

Nechako Cold Water Release Facility (CWRF)

Summary of DFO Position

Background:

- The Nechako Fisheries Conservation Program (NFCP) was established by the *1987 Settlement Agreement* between Alcan Aluminium Limited, the Province of BC, and the Government of Canada to resolve outstanding water flow issues associated with the Kemano Completion Project (KCP) in north central and western BC.
- The mandate of the NFCP is to annually plan and implement a program including flow releases, monitoring, research, and if required, remedial measures to conserve:
 - the chinook salmon that use the Nechako River year-round; and
 - the sockeye salmon that migrate through the Nechako River to tributary river systems
- DFO contributes approximately \$200K to the programs conducted under the NFCP.
- In 1997, after BC cancelled the Kemano II project, Alcan and Province of BC established the Nechako Environmental Enhancement Fund (NEEF) as part of their bilateral 1997 Settlement Agreement. Alcan agreed to contribute up to \$50M on a matching dollar basis to this fund. When asked, DFO did not oppose the project but did not agree to provide funding.
- The Nechako Watershed Committee (NWC) was formed and supported by Alcan in 1998 and includes representatives from various levels of government, First Nations, business and community groups. While it has representation from many of the interest groups in the area, it does not include all First Nation communities in the area or environmental groups. Its goals are to address issues and objectives through the NEEF process.
 - Short Term Goal - A river management plan, which will encompass the solutions to the issues, while balancing environmental, social and economic values.
 - Long Term Goal - A Nechako River that provides for the social, economic and environmental needs of all interests.
- In 2001 NEEF released a report which recommended the construction of a Cold Water Release Facility (CWRF) at the Kenny Dam as the best way to address these goals. This would reduce the volume of water required for fisheries management while maintaining the required temperatures for salmon and restoring the flow of the river to a more natural hydrograph, while providing to Alcan better control and more water for power generation. The reduction in flows predicted to be required for salmon management could make more water available to other interests in the watershed (freed-up flows). The CWRF would also permit the reduction in flows and restoration at the Skins Lake Spillway which is of considerable interest to the Cheslatta First Nation. High summer flows released at the spillway have caused erosion within the Murray-Cheslatta Lake system and impacts on fish habitat.

- Subsequently, the NWC developed a multi-year work plan to address this recommendation. As part of the work plan, the Nechako Enhancement Society (NES) was created as an entity to implement the work plan. Recently the Province has shown an increased interest in the Cold Water Release Facility on the Kenny Dam.
- The preliminary assessment has identified four environmental considerations that will have to be addressed in the design and operation of this facility:
 - Total Gas Pressure (TGP) levels in Nechako River
 - Minimum Flows in Murray/Cheslatta system
 - Turbidity of the Water and Sedimentation Considerations
 - Natural channel concept for Cheslatta Fan
 - Flushing of Nechako Canyon (Sediment transport downstream)
 - Water temperature issues associated with a CWRF
- In addition, we need to clarify the role of DFO officials in the review of this project and the relationship with Alcan and provincial officials. This needs to be done in the context of the various existing bodies and DFO's current participation in the NFCP.
- There may also be a proposal from Alcan or the province for federal investment or financial participation in the CWRF or related projects.

Analysis:

1. TGP levels in Nechako River

- The release of water over dam spillways often leads to dissolved gas supersaturation (DGS) in the river below the dam. Fish exposed to elevated DGS frequently exhibit a condition known as Gas Bubble Trauma (GBT) in which bubbles form in the cardiovascular system, in tissue and organs, and on the external body surfaces of the animal. These "signs" of GBT are usually harmful and often fatal. In British Columbia, guidelines for DGS have been developed to protect fish and other aquatic organisms from the effects of GBT.
 - Primary Guideline for All Water Bodies Other Than Fish Culture Environments: The maximum should not exceed 76 mmHg regardless of water pO₂ levels. For sea level conditions, this corresponds to a TGP% of 110%. This is the primary guideline that would apply to the Kenney Dam CWRF and the river immediately downstream. TGP of 110% at the CWRF should protect all species and life-history phases against the acute effect of DGS 2. There is also a guideline that says that if TGP from natural sources exceeds the guidelines, then no increase in TGP should be allowed. This means that the confluence of Nechako and Cheslatta - below Cheslatta Falls (which produces high TGP naturally) - the TGP should not be increased. There will need to be verification that the 110% at the CWRF is sufficient to ensure no increase at the confluence. If not, then there will need to be a revised target at the CWRF. Although all fish species could be at risk from GBT, the species of most concern is the white sturgeon. This species has been

