

**Takla-Nechako Area
Nechako River
Water Quality Assessment
and Objectives**

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*WATER MANAGEMENT
WATER QUALITY BRANCH*

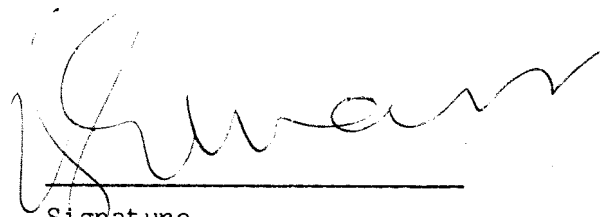
MINISTRY OF ENVIRONMENT AND PARKS
PROVINCE OF BRITISH COLUMBIA

TAKLA-NECHAKO AREA
NECHAKO RIVER
WATER QUALITY ASSESSMENT AND OBJECTIVES

L.G. Swain, P.Eng.
Water Management Branch

R. Girard
Waste Management Branch

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Signature
Deputy Minister

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Swain, L. G. (Leslie Grant), 1950-

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INTRODUCTION

The water quality of the Nechako River and some of its tributaries (Figure 1) in the Takla-Nechako area was assessed by examining water quality data collected to about December 1983. This assessment was begun because of a proposal by Alcan to proceed with the Kemano Completion project. Although Alcan's proposal was subsequently postponed for an indefinite period, the water quality assessment was completed so that water quality objectives would be in place. A detailed technical appendix was prepared and forms the basis for the conclusions presented here.

The Nechako River is one of the major tributaries to the Fraser River which it joins at Prince George. It originates from a former chain of lakes, now known as the Nechako Reservoir (Figure 2), which drain an area of about 14 000 km² west of Prince George.

Before 1950, the Nechako River was formed by water draining eastwards from two sets of lakes. One set comprised Skins Lake which flowed into Cheslatta Lake, then into Murray Lake, and finally into the Nechako River at Cheslatta Falls. The second set originated from Knewstubb Lake as the combined flow from Ootsa, Entiako and Eutsuk Lake drainages, and after passing through the Grand Canyon of the Nechako was joined at Cheslatta Falls by waters from the first set of lakes.

Since 1950, the larger lakes have been used as a storage reservoir for hydroelectric power. The power is generated at Kemano, about 240 km west from Cheslatta Falls, and is transmitted to Alcan's aluminum plant at Kitimat. To form the reservoir, the Kenney Dam was completed in 1952 at what became the outlet to Knewstubb Lake. The dam eliminated previous flows into the Nechako River at this point and backed water westward via Knewstubb and Nataalkuz Lakes into Ootsa Lake. Excess water, not required for power generation, is released from Ootsa Lake into Skins Lake via the Skins Lake Spillway. The overflow then travels via Cheslatta and Murray Lakes to the Nechako River.

Downstream from Cheslatta Falls, the Nechako River flows in a north-easterly direction to Fort Fraser. Here it is joined by the Nautley River, a short river draining Francois Lake and Fraser Lake from the west. The Nechako River then flows east, past Vanderhoof and Isle Pierre, into the Fraser River at Prince George. Major tributaries in this reach are the Stuart River, which drains Stuart Lake from the north, and the Chilako River, which enters from the south near Prince George.

Kemano Completion was a proposed Alcan project (Figure 2) designed to increase hydroelectric power generated at Kemano while increasing aluminum smelting capacity at other new sites. It involved increasing the water supply to the Nechako Reservoir by diverting water from the Nanika River system, which presently drains northward via the Morice River to the Bulkley River, and by decreasing the discharge to the Nechako River. It was contemplated that the flow and temperature of water entering the Nechako River would be controlled by building a dam at the outlet of Murray Lake and a cold water release structure at the Kenney Dam. This latter structure would once again allow water to flow from Knewstubb Lake into the Nechako River.

HYDROLOGY

The Nechako River has a drainage area of over 46 000 km². The average 7-day low flow (10-year return period) in the Nechako River at Fort Fraser is 23.1 m³/s, and increases to 55 m³/s at Isle Pierre. These are regulated flows based on the 1978 to 1983 period. Should Alcan's proposed Kemano Completion project proceed, the 7-day low flow (10-year return period) in the Nechako River at Isle Pierre would be about 45 m³/s. This flow is based upon a low flow of 14.2 m³/s at Cheslatta Falls (31%), 4.9 m³/s from the Nautley River (11%), and 26.4 m³/s from the Stuart River (58%).

Between 1980 and 1985, flows in the Nechako River were governed by a B.C. Supreme Court injunction which required certain minimum flows to protect spawning sockeye salmon passing through the Nechako River. These minimum flows could vary, depending upon the year.

The Stuart River has a drainage area of over 15 000 km². The 7-day low flow (10-year return period) in the Stuart River has been about 26.4 m³/s, which is about 50% of the regulated post-Kemano 7-day low flow in the Nechako River at Vanderhoof. Should Alcan's proposed Kemano Completion project proceed, or should Nechako River flows at Cheslatta Falls be reduced for some other reason, the flow contribution from the Stuart River (58%) will become more important in determining Nechako River water quality downstream from the Stuart River.

