REPORT ON

BACKGROUND INFORMATION REPORT MURRAY-CHESLATTA RIVER SYSTEM

Submitted to:

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1.0 INTRODUCTION

With the cancellation of the proposed Kemano Completion Project (KCP) by the Province of British Columbia in 1995, Alcan and the province reached an agreement in 1997 to establish the Nechako Environmental Enhancement Fund (NEEF). A management committee was set up to decide how this fund should be administered and in 2001 a decision was made that the best use of the funds would be for the construction of a cold water release facility (CWRF) at Kenny Dam.

The Nechako Watershed Council (NWC) was formed in 1998 to provide a forum for the diverse interests in the Nechako River watershed and the communities that depend on the watershed. The intent was to work cooperatively in addressing long-standing water management and related issues. In 2002, NWC and provincial government representatives released a work plan that would lead to the construction of the CWRF at Kenny Dam. In the same year the Nechako Enhancement Society (NES) was established to administer, support and fund the planning of a CWRF at Kenny Dam. The NES is currently coordinating and overseeing the implementation of the NWC's "*Proposed Work Plan for the Cold Water Release Facility at Kenny Dam*". Membership in the NES includes equal representation from the provincial government of British Columbia and Alcan. The NWC acts as an advisory body to the NES.

If a CWRF is constructed at Kenny Dam, the amount of water released via the Skins Lake Spillway will be significantly reduced. Included within the NWC Work Plan were recommendations to undertake further studies to determine the optimal flow regime at Skins Lake Spillway and at the confluence of the Nechako and Cheslatta Rivers, and the optimal lake levels in the Murray-Cheslatta System. The NES issued a request for proposal (RFP) on 10 June 2005 for collection of background information on the Murray-Cheslatta watershed. Golder Associates Ltd.(Golder) was retained in June 2005 to prepare the background information report.

The overall purpose of this report, entitled "Background Information Report Murray-Cheslatta River System," was to summarize relevant contained within the reports listed in Appendix D of the RFP.

Specific tasks included:

(a) Review information contained within documents listed in Appendix D of the RFP (see Appendix A of this report);

(b) Work with the NES to develop an agreed-upon format and Table of Contents for the report;

(c) draft a document based on a compilation of presently available key information, including a review of:

- biological, hydrological and other technical information;

- identified interests and issues with a special interest and focus on First Nations interests and issues;
- performance measures/indicators that have been developed;
- flow options that have been developed, proposed or recommended;
- fish management plans and objectives that have been developed;
- redevelopment plans that have been developed, proposed or recommended;
- results of any modelling or analysis that has been conducted;
- areas of agreement/consensus; and
- areas of disagreement (unresolved issues).

2.0 OVERVIEW OF THE CHESLATTA WATERSHED

The Cheslatta River (53°39' N - 124°56' W) is located approximately 70 km southwest of Vanderhoof (Figure 1). The Cheslatta River flows from northwest to southeast to join the Nechako River below the Nechako Canyon. The river drains an area of approximately 1300 km^2.

