Water Quality Branch

Ambient Water Quality Objectives For Bessette Creek

Overview Report

Water Management Division
Ministry Of Environment

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SUMMARY
This report assesses the water quality of five creeks in the Bessette Creek watershed, Bessette Creek being a tributary to the Shuswap River. Provisional water quality objectives are set to protect aquatic life and wildlife, livestock, irrigation and drinking water in the five creeks.

The most severe water contamination comes from wood processing operations, which include sawmills and a pole treatment facility. As a result, chlorophenol contamination is apparent in one creek at levels

where some remediation work will be required, while the effects of leachate from woodwaste such as increased dissolved solids are apparent in two other creeks. Agricultural operations can cause increases in nutrients and bacteria.

Provisional water quality objectives have been set for bacteriological indicators, dissolved and suspended solids, turbidity, substrate sedimentation, nutrients, pH, colour, temperature, dissolved oxygen, resin acids and chlorophenols. Attainment of these objectives will protect aquatic life and will allow other designated uses of these waters

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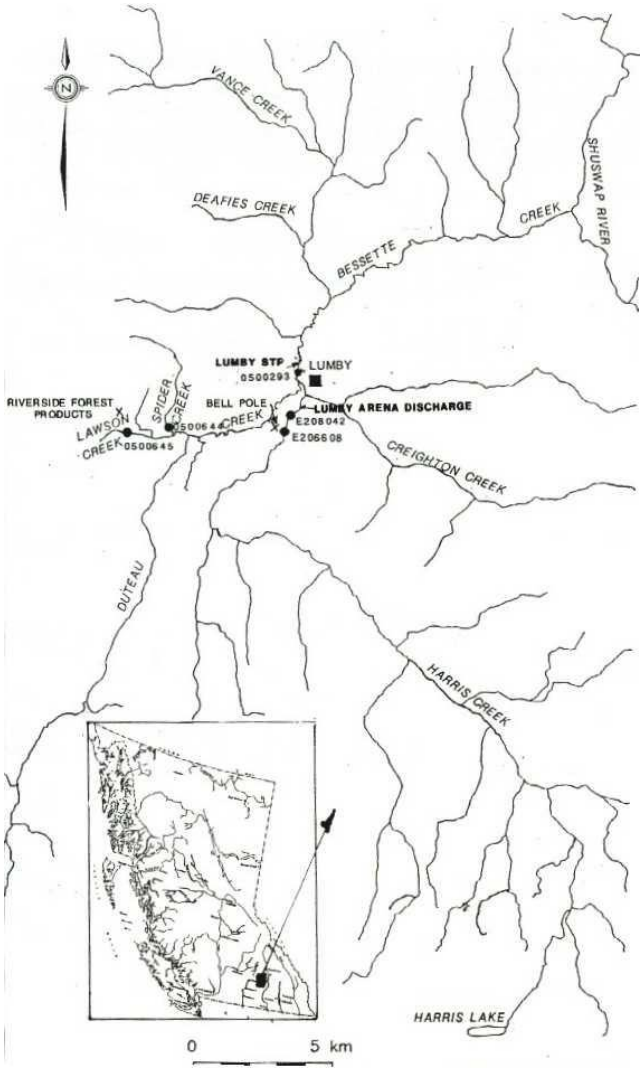
Figure 1. Bessette Creek Watershed



PREFACE
Purpose of Water Quality Objectives

Water quality objectives are prepared for specific bodies of fresh, estuarine and coastal marine surface waters of British Columbia as part of the Ministry of Environment, Lands and Parks' mandate to manage water quality. Objectives are prepared only for those waterbodies and water quality characteristics that may be affected by human activity now or in the near future.

How Objectives Are Determined

Water quality objectives are based the BC approved and working criteria as well as national water quality guidelines. Water quality criteria and guidelines are safe limits of the physical, chemical, or biological characteristics of water, biota (plant and animal life) or sediment which protect water use. Objectives are established in British Columbia for waterbodies on a site-specific basis. They are derived from the criteria by considering local water quality, water uses, water movement, waste discharges, and socio-economic factors.

