Water Quality

Ambient Water Quality Objectives For San Jose River Basin (Williams Lake Area)

Overview Report

Water Management Branch
Environment And Resource Division
Ministry Of Environment, Lands And Parks

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SUMMARY
This document is one in a series that presents ambient water quality objectives for British Columbia. It has two parts: an overview - which is also available as a separate document - and the report. The overview provides general information about water quality in the San Jose River basin, and a water quality objectives and monitoring table for this readers requiring data. It is intended for both technical readers and for readers who may not be familiar with the process of setting water quality objectives. The

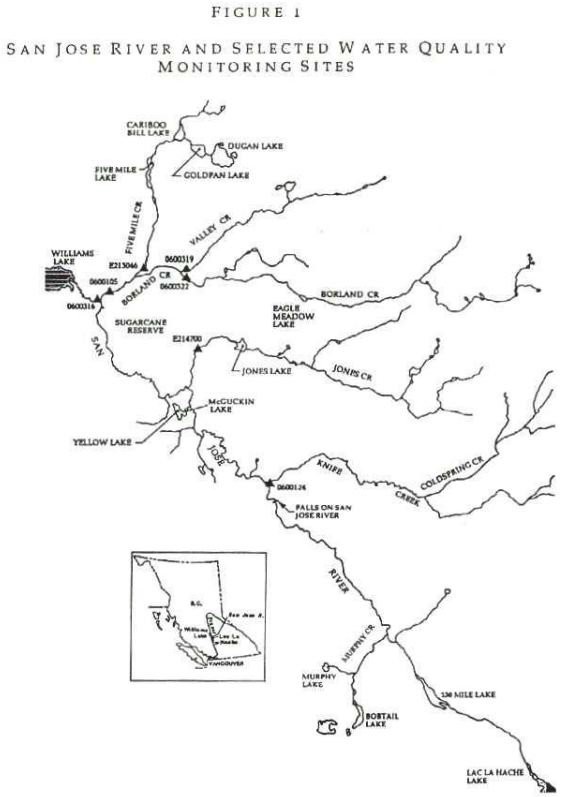
report presents the details of the water quality assessment in the San Jose River basin, and forms the basis of the recommendations and objectives presented in the overview.

In 1987 the Ministry of Environment, Lands and Parks assessed water quality and set water quality objectives in Williams Lake. The report suggested that the San Jose River basin was the major source of phosphorus loading to Williams Lake. As a result, the Northern Sub-Regional Office requested that the Water Quality Branch in Victoria carry out a detailed water quality assessment in the basin to set water quality objectives in the San Jose River and its tributaries.

This report summarizes the results of the water quality assessment of the San Jose River and its tributaries. Objectives for phosphorus in the San Jose River basin are proposed to protect water quality in Williams Lake from land use activities in the basin. All available data and current water quality criteria were used to derive water quality objectives.

FIGURE

Figure 1. Map of the San Jose River Basin in the Williams Lake area.



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 socioeconomic 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

This report, undertaken at the request of the Northern Sub-Regional office, assesses water quality in the San Jose River basin. Water quality objectives for phosphorus in the San Jose River and its tributaries are set to protect water quality in Williams Lake. Water quality objectives to protect designated water uses in the river and the tributaries were not considered in this document. An analysis of the available data did not suggest a need for this action.

The San Jose River originates at the outlet of Lac La Hache and flows northward about 52 km before entering Williams Lake. Borland Creek, Jones Creek, Knife Creek and Five Mile and Valley creeks (which are tributaries of Borland Creek) are the major tributaries of the river.

The river and its tributaries are licensed for domestic water supply, stream improvement, water storage and irrigation water supply. The dammed reservoirs on the San Jose River, Borland Creek, Jones Creek and Knife Creek offer opportunities for storing and controlling water flow.

Rainbow trout - the main sport species resident in Williams Lake, spawns in the San Jose River basin. Commercial species include coho and pink salmon in the Lower Williams Lake river. Knife Creek supports a small winter and summer fishery. The fisheries resource is believed to have declined in the basin because of low summer and winter flows, riparian habitat loss, urbanization, beaver dam obstructions and reduced water quality in the lake. Nevertheless, the San Jose River and its tributaries have the potential to support a good rainbow trout fishery, aided by an enhancement program.

