 0.38 m/s |
| Culvert Shape | Round |
| Culvert Wetted Width | N/A |
| High Water Mark | 48 cm |
| Culvert Water Depth | 16.5 cm |
| Culvert Outfall Drop | 4750 cm |
| Culvert Maintenance | Yes |
| Comment | Culvert elevated 4.75 m above Skeena River |

| **Stream Characteristics** | | |
|---|---|---|
| Pool Depth at Outfall | N/A | |
| Measure | Below Culvert Average | Above Culvert Average |
| Wetted Width avg | 0 | 142 |
| Bankfull Width avg | 145 | 203 |
| Water Depth avg | 10 | 12 |
| Bankfull Depth (cm) | 30.5 | 23 |
| Stream Velocity avg | 0.18 | 0.11 |
| Stream Gradient (%) | 69 % | 1.8 |
| Substrate | riprap | Cobble/boulder |
| Fish Habitat Quality | N/A | Low |
| Beaver Activity/Type | None observed | None observed |
| Barrier Evaluation: | Full | |
| Barrier Type | Outfall drop at low to high water levels | |
| Prescription | Concrete fishway | |
| Comment | | |

| | |
|---|---|
| Q100 Estimate | N/A |
| Stream Length Above Barrier | 3800 m |
| % Stream Barred | 100 % |

| **Fish species** | | **Habitat value** | | **Barrier** | | **Length of new habitat** | | **Stream barred %** | | **Score** |
|---|---|---|---|---|---|---|---|---|---|---|
| Multiple and Significant | 6 | M | 6 | Full | 10 | ≥1 km | 10 | >70% | 10 | **42** |

**Table 8: Map Culvert No. 83**

# Highway #37 and CN Rail – Terrace to Kitimat FPCI Results

## LAKELSE AND KITIMAT RIVERS BACKGROUND

### Location

Highway #37S and CN Rail pass south from Terrace 60 km to Kitimat over a low elevation (240 m) pass. Highway #37S traverses the east side of the Lakelse and Kitimat valleys, while CN Rail is mostly positioned on the west side. Kitimat lies at the head of Douglas Channel, which extends southward approximately 140 km to Caamano Sound and the Pacific Ocean.

### Lakelse and Kitimat Rivers

The Lakelse and Kitimat Rivers are situated south of Terrace in the Kitsumkalum-Kitimat trough, a broad north-south trending depression that dissects the Kitimat Mountain Range. The deep-seated nature of the eastern boundary fault along the Kitsumkalum-Kitimat trough is demonstrated by the hot springs activity. The bedrock geology is described as Late Cretaceous to Early Tertiary, consisting of plutonic rocks that mostly form the Coastal Mountain Belt.

For a short period of time at the end of the last Ice Age, the trough was occupied by the sea (Clague 1984, Gottesfeld 1985). The maximum sea level was about 700 m between 10,000 and 10,600 years ago. Due to postglacial erosion and burial beneath alluvium, glaciomarine sediments presently have a patchy surface distribution in the Kitsumkalum-Kitimat trough. Drift-veneered bedrock knobs and ridges such as Mount Herman break the continuity of this large area of glaciomarine deposits (Clague 1984).

Within the Kitimat watershed, deglaciation has deposited large quantities of unsorted gravels and sands in terminal and lateral moraines, and marine deltas. As well, large bands of glacial marine clays were deposited in the valley bottom and within most of the larger tributaries. Certain portions of the low-lying landscape in the Kitsumkalum-Kitimat trough are riddled with earthflow landslide scars. Most of the valley lowland is below 250 m elevation, is on average six km in width, and is bounded to the east and west by steep mountain slopes.

Lakelse River is a left bank, fifth-order tributary of the Skeena River encompassing 589 $km^2$. The central portion of the watershed is low gradient, with steep topography characterizing the larger tributaries. Major tributaries entering Lakelse Lake and Lakelse River include: White Creek, Coldwater Creek, Schulbuckhand (Scully) Creek, Hatchery Creek, and Williams Creek, which with its tributaries comprises 25% of the total stream length in the Lakelse watershed.

Kitimat River is a relatively small drainage encompassing 1963 $km^2$ with a mean annual discharge of 134 cms. From the headwaters, the mainstem flows northwesterly for about 43 km, at which point it enters the Kitimat valley. It continues with a southerly flow for 32 km in a series of meandering channels with an average gradient of 2.6% before discharging onto the tidal flats of the northwest portion of Kitimat Arm. Major tributaries of the Kitimat River include: Little Wedeene River, Wedeene River, Cecil Creek, Chist Creek, and Hirsch Creek. The river delta is composed mainly of coarse sediment and extends less than three km in width and approximately two km southwards. As a result of forest development activity, bedload movement in the mainstem and major tributary channels has caused the delta to rapidly prograde over the last fifty years.

