State Of Water Quality Of Stikine River Above Choquette River 1981-1994

Environment Environment
Canada Canada

Ministry Of Environment,
Lands And Parks

Canada - British Columbia
Water Quality Monitoring Agreement

State Of Water Quality Of
Stikine River Above Choquette River
1981-1994

Water Quality Section
Water Management Branch
Ministry Of Environment, Lands And Parks

Monitoring And Systems Branch
Pacific And Yukon Region
Environment Canada

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Executive Summary

The Stikine River is located in northwest British Columbia, flowing westward to Alaska and the Pacific Ocean. Activities occurring in the Stikine watershed include mining and forestry.

This report assesses water quality data collected at the monitoring station upstream from the confluence with the Iskut River. Water quality samples were collected between 1981 and 1994 by Environment Canada. Flow was measured at a Water Survey of Canada flow gauge located 58 km southwest of Telegraph Creek and about 70 km upstream from the water quality station.

We concluded that:

· There were no environmentally significant trends in water quality.
· Peak non-filterable residue and turbidity values occurred during peak flow periods.
· High metals and non-filterable residue occurred together in samples collected over the period of record. This would indicate that the metals were in a particulate form, probably not biologically available and would be removed by drinking water treatment needed to remove turbidity.
· Total aluminum, cadmium, chromium, copper, iron, lead, manganese, nickel and zinc, organic carbon, apparent colour, non-filterable residue and turbidity values did not meet various water quality criteria at times due to high levels of suspended sediment carried by high river flow.
· Copper levels exceeded the aquatic life criteria most of the time, suggesting a naturally high copper mineralization in the watershed.
· Turbidity removal and disinfection would be needed prior to drinking.
· The river had a low sensitivity to acid inputs.
· The river was cool enough for drinking, but too cold for water-contact recreation.
· Hardness levels were generally below the optimum range for drinking water in the summer and at or above the optimum range in the winter, but were still quite acceptable for drinking.

We recommend that monitoring be discontinued for the Stikine River above Choquette River because:

· There were no obvious or deleterious trends observed in the plotted data over the 1981 to 1994 sampling period.
· There are no water quality concerns at the present time.
· We now have an adequate baseline of data for comparison to future data.

