WATER QUALITY ASSESSMENT OF Quinsam River

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Prepared for:
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and
Environment Canada

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EXECUTIVE SUMMARY

The Quinsam River is located on eastern Vancouver Island, west of the town of Campbell River, B.C. It is a tributary to the Campbell River, which it joins 3 km inland from the Strait of Georgia. The Quinsam River basin is surrounded by various water bodies. The Campbell River and Campbell Lake border it to the north, Upper Campbell and Buttle Lakes are to the west, the Oyster River is to the south, and the Strait of Georgia is to the east. The main tributary to the Quinsam River is the Iron River, which flows from the south and meets the Quinsam River in between Quinsam and Middle Quinsam Lakes. The total drainage area of the Quinsam River is 280 km².

The Quinsam River just upstream from Middle Quinsam Lake has two B.C. Hydro dams, established in the 1950's. The second dam, located about 2 km upstream from Middle Quinsam Lake, diverts most of the water in the Upper Quinsam River through Gooseneck Lake into the Campbell River chain for hydroelectric use. The remainder of the flow, after leaving Middle Quinsam Lake, goes east for 10 km to Quinsam Lake. This section of the river has two main features, falls and a major tributary. The falls are 2 km downstream from Middle Quinsam Lake, below which is a favourite salmon spawning area, while the Iron River joins the Quinsam River upstream from Quinsam Lake.

The last segment of the Quinsam River, approximately 25 km long, flows east and then north toward its confluence with the Campbell River. On this stretch of the river are the Quinsam River Hatchery and Elk Falls Provincial Park, as well as the flow and water quality stations. The hatchery, operated by the Department of Fisheries and Oceans, is situated 3 km from the mouth of the river. The park is located near the mouth.

Fishing is a major water use associated with the Quinsam River. The river is home to a wide range of salmon, both wild and raised, as well as steelhead and cutthroat trout. Pacific salmon typically spawn below the falls downstream from Middle Quinsam Lake. This is the farthest upstream that the fish can migrate. Hatchery salmon are often introduced above the falls to encourage spawning in other parts of the river system.

Coal mining was introduced to the area when Quinsam Coal Ltd. began mining in December, 1987. The activity is concentrated near Middle Quinsam and Long Lakes,
km from Campbell River. Logging and generation of hydroelectric power are other important economic activities in the region. The Quinsam River watershed is uninhabited.

CONCLUSIONS

- Flows are typical of coastal streams, with peaks occurring during the late autumn to early winter period and low flows taking place during the late Spring through Summer periods.

- Several metals had occasional values that exceeded the guidelines for the protection of aquatic life, but also appeared to be correlated with turbidity and were likely not of biological concern. These included aluminum, cadmium, chromium, cobalt, copper, iron, and molybdenum.

- Total alkalinity has on occasion been below the guideline that indicates that there is only moderate buffering to acidic inputs. Alkalinity may be continuing to show a trend to increasing values, but this should be verified with appropriate statistics (in the 2000 Trend Report, alkalinity was shown to exhibit a statistically significant increasing trend).

- Increasing trends through time appeared to continue for a number of dissolved variables and related parameters, including boron, calcium, magnesium, sodium, sulphate, specific conductivity and hardness. These were identified as statistically significant trends in the 2000 Trend Report, and were attributed to neutralization of acid drainage at the upstream coal mine. The more current data set should be re-assessed statistically to confirm that these trends are continuing. These variables do not exceed aquatic life guidelines and therefore would appear to be of little concern to aquatic life at this time. However, benthic invertebrate assessments carried out in 2001 and 2003 indicated that the population was severely stressed, and deviated strongly from that expected. Assessments in 2004
and 2005 indicated that the population was still stressed, although not as greatly. The causes of these impacts on the benthic population are under investigation.

- Apparent colour values seem to fluctuate with turbidity and regularly exceeded the drinking water guideline for true colour; however, this is to be expected since true colour is measured on a filtered sample (i.e., turbidity removed). True colour values were lower than apparent colour values, as expected; however, values seem to fluctuate with turbidity and regularly exceeded the drinking water guideline.

- Phosphorus was measured as total dissolved phosphorus after 1999 and seemed to decrease between 1999 and 2005, probably due to this change (i.e. measurement of dissolved rather than total phosphorus), and possibly also due to a change in analytical laboratory at about that time. Regardless, phosphorus levels in the river are relatively high. The benthic populations measured at the site have shown some characteristics of nutrient enrichment, so the elevated nutrient levels measured in the river may be the cause of the deviation.

