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APPENDIX 2: SUMMARY OF WATER QUALITY GUIDELINES FOR TURBIDITY, SUSPENDED AND BENTHIC SEDIMENTS

BRITISH COLUMBIA, CANADA

Water Use	Maximum Induced Turbidity -NTU or % of background-	Maximum Induced Suspended Sediments -mg/L or % of background-	Streambed Substrate Composition
Drinking Water -raw untreated-	1 NTU when background is less than or equal to 5	No Guideline	No Guideline
Drinking Water -raw treated-	5 NTU when background is less than or equal to 50 ..... 10% when background is greater than 50	No Guideline	No Guideline
Recreation and Aesthetics	Maximum 50 NTU ..... secchi disc visible at 1.2 m	No Guideline	No Guideline
Aquatic Life -fresh- -marine- -estuarine-	8 NTU in 24 hours when background is less than or equal to 8 ..... mean of 2 NTU in 30 days when background is less than or equal to 8	25 mg/L in 24 hours when background is less than or equal to 25 ..... mean of 5 mg/L in 30 days when background is less than or equal to 25	fines not to exceed -10% as less than 2mm- -19% as less than 3mm- -25% as less than 6.35mm- at salmonid spawning sites
Aquatic Life -fresh- -marine- -estuarine-	8 NTU when background is between 8 and 80 ..... 10% when background is	25 mg/L when background is between 25 and 250 ..... 10% when background is	Geometric mean diameter not less than 12mm ..... Fredle number not less than 5mm

	greater than or equal to 80	**greater than or equal to 250**	
Terrestrial Life -wildlife- -livestock water- Irrigation Industrial	**10 NTU when background is less than or equal to 50 ..... 20% when background is greater than or equal to 50**	**20 mg/L when background is less than or equal to 100 ..... 20% when background is greater than or equal to 100**	**No Guideline**

To determine if guidelines have been exceeded, ideally, for short-term (acute) exposures, hourly samples taken over a 24-hour period are preferred to demonstrate the continuity of an event. Initially, less frequent monitoring may be appropriate to determine the need for more extensive monitoring. For long-term (chronic) exposures daily samples taken over a 30-day period are preferred, but also may initially be checked by less frequent monitoring. Obviously, the statistical reliability of the data is increased as the frequency of monitoring is increased.

PREFACE

THE MINISTRY OF ENVIRONMENT, LANDS AND PARKS develops province-wide ambient water quality guidelines for variables that are important in the surface waters of British Columbia. This work has the following goals:

1. to provide guidelines for the evaluation of data on water, sediment, and biota
2. to provide guidelines for the establishment of site-specific ambient water quality objectives

Ambient water quality objectives for specific waterbodies will be based on the guidelines and also consider present and future uses, waste discharges, hydrology/limnology/oceanography, and existing background water quality. The process for establishing water quality objectives is more fully outlined in ***Principles for Preparing Water Quality Objectives in British Columbia***, copies of which are available from Water Quality Section of the Water Management Branch.

Neither guidelines nor objectives which are derived from them, have any legal standing. The objectives, however, can be used to calculate allowable limits or levels for contaminants in waste discharges. These limits are set out in waste management permits and thus have legal standing.

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The objectives are not usually incorporated as conditions of the permit.

The definition adopted for a guideline is:

A maximum and/or a minimum value for a physical, chemical or biological characteristic of water, sediment or biota, which should not be exceeded to prevent specified detrimental effects from occurring to a water use, including aquatic life, under specified environmental conditions.

The guidelines are province-wide in application, are use-specific, and are developed for some or all of the following specific water uses:

Raw drinking, public water supply and food processing

Aquatic life and wildlife

Agriculture (livestock watering and irrigation)

Recreation and aesthetics

Industrial (water supplies)

The guidelines are set after considering the scientific literature, guidelines from other jurisdictions, and general conditions in British Columbia. The scientific literature gives information on the effects of toxicants on various life forms. This information is not always conclusive because it is usually based on laboratory work which, at best, only approximates actual field conditions. To compensate for this uncertainty, guidelines have built-in safety factors which are conservative but reflect natural background conditions in the province.

