Water Quality

Ambient Water Quality Objectives For Upper Finlay Sub-Basin Finlay-Omeneca

Overview Report

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

Prepared Pursuant To Section 2(E) Of The
Environment Management Act, 1981

Original Signed By Ben Marr
Deputy Minister
Environment And Lands Hq Division
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FIGURES
Figure 1. Finlay-Omineca Location Map

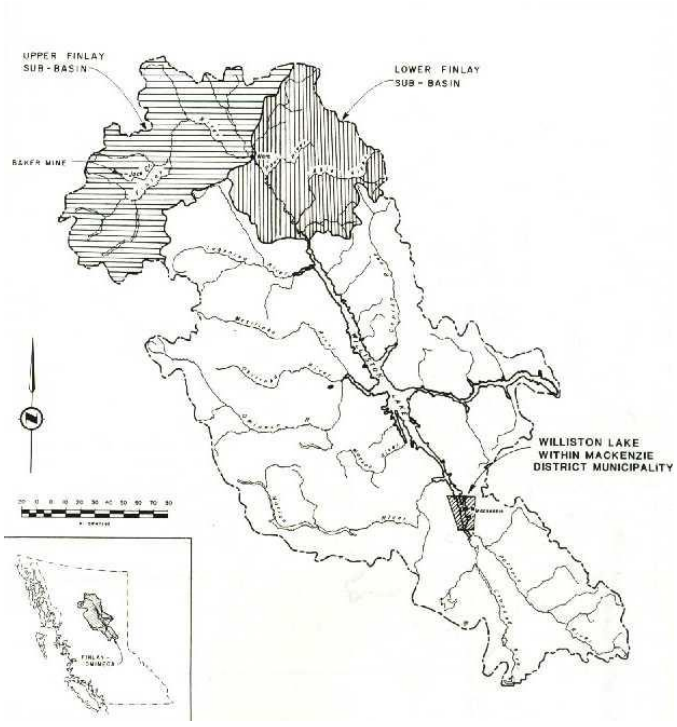