- Larger fluctuations in pH values after 2000 likely reflect a change in analytical laboratory, and the use of more sensitive analytical techniques. pH varies strongly with conductivity. A recent calculation of the Water Quality Index for the Quinsam River site assessed the river as “Fair”. This ranking resulted from a number of values that exceeded the guideline for some total metals, nutrients and alkalinity. Metals that exceeded the guideline were primarily turbidity-related, which may be natural or may be exacerbated by upstream coal mining. It is unlikely that aquatic life would be impacted by these short-term events. However the elevated phosphorus and nitrogen levels could lead to nutrient enrichment of the river, leading to nuisance plant growth, and potentially affecting local aquatic life populations.
**RECOMMENDATIONS**

- We recommend monitoring be continued for the Quinsam River at the mouth to track the possible increases in variables that have been identified in this report. As well, either trivalent and hexavalent forms of chromium should be measured in the future, or alternately, guidelines be developed for total chromium values.

Water quality indicators that are important for future monitoring are:

- flow, water temperature, specific conductivity and related dissolved ions, hardness, alkalinity, pH, turbidity, dissolved nitrogen and phosphorus; total phosphorus and dissolved oxygen should also be added,
- appropriate forms of metals for comparison to their respective guidelines,
- other variables related to drinking water, such as colour,
- and
- benthic invertebrates
ACKNOWLEDGEMENTS

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INTRODUCTION

The Quinsam River is located on eastern Vancouver Island, west of the town of Campbell River, B.C. It is a tributary to the Campbell River, which it joins 3 km inland from the Strait of Georgia. The Quinsam River basin is surrounded by various water bodies. The Campbell River and Campbell Lake border it to the north, Upper Campbell and Buttle Lakes are to the west, the Oyster River is to the south, and the Strait of Georgia is to the east (Figure 1). The main tributary to the Quinsam River is the Iron River, which flows from the south and meets the Quinsam River in between Quinsam and Middle Quinsam Lakes. The total drainage area of the Quinsam River is 280 km².

The Quinsam River originates south of Upper Quinsam Lake, roughly 30 km southwest of Campbell River, B.C. It flows north for about 5 km into Upper Quinsam Lake and then Wokas Lake. The second part of the river flows east for about 5 km before entering Middle Quinsam Lake. This portion of the Quinsam River has two B.C. Hydro dams, established in the 1950's. The second dam, located about 2 km upstream from Middle Quinsam Lake, diverts most of the water in the Upper Quinsam River through Gooseneck Lake into the Campbell River chain for hydroelectric use.

After leaving Middle Quinsam Lake, the river flows east for 10 km to Quinsam Lake. The third part of the river has two main features, falls and a major tributary. The falls are 2 km downstream from Middle Quinsam Lake, below which is a favourite salmon spawning area. The Iron River joins the Quinsam River upstream from Quinsam Lake.

The fourth segment of the Quinsam River is approximately 25 km long. It flows east and then north toward its confluence with the Campbell River. On this stretch of the river are the Quinsam River Hatchery and Elk Falls Provincial Park, as well as the flow and water quality stations. The hatchery, operated by the Department of Fisheries and Oceans, is situated 3 km from the mouth of the river. The park is located near the mouth.

Fishing is a major water use associated with the Quinsam River. The river is home to a wide range of salmon, both wild and raised, as well as steelhead and cutthroat trout. Pacific salmon typically spawn below the falls downstream from Middle Quinsam Lake.
This is the farthest upstream that the fish can migrate. Hatchery salmon are often introduced above the falls to encourage spawning in other parts of the river system.

Coal mining was introduced to the area when Quinsam Coal Ltd. began mining in December, 1987. The activity is concentrated near Middle Quinsam and Long Lakes, 27 km from Campbell River. Logging and generation of hydroelectric power are other important economic activities in the region. The Quinsam River watershed is uninhabited.

FIGURE 1: Quinsam River near the Mouth
This report assesses data from a station on the Quinsam River near its mouth. Data for the Quinsam River near the mouth have been collected at a frequency of about once every two weeks. As well, twice per year, two additional samples are collected in order to ensure that there are two periods when weekly samples are collected during five consecutive weeks, for future assessment of water quality objectives attainment. In addition, quality assurance samples (blanks and replicates) are collected three times per year.

