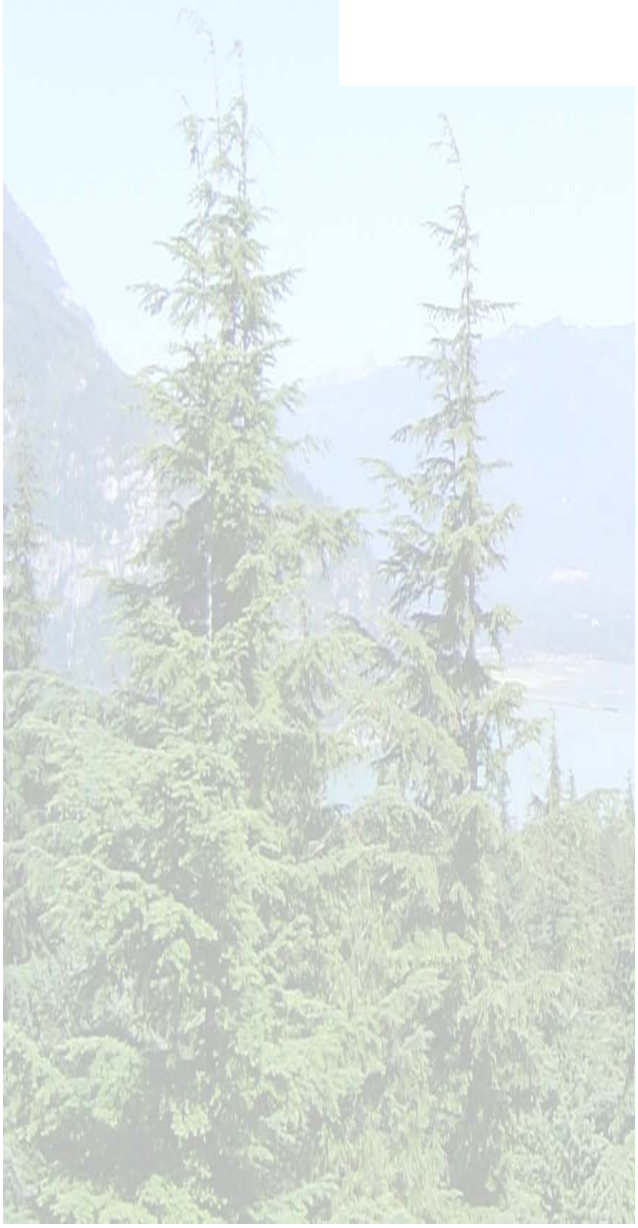
BRITISH COLUMBIA

Ministry of Water, Land & Air Protection

LOWER MAINLAND REGION

Water Quality Objectives Attainment Monitoring for the Coquitlam River in 2002.



Prepared by:

Ed Quilty, QA Environmental Consulting
For: the Environmental Quality Section
Ministry of Water, Land & Air Protection
Lower Mainland Region
Surrey, B.C.

November 2003

ENVIRONMENTAL QUALITY

Water Quality Objectives Attainment Monitoring for the Coquitlam River in 2002.

Prepared by:
Ed Quilty, QA Environmental Consulting
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For: the Environmental Quality Section
Environmental Protection Division
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PREFACE

Water Quality Objectives and Attainment Monitoring

Water quality objectives are established in British Columbia for water bodies on a site-specific basis and are set to protect the most sensitive designated water uses at a specific location. Objectives are prepared for those water bodies and water quality measurements that may be affected by human activity currently, or in the future.

Attainment monitoring and reporting is conducted to check whether the objectives are being met, and is important for preparing water management plans, issuing of permits, licenses and orders, as well as for regulating water uses. Monitoring usually takes place at a critical time, during a five-week period, when water quality objectives may not be met. This will generally represents the 'worst case scenario' for the water uses in question, which will ensure that they will be protected at other times when the threat to water quality is lower.

Water Quality Index

A water quality index was developed by the Canadian Council of Ministers of the Environment (CCME) in 1999 to reflect the overall and ongoing condition of water bodies. The index is based on a formula developed by the BC Ministry of Environment, Lands and Parks (MOELP, 1995), with a few modifications. The index can be used to assess water quality relative to its desirable state (as defined by the water quality objectives) and to provide insight into the degree to which water quality is affected by human activity. The index is also useful for ranking the suitability of water for use by humans and aquatic life.

The index is founded on three factors involving the measurement of the attainment of water quality objectives. The factors measure the number of objectives not met (scope), the frequency with which objectives are not met (frequency), and the maximum amount by which objectives are not met (amplitude). The index then ranks water quality into one of five categories: excellent, good, fair, marginal, and poor.

Acknowledgements

The Ministry of Water, Land, and Air Protection provided funding for this study. Microbiological tests were performed by CANTEST Ltd. (Burnaby, B.C.). Analytical chemistry was performed by PSC Analytical Services (Burnaby, B.C.).

SUMMARY

This report presents the results of monitoring done in 2002 to check the attainment of Coquitlam River water quality objectives that were set in 1989. Objectives have not been monitored since 1989. The CCME Water Quality Index was also determined for the Coquitlam River and its tributaries, Or Creek and Scott Creek, using 2002 results.

Five sites in the Coquitlam River watershed were monitored: Or Creek, Coquitlam River at the GVRD gate, Coquitlam River downstream of the gravel pits, Scott Creek downstream of Hwy. 7, and Coquitlam River near the mouth. Samples and field measurements were collected weekly for five weeks during November and December 2002. Bacteriological indicators included fecal colifoms, enterococci, and *Escherichia coli*. Water quality indicators included dissolved oxygen, water temperature, suspended solids, ammonia, nitrate, and trace metals (aluminum, cadmium, chromium, copper, lead, and zinc).

Objectives for fecal coliforms were met at all sites, while objectives for *E. coli* were met at all sites except Coquitlam River at the mouth. Enterococci objectives were met at Or Creek and Coquitlam River at the GVRD gate, but were not met at the three downstream sites.

Watershed-specific objectives, or B.C. guidelines where objectives are not established, were met at all sites for water temperature, suspended sediment, ammonia, nitrate, and most trace metals. Objectives for dissolved oxygen were not met in Or Creek, Scott Creek, or in the Coquitlam River downstream of the gravel pit and at the mouth. The objective for pH was not met in Or Creek. The objectives for turbidity were not met in the Coquitlam River downstream of the gravel pit or at the mouth. Guidelines for dissolved aluminium and total cadmium were not met on at least one occasion at most sites. The level of non-attainment revealed by the 2002 monitoring program warrants both source investigation and follow-up monitoring.

The Water Quality Index ratings for the Coquitlam River, Or Creek, and Scott Creek were all Fair in 2002, due to several objective exceedences.

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1.0 INTRODUCTION

The Coquitlam River and its tributaries drain from the north shore mountains to the Fraser River through the City of Coquitlam in the Lower Mainland. The Coquitlam headwaters drain into Coquitlam Lake, which provide drinking water for the Greater Vancouver Regional District (GVRD), while the lower portions provide valuable fisheries habitat and recreational opportunities. This attainment report focuses on water quality downstream from Coquitlam Lake. The GVRD, as a water supply purveyor, has the responsibility for water quality monitoring at the lake and headwaters.

Draining through the City of Coquitlam, the Coquitlam River system is exposed to environmental impacts associated with urbanization such as bacterial contamination, trace metals and petroleum hydrocarbon contamination and sedimentation. Monitoring of bacteriological indicators is an important step to protect the most sensitive designated uses such as primary-contact recreation and general irrigation. Important bacteriological indicators include fecal coliforms, enterococci, and *Escherichia coli* (E. coli). While fecal coliforms have historically been used as the primary indicators, *E. coli* and enterococci are considered to be better indicators of gastrointestinal disease (Swain, 1989).

Other important water quality parameters in the Coquitlam River system include water temperature, dissolved oxygen, nutrients, suspended solids, and trace metals such as copper,

lead, and zinc. Water temperature is an important factor in aquatic ecosystems, driving metabolic rates and chemical reactions. Extreme temperatures can be lethal to aquatic life. Dissolved oxygen is essential for respiration by most aquatic organisms and thus is an important parameter. There is potential for nutrient input from human activities to the water, and ammonia and nitrate are of particular concern due to their toxicity at higher concentrations to aquatic organisms, especially fish. Suspended sediments are of concern as they contribute to turbidity and when the particulates settle they can smother fish, fish spawning and rearing areas as well as fish food habitat (benthic macroinvertebrates). Suspended sediments are also a concern as they can be associated with other contaminants such as metals and petroleum hydrocarbons. Aquatic life is particularly sensitive to trace metals, which are commonly associated with urban runoff.

2.0 OVERVIEW OF STUDY AREA

2.1 Location

The Coquitlam River is located in the Lower Mainland Region, approximately 50 km east of Vancouver. The upper reaches of the Coquitlam River drain into Coquitlam Lake, one of three lakes in the GVRD used as the water supply for Greater Vancouver. Downstream from the lake, the river has a relatively steep gradient and is bordered by forest, and then by gravel pit operations. Towards its mouth, the topography near the river is relatively flat with dykes along its length to prevent flooding. Agriculture is the dominant land use near the mouth. Monitoring has focused on three locations in the mainstem (downstream of lake, downstream of gravel pit operations, and at the mouth), and on two of its major tributaries, Or Creek and Scott Creek (**Figure 1**). Or Creek enters the Coquitlam River from the east just downstream from the lake, and Scott Creek enters from the west near the mouth.

2.2 Hydrology

The Coquitlam River has a drainage area of approximately 240 km^2, with an annual precipitation of approximately 1000 mm. River discharges are influenced primarily by coastal rainfall patterns, with high flows occurring during the winter when rainfall is heaviest, and low flows in the summer. In addition, a dam at the outlet from Coquitlam Lake controls flows in the lower river. Daily average flows measured in Coquitlam River by Water Survey Canada (WSC site

number 08HM002), 1951 to 2001, were 6.06 m^3/s, daily maximum flow was 476 m^3/s, and daily minimum flow was 0.025 m^3/s.

2.3 Water Use

The Coquitlam River contains populations of steelhead trout, cutthroat trout, chum salmon, and coho salmon. The best spawning habitat occurs between the GVRD dam at the outlet from Coquitlam Lake and the gravel operations which are generally located upstream from the Hoy Creek confluence (Swain, 1989). There is also some spawning in the tributaries to the lower Coquitlam River. Salmon populations have been severely depleted since the 1950's, primarily due to year-round gravel removal activities in and along the river (Swain, 1989).

Fishing, hiking, rafting, canoeing, and some swimming occur in the lower reaches of the river. The GVRD is licensed to withdraw 159,100 m^3/d for a water supply, and a gravel operator is permitted to withdraw 612 m^3/d from the Coquitlam River for industrial use.

