Water Quality

Ambient Water Quality Objectives For The Tributaries To Okanagan Lake Near Westbank

Overview Report

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

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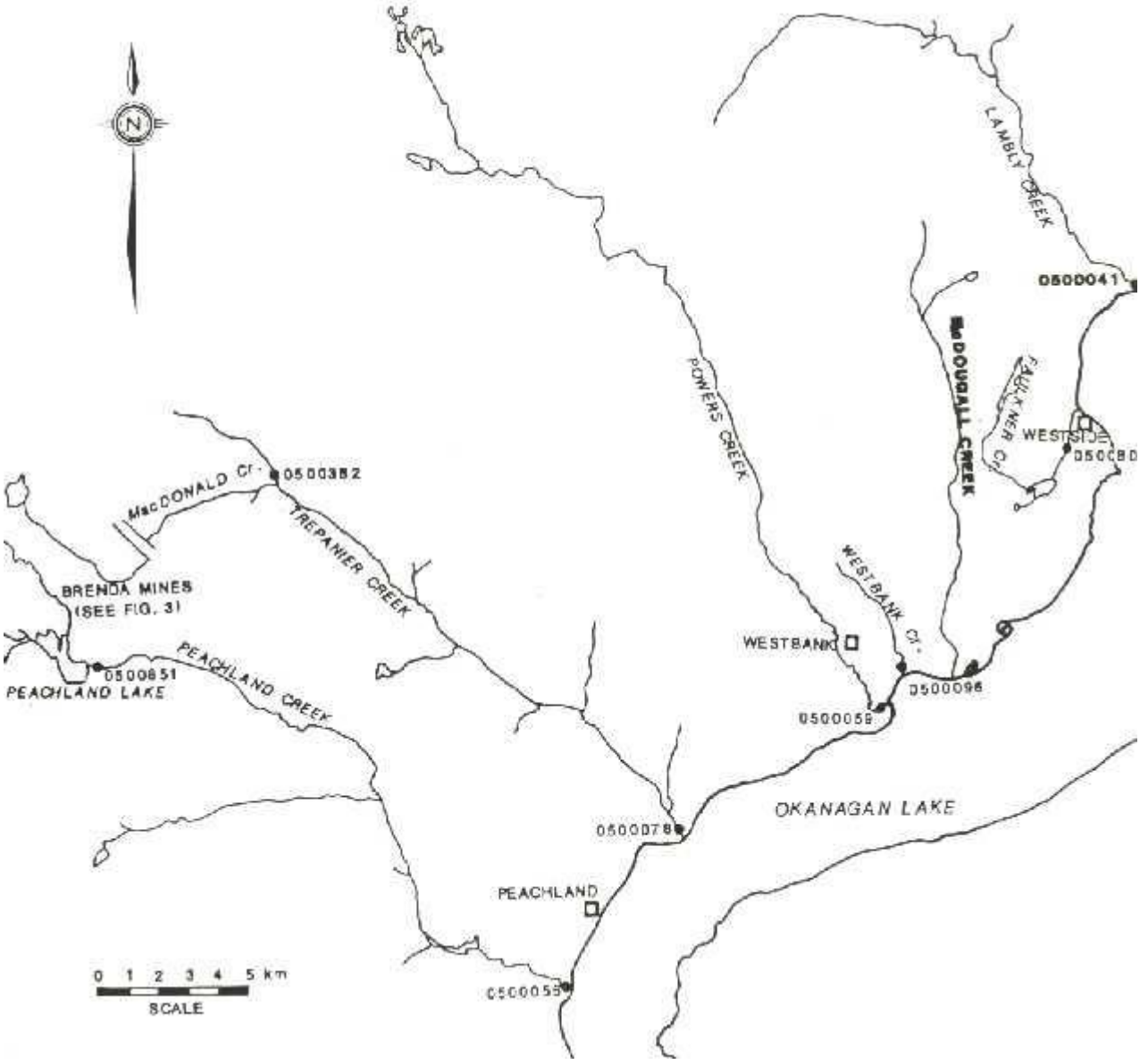
SUMMARY
This report assesses the water quality of seven tributaries to Okanagan Lake on the west shore, near Westbank. Provisional water quality objectives are set to protect aquatic life and wildlife, irrigation and livestock watering, and drinking water supplies in Peachland, Trepanier and Westbank Creeks. In the other four tributaries, objectives are not set but monitoring programs are recommended so that objectives can be considered in the future.