declared endangered by the Committee on the Status of Endangered Wildlife in Canada and may become listed under the Species at Risk Act. At present, the GBT sensitivity of the early life stages of this species is not fully understood.

- Site Specific Water Quality Guideline: A site specific DGS guideline is permitted where sufficient information exists that would assure protection of all aquatic and marine organisms from the effects of GBT. The guideline applies to all TGP regimes that might occur in the water body. This provision must also apply when species are present for which their susceptibility to GBT is unknown. This provision may require GBT bioassay studies and a site-specific guideline less than 110%. Although this permits the development of a site specific DGS guideline, the required supporting physical and biological studies are extremely comprehensive and costly. In the case of the Kenney Dam CWRP, this would involve several years of field studies, would be very difficult and would require expensive studies that could prove inconclusive and likely impact the completion date of the proposed project. It is also possible that the studies might result in a DGS guideline less than that of Part A (i.e., a TGP less than 110%).

2. Minimum Flows in the Murray/Cheslatta system

- DFO is comfortable with a base flow in the Murray/Cheslatta system of between 6 and 15 cubic meters per second. Flows at the higher end of this range significantly constrict options for uses of "freed up water" for other priorities such as for improving conditions for sturgeon, hydro-electric generation, industrial use, etc. If these benefits are not available, many of the stakeholders who currently support the project may withdraw their support. Deciding on the final base flow and hydrograph will require additional work. It is anticipated that the province lead this work as there are no anadromous species or species at risk directly affected within the Murray-Cheslatta system. DFO's primary concern will be to understand how flow distribution between the Murray-Cheslatta system and the CWRP at Kenney Dam will affect temperature management.
- Restoration/recovery of the Murray/Cheslatta system - the Murray-Cheslatta First Nation has had a long standing proposal for Murray/Cheslatta recovery from a habitat and environmental perspective. This is likely to be a very expensive and lengthy project. The First Nation could seek federal funding to support this initiative as well as access to DFO habitat restoration expertise.
- The current plans are for floods greater than 1:200 years to be routed through the Murray-Cheslatta system, as the facility at Kenney Dam would not have the capacity. If a significant effort is made on recovery of the Murray-Cheslatta, routing a flood through this system could cause significant damage, particularly if funds are invested to restore the Murray/Cheslatta habitat. There are many watersheds in BC that have experienced the projected 200 year flood several times in the last decade.

3. Turbidity of the Water and Sedimentation Considerations

A number of options have been identified in the various NES studies for conveyance of water across/through Cheslatta Fan. These include:

- Hayco Option - Meandering Pilot Channel (est. construction cost \$1.41M)
 - Propose excavating a pilot channel through the central part of the fan, diverting water away from the right valley wall. Details were not available.
- Reactivated Natural Channel (est. construction cost \$0 – similar to Hayco's River-cut Channel Option)
 - Use of commissioning flows to naturally (by process of eroding the bed and banks of the existing channel) construct a continuous channel across the fan. Path would follow the right valley wall and requires careful commissioning.
- Reactivated Natural Channel with Side Channel (est. construction cost \$0.667M)
 - Same as previous option, but includes development of a side channel (230m long pilot channel) downstream of the Scour Hole prior to commissioning. Details were not available.
 - Rationale is that the pilot channel would decrease the natural tendency of the existing channel to widen as much or as quickly as a single channel. Also includes construction of two 'temporary' embankments and a length of bank revetment works in the existing channel area.
- Downstream Slot (est. construction cost \$2.3M)
 - Provide additional constriction (dam with a slot) downstream of Cheslatta Falls, coinciding with a natural constriction at the same location. In essence, provide flooding (i.e. backwatering) of the fan and to prevent erosion at high discharges. At low flows, the water is expected to self-erode a channel through the fan.