2.4 Potential Sources of Contamination

Since all the tributaries are in an urban environment, each is subject to accidental chemical spills that can enter through separated storm sewer systems. Although such spills are not discussed further, they could, potentially, have more impact than most of the permitted discharges. Similarly, urban runoff from parking lots and roads can also have significant impacts. Permitted discharges to the Coquitlam River system include effluents from ready-mix concrete and gravel operations. Non-point sources of pollution include pavement street runoff, septic tile fields, agricultural land use, a small closed landfill and refuse site, and surface runoff from gravel operations. Discharges of heavily sedimented stormwater from the gravel operations have been documented as causing siltation of the river bed (Swain, 1989). Historically, a large volume of sediment came off these gravel pits each year and found its way into the Coquitlam River.

3.0 METHODOLOGY

In 2002, monitoring locations for bacteriological and water quality indicators included Or Creek (1189002), Coquitlam River at GVRD gate (030019), Coquitlam River downstream of gravel pit (300011), Scott Creek downstream of Hwy. 7 (1189007), and Coquitlam River at mouth

(0300010) (**Figure 1**). Sampling dates in 2002 were November 7, 14, 21, 28, and December 5 (see photos in **Figure 2 - 6**). Bacteriological indicators monitored included fecal coliform, enterococci, and *E. coli*. Water quality indicators included dissolved oxygen, water temperature, suspended sediment, turbidity, ammonia, nitrate, nitrite, and trace metals.

Sampling was conducted during the fall, when water quality is expected to be at most risk. Sampling protocols followed those outlined by the "British Columbia Field Sampling Manual: 2003 Edition" prepared by the B.C. Ministry of Water, Land, and Air Protection. Field measurements were collected with a YSI 556 multi-meter handheld sensor. Grab samples were collected in laboratory-prepared sample bottles and delivered to the laboratory within 6 hours. Microbiological indicators were sent to CANTEST Ltd. and water quality indicators were sent to PSC Analytical Services (chemical samples).

Quality assurance and quality control (QA/QC) measures were conducted on each sample date. Blind-duplicate samples (duplicates labelled under a fictitious name) for water chemistry and bacteriology were collected from the Coquitlam River mouth site and submitted with regular samples. Field-blanks were also included, and were prepared by filling sample bottles with de-ionized water at the Coquitlam River mouth site.

Hourly precipitation data measured in Abbotsford (site SAB76 - Central Abbotsford) were provided by the GVRD. Daily mean flow values in Coquitlam River (site 08HM002) were provided by Water Survey Canada.

4.0 RESULTS AND DATA ANALYSIS

The Coquitlam River hydrograph for 2002, with sample dates marked, is shown in **Figure 2**. Figure 2 shows that sampling was conducted during the first major fall storm. Although samples were not collected during the peak of the storm, samples were relatively representative of "worst case scenario" conditions. Water chemistry and bacteriological data are summarized in appended tables (**Tables 1** and **2**). Raw field and raw bacteriological data are shown in **Table 3;** raw water chemistry data are shown in **Table 4**. Comparisons to historical data are provided in **Table 5**.

The geometric mean and 90th percentiles were obtained for bacteriological results (see **Table 1**), with the requirement that at least five samples be collected within 30 days. The range,

average, and 90th percentiles were calculated for chemical parameters where relevant (see **Table 2**). For Coquitlam River at the mouth, statistics were calculated from duplicate sample data.

The Water Quality Index was calculated as described in CCME (2001). The factors used in the index are based on results of water quality objectives attainment and include; F_1 (Scope), the number of objectives not met; F_2 (Frequency), the frequency with which objectives are not met; and F_3 (Amplitude), the amount by which objectives are not met. Table 6 in Appendix 2 gives numerical ranges for the rankings and descriptions of the rankings. Since the CCME index was adapted from the BC Ministry of Environment, Lands and Parks index, the same conditions regarding data use were applied (MOELP, 1995). Some of these conditions include omitting incomplete monitoring results and using results from short-term objectives only (MOELP, 1995).

5.0 DISCUSSION

5.1 Bacterial Indicators

The objectives for fecal coliforms, enterococci, and *E. coli* levels in the Coquitlam River watershed are shown in Table 1, and follow those developed in the objectives report (Swain, 1989):

- Fecal coliforms – geometric mean of ≤200 MPN/100 mL and 90th percentile of ≤1000 MPN/100 mL, to protect primary-contact recreation and irrigation (crops eaten raw).
- Enterococci - geometric mean of ≤20 MPN/100 mL and 90th percentile of ≤25 MPN/100 mL, to protect primary-contact recreation and irrigation (crops eaten raw).
- *Escherichia coli* - geometric mean of ≤77 MPN/100 mL and 90th percentile of ≤100 MPN/100 mL, to protect primary-contact recreation and irrigation (crops eaten raw).

Objectives for fecal coliforms were met at all sites in 2002. Of the 5 samples, those collected on November 7 were up to 10 times greater than those collected from all sites on the remaining days, which were generally much less than 100 MPN/100 mL. Similarly, *E. coli* objectives were met at all sites except Coquitlam River at the mouth, where the 90th percentile objective was not met. For enterococci, neither objective was met in Scott Creek or in Coquitlam River at the mouth, while the 90th percentile objective was not met in Coquitlam River downstream of the gravel pit.

Historically, fecal coliform data between 1972 – 1984 (Swain, 1989), showed gradually increasing levels along the length of the River from the GVRD gate to a maximum level of 1300MPN/100 mL was reached at the mouth. A similar trend was observed in 2002 data, although the highest levels were observed in the Scott Creek tributary.

5.2 Dissolved Oxygen

The objectives for dissolved oxygen levels in the Coquitlam River watershed are shown in Table 1, and follow those developed in the objectives report (Swain, 1989):

- Dissolved oxygen – the minimum dissolved oxygen level should be greater than 8.0 mg/L. As well, when embryos or larvae are present, the minimum concentration should not be less than 11.0 mg/L. This latter objective will apply between November and March.

Objectives for dissolved oxygen were not met in Or Creek, Scott Creek, or in Coquitlam River at the GVRD gate and at the mouth. Of the five field measurements, only one was below the minimum objective in Or Creek and Coquitlam River at the GVRD gate, 4 below the objective in Scott Creek, and 2 below the objective in Coquitlam River at the mouth. According to historical data, of which up to 34 measurement were collected between 1972 – 1984 (Swain, 1989), values were lowest at the mouth, ranging from 8.2 to 13.2 mg/L. Conditions may have therefore improved slightly since that time, but is difficult to be sure given differences in the number of samples and time of year of sampling.

5.3 Water Temperature

The guidelines for water temperature in the Coquitlam River watershed are shown in Table 1, and follow those outlined in the B.C. Approved Working Water Quality Guidelines for the protection of freshwater life (MWLAP, 2001):

- Water temperature – water temperature should not exceed 15^{o}C maximum, for the protection of aquatic life. This guideline is based on +1^{o}C change from the optimum rearing range of the most sensitive salmon species present (Chum).

Guidelines were met for water temperature at all sites. This guideline is not expected to be exceeded during the fall season. According to historical data, of which up to 38 measurements were collected between 1972 – 1984 (Swain, 1989), values were highest in Coquitlam River below the gravel pits and at the mouth, reaching up to 19.5^{o}C. Historical data cannot be directly compared to 2002 data due to differences in timing of sampling (i.e. fall 2002 versus year-round 1972 – 1984).

5.4 pH

The objectives for pH levels in the Coquitlam River watershed are shown in Table 1, and follow those developed in the objectives report (Swain, 1989):

- pH – pH should be between 6.5 and 8.5. If the lower objective cannot be attained, the pH should not decline by more than 0.2 units going from upstream to downstream of a discharge or series of discharges.

Objectives for pH were met at all sites, except once in Or Creek (pH 6.3). Historical data, (41 samples collected between 1972 – 1984 (Swain, 1989)), values were as low as 5.8 downstream from Coquitlam Lake, 6.3 in Scott Creek, and 6.0 in Or Creek. Although pH appears to have improved in Scott Creek and in Coquitlam River at the mouth, the sampling frequency in 2002 was not high enough to determine conclusively that pH has changed.

5.5 Suspended Sediments

The objectives for suspended sediment levels in the Coquitlam River watershed are shown in Table 1, and follow those developed in the objectives report (Swain, 1989):

- Suspended sediment – suspended sediment should not increase by more than 10 mg/L if upstream levels are ≤100 mg/L, nor by more than 10% if upstream levels exceed 100 mg/L.

Objectives for suspended sediment were met at all sites. Suspended sediments entering the Coquitlam River, especially from gravel operations, have been a concern (Swain, 1989). According to historical data, of which up to 37 samples were collected between 1972 – 1984 (Swain, 1989), maximum values were as high as 433 mg/L (Or Creek). The data may indicate that on occasion, a large amount of suspended solids may be natural. The data also suggested that suspended solids are settling to the river bottom along the length of the river.

5.6 Turbidity

The objectives for turbidity levels in the Coquitlam River watershed are shown in Table 1, and follow those developed in the objectives report (Swain, 1989):

- Turbidity – induced turbidity should increase by no more than 1 NTU if upstream values are ≤5 NTU, 5 NTU if upstream values are ≤50 NTU, and by not more than 10% if upstream values are >50 NTU.

Objectives for turbidity were not met in the Coquitlam River downstream of the gravel pit or at the mouth. Turbidity downstream of the gravel pit was up to 13 times higher than the upstream site (at the GVRD gate), while increases at the mouth were up to 10 times higher. Historical data and anecdotal observations indicate that turbidity is highly episodic in Coquitlam River, and can exceed 160 NTU (Swain, 1989).

5.7 Ammonia

The objectives for ammonia levels in the Coquitlam River watershed are shown in Table 1, and follow those developed in the objectives report (Swain, 1989):

- Ammonia – the 30-day average total ammonia-nitrogen value is not to exceed 1.84 mg/L (temperature less than 10^{o}C and pH <7).

Objectives for ammonia were met at all sites. According to historical data, levels are always well below the objective level (Swain, 1989).

5.8 Nitrate

The guidelines for nitrate-nitrogen levels in the Coquitlam River watershed are shown in Table 1, as outlined in the B.C. Approved Working Water Quality Guidelines for the protection of freshwater life (MWLAP, 2001):

- Nitrate – the maximum nitrate-nitrogen value is not to exceed 200 mg/L, or 40 mg/L average.

Guidelines for nitrate were met at all sites. According to historical data, levels are always well below the objective level (Swain, 1989).

5.9 Dissolved Aluminum

The guidelines for dissolved aluminium levels in the Coquitlam River watershed are shown in Table 1, and follow those outlined in the B.C. Approved Working Water Quality Guidelines for the protection of freshwater life (MWLAP, 2001):

- Dissolved aluminium – the maximum dissolved aluminum value is not to exceed 100 µg/L (when pH is greater than 6.5). Average dissolved aluminum is not to exceed 50 µg/L (when pH is greater than 6.5).