### Hydrology

The Kitimat River has a modified maritime climate with a strong continental influence. There is a considerable temperature and precipitation gradient from Kitimat northward to Terrace. Kitimat has annual precipitation of 2230 mm, receiving about 40% more precipitation than Terrace. Kitimat has cooler summer temperatures and warmer winter temperatures than Terrace. Karanka (1993) notes that the eastern drainages, such as Hirsch Creek, receive only 66% of the annual unit run-off volumes compared to Wedeene and Little Wedeene located on the west side of the valley. The mean annual discharge of the Kitimat River is 134 cms, measured at Station 08FF001 downstream of Hirsch Creek. Approximately 60% of the annual run-off volume occurs between May and September as summer snowmelt, with peak summer flows in mid-June. Summer peak flows are usually 50% smaller than late fall–early winter peak flows.

**Figure 44: View northwest of Kitimat River from Highway #37S**

## LAKELSE WATERSHED FISHERIES VALUES

The Lakelse Watershed possesses very high fisheries values and is a major producer of coho and pink salmon as well as supporting sockeye, chum, chinook, and steelhead populations. McKean (1986) noted that the Lakelse system supports about 35% of the total Skeena River commercial fishery catch for all species. Steelhead, coho, and cutthroat trout support major sport fisheries. Resident species present in the system include rainbow trout, cutthroat trout, Dolly Varden, bull trout, mountain whitefish, and the following coarse fish: prickly sculpin, largescale suckers, redside shiners, northern pikeminnow, peamouth chub, and threespine stickleback. Currently, the sockeye population is at risk; however, a sockeye recovery plan with conservation and restoration measures is in place.

### Chinook

The Lakelse chinook aggregate salmon population abundance has fluctuated from the decadal mean in the 1950s of 108 chinook spawners, to 298 in the 1970s, then to 100 in the 1990s. Chinook enter the Lakelse system in mid-August through early September. The vast majority of chinook spawning principally occurs below the lake outlet, with limited spawning in the Lakelse River mainstem in a patchwork of small areas (DFO 1991b). Historically, chinook have spawned in low numbers (20-30) in Coldwater Creek, White Creek, Sockeye Creek, and Williams Creek.

### Chum

The chum salmon run into the Lakelse River is modest. Recent escapement trends are unknown due for the most part to a lack of counts over the last thirty years. Run timing typically starts in late August, and peaks in mid September; usually all chum are in by mid October. Hancock *et al.* (1983) show patches of chum spawning grounds scattered sporadically from below Mink Creek upstream to the lake outlet. Chum have been observed spawning up to 6.0 km in Coldwater Creek.

**Sockeye**

Sockeye escapements to Lakelse Lake have been low in recent years and appear to be depressed relative to historic levels. The Lakelse Lake sockeye stock has experienced a 92% decline over the last three cycles based on the last 14 years of visual escapement surveys (1992-2003). Exploitation rates for Lakelse Lake sockeye have been low to modest since 1970, primarily because of the early timing of this stock through mixed-stock interception fisheries targeting enhanced Babine Lake sockeye. Fisheries exploitation is not believed to be the major factor affecting escapements and subsequent sockeye production from Lakelse Lake.

Recent (2003) lake trophic studies indicate that Lakelse Lake provides a favourable rearing environment for juvenile sockeye. Lakelse Lake has the capacity to rear the progeny from approximately 29,000 spawners. In 2003, juvenile sockeye densities in Lakelse Lake were less than 5% of estimated lake rearing capacity, representing the progeny from just 750 spawners. Lakelse Lake is fry recruitment limited and is producing sockeye well below potential production. Degraded or limited tributary spawning habitat, particularly in the lower reaches of Williams and Scully Creeks relative to historic levels, is believed to be restricting spawner access and recruiting success.

Currently, the Lakelse Sockeye Recovery Plan proposes specific recovery goals, objectives and actions that will restore this unique and at risk sockeye salmon population. Increasing fry recruitment by increasing escapements, combined with spawning habitat restoration and/or fry out planting, has been suggested for improving sockeye production from Lakelse Lake.

The Lakelse sockeye salmon run usually enters the system in June, holding in Lakelse Lake and start ascending the streams in August. Spawning occurs in the lower reaches of many Lakelse Lake tributaries, including: Andalas Creek, Clearwater Creek, Hatchery Creek, Granite Creek, Sockeye Creek and Blackwater Creek. Historically, Williams Creek and Scully Creek have been the two important spawning streams.

**Coho**

The Lakelse aggregate coho stock remains one of the most productive coho stocks in the Skeena drainage. Coho escapement in the 1950s annually averaged 21,000 fish, with an increase in the 1960s to 34,000 annual spawners. Coho escapement declined by the mid-1970s to an annual average of 8,000 fish, and the decadal mean has stayed at that level until 2000. Since then, the mean annual average escapement has been 4,260. Lakelse River typically absorbs 80-90% with Clearwater and Williams Creeks being the other two significant spawning locales.