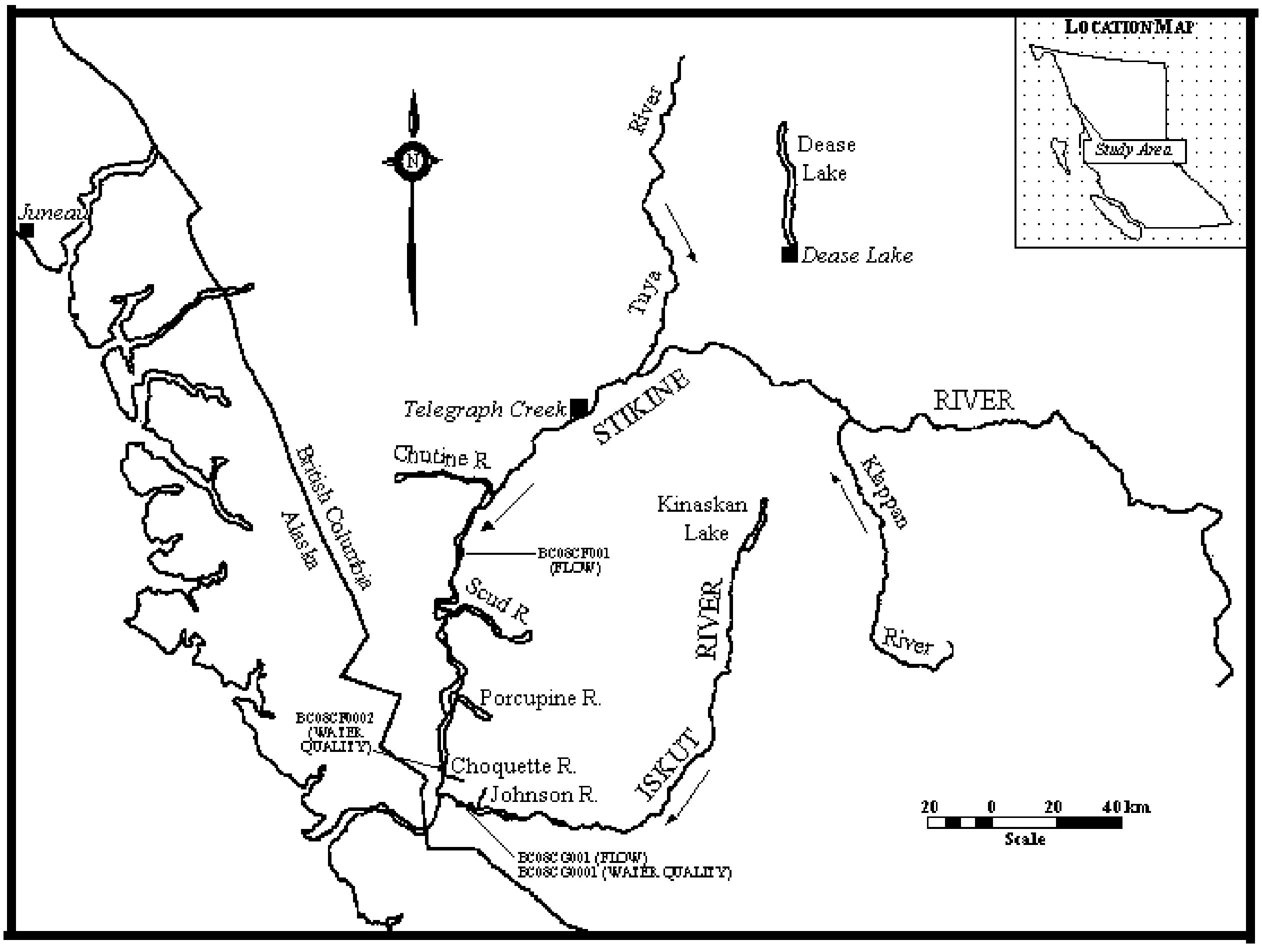

Figure 1 Map of Stikine River (Scale 1:2,100,000)

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Introduction

The Stikine River originates in the Cordilleran region of north central British Columbia. The river flows westward towards Telegraph Creek, and then takes a southward path towards its confluence with the Iskut River. The Stikine then continues westward across the Alaska border, discharging into the Pacific Ocean.

The Iskut River is the largest tributary of the Stikine River, and a number of mining operations exist in its watershed (Jang, 1996). Other tributaries include the Klappan and Tuya Rivers above Telegraph Creek, and the Chutine, Scud and Porcupine Rivers below. The Stikine River is under ice from November to April.

The water quality monitoring station is located 8.2 km upstream from the confluence of the Stikine and Iskut Rivers. Water quality of the Stikine River may be affected by mining and forestry activities. Also, the Stikine is important as a commercial fisheries resource. Telegraph Creek is located on the Stikine River, approximately 25 km downstream from the Tuya River and 100 km upstream from the water quality monitoring station.

Data for this report were obtained from samples collected primarily by Environment Canada between 1981 and 1994; the data are stored under ENVIRODAT station number BC08CF0002. The drainage area at the water quality station is about 42,250 km^2. The water quality indicators are plotted in Figures 3 to 47. Water Survey of Canada operates a flow gauge located 2.4 km above Butterfly Creek and approximately 70 km upstream from the water quality station (site number BC08CF001). The drainage area at the flow station is 36 000 km^2. Flow data from 1981 to 1993 are graphed in Figure 2.