Figure 2. Upper Finlay sub-basin Map

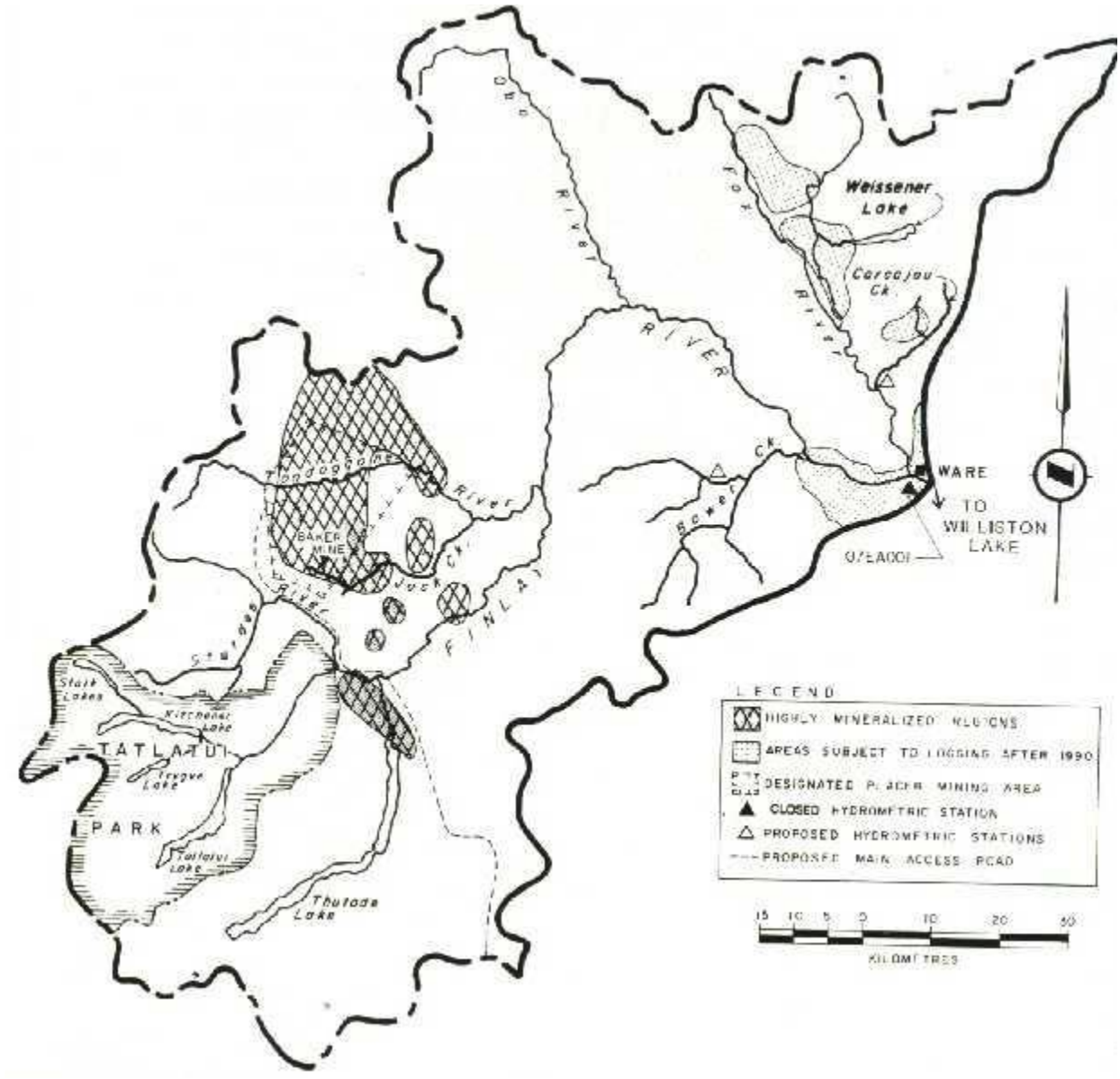


Figure 3. Jock and Attorney Creeks Location Map

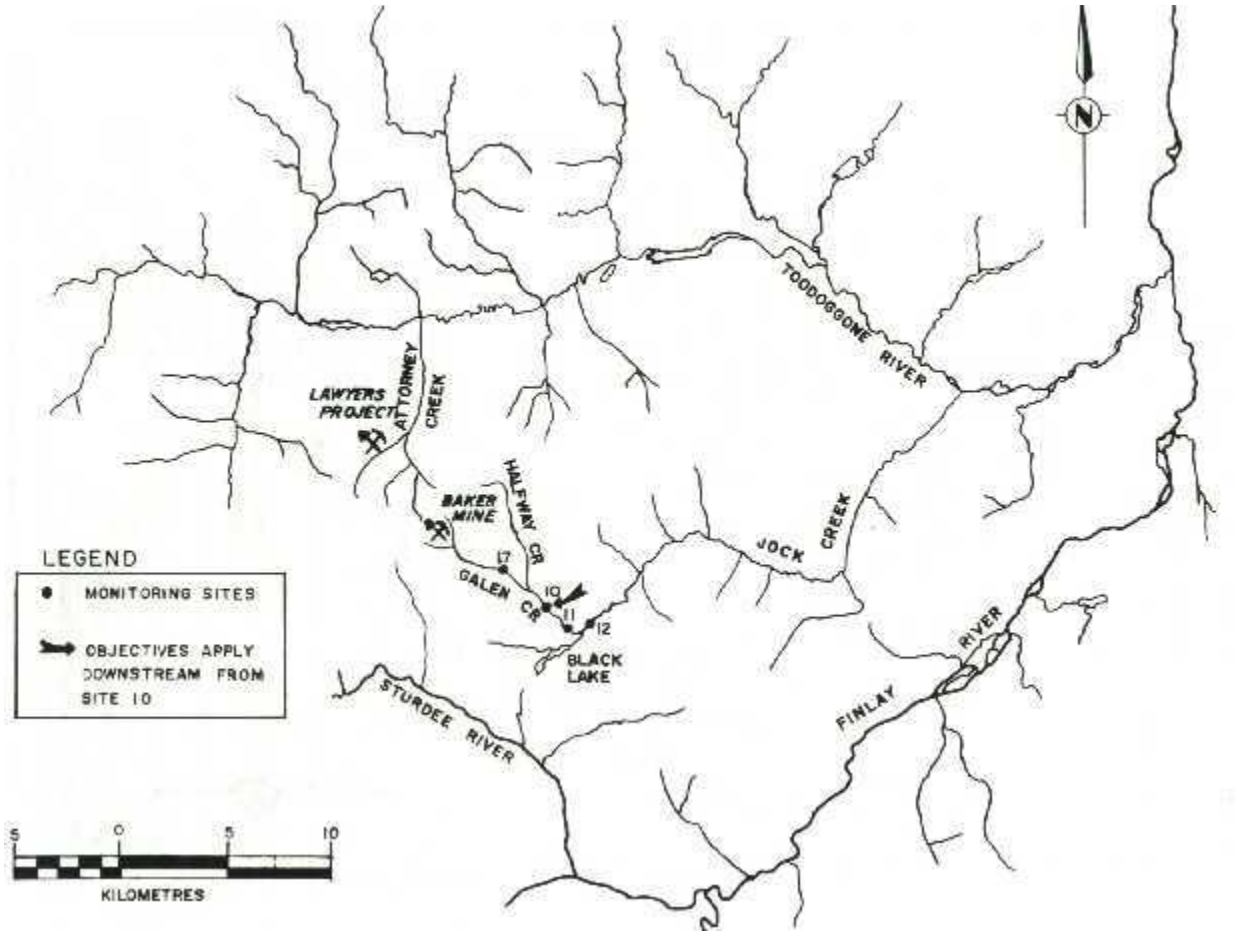
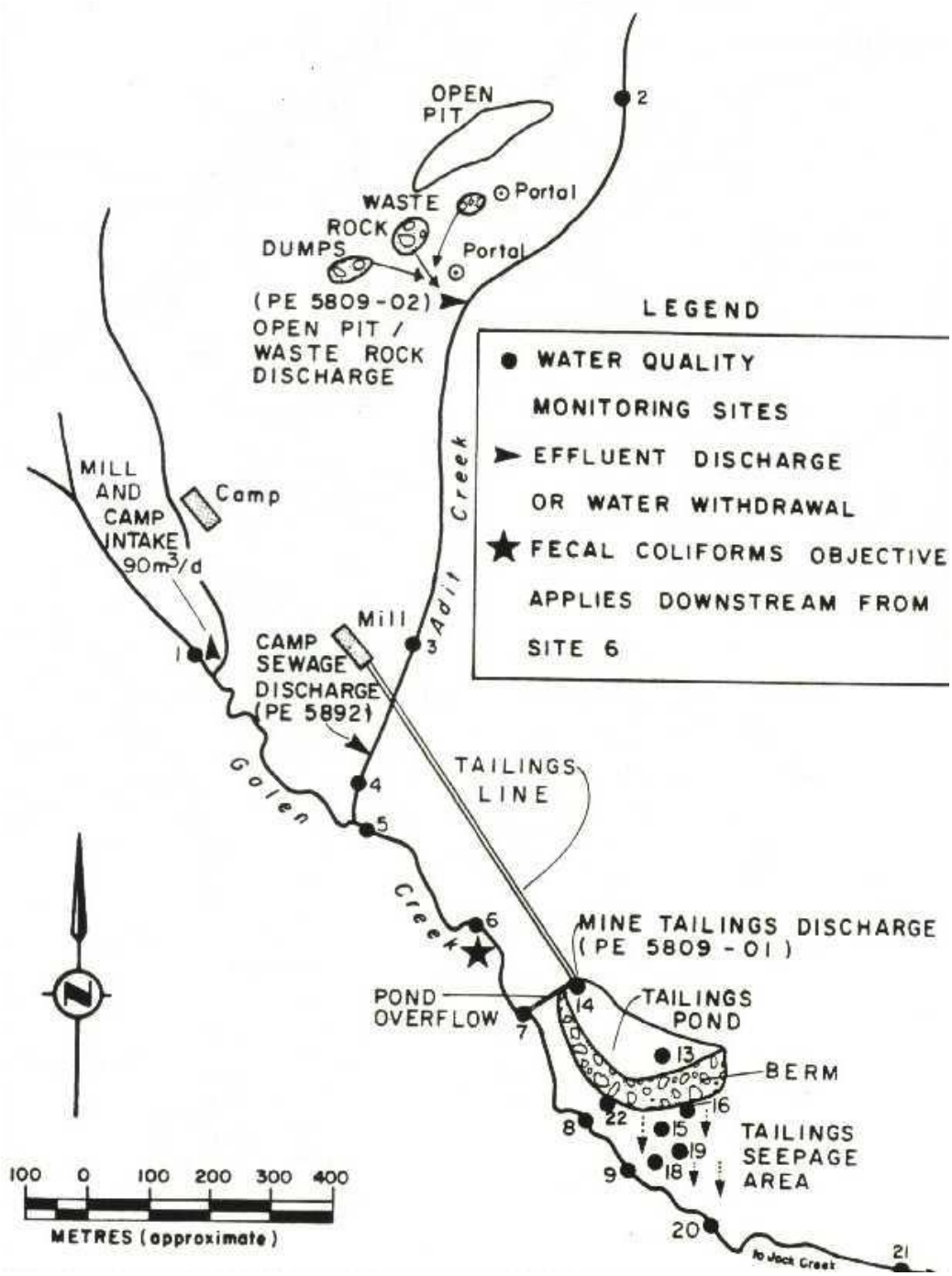