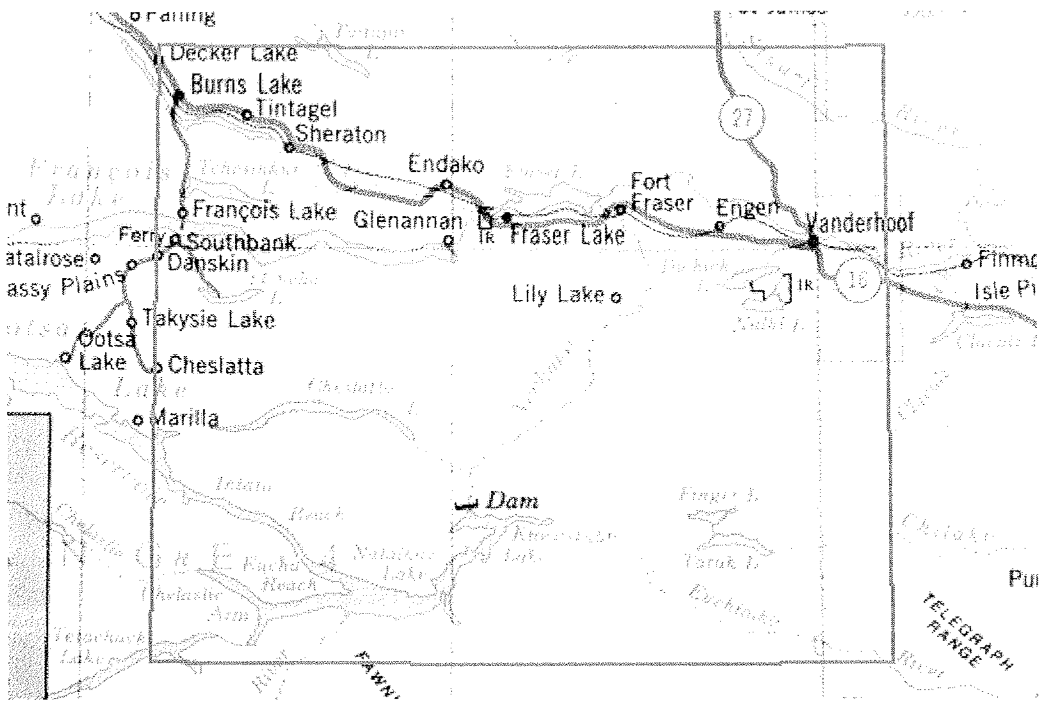


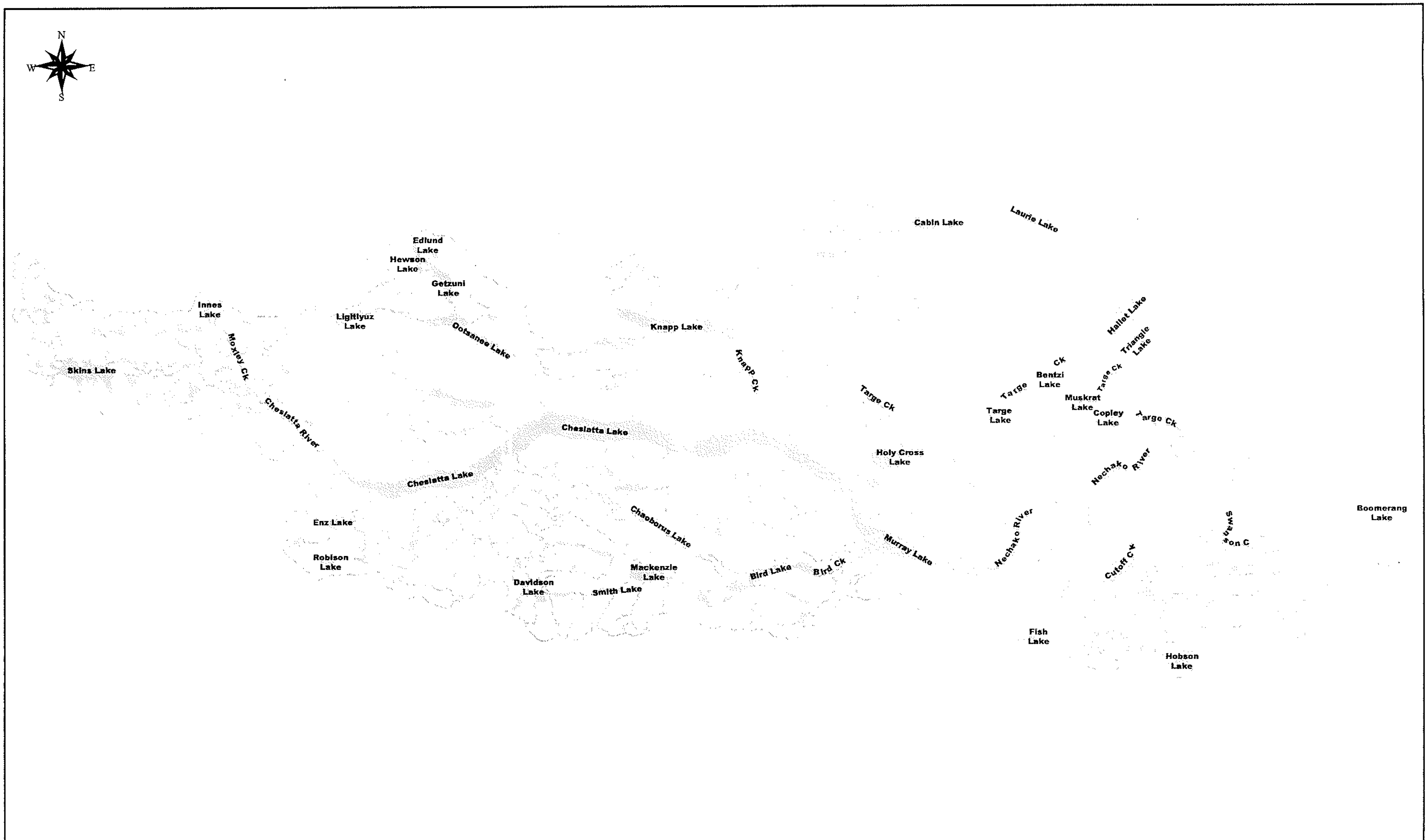
Figure 1. Location of Chelsatta River

(Source: http://ceonet.ccrs.nrcan.gc.ca/earthscapeliteserver)

There are two large lakes along the mainstem, Cheslatta Lake and Murray Lake (Figure 2). There are also a number of lake headed tributary streams in the watershed, the largest are Bird, Holy Cross, Knapp and Ootsanee creeks (Figure 2). Prior to the development of the Nechako Reservoir, the headwaters of the Cheslatta were formed by a short section of stream (approximately 2 km) at the west end of Cheslatta Lake (Lyons and Larkin 1952; Figure 3).

With the development of the Nechako Reservoir, the Cheslatta River is now connected to the reservoir via the Skins Lake Spillway. Since 1956 eastward flows from the Nechako Reservoir have been discharged via the Skins Lake Spillway. From Skins Lake the river follows a glacial spillway trench originally occupied by small fans and the floodplain of the Cheslatta River (Kellerhals et al. 1979). The river flows into Cheslatta lake and then a short distance downstream it enters Murray Lake. From Murray Lake, the river continues downstream approximately 2.5 km to the confluence of the Nechako River.

n:\active\2005\1490 Prince George\Cheslatta_River\cheslatta_watershed.apr (Layout: 8.5x11 Landscape) 07/12/2005



LEGEND

- River, Stream, Creek
- Lake

REFERENCE

Watershed Info: Ministry of Sustainable Resource Management -
http://www.bcfisheries.gov.bc.ca/fishinv/basemaps-maps.html
Datum: NAD 83 Projection: BC Albers

5 0 5 10
Scale 1:400,000 Kilometres

PROJECT
BACKGROUND INFORMATION REPORT
FOR THE MURRAY-CHESLATTA SYSTEM

TITLE
CHESLATTA RIVER WATERSHED

Golder Associates
Prince George, BC

PROJECT No. 05-1490-006			SCALE AS SHOWN	REV. 0
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GIS	MJM	12 Jul. 2005		
CHECK				
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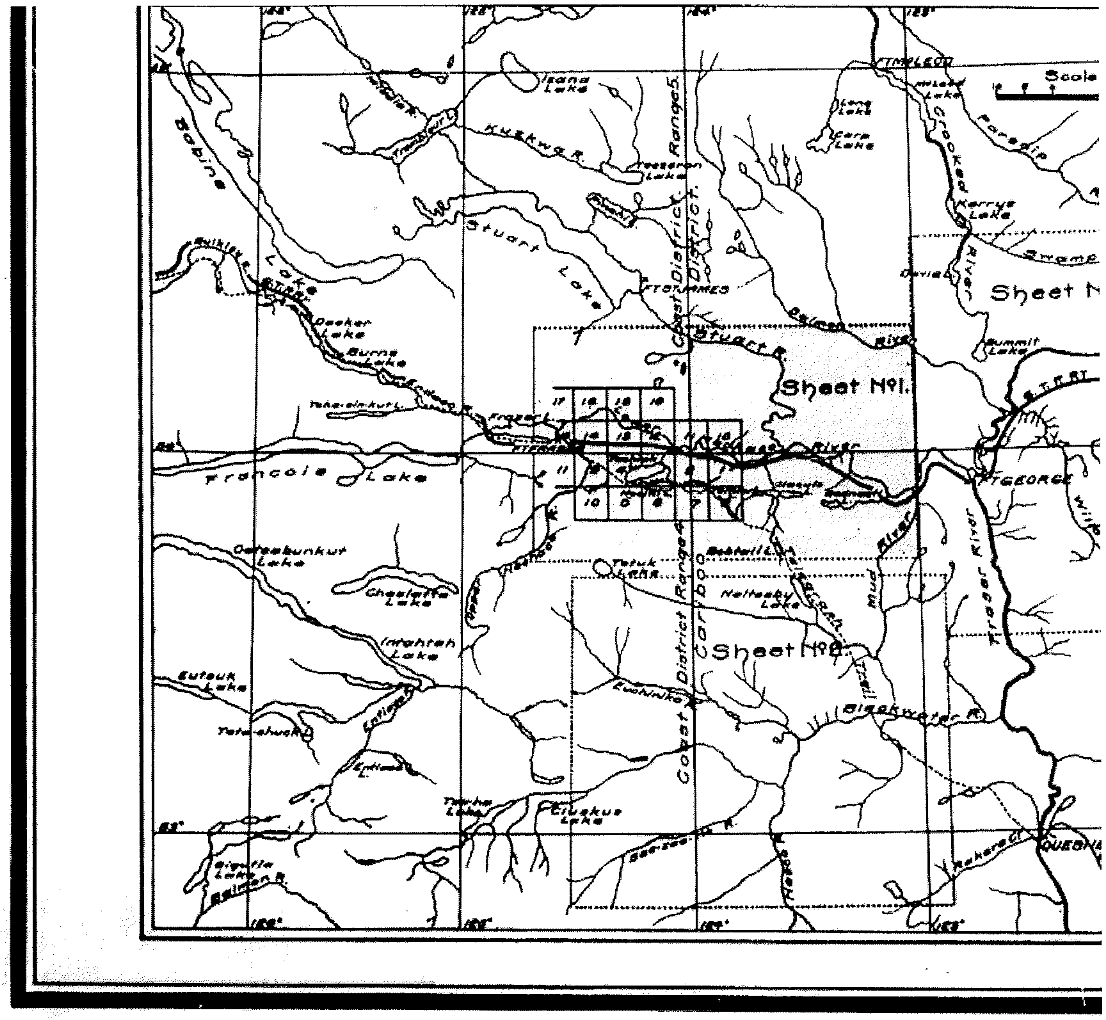

