Summary of Anticipated Benefits of a Cold Water Release Facility at Kenney Dam Based on Studies to Date

Nechako Enhancement Society

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EXECUTIVE SUMMARY

This report summarizes the anticipated benefits, as described in the existing literature, of a Cold Water Release Facility (CWRF), proposed to be built at Kenney Dam. This report is not intended to be a critique, review or endorsement of the existing literature or the anticipated benefits described in the existing literature. Readers are cautioned that the number, significance and magnitude of benefits will be influenced by a number of variables that are described in the introduction to the report.

The dam was constructed in the upper reaches of the Nechako River in the early 1950's, creating the Nechako Reservoir, as part of the Aluminum Company of Canada's (Alcan) development of hydroelectric power generation facilities and an aluminum industry in northern British Columbia. Water is released from the reservoir, westward, through the Kemano generating station, and from the Skins Lake Spillway (SLS), eastward, into the Murray-Cheslatta system flowing into the Nechako River. Currently, no water can be released at Kenney Dam.

A CWRF release facility is a structure that would be built next to the Kenney Dam allowing most of the water to flow from the reservoir into the Nechako River channel at Kenney Dam, instead of through the Skins Lake Spillway. The facility would more efficiently control the temperature, volume and timing of the water releases than is possible with the current arrangement. The proposed CWRF would accomplish the following:

- ↘ Remove the large, fluctuating water releases from the Murray-Cheslatta drainage.
- ↘ Use less water to meet the required summer temperature target in the Nechako River for migratory salmon stocks, thus freeing-up water to meet other interests.
- ↘ Reduce the unnatural high summer cooling flows from the Nechako River.
- ↘ Re-water the Nechako Canyon on a year-round basis.

The literature on the CWRF identifies a number of anticipated benefits, which are summarized in the report:

- Rehabilitate the Murray-Cheslatta system, rehabilitating fish habitat and enabling the Cheslatta Carrier Nation and area residents to pursue tourism and recreation opportunities.
- Implement flow regimes with more natural seasonal variations for both the Nechako River and the Murray-Cheslatta drainage which may benefit resident and migratory fish.
- Create the potential for hydro-electricity generation at Kenney Dam.
- Allow more flexibility in managing reservoir levels, depending on how freed-up flows are shared, resulting in water being available for a range of interests.
- Depending on how the freed-up flows are shared, contribute to hydro-electricity generation at Kemano, especially during years of below average precipitation.
- Re-establish fish habitat and natural aesthetics in the Nechako Canyon, and enhance angling opportunities in the upper reaches of the Nechako.
- Respond more quickly to flood conditions.
- Reallocate a portion of freed-up flows to the Nechako River during spring through autumn to improve livestock containment, enhance recreation opportunities and improve float plane operations.
- Generate an estimated 180 person years of direct employment during construction, and two or three person-years for operation and maintenance, plus additional indirect employment.

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1.0 INTRODUCTION

The purpose of this report is to summarize the anticipated benefits of a Cold Water Release Facility at Kenney Dam as described in existing literature. This report is not intended to be a comprehensive socio-economic analysis of the Cold Water Release Facility. No original research was conducted to prepare this report. This report is not a critique, review or endorsement of existing literature.

In most cases, the anticipated benefits are described in qualitative terms only. Most of the benefits of a CWRF are difficult to quantify in either bio-physical or economic terms. Many of the benefits of a CWRF are primarily related to environmental, First Nations, social, and recreational interests, which do not lend themselves well to monetary valuation due to the lack of data and the challenges of placing economic values on items that may not trade in markets.

The Nechako River supports two species of salmon: sockeye and chinook or "springs". Both depend on the Nechako, but in quite different ways. Sockeye utilize the Nechako as a path for their migrations to and from spawning areas located primarily in the system of lakes and streams that drain into the Nechako, primarily through the Stuart, Stellaquo and Nautley Rivers. Chinook, on the other hand, utilize the Nechako River throughout their life cycle for spawning and rearing as well as for migration to and from the Fraser River.

Nechako River flow conditions for chinook are tightly regulated by the 1987 Settlement Agreement between Alcan and the Governments of Canada and British Columbia. The monitoring system established under that agreement confirms that these conditions have consistently been met and that chinook populations consistently meet the required targets. In other words, "bottom line" conditions for chinook are already being met and the Cold Water Release Facility, which would also be bound by the Settlement Agreement requirements, would have no incremental benefit.