**Pink**

The Lakelse River is one of the major pink salmon producing areas of the Skeena River system, with pink escapement exceeding 1.5 million fish in some years. The mid-season pink run typically averages 50% of Area 4 production (DFO 1985). Pink salmon escapement and catch were comparatively high from the early 1980s through to the mid-1990s. Annual mean odd-year abundance for the 1990s was 683,000, while the even year was 539,000 pinks.

The Lakelse pink salmon run enters the Lakelse River in late August, peaks early to mid-September, and ends mid-September to mid-October. Odd-year pink salmon usually enter and spawn over a longer time period than even-year pinks. Pink salmon spawn virtually throughout the mainstem, with extremely heavy spawning taking place between Coldwater and Herman Creeks. This area often has the latest pink spawning timing in the Lakelse Watershed (DFO 1991). The lower reaches of White Creek, Mink Creek, Coldwater Creek, Herman Creek, Scully Creek, Hatchery Creek, and Granite Creek are also occasionally utilized for spawning. Upon emerging from the gravel in spring, pink salmon fry migrate immediately to the saltwater.

**Steelhead**

Information concerning Lakelse steelhead escapement and population trends is not available. Steelhead trout enter the Lakelse Watershed in three distinct runs: a spring run from March until May, a summer run of steelhead in September, and typically a winter run from October until January (Culp 2003). The latter run is one of a few substantial winter run steelhead populations in the Skeena River system.

**Freshwater Fish**

In comparison to salmon, information is sparse on resident, non-anadromous or freshwater fish in both fluvial (or river) and lacustrine (or lake) habitats of the Lakelse Watershed. Known freshwater species and documented populations inhabiting the Lakelse Watershed include Rainbow trout (*Oncorhynchus mykiss*), Cutthroat trout (*Oncorhynchus clarki clarki*), Bull trout (*Salvelinus confluentus*), Dolly Varden char (*Salvelinus malma*), Mountain whitefish (*Prosopium williamsoni*), Northern pikeminnow (*Ptychocheilus oregonesis*), Largescale sucker (*Catostomus macrocheilus*), River lamprey (*Lampetra ayresi*), Redside shiner (*Richardsonius balteatus*), Peamouth chub *(Mylocheilus caurinus)*, Threespine stickleback *(Gasterosteus aculeautus)*, and Prickly sculpin (*Cottus asper*).

## KITIMAT WATERSHED FISHERIES VALUES

The Kitimat River system supports runs of the five Pacific salmon: chinook, coho, chum, pink, and sockeye, as well as steelhead, eulachon, cutthroat trout, Dolly Varden, and other freshwater indigenous species. Chinook, steelhead, coho, chum, and cutthroat trout are enhanced by Kitimat Hatchery and consequently support major sport fisheries. As with any Northwest Coast system, species life histories can vary between tributaries. The following summarizes general trends within the Kitimat system.

**Chinook**

Chinook salmon are present in the Kitimat River mainstem, which absorbs the majority of the escapement, as well as in most of the larger tributaries including Wedeene River, Little Wedeene River, Chist Creek, and Hirsch Creek. Escapement has fluctuated from over 50,000 chinook in the 1930s to a low of slightly more than a 1,000 chinook in some years. The mean annual escapement for the 1990s was 13, 406 chinook. Kitimat Hatchery enhances this chinook stock, and it is likely that hatchery enhanced stock predominate the escapement. Spawning occurs in the system from May to September with the heaviest spawning in July and August. Chinook fry are quite variable in their rearing and outmigration behavior; most fry immediately migrate to the ocean. Approximately 8% remain in their natal streams for 60-90 days before outmigration, while a third component composed of an unknown percentage remain in their natal stream for a full year (Birch et al. 1981).

**Chum**

Most chum spawn in the Kitimat River with lesser numbers spawning in the Wedeene River, Little Wedeene River, Humphrys Creek, Nalbeelah Creek, Hirsch Creek, and Chist Creek. Drews (pers. comm. 2006) notes that the lowest reach of Hirsch Creek has the largest production per area in the system. The escapement is highly variable, and since 1990 annual escapement has ranged from a high in 2003 of 250,000 to a low of 22,230 spawners in 1990. An unknown portion of the escapement is a result of the enhanced chum produced from the Kitimat Hatchery. Spawning begins in this system in July, peaks sometime in August, and is typically over by the end of September. Mark recapture study results show that Kitimat chum consistently spend three years in the saltwater before returning to spawn (Westcott 1996).