Guidelines for dissolved aluminium were not met at any site in 2002, with most sites exceeding the maximum guideline on both November 14 and 21. Historically, only single measurements for <u>total</u> aluminium were made at each of the five sites, and of those, three sites had total levels

that exceeded the objective level; however, these comparisons are not very meaningful since dissolved values are usually lower than total values and therefore may have met the objectives (Swain, 1989).

5.10 Total Cadmium

The guidelines for total cadmium levels in the Coquitlam River watershed are shown in Table 1, and follow those outlined in the B.C. Approved Working Water Quality Guidelines (MWLAP, 2001):

- Total cadmium – the maximum total cadmium value, under Ministry review, is hardness dependent and based on the following formula: Cd = 10 exp (0.86[log{hardness}]-3.2) in µg/L. Hardness values in the Coquitlam River watershed range from less than 5 to approximately 60 mg/L CaCO3. At this range, total cadmium guidelines range from approximately 0.01 µg/L (at 30 mg/L CaCO3) to 0.02 µg/L (at 60 mg/L CaCO3).

Guidelines for total cadmium were not met in Or Creek, Scott Creek, or Coquitlam River at the mouth. Values were slightly above the objective on December 5 at those sites, and on November 7 at the mouth site; however, these values are near the laboratory minimum detection limit and thus may not be reliable. Historically, levels were always below the objectives level, although less than 10 cadmium samples were collected in the past from only 3 sites (Swain, 1989).

5.11 Total Chromium

The guidelines for total chromium levels in the Coquitlam River watershed are shown in Table 1, and follow those outlined in the B.C. Approved Working Water Quality Guidelines (MWLAP, 2001):

- Total chromium – the maximum total chromium value is not to exceed 9 µg/L (Cr(III)).

Guidelines for total chromium were met at all sites. Historically, up to 15 chromium samples were collected from 3 sites; levels were always below the objectives level (Swain, 1989).

5.12 Total Copper

The guidelines for total copper levels in the Coquitlam River watershed are shown in Table 1, and follow those outlined in the B.C. Approved Working Water Quality Guidelines (MWLAP, 2001):

- Total copper – total copper guidelines are hardness dependent and are based on the following formula: (0.094(hardness)+2) in µg/L, where hardness is mg/L CaCO3. Based on this formula, the guideline ranges from 2.5 µg/L (at 5 mg/L CaCO3) to 7.0 µg/L (at 50 mg/L CaCO3). Average total copper is not to exceed 2 µg/L.

Objectives for total copper were met at all sites. Historically, up to 15 chromium samples were collected from 3 sites; levels were always below the objectives level (Swain, 1989).

5.13 Total Lead

The guidelines for total lead levels in the Coquitlam River watershed are shown in Table 1, and follow those outlined in the B.C. Approved Working Water Quality Guidelines (MWLAP, 2001):

- Total lead – total lead guidelines are hardness dependent. For hardness less than 8 mg/L CaCO3, maximum lead is given as 3 µg/L (none proposed for 30-day averages). For hardness greater than 8 mg/L CaCO3, maximum and 30-day averages and are based on the following formulas (respectively):
    - e(1.273 ln [hardness] - 1.460) µg/L; and
    - $3.31+e^{(1.273\ln [\text{mean hardness}] - 4.704)}$ µg/L

For hardness of 50 mg/L CaCO3, these guidelines would be equivalent to 33 µg/L (maximum) and 5 µg/L (30-day average). Guidelines for total lead were met at all sites. Historically, up to 22 lead samples were collected from 3 sites; levels were always below the objectives level (Swain, 1989).

5.14 Total Zinc

The guidelines for total zinc levels in the Coquitlam River watershed are shown in Table 1, and follow those outlined in the B.C. Approved Working Water Quality Guidelines (MWLAP, 2001):

- Total zinc – zinc guidelines are hardness dependent. For hardness less than 90 mg/L CaCO3, the maximum total zinc value is not to exceed 33 µg/L.

Objectives for total zinc were met at all sites. Historically, up to 27 zinc samples were collected from 3 sites; levels were always below the objectives level (Swain, 1989).

5.15 Water Quality Index Rating

The CCME Water Quality Index (WQI) was calculated with and without the trace metal results since they were not part of the original objectives, but are important indicators for the protection of aquatic life in this river system. The CCME Water Quality Index (WQI) ratings for Or Creek

(index=70), Coquitlam River (index=73), and Scott Creek (index=79) were all Fair in 2002, when metal results were excluded. The ratings and index values were all the same when metals were included, except the index value for the Coquitlam River increased to 76. The Fair rating for Or Creek resulted from dissolved oxygen (DO) and pH exceedences, but resulted mainly from a lack of usable attainment data, i.e. four samples were insufficient for an average calculations resulting in their exclusion. The Fair ratings for both the Coquitlam River and Scott Creek resulted mainly from enterococci and DO exceedences, although turbidity exceedences were also a factor in the Coquitlam River rating.

6.0 CONCLUSIONS AND RECOMMENDATIONS

As water quality objectives have not been monitored since 1993, the Ministry prioritized attainment monitoring in the Coquitlam River in 2002. Objectives in 2002 were met for:

- stream temperature,
- total suspended solids,
- turbidity,
- ammonia nitrogen and
- heavy metals.

Objectives in 2002 were not met for:

- bacteriology in Scott Creek for all three microbial indicators monitored.
- enterococci in the Coquitlam River downstream the gravel pit and near the Mouth.
- dissolved oxygen in Or Creek, Scott Creek and Coquitlam River at Mouth.
- pH in Or Creek

While the current and past water quality data sets are too limited to conduct detailed statistical analyses, comparison with historical data shows an overall improvement water column fecal coliforms, total suspended solids and turbidity. No trends were observed for dissolved oxygen, ammonia nitrogen and most heavy metals.

The CCME Water Quality Index (WQI) ratings for Or Creek (index=70), Coquitlam River (index=73), and Scott Creek (index=79) were all Fair in 2002. The Fair ratings for both the Coquitlam River and Scott Creek resulted mainly from enterococci and DO exceedences, although turbidity exceedences were also a factor in the Coquitlam River rating. The water uses in the Coquitlam River and its tributaries can be considered to be somewhat suitable and protected for aquatic life, wildlife, recreation, irrigation and livestock watering uses at this time.

The level of non-attainment revealed by the 2002 monitoring program warrants both source investigation and follow-up monitoring.

Resourcing of future monitoring, could hopefully be prioritized through the Stormwater Interagency Liaison Group made up of member municipalities of the Greater Vancouver Regional District with technical input from the GVRD's Environmental Monitoring Committee

7.0 REFERENCES

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Swain, L.G. 1989. Coquitlam – Pitt River area, tributaries to the lower Fraser River along the north shore, water quality assessment and objectives. British Columbia Environment. Water Management Division, Victoria, British Columbia. ISBN-0-7726-1605-1.

APPENDIX 1. FIGURES

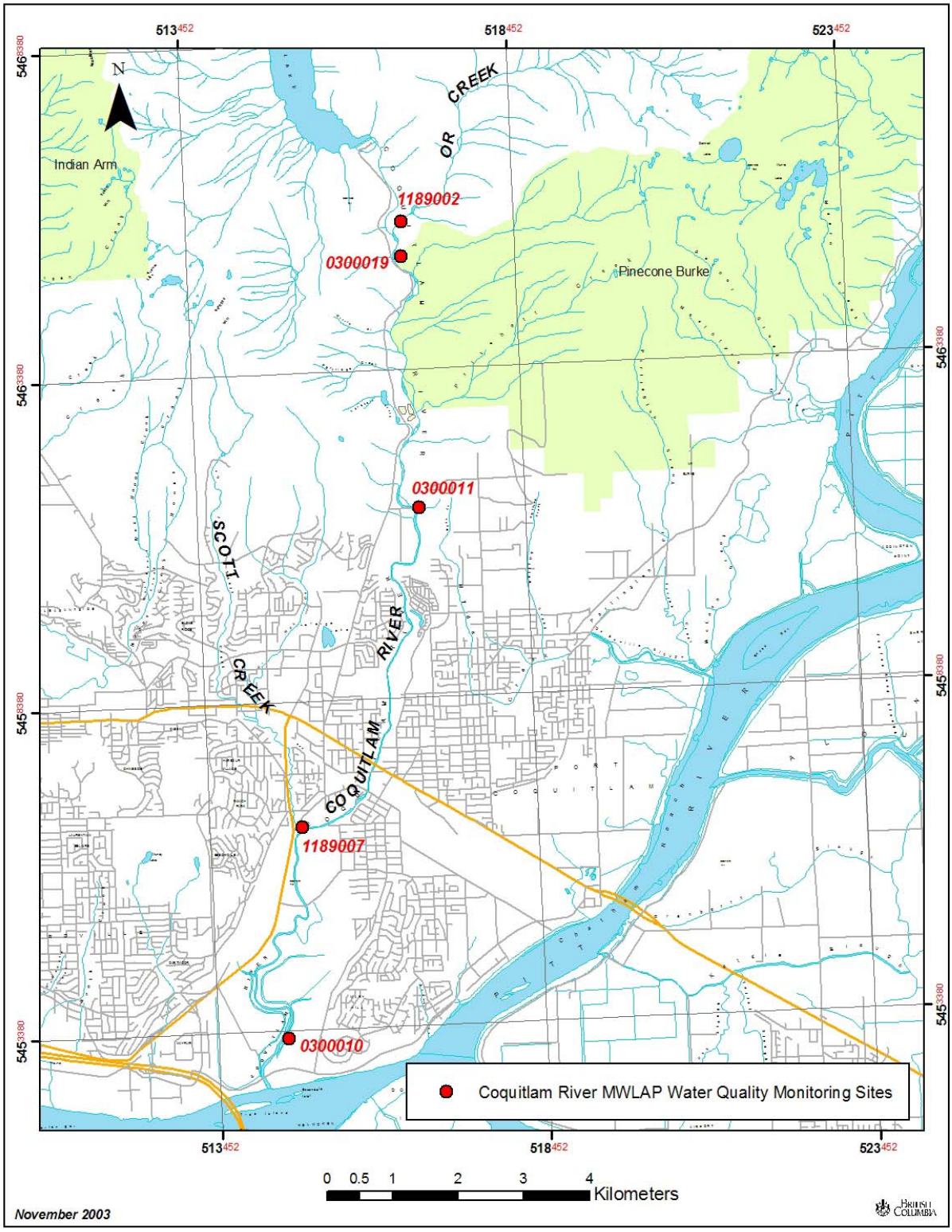


Figure 1. Coquitlam River watershed and sampling locations.