It is our understanding that the current preferred options are the Reactivated Natural Channel or the Reactivated Natural Channel with Side Channel. We understand that NES is preparing to proceed to the next stage of study and evaluation subject to a clear indication from all regulatory agencies involved that they will be willing to accept alternative suspended sediment concentration-duration criteria for the purpose of evaluating this project. If the side channel and berms are to be considered, then additional field level work is required (i.e. additional surveys, test pits, drilling and geotechnical investigations).

Comments and analysis of the expected preferred options have been separated between the Nechako Canyon and Cheslatta Fan.

Nechako Canyon: (Kenney Dam to the Scour Hole, approx. 7 kilometres)

- Re-introduction of flows into the Nechako Canyon would result in unavoidable and potentially high suspended sediment concentrations for some unspecified duration.
- Existing sediment volume has been 'visually' estimated to be 28,000 m³, consisting primarily (est. 75%) of silt-sized and finer material. Amount of material in the canyon is finite.
- It is estimated that material could be mobilized at flows of 10 m³/s (cms) and a flow in the order of 50 cms would be required to clear the canyon.
- Some mitigative measure could be undertaken to reduce the sediment mobilization (i.e., protection of the toe of a spoil pile and pre-excavating materials from two small fans) though the magnitude of the reduction is not presented.
- Likely that sand-sized particles will be deposited at the scour hole and the finer material will continue downstream.
- The transport of woody debris and other vegetative matter was also assessed and the risk of debris jams in the canyon was deemed low. Mitigative measures were suggested (i.e. removal of some material from the canyon, collection and removal of material downstream, etc.)

Cheslatta Fan: (downstream of Scour hole to the confluence with Cheslatta Falls)

- Propose that channel commissioning occur between May 15 and August 20 over a period of time with initial releases of 10 cms with incremental flow releases to 60 cms with monitoring of suspended sediment concentrations downstream. The intent is to use controlled commissioning flow releases to perform the entire channel enlargement by eroding the bed and banks of the existing channel in a way that is closer to natural channel evolution.
- There is no definitive answer as to how long the channel commissioning period would be should channel incision fail to encounter sufficiently coarse material (gravel-cobble), erosion of the fan will continue until such time a balance is reached between the size of the channel armour material and the channel slope across the fan. This activity could result in considerable suspended sediment and bedload movement downstream.
- Estimated that the combined volume of sediment likely to be removed from the canyon flushing and from the fan as a result of the commissioning is in the range of 120,000 to 180,000 m³.
- It has been suggested that an instantaneous suspended sediment concentration of 10,000 mg/L could occur at the mouth of the canyon and on the fan, prior to dilution with flows from Cheslatta Falls.
- The channel enlargement process through the fan will result in sediment transport, both suspended and bedload, downstream. Significant bedload deposition at some location downstream could contribute negatively to flood conditions (and the need for preventative maintenance works) and fish habitat conditions.
- There are inherent risks associated with constructing works within a fan feature, especially with respect to long-term stability of the fan with the introduction of flows and any proposed channel works. Further assessment of risks associated with the proposed works in the vicinity of the fan should be considered as the proposed self-eroding process could result in on-going sediment input for an unknown duration due to the unstable nature of the fan itself.

4. Water temperature issues related to the CWRF

There are three questions addressed:

a) Assess benefits of current temperature regime to sockeye salmon

An analysis of the current temperature regime indicates that increased flow has a positive effect on the moderation of summer temperatures in the Nechako River above the confluence of the Stuart River. In one analysis, Nechako water temperatures were on average 0.07°C lower at Vanderhoof as a result of the summer cooling flow program than temperatures predicted at spring base flows of 53.25 cms. During warm water years (e.g. 1998) Nechako temperatures below the confluence of the Stuart River were also predicted to be lower as a result of the cooling flows as the Nechako water tends to be cooler than the Stuart water.