Water quality objectives are set to protect the most sensitive designated water use at a specific location. A designated water use is one that is protected in a given location and is one of the following:

- raw drinking water, public water supply, and food processing
- aquatic life and wildlife
- agriculture (livestock watering and irrigation)
- recreation and aesthetics
- industrial water supplies.

Each objective for a location may be based on the protection of a different water use, depending on the uses that are most sensitive to the physical, chemical or biological characteristics affecting that waterbody.

How Objectives Are Used

Water quality objectives routinely provide policy direction for resource managers for the protection of water uses in specific waterbodies. Objectives guide the evaluation of water quality, the issuing of permits, licences and orders, and the management of fisheries and the province's land base. They also provide a reference against which the state of water quality in a particular waterbody can be checked, and help to determine whether basin-wide water quality studies should be initiated.

Water quality objectives are also a standard for assessing the Ministry's performance in protecting water uses. While water quality objectives have no legal standing and are not directly enforced, these objectives become legally enforceable when included as a requirement of a permit, licence, order, or regulation, such as the Forest Practices Code Act, Water Act regulations or Waste Management Act regulations.

Objectives and Monitoring

Water quality objectives are established to protect all uses which may take place in a waterbody. Monitoring (sometimes called sampling) is undertaken to determine if all the designated water uses are being protected. The monitoring usually takes place at a critical time when a water quality specialist has determined that the water quality objectives may not be met. It is assumed that if all designated water uses are protected at the critical time, then they also will be protected at other times when the threat is less.

The monitoring usually takes place during a five week period, which allows the specialists to measure the worst, as well as the average condition in the water.

For some waterbodies, the monitoring period and frequency may vary, depending upon the nature of the problem, severity of threats to designated water uses, and the way the objectives are expressed (*i.e.*, mean value, maximum value).

INTRODUCTION

Bessette Creek, which flows into the Shuswap River, is considered in this assessment to be formed by the joining of Harris and Duteau creeks near the town of Lumby (See Figure 1.) There is confusion between the local name and the gazetted names for these creeks, hence the local names are used. This report develops water quality objectives in this watershed for use by Resource Managers.

HYDROLOGY

Bessette Creek and most of its tributaries have regulated flow regimes. However, natural flows would likely have seen freshet occur during spring snowmelt, with flows typically diminishing during the hot summer months.

Seven-day low flows have ranged from 0.01 m^3/s to 0.77 m^3/s in Harris Creek, from 0.0 m^3/s to 2.02 m^3/s in Duteau Creek and from 0.28 m^3/s to 1.07 m^3/s in Bessette Creek near its mouth. Creighton reek is a tributary to Harris Creek from the east just south from Lumby and Vance Creek is a tributary to Bessette Creek from the west just north from Lumby. Seven-day low flows were not available for Creighton Creek, although mean monthly flows were from 0.10 m^3/s to 1.09 m^3/s. In Vance Creek, seven-day low flows were from 0.02 m^3/s to 0.11 m^3/s.

WATER USES

The Bessette Creek watershed provides the necessary habitat for four fish species of economic importance: rainbow trout, kokanee, chinook salmon and coho salmon. Kokanee from Mabel lake

migrate up the Shuswap River to Bessette Creek in October and spawn in a six kilometer reach just upstream from its confluence with the Shuswap River.

Rainbow trout spawn in Bessette Creek in April and May and this spawn provides most of the rainbow trout stock for Mabel Lake. Many of the young trout remain in Bessette Creek for several years or for life. Important runs of chinook and coho salmon utilize Bessette Creek. These fish spawn from August to November and many of the young spend at least one year in Bessette Creek. Consumptive water uses in Bessette Creek are 6.8 m^3/d for domestic consumption and 1162 dam^3 per year for irrigation.

Coho salmon utilize Duteau Creek for a distance of about ten kilometers upstream from its confluence with Bessette Creek. Consumptive water uses are for 6.8 m^3/d for domestic consumption, 22,480 dam^3 per year for irrigation and 10.4 dam^3/d for waterworks.

Lawson Creek is a tributary to Duteau Creek just upstream from Bessette Creek and has minimal water consumption of 9.1 m^3/d for domestic consumption and 4.5 m^3/d for industrial use by Riverside Forest Products. A tributary to Lawson Creek, Spider Creek, has water licences permitting the withdrawal of 18.2 m^3/d for domestic use, 1.3 dam^3 per year for irrigation and 2.28 m^3/d for industrial use by Riverside Forest Products.