**Sockeye**

Sockeye in the Kitimat system are a river spawning type population. Sockeye are known to spawn in mainstem ground water channels downstream of Hunter Creek and as well are suspected to spawn in Bannock and Chist Creeks. Though sockeye escapement has ranged from as high at 15,000 in 1938, since 1980 the mean annual escapement has been 3,003 spawners. After emerging from the gravel, sockeye fry drop down to the estuary to rear for the summer.

**Pink**

As in other Northern BC systems, the Kitimat River pink salmon even-year run is predominant. The major portion of the escapement, approximately 75%, spawns in the Kitimat mainstem. The remainder spawn in Wedeene and Little Wedeene Rivers, and in Humphrys, Nalbeelah, Hirsch, Lone Wolf, Cecil, and Chist Creeks. Escapement has varied from 750 in 1971 to a high of 300,000 in 2003. By the end of August most spawning is completed. Juveniles emerge from the gravel in late March and early April and usually spend the first summer in the brackish estuary waters.

**Coho**

Coho salmon are distributed throughout the drainage's accessible streams, with Cecil Creek providing the largest amount of high quality spawning habitat. A major portion of the escapement spawns in or adjacent to the Kitimat River, but Chist, Hirsch, Humphrys, and Nalbeelah Creeks, and Wedeene and Little Wedeene Rivers are all important coho producers. In general, all available gravel bars, side channels, and streams are utilized for spawning; the Kitimat is especially important due to the relatively large amount of available, high-quality coho rearing habitat. Since the mid-1970s, coho escapement has varied from a low of 4,000 to a high of 75,000 in 1999. Since 1980, the mean annual escapement has been 22,392 coho spawners. Most coho fry enter the estuary during spring in their second-year and remain there feeding until the end of August.

**Steelhead**

Kitimat winter run steelhead are found throughout the watershed, entering the river in late March through early May with peak migration in mid-April. A small summer run is thought to spawn in the upper reaches of the mainstem and its tributaries. The peak spawning occurs in the first week of May. Adults primarily return at age $3_3$, but $3_2$s and $2_2$s are common (Beere pers comm.). The mainstem absorbs the majority of spawners, with Cecil Creek being the most important tributary. Tributaries with significant spawning include Wedeene and Little Wedeene Rivers, and Davis, Chist, Humphrys, and Nalbeelah Creeks. Recent juvenile surveys recorded the highest densities in the Little Wedeene River and Nalbeelah and Chist Creeks (Beere pers comm.). Steelhead juvenile age at outmigration is variable, ranging from age two to four with age three being the most typical.

**Eulachon**

Eulachons are highly valued by the Haisla. Eulachon spawn in the lower 16 km of the Kitimat River during March and April, attracting Haisla fishers as well as many avian, mammalian, and piscine predators to the estuary during their spawning period. However, with the start-up of the Eurocan pulp mill and the discharge of treated pulp mill effluent into the Kitimat River, the eulachons became tainted and consequently unfit for human consumption. Since 1972, due to this tainting, the Haisla have only harvested eulachon from the Kemano River.

## LAKELSE AND KITIMAT FISHERIES

**Gitlusau First Nation Traditional Use**

First Nations traditional occupation and use of the Lakelse Watershed is extensive and conservatively estimated to be since at least 7,000 years ago. The Lakelse River Watershed is territory held by Gitlusau (Barbeau 1917), considered part of the Kitselas people. Gitlusau, also called Killutsal was an important settlement close to the southeast bank at the Lakelse-Skeena confluence (Dawson 1881). Most of the occupants of this village moved to Port Simpson prior to 1900, and the village was largely abandoned at this time.

Subsistence activities were tightly interwoven with the social structure, the local landscapes, and the broader regional environment. The Gitlusau salmon fishery formed the principal foundation of the Gitlusau economy. Hereditary House Chiefs exercised authority for management and decision-making. The principal fisheries management tools included ownership of specific sites, access allocation, control of harvest techniques and harvest timing, and harvest limitations imposed by processing capacity.

**Haisla First Nation Traditional Use**

The Kitimat watershed has long been the traditional homeland of the Xanaksiyala people. Kitamaat Village is now also home to the Haisla, a closely related but distinct First Nations peoples, who are from Misk'usa, located on the Kitlope River. In the past, salmon, eulachon, and other species of fish were abundant and played a central and integral role in the Haisla's well being. They also played an important role in shaping and strengthening the Haisla culture.

Families own specific places to fish and gather aquatic resources, and those are known and respected by others. Besides salmon and steelhead, eulachon, herring, and groundfish such as lingcod, grey cod, rockfish, sole and flounder, and halibut were reasonably abundant in the area. Management of the fishery was similar to the Gitlusau regime described above.