Agriculture is the principle activity in the San Jose River basin. Traditional ranching practices involve forage production and watering and feeding cattle adjacent to the streams, particularly in winter. As yet, no appropriate survey or study has been conducted to link agriculture with fish habitat loss in the San Jose River basin.

Commercial logging activities in the San Jose River basin are concentrated at the middle to upper elevations. A study commissioned by the Ministry of Forests, Williams Lake, concluded that the effects of forestry on water quality (*e.g.* phosphorus loading) in the basin are minor, if any.

HYDROLOGY

The San Jose River is approximately 52 km long from its origin at the outlet of Lac La Hache to the point where it enters Williams Lake (Figure 1). In terms of drainage area, the three most significant tributaries to the San Jose River are Borland Creek (228 km^2), Knife Creek (234 km^2) and Jones Creek (82.6 km^2); together they comprise about 51% of the total drainage area of the San Jose River basin. Five Mile Creek (52.1 km^2) and Valley Creek (65 km^2) aremajor tributaries of Borland Creek.

Streamflow records in the San Jose River basin are sparse. They span fourty years, but very few of the fifteen Water Survey of Canada stations have data that are complete and comparable. The San Jose River and most of its tributaries have storage areas, small lakes and swampy areas within the basin that affect their flow.

Streamflow in the San Jose River basin is highly variable depending on the amount and timing of snowfall and rainfall, and on the melt pattern of the snow. Tributaries such as Borland Creek show two peaks: one in March and April caused by snowmelt, and a smaller peak in the fall. Rainfall in June or July can sometimes cause later or secondary flow peaks. The tributaries are typically dry during the summer and winter months.

Knife Creek is different from the other tributaries. It maintains a small flow throughout the year because of a spring-fed creek, which is a tributary to Knife Creek located upstream from Coldspring Creek.

Streamflow in the mainstem San Jose River is moderated by Lac la Hache. In high runoff years, the lake stabilizes the river's flow by providing storage capacity for the excess runoff. However, in dry years the lake has minimal outflow, causing the river to have very low flows.

WATER USE

Licenses

The San Jose River and its tributaries are licensed for domestic water supply but are primarily used for livestock watering, stream improvement, water storage and irrigation water supply. There are 15 domestic water licenses in the basin, but the majority of water licenses are for irrigation and water storage. The watershed of Borland Creek and Valley Creek are fully recorded.

Recreation

Water-based recreation in the San Jose Basin has not been developed. Much of the land along the stream banks is private, and access to the streams is restricted. Also, the narrowness and shallowness of the streams discourage recreational activities. On the mainstem of San Jose River, some canoeing, bird watching, hunting or walking maytake place.

Fisheries

The San Jose River and its tributaries provide a habitat for rainbow trout, which is the main sport species in the basin. However, the rearing and spawning locations for the fish are not well known, but juveniles may be reared in Borland and Jones creeks. Other fish species in the basin include large-scale suckers, peamouth chub, northern squafish, redside shiners, burbot, and lake white fish. Knife creek supports a small winter and summer sport fishery.

In general, the fisheries resource is believed to have declined in the basin because of low summer and winter flows, riparian habitat loss, urbanization, beaver dam obstructions and reduced water quality. Destruction of fish habitat by agricultural activities and low stream flows caused by irrigation withdrawals and drought conditions during the 1980s are thought to be the principal causes of the decline. However, no appropriate survey or study has been conducted in the basin to link agriculture with the loss of fish habitat.

The Regional Fisheries Branch in Williams Lake has determined that the San Jose River and its tributaries have the potential to support a good rainbow trout fishery, aided by enhancement programs. Rainbow trout eggs were released into Borland, Jones and Knife creeks in June and July 1990 to improve fish stock in Williams Lake by 1992. Kokanee were also stocked in the San Jose River several years ago for the same reason. The results are as yet unknown. Rehabilitation projects may include fencing and revegetating areas along the San Jose River to prevent cattle access, reduce summer stream temperatures, enhance fish habitat, stabilize stream-bank erosion, and water augmentation.

Water Discharges

Several human activities influence water quality in the San Jose River basin to varying degrees. They include residential development in and around Williams Lake, logging in the headwaters of the tributaries, road development and agriculture. However, a primary concern is the impact of traditional agricultural activities on ambient water quality in the San Jose River and its tributaries.