The federal data are stored under ENVIRODAT station number BC08HD0004, and are all available on our Water Quality Website, at www.waterquality.ec.gc.ca. The water quality variables are plotted in Figures 3 to 79. Water Survey of Canada operates a flow gauge just upstream (site number BC08HD005). Flow data from 1986 to 2005 are graphed in Figure 2.

**FIGURE 2: Water Survey of Canada Flow Data for Quinsam River near the Mouth**
WATER QUALITY ASSESSMENT

The state of the water quality was assessed by comparing the values to B.C.'s approved and working guidelines for water quality (B.C. Ministry of Environment, Lands and Parks, 2001), and by looking for any obvious trends in the data. Any levels or apparent trends that were found to be deleterious or potentially deleterious to sensitive water uses, including drinking water, aquatic life, wildlife, recreation, irrigation, and livestock watering were noted in the following variable-by-variable discussion.

The following water quality indicators are not discussed as they met all water quality guidelines and showed no clearly visible trends: ammonia, arsenic, barium, beryllium, bismuth, bromide, niobium, nitrite, total nitrogen, tin, thallium, filterable residue, fixed filterable residue, non filterable residue, and fixed non filterable residue. The following water quality indicators seemed to fluctuate through the year according to turbidity concentrations, but were below guideline values and had no other trends: antimony, dissolved organic carbon, lanthanum, lithium, manganese, nickel, lead, and vanadium.

Other water quality indicators seemed to fluctuate through the year according to the specific conductivity of the water. For dissolved forms of many of these indicators, they would be a part of the measured conductivity, and this is to be expected. These types of indicators that were not measured above guideline values included: dissolved inorganic carbon, calcium, chloride, fluoride, potassium, magnesium, strontium, and uranium.

Flow (Figure 2) values are typical of coastal streams, with peaks (>100 m$^3$/s) occurring during the late autumn to early winter period and low flows (<10 m$^3$/s) taking place during the late spring through summer periods. Flow monitoring should continue because of its importance in interpreting many water quality indicators.
**Total Aluminum** (Figures 3 and 4): was measured as total and extractable forms; however, the guideline for the protection of aquatic life is expressed as a dissolved. Aluminum concentrations are strongly correlated with turbidity values, meaning that most of the aluminum is likely in particulate form and not available to aquatic life.

**Alkalinity – total** (Figure 5): has on occasion been below the 20 mg/L guideline that indicates that there is only moderate buffering to acidic inputs. Alkalinity tends to fluctuate with specific conductivity, with higher values when leak conductivity occurs. We tested alkalinity for the period of record using a linear regression analysis and determined there was a potential increasing trend ($R^2 = 0.07$). This should be verified with appropriate statistics. Low alkalinity is of concern at this site, due to the potential release of acid generated from coal mining operations upstream.

**Boron** – (Figure 10): Extractable concentrations seem to be reflective of specific conductivity, with peak values being approximately at the same time. We tested the data for possible increases through time using a linear regression analysis and determined that there was a potential increasing trend ($R^2 = 0.21$). This should be confirmed with appropriate statistics.

**Cadmium** (Figures 20 and 21): concentrations appeared to fluctuate with turbidity concentrations. Occasional cadmium concentrations that exceeded the aquatic life guideline coincided with peak turbidity values, which mean that the cadmium was likely associated with particulate matter and not biologically available.

**Cobalt** (Figures 23 and 24): one cobalt value in late 1993 exceeded the aquatic life guideline for 30-d mean concentrations; however, none since that time have exceeded the guideline. Cobalt concentrations appear to be related to turbidity concentrations, with peak values in each occurring simultaneously. This means that the cobalt is likely in particulate form and not biologically available.
Water Quality Assessment of the Quinsam River near the Mouth 1986-2004

Colour: apparent colour (Figure 25) values seem to fluctuate with turbidity and regularly exceeded the drinking water guideline for true colour; however, this is to be expected since true colour is measured on a filtered sample (i.e., turbidity removed). True colour values (Figure 26) were lower than apparent colour values, as expected; however, values seem to fluctuate with turbidity and regularly exceeded the drinking water guideline.