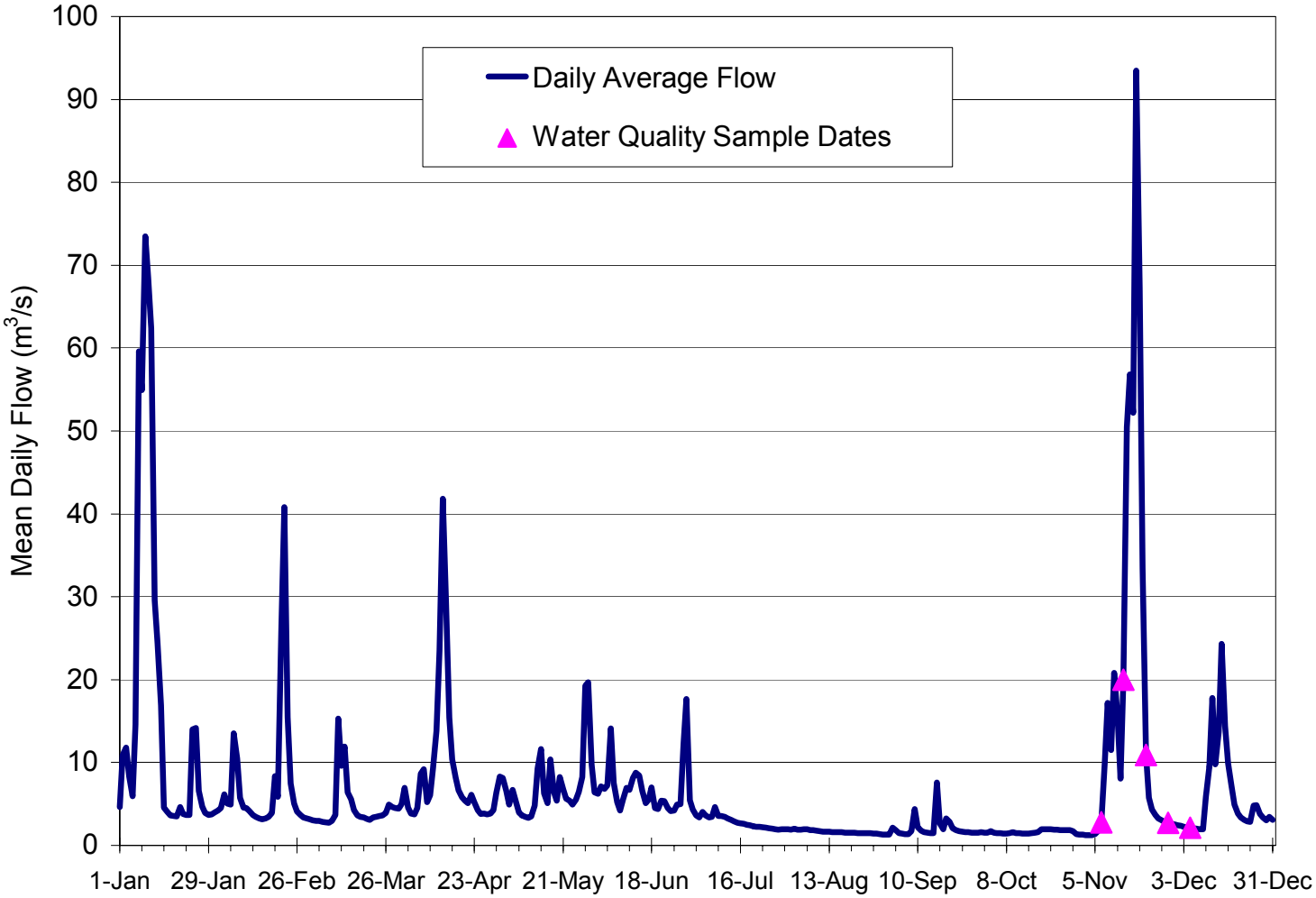


Figure 2. Coquitlam River hydrograph (WSC station 08HM002), 2002. Sample dates are marked as triangles on hydrograph.

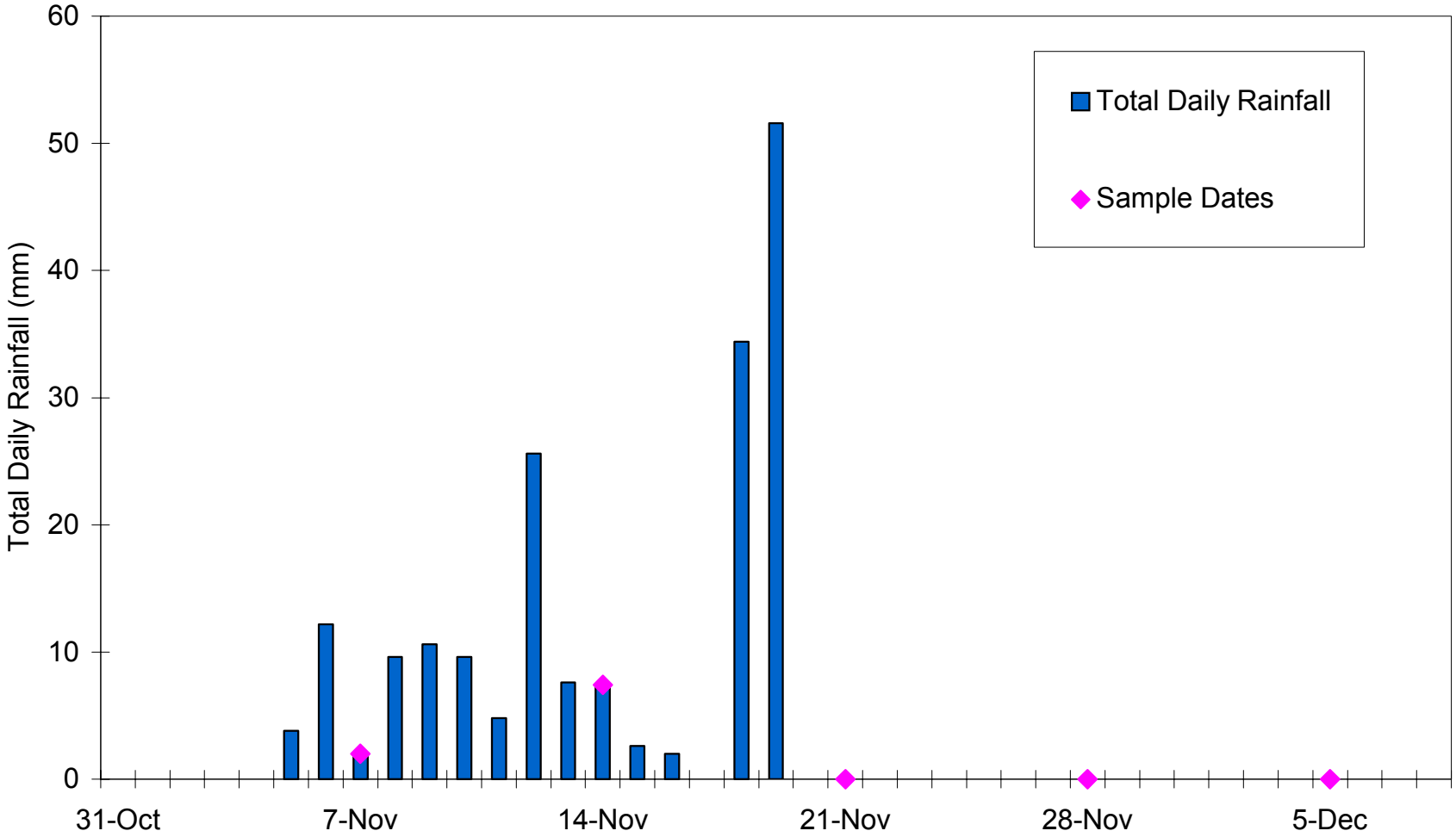


Figure 3. Total daily rainfall in Abbottsford, Nov. 1 to Dec. 5, 2002. Sample dates are marked as triangles.

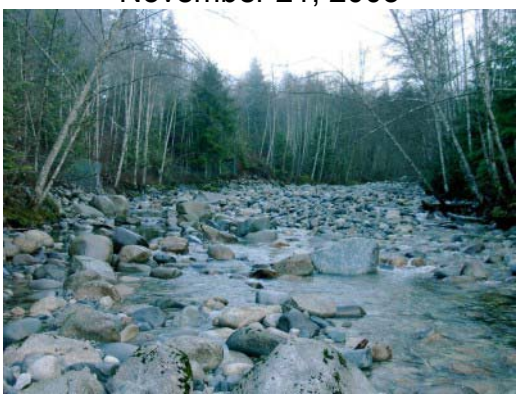
(Not sampled)

November 7, 2003

November 14, 2003

November 21, 2003

November 28, 2003



December 5, 2003

Figure 4. Photographs of Or Creek.

(No Photo)

November 7, 2003

November 14, 2003

November 21, 2003

November 28, 2003

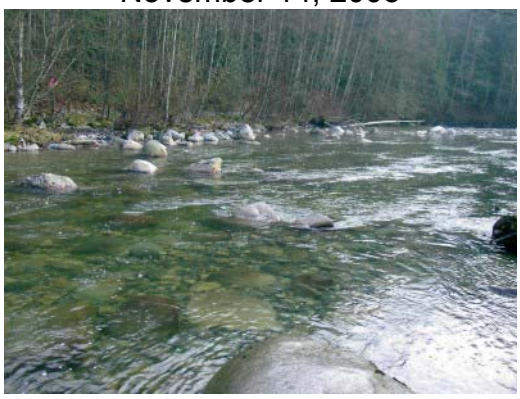
December 5, 2003

Figure 5. Photographs of Coquitlam River downstream of GVRD gate.

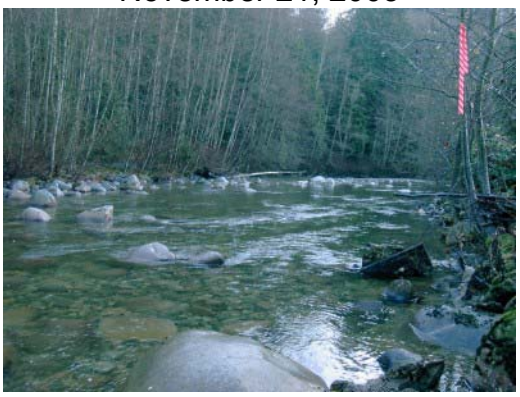
November 7, 2003

November 14, 2003

November 21, 2003



November 28, 2003



December 5, 2003

Figure 6. Photographs of Coquitlam River downstream of gravel pit.

November 7, 2003

November 14, 2003

November 21, 2003

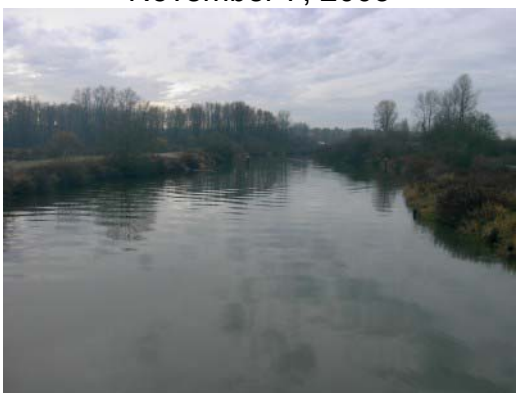
November 28, 2003

December 5, 2003

Figure 7. Photographs of Scott Creek downstream of Hwy. Bridge.