The site-specific water quality objectives are, in most cases, the same as guidelines. However, in some cases, such as when natural background levels exceed the guidelines, the objectives could be less stringent than the guidelines. In relatively rare instances, for example if the resource is unusually valuable or of special provincial significance, the safety factor could be increased by using objectives which are more stringent than the guidelines. Another approach in such special cases is to develop site-specific guidelines by carrying out toxicity experiments in the field. This approach is costly and time-consuming and therefore seldom used.

Guidelines are subject to review and revision as new information becomes available, or as other circumstances dictate.

The guidelines apply to the ambient raw water source before it is diverted or treated for domestic use.
The Ministry of Health regulates the quality of water for domestic use after it is treated and delivered by a water purveyor.

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Guidelines relating to public health at bathing beaches are the same as those used by the Ministry of Health which regulates the recreation and aesthetic use.

RECOMMENDED GUIDELINES

These guidelines are based on information presented in a technical appendix and are summarized in Table 1. The Canadian Council of Ministers of the Environment (CCME) guidelines for turbidity and suspended sediments were adopted from the original British Columbia ambient water quality criteria for particulate matter published in 1985. The 1985 BC criteria are superseded by the guidelines presented herein.

1. RAW DRINKING WATER SUPPLY

In this document, raw drinking water refers to water before it enters the distribution system. This raw water may be treated for the removal of turbidity and suspended particulates before it is distributed to consumers. Separate turbidity guidelines for raw drinking water without treatment and for raw drinking water with treatment are set here for both health and aesthetic considerations.

1.1 Raw Drinking Water Without Treatment

For raw waters of exceptional clarity (less than or equal to 5 NTU) which normally do not require treatment to reduce natural turbidity, induced turbidity should not exceed 1 NTU and the total turbidity should not exceed 5 NTU at any time.

1.2 Raw Drinking Water With Treatment

For raw waters which normally require some form of treatment to reduce natural turbidity to a level that complies with the standard for finished water (5 NTU) in British Columbia, induced turbidity should not exceed 5 NTU when background turbidity is less than or equal to 50 NTU. When background is greater than 50 NTU, the induced turbidity should not be more than 10% of background.

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2. AQUATIC LIFE

The guidelines set here are designed to protect aquatic life in fresh, estuarine and coastal marine waters from excessive suspended sediments originating from anthropogenic sources. They are established according to the amount of suspended sediments and the turbidity of the aquatic system. Guidelines for substrate composition and for bedload transport have also been developed, which are specific to salmonid spawning and mariculture areas. As the biotic, physical and chemical conditions describing aquatic ecosystems are diverse, the recommended guidelines will need to be compared to natural background levels.

Distinct water quality guidelines for suspended sediments and turbidity are required for the protection of aquatic life during clear flow and turbid flow periods. The terms ***clear flow period*** and ***turbid flow period*** are used to describe the portion of the hydrograph when suspended sediment concentrations are low (i.e., less than 25 mg/L or less than 8 NTU) and relatively elevated (i.e., greater than or equal to 25 mg/L or greater than or equal to 8 NTU), respectively.

The clear and turbid flow periods for individual stream systems should be defined using data on the background concentrations of suspended sediment at the site-specific level. The recommended transition value (25 mg/L or 8 NTU) was selected by examining the hydrographs for a number of streams in British Columbia and is intended to provide an operational definition of clear flow conditions that can be applied consistently in the province.

2.1 Suspended Sediments

2.1.1 Clear Flow Periods

Induced suspended sediment concentrations should not exceed background levels by more than 25 mg/L during any 24-hour period (hourly sampling preferred). For sediment inputs that last between 24 hours and 30 days (daily sampling preferred), the average suspended sediment concentration should not exceed background by more than 5 mg/L.

The statistical reliability of the data set is improved with increased monitoring frequency. Ideally, 24 samples in 24 hours and/or 30 samples in 30 days are preferred.

2.1.2 Turbid Flow Periods

Induced suspended sediment concentrations should not exceed background levels by more than 25 mg/L at any time when background levels are between 25 and 250 mg/L. When background exceeds 250 mg/L, suspended sediments should not be increased by more than 10% of the measured background

level at any one time.