Figure 3. **Map of the upper Nechako River watershed circa 1911.**

Source: http://www.bcarchives.gov.bc.ca/index.htm

3.0 HYDROLOGY AND GEOMORPHOLOGY

3.1 Pre-development

Prior to creation of the Nechako Reservoir and diversion of water into the Murray-Cheslatta system via the Skins Lake Spillway, the Murray-Cheslatta system had a natural watershed area of approximately 1,300 km^2 (NHCL 2000). The mainstem of the Cheslatta River originated at Skins Lake in the west. The reach from Skins Lake to Cheslatta Lake, known as the upper Cheslatta River, had a total drainage area of 190 km^2. Water then flowed through Cheslatta Lake, which had a width of approximately 1 km, for a distance of approximately 50 km. Below Cheslatta Lake, a short section of river conveyed flow from Cheslatta Lake into Murray Lake, which was approximately 8 km long and less than 1 km wide. From Murray lake, the lower Cheslatta River[1] conveyed flow into the Nechako River, approximately 10 km downstream of Kenney Dam. The system included the following main tributaries (Gordon and Associates 2004):

- Moxley Creek, a northern tributary of Cheslatta River (located in the west of the watershed);
- Dog Creek, a northern tributary of Cheslatta River (located east of Moxley Creek);
- Home Creek, a northern tributary of Cheslatta River (east of Dog Creek);
- Sather Creek, which entered Cheslatta Lake from the north (located east of Home Creek);
- Ootsanee Creek, which entered Cheslatta Lake from the north (located east of Sather Creek, and its watershed included Ootsannee Lake);
- Knapp Creek, which entered Cheslatta Lake from the north (located east of Ootsanee Creek, and its watershed included Knapp Lake);
- Holy Cross Creek, a northern tributary of Murray Lake (located east of Knapp Creek, and its watershed included Holy Cross Lake); and
- Bird Creek, a southern tributary of Murray Lake (watershed included Bird Lake).

Other minor tributaries drained into the Murray-Cheslatta system from the north and south.

Prior to filling of the Nechako Reservoir and the operational start-up of the Skins Lake Spillway in 1956, the mean annual discharge from the Murray-Cheslatta system was approximately 5 m^3/s. The upper Cheslatta River, which terminated at its entry to Cheslatta Lake with a watershed area of approximately 190 km^2, had a mean annual discharge of 0.6 m^3/s (NHCL 2000).

The natural hydrological regime of the upper Cheslatta River, which includes the inflows from tributaries within the Murray-Cheslatta system, is represented by the flows recorded at Environment Canada Gauging Station 08JA014 on Van Tine Creek (Bouillon and Pisio 2000).

[1] The upper Cheslatta River has been used to refer to the mainstem portion of the watershed upstream of Cheslatta Lakes. The lower Cheslatta River refers to the length of mainstem from Murray Lake to the Nechako River.

Discharges generally increase from a minimum in March as spring snowmelt begins, peak in May and then decline for the remainder of the year. Autumn rainfall produces a smaller runoff peak in some years (NHCL 2000).

The total annual flow volume of the Murray and Cheslatta Lakes prior to regulation was estimated to be 990,000 dam^3 (one dam^3 is equal to 1000 m^3) (Lyons and Larkin 1952). Based on the natural mean annual discharge, the mean hydraulic residence time[2] in the lakes was approximately 6 years.

3.2 Existing Conditions

The Nechako Reservoir was created by constructing Kenney Dam and nine other saddle dams (including the Skins Lake Spillway) on the upper Nechako River, to divert water for power generation at Kemano. The reservoir was filled by 1956 and since then water from the reservoir is discharged through the Kemano generating station and to the Murray-Cheslatta system, via the Skins Lake Spillway. No water is currently released to the Nechako River at Kenney Dam. The diversion increases flows along the mainstem of the Murray-Cheslatta River, including (in downstream order) the upper Cheslatta River, Cheslatta Lake, the Murray River, Murray Lake and the lower Cheslatta River. All other tributaries noted in Section 3.1 still exist and their flow regimes are unaffected by the diversion.

The estimated long-term mean annual inflow to the Nechako Reservoir is 195 m^3/s (1930 to 1998), though it has been somewhat less for the period since 1981 (NHCL 2000). Between 1981 and 1998 an average of 63.7 m^3/s per year was diverted to the Murray-Cheslatta system via Skins Lake Spillway.

Diversions to the Murray-Cheslatta system consist of:

- base flow releases, as required of Alcan by the 1987 Settlement Agreement, to provide for fisheries conservation;
- cooling flow releases, as required of Alcan by the 1987 Settlement Agreement, to facilitate sockeye salmon migration in July and August; and
- flood releases, as required to regulate water levels in the Reservoir. These are scheduled in consultation with the Nechako Fisheries Conservation Program and the Comptroller of Water Rights and can occur at any time of year, but generally occur prior to spring runoff.

The increase in mean annual flow in the Murray-Cheslatta system from the natural value of 5 m^3/s to the existing value of 68.7 m^3/s [3] represents a thirteen-fold increase. In upper Cheslatta

[2] Mean hydraulic residence time is equal to the volume of the waterbody divided by the mean inflow rate

[3] Average diversion flows of 63.7 m^3/s plus the 5 m^3/s of natural inflow

River, the increase from 0.6 m^3/s to 64.3 m^3/s represents greater than a hundred-fold increase. The water level in Cheslatta Lake has risen by an estimated one to two metres. The effects of these increases are discussed further in Section 4.0.

The existing flows result in a mean hydraulic residence time in Murray and Cheslatta Lakes of 5.5 months, compared to the non-regulated value of 6 years. Based on an estimated elevation-discharge rating curve for the Murray-Cheslatta Lakes, it was estimated that maximum water levels in the lakes were raised by up to 3.5 m above natural conditions, and that the maximum range of lake water levels was increased from 1 m under natural conditions to 3.5 m under existing conditions.

3.3 Monitoring and Modeling

The results of hydrological data collection in the Murray-Cheslatta system for the period 1989 to 1993 were presented by Triton (1993). This report includes:

- Air temperature, relative humidity, precipitation and snow depth data from Bird Creek meteorology station (1989 to 1993);
- Discharge data from Bird Creek hydrometric station (1989 to 1993);
- Comparisons of Bird Creek meteorological and hydrometric data to concurrent regional data.

Monitoring data from Bird Creek were used, in conjunction with regional data provided by Environment Canada and the Province of British Columbia, to develop a procedure for forecasting natural inflows into the Murray-Cheslatta system (Triton 1995).

Monitoring data from several regional watersheds were used as a basis for developing surrogate hydrographs for the Murray-Cheslatta system (Bouillon and Pisio 2000). These were intended to provide a basis for selecting an operational hydrograph for the Skins Lake Spillway for a selected rehabilitation alternative.