November 7, 2003

November 14, 2003



November 21, 2003

November 28, 2003

December 5, 2003

Figure 8. Photographs of Coquitlam River at mouth.

APPENDIX 2. TABLES

Table 1. Coquitlam River bacteriological objectives – 2002

Variable & Objective	Site	Date	Sample Size (n)	Range, Median (gm) 90th %'ile (np)	Conclusion
Fecal coliforms ≤200/100 mL gm ≤1000/100 mL np	Or Creek 1189002	Nov. 7, 14, 21, 28, Dec. 5	4	<1 – 2 1 2	Objectives met
≤200/100 mL gm ≤1000/100 mL np	Coquitlam River (@ GVRD gate) 0300019	Nov. 7, 14, 21, 28, Dec. 5	5	<1 – 9 2 6	Objectives met
≤200/100 mL gm ≤1000/100 mL np	Coquitlam River (d/s gravel pit) 0300011	Nov. 7, 14, 21, 28, Dec. 5	5	1 – 16 5 13	Objectives met
≤200/100 mL gm ≤1000/100 mL np	Scott Creek (below Hwy. 7) 1189007	Nov. 7, 14, 21, 28, Dec. 5	5	16 – 780 66 498	Objectives met
≤200/100 mL gm ≤1000/100 mL np	Coquitlam River at mouth 0300010	Nov. 7, 14, 21, 28, Dec. 5	5	5 – 68 38 64	Objectives met
Escherichia coli ≤77/100 mL gm ≤100/100 mL np	Or Creek 1189002	Nov. 7, 14, 21, 28, Dec. 5	4	<1 <1 <1	Objectives met
≤77/100 mL gm ≤100/100 mL np	Coquitlam River (@ GVRD gate) 0300019	Nov. 7, 14, 21, 28, Dec. 5	5	<1 – 7 2 5	Objectives met
≤77/100 mL gm ≤100/100 mL np	Coquitlam River (d/s gravel pit) 0300011	Nov. 7, 14, 21, 28, Dec. 5	5	<1 – 9 4 8	Objectives met
≤77/100 mL gm ≤100/100 mL np	Scott Creek (below Hwy. 7) 1189007	Nov. 7, 14, 21, 28, Dec. 5	5	3 – 46 23 32	Objectives met
≤77/100 mL gm ≤100/100 mL np	Coquitlam River at mouth 0300010	Nov. 7, 14, 21, 28, Dec. 5	5	13 – 250 33 164	**90th perc objective not met**
Enterococci ≤20/100 mL gm ≤25/100 mL np	Or Creek 1189002	Nov. 7, 14, 21, 28, Dec. 5	4	<1 – 8 3 7	Objective met
≤20/100 mL gm ≤25/100 mL np	Coquitlam River (@ GVRD gate) 0300019	Nov. 7, 14, 21, 28, Dec. 5	5	<1 – 15 3 11	Objective met
≤20/100 mL gm ≤25/100 mL np	Coquitlam River (d/s gravel pit) 0300011	Nov. 7, 14, 21, 28, Dec. 5	5	1 – 44 7 32	**90th perc objective not met**
≤20/100 mL gm ≤25/100 mL np	Scott Creek (below Hwy. 7) 1189007	Nov. 7, 14, 21, 28, Dec. 5	5	1 – 160 22 123	**Objectives not met**

≤20/100 mL gm ≤25/100 mL np	Coquitlam River at mouth 0300010	Nov. 7, 14, 21, 28, Dec. 5	5	12 – 870 100 710	**Objectives not met**

Table 2. Coquitlam River water quality objectives – 2002

Variable & Objective	Site	Date	Sample Size (n)	Range & Average	Conclusion
Dissolved Oxygen (mg/L) 11 min. (Nov. to March)	Or Creek 1189002	Nov. 7, 14, 21, 28, Dec. 5	4	10.9 – 12.4	**Objective not met**
11 min. (Nov. to March)	Coquitlam River (@ GVRD gate) 0300019	Nov. 7, 14, 21, 28, Dec. 5	5	10.9 – 11.6	**Objective not met**
11 min. (Nov. to March)	Coquitlam River (d/s gravel pit) 0300011	Nov. 7, 14, 21, 28, Dec. 5	5	11.1 – 11.9	Objective met
11 min. (Nov. to March)	Scott Creek (below Hwy. 7) 1189007	Nov. 7, 14, 21, 28, Dec. 5	5	9.4 – 11.1	**Objective not met**
11 min. (Nov. to March)	Coquitlam River at mouth 0300010	Nov. 7, 14, 21, 28, Dec. 5	5	9.6 – 12.4	**Objective not met**
Temperature (^{o}C) (15^{o}C max.)	Or Creek 1189002	Nov. 7, 14, 21, 28, Dec. 5	4	5.1 – 7.8	Objective met
(15^{o}C max.)	Coquitlam River (@ GVRD gate) 0300019	Nov. 7, 14, 21, 28, Dec. 5	5	6.9 – 8.5	Objective met
(15^{o}C max.)	Coquitlam River (d/s gravel pit) 0300011	Nov. 7, 14, 21, 28, Dec. 5	5	6.3 – 8.5	Objective met
(15^{o}C max.)	Scott Creek (below Hwy. 7) 1189007	Nov. 7, 14, 21, 28, Dec. 5	5	7 – 10.5	Objective met
(15^{o}C max.)	Coquitlam River at mouth 0300010	Nov. 7, 14, 21, 28, Dec. 5	5	5.6 – 9.0	Objective met
pH 6.5 – 8.5	Or Creek 1189002	Nov. 7, 14, 21, 28, Dec. 5	4	6.3 – 6.8	**Objective not met**
6.5 – 8.5	Coquitlam River (@ GVRD gate) 0300019	Nov. 7, 14, 21, 28, Dec. 5	5	6.5 – 7.0	Objective met

Variable & Objective	Site	Date	Sample Size (n)	Range & Average	Conclusion
6.5 – 8.5	Coquitlam River (d/s gravel pit) 0300011	Nov. 7, 14, 21, 28, Dec. 5	5	6.6 – 7.2	Objective met
6.5 – 8.5	Scott Creek (below Hwy. 7) 1189007	Nov. 7, 14, 21, 28, Dec. 5	5	7.3 – 7.6	Objective met
6.5 – 8.5	Coquitlam River at mouth 0300010	Nov. 7, 14, 21, 28, Dec. 5	5	6.9 – 7.9	Objective met
NFR (TSS) 10 increase from u/s	Or Creek 1189002	Nov. 7, 14, 21, 28, Dec. 5	4	<1 – 3 1	Reference (no u/s site)
10 increase from u/s	Coquitlam River (@ GVRD gate) 0300019	Nov. 7, 14, 21, 28, Dec. 5	5	<1 – 2 1	Reference (no u/s site)
10 increase from u/s	Coquitlam River (d/s gravel pit) 0300011	Nov. 7, 14, 21, 28, Dec. 5	5	1 – 10 4	Objective met
10 increase from u/s	Scott Creek (below Hwy. 7) 1189007	Nov. 7, 14, 21, 28, Dec. 5	5	1 – 10 3	Reference (no u/s site)
10 increase from u/s	Coquitlam River at mouth 0300010	Nov. 7, 14, 21, 28, Dec. 5	5	5 – 16 8.8	Objective met
Turbidity (NTU) 1 increase from u/s (when less than 5)	Or Creek 1189002	Nov. 7, 14, 21, 28, Dec. 5	4	0.11 – 0.43 0.24	Reference (no u/s site)
1 increase from u/s (when less than 5)	Coquitlam River (@ GVRD gate) 0300019	Nov. 7, 14, 21, 28, Dec. 5	5	0.34 – 0.74 0.47	Reference (no u/s site)
1 increase from u/s (when less than 5)	Coquitlam River (d/s gravel pit) 0300011	Nov. 7, 14, 21, 28, Dec. 5	5	0.49 – 13.40 3.71	**Objective not met**
1 increase from u/s (when less than 5)	Scott Creek (below Hwy. 7) 1189007	Nov. 7, 14, 21, 28, Dec. 5	5	0.91 – 3.51 1.77	Reference (no u/s site)
1 increase from u/s (when less than 5)	Coquitlam River at mouth 0300010	Nov. 7, 14, 21, 28, Dec. 5	5	1.30 – 9.82 6.55	**Objective not met**
Ammonia (mg/L) 1.84 average (temp less than 10^{o}C, pH <7)	Or Creek 1189002	Nov. 7, 14, 21, 28, Dec. 5	4	<0.005 <0.005	Objective met
1.84 average (temp less than 10^{o}C, pH <7)	Coquitlam River (@ GVRD gate) 0300019	Nov. 7, 14, 21, 28, Dec. 5	5	<0.005 <0.005	Objective met

Variable & Objective	Site	Date	Sample Size (n)	Range & Average	Conclusion
1.84 average (temp less than 10°C, pH <7)	Coquitlam River (d/s gravel pit) 0300011	Nov. 7, 14, 21, 28, Dec. 5	5	<0.005 <0.005	Objective met
1.84 average (temp less than 10°C, pH <7)	Scott Creek (below Hwy. 7) 1189007	Nov. 7, 14, 21, 28, Dec. 5	5	0.012 – 0.324 0.138	Objective met
1.84 average (temp less than 10°C, pH <7)	Coquitlam River at mouth 0300010	Nov. 7, 14, 21, 28, Dec. 5	5	<0.005 - 0.063 0.030	Objective met
Nitrate (mg/L) 40 average, 200 max.	Or Creek 1189002	Nov. 7, 14, 21, 28, Dec. 5	4	0.26 – 0.29 0.28	Objectives met
40 average, 200 max.	Coquitlam River (@ GVRD gate) 0300019	Nov. 7, 14, 21, 28, Dec. 5	5	0.17 – 0.33 0.25	Objectives met
40 average, 200 max.	Coquitlam River (d/s gravel pit) 0300011	Nov. 7, 14, 21, 28, Dec. 5	5	0.21 – 0.40 0.30	Objectives met
40 average, 200 max.	Scott Creek (below Hwy. 7) 1189007	Nov. 7, 14, 21, 28, Dec. 5	5	0.41 – 1.04 0.72	Objectives met
40 average, 200 max.	Coquitlam River at mouth 0300010	Nov. 7, 14, 21, 28, Dec. 5	5	0.09 – 0.69 0.33	Objectives met
Dissolved Aluminium (µg/L) 50 average, 100 max.	Or Creek 1189002	Nov. 7, 14, 21, 28, Dec. 5	4	58 – 172 117	**Objectives not met**
50 average, 100 max.	Coquitlam River (@ GVRD gate) 0300019	Nov. 7, 14, 21, 28, Dec. 5	5	66 – 132 94.1	**Objectives not met**
50 average, 100 max.	Coquitlam River (d/s gravel pit) 0300011	Nov. 7, 14, 21, 28, Dec. 5	5	67 – 443 173	**Objectives not met**
50 average, 100 max.	Scott Creek (below Hwy. 7) 1189007	Nov. 7, 14, 21, 28, Dec. 5	5	19 – 154 81	**Objectives not met**
50 average, 100 max.	Coquitlam River at mouth 0300010	Nov. 7, 14, 21, 28, Dec. 5	5	77 – 414 212	**Objectives not met**
Total cadmium (µg/L) 0.01 – 0.02 max.	Or Creek 1189002	Nov. 7, 14, 21, 28, Dec. 5	4	<0.01 – 0.04 0.02	**Objective not met**
0.01 – 0.02 max.	Coquitlam River (@ GVRD gate) 0300019	Nov. 7, 14, 21, 28, Dec. 5	5	<0.01 – 0.01 <0.01	Objective met