Figure 4. Baker Mine Site Details Map



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

This report presents the major findings and recommendations of an assessment of available water quality information for the upper Finlay sub-basin, defined as the drainage upstream from the community of Ware (Figure 1). A detailed technical appendix was prepared and forms the basis of this report. This report is one of three being written to help prepare a strategic plan for the Finlay-Omineca area (Figure 1). The major water quality issue in the upper Finlay sub-basin is the contamination from a gold and silver mine.

HYDROLOGY

The upper Finlay sub-basin drainage area is 11100 km^2, mainly including portions of the Skeena Mountains, Spatsizi Plateau, Omineca Mountains and the Rocky Mountains. The Finlay Riover has its source in Tatlatui Park and the Thutade watershed, and flows across the sub-basin in a north-easterly and easterly direction (Figure 2). It leaves the sub-basin at Ware and then flows south into the north end of Williston Lake (Figure 1). The major tributaries to the Finlay River within this sub-basin include the Sturdee, Toodoggone, Obo and Fox Rivers.

Few flow data from this remote area exist. A flow gauge was located on the Finlay River at Ware until 1983. Although no reliable flow data exist for Adit andf Galen Creeks, which receive the only permitted waste discharges in the sub-basin, it is assumed that periods of zero flow occur during the winter months in this small alpine watershed (Figure 3) and (Figure 4).

WATER USES

The upper Finlay sub-basin is largely undeveloped wilderness with no road access. The only licenced water user in the sub-basin was a gold and silver mine and mill known as the Baker Mine. The mine closed indefinitely in November 1983, but is subject to re-activation depending on the results of further exploration and the feasibility of the mill processing ore from other nearby potential mines.

Serem Inc. has proposed developing a gold and silver mine (Lawyers Project) on Attorney Creek, 8 km northwest of the Baker Mine. Attorney Creek flows north into the Toodoggone River (Figure 3). This development requires the construction of a 96 km extension to the Omineca Road (Figure 2) and possibly hydroelectric generation facilities involving stream diversions and reservoir construction. Ore will be processed using cyanidation.

An area on the Toodoggone River has been designated for placer mining (Figure 2). However, activities have been minimal due to access difficulties.