Agriculture

Ranching is the primary agricultural activity in the San Jose River basin. It includes the ranging of cattle on upland pastures during the summer, the irrigation of lowland fields for the production of hay and the over-wintering of cattle on lowland fields.

Traditional ranching practices involve watering and feeding cattle next to the streams, primarily in winter. These activities also take place in summer to some degree, especially at higher elevations. The unrestricted access of cattle to a stream of a river channel can affect ambient water quality in several ways:

- *Overgrazing and the removal of riparian vegetation.* Vegetation along the banks prevents elevated summer water temperatures by shading the stream. It also improves a fish habitat, stabilizes the stream banks against excessive erosion and makes the stream less vulnerable to erosion and siltation.

- *Trampling of the stream or river banks by cattle*. The impact is the further destabilization of the stream banks causing erosion and siltation.

- *Accumulation of manure on frozen ground during winter.* The manure will be carried with the surface runoff directly into nearby streams during freshet when the ground is still frozen and soil infiltration is minimal. The results are high concentrations of bacteria and nutrients in the stream.

In earlier assessments by the Ministry of Environment, Lands and Parks, San Jose River had been identified as the principal source of nutrients such as phosphorus to Williams Lake. Excessive amounts of phosphorus going into Williams Lake from agricultural activities in the San Jose River basin has resulted in unacceptable water quality for domestic water uses, primary-contact recreation, and freshwater fisheries of the lake. To reduce phosphorus loading and to improve water quality in Williams Lake, two recommendations were made. First, the agricultural practices causing the effect, including the location and extent of over-wintering areas for cattle, should be identified. Second, water quality objectives should be set to protect water uses in the San Jose River basin and Williams Lake.

Recently, the Ministry of Environment, Lands and Parks, in cooperation with the Cariboo Cattlemen's Association and the Agricultural Environmental Protection Council (BC Federation of Agriculture) has initiated an active program of inspecting and enforcing the Agricultural Waste Control Regulations in the San Jose River basin. In late 1992, all ranches with high impact sites have put in place Best Waste Management Plans developed with the help of the Ministry of Agriculture, Food and Fisheries. As a result, all sites that have had high and moderate impact have been upgraded to low or low-to-moderate class.

Sewage Disposal

The effects of the residential septic systems along the shore of Williams Lake are the subject of a separate report.

Forestry

Most commercial logging in the San Jose River was conducted in the 1970s and 1980s. Douglas fir, which occupies the mid-elevations of the basin, is currently harvested by faller selection. Lodgepole pine, the other main species of timber occupying upper elevations, is harvested by clearcutting.

A study commissioned by the Ministry of Forests, Williams Lake, concluded that the effects of timber harvesting and related activities on water quality in the San Jose River basin is minor, if any.

WATER QUALITY ASSESSMENT

During the assessment of the data, several observations were made regarding water quality in the San Jose River basin.

- Agricultural activity was a major reason for high phosphorus concentrations in the San Jose River. Much of the phosphorus going into streams from agricultural areas in the basin occurred during snowmelt.

- Among the tributaries, Borland Creek was the major source of phosphorus loading in the San Jose River. In 1991, Borland Creek contributed over 30% to the dissolved phosphorus going into the San Jose River at Williams Lake. Between April 12 and December 31, 1991, the dissolved and total phosphorus loading in Borland Creek at its mouth was estimated to be 920 kg and 2000 kg, respectively.

- Within the Borland Creek watershed, Five Mile Creek was the major source of phosphorus loading. It was estimated that Five Mile Creek contributed 745 kg of dissolved phosphorus to Borland Creek between January 24 and December 19, 1991. The total dissolved phosphorus going into Borland creek downstream from Five Mile Creek was 920 kg between April 12 and December 31, 1991. Valley Creek, the other source of phosphorus entering Borland Creek, also contributed significantly, but to a lesser degree than Five Mile Creek.

- Knife Creek and Jones Creek also contributed significantly to phosphorus loading in the San Jose River. Knife Creek contributed 623 kg of dissolved phosphorus between April 9, 1991 and March 28, 1992. Jones Creek contributed 160 kg of dissolved phosphorus between April 9, 1991 and March 28, 1992.