The Nautley River drains 6030 km² and has a 7-day average low flow (10-year return period) of 4.9 m³/s. It contributes about 9% of the flow in the Nechako River at Isle Pierre, which would increase to 11% should Alcan's proposed Kemano Completion project proceed.

The Chilako River drains 3 390 km² and has a 7-day average low flow (10-year return period) of 3.4 m³/s. This is only about 6% of the 7-day average low flow (10-year return period) in the Nechako River at Isle Pierre, or 7.5% of the Nechako River flow should Alcan's proposed Kemano Completion proceed.

WATER USES

The Nechako River and the Stuart River are extremely important migration routes for juvenile and returning adult salmon. Extensive areas of both rivers are used for spawning by adult salmon, and the mouths of several tributaries are used for spawning by rainbow trout. Stuart Lake has extensive sockeye salmon stocks. There are at least 13 known species of resident fish found in the lake system in the upper reaches of the Stuart River watershed.

The Nechako River also is used extensively for irrigation, livestock watering, and drinking water, with some primary-contact recreation (i.e., swimming). Water from the Chilako River is used by wildlife and only for irrigation and some non-licensed drinking water, while water from the Stuart

River also is used by wildlife and for drinking water. Stuart Lake water is used for drinking water and by wildlife. Recreational use is also made of Stuart Lake, both for primary-contact recreation (i.e., swimming) and secondary-contact recreation (i.e., boating, fishing). Burns and Fraser Lakes are used for primary and secondary-contact recreation, drinking water, irrigation, livestock, and used by wildlife and aquatic life.

WASTE DISCHARGES

Three treated domestic sewage discharges occur in this sub-basin. These are from Vanderhoof (population: 3 800), Fort Fraser (population: 1 500), and Fort St. James (population: 2 300).

Fort St. James, located near the start of the Stuart River at the outlet from Stuart Lake, discharges as much as 3 200 m³/d of wastewater from a secondary treatment facility. The discharge is to the Necoslie River, a low flow river, about one kilometre upstream from its confluence with the Stuart River. The Necoslie River has no salmon spawning and very little fisheries value, although chinook salmon spawn at its mouth.

This discharge increases fecal coliforms, ammonia, BOD₅, orthophosphorus and total phosphorus in the Necoslie River near its mouth. A concern about this discharge relates to maintaining water quality in the Necoslie downstream from the discharge to permit swimming. No impact from this discharge is expected in the Stuart River if recent improvements to the treatment system are as effective as anticipated.

The Village of Fort Fraser, located about 100 km west from Prince George, discharges as much as 250 m³/d of wastewater to the Nechako River, following secondary treatment. The discharge increases only fecal coliforms in the river outside the initial dilution zone. The increase could affect use of the water by downstream consumers, but the closest downstream drinking water withdrawal is 25 km away. Therefore no concerns exist. The sewage treatment facility has just been expanded, so that effluent quality

should be improved. Should Alcan's Kemano Completion project proceed, dilution available for this wastewater in the Nechako River may decrease. Additional improvements could be required at this facility.

The Village of Vanderhoof discharges as much as 1 640 m³/d of treated municipal wastewater (secondary treatment) to the Nechako River. The discharge has at times increased values of fecal coliforms, ammonia, dissolved orthophosphorus, and total dissolved phosphorus in the river. Downstream drinking water users could theoretically be affected by this discharge.

A mercury mine complex operated on Pinchi Lake in the 1940's, the 1960's, and 1970's. Tailings which were discharged to Pinchi Lake in the 1940's are continuing to affect mercury concentrations in fish in this lake, which drains to Stuart Lake via Pinchi Creek.

Other point source waste discharges in this sub-basin are refuse sites or small domestic sewage facilities. No impacts are anticipated, or have been measured, from these waste discharges.

Non-point sources such as agriculture, forestry, and unsewered residential developments can also affect water quality. These sources may be raising values of phosphorus, nitrogen, and fecal coliforms in the sub-basin. Phosphorus potentially can increase algal growth; certain forms of nitrogen in extreme cases can be toxic to humans and aquatic life; fecal coliforms can necessitate more elaborate water treatment. The relative impact of non-point sources compared to point discharges on river water quality is not known.

WATER QUALITY

The water quality in the Nechako River generally would be considered as good. This is reflected in low levels for nutrients, suspended solids, and metals, and high dissolved oxygen concentrations. At present, the turbidity in the river can be increased dramatically when water is released by Alcan

to supplement Nechako River flows. As well, some high natural aluminum concentrations have been evident. Total dissolved gas pressures near Cheslatta Falls can occasionally reach levels associated with acute gas-bubble trauma and be of major concern for fish.

At present, aquatic weed growths near Fort Fraser and Vanderhoof are abundant, but these do not appear to be related to the discharges of treated municipal wastewater from these two centres.

The proposed Kemano Completion project could increase water clarity, leading to a concern for greater aquatic plant growths and algal production. In extreme situations, which are unlikely, this could have a serious effect on salmonid fish. The possible detrimental effects could be offset by the capability to change temperature regimes in the river using the proposed cold water withdrawal structure at the Kenney Dam. Improved management of temperature regimes in the river could minimize stress on fish in the system, as well as maximize the amount of water which could be used by Alcan for power production.