Water balance modeling was also performed as part of the environmental studies for the proposed Kemano Completion Hydroelectric Development (Envirocon 1984). However, this project was not approved and the data presented there should only be used as background information.

4.0 GEOMORPHOLOGY

4.1 Pre-development

Prior to diversion of water from the Nechako Reservoir to the Murray-Cheslatta system, the upper Cheslatta River (above Cheslatta Lake) was a small, torturously meandering[4], single-thread channel with a bankfull width of approximately five metres, unconfined within its floodplain (Kellerhalls et al. 1979; Lyons and Larkin 1952). A delta existed where the upper river entered Cheslatta Lake.

To create the connection from the Skins Lake Spillway to the Cheslatta River, the developers planned a water flow pathway to the Skins Lake where one did not previously exist.

4.2 Existing Conditions

Subsequent to the filling of the Nechako Reservoir and commencement of operation of the Skins Lake Spillway in 1956, the channel has undergone significant changes attributable to increased flows. The channel has become an entrenched and confined, single-thread gravel-bed channel, with prominent diagonal bars and a bankfull width[5] of approximately 75 to 150 m. The river drops approximately 50 to 70 m over a thalweg[6] length of approximately 25 km. The existing channel has degraded up to 20 m below the former floodplain (Kellerhals 1979; Kellerhals et al. 1979; NHCL 2000). The former floodplain, once vegetated with willows, is now a dry, grassed or forested terrace. Degradation and meander removal have doubled the channel bed slope (i.e., made the channel bed steeper). Its profile is now mainly controlled by bedrock sills and boulder rapids, with short reaches of coarse alluvium between controls in depressions along the old valley (Kellerhals 1979).

Kellerhals et al. (1979) estimate that between 1956 and 1975 approximately 10 million cubic metres of predominantly glaciofluvial gravel overlain by silty floodplain deposits were moved from the Cheslatta valley and deposited in Cheslatta Lake. This has raised the lake level by an estimated one to two metres, and increased both the thickness and size (from 1.5 km to 2.5 km) of the original delta at the upper end of the lake. Fine sediments have been carried further into the lakes and deposited on the shores and bed, with the finest fractions transported through to the Nechako River. Discharges from the reservoir have resulted in higher lake water levels and greater annual ranges, which have contributed to shoreline erosion due to wave action at higher elevations.

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[4] A meandering channel, with high meander:width ratio (refer to Rosgen 1994).

[5] Bankfull width is the width of a channel when flow levels are at the top of the banks.

[6] Thalweg refers to the deepest portion of the channel.

A deep scour hole has formed between Cheslatta and Murray Lakes, and the eroded material has been deposited at the head of Murray Lake (NHCL 2000; refer to Page 4 of Gordon 2004)). In the lower Cheslatta River, between Murray Lake and Cheslatta Falls, the right downstream bank overtopped on several occasions. This caused an avulsion and erosion of glacial deposits in the gully that conveyed the diverted flows to the Nechako River (RCPL 1987). A saddle dam was constructed prior to 1979 and banks raised to prevent future overtopping.

Lowering of the thalwegs of the Murray and Cheslatta Rivers has caused tributary streams to adjust by downcutting through alluvial fans[7] at their mouths. Upstream, deep gullies with active head scarps have formed (Kellerhals 1979; Kellerhals et al. 1979). The resulting high channel slopes may impede fish passage on tributaries to the rivers, particularly on Home Creek (NHCL 2000). Tributaries of Murray and Cheslatta Lakes, including Bird, Knapp, Ootsanee and Sather Creeks, are not affected by channel degradation, but flooding of their lower reaches due to the changed lake water level regime has eliminated riparian vegetation in these areas and degraded fish habitat (Harder 1986).

A field inspection of the Cheslatta River, Murray and Cheslatta Lakes, and Bird, Knapp and Ootsanee Creeks was performed on September 6, 2000 and reported by NHCL (2000). The observations on this date were generally consistent with those previously reported.

A photomosaic of the Murray-Cheslatta system, including named tributaries, was commissioned by Alcan Primary Metal BC (Gordon and Associates 2004). This document contains large-scale, colour aerial photographs of the entire reach from the Skins Lake Spillway to the Nechako Canyon and can provide a basis for assessment of existing conditions and evaluation of rehabilitation alternatives.

[7] A triangular deposit of sediment left by a stream that has lost velocity upon entering a broad, relatively flat valley.

5.0 BIOLOGICAL INFORMATION

5.1 Limnology

Prior to the activation of the Skins Lake Spillway, Cheslatta Lake had a surface area of 3496 ha, a maximum length of 40 km and a maximum width of 1.6 km. Approximately 80% of the lake area was greater than 15 m in depth and a maximum depth of 73 m. The lake thermally stratified, with a mesolimnion extending from approximately 3 to 14 m. The Secchi depth was 4.9 m (Lyons and Larkin 1952). The lake was classified as "mesotrophic with the favourable conditions of a highly productive and high efficiency food chain" (Lyons and Larkin 1952). Based on the information reviewed in preparing the Background Report, there does not appear to be a recent limnological survey of either Cheslatta Lake (or Murray Lake). Therefore, it is not possible to completely assess how limnological processes may have changed since the 1952 survey. There is some anecdotal information (see below) which suggests that the lakes have experienced a trophic shift.

Murray Lake is much smaller than Cheslatta Lake, with a surface area of 554 ha prior to regulation. The lake was approximately 8.2 km long and 1 km wide. The mean depth was 10 m and the maximum depth was 26 m. The lake thermally stratified during the summer. In the deep basin of the lake, the mesolimnion extended from approximately 3 to 14 m. The Secchi depth was not measured but the water transparency was reported to be similar to that of Cheslatta Lake (Lyons and Larkin 1952). Lyons and Larkin (1952) indicated that the "low mean depth and small area are characteristic of the eutrophic or highly productive type of lake in which the large quantities of food organisms are not efficiently utilized."

Accelerated flushing has reduced nutrient retention and reduced the productivity of the lakes (Harder 1986). High turbidity in the lakes, as a result of the erosion in the upper Cheslatta, has reduced light penetration in the water column, which in turn has decreased primary productivity and the size of the littoral zone of the lakes (Harder 1986). Abelson (1985) indicated that despite high spring phosphorus values reduced light penetration is limiting summer productivity. As a result, the lakes are similar to stressed oligotrohic-mesotrophic lakes.

The lake levels now fluctuate substantially with the discharges from Skins Lake (up to 3.5 m.). As a result , a large, treeless foreshore area is evident along the entire length of both lakes when discharges are low (nhc 2000).

The future reduction of flows in the Cheslatta River and stabilizing water levels were predicted to have a number of positive effects on the lakes, including (Envirocon 1984):

- Reduced sediment transport into the lakes and improved water clarity;
- Reduced spring phosphorus loading;

- Increased retention time and increased water clarity, likely resulting in increased primary productivity;
- Likely increase in zooplankton in response to higher primary productivity and improved feeding conditions.