The critical issue for sockeye is water temperature in the Nechako River during their annual summer migrations from the Fraser River, through the Nechako and into their spawning areas. The 1987 Settlement Agreement establishes controls on these temperatures through a binding regime of cooling flow releases from the Nechako Reservoir. These flows must be adjusted as necessary by reservoir managers to maintain a safe environment during the migrations. This regime would continue to be in effect when a Cold Water Release Facility is constructed

so in that sense there is no identifiable benefit to sockeye salmon. Rather, the benefit comes from the projected ability to meet these temperature targets with lesser volumes of water, which in turn creates the “freed up flows” described in section 3.0 of this report.

To the extent that there are dollar figures in this report, the figures should be considered indicative only.

Finally, readers are cautioned that whether or not the anticipated benefits described in this report materialize - or the magnitude of the benefits - will be influenced by a number of variables including the eventual cost, configuration, and size of the CWRF, how much water is still released from the Skins Lake Spillway after a CWRF is constructed, inflows to the Reservoir, and the allocation of freed up flows among various interests. Moreover, there may be other benefits that only become apparent in the future after a CWRF is constructed and operating.

2.0 HISTORY of the COLD WATER RELEASE FACILITY

The Kenney Dam was constructed in the upper reaches of the Nechako River in the early 1950’s, as part of the Aluminum Company of Canada’s (Alcan) development of hydroelectric power generation facilities and an aluminum industry in northern British Columbia (Map 1). The rock-fill dam is located about 90 kms south of Vanderhoof, in BC’s central interior. The resulting Nechako Reservoir has a surface area of about 1200 km2, extending roughly 200 kms west to the Coast Mountains. Alcan’s hydro-electricity generating station was constructed in Mount Dubose, next to the Kemano River on the coast, with the aluminum smelter built in Kitimat along with the construction of the town itself. An 82 km transmission line delivers the electricity from Kemano to Kitimat (BCUC, 1994, p.15-17).

Water is currently released from the reservoir at two points: 1) at the west end through the Mount Dubose tunnel and out through the Kemano generating station; and 2) at the east end from the Skins Lake Spillway (SLS) on the north side of the reservoir, through the Murray-Cheslatta drainage into the Nechako River. Under this existing arrangement, no water is released at Kenney Dam into the Nechako River. The river channel is essentially dry for approximately 9 km downstream of the Dam.

In the late 1970’s, Alcan announced its intention to finish developing the Nechako’s water resources, for generating hydro-electricity, allowed by its conditional water license granted in 1950, a project that eventually became known as the Kemano Completion Project, or KCP. In the 1980s, there was a dispute between the Department of Fisheries and Oceans (DFO) and Alcan regarding the release of water from the Reservoir to conserve and protect the

fisheries resources of the Nechako River. Ultimately, the controversy was resolved as between the DFO, the Province of B.C. and Alcan by way of the 1987 Settlement Agreement. The 1987 Agreement - along with the Summer Temperature Management Protocol (STMP) - established the amount and timing of water releases from the Nechako Reservoir for the purposes of protecting and conserving salmon.

An integral aspect of KCP was the construction of a water release facility at Kenney Dam, a facility that was also contemplated by the 1987 Settlement Agreement.