The Stuart River water is considered to be soft, with good buffering to acidic discharges and high dissolved oxygen levels. Some high iron, manganese, and copper values have been measured, but these metals were believed to be naturally occurring. No water chemistry data existed for Stuart Lake. However, tissues from fish collected from Stuart Lake had mercury values which met the working water quality criterion for human consumption.

Pinchi and Tezzeron Lakes, which drain to Stuart Lake, are both located in the Pinchi Lake Fault zone. This is a geological formation which contains numerous mercury-bearing ore deposits. Pinchi Lake had soft water, good buffering to acids, adequate dissolved oxygen, and low suspended solids levels. The trophic status of the lake is unknown. The lake had some high lead and iron values, but mercury levels in the water column generally were low. Fish in the lake contain high mercury levels in their flesh, which are too high for human consumption. Tezzeron Lake also had soft water, good

buffering to acids, high dissolved oxygen, and low suspended solids levels. The lake is probably oligotrophic, according to phosphorus concentrations. Some maximum values for metals (cadmium, copper, iron, and lead) exceeded working water quality criteria for aquatic life, but these metals were believed to be naturally occurring. High values occurred as localized short-term peaks, and therefore metals are not a major concern to aquatic life. Mercury values in most fish muscle met the working water quality criterion for human consumption, but flesh from one northern squawfish exceeded the criterion. The mercury is likely naturally occurring, due to the presence of the Pinchi Lake Fault zone.

The Chilako River water was harder, had higher nutrient levels, and was better buffered to acids than the Nechako River. Dissolved oxygen levels were good, and some high metal values have been associated with high suspended solids during freshet. Therefore the metals likely are bound to the solids and not available to aquatic life. One high dissolved mercury value probably reflects the fact that the Chilako River is influenced by the presence of the Pinchi Lake Fault zone.

PROVISIONAL WATER QUALITY OBJECTIVES

A summary of designated water uses and proposed provisional water quality objectives is given in Table 1. Provisional water quality objectives are proposed for the Nechako River, Necoslie River, and the Stuart River. The objectives are based on working criteria for water quality and on available data on water quality, waste discharges, water uses, and river flows. The objectives will remain provisional until receiving water monitoring programs provide adequate data, and the Ministry has established approved water quality criteria for the characteristics of concern.

Water quality objectives have no legal standing and would not be directly enforced. The objectives can be considered as policy guidelines for resource managers to protect water uses in the specified water bodies. They will guide the evaluation of water quality, the issuing of permits,

licences, and orders, and the management of the fisheries and of the Province's land base. They will also provide a reference against which the state of water quality in a particular water body can be checked, and serve to make decisions on whether to initiate basin-wide water quality studies.

Depending on the circumstances, water quality objectives may already be met in a water body, or may describe water quality conditions which can be met in the future. To limit the scope of the work, objectives are only being prepared for water bodies and for water quality characteristics which may be affected by man's activity, now and in the foreseeable future.

Designated uses have been proposed for a number of water bodies, although objectives have not been proposed for them at this time. Should developments be proposed for these water bodies in the future, appropriate objectives may be required, depending on the development. Water bodies which come under this category are Pinchi Creek, Ocock River, Tsilcoh River, Tezzeron Lake, Pinchi Lake, Tezzeron Creek, Hatdudatehl Creek, and Stuart Lake. The designated uses for the water bodies are drinking water, aquatic life, wildlife, irrigation, livestock watering, and primary and secondary-contact recreation in the lakes only.

Designated water uses in lakes and rivers where objectives have been proposed are shown in Table 1. Fecal coliform objectives to permit recreation from June through August are proposed for the Nechako River from just above the Fort Fraser sewage discharge to the Nautley River, and in the Necoslie River from just above the Fort St. James sewage discharge to the Stuart River. A more restrictive fecal coliform objective, applicable on a year-round basis to protect drinking water supplies, is proposed for the Stuart River and the entire length of the Nechako River, excluding the above area between the Fort Fraser outfall and the Nautley River. An area of the Stuart River to which this objective is not applicable, is along its east bank, from the Necoslie River to a point on the river 200 metres downstream from the highway 27 bridge. This area is considered as a mixing zone for Necoslie River water with Stuart River water for the purpose of the fecal

coliform objective only. In this area water withdrawals should only be undertaken with provision of a high level of water treatment.

Since the sewage treatment plants chlorinate, or may have to chlorinate their effluents in order to achieve the coliform objectives, an objective is proposed for total chlorine residual to protect aquatic life from chlorine toxicity.

Ammonia can also be toxic to aquatic life. An objective is proposed for the Nechako and Stuart Rivers. As a further aid in this regard, an objective for pH is also proposed. The upper portion of the pH range has been reduced purposely from the working water quality criteria since background pH values are naturally lower, and the amount of ammonia can be increased safely at lower pH's.

An objective for nitrite is proposed since nitrite can be toxic to aquatic life. Nitrite can be formed when ammonia is oxidized. If further oxidation to convert the nitrite to nitrate is inhibited, nitrite can be relatively high below such places as sewage treatment plant outfalls.