5.2 Fisheries

Fisheries data specific to Murray and Cheslatta lakes is very limited. Based on the information reviewed, there was one survey done by Lyons and Larkin (1952) prior to impoundment of the Nechako Reservoir and operation of the Skins Lakes Spillway. The sampling of Cheslatta and Murray lakes was not intensive as the Lyons and Larkin (1952) work was focused on the lakes and rivers that were to be altered by the development of the Nechako Reservoir (i.e., the Great Circle Lakes including Tahtsa, Whitesail, Sinclair, Ootsa, Intata, Natalkuz, Eutsuk, Tetachuk, Euchu, and Chelaslie lakes). The next reported fisheries surveys were carried out in the early and mid 1980s. Abelson (1985) evaluated the results of fisheries surveys in the upper Nechako River, including the Cheslatta River, watershed conducted in the early 1980's. Harder (1986) summarized the results of gill netting that the Fish and Wildlife Branch carried out in the lakes during 1981. Harder (1986) also reported the results of their assessment of the fisheries capabilities and enhancement opportunities in four tributary streams.

5.2.1 Cheslatta and Murray Lake

Lyons and Larkin (1952) reported the presence of rainbow trout, lake char, lake whitefish as well as unspecified species of suckers and sculpin in Murray and Cheslatta lakes. Harder (1986) expanded the knowledge of fish species in the lakes. In addition to the species noted in the 1952 survey, Harder indicated that kokanee, longnose sucker, coarsescale sucker, mountain whitefish and redside shiner were captured in gill nets. Abelson (1985) also reported the presences of peamouth chub, lake chub and burbot in the lakes Table 1.

It is conceivable that the expanded species list noted in the 1980's could reflect the introduction of some new species from upstream sources, as many of the additional species noted in the mid-1980's were observed by Lyons and Larkin (1952) in other lakes in the upper Nechako River watershed (which is now connected to the Cheslatta River watershed via Skins Lake Spillway). The difference in species composition between 1952 and mid-1980's may also be attributable to differences in sampling intensity and gear selectivity between the various surveys. The Lyons and Larkin survey was a quick assessment of the fisheries resources using gillnets. The surveys in the early and mid-1980's appear to have had more sampling effort. In addition, Abelson (1985) and Harder (1986) sampled a number of the tributary streams where alternative sampling methods (e.g., backpack electrofishing, minnow traps) would have more effectively sampled smaller bodied fish. Given the limited amount of pre-impoundment fisheries data, it is not possible to definitely determine if the species assemblage existing in the 1980's (and presumably at present) is similar to what was present in the lakes prior to operation of the Skins Lake Spillway.

Table 1. Summary of fish species know to be in the Cheslatta River Watershed

Common Name	Scientific Name	Murray and Cheslatta Lakes	Tributary Streams
Sucker species	*Catostomus* spp.	✓[1]	
Longnose sucker	*C. catostomus*	✓[2]	
Coursescale sucker	*C. macrocheilus*	✓[2]	✓[2]
Lake whitefish	*Coregonus clupeaformis*	✓[1,2]	
Sculpin species	*Cottus* spp.	✓[1]	✓[2]
Lake chub	*Couesius plumbeus*	✓[3]	
Burbot	*Lota lota*	✓[3]	
Peamouth chub	*Mylocheilus caurinus*	✓[3]	
Rainbow trout	*Oncorhynchus mykiss*	✓[1,2]	✓[2]
Kokanee	*O. nerka*	✓[2]	
Mountain whitefish	*Prosopium williamsoni*	✓[2]	✓[2]
Northern pikeminnow	*Ptychocheilus oregonensis*		✓[2]
Redside shiner	*Richardsonius baleatus*	✓[2]	✓[2]
Bull trout	*Salvelinus confluentus*		✓[2]
Longnose dace	*Rhinichthys cataractae*		✓[2]
Lake trout	*S. namaycush*	✓[1,2]	

Source: [1]Lyons and Larkin (1952); [2]Harder (1986); [3]Abelson (1985)

According to Lyons and Larkin (1952), local residents reported that 1.4-1.8 kg whitefish and 2.3-4.5 kg lake trout were common. The authors also indicated that whitefish, lake trout and rainbow trout "form an indispensable item in the diet of the Indian residents of the region."

Lyons and Larkin (1952) noted several possible spawning locations for rainbow trout, although active spawning was not observed. Their assessment was based on availability of suitable physical habitat. Possible spawning locations included:

- Cheslatta River inlet to Cheslatta Lake;

- Enz Creek;
- Ootsanee Creek;
- Knapp Creek;
- Holy Cross Creek;
- Bird Creek (tributary to Murray Lake); and
- Cheslatta River at the outlet of Cheslatta Lake

Based on the results of the 1986 survey (Harder 1986), sportfish populations were less abundant and growth rates of rainbow trout were slower than those observed during the Lyons and Larkin (1952) survey. Harder (1986) indicated that channel degradation in the upper Cheslatta had reduced spawning and rearing capabilities in the mainstem portion of the river. This conclusion was based on an assessment of the river conditions in 1986 and Lyons and Larkin (1952) report of potential spawning areas. Seasonal lake fluctuation also adversely affected fish habitat in tributary streams, which has degraded spawning and rearing habitat between the high and low water levels (i.e., stream habitat in the lower section of the tributary stream that could be used by species such as rainbow trout and kokanee, is seasonally inundated by water as the lake surface elevation changes).

5.2.2 Cheslatta River

Other than the reference to possible spawning areas in the mainstem portion of the river by Lyons and Larkin (1952), no other fisheries information for the mainstem Cheslatta River was found in the documents reviewed in this project.

5.2.3 Cheslatta Tributaries

There are approximately 25 tributary streams that flow into Murray or Cheslatta lakes. The majority of these streams are ephemeral. Only seven are flowing in September and of these four are considered to be capable of supporting fish (Envirocon 1984; Harder 1986). Harder (1986) assessed the fish habitat in four of the larger tributaries, Holy Cross, Knapp, Bird and Ootsanee Creek (Table 2) and examined enhancement opportunities.

Table 2 Summary of watershed characteristics

Watershed	Area (km^2)	Maximum Elevation (m)	Total Lake Storage (ha)	Low Summer Flow (cms)
Bird	189	899	530	0.301
Holy Cross	71.5	860	400	0.043
Knapp	236.4	844	430	0.031
Ootsanee	137.5	872	530	0.052

Source: Harder (1986)

The lower-most reach of each of these streams was sampled in July and August 1986. The catch included rainbow trout, mountain whitefish, bull trout[8], longnose dace, redside shiner, coursescale sucker, sculpin, and northern pikeminnow. Fish were reported to be present in low densities, and salmonid species were only captured in Bird and Ootsanee Creek (Harder 1986). Harder (1986) referenced earlier work by Envirocon. These investigators observed rainbow trout near the mouths of Knapp, Ootsanee and several unnamed tributaries, and adult kokanee in spawning colouration in Knapp Creek. In the absence of more recent data, it has been assumed that all of the species noted in the early and mid-1980's would still be present in the Murray-Cheslatta system.

Harder (1986) suggested that rainbow trout production in the system was limited by insufficient fry seeding (i.e., unsuccessful spawning and recruitment), low summer flows in tributary streams, restricted access to the upper reaches of the tributary streams (mainly as a result of beaver dams) and habitat degradation in the lower reaches of the tributaries as a result of the annual inundation.