**Lakelse and Kitimat Recreational Fisheries**

The Lakelse River supports a strong recreational steelhead, coho, cutthroat and rainbow trout fishery. The cutthroat trout sport fishery is described by Bilton and Shepard (1955), Imbleau (1978), Hatlevik *et al* (1981), and de Leeuw (1991). Grieve and Webb (1999) comprehensively reviewed the Lakelse River steelhead recreational fishery. Due to a substantial winter steelhead run and easy access, there is generally an easily exploitable eight months of steelhead fishing. A large and popular coho fishery takes place in September particularly on the lower half of the river. Proximity to Terrace and Kitimat and high aesthetic values also contribute to this popular high value angler destination.

The Lakelse River is designated a Class II water with specific regulations applicable to the river and its tributaries, including use of a single barbless hook, a bait ban, and on a seasonal basis catch and release and fly fishing only. The fall and winter fishery (October to January) is principally located from the CN Bridge crossing upstream to Herman Creek, though there is also fishing throughout the entire Lakelse mainstem with the easiest access points receiving most of the angling pressure.

Kitimat River is one of Canada's most heavily fished rivers, offering some of BC's finest salmon, steelhead, and trout fishing. The fishery is characterized by the ease of access for short-duration angling in the Kitimat River mainstem and its tributaries, which is afforded by Highway #37S and the extensive secondary road network as well as the large number of fish due to hatchery releases. Angler effort is primarily by shoreline fishing; however, drift boats are popular and common. The majority of anglers fish the lower mainstem in April through October. Principal species fished are chinook, steelhead, coho, chum, and sea run cutthroat trout.

Kitimat River fishing regulations include the prohibition of fishing on the west half of the river between signs near the hatchery outfall, wild steelhead release, a hatchery steelhead monthly quota of ten, a bait ban from May 1 to August 31, and no power boats. Chudyk *et al.* (1977), Eccles *et al.* (1977), and Morris and Eccles (1977) comprehensively describe aspects of the Kitimat sports fishery.

**Enhancement Activities**

The first hatchery in the Skeena system, constructed in 1901 and operated until 1920, was located at the Coldwater Creek-Lakelse River confluence. Due to cold water and flooding, the hatchery moved in 1920 to Granite Creek. This hatchery operated until the fall flood of 1935, then closed due to a shift in Government funding during the Depression (FRB 1948). From 1960 to 1962, DFO-operated counting fences were on the lower Lakelse River, Scully Creek, and Williams Creek. Fish eggs obtained from these fences were raised at an experimental hatchery operated on Scully Creek.

Scully and Williams Creeks hatcheries ran from 1962 to probably 1967 (Hancock *et al.* 1983). Various studies for enhancement opportunities were undertaken under the auspices of SEP, particularly reconnaissance for sites with good groundwater flow (Brown 1980). In the 1980s, a small volunteer facility at Howe Creek in Terrace, Eby Street Hatchery, began enhancing many of the small streams flowing into the east shore of Lakelse Lake. This group consistently produced coho fry from broodstock collected on Clearwater Creek for at least eight years. In the late 1980s, Deep Creek Hatchery conducted chinook enhancement on Coldwater Creek. Presently, there is one small project for coho, on Scully Creek.

Current Lakelse enhancement work revolves around stock assessment and habitat projects initiated by the Lakelse Sockeye Recovery Plan. These projects include a sediment source and transport study on Williams Creek, improvement of spawning areas in lower Scully Creek, improvement of spawning opportunities in upper Hatchery Creek, sockeye spawner counts, sampling egg to alevin survival, and sockeye fry outplanting.

The Kitimat River hatchery, built under the auspices of the Federal/Provincial Salmonid Enhancement Program (SEP) was completed in 1983 at a capital cost of $10 million. The hatchery program was designed to rebuild endangered salmon and steelhead to their former levels of abundance, which would offset damaged and degraded habitat resulting from destructive forest development activities.

Chum, chinook, coho, cutthroat, and steelhead are incubated, reared, and returned to their natal streams. Broodstock are obtained by angling, tangle netting, or seining by hatchery staff and volunteers. Kitimat Hatchery equipment consists of 14 outside raceways, 62 Capilano troughs, 6 chum keeper channels, 80 Atkin Cells, and 672 Heath trays. A unique association with Eurocan Pulp and Paper Co. provides warm water to the hatchery for fish rearing and pumphouse de-icing. The 40$^{o}$C industrial wastewater supplied by Eurocan is used to heat the building as well as manipulate the growth of the fry. Freshwater is obtained from five wells and a river water intake. Prior to fry release, one out of every forty chum, ten percent of the chinook and coho, and all steelhead and cutthroat are marked. Chinook and coho get a coded wire tag; the others are externally marked with adipose clips.

Since 1984, approximately 50,00 steelhead smolts reared in Kitimat Hatchery have been released annually. Concerns have been raised about the threat to wild stocks from the current hatchery management regime. Heggenes et al (2005) assayed allelic variation at 10 microsatellite loci in steelhead scale samples collected between 1976 and 2003. They concluded that there is little genetic differentiation among the studied year classes, or between pre and post hatchery populations. The steelhead escapement ratio between hatchery and wild stocks is shown below.