Minimum dissolved oxygen values are proposed as objectives in the Nechako and Stuart Rivers to protect the migration of salmon and resident salmonid populations.

Objectives for the average water temperature have been proposed for the following two locations on the Nechako River: just upstream from the Stuart River confluence to protect aquatic life and to permit upstream migration, and just downstream from Cheslatta Falls to permit spawning, growth of juvenile rainbow trout, and egg incubation.

Since recreational use is made of the entire length of the river, objectives have been proposed for periphyton chlorophyll-a. This objective will help in maintaining low algal productivity, thereby maintaining the aesthetic quality of the river.

High total dissolved gas pressures can cause gas bubble disease in fish. Alevin and juveniles are particularly susceptible. To protect these sensitive life stages, an objective is proposed for total dissolved gas pressure along the length of the Nechako River.

MONITORING RECOMMENDATIONS

Monitoring programs have been proposed in Table 4 to check attainment of the provisional objectives and to develop new objectives. Monitoring to check attainment of the objectives will take place at a practical sampling frequency and at points in the environment where objectives are most likely to be exceeded. Monitoring may need to be increased if it is believed that the objectives are not being attained. New data would be used in the future to finalize provisional objectives, revise objectives or develop new objectives.

The recommended monitoring program is based upon technical considerations. Regional priorities and available funding are factors which could either limit or expand the program.

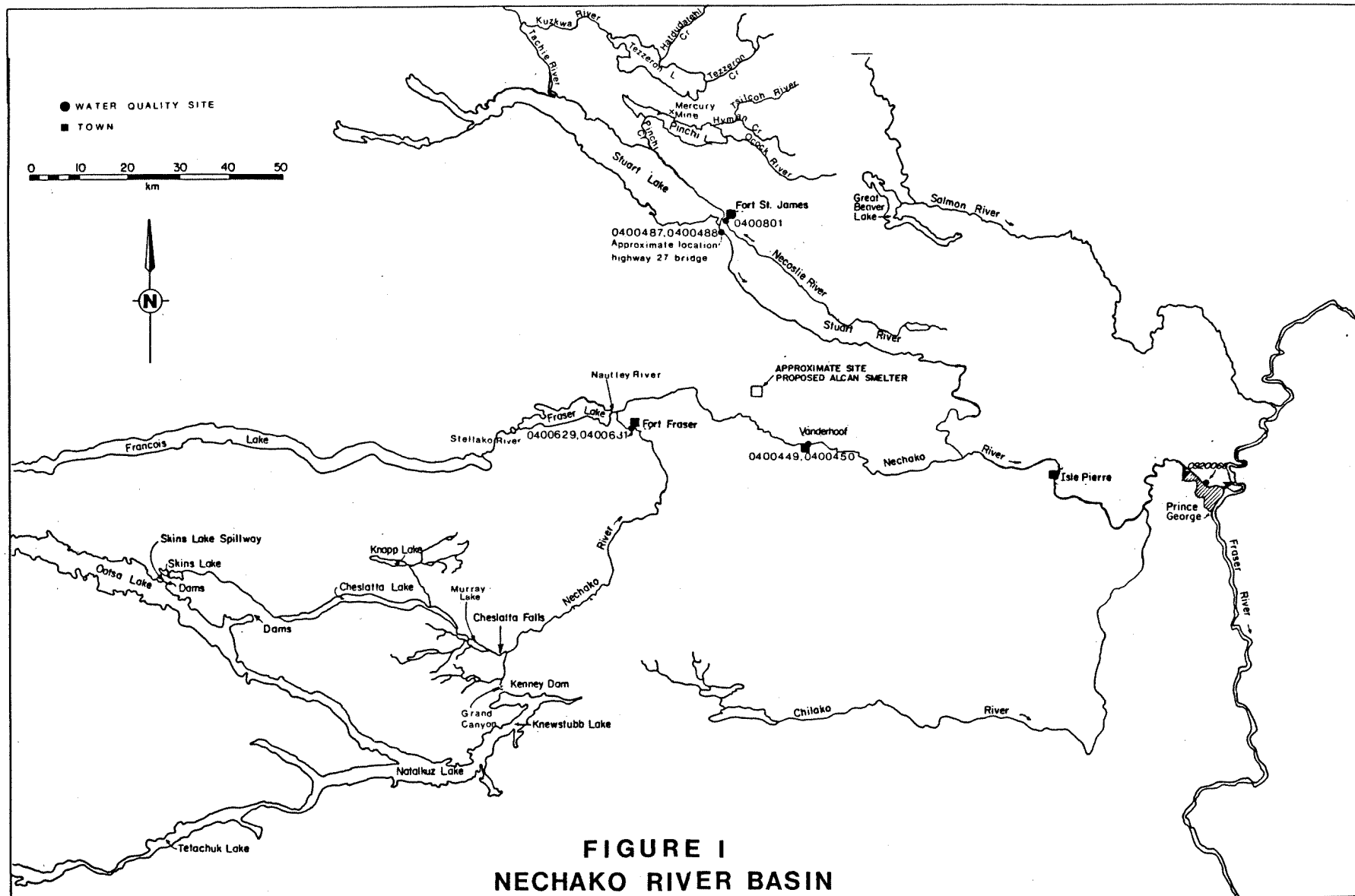




FIGURE 2 : The Nechako River Reservoir (after building of the Kenney Dam)