The most serious water contamination in the area arises from the Brenda Mines operation which can affect both the Trepanier and Peachland Creek watersheds. Mining ceased in early 1990, although the mill continues to process ore stockpiles. The company is working on post-abandonment plans to maximize environmental protection. Characteristics of most concern for the future related to this operation are molybdenum, sodium, and total dissolved solids.

Provisional water quality objectives set for Westbank Creek will likely not be achieved on a consistent basis until the discharge from the Westbank sewage treatment plant is discontinued to the creek or the treatment facilities are upgraded. Attainment of the water quality objectives will protect human health as far as recreation is concerned at nearby beaches on Okanagan Lake as well as protect aquatic life while allowing other uses of these waters.

Figure 1. Location Map for the Okanagan Lake tributaries near Westbank



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

Peachland, Trepanier, Powers, Westbank, McDougall, Faulkner and Lambly creeks are tributaries to Okanagan Lake along the west shore near Westbank (Figure 1). The purpose of this report was to prepare water quality assessments and develop water quality objectives in these watersheds for use by Water Managers, particularly for use by Fisheries Managers in developing a fisheries management plan for the Okanagan Lake tributaries.

HYDROLOGY

Six of the seven streams have similar flow patterns, influenced by snowmelt, with high flows occurring during May, and low flows usually being during the January/February period. Flow data were not available for Faulkner Creek.

Peachland Creek is regulated by Brenda Mines, with a release structure on Peachland Lake. Peachland Creek upstream from Peachland Lake did not enter the lake until the late 1960's when it was diverted to augment water supplies for Brenda Mines. Seven-day low flows near the mouth have ranged from 0.030 m^3/s to 0.181 m^3/s.

Flows in Trepanier Creek which passes near the Brenda Mines operation, have not been directly altered by the mining operation, although flows in MacDonald Creek, a Trepanier Creek tributary, have been. Seven-day low flows near the mouth have ranged from 0.0 m^3/s to 0.15 m^3/s.

Powers Creek is diverted by Westbank Irrigation District. Seven-day low flows near the mouth have ranged from 0.045 m^3/s to 0.139 m^3/s.

Peachland, Trepanier and Powers Creeks have flows of similar magnitude. Flows in Westbank Creek are an order of magnitude smaller. Seven-day low flows have ranged from 0.007 m^3/s to 0.014 m^3/s.

It is difficult to assess flows in McDougall Creek relative to the other tributaries since flows have never been gauged for an entire calendar year. Seven-day low flows in the April to September period ranged from 0.003 m^3/s to 0.215 m^3/s.

Flows in Lambly Creek are greater than in Westbank but lesser than the other three tributaries (excluding McDougall Creek). Seven-day low flows near the mouth ranged from 0.0 m^3/s to 0.047 m^3/s.

WATER USE

All the tributaries, except Westbank and Faulkner, support spawning populations of kokanee and/or rainbow trout. Of 18 Okanagan Lake tributaries ranked in terms of fisheries management importance, the following ranking (in brackets) occurred: Powers (2), Peachland (3), Trepanier (5), Lambly (8) and McDougall (16).

Irrigation in most watersheds does not occur above 4 km upstream from the lake due to the presence of shallow soil veneer, bedrock outcrops, and slopes in excess of 30%. The following are licenced irrigation withdrawals (with the flow in dam^3/year in brackets: Trepanier (1421), Peachland (2806), Powers (3216), Westbank (262), Lambly (8017) and Faulkner (28).