The community of Ware, (Figure 1) and (Figure 2) does not have a public water supply system, although the Finlay River is used for drinking water. Other water uses are related to hiking, hunting, fishing and trapping activities of those people who live in or visit this wilderness area.

Aquatic life values, particularly for rainbow trout and Dolly Varden char, are high throughout the sub-basin and attract a valuable sports fishery. Due to natural migration barriers, those waters affected by Baker Mine effluents are devoid of fish. Fish and Wildlife, Northern Region, considers the majority of the affected waters good fish habitat, and intends to stock them when water quality improves.

WASTE DISCHARGES

The only three permitted waste discharges to water in the upper Finlay sub-basin were associated with the Baker Mine, including drainage from an open pit and waste rock dump, camp sewage and a tailings pond. The open pit/waste rock effluent and the camp sewage effluent both discharged to Adit Creek, which then flows into Galen Creek (Figure 4). Further downstream the mill effluent was discharged to a tailings pond which exfiltrated to Galen Creek. The Baker Mine employed cyanidation for extraction of gold and silver followed by alkaline chlorination to oxidize toxic cyanides to less toxic cyanates in the tailings. There was no recycling of tailings supernatant. This tailings treatment process proved ineffective at the Baker Mine and resulted in high cyanide concentrations in the tailings and receiving waters. Experimentation with another tailings treatment process known as the INCO SO_2/Air process during the last year of operation proved inconclusive.

The open pit/waste rock effluent generally met receiving water quality criteria. The quality of the camp sewage discharge was poor, resulting in levels of suspended solids, BOD_5, fecal coliforms, nitrite and residual chlorine which either exceeded the effluent permit levels, or produced concentrations in Adit Creek exceeding receiving water quality criteria for aquatic life. Further downstream, seepage from the tailings pond entered Galen Creek, resulting in cyanide, copper and nitrite concentrations above receiving water quality criteria for the protection of aquatic life. Theoretical estimates suggest that cyanide and copper concentrations above criteria for aquatic life may have occurred the full length of

Galen and Jock Creeks, a distance of approximately 35 km downstrean from the Baker Mine (Figure 3). Assessment of effluent and receiving water quality indicates acid mine drainage has not occurred.

The proposed Lawyers Project gold and silver mine and cyanidation mill will discharge to a tailings pond located adjacent to Attorney Creek (Figure 3). This project would also involve discharges from waste rock dumps, mine adits and camp facilities. If this project is approved, water quality objectives for the area may be prepared based on results of future monitoring.

WATER QUALITY

Few water quality data are available for the sub-basin other than those related to the Baker Mine. Extensive construction of mine exploration roads and limited placer mining have created sedimentation problems. However, no water quality data related to these activities exist.

Fish tissue mercury data from Weissener Lake and the Finlay River near Ware suggest that natural mercury availability in this sub-basin is high enough to warrant further investigation (Figure 2). Fish mercury concentrations of medical significance to fish consumers have been documented; some samples have exceeded the Canadian Food and Drug Directorate. No human health problems related to fish consumption in this sub-basin are known.

Although very few water quality data exist, the water quality in the upper Finlay sub-basin is believed to be excellent and largely unaffected by man. Mineral exploration and mining have had some localized impacts. Future road access to this wilderness area will increase water uses and waste discharges by encouraging mining development of this highly mineralized region (Figure 2).

WATER QUALITY OBJECTIVES

Provisional water quality objectives are proposed to protect water uses for Galen and Jock Creeks. The objectives are based on preliminary working criteria for water quality and on available data on ambient 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.

The objectives can be considered as policy guidelines for resource managers to protect water uses in specified water bodies. For example, they can be used in preparing waste management permits and plans, regulating water use or planning fisheries management. They can also provide a reference against which the state of water quality in a particular water body can be checked.

Water quality objectives have no legal standing and their direct enforcement would not be practical. This is due to the difficulty of accurately measuring contaminants in receiving water and attributing the contamination exceeding the objective to particular sources for legal purposes, and thus of proving violations and their causes. Hence, although water quality objectives should be used when determining

effluent permit limits, they should not be incorporated as part of the condition in a waste management permit.