TABLE 1

PROVISIONAL WATER QUALITY OBJECTIVES FOR THE NECHAKO RIVER SUB-BASIN

WATER BODIES	CHILAKO RIVER	STUART RIVER	NECHAKO RIVER	NECOSLIE RIVER
DESIGNATED WATER USES	Drinking water (partial treatment), aquatic life, wildlife, livestock, irrigation	Drinking water (disinfection), aquatic life, wildlife, recreation, livestock, irrigation	Drinking water (partial treatment), aquatic life, wildlife, recreation ¹ , livestock, irrigation	Recreation, livestock, irrigation
Fecal Coliforms ^{1,2,3}	≤100/100 mL 90th percentile	≤10/100 mL 90th percentile ¹	≤100/100 mL 90th percentile ²	≤200 /100 mL geometric mean ≤400 /100 mL 90th percentile
Total Chlorine Residual ⁴	not applicable	0.002 mg/L maximum		not applicable
Total Ammonia-N	See Tables 2 and 3			not applicable
Nitrite-N ⁵	≤0.02 mg/L average		0.06 mg/L maximum	not applicable
Periphyton ⁶ Chlorophyll- <u>a</u>	≤100 mg/m ² average	≤50 mg/m ² average		not applicable
Dissolved Oxygen ⁷	11.2 mg/L minimum when fish eggs are in "eyed" to hatch stage 8.0 mg/L minimum when fish eggs and/or larvae or alevin present 7.75 mg/L minimum at all other times			not applicable
pH ⁸	6.5 - 8.5			not applicable
Temperature (°C) ⁹	not applicable	not applicable	At Cheslatta Falls: ≤15° average At Stuart River: ≤20° average (July-August) : ≤18° average (September-June)	not applicable
Total Gas Pressure (% Saturation)	not applicable	not applicable	109% maximum	not applicable

Note: The objectives apply to discrete samples from all parts of the water body, except from the initial dilution zones of effluents. These excluded initial dilution zones in streams are defined as extending up to 100 m downstream from the discharge point, and no more than 50% across the width of the stream, from the surface to the bottom.

1. The drinking water objective of $\leq 10/100$ mL applies to the Stuart River, except in an area along the east bank of the river from the Necoslie River to a distance of 200 m downstream from the highway 27 bridge, where the drinking water objective of $\leq 100/100$ mL applies. Both objectives apply all year.
2. The drinking water objective of $\leq 100/100$ mL applies to the Nechako River, except in an area from the Fort Fraser outfall to the Nautley River. This objective applies year round. In the area from one kilometre downstream from the outfall to the Nautley River, the recreation objective (200-400/100 mL) applies during the recreation season.
3. The geometric mean and the 90th percentile are calculated from samples collected once per week for five weeks in a period no longer than 30 days.
4. Since the objective is less than the minimum detectable concentration, it will be necessary to estimate the receiving water concentration using effluent loadings and stream flow. The objective applies only if the sewage effluent is chlorinated.
5. The average is calculated from samples collected once per week for five weeks in a period no longer than thirty days.
6. The average is calculated from at least five samples collected randomly from natural substrate.
7. Fish eggs typically would be in the "eyed" to hatch stage from October through December and May to June 15.
8. Measurements can be made in-situ, but must be confirmed in the laboratory if the objective is exceeded.
9. The objectives apply to the average of measurements made at river cross-sections approximately 100 m downstream from Cheslatta Falls and 100 m upstream from the Stuart River. Measurements are to be made at 0.2 and 0.8 of the depth at each of five points at each cross-section. The five points are located as follows: where a depth of 1.6 m is achieved going out from each shore, one-half the distance from this point to the closest shore, and at the mid point of the cross section. The average value outlined as objectives is the average of at least three sets of the aforementioned ten measurements, each set taken at approximately equal time intervals during an eight-hour period.

TABLE 2

MAXIMUM CONCENTRATION OF TOTAL AMMONIA NITROGEN FOR PROTECTION OF AQUATIC LIFE
(mg/L-N)