Variable & Objective	Site	Date	Sample Size (n)	Range & Average	Conclusion
0.01 – 0.02 max.	Coquitlam River (d/s gravel pit) 0300011	Nov. 7, 14, 21, 28, Dec. 5	5	<0.01 <0.01	Objective met
0.01 – 0.02 max.	Scott Creek (below Hwy. 7) 1189007	Nov. 7, 14, 21, 28, Dec. 5	5	<0.01 – 0.03 0.01	**Objective not met**
0.01 – 0.02 max.	Coquitlam River at mouth 0300010	Nov. 7, 14, 21, 28, Dec. 5	5	<0.01 – 0.06 0.02	**Objective not met**
Total Chromium (µg/L) 9 max.	Or Creek 1189002	Nov. 7, 14, 21, 28, Dec. 5	4	<0.2 <0.2	Objective met
9 max.	Coquitlam River (@ GVRD gate) 0300019	Nov. 7, 14, 21, 28, Dec. 5	5	<0.2 <0.2	Objective met
9 max.	Coquitlam River (d/s gravel pit) 0300011	Nov. 7, 14, 21, 28, Dec. 5	5	<0.2 <0.2	Objective met
9 max.	Scott Creek (below Hwy. 7) 1189007	Nov. 7, 14, 21, 28, Dec. 5	5	<0.2 – 0.4 0.04	Objective met
9 max.	Coquitlam River at mouth 0300010	Nov. 7, 14, 21, 28, Dec. 5	5	<0.2 – 0.3 0.2	Objective met
Total copper (µg/L) 2.5 – 7.0 max.	Or Creek 1189002	Nov. 7, 14, 21, 28, Dec. 5	4	<0.05 – 0.28 0.16	Objective met
2.5 – 7.0 max.	Coquitlam River (@ GVRD gate) 0300019	Nov. 7, 14, 21, 28, Dec. 5	5	<0.05 – 0.32 0.15	Objective met
2.5 – 7.0 max.	Coquitlam River (d/s gravel pit) 0300011	Nov. 7, 14, 21, 28, Dec. 5	5	<0.05 – 1.5 0.46	Objective met
2.5 – 7.0 max.	Scott Creek (below Hwy. 7) 1189007	Nov. 7, 14, 21, 28, Dec. 5	5	0.290 – 3.6 1.47	Objective met
2.5 – 7.0 max.	Coquitlam River at mouth 0300010	Nov. 7, 14, 21, 28, Dec. 5	5	0.20 – 2.12 1.27	Objective met
Lead total (µg/L) 5 average, 33 max.	Or Creek 1189002	Nov. 7, 14, 21, 28, Dec. 5	4	0.07 – 0.12 0.09	Objectives met
5 average, 33 max.	Coquitlam River (@ GVRD gate) 0300019	Nov. 7, 14, 21, 28, Dec. 5	5	0.05 – 0.11 0.08	Objectives met

Variable & Objective	Site	Date	Sample Size (n)	Range & Average	Conclusion
5 average, 33 max.	Coquitlam River (d/s gravel pit) 0300011	Nov. 7, 14, 21, 28, Dec. 5	5	<0.01 – 0.3 0.13	Objectives met
5 average, 33 max.	Scott Creek (below Hwy. 7) 1189007	Nov. 7, 14, 21, 28, Dec. 5	5	0.17 – 0.96 0.41	Objectives met
5 average, 33 max.	Coquitlam River at mouth 0300010	Nov. 7, 14, 21, 28, Dec. 5	5	0.06 – 0.39 0.25	Objectives met
Zinc total (µg/L) 33 max.	Or Creek 1189002	Nov. 7, 14, 21, 28, Dec. 5	4	0.3 – 1.5 0.9	Objective met
33 max.	Coquitlam River (@ GVRD gate) 0300019	Nov. 7, 14, 21, 28, Dec. 5	5	0.4 – 1.4 0.88	Objective met
33 max.	Coquitlam River (d/s gravel pit) 0300011	Nov. 7, 14, 21, 28, Dec. 5	5	<0.1 – 2.7 1.1	Objective met
33 max.	Scott Creek (below Hwy. 7) 1189007	Nov. 7, 14, 21, 28, Dec. 5	5	4.4 – 13.6 7.76	Objective met
33 max.	Coquitlam River at mouth 0300010	Nov. 7, 14, 21, 28, Dec. 5	5	1.7 – 3.9 2.62	Objective met

Table 3. Comparison of Coquitlam River historical data (1973 – 1984) to 2002 data.

Variable & Objective	Site	2002		1972 - 1984		Conclusion
		Sample Size (n)	Median[1]	Sample Size (n)	Median[1]	
Fecal coliforms ≤200/100 mL gm ≤100/100 mL np	Or Creek 1189002	4	<1	10	2	Improvement
≤200/100 mL gm ≤100/100 mL np	Coquitlam River (@ GVRD gate) 0300019	5	1	26	11	Improvement
≤200/100 mL gm ≤100/100 mL np	Coquitlam River (d/s gravel pit) 0300011	5	7	34	20	Improvement
≤200/100 mL gm ≤100/100 mL np	Scott Creek (below Hwy. 7) 1189007	5	54	10	420	Improvement
≤200/100 mL gm ≤100/100 mL np	Coquitlam River at mouth 0300010	5	39	29	215	Improvement
Dissolved Oxygen (mg/L) 11 min. (Nov. to March)	Or Creek 1189002	4	10.2	4	12	No change
11 min. (Nov. to March)	Coquitlam River (@ GVRD gate) 0300019	5	10.9	30	9.2	No change
11 min. (Nov. to March)	Coquitlam River (d/s gravel pit) 0300011	5	11.1	39	8.8	No change
11 min. (Nov. to March)	Scott Creek (below Hwy. 7) 1189007	5	9.4	4	11	No change
11 min. (Nov. to March)	Coquitlam River at mouth 0300010	5	9.6	34	8.2	No change
Temperature (°C) (15°C max.)	Or Creek 1189002	4	7.8	5	14	Not comparable
(15°C max.)	Coquitlam River (@ GVRD gate) 0300019	5	8.5	30	18	Not comparable
(15°C max.)	Coquitlam River (d/s gravel pit) 0300011	5	8.5	38	19.5	Not comparable

Variable & Objective	Site	2002		1972 - 1984		Conclusion
		Sample Size (n)	Median[1]	Sample Size (n)	Median[1]	
(15°C max.)	Scott Creek (below Hwy. 7) 1189007	5	10.5	5	14	Not comparable
(15°C max.)	Coquitlam River at mouth 0300010	5	9.0	33	19	Not comparable
pH 6.5 – 8.5	Or Creek 1189002	4	6.3 – 6.8	10	6.0 – 6.6	No change
6.5 – 8.5	Coquitlam River (@ GVRD gate) 0300019	5	6.5 – 7.0	33	6.1 – 7.3	No change
6.5 – 8.5	Coquitlam River (d/s gravel pit) 0300011	5	6.6 – 7.2	41	6.0 – 7.6	No change
6.5 – 8.5	Scott Creek (below Hwy. 7) 1189007	5	7.3 – 7.6	11	6.3 – 6.9	Improvement
6.5 – 8.5	Coquitlam River at mouth 0300010	5	6.9 – 7.9	31	6.0 – 7.5	Improvement
NFR (TSS) 10 increase from u/s	Or Creek 1189002	4	1	10	77	Improvement
10 increase from u/s	Coquitlam River (@ GVRD gate) 0300019	5	1	33	28.3	Improvement
10 increase from u/s	Coquitlam River (d/s gravel pit) 0300011	5	4	37	46.3	Improvement
10 increase from u/s	Scott Creek (below Hwy. 7) 1189007	5	3	10	18	Improvement
10 increase from u/s	Coquitlam River at mouth 0300010	5	8.8	27	23	Improvement
Turbidity (NTU) 1 increase from u/s (when <5)	Or Creek 1189002	4	0.24	10	21	Improvement
1 increase from u/s (when <5)	Coquitlam River (@ GVRD gate) 0300019	5	0.47	5	3.7	Improvement

Variable & Objective	Site	2002		1972 - 1984		Conclusion
		Sample Size (n)	Median[1]	Sample Size (n)	Median[1]	
1 increase from u/s (when <5)	Coquitlam River (d/s gravel pit) 0300011	5	3.71	10	6.7	Improvement
1 increase from u/s (when<5)	Scott Creek (below Hwy. 7) 1189007	5	1.77	11	8.9	Improvement
1 increase from u/s (<5)	Coquitlam River at mouth 0300010	5	6.55	7	19	Improvement
Ammonia (mg/L) 1.84 average (temp <10°C, pH <7)	Or Creek 1189002	4	<0.005	-	-	NA
1.84 average (temp less than 10°C, pH <7)	Coquitlam River (@ GVRD gate) 0300019	5	<0.005	27	0.007	No change
1.84 average (temp less than 10°C, pH <7)	Coquitlam River (d/s gravel pit) 0300011	5	<0.005	32	0.010	No change
1.84 average (temp less than 10°C, pH <7)	Scott Creek (below Hwy. 7) 1189007	5	0.138	-	-	NA
1.84 average (temp less than 10°C, pH <7)	Coquitlam River at mouth 0300010	5	0.030	27	0.060	Improvement
Nitrate (mg/L) 40 average, 200 max	Or Creek 1189002	4	0.28	-	-	NA
40 average, 200 max	Coquitlam River (@ GVRD gate) 0300019	5	0.25	18	0.22	No change
40 average, 200 max	Coquitlam River (d/s gravel pit) 0300011	5	0.30	22	0.26	No change
40 average, 200 max	Scott Creek (below Hwy. 7) 1189007	5	0.72	-	-	NA
40 average, 200 max	Coquitlam River at mouth 0300010	5	0.33	17	0.37	No change
Total cadmium (µg/L) 0.01 – 0.02 max.	Or Creek 1189002	4	1.0	-	-	NA