Licenced withdrawals for public waterworks systems occur only as follows: for 1787 dam^3/year from Trepanier Creek; for 664 dam^3/year from Peachland Creek; and for 2605 dam^3/year from Lambly Creek. Licenced domestic water supplies are for 12.5 m^3/d from Trepanier Creek, 6.8 m^3/d from Peachland Creek, 47.7 m^3/d from Powers Creek, 2.3 m^3/d from Westbank Creek, and 9.1 m^3/d from Lambly Creek.

WASTE WATER DISCHARGES

Permitted waste discharges occur in the following watersheds: Peachland, Trepanier, Powers, Westbank and McDougall Creeks. The most significant waste discharge is from the Brenda Mines operation, located on a divide between Peachland and Trepanier Creek watersheds. Brenda Mines began processing ore to extract molybdenum in 1970 and the mining of ore has been terminated in early 1990 due to the collapse of the open pit. The company continues to mill stockpiles of ore, and is currently determining post-abandonment scenarios which will minimize environmental degradation. Seepage from the mill tailings impoundment is recycled, although some does make its way to Peachland and Trepanier Creeks. Molybdenum concentrations in both creeks have increased above the BC water quality criteria which were set to protect irrigation water supplies.

Refuse sites are permitted in Peachland, Powers and Westbank Creek watersheds. These refuse sites are located at distances from 500 m to one kilometre from the water bodies, and leachates are not expected to be a problem.

The sewage treatment facility for Westbank discharges to Westbank Creek since land has not been available to permit spray irrigation. The Westbank Irrigation District is in the process of preparing a Liquid Waste Management Plan, and is designing a new facility which could be in operation as early as 1990. The existing facility has had considerable impact on water quality of Westbank Creek, affecting current water uses. A second sewage treatment facility in this watershed produces very high quality effluent which is discharged to a soil disposal system over two kilometres from Westbank Creek.

Within the McDougall Creek watershed there are three licenced discharges: one is from a mobile home park and is a municipal type discharge which is treated in a septic tank and discharged to a tile field about one kilometre from the creek; a second is from a winery and is washdown water which is discharged to seepage pits about 600 m from the creek; and the third discharge, coming from a metal plating operation, is treated prior to entering an evaporation/exfiltration pond about one kilometre from the creek.

WATER QUALITY

The pH of Peachland Creek was slightly basic, with increased buffering to acidic inputs as water proceeds downstream. The water hardness also increased, with copper and molybdenum concentrations frequently exceeding criteria to protect aquatic life and irrigation, respectively. Ammonia, nitrite and nitrate concentrations were usually below BC criteria to protect aquatic life and drinking water supplies. Dissolved oxygen concentrations were high. Dissolved solids increased in a downstream direction but were below drinking water criteria. Suspended solids and fecal coliform concentrations were generally low.

Trepanier Creek also had a basic pH, water of moderate softness, concentrations higher than criteria for copper, lead and on occasion, molybdenum and zinc. Nitrogen concentrations were below criteria levels set to protect aquatic life, and dissolved oxygen concentrations were high. Dissolved solids concentrations were below drinking water criteria. Bacteriological quality was such that at least partial treatment of the water would be required for drinking.

Powers Creek also had a basic pH, with a low sensitivity to acidic inputs. The water was moderately hard, with all metals being at concentrations less than water quality criteria to protect aquatic life. Nitrogen compounds were well below criteria to protect aquatic life; however, phosphorus concentrations were high enough to possibly cause algal growths. It is not known if algal problems occur. Dissolved oxygen concentrations were high. Both dissolved and suspended solids concentrations can be high, with the former below drinking water criteria. Bacteriological quality was such that complete treatment should be provided for drinking water supplies.