pH	Temp.										
	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
6.5	27.7	28.3	27.9	27.5	27.2	26.8	26.5	26.2	26.0	25.7	25.5
6.6	27.9	27.5	27.2	26.8	26.4	26.1	25.8	25.5	25.2	25.0	24.7
6.7	26.9	26.5	26.2	25.9	25.5	25.2	24.9	24.6	24.4	24.1	23.9
6.8	25.8	25.5	25.1	24.8	24.5	24.2	23.9	23.6	23.4	23.1	22.9
6.9	24.6	24.2	23.9	23.6	23.3	23.0	22.7	22.5	22.2	22.0	21.8
7.0	23.2	22.8	22.5	22.2	21.9	21.6	21.4	21.1	20.9	20.7	20.5
7.1	21.6	21.3	20.9	20.7	20.4	20.2	19.9	19.7	19.5	19.3	19.1
7.2	19.9	19.6	19.3	19.0	18.8	18.6	18.3	18.1	17.9	17.8	17.6
7.3	18.1	17.8	17.5	17.3	17.1	16.9	16.7	16.5	16.3	16.2	16.0
7.4	16.2	16.0	15.7	15.5	15.3	15.2	15.0	14.8	14.7	14.5	14.4
7.5	14.4	14.1	14.0	13.8	13.6	13.4	13.3	13.1	13.0	12.9	12.7
7.6	12.6	12.4	12.2	12.0	11.9	11.7	11.6	11.5	11.4	11.3	11.2
7.7	10.8	10.7	10.5	10.4	10.3	10.1	10.0	9.92	9.83	9.73	9.65
7.8	9.26	9.12	8.98	8.88	8.77	8.67	8.57	8.48	8.40	8.32	8.25
7.9	7.82	7.71	7.60	7.51	7.42	7.33	7.25	7.17	7.10	7.04	6.98
8.0	6.55	6.46	6.37	6.29	6.22	6.14	6.08	6.02	5.96	5.91	5.86
8.1	5.21	5.14	5.07	5.01	4.95	4.90	4.84	4.80	4.75	4.71	4.67
8.2	4.15	4.09	4.04	3.99	3.95	3.90	3.86	3.83	3.80	3.76	3.74
8.3	3.31	3.27	3.22	3.19	3.15	3.12	3.09	3.06	3.03	3.01	2.99
8.4	2.64	2.61	2.57	2.54	2.52	2.49	2.47	2.45	2.43	2.41	2.40
8.5	2.11	2.08	2.06	2.03	2.01	1.99	1.98	1.96	1.95	1.94	1.93
8.6	1.69	1.67	1.65	1.63	1.61	1.60	1.59	1.58	1.57	1.56	1.55
8.7	1.35	1.33	1.32	1.31	1.30	1.29	1.28	1.27	1.26	1.26	1.25
8.8	1.08	1.07	1.06	1.05	1.04	1.04	1.03	1.03	1.02	1.02	1.02
8.9	0.871	0.863	0.856	0.849	0.844	0.839	0.836	0.833	0.832	0.831	0.831
9.0	0.703	0.697	0.692	0.688	0.685	0.682	0.681	0.681	0.680	0.681	0.682
	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	
6.5	25.2	25.0	24.8	24.6	24.5	24.3	24.2	24.0	23.9	23.8	
6.6	24.5	24.3	24.1	23.9	23.8	24.6	23.5	23.3	23.3	23.2	
6.7	23.7	23.5	23.3	23.1	23.0	22.8	22.7	22.6	22.5	22.4	
6.8	22.7	22.5	22.3	22.2	22.0	21.9	21.8	21.7	21.6	21.5	
6.9	21.6	21.4	21.3	21.1	21.0	20.8	20.7	20.6	20.5	20.4	
7.0	20.3	20.2	20.0	19.9	19.7	19.6	19.5	19.4	19.3	19.2	
7.1	18.9	18.8	18.7	18.5	18.4	18.3	18.2	18.1	18.0	17.9	
7.2	17.4	17.3	17.2	17.1	16.9	16.8	16.8	16.7	16.6	16.5	
7.3	15.9	15.7	15.6	15.5	15.4	15.3	15.2	15.2	15.1	15.1	
7.4	14.2	14.1	14.0	13.9	13.9	13.8	13.7	13.6	13.6	13.5	
7.5	12.6	12.5	12.4	12.4	12.3	12.2	12.2	12.1	12.1	12.0	
7.6	11.1	11.0	10.9	10.8	10.8	10.7	10.7	10.6	10.6	10.5	
7.7	9.57	9.50	9.43	9.37	9.31	9.26	9.22	9.81	9.15	9.12	
7.8	8.18	8.12	8.07	8.02	7.97	7.93	7.90	7.87	7.84	7.82	
7.9	6.92	6.88	6.83	6.79	6.75	6.72	6.69	6.67	6.65	6.64	
8.0	5.81	5.78	5.74	5.71	5.68	5.66	5.64	5.62	5.61	5.60	
8.1	4.64	4.61	4.59	4.56	4.54	4.53	4.51	4.50	4.49	4.49	
8.2	3.71	3.69	3.67	3.65	3.64	3.63	3.62	3.61	3.61	3.61	
8.3	2.97	2.96	2.94	2.93	2.92	2.92	2.91	2.91	2.91	2.91	
8.4	2.38	2.37	2.36	2.36	2.35	2.35	2.35	2.35	2.35	2.36	
8.5	1.92	1.91	1.91	1.90	1.90	1.90	1.90	1.90	1.91	1.92	
8.6	1.55	1.54	1.54	1.54	1.54	1.54	1.55	1.55	1.56	1.57	
8.7	1.25	1.25	1.25	1.25	1.25	1.26	1.26	1.27	1.28	1.29	
8.8	1.02	1.11	1.02	1.02	1.03	1.03	1.04	1.05	1.06	1.07	
8.9	0.832	0.834	0.838	0.842	0.847	0.853	0.861	0.870	0.880	0.891	
9.0	0.684	0.688	0.692	0.698	0.704	0.711	0.720	0.729	0.740	0.752	