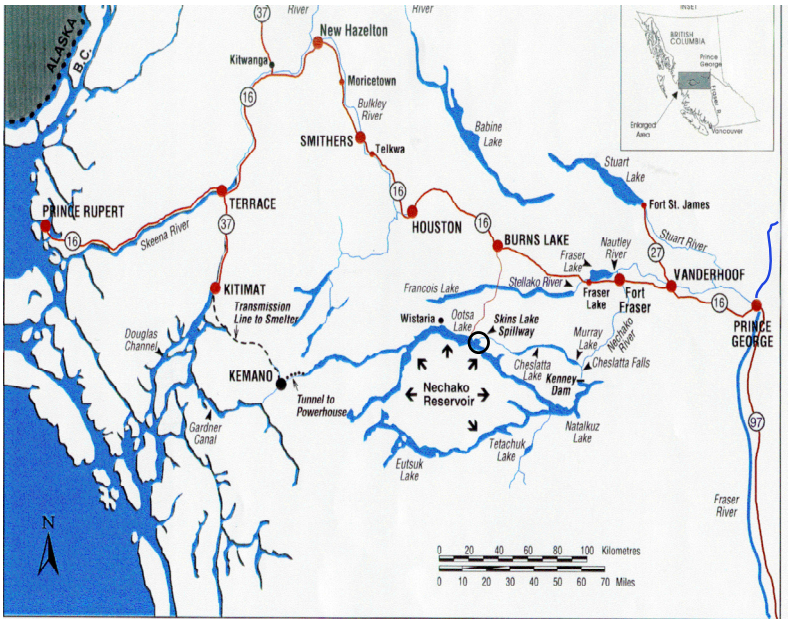


Figure 1. Map of North Central British Columbia

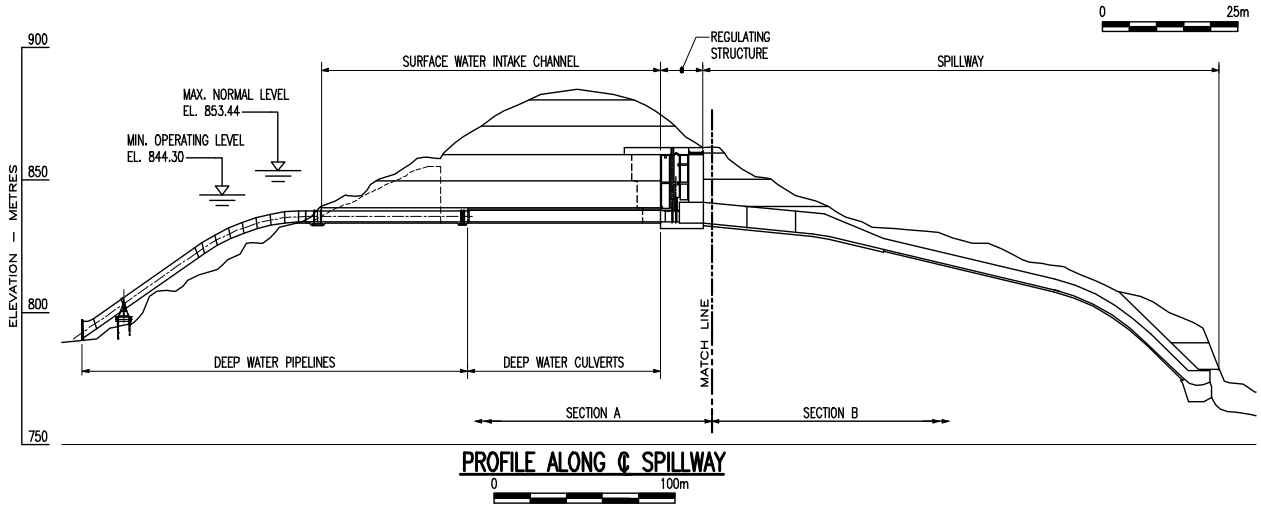
Despite the 1987 Settlement Agreement, KCP continued to generate much public controversy regarding the anticipated impacts, especially on fish values. After requesting the BC Utilities Commission to conduct a review, and receiving the report, the provincial government rejected the KCP in January 1995. As a result, KCP and the related water release facility at Kenney Dam did not proceed.

In August 1997, the Province of British Columbia and Alcan reached an out-of-court settlement regarding the government's rejection of KCP. The BC/Alcan 1997 Agreement included a number of key elements, including the Nechako Environmental Enhancement Fund (NEEF). The Agreement created a NEEF Management Committee (NEEFMC) whose members were given the mandate "… to review, assess and report on options that may be available for the downstream enhancement of the Nechako watershed area" (BC/Alcan 1997 Agreement, Schedule 4). Schedule 4 states that if "another person" contributes to the Fund, Alcan is obliged to match the contribution up to a maximum of C$50 million (less eligible costs of up to C$10 million already incurred) for purposes of downstream enhancement of the Nechako watershed area.