2.2 Turbidity

2.2.1 Clear Flow Periods

Induced turbidity should not exceed background levels by more than 8 NTU during any 24-hour period (hourly sampling preferred). For sediment inputs that last between 24 hours and 30 days (daily sampling preferred) the mean turbidity should not exceed background by more than 2 NTU.

The statistical reliability of the data set is improved with increased monitoring frequency. Ideally, 24 samples in 24 hours and/or 30 samples in 30 days are preferred.

2.2.2 Turbid Flow Periods

Induced turbidity should not exceed background levels by more than 8 NTU at any time when background turbidity is between 8 and 80 NTU. When background exceeds 80 NTU, turbidity should not be increased by more than 10% of the measured background level at any one time.

2.3 Streambed Substrate Composition

The composition of fine sediment in streambed substrates (i.e., percent fines) should not exceed 10% having a diameter of less than 2.00 mm, 19% having a diameter of less than 3.00 mm, and 25% having a diameter of less than 6.35 mm at potential salmonid spawning sites. The geometric mean diameter and Fredle number of streambed substrates should not be less than 12.0 mm and 5.0, respectively. The minimum and 30-day average guideline for intra-gravel dissolved oxygen levels are 6.0 and 8.0 mg/L, respectively. These guidelines apply to actual and potential spawning sites in streams throughout the province.

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3 WILDLIFE, LIVESTOCK WATERING, IRRIGATION, AND INDUSTRIAL WATER SUPPLIES

Guidelines to protect wildlife, livestock watering, irrigation and industry from excessive suspended sediment in BC waters are presented in terms of turbidity and suspended sediments, and are based on natural background levels. A narrative guideline is also provided for industrial uses.

3.1 Suspended Sediments

Induced suspended sediments should not exceed 20 mg/L when background suspended sediment is less than or equal to 100 mg/L, nor should induced suspended sediment be more than 20% of background when background is greater than 100 mg/L.

3.2 Turbidity

Induced turbidity should not exceed 10 NTU when background turbidity is less than or equal to 50 NTU, nor should induced turbidity be more than 20% of background when background is greater than 50 NTU.

3.3 Narrative (for industrial uses only)

No induced increase in turbidity or suspended sediments that will interfere with established water supplies.

4 RECREATION AND AESTHETICS

Guidelines relating to public health at bathing beaches are adopted from those used by the Ministry of Health which regulates the recreation and aesthetic use.

4.1 Turbidity

A maximum limit of 50 NTU is suggested.

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4.2 Clarity-Light Penetration

Water should be sufficiently clear that a Secchi disc is visible at a minimum depth of 1.2 metres.

4.3. Aesthetics

All water should be free from substances attributable to wastewater or other discharges that produce objectionable turbidity or would interfere with the existence of life forms of aesthetic value.

APPLICATION OF GUIDELINES

The guidelines can be used to assess water quality impacts or as starting points to develop site-specific objectives. It is recommended that the user be familiar with the concepts and guidelines detailed in the written Technical Document prior to making comparisons between monitoring results and guidelines. In a situation where the guidelines have been exceeded and compliance and/or prosecution measures are contemplated, the reader should refer to ***Channel Sediment Pollution: A Provisional Fisheries Field Guide for Assessment of Risk and Impact*** published by the Habitat Protection Branch of BC Environment, for further guidance.

A separate publication, ***Sampling Strategy for Turbidity, Suspended and Benthic Sediments*** has been supplied as an addendum to the Technical Appendix to guide the user through various sampling scenarios. This strategy document can be used to verify whether guidelines have been exceeded, and will provide field personnel with general sampling designs and methods which they will need to adapt to their situation. While this addendum was designed primarily for the application of the aquatic life guidelines, some of the principles could apply to other water uses where there is a need to show a statistically significant increase over background.

The strategy focuses primarily on the monitoring of lotic systems in British Columbia. Furthermore, because every watershed is different in terms of its physical, chemical and biological characteristics, all possible scenarios cannot explicitly be addressed. Instead, the strategy recommends more general procedures that can be adapted to suit the requirements of

site-specific conditions.

The severity-of-ill-effects (SEV) model that was used as a basis to derive the aquatic life guidelines will predict the expected severity of effects once the guidelines have been exceeded. This method will assist BC Environment in their design, planning and implementation of control options.

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