Quality Assurance

The water quality graphs were inspected and erroneous values were removed. There were questionable values for pH, filterable residue, and air and water temperature. Total chromium, copper, lead, and zinc exhibited high values between 1986 and 1991 due to the failure of preservative vial lid liners which resulted in sample contamination. Mercury data were not plotted because all detectable values were likely due to contamination as well (Pommen, 1994). Observed pH values between 1986 and 1988 were much lower than the rest of the pH data due to laboratory method control problems at that time and have been removed from the data base. Quality assurance issues are discussed in further detail in the next section.

State of the Water Quality

The state of the water quality was judged by comparing values to the Ministry of Environment, Lands and Parks' Approved and Working Criteria for Water Quality (Nagpal *et al.*, 1995). The following 24 water quality indicators were not discussed as they easily met all water quality criteria and showed no clearly visible trends: arsenic, barium, beryllium, carbon (total inorganic), chloride, cobalt, lithium, magnesium, molybdenum, nitrate/nitrite, total dissolved nitrogen, phosphorus, potassium, filterable residue, fixed filterable residue, fixed non-filterable residue, selenium, silica, sodium, specific conductance, strontium, sulphate and vanadium.

Flow (Figure 2) values were highest during freshet (April-July). Peak flow values were similar most years except for higher values in 1990 and 1992. Lower peak values occurred in 1984, 1986, 1989 and 1991. Secondary peaks occurred in the fall due to fall rains.

Total alkalinity (Figure 3) and **calcium** (Figure 9) concentrations indicated a low sensitivity to acid inputs.

Total aluminum (Figure 4) values exceeded the 5 mg/L total aluminum criterion for wildlife and livestock three times (spring 1993 and summer 1994). These periods of high values corresponded with periods of high suspended sediments (non-filterable residues and turbidity). This suggests that the aluminum was in a particulate form and probably not biologically available. Dissolved aluminum should also be measured to permit comparisons to criteria for drinking water and aquatic life.

Total cadmium (Figure 8) had minimum detectable limits (0.0001 mg/L, 0.0005 mg/L, 0.001 mg/L) 5 to 50 times above the aquatic life criterion (0.00002 mg/L). Suspected preservative vial contamination occurred between 1986 and 1991, making values during that time questionable. High cadmium and suspended sediments occurred together in 1982, 1993 and 1994. This suggests that cadmium was in a particulate form and probably not biologically available. To evaluate the criteria for aquatic life accurately, the minimum detectable limit should be lowered to at least one-tenth of the criterion value, and dissolved cadmium should also be measured when suspended sediments or turbidity are present.

Total organic carbon (Figure 11) values exceeded the 4 mg/L criterion for drinking water 18% of the time when non-filterable residue (Figure 32) was very high. However, all values since 1983 have met this criterion.

Total chromium (Figure 13) had suspected vial contamination between 1986 and 1991 making values collected during that time questionable. Since then, two values (May 15, 1993 and Aug. 11, 1994) have exceeded the 0.02 mg/L criterion for fish. Also, 86% of the values were above the 0.002 mg/L criterion for phyto- and zoo-plankton. High chromium and suspended sediments occurred together in samples from 1993 and 1994. This suggests that chromium was in a particulate form and probably not biologically available.

Apparent colour (Figure 15) values were highest during the summer and near the minimum detectable limit (5 units) during the winter. The 100-unit recreation (maximum) criterion for true colour was met except for three times (July 2 and 9, 1982 and September 26, 1985), and the 15-unit drinking water and recreation criterion was met at least 40% of the time. However, all criteria are given as true colour values, where turbidity is removed before measurement. High apparent colour values occurred in samples with high turbidity, and thus true colour would have been much lower. True colour should be measured at the site to compare the data to the criteria effectively.

Total copper (Figure 16) exhibited high values between 1986 and 1991 due to preservative vial contamination. Seventy-eight percent of the values exceeded the upper (0.004 mg/L) aquatic life criterion, and 89% of the values exceeded the lower (0.002 mg/L) aquatic life criterion outside of the contamination period. High copper and suspended sediments occurred together. This suggests that copper was in a particulate form and probably not biologically available. However, copper exceeded the criteria even when non-filterable residue or turbidity were low, indicating that the Stikine River had naturally high copper levels. Dissolved copper should be measured in the future.