Coho salmon use the reach of Harris Creek from its confluence with Duteau Creek upstream for a distance of four kilometers. Consumptive water uses are 10.3 m^3/d for domestic use and 1031 dam^3 per year for irrigation. The Village of Lumby maintains a series of infiltration wells adjacent to Harris Creek. In Creighton Creek, a tributary to Harris Creek, coho salmon spawn in the four kilometer reach upstream from Harris Creek. Licenced water withdrawals are 55 m^3/d for domestic consumption and 169 dam^3 per year for irrigation.

Consumptive water uses in Vance Creek are 29.5 m^3/d for domestic use and 562.5 dam^3 per year for irrigation

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WASTE DISCHARGES

All of the waterbodies have agriculture near them such as crops which would be fertilized and cattle. These sources can affect the creeks by introducing nutrients and bacteriological contaminants. Other diffuse type waste discharges would be related to anthropogenic activities such as logging. Stormwater enters the creeks in Lumby.

The only permitted discharge to Bessette Creek is from the Lumby sewage treatment plant (STP). Sewage is treated in an aerated lagoon system; however, there have been no positive discharges to the creek since wastewater exfiltrates to the creek. This exfiltrate is increasing concentrations of nitrogen and phosphorus but water uses are not impacted.

There are three wastewater discharges into Harris Creek. A woodwaste refuse site does not appear to impact water quality in the creek. A stormwater discharge from a sawmill introduces pentachlorophenol and tetrachlorophenol to the creek. The impact of this discharge on Harris Creek is masked by the contaminated ground water from the Bell Pole operation which appears to be impacting Harris Creek.

This operation treats telephone poles. Significant increases have been observed in penta-, tetra- and trichlorophenol concentrations in the water, sediments and biota near this operation. It is suspected that there may be dioxins, furans and other phenolics associated with the chlorophenols in Harris Creek and that creosote from this operation may also be reaching and possibly affecting Duteau Creek.

The only discharge to Duteau Creek, other than the possible impact from the Bell Pole property, is the cooling water discharge from the Lumby Arena. Data have not been collected to determine if this discharge is impacting the creek.

Riverside Forest Products operates a sawmill/veneer plant with an associated woodwaste landfill bordered by Lawson and Spider creeks. Slight increases in some variables have been noted but the number of measurements were too few to be conclusive as to the degree of the impact.

Silver Star Sports has an extended aeration sewage treatment plant which serves the Silver Star Ski Resort near the headwaters of Vance Creek. The treated sewage is exfiltrating from the storage lagoon but data have not been collected to determine if an impact is occurring on the creek.

WATER QUALITY

Lawson and Spider creeks have basic pH with a high buffering capacity to acidic inputs. The water is of moderate hardness which will reduce the toxicity to aquatic life of metals which may be present. Metal concentrations have not been measured in Spider Creek; however, in Lawson Creek some high total aluminum, iron and manganese values exceeded water quality criteria. All nitrate, nitrite and ammonia concentrations were low and of little concern. Phosphorus concentrations have been high enough to cause nuisance algal growths in areas of optimal water velocities for growth. Dissolved solids concentrations were sometimes higher than than water quality criteria to protect drinking water supplies. Turbidity levels were low. Fecal coliform values were higher than some water quality crieria for irrigation and would require that domestic water supplies be provided complete treatment plus disinfection. Resin acids in Lawson Creek were low.

Minimal sampling (twice) of Duteau Creek has occurred in the past. Ammonia, fecal coliforms and dissolved solids were low and below water quality criteria.

Bessette Creek has a basic pH and an associated alkalinity which would provide moderate buffering to acidic inputs. The water was relatively hard which would help to ameliorate the toxic effects of metals to aquatic life. Some values for total chromium, copper, iron and zinc were higher than some water quality criteria. All nitrate, nitrite and ammonia concentrations were low and of little concern. Phosphorus concentrations have been high enough to cause nuisance algal growths in areas of optimal water velocities for growth. Dissolved oxygen concentrations were usually high and above water quality criteria. Fecal coliform values were higher than some water quality crieria for irrigation and would require that domestic water supplies be provided complete treatment plus disinfection.