TABLE 3

AVERAGE 30-DAY CONCENTRATION OF TOTAL AMMONIA NITROGEN FOR PROTECTION OF AQUATIC LIFE
(mg/L-N)

pH	Temp.										
	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
6.5	2.08	2.05	2.02	1.99	1.97	1.94	1.92	1.90	1.88	1.86	1.84
6.6	2.08	2.05	2.02	1.99	1.97	1.94	1.92	1.90	1.88	1.86	1.84
6.7	2.08	2.05	2.02	1.99	1.97	1.94	1.92	1.90	1.88	1.86	1.84
6.8	2.08	2.05	2.02	1.99	1.96	1.94	1.92	1.90	1.88	1.86	1.84
6.9	2.08	2.05	2.02	1.99	1.97	1.94	1.92	1.90	1.88	1.86	1.84
7.0	2.08	2.05	2.02	1.99	1.97	1.94	1.92	1.90	1.88	1.86	1.84
7.1	2.08	2.05	2.02	1.99	1.97	1.94	1.92	1.90	1.88	1.86	1.84
7.2	2.08	2.05	2.02	1.99	1.96	1.95	1.92	1.90	1.88	1.86	1.85
7.3	2.08	2.05	2.02	1.99	1.97	1.95	1.92	1.90	1.88	1.86	1.85
7.4	2.08	2.05	2.02	2.00	1.97	1.95	1.92	1.90	1.88	1.87	1.85
7.5	2.08	2.05	2.02	2.00	1.97	1.95	1.93	1.91	1.88	1.87	1.85
7.6	2.09	2.05	2.03	2.00	1.97	1.95	1.93	1.91	1.89	1.87	1.85
7.7	2.09	2.05	2.03	2.00	1.98	1.95	1.93	1.91	1.89	1.87	1.86
7.8	1.78	1.75	1.73	1.71	1.69	1.67	1.65	1.63	1.62	1.60	1.59
7.9	1.50	1.48	1.46	1.44	1.43	1.41	1.39	1.38	1.36	1.35	1.34
8.0	1.26	1.24	1.23	1.21	1.20	1.18	1.17	1.16	1.15	1.14	1.13
8.1	1.00	0.989	0.976	0.963	0.952	0.942	0.932	0.922	0.914	0.906	0.899
8.2	0.799	0.788	0.777	0.768	0.759	0.751	0.743	0.736	0.730	0.724	0.718
8.3	0.636	0.628	0.620	0.613	0.606	0.599	0.594	0.588	0.583	0.579	0.575
8.4	0.508	0.501	0.495	0.489	0.484	0.479	0.475	0.471	0.467	0.464	0.461
8.5	0.405	0.400	0.396	0.381	0.387	0.384	0.380	0.377	0.375	0.372	0.370
8.6	0.324	0.320	0.317	0.313	0.310	0.308	0.305	0.303	0.301	0.300	0.298
8.7	0.260	0.257	0.254	0.251	0.249	0.247	0.246	0.244	0.243	0.242	0.241
8.8	0.208	0.206	0.204	0.202	0.201	0.200	0.198	0.197	0.197	0.196	0.196
8.9	0.168	0.166	0.165	0.163	0.162	0.161	0.161	0.160	0.160	0.160	0.160
9.0	0.135	0.134	0.133	0.132	0.132	0.131	0.131	0.131	0.131	0.131	0.131
	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	
6.5	1.82	1.81	1.80	1.78	1.77	1.64	1.52	1.41	1.31	1.22	
6.6	1.82	1.81	1.80	1.78	1.77	1.64	1.52	1.41	1.31	1.22	
6.7	1.83	1.81	1.80	1.78	1.77	1.64	1.52	1.41	1.31	1.22	
6.8	1.83	1.81	1.80	1.78	1.77	1.64	1.52	1.42	1.32	1.22	
6.9	1.82	1.81	1.80	1.78	1.77	1.64	1.53	1.42	1.32	1.22	
7.0	1.83	1.81	1.80	1.79	1.77	1.64	1.53	1.42	1.32	1.22	
7.1	1.83	1.81	1.80	1.79	1.77	1.65	1.53	1.42	1.32	1.23	
7.2	1.83	1.81	1.80	1.79	1.78	1.65	1.53	1.42	1.32	1.23	
7.3	1.83	1.82	1.80	1.79	1.78	1.65	1.53	1.42	1.32	1.23	
7.4	1.83	1.82	1.80	1.79	1.78	1.65	1.53	1.42	1.32	1.23	
7.5	1.83	1.82	1.81	1.80	1.78	1.66	1.54	1.43	1.33	1.23	
7.6	1.84	1.82	1.81	1.80	1.79	1.66	1.54	1.43	1.33	1.24	
7.7	1.84	1.83	1.81	1.80	1.79	1.66	1.54	1.44	1.34	1.24	
7.8	1.57	1.56	1.55	1.54	1.53	1.42	1.32	1.23	1.14	1.07	
7.9	1.33	1.32	1.31	1.31	1.30	1.21	1.12	1.04	0.970	0.904	
8.0	1.12	1.11	1.10	1.10	1.09	1.02	0.944	0.878	0.818	0.762	
8.1	0.893	0.887	0.882	0.878	0.874	0.812	0.756	0.704	0.655	0.611	
8.2	0.714	0.709	0.706	0.703	0.700	0.651	0.606	0.565	0.527	0.491	
8.3	0.571	0.568	0.566	0.564	0.562	0.523	0.487	0.455	0.424	0.396	
8.4	0.458	0.456	0.455	0.453	0.452	0.421	0.393	0.367	0.343	0.321	
8.5	0.369	0.367	0.366	0.366	0.365	0.341	0.318	0.298	0.278	0.261	
8.6	0.297	0.297	0.296	0.296	0.296	0.277	0.259	0.242	0.227	0.213	
8.7	0.241	0.240	0.240	0.241	0.241	0.226	0.212	0.198	0.186	0.175	
8.8	0.196	0.196	0.196	0.197	0.198	0.185	0.174	0.164	0.154	0.145	
8.9	0.160	0.161	0.161	0.162	0.163	0.153	0.144	0.136	0.128	0.121	
9.0	0.132	0.132	0.133	0.134	0.135	0.128	0.121	0.114	0.108	0.102	