Specific Conductivity (Figure 27): values seem to increase during the period of record. We tested the data for possible increases through time using a linear regression analysis and determined that there was a potentially increasing trend ($R^2 = 0.24$). This should be verified with appropriate statistics.

Chromium (Figures 28 and 29): values fluctuate with turbidity values, and as a result the guideline for hexavalent chromium is exceeded during periods of high flow and turbidity. We recommend that either trivalent and hexavalent forms of chromium be measured in the future, or guidelines be developed for total chromium values.

Copper (Figures 30 and 31): values regularly exceeded the BC guidelines for 30-d mean concentrations but only on occasion exceeded the guideline for maximum concentrations. As well, values varied in relation to turbidity values, meaning that the higher copper values are likely in particulate form and not biologically available.

Iron (Figures 32 and 33): values exceeded the drinking water and aquatic life guideline of 300 µg/L more frequently in the late 1980’s and up to 1991 when preservative vial contamination was potentially a problem, although values in excess of the guidelines continues. Iron concentrations vary in relation to turbidity, so that the iron is likely in particulate form and not biologically available.

Hardness (Figure 35): values seem to increase during the period of record, and varies with conductivity. In the 2000 Trend Report, hardness and other related variables were assessed as exhibiting statistically significant increasing trends, likely due to acid neutralization procedures being used at the upstream coal mine. One value in 1990 exceeded the drinking water guideline. When tested for the period of record using a linear
regression analysis, it was determined that there was an ongoing potential increasing trend ($R^2 = 0.065$). This should be verified with appropriate statistics. **Magnesium** (Figure 41): values seem to increase during the period of record, and also varied with hardness and conductivity. We tested the data for possible increases through time using a linear regression analysis and determined that there was a potentially increasing trend ($R^2 = 0.05$) for extractable magnesium. This should be verified with appropriate statistics.

**Molybdenum** (Figures 44 and 45): values regularly exceeded the CCME guideline of 73 µg/L and on occasion the BC guideline of 1 µg/L. Values seem to fluctuate with conductivity, indicating that molybdenum is mainly in the dissolved form at the site.

**Sodium** (Figure 47): values are also related to specific conductivity and hardness, and show similar apparent increasing concentrations during the period of record. We tested the data for possible increases through time using a linear regression analysis and determined that there was a potentially increasing trend ($R^2 = 0.35$). This should be tested using appropriate statistics.

**Phosphorus** (Figures 55 and 56): values seemed to be related to turbidity values and regularly exceeded the guideline of 0.01 mg/L for drinking water supplies. Total phosphorus values ceased to be collected in 1999 and total dissolved phosphorus values continued thereafter. Total dissolved phosphorus values seemed to decrease between 1999 and 2005, and this may be related to a change in analytical laboratory at about that time. We tested the values to see if there was a trend in the data using a linear regression analysis and determined that there was a potentially decreasing trend ($R^2 = 0.10$). This should be verified using appropriate statistics. Regardless, dissolved phosphorus values at the site are quite high; benthic invertebrate populations assessed at the site are stressed, and show some indications of nutrient enrichment. Total phosphorus measurements should be re-instated at the site to assess overall phosphorus loadings.

**pH** (Figure 59): Larger fluctuations in pH values after 2000 are likely related to a change in analytical laboratory and the use of more sensitive analytical techniques at that time.
pH values correlate well with conductivity at the site. pH should continue to be monitored due to its effect on organism physiology and its influence on other variables.
REFERENCES


Quinsam River near the Mouth
Aluminum Total (ug/L)
Figure 3

- **Al Total**
- **Al Ext**
- CCME Al AW/DW Guideline Max-100 ug/L
  - pH>6.5, Ca>4mg/L, DOC>2mg/L
- CCME Al AW Guideline Max-5 ug/L
  - pH<6.5, Ca<4mg/L, DOC<2mg/L
- Turbidity (NTU)
Quinsam River near the Mouth
Aluminum Total (ug/L)
Figure 4

- **Al Total**
- **Al Ext**
- CCME Al AW/DW Guideline Max-100 ug/L
  - pH>6.5, Ca>4mg/L, DOC>2mg/L
- CCME Al AW Guideline Max-5 ug/L
  - pH<6.5, Ca<4mg/L, DOC<2mg/L
- Turbidity (NTU)
Quinsam River near the mouth