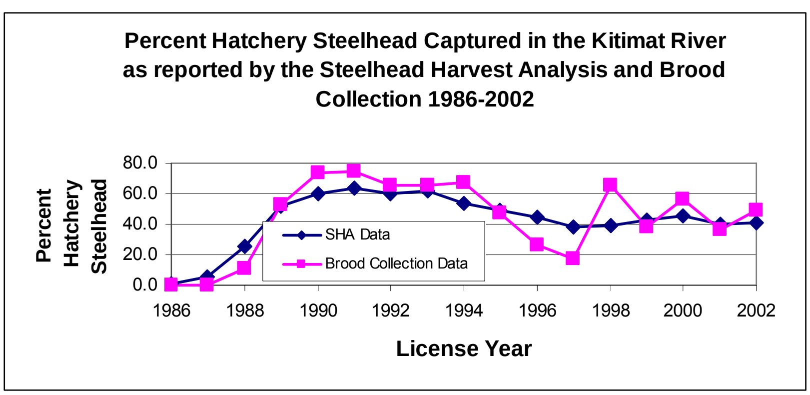


**Figure 45: Hatchery Steelhead percentage captured in the Kitimat River**

## DEVELOPMENT ACTIVITIES

The principal development activities in the Lakelse Watershed are forestry, settlement, transportation, and utilities. The principal development activities in the Kitimat watershed revolve around forestry, transportation, industrial, and settlement.

### Forest Resource Development

The conclusion of the Second World War brought a great demand for lumber, and small mills selectively logged portions of the most valuable timber stands. Since 1948, large areas of the easily accessible timber in Lakelse watershed were awarded to Columbia Cellulose and its predecessors. In 1960, the area south of Lakelse Lake was awarded to Eurocan Pulp and Paper Co. as TFL #41.

The majority of roads in the watershed were built in the 1964 to 1972 period when logging was most active. Since 1980, few patches of accessible, viably commercial mature timber have been left standing. Over this period, the following areas were intensively logged: Herman Creek, along Beam Station Road, in the lower Coldwater and White Creeks drainages, and north of Lakelse Lake in Sockeye Creek and Blackwater Creek watersheds. South of Lakelse Lake, logging development occurred in the Andalas Creek area, the Ena Lake area of Coldwater Creek, the south end of the lake, parts of Clearwater Creek Watershed, and at Onion Lake Flats. Since 1962, tributary valleys and their fans on the east side of Lakelse Lake have been heavily harvested; these include Williams Creek, Hatchery Creek, and Scully Creek.

**Figure 46:**
**View upstream on Williams Creek to the left, Llewellyn Creek in center.**
J&S Outdoor Ventures.

The Lakelse Watershed Restoration Program (Triton 1996) noted that of the 64 stream reaches rated for logging-related impacts to riparian habitats, 25% were rated as having very high impacts, 31% as having high impacts, 22% were given moderate impact ratings, 6% low impact ratings, and 16% had no riparian impacts. Results of the fisheries assessment noted a total of 63 reaches assessed, with 43 reaches being rated as very highly impacted (68%), and eight reaches as highly impacted (13%). Ten reaches were rated as moderate (16%); no reaches were rated with low impacts, while only two reaches had nil impact (3%). The large-scale industrial logging of timber along many of the streams has had profound impacts on stream structures and has lowered the productive capacity of the sub-watersheds (Gordon *et al. 19*96).

Since the 1890s, small-scale forest harvesting has occurred in the Kitimat valley, though it wasn't until 1964 to 1972, that most areas alongside the Kitimat River mainstem were harvested. By 1990, approximately 30% of the forested land base in the Kitimat drainage was harvested (Karanka 1993). This massive rate and amount of harvesting coupled with periodic intense rain events caused accelerated erosion surpassed by few places in the world. The Kitimat River channel received so much coarse material from erosion that the channel was considerably filled and has consequently widened and became shallower. This aggradation has also caused rapid prograding of the delta front, which has advanced more than 350 m since the 1950s.

**Transportation and Utilities**

A network of transportation and utility systems traverse the Lakelse and Kitimat watersheds. Linear development includes Highway #37S, a major north-south, 60 km route connecting Terrace and Highway #16 with Kitimat and tidewater to the south. Alongside the highway, built in 1957, is PNG's natural gas pipeline and a BC Hydro major transmission line. The transmission line forks north of Lakelse Lake with a branch transmission line heading down the south side of the Skeena River. Secondary roads through the watershed provide access to the two Provincial Parks, residential developments, and a myriad of forest development settings.