Dissolved fluoride (Figure 17) values exceeded the 0.3 mg/L criterion for aquatic life twice (Feb. 18, 1982 and Apr. 7, 1994) when hardness was greater than 50 mg/L. All sampled values met the 1.0 mg/L criteria for drinking water, wildlife and livestock.

Hardness (Figure 18) samples were within the optimum range for drinking water (80-100 mg/L as $CaCO_3$) 16% of the time. Seventy-nine percent of the values were below this range, but were still quite acceptable for drinking water. Lowest hardness values occurred in the summer and highest values occurred in the winter. Higher flow leads to increased dilution of dissolved constituents in ground water such as hardness, while lower flow results in less dilution and higher hardness values.

Total iron (Figure 19) values exceeded the 0.3 mg/L drinking water (aesthetics) and aquatic life criteria in all but two samples (Feb. 18, 1982 and Feb. 16, 1983). High values of iron and suspended sediments occurred together in samples collected between 1982 and 1994. This suggests that iron was in a particulate form and probably not biologically available. Also, iron would be removed by drinking water treatment needed to remove turbidity.

Total lead (Figure 20) had suspected vial contamination between 1986 and 1991 making values collected during that time questionable. Outside of this period, two values (Aug. 20, 1982 and May 17, 1984) were above the 0.01 mg/L criterion for drinking water. Also, 9 % of the values exceeded the upper criterion (0.007 mg/L) and 22% exceeded the lower criterion (0.004 mg/L) for aquatic life. High lead and suspended sediments occurred together in samples collected in 1982, 1984, 1993 and 1994. This suggests that lead was in a particulate form and probably not biologically available. Also, lead would be removed by drinking water treatment needed to remove turbidity.

Total manganese (Figure 23) values exceeded the criterion for aquatic life (0.1 mg/L) 44% of the time and the criterion for drinking water aesthetics (0.05 mg/L) 73% of the time. High manganese and suspended sediments occurred together between 1982 and 1994. This suggests that manganese was in a particulate form and probably not biologically available. Also, manganese would be removed by drinking water treatment needed to remove turbidity.

Total nickel (Figure 25) had one value (May 15, 1993) above the 0.025 mg/L lower criterion for aquatic life. However, the hardness corresponding to this value (60.6 mg/L) is above the criterion's hardness range, so this value is acceptable. High nickel values in 1993 and 1994 corresponded to high values of suspended sediments. This would indicate that the nickel was in a particulate form and probably not biologically available.

pH (Figure 28) values between 1986 and 1988 were low because of federal laboratory control problems, and have been omitted. One value (June 16, 1994) was below the 6.5-unit lower limit for drinking water and aquatic life, but is a probable error. All other values met criteria.

Non-filterable residue (Figure 32) exceeded the 25 mg/L criterion for good fisheries 82% of the time, although this criterion may not necessarily apply to mountain and northern streams. Peak non-filterable residue values corresponded to peak flows. Figure 33 illustrates the relationship between non-filterable residue and flow. Many water quality indicators reported high values corresponding to high non-filterable residue. Non-filterable residue and turbidity (Figure 44) had nearly identical patterns.

Air temperature (Figure 42) values did not drop below 0°C during the winter prior to 1992. This pattern has been noticed at several of the long-term stations in B.C. and may be due to a systematic error in measuring or recording air temperature (Pommen, 1996).

Water temperature (Figure 43) exceeded the 15°C upper aesthetic limit for drinking water and the lower limit for recreation once (Aug. 17, 1989). This means that the water was cool enough to be aesthetically pleasing for drinking, but too cold for water-contact recreation such as swimming.