Westbank Creek also had a basic pH, with extremely low sensitivity to acidic inputs. The creek water was hard, and metals concentrations usually were below criteria levels set to protect aquatic life.

Ammonia and nitrite concentrations can exceed criteria to protect aquatic life, while phosphorus concentrations were high enough to cause algal growths.

Dissolved oxygen concentrations have been measured below criteria, and measurable concentrations of oxygen demanding substances have been found. Dissolved solids have exceeded criteria for drinking water and irrigation supplies. Fecal coliform concentrations have been well in excess of criteria for primary contact recreation, a concern not for the creek but for Okanagan Lake which is a short distance downstream and where a beach is located.

Faulkner Creek had a basic pH, with an extremely low sensitivity to acidic inputs. The water was hard, with low concentrations of nitrogen compounds. Phosphorus can be high enough to cause algal growth. Dissolved solids were at concentrations approaching criteria to protect drinking water supplies and irrigation. Fecal coliform concentrations were high enough to require at least partial treatment of the water so that it could be used as a drinking water supply.

Lambly Creek had a basic pH, with low sensitivity to acidic inputs. Water would be considered to be soft and metals concentrations were generally less than criteria to protect aquatic life. Nitrogen compounds were well below criteria, but phosphorus concentrations were high enough to cause algal growths and this may explain some very low dissolved oxygen percent saturation values. Dissolved solids were well below criteria, and fecal coliform concentrations were so low that only disinfection of the water would be required.

Ambient water quality data have not been collected for McDougall Creek.

PROVISIONAL WATER QUALITY OBJECTIVES

Provisional water quality objectives proposed for Peachland Creek, Trepanier Creek and Westbank Creek are summarized in Table 1. The objectives are based on working and approved criteria for water quality and on available data on ambient water quality, waste discharges, water uses and stream 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 water uses for all water bodies are for the protection of aquatic life and wildlife, irrigation, livestock watering and drinking water supplies.

Long-term objectives have been proposed for several characteristics of concern in Westbank Creek. This reflects the fact that ambient water quality is presently degraded for certain uses. The long-term objectives indicate that the Ministry of Environment feels that it is feasible to upgrade water quality for these uses, especially when a new sewage treatment facility is installed at Westbank.

Provisional objectives for bacteriological quality based on Ministry criteria are proposed for Westbank Creek assuming primary-contact recreation takes place a short distance downstream at a beach in Okanagan Lake.

Objectives have been proposed in Westbank Creek 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. The objective for substrate sedimentation based on Ministry criteria is also proposed to protect spawning beds.

Objectives proposed in Peachland and Trepanier creeks for dissolved solids and sodium are meant to protect drinking water supplies and irrigation, respectively from increases which could occur when the Brenda Mines site is abandoned. The objective for sodium is based upon concentrations which will allow a sodium absorption ratio of less than or equal to 2 to be maintained, thereby protecting fruit trees irrigated from these creeks.

Ammonia, nitrite and nitrate can be influenced by blasting compounds or sewage discharges, and for this reason objectives based on Ministry criteria are proposed. Periphyton chlorophyll-a objectives are proposed for flowing water based on Ministry criteria which were developed on the basis of a mixed algal community.

Objectives are proposed for dissolved oxygen concentrations in Westbank Creek, based upon the Ministry's modification of the CCREM criteria. These objectives will likely not be achieved until the sewage discharge is either removed from Westbank Creek or provided better treatment prior to discharge.

An objective is proposed for pH as a range in Peachland and Trepanier creeks. Peachland Creek has naturally higher pH values than Trepanier Creek, and although the range cited for both creeks will protect aquatic life, the narrower range of values for Trepanier Creek will also protect aesthetics related to drinking water supplies.

Objectives are proposed for dissolved aluminum, total copper and total molybdenum based on Ministry criteria, while those proposed for total iron and total zinc are based on working criteria. The objectives for metals in Westbank Creek are long-term objectives. For Peachland and Trepanier Creeks, upstream values can exceed the proposed objective. In such a situation, no significant increase over upstream values is to occur, and this is defined as a maximum 20% increase.