Alkalinity Total CaCO3 (mg/L)

Figure 5
Quinsam River near the mouth
Ammonia Dissolved (ug/L)
Figure 6
Quinsam River near the Mouth
Antimony Total and Extractable (ug/L)
Figure 7

CCME Sb DW Guideline Max 6 ug/L

Canada – British Columbia Water Quality Monitoring Agreement 14
Quinsam River near the mouth

Arsenic Total and Extractable (ug/L)

Figure 8

CCME/BC Max DW guideline - 25 ug/L
CCME/BC Max AW guideline - 5 ug/L
Quinsam River near the mouth
Arsenic Total and Extractable (ug/L)
Figure 9
Quinsam River near the Mouth
Boron Total and Extractable (ug/L)
Figure 10
Quinsam River near the mouth
Barium Total and Extractable (ug/L)
Figure 11

- Max BC/CCME/BC 30 Day Guideline DW - 1000 ug/L
- Mac BC Guideline AW - 5000 ug/L
Quinsam River near the mouth
Barium Total (ug/L)
Figure 12

© Max BC/CCME/BC 30 Day Guideline DW - 1000 ug/L
© Mac BC Guideline AW - 5000 ug/L
Quinsam River near the mouth
Beryllium Total and Extractable(ug/L)
Figure 13

- BC Max AW Guideline - 5.3 ug/L
- CCME DW Guideline - 4 ug/L
Quinsam River near the mouth
Beryllium Total and Extractable (ug/L)
Figure 14

BC Max AW Guideline - 5.3 ug/L
CCME DW Guideline - 4 ug/L
Quinsam River near the Mouth
Bismuth Total and Extractable (ug/L)
Figure 15
Quinsam River near the mouth
Bromide Dissolved (ug/L)
Figure 16
Quinsam River near the mouth
Carbon Dissolved Inorganic and Organic (mg/L)
Figure 17
Quinsam River near the mouth
Carbon Dissolved Inorganic and Organic (mg/L)
Figure 18
Quinsam River near the mouth
Calcium Dissolved and Extractable (mg/L)
Figure 19
Quinsam River at the mouth
Cadmium Total and Extractable (ug/L)
Figure 20

CCME/BC Max DW guideline - 5 ug/L
Quinsam River at the mouth
Cadmium Total and Extractable (ug/L)
Figure 21

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Quinsam near the mouth
Chloride Dissolved (mg/L)
Figure 22

- BC Max Cl AW Guideline - 600 mg/L
- BC Max Cl DW Guideline - 250 mg/L
- BC 30 Day AW Guideline - 150 mg/L
Quinsam River near the Mouth
Cobalt Total and Extractable (ug/L)
Figure 23

BC Co AW Guideline Max 110 ug/L
BC Co AW 30 Day Guideline Max 4 ug/L
Quinsam River near the Mouth
Cobalt Total and Extractable (ug/L)
Figure 24

BC Co AW Guideline Max 110 ug/L
BC Co AW 30 Day Guideline Max 4 ug/L
Quinsam River near the mouth
Colour Apparent (Colour Units)
Figure 25
Quinsam River near the mouth
Colour True (Colour Units)
Figure 26
Quinsam River near the mouth
Specific Conductance (uS/cm)
Figure 27
Quinsam River near the mouth
Chromium Total and Extractable (ug/L)
Figure 28

- BC Max/CCME Cr DW Guideline - 50 ug/L
- Outlier removed at 2/3/93 - 53.7 ug/L
Quinsam River near the mouth
Chromium Total and Extractable(ug/L)
Figure 29

BC Max/CCME Cr DW Guideline - 50 ug/L
Quinsam near the mouth
Copper Total and Extractable (ug/L)
Figure 30

- BC Max DW Cu Guideline - 500 ug/L
- CCME AW Cu Guideline range 2 - 39.1ug/L

Total outliers removed at 5/24/88 - 296 ug/L
5/17/88 - 47.5 ug/L
9/6/88 - 79.1 ug/L
9/27/88 - 45.1 ug/L
9/27/89 - 131 ug/L
Quinsam near the mouth
Copper Total and Extractable (ug/L)
Figure 31

- BC Max DW Cu Guideline - 500 ug/L
- CCME AW Cu Guideline range 2 - 39.1 ug/L
Quinsam River near the mouth
Iron Total (ug/L)
Figure 32