[8] These were reported as Dolly Varden

6.0 CHESLATTA RIVER REDEVELOPMENT

The need for addressing the impacts to the Cheslatta River watershed have been examined since at least the early 1980's. The Provincial Government initially developed plans for restoring the sport fishery in Murray and Cheslatta lakes as early as 1985 (see Abelson 1985). This section of the report highlights the various plans and their associated goals and objectives

6.1 Restoration, Rehabilitation, or Redevelopment

There have been a variety of plans for the rehabilitation, restoration, and redevelopment of the Murray-Cheslatta watershed proposed over the last 20 years. The various plans are discussed in more detail in the following sections. Because the concepts of restoration and rehabilitation are fundamentally different with respect to their goals and outcome, it is important to define them in the context of watershed or ecological process.

Restoration: "Restoration of such a stream involves returning it to its previously undisturbed condition by reconstructing the structure and function of the pre-disturbance ecosystem." (http://www.geog.soton.ac.uk/users/WheatonJ/Definitions/Stockwell.htm)

Rehabilitation: "The partial structural and functional return to a pre-disturbance state." (http://www.geog.soton.ac.uk/users/WheatonJ/Definitions/QG0103.htm)

As a result of the magnitude and types of the changes to the Cheslatta system, it would not be possible to restore the river back to its pre-disturbance state. Therefore, rehabilitation is a more achievable goal.

The Cheslatta Carrier Nation have proposed another concept, redevelopment. This plan includes the rehabilitation of the environment in the watershed (aquatic and terrestrial); however, the overall goal of the plan is to manage the watershed resources as a whole and build a sustainable economic base for the Cheslatta Carrier Nation (refer to Section 6.3).

6.2 Flow Options

Critical to the success of all the proposed plans is the need to develop a hydrograph that approximates a natural river and restore ecosystem function. This would reduce erosion in the upper Cheslatta and downstream sediment transport. It would also reduce the fluctuation of water levels in the lakes and improve the limnological conditions. This should in-turn result in positive effects on resident fish populations. The key assumption is that the river and lakes are stabilized and become ecologically healthy with naturalized, annual hydrologic cycles (Holman and Schienbein 2000).

The proposed Cold Water Release Facility (CWRF) at Kenney Dam would release some of the water for baseflows and all the cooling flow water from the Nechako Reservoir at Kenney Dam (NHCL 2000). This would reduce discharge rates through the Skins Lake Spillway and restore flows in the Murray-Cheslatta system closer to natural conditions. Seven CWRF alternative concepts were examined by Rescan Environmental Services Ltd. (2000). All of the alternatives included a low level outlet and provided temperature control by surface water release or selective withdrawal. The viable alternatives reduced the operating frequency of Skins Lake Spillway to no more than once in 200 years, on average.

NHCL (2000) recommended that any rehabilitation alternative should include some discharge from the Skins Lake Spillway, because "natural river flows would barely wet the existing broad channel with its coarse bed material [and] it is expected that flows would be sub-surface through part of the channel during the late summer, fall and winter." It was recommended that approximately one-third to one-half of the base flow to the Nechako River be diverted via the Skins Lake Spillway and the Murray-Cheslatta system. NHCL (2000) examined several alternative hydrographs, based on flow regimes of regional streams. It was recommended that any hydrograph adopted for rehabilitation be adjusted, based on post-commissioning observations, to achieve the following goals:

- Low flows of sufficient volume to maintain continuous surface flow over a channel width of 10 to 15 m; and
- Peak flows large enough to re-work channel substrates to maintain clean spawning gravel and high biodiversity.

The proposed rehabilitation alternatives consider release of large, infrequent reservoir discharges through the Skins Lake Spillway. These discharges would occur with a frequency, on average, of 300 to 400 years (NHCL 2000) and be similar in magnitude to the cooling or pre-spill release flows under existing conditions.

The Nechako Environmental Enhancement Fund (NEEF) Management Committee recommended that a more natural flow regime in the Murrary-Cheslatte system be achieved by (NEEF 2001):

- removing Nechako River base flows from the Murray-Cheslatta system;
- removing cooling water flows from the Murray-Cheslatta system;
- removing flood flows up to the 1 in 200 year flows from the Murray-Cheslatta system, except for the occasional flushing flows; and
- adopting an adaptive management approach to create a more natural hydrograph with average annual flow rates through Skins Lake beginning at 5 m^3/s and increasing gradually up to 15 m^3/s

Abelson (1990, 1994) expressed concern that without sufficient flow augmentation the natural inflows would run subsurface (i.e., in areas were deep gravel deposits have developed) and the river would not flow in summer months. NHCL (2000) indicated that due to the channel widening, natural river flows would "barely wet the existing broad channel" and that flows would be sub-surface through part of the channel during the late summer, fall and winter. This indicates that a great deal of consideration is required to determine the monthly flow schedule for a future Cheslatta River and will likely require additional physical manipulation to some areas of the habitat to ensure a year round wetted channel.

There is uncertainty as to the amount of water that should be released. NHCL (2000) suggested that annualized flows of 10 to 15 m^3/s could be released through Skins Lake. Ableson (1990) indicated (based on suggestions from regional water engineers) that releases from Skins Lakes in the order of 2-5 m^3/s (100-200 cfs) would be required during low flow periods to ensure continuous river flows. The economic assessment of tourism benefits used a flow of 20 m^3/s (Holman and Schienbein 2000). The NEEF Management Committee recommended an adaptive management approach, starting with 5 m^3/s and gradually increasing to 15 m^3/s (NEEF 2001). The NWC, in collaboration with the Cheslatta First Nation and reservoir residents have tentatively agreed to an annualized flow of 15 m^3/s subject to confirmation that this volume and delivery of water will be sufficient to achieve a functioning, intact habitat for aquatic resources year-round. A 15m^3/s annualized flow would deliver a low of 10 m^3/s in winter and about 45 m^3/s at peak spring flow.

There is also some uncertainty as to the shape of the discharge hydrograph that should be established. NHCL (2000) indicated that seasonal flow patterns should be re-established. Unfortunately, hydrologic data for the Cheslatta River prior to the operation of Skins Lake spillway does not exist (Bouillon and Pisio 2000). Therefore, a surrogate watershed needs to be selected in order to determine the shape and magnitude of the hydrograph (Bouillon and Pisio 2000).

The amount of water discharged through Skins Lake Spillway and the seasonal hydrograph selected are critical to the success of the redevelopment plans. The Cheslatta River redevelopment plans cannot be fully implemented until these issues are resolved. Currently the use of the Stellako River hydrograph and an annualized flow of 15 m^3/s appear to be favoured. A formal mechanism (such as a Memorandum of Understanding) that outlines the initial flow management strategy needs to be developed, so that rehabilitation or redevelopment plans can be initiated.

6.3 Options for Fluvial Geomorphology and Lakeshore Restoration

A comprehensive review of rehabilitation alternatives for the various reaches of the Murray-Cheslatta system were discussed by NHCL (2000). These were based on an expectation of reduced releases from the Skins Lake Spillway, though some components could be implemented under the existing flow regime or one that does not include the CWRF. A summary of issues and objectives related to fluvial and shoreline geomorphology, excerpted from NHCL (2000) except where noted, is provided in Table 3.