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 waterbodies and for water quality characteristics which may be affected by man's activity, now and in the future.

In this case, provisional water quality objectives are proposed for Galen and Jock Creeks, in the event that the Baker Mine is re-activated. The water uses that have been designated for protection are aquatic life, wildlife and recreation. Water quality objectives to protect aquatic life and wildlife are proposed for weak-acid dissociable cyanide. total copper, nitrite-nitrogen, residual chlorine, ammonia-nitrogen, total iron, total lead, total zinc, total silver and total mercury. If the mine resumes operation using the INCO SO_2/air treatment process (which oxidizes cyanide to thiocyanate), a provisional objective for thiocyanate may be proposed. Much less toxicological information exists for thiocyanate than for the other constituents for which objectives are proposed. An objective for fecal coliforms is also proposed, to protect recreational water use by mine employees, exploration personnel, hunters and visitors. All provisional water quality objectives are summarized in Table 1. With the exception of fecal coliforms, these objectives apply to Galen Creek downstream from a 2.5 kilometer initial dilution zone and to all of Jock Creek (Figure 3). The relatively long dilution zone is considered necessary due to the low dilution capacity of this headwater alpine creek. The absence of fish in all of Galen and most of Jock Creeks makes this long dilution zone acceptable. Nevertheless, these objectives ensure that most of the best fish habitat in Galen Creek and all of Jock Creek are protected to facilitate future stocking and that other forms of aquatic life are also protected. The fecal coliform objective applies to Galen Creek, downstream from an initial dilution zone of about 400 m (Figure 4).

These unusually long initial dilution zones are specific to the conditions and other circumstances of the Baker Mine operation, and are not necessarily applicable to other existing or proposed waste discharges.

MONITORING RECOMMENDATIONS

Should the mill re-open, modifications to the recently amended permittee monitoring requirements are proposed to define more clearly the extent and sources of pollution and to assist in future waste management (Table 2.). This includes the addition of certain variables, increased monitoring frequency and changes to the monitoring sites used. The additional monitoring proposed includes stream flow measurements of Galen Creek, and the addition of variables such as nitrogen, mercury, silver, chlorine residual, non-filterable residue, hardness and temperature. Although the proposed cyanide objective refers to the weak-acid dissociable fraction, monitoring of both the weak-acid and strong-acid dissociable fractions is recommended to assist interpretation. Similarly, total metals are proposed as objectives, while both total and dissolved metals are recommended for monitoring to assist interpretation. Although no objective is proposed for thiocyanate, monitoring for thiocyanate is recommended in the event the mine re-opens using the INCO SO_2/Air treatment process.

Initial monitoring of mercury is recommended to determine in mining operations enhance natural levels. Also, it is recommended that fish tissues be tested from representative areas throughout the sub-basin to determine the extent and significance of present mercury levels. Monitoring of mercury in water,

sediments and biota should be considered as part of environmental assessments prior to resource developments in this mercuriferous region

To facilitate water quality surveillance, and to develop future receiving water quality objectives that will protect fisheries values and other water uses, it is desirable to accumulate a data base, particularly for the Todoggone River. Future placer mining, open pit and underground mining, mine exploration and road construction activities will require more extensive baseline data than are presently available/

These monitoring recommendations are based on technical considerations. The amount of monitoring that will take place in any year will depend on budget and program priorities. Permittee monitoring requirements would be determined at such time as the mine re-opens.