- The 1990-91 average phosphorus concentrations in the San Jose River downstream from Borland Creek were 0.054 mg/L dissolved phosphorus and 0.041 mg/L suspended phosphorus. These data suggested that dissolved phosphorus contributed about 57% of the total phosphorus going into the San Jose River. Upstream from Borland Creek, however, the amount of dissolved phosphorus in the San Jose River was 43% of the total phosphorus.

WATER QUALITY OBJECTIVES

Water quality objectives have been set for the dissolved phosphorus in the San Jose River basin to protect water quality in Williams Lake (Table 1). Table 1 also shows mean annual concentrations for the average flow year. These mean annual concentrations may be used to check the attainment of the objectives in the absence of or delay in the availability of flow measurements. It was assumed that the dissolved fraction was the most important component of the phosphorus loading to Williams Lake. The proposed water quality objectives were exceeded in the San Jose River downstream from Borland Creek.

WATER QUALITY MONITORING

In general, water quality monitoring in the San Jose River basin has been inadequate. Given that waster flow and phosphorus concentrations in the San Jose River and its tributaries are highly variable, and water quality objectives in the basin are based on allowable annual phosphorus loading to protect water uses in Williams Lake, it is recommended that both phosphorus concentrations and water flow must be measured simultaneously to check water quality objectives. As well, water quality objectives should be checked based on samples collected during the entire year. In the late spring, summer and early fall, biweekly samples may be acceptable. The frequency of sampling may be increased to a daily or weekly interval during snowmelt or a storm event, depending on changes in water flow patterns.

Water quality objectives for the allowable maximum phosphorus loading are proposed for several sites in the San Jose River basin (Table 1). it is recommended, however, that only site 0600316 in the San Jose River downstream from Borland Creek be monitored for attainment of the objectives. The reasons for this are:

- The recommended objectives are based on protecting water quality in Williams Lake.

- Water Quality in the San Jose River and its tributaries is not a major concern for aquatic life, livestock and/or irrigation water uses.

- The recommended phosphorus loading for the San Jose River and its tributaries was apportioned arbitrarily based on the size of the drainage area and not on any other watershed characteristics such as soil type, stream sensitivity to phosphorus, instream water uses, background phosphorus concentrations and/or loading etc.. Nevertheless, the tributary-wide objectives are useful in delineating problem areas where future action may be warranted.

- Extensive monitoring will yield a better estimate of phosphorus loading to Williams Lake.

TABLE

Table 1 provides a summary of the objectives data and monitoring recommendations. For the purpose of measuring the attainment of the recommended objectives, water quality monitoring is proposed for a single site (0600316) on the mainstem of the San Jose River below Borland Creek. The corresonding water flow measurement should be obtained from the Water Survey of Canada station (08MC040) located on the San Jose River upstream from Borland Creek in conjunction with water flow measurements to be carried out at the mouth of Borland Creek.

Table 1. Dissolved Phosphorus Loading and Mean Annual Concentrations for various Water Basins in the San Jose River Watershed

Water Basin	Site	Mean Annual Discharge [m^3/sec]	Allowable Maximum dissolved phosphorus loading [kg/year]	Mean Annual Concentration [mg P/L]	Monitoring Schedule
Five Mile Creek at the mouth	E213046	0.043	120	0.090	None proposed
Valley Creek at the mouth	0600319	0.054	150	0.090	None proposed
Borland Creek above Valley Creek	0600322	0.075	.....	.....	None proposed
Borland Creek at the mouth	0600105	0.166	540	0.100	None proposed
Jones Creek at the mouth	E214700	0.068	200	0.090	None proposed
Knife Creek at the mouth	0600124	0.148	550	0.120	None proposed
San Jose River at Lac La Hache	.....	0.810	300	.....	None proposed

San Jose River below Borland Creek	**0600316**	**1.583**	**2500**	**0.050**	**See #4 in the table below for details**

1. The Mean Annual Discharge data is courtesy of Chapman of the Hydrology Branch
2. The Mean Annual Concentration (equals the allowable maximum dissolved phosphorus loading divided by the mean annual discharge times 31536) is for the average flow year
3. See the subsection on Monitoring Recommendations for flow measurements
4. The San Jose River below Borland Creek monitoring schedule is: Monthly samples from June to January +3 samples in 2 trips/week in February +5 samples in 3 trips/week in March + weekly samples in April and May. This constitutes 48-50 annual samples.

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