During the late 1990's, the NEEFMC conducted an extensive consultation process, seeking advice from residents, technical experts and government representatives as to how to best spend the NEEF (assuming someone contributed to NEEF). In June 2001, the Committee released its report, stating that "We have decided that a Cold Water Release Facility (CWRF) be constructed at Kenney Dam to enable downstream enhancement of the Nechako Watershed" (NEEFMC, 2001, p.23). [1]

3.0 DESCRIPTION of the COLD WATER RELEASE FACILITY

A release facility is a structure that would be built next to Kenney Dam to transport water from the reservoir and into the Nechako Canyon, allowing most of the flow to be released at Kenney Dam instead of through the Skins Lake Spillway (Figure 1). In particular, the structure would be able to draw water from varying depths, and thus of varying temperatures, from the reservoir, to meet specified river temperatures downstream for migrating salmon. By using deep cold water, rather than warmer surface water, less water would be needed for the cooling flows to meet the target temperatures for the salmon downstream in the Nechako River during the summer. The difference in volume, known as 'freed-up flows', would then be available to meet a range of other interests throughout the year. The facility would also be able to more efficiently control the overall volume of water released - as well as the timing - compared to the current situation. It would enable a flow pattern that more closely resembles the natural river regime that existed prior to the Kenney Dam.



(Klohn Crippen. May 2001)

Figure 2. Conceptual Drawing of the Proposed Cold Water Release Facility

[1] The NEEFMC consisted of one member from Alcan and one from the province, and an independent member. As stated in Schedule 4, it is understood that the NEEFMC's "decision" that a CWRF should be built, is contingent on available funding.

4.0 ANTICIPATED BENEFITS

During its consultation process, the NEEFMC heard from many participants that downstream enhancement of the Nechako watershed area depended on a more natural flow pattern in the Nechako River, and in turn, achieving a natural flow pattern required a release facility at the Dam (NEEFMC, 2001, p.12). Compared to the existing situation, and at a very broad level, the advantages of the proposed release facility are:

- *Removal of excess flows from the Murray/Cheslatta system, thus allowing for the potential redevelopment of that system;*
- *Reduction or removal of the unnatural high summer flows in the Nechako River;*
- *Rewatering the Nechako Canyon on a year round basis; and*
- *Allowing reallocation of the freed-up flows* (Nechako Watershed Council, 2000, p. 3-4).

As well, the structure would allow Alcan to continue meeting its interests in ensuring dam and public safety, satisfying the obligations in the 1987 Settlement Agreement, managing Reservoir levels and generating electricity at Kemano.

The following sections summarize the anticipated benefits of a CWRF as described in existing literature.

4.1 Murray-Cheslatta System Redevelopment

The Murray-Cheslatta drainage flows from west to east and includes the Cheslatta River, Cheslatta Lake, Murray Lake, and the lower Cheslatta River (1 km), where the system joins the Nechako River at Cheslatta Falls, nine kilometers downstream from the Kenney Dam. The total distance from the SLS to Cheslatta Falls is 76 km. This drainage receives all releases from the reservoir through SLS, which are required for: public and dam safety; base and cooling flows for fish as required under the 1987 Settlement Agreement; and volumes surplus to generating hydro-electricity at Kemano.

It has been estimated that prior to the Kenney Dam, the natural flows in the Cheslatta River were 1.5 cubic metres per second (cms) as the mean annual flow, and up to 9.5 cms as the maximum average (G. Davidson, March 2000). After the completion of Kenney Dam and the creation of the Nechako Reservoir, there have been much larger variations in flows released from SLS into the drainage, causing severe erosion and scouring.

From 1955 to 1979, the average daily flow ranged from about 75 cms up to 200 cms, with maximum daily flows ranging generally between 250 cms and 500 cms. Since 1980, the pattern of daily flow has changed mostly in the seasonal distribution, due to the cooling flows for the protection of migratory salmon. For the two decades 1980 to 2001, the average daily flow ranged from about 40 cms to 280 cms, with maximum daily flow ranging from 60 cms to over 500 cms (Environmental Dynamics Inc., 2003, Fig 2.1.4-3).

With the bulk of the water release occurring through the proposed CWRF, a more natural seasonal pattern of flows can be established from SLS into the Murray-Cheslatta (NEEFMC, 2001, p.23). A natural pattern would enable the rehabilitation of this watershed, including fish habitat, natural aesthetics, angling and other recreational activities, and potentially tourism. One study estimated that if the system were rehabilitated, the potential increase in tourism income in the area could approach $2.0 M/yr. and generate the equivalent of up to 35 full time jobs (Holman and Schienbein, 2000, p.2).