PROVISIONAL WATER QUALITY OBJECTIVES

Provisional water quality objectives proposed for the Bessette Creek watershed are in Table 1. The objectives are based on working water quality criteria for water quality and on available data on ambient water quality, waste discharges, water uses and stream flows. The objective will remain provisional until receiving water monitoring programs provide adequate data and the Ministry has established approved water quality criteria for all the characteristics of concern.

Water quality objectives have 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 fisheries and 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 water quality characteristics which may be affected by man's activities now or in the foreseeable future.

Designated water uses for all the water bodies are the protection of aquatic life, drinking water with complete treatment plus disinfection, livestock watering and irrigation water supplies. Unless stated otherwise the proposed objectives apply to all the water bodies except Duteau Creek.

Provisional objectives for bacteriological quality are based on Ministry criteria. These apply to Spider, Lawson and Bessette creeks and are to protect drinking water supplies.

Objectives have been proposed for suspended solids based on Ministry criteria to prevent possible physical damage to aquatic life. Objectives for turbidity, also based on Ministry criteria, are meant to protect drinking water use and address the effect of light attenuation on aquatic life. Suspended solids can be increased by urban stormwater discharges and by other activities such as logging. In order to protect spawning areas from the deposition of solids, objectives are proposed for substrate sedimentation which correspond to Ministry criteria. Objectives are proposed for dissolved solids in Spider and Lawson creeks since these can enter the creeks from landfill leachate.

Agricultural runoff and sewage discharges can affect ammonia and nitrite levels, therefore objectives based on Ministry criteria are proposed for those characteristics to protect aquatic life. Similarly, objectives are proposed for nitrate to protect drinking water supplies. Periphyton chlorophyll-*a* objectives are also proposed for flowing waters based on Ministry criteria which were developed on the basis of a mixed algal community.

An objective has been proposed for colour in Spider and Lawson creeks to protect drinking water supplies. This is based on the Canadian drinking water standards.

A cooling water discharge from the Lumby Arena into Duteau Creek has resulted in the proposal for an objective for temperature to protect aquatic life. The objective is based on a maximum increase which should be measured at a distance from the east shore of one-quarter the width and at a depth of one metre or, should the water level be less than one metre, at one-half the total depth of the creek.

An objective is proposed for pH as a range of values. The upper value will control the formation of toxic quantities of ammonia. Different dissolved oxygen levels, based upon the Ministry's modification of the CCREM (now known as the CCME) criteria, are proposed for the water bodies.

Objectives proposed for resin acids reflect the concern for the large number of wood handling facilities in this area. The objectives are based on criteria developed for the Province of Ontario.

Objectives are proposed for chlorophenols in the water column, bottom sediments and fish muscle tissue in Harris Creek since chlorophenols enter through a road ditch adjacent to the Bell Pole property, as well as from contaminated ground water from the Bell Pole property. The proposed chlorophenol objectives for fish are consistent with those that exist in the Fraser River, where an extensive data base exists, while those for sediments are one-half those in the Fraser River since the background sediment concentrations in Harris Creek are lower than those for the Fraser River. The objectives proposed for the water column are based on a draft Ministry criteria document for chlorophenols.

MONITORING RECOMMENDATIONS

We recommend that monitoring be carried out for at least three years to check how well the objectives are being achieved. The extent of monitoring after that will depend on results, as well as on regional priorities and available funding.

TABLES

Table 1 Provisional Water Quality Objectives for Bessette Creek

Water Bodies	**Bessette Creek**	**Harris Creek**	**Spider Creek Lawson Creek**	**Duteau Creek**
Designated Water Uses	**aquatic life, wildlife, livestock, irrigation, drinking water (with complete treatment plus disinfection)**			
fecal coliforms	**less than or equal to 100/cL 90th percentile 200/cL maximum**	**not applicable**	**less than or equal to 100/cL 90th percentile 200/cL maximum**	**not applicable**
Escherichia coli	**less than or equal to 100/cL 90th percentile**	**not applicable**	**less than or equal to 100/cL 90th percentile**	**not applicable**