Turbidity (Figure 44) values exceeded the 50 NTU criterion for recreation 43% of the time. The 5 NTU aesthetics criterion for drinking water was exceeded 83% of the time during peak flows, and the 1 NTU health criterion for drinking water was exceeded 96% of the time. Figure 45 illustrates the relationship between turbidity and flow. Turbidity removal and disinfection would be needed prior to drinking.

Total zinc (Figure 47) may have had high values due to preservative vial contamination between 1986 and 1991. Outside that period, 9% of the values were above the 0.03 mg/L fish and invertebrates criterion. Additionally, 31% of the values exceeded the 0.015 mg/L algae criterion. High zinc and suspended sediments occurred together in samples collected during peak flows. This suggests that zinc was in a particulate form and probably not biologically available.

Conclusions - State of Water Quality

· There were no environmentally significant trends in water quality that could be identified through visual examination of the data.
· Peak non-filterable residue and turbidity values occurred during peak flow periods.
· High metals and non-filterable residue occurred together in samples collected over the period of record. This would indicate that the metals were in a particulate form, probably not biologically available and would be removed by drinking water treatment needed to remove turbidity.
· Total aluminum, cadmium, chromium, copper, iron, lead, manganese, nickel and zinc, organic carbon, apparent colour, non-filterable residue and turbidity values did not meet various water quality criteria at times due to high levels of suspended sediment carried by high river flow.
· Copper levels exceeded the aquatic life criteria most of the time, suggesting a naturally high copper mineralization in the watershed.

· Turbidity removal and disinfection would be needed prior to drinking.
· The river had a low sensitivity to acid inputs.
· The river was cool enough for drinking, but too cold for water-contact recreation.
· Hardness levels were generally below the optimum range for drinking water in the summer months and at or above the optimum range in the winter months, but were still quite acceptable for drinking.

Recommendations for Water Quality Management

Remediation

· No remedial activities appear to be necessary at this time.

Monitoring

We recommend that monitoring be discontinued for the Stikine River above Choquette River because:

· There were no obvious or deleterious trends observed in the plotted data over the 1981 to 1994 sampling period.
· There are no water quality concerns at the present time.
· We now have an adequate baseline of data for comparison to future data.