Of note are the NEEFMC's conclusions that "Rehabilitation of the Murray-Cheslatta system is one of the most important benefits of the Cold Water Release Facility", and that the "Rehabilitation of the Murray-Cheslatta system is a high priority among all interests …" (NEEFMC, 2001, p.16, p.15).

The redevelopment of the Murray-Cheslatta system has been a goal for the Cheslatta Carrier Nation for many decades. Thus the Cheslatta people are very supportive of the CWRF, stating that "This is truly a 'green' project which will provide long-term, sustainable employment and economic development opportunities for our region" (M. Robertson, letter to G. Enemark, September 13, 2004). The reservoir adversely affected the Cheslatta's traditional territory, displacing the people and their hunting and fishing areas (M. Robertson, July 1999, March 2000).

Assuming construction of the CWRF, the Cheslatta's redevelopment plan has four parts:

1. the rehabilitation of the Murray and Cheslatta Lakes and river system
2. the identification of historical sites and trails
3. the creation of recreational opportunities
4. skills and employment training for Cheslatta Carrier people (Cheslatta Band, 1992, pp 5-8,p.15).

Therefore, if implemented, the redevelopment plan would have a positive influence on the quality of life for the Cheslatta people. One of the studies quoted above also stated that the rehabilitation "… offers an opportunity for the Cheslatta to recapture their cultural and spiritual identity" (Holman and Schienbein, 2000, p.14).

4.2 Resident Fish

Resident Fish – Nechako River

The Nechako River supports 15 species of resident fish, including white sturgeon, rainbow trout, bull trout, mountain whitefish, suckers, red-sided shiners and northern pikeminnow (Triton, July 1999, p.2). It is anticipated that the CWRF may be beneficial to some species, such as Nechako white sturgeon, although the extent of the benefit is not yet known.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has recommended to the federal Minister of Environment that white sturgeon be listed as endangered under the new *Species at Risk Act*. There are concerns about the Nechako River white sturgeon because research indicates that the population is not sustainably reproducing and there are few young fish. The Nechako Sturgeon Recovery Initiative is investigating the factors that are affecting sturgeon in the Nechako River and developing a plan to address these factors. Whether or not a CWRF may be required for recovery of Nechako white sturgeon has not yet been determined. However, a CWRF will provide greater flexibility in managing water temperatures and flows that might be required for sturgeon recovery (D. Cadden, March 2006).

The advantage of the CWRF is that it would be able to more efficiently control water volume, temperature and timing, and thus potentially deliver flows more appropriate to sturgeon conservation, compared to what is possible with the existing SLS. Some believe that the facility's flexibility to manage water flows will benefit species such as white sturgeon. As well, with a CWRF, water will flow through the Nechako Canyon creating additional fish habitat upstream, which could potentially be used by a variety of fish species (Triton,July 1999). One report estimates that angling on the upper reach of the Nechako, downstream of the canyon, could have an annual value of $740,000 (Ableson, 1985, p.12).

Resident Fish – Murray-Cheslatta System

Fish species in this system include kokanee, rainbow trout, bull trout, lake trout, whitefish, burbot, suckers, pikeminnow, shiners, chub and dace (D.Cadden, July 1999). The Murray-Cheslatta system has been significantly altered by the releases from SLS, as described in section 4.1 above.

The proposed CWRF would benefit fish populations in the Murray-Cheslatta system, because large water volumes would be released at Kenney Dam instead of SLS, and thus the system would no longer be subject to the extreme variation in flows. Rather, it would be possible to implement a flow regime that is more consistent with the valley's natural precipitation and seasonal pattern. Such a flow regime would greatly reduce the extreme erosion and the associated

sedimentation and siltation; allow the river banks and lakes' shoreline to be stabilized; and enable revegetation of riparian areas, all of which would benefit fish habitat and populations. (D.Cadden, July 1999).

4.3 Potential Hydro-electricity Generation at Kenney Dam

At present no water is released at the Kenney Dam. With a CWRF, water would be released at the Dam and thus would create the opportunity to generate electricity. Power turbines could capture the energy created by the released water as it falls into the river channel and travels downstream through the Nechako Canyon. Without the installation, the CWRF would otherwise have to dissipate that energy before the water hits the river channel. A hydroelectric power generation plant at Kenney Dam would be "green" because no additional land would be flooded with the associated loss of natural resources and affects on ecosystems and people[2].