	200/cL maximum		200/cL maximum	
enterococci	less than or equal to 25/cL 90th percentile 50/cL maximum	not applicable	less than or equal to 25/cL 90th percentile 50/cL maximum	not applicable
dissolved solids	not applicable		500 mg/L maximum or a 20% increase whichever is greater	not applicable
suspended solids	10 mg/L maximum increase when upstream is greater than or equal to 100 mg/L 10% maximum increase when upstream is greater than 100 mg/L			not applicable
substrate sedimentation	no significant increase by weight in particulate matter less than 3 mm in diameter			not applicable
turbidity	5 NTU maximum increase when upstream is less than or equal to 50 NTU 10% maximum increase when upstream is greater than 50 NTU			not applicable
total ammonia-N	ammonia guidelines			not applicable
nitrite-N	nitrite guidelines			not applicable
nitrate-N	10 mg/L maximum			not applicable
periphyton chlorophyll-*a*	100 mg/m^2 maximum			not applicable
temperature	not applicable			maximum 1 degree Celcius increase
dissolved oxygen	8.0 mg/L minimum except 11.0 mg/L minimum when			not applicable

	salmonid embryos and larvae are present from November to April		
colour	**not applicable**	**15 true colour units maximum or 20% increase whichever is greater**	**not applicable**
pH	**6.5 to 8.5 or a maximum 0.2 unit increase when pH is less than 8.5**	**6.5 to 8.5**	**not applicable**
resin acids	**not applicable**	**See Table 5**	**not applicable**
monochlorophenol	**not applicable**	**0.5 micrograms/L maximum**	**not applicable**
dichlorophenol	**not applicable**	**0.1 micrograms/L maximum**	**not applicable**
trichlorophenol	**not applicable**	**0.05 micrograms/L maximum**	**not applicable**
tetrachlorophenol	**not applicable**	**0.1 micrograms/L maximum**	**not applicable**
pentachlorophenol	**not applicable**	**0.05 micrograms/L maximum**	**not applicable**

Note: The objectives apply to discrete samples from all parts of the water body except from initial dilution zones of effluents. These excluded dilution zones are defined as extending up to 100 m downstream from the discharge point and no more than 50 percent across the width of the stream, from the surface to the bottom. In Lawson and Spider creeks, the initial dilution zone is defined as existing along the length of the woodwaste landfill site and extending up to 25% of the width of the creeks from the bed to the surface.

1. The fecal coliform, Escerichia coli, Enterococci and nitrite-nitrogen averages and 90th percentiles are calculated from at least 5 samples taken weekly in a period of 30 days. For values recorded as less than the detection limit the detection limit itself should be used in calculating the statistic. The 90th percentile can be interpolated by graphical methods when fewer than 10 samples are collected.

2. The increase (in NTU, mg/L, pH units, degrees Celcius, true colour or %) for temperature, colour, pH, turbidity and suspended solids, is over levels measured at a site u/s from a discharge or series of discharges and as close to them as possible, and applies to d/s levels. For substrate sedimentation the increase is measured on the basis of the averages of at least 3 samples collected upstream and downstream and the significant increase will be defined as no difference greater than 10%.

4. The periphyton chlorophyll-a maximum is based on an average calculated from at least five randomly located samples from natural substrates at each site on any one sampling date.

5. The term chlorophenols means the sum of tri-, tetra- and pentachlorophenol which may be present in sediment or fish.

6. The maximum chlorophenol value should not be exceeded in bottom surface sediments taken in any part of the sub-basin, except in the initial dilution zones of effluents. The average of atleast three replicate sediment samples taken from the same site should be used to check the objective.

7. The total chlorophenols objective applies only to fish muscle tissue, not the whole fish or organs, of a fish of any species caught in any part of the sub-basin, including the initial dilution zones of effluents.

Table 5 Maximum Concentrations for Resin Acids

pH	Maximum Concentration in micrograms/L	
	dehydroabietic acid	total resin acids
5.0	1	1
5.5	2	3

6.0	**2**	**4**
6.5	**4**	**9**
7.0	**8**	**25**
7.5	**12**	**45**
8.0	**13**	**52**
8.5	**14**	**60**
9.0	**14**	**62**

Note: Total Resin Acids are defined as the sum of the individual concentrations for abietic, dehydroabietic, isomaric, levopimaric, neoabietic, pimaric and sandaracopimaric acids.

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