However, the hydrograph created by the cooling flow program is unnatural, creating peak flows in the summer rather than the spring. This may have far-reaching biological effects that are not well understood. Provincial officials are of the view that this could be affecting white sturgeon recruitment.

b) Review the NFCP temperature objective with a view to revising it to another temperature measured at another location.

From a fisheries management perspective, the temperature objective is flawed in that it imposes temperature targets above the confluence of the Stuart River, when temperatures below the confluence have a more direct influence on the Early Stuart sockeye run. The addition of Stuart water complicates temperature predictions below the confluence, but we are confident that Nechako water moderates the effect of the warmer Stuart system during warm summers. Additionally, summer temperatures have been set by the agreement to a maximum of 20°C. Research indicates this temperature to be lethal to salmon particularly when the fish have been exposed to these temperatures during a large portion of their freshwater migration. A maximum target of 18°C at locations in the migration corridor where temperature control is a possibility is more precautionary and scientifically defensible.

The most recent research pertaining to Fraser sockeye is summarized as follows:

1. Sockeye exposed to 19.6°C water for 9 days will suffer 50% mortality, whereas it requires 16 days of exposure to 18°C water to have the same effect.
2. Swimming performance and energy use efficiency also decline with increasing temperature. For example, maximum sustainable swimming speed declines by 20% if temperatures rise from 18 to 19.6°C.

3. In the summer of 2004, the Nechako River at Prince George and the Stuart River at Fort St James was frequently 22°C and did not drop below 19°C until late August. The sockeye runs using these corridors arrived on the spawning grounds in far lower numbers than expected. The run discrepancies were as follows: Early Stuart - 91%, Stellako - 64%, Nadina – 81%.

- c) Scope the effects of changing from the current temperature regime to the potential CWRF regime.

Assuming the overall annual base flow from the Nechako Reservoir will remain at 36.8 cms in the future, a source of cool water at the Kenney Dam site will likely reduce the volume of water required to be released to meet summer temperature targets and increase the amount of water available to provide a more natural annual hydrograph (e.g. increased flows in the spring). Releases from the Kenney Dam will pass directly into the upper Nechako avoiding the buffering influence on flows that enter Murray and Cheslatta Lakes and the associated complications to moderating Nechako flows and temperatures. However, cool water releases may result in temperature shock to ecosystems at point of entry and flow fluctuations associated with downstream temperature control may result in rapid changes in water temperature. Ecosystem impacts may prove difficult to avoid.

Assuming NFCP summer temperature objectives remain unchanged, it is likely that a maximum temperature target of 20°C at Vanderhoof will be attainable with less water from the cold water release facility (CWRF) at Kenney Dam than with the present regime using the Skins release facility. It follows that with the CWRF the Nechako above the confluence with the Stuart River will have lower flows and thus be less able to moderate the warmer Stuart flow below the confluence. Therefore it is conceivable that Early Stuart sockeye salmon may be exposed to warmer temperatures under a CWRF regime than under the summer cooling flow regime that currently exists. At temperatures of 20°C these fish are already at the limit of their endurance. Increased exposure to potentially lethal temperatures will hamper stock recovery goals.

5. DFO Roles and Responsibilities with regard to the Nechako CWRF

The Nechako Watershed Committee (NWC) was formed and supported by Alcan in 1998 and includes representatives from various levels of government, First Nations, business and community groups. While it has representation from many of the interest groups in the area, it does not include all First Nation communities in the area or environmental groups. In part because of the representation concerns, the federal government has not participated formally as a member of the NWC, although DFO staff has participated occasionally as observers.