Two preliminary reports have indicated that there is potential for power generation at Kenney Dam (Columbia Power Corp., 1999; Klohn Crippen, 2000). The first report by the Columbia Power Corporation identifies that the following factors are conducive to power generation at Kenney Dam:

- *Dam already exists*
- *Head and flow available*
- *Potential to make use of existing dam facilities (diversion tunnel) and proposed facilities (cold water release facility) which reduces cost*
- *Minimal environmental impacts* [given that the Dam already exists]
- *Good location in the overall hydro system* (Columbia Power Corp., 1999, Slide 11).

The report assumes a capacity of 45 megawatts (MW).
The second report by Klohn Crippen also presents a preliminary feasibility analysis, but uses a range of scenarios based on different:

- flows (winter flows at 60% of summer flows or constant flow)
- installed capacities (MW) depending on the water flow available, and
- annual generation (GWh),

as well as other assumptions and industry factors, to generate 20 scenarios.

4.4 Reservoir Management

The benefit for Reservoir management depends on how the freed-up flows are shared, between the reservoir and downstream (i.e. Nechako River) interests.

[2] Two reports have been prepared on power generation at Kenney Dam: Columbia Power Corporation 1999 and Klohn Crippen 2000.

The benefit of a CWRF would potentially be the greatest during years of below average precipitation:

> *The amount of the freed-up flow kept for the reservoir will contribute in the long term to increase the reservoir level. The water stored could be available to maintain the generation during persisting low inflow conditions. Retention of the freed-up flows in the reservoir would serve to maintain higher summer reservoir levels, especially during low water years* (Alcan Sept.13, 2005).

The CWRF would allow more flexibility in managing Reservoir levels and thus the water available to meet a range of interests in addition to electricity generation. The Reservoir levels could potentially be higher than what would normally be possible during drought conditions.

4.5 Hydro-electricity Generation at Kemano

Similar to the above, the benefit of a CWRF to hydro-electricity generation at Kemano depends on how the freed-up flows would be shared:

> *The retention of some of the freed-up flows in the reservoir would increase average annual power production at the existing Kemano generating station … The impact of the freed-up flow to maintain an acceptable reservoir level and to respect the generation requirements would be increased if the amount of water for the reservoir could be modulated over the years* (Alcan. Sept. 13, 2005).

Conversely, it is noted that,

> *In high inflow conditions, the freed-up flow would have no value for Kemano generation, the generation being limited to the maximum capacity of the Plant. In fact, simulations show that in over 40% of the years, the reservoir level would be too high to retain any of the freed-up flows* (Alcan. Sept. 13, 2005).

Thus, a CWRF facility has the potential to be more beneficial to electricity generation at Kemano during years with below average precipitation and low Reservoir levels. The magnitude of the benefits is not yet known.

4.6 Re-watering the Nechako Canyon

After Kenney Dam was constructed, water no longer flowed in the reach below it. Since the 1950s, the Nechako River has been essentially dry for the 9 km from the Dam downstream to its confluence with the Cheslatta River. This reach now consists of the 7 km bedrock Nechako Canyon and then a 2 km alluvial sediment deposit known as Cheslatta Fan, immediately upstream of Cheslatta Falls. This 9 km stretch of riverbed is essentially dry, with minor contributions from local precipitation, groundwater and small tributary creeks. The riverbed meets the

Cheslatta River at Cheslatta Falls, where the water released from SLS joins the Nechako, after traveling through the Murray-Cheslatta system (Environmental Dynamics Inc., 2003, p.ii, p.52).

Re-watering the canyon would result in a more natural flow regime for the Nechako River, improvements to the visual quality of this 9 km of riverbed, as well as potentially increasing fish habitat (over time) in this portion of the River.

4.7 Flood Management

The Nechako River has a long history of flooding. Floods occur as three types: open water (ie. spring run-off), freeze-up and break-up, with ice jams having been the most common flood event. The Nechako Reservoir provides flood management for the Nechako, especially for the upper reaches and less so for the lower reaches and into the Fraser River. Flood management is limited to smaller events, such as a one-in-10 or 20-year event, compared to a major event, such as a one-in-100 or 200-year event.