MONITORING RECOMMENDATIONS

A summary of recommended routine water quality monitoring is given in Table 5. Recommended monitoring is the minimum required to check that water quality objectives are being achieved, to finalize provisional objectives that have been proposed, or to increase the accuracy of the information collected.

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

WATER QUALITY OBJECTIVES AND MONITORING TABLES

Table 1a. Provisional Water Quality Objectives for Tributaries to Okanagan Lake near Westbank-Trepanier Creek

Designated Water Uses: aquatic life, wildlife, drinking water, livestock watering, irrigation (lowest 2.5 km only).

Characteristics	Objectives for Trepanier Creek
total dissolved solids	500 mg/L maximum
sodium	16.2 $(0.2\ Ca^{++} + 0.3\ Mg^{++})^{1/2}$ meq/L maximum May to September 270 mg/L maximum
pH	6.5 to 8.5
dissolved aluminum	0.1 mg/L maximum less than or equal to 0.05 mg/L mean
total molybdenum	0.25 mg/L maximum ... for 2.5 km u/s from Okanagan Lake 0.05 mg/L maximum less than or equal to 0.01 mg/L mean May to September as a long-term objective

Table 1b. Provisional Water Quality Objectives for Tributaries to Okanagan Lake near Westbank-Peachland Creek

Designated Water Uses: aquatic life, wildlife, drinking water, livestock watering, irrigation.

Characteristics	Objectives for Peachland Creek
total dissolved solids	500 mg/L maximum
sodium	16.2 (0.2 Ca^{++} + 0.3 Mg^{++})$^{1/2}$ meq/L maximum May to September 270 mg/L maximum
pH	6.5 to 9.0
dissolved aluminum	0.1 mg/L maximum less than or equal to 0.05 mg/L mean or a 20% maximum increase whichever is greater
total molybdenum	0.05 mg/L maximum ... d/s from Peachland Lake less than or equal to 0.01 mg/L mean or a maximum 20% increase May to September as a long-term objective
total copper	less than or equal to values in micrograms/L hardness as mg/L of $CaCO_3$ maximum (0.094 [hardness] + 2) average (0.04 [hardness] for hardness over 50 average 2 for hardness up to 50 or 20% maximum increase whichever is greater
periphyton chlorophyll-a	less than or equal to 100 mg/m^2 as a mean
nitrate nitrogen	10 mg/L mazimum
nitrite nitrogen	0.06 mg/L maximum 0.02 mg/L average

ammonia nitrogen	**AMMONIA TABLE**

Table 1c. Provisional Water Quality Objectives for Tributaries to Okanagan Lake near Westbank-Westbank Creek

Designated Water Uses: aquatic life, wildlife, drinking water, livestock watering, irrigation.

Characteristics	Objectives for Westbank Creek
dissolved aluminum	**0.1 mg/L maximum less than or equal to 0.05 mg/L mean as a long-term objective**
total copper	**less than or equal to values in micrograms/L hardness as mg/L of $CaCO_3$ maximum (0.094 [hardness] + 2) average (0.04 [hardness] for hardness over 50 average 2 for hardness up to 50 or 20% maximum increase whichever is greater**
periphyton chlorophyll-a	**less than or equal to 100 mg/m^2 as a mean**
nitrate nitrogen	**10 mg/L mazimum**
nitrite nitrogen	**NITRITE TABLE**
ammonia nitrogen	**AMMONIA TABLE**
total iron	**0.3 mg/L maximum as a long-term objective**
total zinc	**0.03 mg/L maximum as a long-term objective**