CN Rail, which was completed late in 1954, is for the most part positioned on the west side of Lakelse and Kitimat valleys. The regional airport is located on a bench south of Terrace. Both commercial and private floatplanes utilize Lakelse Lake as a base. Known impacts from linear development within the watershed include degradation of riparian habitat, a reduction in stream channel complexity at stream crossings, channelization, and bank erosion and degradation. Current activities are directed towards deactivation on recent and proposed roads and more awareness of fish, fish habitat, and riparian zones.

**Figure 47: View southward Lakelse Lake**

**Population and Settlement**

Terrace, the regional business centre for the area, is located on a series of natural flat benches within the broad Skeena River Valley. The population is currently 20,000 people employed in retail, manufacturing, educational, forestry, and tourism sectors. Terrace is surrounded by natural beauty. Affordable housing, diversified health care and education services, and a wide range of recreational pursuits, including natural hotsprings, ski hill, world-class fishing, lakes and nature trails within close proximity, are an attraction to residents. Terrace's economic foundation lies in its location as a hub for highway, rail, and air transportation routes.

Northwest BC has traditionally been highly dependent upon the extraction, transportation, and manufacturing of natural resources. As a result, the regional economy has traditionally been susceptible to the vagaries of international price cycles. This is slowing changing, as Terrace becomes more of a regional center for business, retail, education, medical, and government services.

The Lakelse Watershed supports a relatively high number of seasonal and full-time residences providing a variety of rural and high quality lifestyles for a population of 360 people (RDKS 2002). Lakelse Lake is thought to be the most heavily utilized recreational lake in the region. There is concern associated with any housing development at or near Lakelse Lake because of the contribution of phosphorus to the watershed. The lake has been described as a phosphorous limited system that is in danger of becoming mesotrophic, or even eutrophic (Remington 1996).

Kitimat was built in the early-1950s by the Aluminum Company of Canada (Alcan) to provide residential infrastructure for the world's largest aluminum smelter. The project also included building the Kenney Dam on the Nechako system, tunnel, powerhouse, and the town of Kemano. The community was pre-planned with defined residential areas and a centralized urban core. Current population is approximately 11,500, and another 700 reside in Kitimaat Village situated on the eastern shore at the head of Kitimat Arm. Currently, Kitimat also supports the Eurocan Pulp and Paper Company Ltd, which employs 1,200 employees in its mill, logging, and other operations; the Methanex Corporation who established a petro-chemical plant that produces export methanol; and Pacific Ammonia, an ammonia production plant.

## FPCI Results –Terrace to Kitimat

Fish passage surveys were conducted on Highway #37S and CN Rail Kitimat Subdivision in mid to late-September 2005 period that co-relates to late summer low flows. Highway #37S and CN Rail cross thirty-five fish bearing streams. Of these thirty-five stream reaches, one is characterized as having a fish passage issue and it is rated as high priority. Nine culverts need maintenance effort; the majority of these are beaver activity issues.

### LAKELSE AND KITIMAT DRAINAGES

In general, streams crossed by Highway #37 and CN Rail through the Lakelse and Kitimat drainages exhibited relatively superior compliance with fish passage guidelines. This is evidenced by the numerous new culvert or bridge structures on streams crossed by Highway #37 and CN Rail. Powerline Creek, Cable Car Creek, and Scully Creek channels–north, central, and south have caused fish passage problems in the past, but recent rehabilitation efforts have ensured straightforward juvenile and adult migration. CN Rail has recently upgraded several culverts and has completed comprehensive revegetation activities.

From Terrace south to Lakelse Lake, the highway traverses a terrace and is crossed by only one creek. Streams flowing into the eastside of Lakelse Lake and crossed by the highway include Williams, Furlong, Granite, Hatchery, and Schulbuckhand (Scully) Creeks; all have been rated as having high fisheries values. Currently, stream channel and fisheries habitat damages are also rated as high due to development revolving around residential, roads, forest harvesting, water withdrawal, and transportation and utility corridors. Channel alterations or relocations, channel instability, bedload movement and dyking, and a loss of complex habitat typify the impacts.

South of Lakelse Lake few streams are crossed until the highway traverses the Kitimat River floodplain, which for the most part is situated on semi-continuous alluvial terraces that are adjacent to the river. South of Terrace, CN Rail traverses through the low gradient Alwyn Creek drainage and then runs along terraces above the Lakelse River. Close to Lakelse River, field crews experienced some difficulty surveying stream crossings due to the number of bears present, which were associated with the massive pink salmon run.

South of the Lakelse drainage, CN Rail passes down the west side of Kitimat River positioned on alluvial terraces and sections of the floodplain. Similar to the Lakelse River situation, the field crew experienced difficulty accessing CN's five km right-of-way east of Wedeene River, due to the number of bears and their aggressive behavior.