Variable & Objective	Site	2002		1972 - 1984		Conclusion
		Sample Size (n)	Median[1]	Sample Size (n)	Median[1]	
0.01 – 0.02 max.	Coquitlam River (@ GVRD gate) 0300019	5	1.0	9	<0.5	No change
0.01 – 0.02 max.	Coquitlam River (d/s gravel pit) 0300011	5	<0.010	9	<0. 5	No change
0.01 – 0.02 max.	Scott Creek (below Hwy. 7) 1189007	5	0.060	-	-	NA
0.01 – 0.02 max.	Coquitlam River at mouth 0300010	5	1.0	8	<0.5	No change
Total Chromium (µg/L) 9 max.	Or Creek 1189002	4	<0.2	-	-	NA
9 max.	Coquitlam River (@ GVRD gate) 0300019	5	<0.2	14	<5	No change
9 max.	Coquitlam River (d/s gravel pit) 0300011	5	<0.2	16	<5	No change
9 max.	Scott Creek (below Hwy. 7) 1189007	5	0.28	-	-	NA
9 max.	Coquitlam River at mouth 0300010	5	<0.2	15	<5	No change
Total copper (µg/L) 2.5 – 7.0 max.	Or Creek 1189002	4	3.0	-	-	NA
2.5 – 7.0 max.	Coquitlam River (@ GVRD gate) 0300019	5	3.0	25	3	No change
2.5 – 7.0 max.	Coquitlam River (d/s gravel pit) 0300011	5	3.0	30	5	No change
2.5 – 7.0 max.	Scott Creek (below Hwy. 7) 1189007	5	5.0	-	-	NA
2.5 – 7.0 max.	Coquitlam River at mouth 0300010	5	2.12	29	4	No change
Lead total (µg/L) 33 max., 5 average	Or Creek 1189002	4	4.0	-	-	NA

Variable & Objective	Site	2002		1972 - 1984		Conclusion
		Sample Size (n)	Median[1]	Sample Size (n)	Median[1]	
33 max., 5 average	Coquitlam River (@ GVRD gate) 0300019	5	5.0	18	<1	Degraded
33 max., 5 average	Coquitlam River (d/s gravel pit) 0300011	5	4.0	22	1	Degraded
33 max., 5 average	Scott Creek (below Hwy. 7) 1189007	5	5.0	-	-	NA
33 max., 5 average	Coquitlam River at mouth 0300010	5	0.39	20	1	No change
Zinc total (µg/L) 33 max.	Or Creek 1189002	4	4.0	-	-	NA
33 max.	Coquitlam River (@ GVRD gate) 0300019	5	5.0	19	6	No change
33 max.	Coquitlam River (d/s gravel pit) 0300011	5	4.0	23	6	No change
33 max.	Scott Creek (below Hwy. 7) 1189007	5	8.3	-	-	NA
33 max.	Coquitlam River at mouth 0300010	5	3.9	21	7	No change

Table 4. Coquitlam River raw field data and bacteriological data – 2002

		Nov. 7	Nov. 14	Nov. 21	Nov. 28	Dec. 5
Temperature	Or Creek		7.2	7.8	5.1	5.9
	Coquitlam River @ Gate	8.5	7.8	8.4	6.9	7
	Coquitlam River d/s Gravel Pit	8.1	8	8.5	6.3	6.9
	Scott Creek d/s of Hwy.	8.9	10.5	10.3	7	8.3
	Coquitlam River @ Mouth	6.9	8.6	9	5.9	5.6
Dissolved Oxygen	Or Creek		12.2	10.9	12.4	11.5
	Coquitlam River @ Gate	11.6	11.6	10.9	11.6	11.2
	Coquitlam River d/s Gravel Pit	11.9	11.7	11.1	11.4	11.2
	Scott Creek d/s of Hwy.	10.1	10.1	9.4	11.1	9.5
	Coquitlam River @ Mouth	12.4	10.2	9.6	11.7	11.5
Fecal coliforms	Or Creek	n/a	2	<1	<1	<1
	Coquitlam River @ Gate	9	2	1	1	<1
	Coquitlam River d/s Gravel Pit	16	5	8	7	1
	Scott Creek d/s of Hwy.	780	54	75	16	24
	Coquitlam River @ Mouth	68, 57	58, 57	41, 37	25, 33	20, 5
E. coli	Or Creek		<1	<1	<1	<1
	Coquitlam River @ Gate	7	<1	<1	1	<1
	Coquitlam River d/s Gravel Pit	9	2	5	6	<1
	Scott Creek d/s of Hwy.	31, 46	32, 30	20, 14	21, 23	16, 3
	Coquitlam River @ Mouth	250	28	34	13	13
Enterococci	Or Creek		5	3	8	<1
	Coquitlam River @ Gate	15	6	<1	1	4
	Coquitlam River d/s Gravel Pit	44	15	13	1	2
	Scott Creek d/s of Hwy.	160, 160	68, 90	45, 28	10, 14	1, 4
	Coquitlam River @ Mouth	870	470	48	12	43

Table 5. Coquitlam River raw water chemistry and trace metals data – 2002

Or Cr (@ Coquitlam R)					
Site/Parameter	**MDL[1]**	**7-Nov**	**14-Nov**	**21-Nov**	**28-Nov[2]**	**5-Dec**
pH	0.1	6.3	6.5	6.8	6.8
NFR (TSS)	1	<1	<1	<1	3
Turbidity	0.1	0.27	0.43	0.13	0.11
Hardness (total)		3.8	4	5.8	6.7
Ammonia	0.005	<0.005	<0.005	<0.005	<0.005
Nitrate	calc	0.26	0.29	0.29	0.28
Nitrate + nitrite	0.002	0.263	0.29	0.293	0.278
Nitrite	0.002	0.002	0.003	<0.002	0.003
Ortho-Phosphorus	0.001	0.001	0.003	0.001	0.004
Total phosphorus	0.002	0.004	0.004	0.004	0.003
Aluminum (dissolved)	0.3	172	147	58.3	90.6
Antimony (total)	0.005	0.024	0.005	0.044	<0.005
Arsenic (total)	0.1	0.1	<0.1	<0.1	0.1
Barium (total)	0.02	4.16	4.8	3.81	4.3
Beryllium (total)	0.02	<0.02	<0.02	<0.02	<0.02
Bismuth (total)	0.02	<0.02	<0.02	0.23	<0.02
Cadmium (total)	0.01	<0.01	<0.01	<0.01	0.04
Calcium (total)	0.05	1.27	1.24	1.85	2.09
Chromium (total)	0.2	<0.2	<0.2	<0.2	<0.2
Cobalt (total)	0.005	0.011	<0.005	<0.005	<0.005
Copper (total)	0.05	0.28	0.07	<0.05	0.25
Lead (total)	0.01	0.12	0.09	0.07	0.07
Lithium (total)	0.05	<0.05	0.28	0.22	0.28
Magnesium (total)	0.05	0.16	0.21	0.29	0.35
Manganese (total)	0.008	2.95	2.26	0.353	3.16
Molybdenum (total)	0.05	<0.05	<0.05	<0.05	<0.05
Nickel (total)	0.05	<0.05	<0.05	<0.05	<0.05
Selenium (total)	0.2	<0.2	0.5	<0.2	<0.2
Silver (total)	0.02	<0.02	<0.02	<0.02	<0.02
Strontium (total)	0.005	8.42	9.67	10.8	12.7
Thallium (total)	0.002	<0.002	<0.002	<0.002	<0.002
Tin (total)	0.01	0.01	0.04	<0.01	0.02
Uranium (total)	0.002	0.026	0.024	0.012	0.015
Vanadium (total)	0.06	0.18	0.22	0.09	0.21
Zinc (total)	0.1	1.5	1.3	0.5	0.3

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Coquitlam R (@ watershed gate)						
Site/Parameter	**MDL[1]**	**7-Nov**	**14-Nov**	**21-Nov**	**28-Nov[2]**	**5-Dec**
pH	0.1	7	6.5	6.5	6.8	6.6
NFR (TSS)	1	<1	1	2	1	<1
Turbidity	0.1	0.44	0.34	0.74	0.41	0.4
Hardness (total)		6.3	4.6	3.9	4.7	4.6
Ammonia	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nitrate	calc	0.22	0.32	0.33	0.23	0.17
Nitrate + nitrite	0.002	0.22	0.317	0.335	0.234	0.174
Nitrite	0.002	<0.002	<0.002	0.003	0.002	0.003
Ortho-Phosphorus	0.001	0.001	0.001	0.003	<0.001	0.002
Total phosphorus	0.002	0.009	0.004	0.005	0.007	0.005
Aluminum (dissolved)	0.3	65.5	132	126	74.1	72.7
Antimony (total)	0.005	<0.005	0.027	<0.005	0.016	<0.005
Arsenic (total)	0.1	0.1	0.1	<0.1	<0.1	0.1
Barium (total)	0.02	4.02	4.32	4.93	3.55	3.14
Beryllium (total)	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Bismuth (total)	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cadmium (total)	0.01	<0.01	<0.01	<0.01	<0.01	0.01
Calcium (total)	0.05	2.01	1.44	1.22	1.47	1.48
Chromium (total)	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cobalt (total)	0.005	0.016	0.008	<0.005	<0.005	<0.005
Copper (total)	0.05	0.23	0.32	<0.05	<0.05	0.1
Lead (total)	0.01	0.06	0.11	0.11	0.09	0.05
Lithium (total)	0.05	<0.05	<0.05	<0.05	0.37	<0.05
Magnesium (total)	0.05	0.31	0.24	0.2	0.26	0.22
Manganese (total)	0.008	6.62	20	11.1	7.62	7.05
Molybdenum (total)	0.05	0.14	<0.05	<0.05	<0.05	<0.05
Nickel (total)	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Selenium (total)	0.2	0.5	<0.2	0.4	<0.2	<0.2
Silver (total)	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Strontium (total)	0.005	10.3	9.47	8.09	7.58	7.6
Thallium (total)	0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Tin (total)	0.01	0.08	0.04	<0.01	<0.01	0.06
Uranium (total)	0.002	0.033	0.03	0.027	0.024	0.031
Vanadium (total)	0.06	0.21	0.2	0.25	0.14	0.18
Zinc (total)	0.1	0.8	1.4	1.1	0.4	0.7