Total outlier removed at 12/13/93 - 10200 ug/L
Quinsam River near the mouth
Iron Total (ug/L)
Figure 33
Quinsam near the mouth
Fluoride Dissolved and Fluoride Total(mg/L)
Figure 34

BC 30 Day DW Guideline - 1 mg/L
BC/CCME DW Guideline - 1.5 mg/L

Dissolved outlier removed at 3/28/95 - 1.86 ug/L
Quinsam River near the mouth
Hardness Total and Total Calcd (CaCO3)
Figure 35
Quinsam River near the mouth

Potassium Dissolved and Extractable (mg/L)

Figure 36
Quinsam River near the Mouth
Lanthanum Total and Extractable (ug/L)
Figure 37
Quinsam River near the Mouth
Lanthanum Total and Extractable (ug/L)
Figure 38
Quinsam River near the mouth
Lithium Total (ug/L)
Figure 39

BC Max Li AW Guideline - 5000 ug/L
Total outlier removed at 12/13/93 - 3.2 ug/L
9/19/01 - 3.41 ug/L
Extractable outlier removed at 9/19/01 - 3.6
Quinsam River near the mouth
Lithium Total (ug/L)
Figure 40

- BC Max Li AW Guideline - 5000 ug/L
- Total outlier removed at 9/19/01 - 3.41 ug/L
- Extractable outlier removed at 9/19/01 - 3.6 ug/L
Quinsam River near the mouth
Magnesium Dissolved, Dissolved Calculated and Extractable (mg/L)
Figure 41

- BC Max DW Guideline - 100 mg/L
- Magnesium Dissolved outlier removed at 10/10/89 - 13.3 µg/L
Quinsam River near the mouth
Manganese Total and Extractable (ug/L)
Figure 42

*BC Max AW Mn Guideline range 543.64 - 2401 ug/L
*BC 30 Day Aw Mn Guideline range 606.46 - 1348 ug/L
Quinsam River near the mouth
Manganese Total (ug/L)
Figure 43

- BC Max AW Mn Guideline range 543.64 - 2401 ug/L
- BC 30 Day Aw Mn Guideline range 606.46 - 1348 ug/L
Quinsam River near the mouth
Molybdenum Total (mg/L)
Figure 44

- BC Max DW Guideline - 250 ug/L
- BC Max AW Guideline - 2000 ug/L
Quinsam River near the mouth
Molybdenum Total (mg/L)
Figure 45

- BC Max DW Guideline - 250 ug/L
- BC Max AW Guideline - 2000 ug/L
Quinsam River near the mouth
Nitrogen Dissolved NO3 and NO2 (mg/L)
Figure 46

- BC Max NO2 and NO3 DW Guideline 1 mg/L
- BC Max NO3 AW Guideline 200 mg/L
- BC Max NO 3 DW Guideline 10 mg/L
- 30-Day-BC NO3 AW Guideline 40 mg/L
- CCME Max NO3 DW Guideline 45 mg/L
- CCME Max NO3 AW Guideline 13 mg/L
Quinsam River near the mouth
Sodium Dissolved and Extractable (mg/L)
Figure 47
Quinsam River near the mouth
Nitrogen Dissolved Nitrate (mg/L)
Figure 48

- BC 30 Day/CCME NO3 AW Guideline - 40 mg/L / 13 mg/L
- BC Max NO3 AW Guideline - 200 mg/L
- BC Max/CCME NO3 DW Guideline - 10 mg/L / 45 mg/L
- BC NO2 AND NO3 DW Guideline - 1 mg/L
Quinsam River near the mouth

Nitrogen Total Dissolved (mg/L)

Figure 49

Outlier removed at 1/15/91 - 34 mg/L
1/7/03 - 4.6 mg/L
Figure 50

Quinsam River near the mouth
Nickel Total (ug/L)

BC/CCME AW Ni Guideline range 1.2 - 142.3 ug/L
Quinsam River near the mouth
Nickel Total (ug/L)
Figure 51

BC/CCME AW Ni Guideline range 1.2 - 142.3 ug/L
Quinsam River near the Mouth
Niobium Extractable (ug/L)
Figure 52
Quinsam River near the mouth
Nitrogen Nitrite (mg/L)
Figure 53
Quinsam River near the mouth