The majority of fish passage issues turn around culvert maintenance requirements. CN Rail stream crossings in particular have a relatively large amount of beaver activity. Beaver grate and guard installations often need cleaning before small woody debris captures silt and creates stream flow limitations.

| Map Culvert No. | Stream Name | Comment | Fish Species | Fish Passage Issue | Restoration Site Priority |
|---|---|---|---|---|---|
| 94 | Furlong Creek | Culvert is a 10 m in width concrete box culvert that spreads the flow across the surface leaving little water depth for fish passage. | CO and CT | Barrier at low to high flows. | High. Conceptual design plan that incorporates flow deflector needs to be finalized. |

**Table 9: Highway #37 and CN Rail culverts with fish passage issues-Terrace to Kitimat.**

## HIGH PRIORITY FISH PASSAGE SITES

**Map Culvert No. 94** represents Furlong Creek, which is crossed by Highway #37S. Furlong Creek is located east of Lakelse Lake and approximately 14 km south of Terrace. The watershed is a third order, 12 $km^2$ basin draining the slopes of Mount Layton. The concrete box culvert is 1.4 m in width and 27 m in length, with a concrete floor. The stream flow is spread across the floor and at all but the highest flows does not provide sufficient water depth for juvenile and adult fish passage.

The creek supports sockeye, coho, and pink salmon, as well as Dolly Varden and cutthroat. Coho have been observed up to the highway crossing and cutthroat upstream of it.

Development includes residential on both sides of the creek near the lake, transportation and utilities corridors, and forest harvesting. Due to these development activities, Furlong Ceek channel bedload is unstable with annual variations in channel morphology and in some years these conditions can create bedload and debris barriers that impede fish passage. The highway crossing increases the stream velocity and observations suggest that bedload movement upstream and downstream of the highway is accentuated.

**Figure 48: Furlong Creek box culvert, view shows inlet downstream.**

The Furlong Creek concrete box culvert is rated as a high priority for restoration due to the fish species involved, habitat values upstream and downstream, the type of barrier, and the amount of habitat gained. Initial discussions with DFO habitat restoration biologists have identified several restoration options. The most cost effective option that will fulfil restoration objectives is to create a concrete apron at the inlet that will force all but the high flows down one side of the culvert. Establishing a concrete sill down the length of the culvert will ensure flows stay entrained to the side. It is anticipated that concrete baffles will be needed to slow the water velocity and facilitate upstream fish passage.

**Figure 49: Furlong Creek showing outlet upstream**

**Figure 50: Furlong Creek showing outlet upstream**

## Discussion

This report presents the fish passage issues on Highway #16, #37S, and CN Rail between Prince Rupert, Terrace, and Kitimat that need to be addressed with restorative action. A total of 84 culvert structures were recorded on Highway #16, Highway #37, and the CN Rail lines. Our findings indicate the need for restoration or rehabilitation on eleven stream crossings. Of these culvert crossings, four are rated as high priority and seven are rated as medium and low priorities. The assessment also found thirteen stream crossing that require maintenance by B.C. Ministry of Highways and CN Rail. The greatest part of the maintenance work is routine and cost effective.

The task of restoring fish passage and upstream habitat at stream crossings involves establishing priorities based on measurable benefits. With limited resources, a focused approach providing the greatest short and long-term benefits to our fish and fish habitat resources is required. Exchamsiks Backchannels (Map Culvert No.s 35, 36, 37, and 38) are the highest priority culverts to rehabilitate in this study. For biological, social, and economic reasons, Skeena Fisheries Commission strongly recommends the Exchamsiks Backchannels as the highest priority candidate. The amount of potential habitat gained and probable coho production are thought to be significant.

Support for moving forward with restoration efforts has been verbally forthcoming from Department of Fisheries and Oceans and the B.C. Ministry of Highways. The next step includes a meeting of partners and stakeholders to discuss and consider survey results and the conceptual restoration plan, then to provide consensus for a work plan that outlines information gaps and assumptions in regard to:

- Restoration cost, funding sources, and risks to investment if any,
- Fish species life histories,
- Limiting habitat factors,
- Engineering hypothesis such as water flushing volumes and terms, water supply alternatives, options for sealing the riprap berm, and natural variability; for example, detrimental outcomes from large flood events depositing high silt loads.
- Further site assessments needed.

Skeena Fisheries Commission recognizes that a considerable investment will be required to modify the existing Exchamsiks Backchannel and Backchannel #1 culverts and stabilizing water levels, but restoring fish passage will provide long-term benefits to the aboriginal, recreational, and commercial fisheries, as well to the BC Ministry of Transportation and CN Rail.

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## Appendix 1  Photographs and Data Tables

Photographs and Data Tables submitted under separate cover.

## Appendix 2 Financial Statement of Expenditures

## Appendix 3 Exchamsiks Backchannels Conceptual Restoration Plan

Exchamsiks Backchannels Conceptual Restoration Plan submitted under separate cover.

# Appendix 4 Maps

Five 1:50,000 maps in pockets.