6.4 First Nations Interests and Issues

The Cheslatta Carrier Nation have developed a comprehensive redevelopment plan for the Cheslatta watershed to address the long-term goals of the Cheslatta Carrier Nation (Cheslatta Band 1992). The Cheslatta Redevelopment Project (CRP) is intended to provide for the Cheslatta's future economic and psychological needs as well as meet the needs of industry (e.g., forestry) and the long-term needs of the local populace. The CRP is intended to parallel and complement the fisheries management plan prepared by the Ministry of Environment in the 1980's and 90's (see Abelson 1985, 1990, and Section 6.4 of this report). It was noted that the two plans were to be implemented bilaterally.

The CRP outlines two over arching goals:

- Solve the present and long-term economic difficulties which the Carrier Cheslatta Nation has been facing; and
- Restoration of Murray-Cheslatta lakes.

Specific goals include:

- Restoration [rehabilitation] of Murray-Cheslatta lakes. This is anticipated to have many positive social and economic benefits, not only for the Cheslatta Carrier Nation, but also for the Lakes District and downstream areas in the Nechako basin. Benefits would be accrued from restoring the sport fishery and from the resulting effect this would have on the tourism industry.

- Identification and establishment of historical sites. Focus was to document and preserve historical sites and the creation of an off-site museum to preserve and store artifacts.

Table 3 Summary of Objectives and Issues for Rehabilitation of Murray-Cheslatta System Geomorphology

Reach	Objectives	Issues
Upper Cheslatta River	• Release "healing flows" to rehabilitate fish habitat. • Reduce channel erosion and downstream turbidity and sedimentation.	• Requires natural flows plus releases from Skins Lake Spillway; recommend minimum practical release for increasing hydraulic residence time in Murray and Cheslatta Lakes. • May require construction to narrow channel and cut through delta at Cheslatta Lake. • Channel should be stable, but erosion may continue in tributaries as they adjust to lower water levels. • Infrequent extreme event flood releases from the Skins Lake Spillway may be compatible with channel rehabilitation, but a broad floodplain will be required to pass such flows. • Gravels are stored on bar tops and edges that could be above normal water levels under a reduced flow regime[a].
Tributaries to Upper Cheslatta River[a]	• Ensure fish passage on tributary channels.	• Small tributaries may downcut further in response to lower water levels on the upper Cheslatta River. Existing steep lower reaches may impede fish passage, particularly during low flows.
Murray and Cheslatta Lakes	• Reduce fluctuation of lake levels over the course of the year. This will reduce shoreline erosion, sediment input and deposition. • Rehabilitate the eroded scarp on the upper beaches of the lakes.	• Adopting the minimum practical release from Skins Lake Spillway would reduce lake level fluctuations and peak water levels. • This would reduce shoreline erosion and sediment delivery to the lakes. • Some revegetation could be expected to occur naturally, but seeding, planting and bioengineering could increase the rate of recovery and should be considered, especially at high value sites. • Erosion could still occur during infrequent/extreme spill events.
Tributaries to Murray and Cheslatta Lakes	• Restore channel substrates and riparian vegetation in the lower reaches of Ootsanee, Bird, Knapp and Holy Cross Creeks.	• These areas can be revegetated after the lake level regime of Murray and Cheslatta Lakes changes in response to lower flows.
Murray River	• Add substrates for spawning to areas damaged by siltation.	• Deep scour hole, very low flow velocities and fine substrate may reduce the value of proposed remediation.
Lower Cheslatta River	• No objectives expressed	• Right downstream bank avulsion, since remediated, was noted to have resulted in erosion and loss of spawning gravels in this reach.

(a) Not directly addressed by NHCL (2000) summary but noted elsewhere in the document.

- Creation of recreational opportunities in the Murray-Cheslatta watershed. This objective would involve the development of recreational sites and facilities on the shores of both Cheslatta and Murray lakes. This would benefit the region as a whole by providing new recreational opportunities and provide the Cheslatta people with a source of long-term revenue. The increased need for a support industry would also provide long-term employment and improve self-esteem for the Carrier Cheslatta Nation. Holman and Schienbein (2000) indicate that direct tourism benefits that arising from the rehabilitation of the Cheslatta watershed could result in the creation of 35 full-time jobs and generate approximately $2 million/yr.

- Training for the Cheslatta Carrier Nation. This objective has been established to provide Cheslatta Carrier Nation members with the necessary skills to be active participants in the restoration work in the watershed and in future monitoring programs.

The CRP indicates that rehabilitation of the watershed, re-establishment of a variety of sport fish species and the rehabilitation of connected wildlife values are essential (Cheslatta Band 1992). The CRP recommends the following specific activities leading to the above outcomes:

- Assessment of the Cheslatta river and its connected tributaries;
- The revegetation of the river and lakeshore;
- Initiate the restocking of both Cheslatta and Murray lake;
- Develop and implement prescriptions;
- Monitor and evaluate the total prescription;
- Complete a water and stream inventory;
- River channeling;
- Wildlife habitat enhancement;
- Fish habitat enhancement; and
- Lakeshore cleanup and rehabilitation.

6.5 Fisheries Management Plans and Objectives

The Provincial Government has developed a number of objectives for the redevelopment or enhancement of fisheries resources in the Murray-Cheslatta watershed. Abelson (1985; 1990) stated the following objectives:

- Restoration of the depressed fish stocks and recreational and sustenance values associated with Murray and Cheslatta lakes.

- Restore the sport fish productive capacity and develop a significant lake fishery. It has been estimated that the watershed could support up to 10,000 angler days per year (Ableson 1990).

Abelson (1990) also stated that the stabilization of flows through Murray and Cheslatta lakes provides the opportunity to restore the two lakes as important recreational and subsistence fisheries. Restoration should be directed at fish species present, including rainbow trout, lake trout, kokanee, and bull trout.

Abelson (1985) outlined the following strategies to achieve these goals:

- Reduce erosive flows from Skins Lake. This would provide more stable lake levels, reduce sediment load in the lakes, which should increase aquatic plant and invertebrate production and improve littoral conditions in the lakes (refer to Envirocon 1984).
- Implement restrictive angling regulations and reduce First Nations subsistence fishery to protect badly depleted stocks, until restoration measures have been successful.
- Assess the habitat improvement opportunities in the Cheslatta River downstream of Skins Lake. Restoration of the Cheslatta River was seen as a critical component for the re-establishment of a successful rainbow trout and char fishery.
- Assess habitat enhancement opportunities in the tributary streams.
- Initiate short-term restocking of native rainbow trout in lakes and enhance tributary streams. It was estimated that this would need to be undertaken for a five year period.
- Implement a juvenile lake trout (char) stocking project for 5-10 years.
- Undertake shoreline assessments to identify opportunities to improve shoreline spawning habitat for lake char and lake whitefish.
- Clearing of partially submerged trees where practical, with special attention to the channel between Murray and Cheslatta lakes. The intent would be to enhance recreational fishing.
- Development of direct public access to Murray Lake upstream of Cheslatta Falls, in consultation with the BC Forest Service (now Ministry of Forests and Range) and other recreational agencies; these efforts should coincide with the restoration of the recreational sport fishery.