Nitrogen Total (mg/L)

Figure 54
Quinsam River near the Mouth
Phosphorus Total (mg/L)
Figure 55

Outliers removed at 12/13/93 - 0.64, 0.64, 0.9 mg/L
Quinsam River near the Mouth
Phosphorus Total Dissolved (mg/L)
Figure 56
Quinsam River near the mouth

Lead Total and Extractable (ug/L)

Figure 57

- BC Max 30 Day AW Guideline range 3.31 - 9.52 ug/L
- Max BC Pb AW Guideline range 9 - 159.1 ug/L
- CCME Pb DW Guideline - 10 ug/L
- BC Max Pb DW/RA Guideline - 50 ug/L
- CCME Pb AW Guideline range 0.002 - 6.1 ug/L
Quinsam River near the mouth

Lead Total and Extractable (ug/L)

Figure 58

- BC Max 30 Day AW Guideline range 3.31 - 9.52 ug/L
- Max BC Pb AW Guideline range 9 - 159.1 ug/L
- CCME Pb DW Guideline - 10 ug/L
- BC Max Pb DW/RA Guideline - 50 ug/L
- CCME Pb AW Guideline range 0.002 - 6.1 ug/L
Quinsam River near the mouth

Lead Total and Extractable (ug/L)

Figure 58 (a)

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- **BC Max 30 Day AW Guideline range 3.31 - 9.52 ug/L**
- **Max BC Pb AW Guideline range 9 - 159.1 ug/L**
- **CCME Pb DW Guideline - 10 ug/L**
- **BC Max Pb DW/RA Guideline - 50 ug/L**
- **CCME Pb AW Guideline range 0.002 - 6.1 ug/L**

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Water Quality Assessment of the Quinsam River near the Mouth 1986-2004

Quinsam River near the mouth
pH (relative units)
Figure 59

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Quinsam River near the Mouth
Rubidium Total and Extractable (ug/L)
Figure 60
Quinsam River near the Mouth
Rubidium Total and Extractable (ug/L)
Figure 61
Quinsam River near the mouth
Residue Filterable ug/L
Figure 62
Quinsam River near the mouth
Residue Fixed Filterable ug/L
Figure 63
Quinsam River near the mouth
Residue Fixed non-Filterable ug/L
Figure 64
Quinsam River near the mouth
Residue non-Filterable ug/L
Figure 65
Quinsam River near the Mouth
Selenium Total and Extractable (ug/L)
Figure 66

- BC/CCME Se DW Guideline Max 10 ug/L
- BC/30-Day Se AW Guideline Max 2 ug/L
- CCME SE AW Guideline Max 1 ug/L

Outlier removed at 2/17/04 - 3.54 ug/L
Quinsam River near the mouth

Silicon Extractable (mg/L)

Figure 67
Quinsam River near the mouth
Silica Reactive and Dissolved (mg/L)
Figure 68
Quinsam River near the mouth
Sulphate Dissolved (mg/L)
Figure 69

BC DW Sulphate Guideline - 500 mg/L
BC AW Sulphate Guideline - 100 mg/L
Quinsam River near the mouth
Strontium Total (ug/L)
Figure 70
Quinsam River near the mouth
Strontium Total and Extractable (ug/L)
Figure 71
Quinsam River near the Mouth
Tin Total and Extractable (ug/L)
Figure 72
Quinsam River near the Mouth
Thallium Total and Extractable (ug/L)
Figure 73
Quinsam River near the Mouth
Uranium Total and Extractable (ug/L)
Figure 74

CCME U DW Guideline Max-20 ug/L
Quinsam River near the Mouth
Uranium Total and Extractable (ug/L)
Figure 75
Quinsam River near the mouth
Vanadium Total (ug/L)
Figure 76

BC Max DW Guideline - 100 ug/L
Quinsam River near the mouth
Vanadium Total (μg/L)
Figure 77

BC Max DW Guideline - 100 μg/L

Vanadium Total
Vanadium Extractable
Turbidity (NTU)
(background)
Quinsam River near the mouth

Zinc Total and Extractable (ug/L)

Figure 78
Quinsam River near the mouth
Zinc Total and Extractable (ug/L)

Figure 79

- **BC Max Zn AW Guideline - 33 ug/L**
- **CCME Zn AW Guideline - 30 ug/L**