The Nechako Fisheries Conservation Program (NFCP) was established by the *1987 Settlement Agreement* between Alcan Aluminium Limited, the Province of BC, and the Government of Canada to resolve outstanding water flow issues associated with the Kemano Completion Project (KCP) in north central and western BC. The mandate of the

NFCP is to annually plan and implement a program including flow releases, monitoring, research, and if required, remedial measures to conserve:

the chinook salmon that use the Nechako River year-round; and
the sockeye salmon that migrate through the Nechako River to tributary river systems

DFO contributes approximately \$200K to the programs conducted under the NFCP. For most issues, DFO, BC and Alcan are the main parties, and it is difficult to make decisions on any specific issue in isolation of the other interests and processes that currently exist in the watershed. The role of the NFCP and the Technical Committee as a lead for watershed planning has been recommended by others. Based on the NFCP Technical Committee's preliminary/draft recommendation resulting from the review of approximately 15 years of Program data, the Settlement Agreement as conceived in 1987 has most likely run its course and the department should actively examine the implications, benefits and costs of recommending to the other Parties to the Agreement invoking the "sunset clause".

Departmental experts can provide guidance on the relevant issues related to the CWRP from the perspective of our regulatory role with regard to assessing impacts on fish and fish habitat. From the analysis above, it is clear that there is considerable work needed with regard to the water temperature questions and the management and mitigation of sediments in the Nechako Canyon and through the Cheslatta Fan. As requirements for migrating sockeye, juvenile chinook and spawning sturgeon are not mutually compatible; a plan to examine the water temperature issue will be developed in cooperation with Science and the Province in order to set out fish requirements. It would also be useful to workshop the management and mitigation options to address Turbidity of the Water and Sedimentation Considerations

DFO regulatory requirements for a CWRP could have a bearing on the costs of a water release facility and the volume of freed up flows that are available for other uses. If costs increase or benefits are reduced to satisfy DFO, BC and Alcan may argue that the federal government should contribute to the overall cost of construction.

Federal government policy is to not contribute funds to rehabilitate and restore environmental impacts resulting from industrial and commercial development. Minister Dahliwal indicated to the NEEF management committee in 2002 that DFO is not in a position to contribute financially to the restoration of the Nechako River beyond its current commitments with the Nechako Fisheries Conservation Program established in the 1987 Settlement Agreement.

Recommendations

It is recommended that DFO take the following positions with regard to the Nechako CWRP:

- A CWRF has potentially positive benefits to fish and fish habitat through the re-watering of the Nechako Canyon and the establishment of a more natural hydrograph in the Murray/Cheslatta system
- There are four environmental considerations that will have to be addressed in the design and operation of this facility.
- TGP of 110% at CWRF should protect all species and life-history phases against the acute effect of DGS 2. If TGP from natural sources exceeds the guidelines, then no increase in TGP will be allowed. This means that the confluence of Nechako and Cheslatta - below Cheslatta Falls (which produces high TGP naturally) - the TGP should not be increased. A study will be needed to check to see if the 110% at the CWRF is sufficient to ensure no increase at the confluence. If it is not, then a revised target at the CWRF will be required.
- DFO is comfortable with a base flow in the Murray/Cheslatta system of between 6 and 15 cubic meters per second. Deciding on the final base flow and hydrograph will require additional work. It is anticipated that the province lead this work
- With regard to turbidity and sediment, DFO will participate in a multi-agency workshop to develop management and mitigation measures for the identified preferred options through the Nechako Canyon and Cheslatta Fan
- With regard to temperature issues, DFO will participate in a multi-agency workshop to review the not mutually compatible requirements for migrating sockeye, juvenile chinook and spawning sturgeon. The expected outcome will be a research plan to establish temperature objectives for the various fish requirements including understanding the impacts of the colder water of rearing chinook and resident species, water temperature requirements for migrating sockeye and temperature and flow requirements for spawning sturgeon.
- DFO will participate in the review of the issues associated with the CWRF from the regulatory perspective to ensure that fish and fish habitat impacts are satisfactorily addressed. In that participation it is anticipated that we will interact with member of the NWC and NES, but we are not seeking formal membership in these groups or entering into any form of partnership with regard to CWRF project.
- Consistent with previous ministerial direction DFO will not contribute funds to rehabilitate and restore environmental impacts resulting from industrial and commercial development
- DFO should actively examine the implications, benefits and costs of recommending to the other Parties to the Agreement invoking the NFCP "sunset clause".