The proposed CWRF would benefit flood management by maintaining or improving flood control, and would be capable of handling floods of up to a one-in-200 year event, one of the primary objectives set by the NEEFMC (NEEFMC, 2001, p.9, p.15). Releasing water at Kenney Dam will remove most flooding flows from the Murray-Cheslatta system, except for a greater than one-in-200 year event, when the excess water would need to be released through SLS as well as the CWRF. In addition, the CWRF would provide much more precise and rapid flood control because currently water that is released into the Murray-Cheslatta system can take up to two weeks from the time the water is released from the Reservoir until the water reaches the confluence of the Nechako and Fraser Rivers at Prince George. Releases from a CWRF at Kenney Dam can be made more quickly with reduced transit times to Prince George.

4.8 Float Plane Operations

There are about a dozen float plane owners in the Vanderhoof area, who use the Nechako River for take-off and landing. The residents use their planes mostly for personal recreation. The River is used at times for commercial purposes, to service wilderness lodges in the outlying areas. When the summer cooling flows are released, the fluctuation in flows (ie. how much), the rate of change (ie. how fast), and the actual depth (particularly in autumn), make it difficult to use the river for take-off, landing and access to docks (BCUC, 1994, p.189-192; B. McIntosh, Feb. 1999; P. Collard, Sept. 1999).

A CWRF would help alleviate the above difficulties, by reducing the need for the large cooling flows, and allowing a more natural flow pattern to be implemented. For example, depending on how the freed-up flows are allocated, autumn water

levels may be higher, thus enabling more landings to occur during that season than is possible under the current situation without a CWRF.

4.9 Livestock Containment

The fluctuating river levels can cause problems for ranchers with grazing land along the river. When river levels are low, cattle can escape across the river because it is no longer a natural barrier. There is an obvious cost to the owners to recover the livestock. When river levels are high due to the summer cooling flows, fencing near the river can be swept away and/or the ground is eroded and the fencing falls down. These problems seem to be worse upstream of Fort Fraser, where the fluctuations in water releases are most evident; ie. above the Nautley confluence (G. Bambauer, 1999; BCUC, 1994, p.179-180).

The proposed CWRF may benefit the ranchers' ability to contain their cattle. The large fluctuations would no longer occur because the summer cooling flows would not be needed to meet water temperatures for migrating salmon. As well, a more natural flow pattern would keep the river at a level during the summer that is likely to be more of a barrier to cattle.

4.10 Recreation

Recreation interests include water-oriented activities such as canoeing, boating, and swimming. According to residents, in the reach from Fort Fraser to Vanderhoof (approximately 40 km), the Nechako is not deep enough sometimes for small watercraft such as canoes, kayaks and other small boats. These shallow depths can occur in early summer when water is held back before the cooling flows are released, as well as in autumn.

For the Murray-Cheslatta system, one survey found that 100% of local households use the system for recreation (SEDA, 1999). When the large cooling flows are released from SLS during the summer months however, recreation use is limited due to safety concerns immediately downstream at Skins Lake and on the Cheslatta River (NWC, 2000, p.39).

In summary, the proposed CWRF would benefit recreational use for both the Nechako and the Murray-Cheslatta. For the Nechako, the more natural pattern enabled by the CWRF would provide stable flows at sufficient depths to enable more canoeing and boating during the early summer and fall. For the Murray-Cheslatta, the CWRF would release water at Kenney Dam, thus eliminating the large and fluctuating volumes released from SLS, and therefore restoring a more natural flow regime for this drainage as well.

4.11 Expenditures, Jobs and Income

Through the work of the NEEFMC, now several years old, the estimated total project cost for the CWRF was $95,947,000, based on a conceptual layout with the desired features. Of this total cost, construction costs are estimated to be $87.8M, of which $15.3M is for labour. Assuming an average wage and hours per week worked, the direct construction work would be about 138 person years.[3] As well, there is an estimated $26.1M of subcontracts, which would generate approximately 42 person years of work.[4] Thus the total direct employment attributed to the CWRF alone during construction would be an estimated 180 person years (Klohn Crippen, 2001, Table 6-1 and Appendix A). If a hydroelectricity generation facility were also constructed at Kenney Dam, some additional construction jobs would also result.

There would also be costs for operation and routine maintenance, estimated at $230,000 to $320,000 per year, of which salaries would be about $135,000 per year (Klohn Crippen, 2001, p.6-4). This salary estimate is equivalent to two or three ongoing person-years of employment, and is consistent with the Klohn Crippen estimate.