- the average of the measured values must be less than the average of the corresponding individual values in Table 3.
- each measured value is compared to the corresponding individual values in Table 3. No more than one in five of the measured values can be greater than one-and-a-half times the corresponding criteria values in Table 3.

TABLE 4

RECOMMENDED WATER QUALITY MONITORING FOR THE NECHAKO RIVER SUB-BASIN

SITES	FREQUENCY AND TIMING	CHARACTERISTICS TO BE MEASURED
Nechako River 100 m upstream from Stuart River	Once/week: mid July to mid August	Temperature
Nechako River 100 m downstream from Cheslatta Falls	Once/year: mid July to mid August <u>or</u> when temperature 100 m above Stuart River > 20°C	Temperature
Nechako River above (Site 0400629) and below (Site 0400631) Fort Fraser Nechako River above (Site 0400449) and below (Site 0400450) Vanderhoof	Once/year: mid July to mid August Once/year: February or March	pH, temperature, ammonia-N, nitrite-N, nitrate-N, dissolved ortho phosphorus, dissolved oxygen, fecal coliforms, chlorine residual. Locations of aquatic plant growth and approximate density noted, and chlorophyll-a periphyton samples collected in summer.
Nechako River at Prince George (Site 0920066) (Federal-Provincial Trend Monitoring Station)	Once/2 weeks: Year round or minimum of once/month	pH, temperature, specific conductivity, alkalinity, hardness, calcium, magnesium, nitrate, nitrite, total arsenic and selenium, total and dissolved copper, cadmium, iron, lead, manganese, zinc, aluminum, total and total dissolved phosphorus, total dissolved nitrogen, fecal coliforms, TAC colour, solids (dissolved and suspended), turbidity, total mercury, ammonia, phenol. (Special Federal analyses: phenolphthalein alkalinity, potassium, sodium, chloride, fluoride, silica, sulphate).
Necoslie River downstream from Fort St. James outfall (Site 0400801) Stuart River at Highway Bridge (Sites 0400487 and 0400488)	Six times/year: one year Once/year: thereafter	pH, dissolved oxygen, nitrite-N, ammonia-N, temperature, fecal coliforms, chlorine residual, chlorophyll-a periphyton (Stuart River, summer only).
Chilako River (Sites to be determined in future study design)	One year: Frequency to be determined in future study design	To determine impact of land use on water quality in the Nechako River basin. Characteristics to be determined in future study design
Stuart Lake(a) at minimum of one site, but preferably four sites, with minimum of three depths per site (surface, mid-depth, bottom)	4 times/year: first two years	pH, ammonia-N, nitrate/nitrite-N, Kjeldahl-N, total P, ortho P, total dissolved P, chlorophyll-a, phytoplankton, zooplankton, total aluminum, copper, cadmium, chromium, mercury, iron, manganese, lead, zinc, temperature and dissolved oxygen profiles, secchi disc
	Twice/year: Following two years Spring Overturn: Thereafter	pH, ammonia-N, nitrate/nitrite-N, Kjeldahl-N, total P, ortho P, total dissolved P, temperature and dissolved oxygen profiles, secchi disc

TABLE 4 (Continued)

SITES	FREQUENCY AND TIMING	CHARACTERISTICS TO BE MEASURED
Pinchi Lake and Stuart Lake (b)	Once/year (August): Every ten years	Water chemistry and up to five species of fish/lake: six to ten individuals (muscle) per species: weight, length, arsenic, cadmium, copper, iron, lead, mercury, manganese, molybdenum, zinc. Random sampling of livers for metallothionein
Pinchi Creek and Tachie River near mouth	Same as Stuart Lake (a) ?	Same as Stuart Lake (a) ?

Note: Sampling frequency may need to be modified to check objectives, depending on circumstances.