Abelson (1990) later provided a revised list of strategies:

- Gravel placements between Murray and Cheslatta Lake.
- Stabilization of eroding banks in the Cheslatta River.

- Gravel placements in selected sections of the Cheslatta River.
- Rearing habitat improvements including habitat complexing (boulder clusters and woody debris structures) and planting of stream side vegetation.
- Potential improvements to allow migration past an existing waterfall which is a barrier.
- Five year lake stocking program for priority sport fish species (rainbow trout and lake trout)[9].
- Initiate a stocking program for bull trout[9] and kokanee following stabilization of the Cheslatta River.
- Follow-up the Harder (1986) assessment and explore the feasibility of stocking rainbow trout in barren headwater lakes in the tributary streams.
- Lake shore stabilization and revegetation following the reduction in lake levels. This was identified in order to reduce erosion and improve water quality. It was also noted that there were potential wildlife benefits arising from revegetating the foreshore.

6.6 Other Objectives

NHCL (2000) noted several other redevelopment objectives:

- Provide recreational opportunities for canoeing, rafting or kayaking. This would require instantaneous flows greater than 15 m^3/s in order to provide suitable paddling conditions in the present river channel.
- Maintain viewing and picnicking at the Cheslatta Falls located mid way between Skins Lake and Cheslatta Lake. This would require flows greater than 30 m^3/s for flows to pass over the steep side falls on the right downstream side of the river and to maintain viewing opportunities from the trail.
- Maintain drinking water supply for residents that obtain drinking water from the upper Cheslatta River.
- Prevent cattle from crossing the river. This would require flows greater than 30 m^3/s.
- Maintain winter viewing of white swans at Skins Lake. White swans utilize the open water resulting from discharges from the Skins Lake spillway.

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[9] Note: Abelson (1994) indicated that stock enhancement would have to be consistent with regional stock management strategies and therefore stocking of lake trout and bull trout would not be done.

7.0 CONCLUSION

In preparation of this report, the reports outlined in Appendix D of the RFP were reviewed. Those documents were augmented by several reports provided by the Cheslatta Carrier Nation. The principal focus of rehabilitation of the Cheslatta watershed is on the reestablishment of a viable sport fishery in Murray and Cheslatta lakes. The Cheslatta Carrier Nation places an emphasis on the social and economic benefits that this would have on their people.

7.1 Areas of Consensus:

Based on the information reviewed there were a number of areas of commonality or consensus. These included:

- Reducing erosive flows and reducing lake level variation the levels of Murray and Cheslatta lakes were critical to the success of all the rehabilitation and redevelopment plans.
- A naturalized hydrograph needs to be reestablished. This would reduce uncertainties in flows and provide for the biological requirements of the fish species in the lakes.
- Augmentation of the natural inflows would be required to maintain a permanently wetted channel (i.e. year round release from the Skins Lake Spilway).
- A restoration plan, considering the one prepared by the Provincial Government (e.g., Abelson 1985, 1990) should be implemented after flows are modified.
- Rehabilitation of the sport fishery on both Murray and Cheslatta lakes are critical to the success of the Governments rehabilitation plans and the Cheslatta Redevelopment Plan.

7.2 Areas Where Additional Work Required

There were several areas where additional work is required:

- The most critical item is the amount of water that is be released through Skins Lake Spillway to augment the natural flows of the Cheslatta River. NHCL (2000) indicated annualized flows of 10 to 15 m^3/s and Bouillon and Pisio (2000) examined flows ranging from 5 to 20 m^3/s. The economic assessment was based on 20 m^3/s. The NWC, Cheslatta First Nation and Ootsa residents have focused on a flow regime over the past several years that would deliver 15 m^3/s annualized with a monthly range from about 8 m^3/s in winter to 45 m^3/s in the spring.
- Additional work is needed to determine which watershed should be used as a surrogate for establishing the shape of the Cheslatta River hydrograph. Bouillon and Pisio (2000) examined flow scenarios using Nechako Reservoir inflow, Van-Tine Creek, Stellako

River and the Nautley River inflows; however, no recommendation for a preferred surrogate was provided in the information reviewed during the present study. Currently the Cheslatta First Nation has indicated a preference to the Stellako hydrograph because it supports a well known sport fishery.

- Related to the hydrograph and subsequent recreational tourism is the need to better clarify the goals and tradeoffs in the flow scheduling that will be required to optimize the future spillway releases.. For example, a naturalized hydrograph should be beneficial to the fish species in the watershed. However, this would result in flows that would not be optimal during the late summer for canoeing on the river (NHCL 2000) or for viewing the Cheslatta Falls from the existing trail (Holman and Schienbein 2000).

- There are a variety of specific tasks identified in the Provincial Government plans (i.e., Abelson 1985, 1990) and the Cheslatta Restoration Program (Abelson 1995, Cheslatta Band 1992, Cheslatta Carrier Nation 1995). Since the plans were prepared, the scientific knowledge of watershed rehabilitation has advanced significantly. Therefore, the various tasks need to be re-evaluated within the context of current understanding of watershed processes and rehabilitation techniques. The list of activities should then be prioritized and an implementation schedule developed.

- The Cheslatta Carrier Nation emphasized the requirement for active participation of the Cheslatta people in the rehabilitation efforts. They identified the need for training so that their people could participate in the planning, implementation of rehabilitation prescriptions and future monitoring programs. The nature of the training and delivery mechanism has not yet been fully developed.

- Socio-economic information should be updated to reflect current conditions in the watershed. For example, the Cheslatta redevelopment plan included other land-use activities in the Cheslatta Carrier Nation traditional territory. The economic assessment needs to be updated to reflect current levels of land-use (e.g., forestry, mining) in the watershed.

- The economic assessment prepared by Holman and Schienbein (2000) was based on flows of 20 m^3/s. The economic assessment should be updated to reflect the current preference of 15 m^3/s and a discharge hydrograph similar to that of the Stellako River hydrograph.

8.0 CLOSURE

We trust that the information provided meets your current requirement. Should you have any questions, or concerns, please do not hesitate to contact the undersigned.

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N:\ACTIVE\9000\2005\05-1490-006 CHELSATTA HISTORICAL REVIEW\REPORT\R_05-1490-006 BACKGROUND INFORMATION REPORT MURRAY-CHELSATTA SYSTEM (FINAL).DOC

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APPENDIX A

LIST OF DOCUMENTS TO BE REVIEWED

Table A1. Documents list in Appendix D of the Request for Proposal

"Murray - Cheslatta" Reports
1992. Cheslatta Redevelopment Project Discussion Paper. Cheslatta Band, Burns Lake, BC.
2004 Photomosaic of Murray - Cheslatta system prepared for Alcan
Ableson, D. 1985 and 1990. Fisheries Management Plan Upper Nechako River Watershed including Murray and Cheslatta Lakes. BC Ministry of Environment, Fisheries Branch, Prince George, BC.
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Triton Environmental Consultants Ltd. In Prep. Cheslatta-Murray Data Collection. Nechako Fisheries Conservation Program Data Report No. RM95-1
Video of Cheslatta River system taken by Don Cadden in 1989 at low flow