In addition to the direct employment in construction, operation and maintenance, more temporary jobs would be created indirectly during the construction period. For example, local businesses would provide supplies and services to companies involved in the project; and construction workers and their families would spend wages locally on a wide variety of consumer purchases.

[3] Total direct labour is estimated at 248, 879 hours at $61.38 per hour (Klohn Crippen, 2001, Table 6-1 and Appendix A). If one assumes a person year of employment is 1800 hours (48 weeks X 37.5 hours/week), this estimate is equivalent to 138.3 person-years (PY's) of construction work.

[4] The sub-contract work is estimated to be $26.1 million (Klohn Crippen, 2001, Table 6-1 and Appendix A). If one assumes that a similar portion of this work is labour (i.e., $15.3M/$87.8M = 17.4%), then $4.6 million would be paid to labour. At $61.38 per hour, this estimate equals 74,942 hours or 41.6 PYs.

Table 1. Summary of anticipated benefits of a CWRF at Kenney Dam as described in the existing literature.

INTEREST	BENEFIT
Murray-Cheslatta Redevelopment	Would greatly reduce water volumes released through Skins Lake Spillway; creating a more natural seasonal flow pattern, enabling rehabilitation of fish habitat and riparian zones, angling and other recreation, and tourism development; tourism income could approach $2.0M and up to 35 full time jobs locally. Would enable the Cheslatta Carrier Nation to pursue their goal of redeveloping the Murray-Cheslatta drainage including: the rehabilitation of both lakes and their rivers, identification of cultural sites and trails, creation of recreation/tourism opportunities, and skills and employment training for Cheslatta Carrier people.
Fish	May benefit the 15 resident species in the Nechako River and the resident species in the Murray-Cheslatta system.
Potential Hydro-electricity at Kenney Dam	Would create an opportunity to generate electricity at Kenney Dam by capturing the energy from the released water as it falls.and would be a "green" energy source as no new Reservoir is created.
Reservoir Management	Would allow greater flexibility in managing reservoir levels; depending on how freed-up flows are shared, Reservoir storage could be moderated during persisting low inflow conditions, and the water could then be made available to a range of interests; Reservoir storage could be at levels higher than would normally be achieved during drought.
Hydro-electricity at Kemano	Depending on amount of the freed-up flow kept for the reservoir, could increase average annual power production at the existing Kemano generating station; more beneficial during years with below average precipitation and low Reservoir levels. In high inflow conditions, the freed-up flow would have no value for Kemano generation, which is limited by the tunnel size and maximum capacity of the installed turbines.
Rewatering Nechako Canyon	Improvements to the visual quality of this 9 km of riverbed, as well as potentially increasing fish habitat over time.
Flood Management	Would be capable of handling up to one-in-200 year events compared to the current situation of 1-in-10 or 1-in-20 year]; provide more control over releases and the ability to respond more quickly to changing weather and river conditions (eliminates the lag time for water to travel from the Spillway through the Murray-Cheslatta drainage into the Nechako).

INTEREST	BENEFIT
Float Plane Operations	May help alleviate difficulties and safety concerns for landings and take-off's, by reducing the large fluctuations in seasonal (summer) flows in the Nechako River near Vanderhoof; could better manage the rate of change in flows, and the actual river depth, enabling more landings to occur during autumn.
Livestock Containment	Large fluctuations would no longer occur because the summer cooling flows would not be needed to meet water temperatures for migrating salmon; a more natural flow pattern would keep the river at a level during the summer that is likely to be more of a barrier to cattle; would alleviate the loss of fencing due to high flows; should reduce the associated costs to ranchers.
Recreation	For the Nechako River, would provide stable flows at sufficient depths to enable more canoeing and boating during the early summer and fall; for the Murray-Cheslatta drainage, would eliminate the large and fluctuating volumes released from the Skins Lake Spillway, thus enabling more recreational use of the two lakes and rivers.
Expenditures, Jobs, and Income	Estimated project cost of $96M as of 2001; would generate about 180 person years of direct construction employment, and 2-3 person years of operational employment. If hydro-electricity generation installed at Kenney Dam, some additional direct employment created. Would also lead to indirect employment and additional consumer purchases.

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