fecal coliforms	**less than or equal to 200/100 mL as a geometric mean**
Escherichia coli	**less than or equal to 77/100 mL as a geometric mean**
enterococci	**less than or equal to 20/100 mL as a geometric mean**
Pseudomonas aeruginosa	**less than or equal to 2/100 mL as a 75th percentile**
residual chlorine	**0.002 mg/L maximum**
suspended solids	**10 mg/L maximum increase when u/s value is less than or equal to 100 m/L a 10% maximum increase when u/s value is greater than 100 mg/L**
turbidity	**1 NTU maximum increase when u/s value is less than 5 NTU 5 NTU maximum increase when u/s value is between 5 and 50 NTU a 10% maximum increase when u/s value is greater than 50 mg/L**
substrate sedimentation	**no significant increase by weight of particulate matter less than 3mm in diameter (95% confidence level)**

-The objectives apply to discrete samples from all parts of the water bodies except from initial dilution zones of effluents. These excluded initial dilution zones are defined as extending up to 100 metres downstream from a discharge and occupying no more than 50% of the stream width around the discharge point, from the bed of the stream to the surface.
-For fecal coliforms, enterococci, Escherichia coli, Pseudomonas aeruginosa, nitrite, dissolved aluminum and total copper and molybdenum the mean and the 90th percentile are calculated from at least five weekly samples in a period of thirty 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 extrapolated by graphical methods when fewer than ten samples are collected.
-For suspended solids, turbidity, substrate sedimentation, dissolved aluminum and total copper and molybdenum the increase, in mg/L, % or NTU, is over levels measured at a site upstream from the discharge or series of discharges and as close to them as possible and applies to downstream values. For substrate sedimentation the increase is measured on the basis of the averages of at least three samples collected upstream and downstream and the significant increase will be defined as no difference greater than 10%.
-The maximum chlorophyll-a is based on an average calculated from a least five randomly located samples from natural substrates at each site on any sampling date
-pH measurements may be made in situ but must be confirmed in the laboratory if the objective is not achieved.
-For sodium the concentration given by the formula applies only during the irrigation season in the reach of Tepanier Creek 2.5 kilometers immediately upstream from Okanagan Lake and in the reach of Peachland Creek 4.0 kilometers upstream from Okanagan Lake.
-For nitrite, nitrate, periphyton chlorophyll-a, dissolved oxygen and aluminum and total copper, molybdenum, iron and zinc the long-term objectives indicate situations where existing water quality does not suit all desired water uses but it is considered feasible to improve the water quality over time. Short-term objectives protect water uses to a certain dregree until long-term objectives can be achieved.

Table 5. Recommended Water Quality Monitoring for Tributaries to Okanagan Lake near Westbank

Sites	Creek	Frequency and timing	Characteristics to be measured
0500355	Peachland	5 times weekly in a 30-day period January and February July and August	total ammonia-N, nitrite-N, chloride, nitrate-N, pH, temperature, periphyton chlorophyll-a, dissolved aluminum, total copper, molybdenum, sodium and dissolved solids, hardness
0500056			
0500362	Trepanier		pH, dissolved aluminum, total copper,

0500078			**molybdenum, sodium, lead, zinc and dissolved solids, hardness**
0500096	**Westbank**		**total ammonia-N, nitrite-N, chloride, nitrate-N, pH, temperature, periphyton chlorophyll-a, dissolved aluminum, total copper, iron, zinc, sodium and dissolved solids, hardness, turbidity, suspended solids, substrate sedimentation, residual chlorine, fecal coliforms, *Pseudomonas aeruginosa*, enterococci, *Escherichia coli***
0500059	**Powers**	**5 times in 30-days July and August**	**pH, temperature, dissolved oxygen, bacteriological indicators, dissolved and total metals and phosphorus, hardness, dissolved and suspended solids, periphyton chlorophyll-a, nitrite, nitrate and ammonia-N chloride**
at the mouth	**McDougall**		
0500805	**Falkner**		
0500041	**Lambly**		

-Sampling may need to be increased to check objectives, depending on circumstances
-Site numbers are those used by the Ministry of Environment in its computerized data file.

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