TABLES
Table 1. Provisional Water Quality Objectives for Jock and Galen Creeks (for aquatic life, wildlife and recreation)

Characteristics	Objectives
fecal coliforms	-less than or equal to 200 MPN/100 mL geometric mean -less than or equal to 400 MPN/100 mL 90 th percentile
total chlorine residual	0.002 mg/L maximum
weak acid dissociable cyanide (unfiltered)	less than or equal to 0.005 average 0.01 mg/L maximum
un-ionized ammonia	less than or equal to 0.007 average 0.03 mg/L maximum
nitrite nitrogen	less than or equal to 0.02 average 0.06 mg/L maximum
total copper	0.002 mg/L maximum or an increase of 20% over background whichever is greater

total iron	**1.0 mg/L maximum**
total lead	**0.005 mg/L maximum**
total zinc	**0.05 mg/L maximum**
total silver and mercury	**0.0001 mg/L maximum**

Note: Objectives apply to discrete samples from all parts of Galen and Jock Creeks except for the initial dilution zones. For fecal coliforms, the excluded dilution zone extends 400 m downstream from the sewage discharge site. For all the other objectives, the excluded dilution zone extends 2.5 km downstream from the tailings pond seepage area.
1. The coliform geometric mean and 90th percentile are calculated from at least 5 weekly samples taken in a 30-day period.
2. Since the silver and chlorine residual objectives are less than the minimum detectable concentration, it will be necessary to estimate the receiving water concentrations using effluent loading and estimated streamflow.
3. The weak acid dissociable cyanide analytical method should measure free cyanide, simple cyanides and weak-acid dissociable metal cyanides. The current minimum detection limit is 0.005 mg/L. A result of less than this detection limit would be deemed to be achieving the objective, until the detection limit can be lowered.
4. The mean cyanide, nitrite and ammonia are calculated from at least 5 weekly samples in a 30-day period.
5. The percent increase in total copper is over levels measured at a site upstream from the discharge and as close to it as possible, and applies to downstream levels.

Table 2. Recommended Routine Water Quality Monitoring for Galen and Adit Creeks at the Baker Mine

Sites	Frequency	Variables to be measured
-site #1, Galen Creek, u/s from campsite	**monthly**	**pH, total hardness, non-filterable residue, dissolved sulphate, total mercury, total and**

-site #2, Adit Creek, u/s from open pit/waste rock discharge		dissolved copper, iron, lead, silver and zinc
open pit/waste rock discharge (PE 5809-02)	monthly	pH, total hardness, non-filterable residue, dissolved sulphate, total mercury, total and dissolved copper, iron, lead, silver and zinc, ammonia, nitrate, nitrite, flow
site #3, Adit Creek, d/s from open pit/waste rock discharge	monthly	pH, total hardness, non-filterable residue, dissolved sulphate, total mercury, total and dissolved copper, iron, lead, silver and zinc, ammonia, nitrate, nitrite
camp sewage discharge (PE 5892)	monthly	flow, fecal coliforms, 5-day BOD, non-filterable residue, total chlorine residual
site #6, Galen Creek, 300m d/s from Adit Creek confluence	weekly	flow, fecal coliforms
site #14, tailings fluid to pond	weekly	weak acid and strong acid dissociable cyanide, thiocyanate, total mercury, total and dissolved copper, iron, lead, silver and zinc, flow
site #14, tailings fluid to pond	daily	pH
site #13, tailings pond supernatant	weekly	pH, weak acid and strong acid dissociable cyanide, thiocyanate, total mercury, total and dissolved copper, iron, lead, silver and zinc, flow
site #13, tailings pond supernatant	monthly	temperature, ammonia, nitrate, nitrite
-seepage spring and wells between tailings pond and Galen Creek -site #21, Galen Creek 500 m d/s from tailings pond	weekly	pH, weak acid and strong acid dissociable cyanide, thiocyanate, total mercury, total and dissolved copper, iron, lead, silver and zinc, total sulphate
-seepage spring and wells between tailings pond and	weekly	temperature, pH, total hardness, non-filterable residue, total chlorine residual,

Galen Creek -site #10, below confluence of Galen and Halway Creeks		**total sulphate, ammonia, nitrate, nitrite, weak acid and strong acid dissociable cyanide, thiocyanate, total mercury, total and dissolved copper, iron, lead, silver and zinc**

Note: Sampling may need to be increased to check objectives, depending on circumstances.
The locations of the monitoring sites arte shown in Figure 3. and in Figure 4.

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