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Coquitlam R (@ Galette Rd, d/s of gravel pit)						
Site/Parameter	**MDL[1]**	**7-Nov**	**14-Nov**	**21-Nov**	**28-Nov[2]**	**5-Dec**
pH	0.1	7.2	6.6	6.6	7	6.9
NFR (TSS)	1	3	10	6	2	1
Turbidity	0.1	1.4	13.4	2.58	0.49	0.68
Hardness (total)		9.2	6.8	5.3	7.9	8.2
Ammonia	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nitrate	calc	0.26	0.35	0.4	0.29	0.21
Nitrate + nitrite	0.002	0.266	0.35	0.405	0.291	0.214
Nitrite	0.002	0.006	<0.002	0.003	<0.002	0.002
Ortho-Phosphorus	0.001	0.002	0.002	0.002	<0.001	0.004
Total phosphorus	0.002	0.019	0.02	0.007	0.006	0.006
Aluminum (dissolved)	0.3	92.9	443	186	78.2	66.8
Antimony (total)	0.005	0.019	0.04	<0.005	0.01	0.024
Arsenic (total)	0.1	0.1	0.3	<0.1	0.2	0.1
Barium (total)	0.02	4.59	8.75	5.49	4.01	3.91
Beryllium (total)	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Bismuth (total)	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cadmium (total)	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Calcium (total)	0.05	2.75	1.83	1.55	2.26	2.41
Chromium (total)	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cobalt (total)	0.005	0.049	0.308	0.03	<0.005	<0.005
Copper (total)	0.05	0.42	1.48	0.28	<0.05	<0.05
Lead (total)	0.01	0.2	0.3	0.12	<0.01	0.03
Lithium (total)	0.05	0.09	<0.05	<0.05	0.57	0.32
Magnesium (total)	0.05	0.56	0.54	0.34	0.54	0.54
Manganese (total)	0.008	23.1	23	13.8	18.7	21.9
Molybdenum (total)	0.05	0.17	<0.05	<0.05	<0.05	<0.05
Nickel (total)	0.05	<0.05	0.29	<0.05	<0.05	<0.05
Selenium (total)	0.2	0.3	<0.2	0.4	<0.2	<0.2
Silver (total)	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Strontium (total)	0.005	14.7	12.3	11.2	13	13
Thallium (total)	0.002	<0.002	0.003	<0.002	<0.002	<0.002
Tin (total)	0.01	0.02	0.05	<0.01	0.02	0.04
Uranium (total)	0.002	0.033	0.048	0.029	0.02	0.027
Vanadium (total)	0.06	0.35	0.97	0.36	0.2	0.25
Zinc (total)	0.1	1	2.7	1.3	0.4	<0.1

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Scott Cr (@ Hwy 7)						
Site/Parameter	**MDL**	**7-Nov**	**14-Nov**	**21-Nov**	**28-Nov**	**5-Dec**
pH	0.1	7.6	7.3	7.3	7.6	7.4
NFR (TSS)	1	10	3	2	1	1
Turbidity	0.1	3.51	1.85	1.42	0.91	1.14
Hardness (total)		36.6	29.5	30.5	44.9	48.4
Ammonia	0.005	0.012	0.059	0.076	0.219	0.324
Nitrate	calc	0.41	0.81	1.04	0.71	0.64
Nitrate + nitrite	0.002	0.444	0.823	1.05	0.725	0.682
Nitrite	0.002	0.039	0.009	0.007	0.01	0.038
Ortho-Phosphorus	0.001	0.006	0.012	0.009	0.011	0.011
Total phosphorus	0.002	0.058	0.029	0.019	0.025	0.026
Aluminum (dissolved)	0.3	154	124	86	19	21.6
Antimony (total)	0.005	0.268	0.108	0.06	0.058	0.112
Arsenic (total)	0.1	1.3	0.6	0.2	0.4	0.5
Barium (total)	0.02	14.1	10.7	13.8	13.6	14.1
Beryllium (total)	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Bismuth (total)	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cadmium (total)	0.01	<0.01	<0.01	<0.01	<0.01	0.03
Calcium (total)	0.05	10.8	9.11	9.55	13.4	14.4
Chromium (total)	0.2	0.4	<0.2	<0.2	<0.2	<0.2
Cobalt (total)	0.005	0.069	0.08	0.017	<0.005	<0.005
Copper (total)	0.05	3.63	1.62	0.9	0.29	0.91
Lead (total)	0.01	0.96	0.4	0.31	0.17	0.23
Lithium (total)	0.05	0.45	<0.05	<0.05	0.45	0.38
Magnesium (total)	0.05	2.34	1.65	1.62	2.77	3.03
Manganese (total)	0.008	53	33.5	44.9	50.2	54.7
Molybdenum (total)	0.05	0.44	0.17	0.17	0.14	0.18
Nickel (total)	0.05	0.18	0.09	<0.05	<0.05	<0.05
Selenium (total)	0.2	0.2	<0.2	0.3	<0.2	<0.2
Silver (total)	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Strontium (total)	0.005	63.7	52.8	64	80.4	88.9
Thallium (total)	0.002	0.007	0.003	0.005	<0.002	<0.002
Tin (total)	0.01	0.02	0.01	0.04	<0.01	0.08
Uranium (total)	0.002	0.02	0.015	0.007	<0.002	0.004
Vanadium (total)	0.06	0.98	0.67	0.5	0.29	0.35
Zinc (total)	0.1	13.6	8.3	6.9	4.4	5.6

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Coquitlam R (@ mouth)						
Site/Parameter	**MDL**	**7-Nov**	**14-Nov**	**21-Nov**	**28-Nov**	**5-Dec**
pH	0.1	7.9, 7.9	6.9, 6.9	6.9, 6.9	7.2, 7.2	7.3, 7.3
NFR (TSS)	1	9, 9	9, 10	6, 7	5, 6	16, 11
Turbidity	0.1	7.46, 7.31	9.82, 7.32	6.74, 6.59	1.3, 1.55	8.9, 8.46
Hardness (total)		57, 58.1	9.5, 9.1	12.1, 12	18.5, 18.8	42, 41
Ammonia	0.005	<0.005, <0.005	0.008, 0.007	0.012, 0.016	0.061, 0.063	0.038, 0.055
Nitrate	calc	0.1, 0.09	0.36, 0.38	0.69, 0.59	0.38, 0.39	0.15, 0.16
Nitrate + nitrite	0.002	0.101, 0.091	0.366, 0.38	0.693, 0.597	0.385, 0.389	0.155, 0.165
Nitrite	0.002	0.004, 0.005	0.004, 0.002	0.004, 0.007	0.002, 0.002	0.006, 0.006
Ortho-Phosphorus	0.001	0.002, 0.002	0.002, 0.002	0.003, 0.003	0.004, 0.004	0.006, 0.006
Total phosphorus	0.002	0.021, 0.022	0.023, 0.024	0.016, 0.012	0.023, 0.021	0.034, 0.029
Aluminum (dissolved)	0.3	134, 146	403, 414	263, 256	78, 76.5	183, 184
Antimony (total)	0.005	0.029, 0.056	0.053, 0.055	0.009, 0.02	0.04, 0.024	0.087, 0.055
Arsenic (total)	0.1	0.5, 0.4	0.4, 0.3	<0.1, <0.1	0.2, 0.2	0.6, 0.7
Barium (total)	0.02	17.1, 17.3	8.52, 8.44	10.3, 10.5	7.86, 7.99	16.8, 17.1
Beryllium (total)	0.02	<0.02, <0.02	<0.02, <0.02	<0.02, <0.02	<0.02, <0.02	<0.02, 0.02
Bismuth (total)	0.02	<0.02, 0.08	<0.02, <0.02	<0.02, 0.04	<0.02, <0.02	<0.02, <0.02
Cadmium (total)	0.01	0.04, 0.06	<0.01, <0.01	<0.01, <0.01	<0.01, <0.01	0.04, 0.01
Calcium (total)	0.05	16.9, 17.2	2.72, 2.65	3.7, 3.66	5.58, 5.68	12.6, 12.2
Chromium (total)	0.2	<0.2, <0.2	<0.2, <0.2	<0.2, <0.2	<0.2, <0.2	0.2, 0.3
Cobalt (total)	0.005	0.138, 0.111	0.234, 0.239	0.116, 0.111	<0.005, <0.005	0.343, 0.469
Copper (total)	0.05	1.64, 1.5	1.62, 1.69	0.88, 0.85	0.2, 0.5	2.01, 2.12
Lead (total)	0.01	0.25, 0.27	0.39, 0.37	0.27, 0.35	0.06, 0.09	0.29, 0.28
Lithium (total)	0.05	1.12, 1.23	<0.05, <0.05	<0.05, <0.05	<0.05, 0.1	0.61, 0.67
Magnesium (total)	0.05	3.6, 3.69	0.65, 0.61	0.7, 0.7	1.12, 1.11	2.57, 2.57
Manganese (total)	0.008	19.5, 20.3	23.6, 23.3	31.5, 31	39.1, 39.2	43.6, 44.4
Molybdenum (total)	0.05	0.56, 0.56	0.05, 0.05	0.06, 0.06	<0.05, <0.05	0.13, 0.14
Nickel (total)	0.05	0.52, 0.54	0.27, 0.27	<0.05, <0.05	0.11, 0.12	1.25, 1.24
Selenium (total)	0.2	<0.2, <0.2	<0.2, <0.2	0.4, 0.4	<0.2, <0.2	<0.2, <0.2
Silver (total)	0.02	<0.02, <0.02	<0.02, <0.02	<0.02, <0.02	<0.02, <0.02	<0.02, <0.02
Strontium (total)	0.005	87, 86	18.3, 18.1	27.5, 27	33.4, 33.8	62.2, 61.3
Thallium (total)	0.002	0.006, 0.007	<0.002, 0.002	0.009, 0.004	<0.002, <0.002	<0.002, <0.002
Tin (total)	0.01	<0.01, 0.01	0.05, 0.02	0.06, <0.01	0.04, <0.01	<0.01, 0.05
Uranium (total)	0.002	0.234, 0.24	0.046, 0.046	0.032, 0.032	0.015, 0.016	0.132, 0.122
Vanadium (total)	0.06	0.62, 0.65	0.9, 0.95	0.75, 0.77	0.45, 0.45	1.28, 1.28
Zinc (total)	0.1	1.9, 2.3	3.9, 3.5	3.4, 3.1	2.1, 2	1.8, 1.7

[1] MDL (minimum detection limit)

2 duplicates were collected at Coquitlam River at the mouth.

Table 6. Relationship between CCME Water Quality Index (WQI) values and rankings, and descriptions of rankings (CCME, 2001)

Ranking	CCME WQI Value	Description
Excellent	95-100	Water quality is protected with a virtual absence of threat or impairment Conditions very close to natural or pristine levels
Good	80-94	Water quality is protected with only a minor degree of threat or impairment Conditions rarely depart from natural or desirable levels
Fair	65-79	Water quality is usually protected but occasionally threatened or impaired Conditions sometimes depart from natural or desirable levels
Marginal	45-64	Water quality is frequently threatened or impaired Conditions often depart from natural or desirable levels
Poor	0-44	Water quality is almost always threatened or impaired Conditions usually depart from natural or desirable levels