Figure 2 Flow

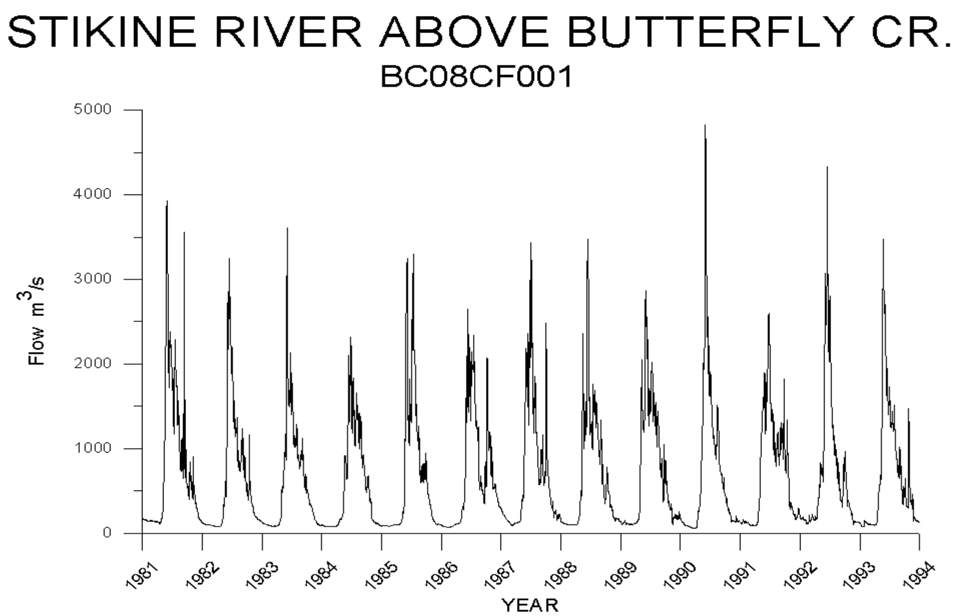


Figure 3 Total Alkalinity

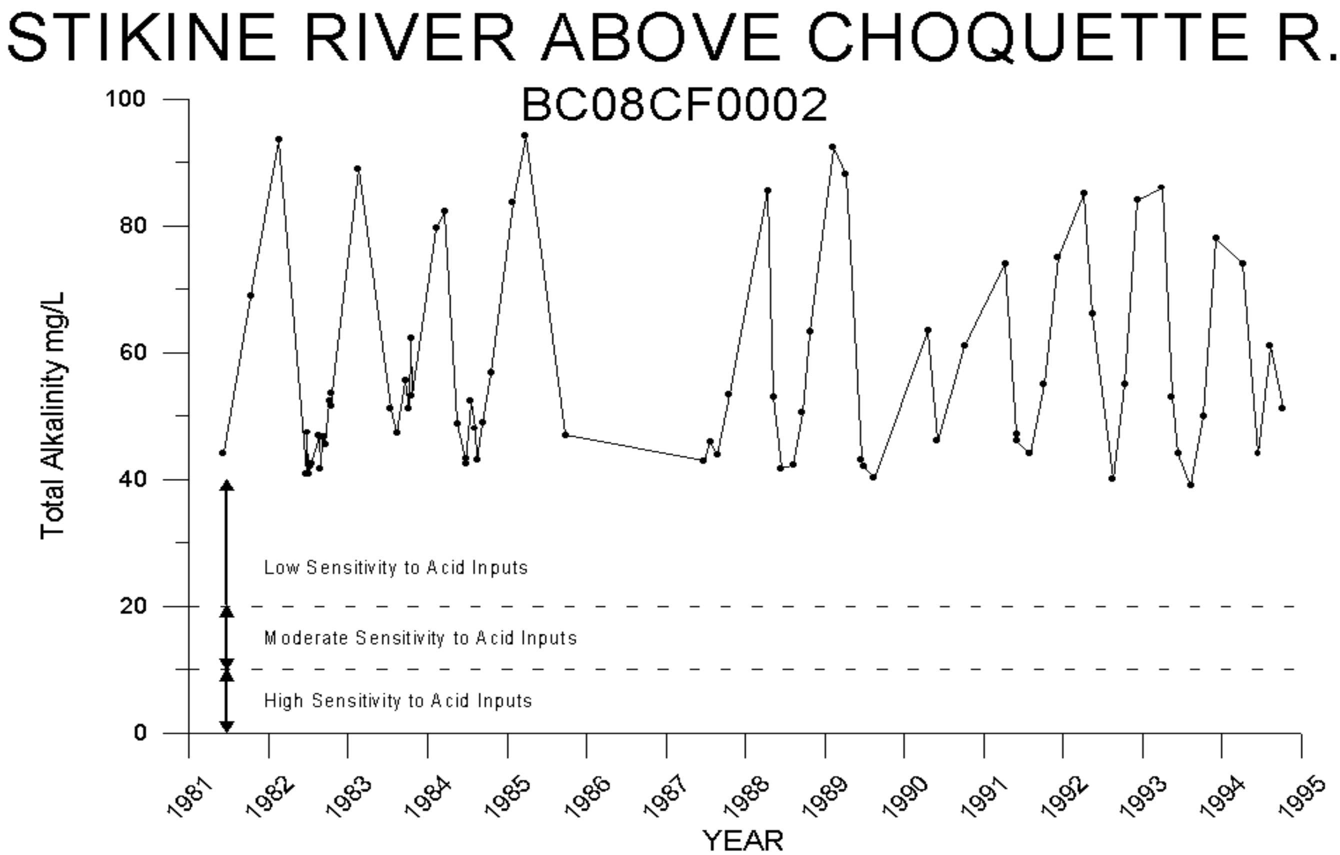


Figure 4 Total Aluminum

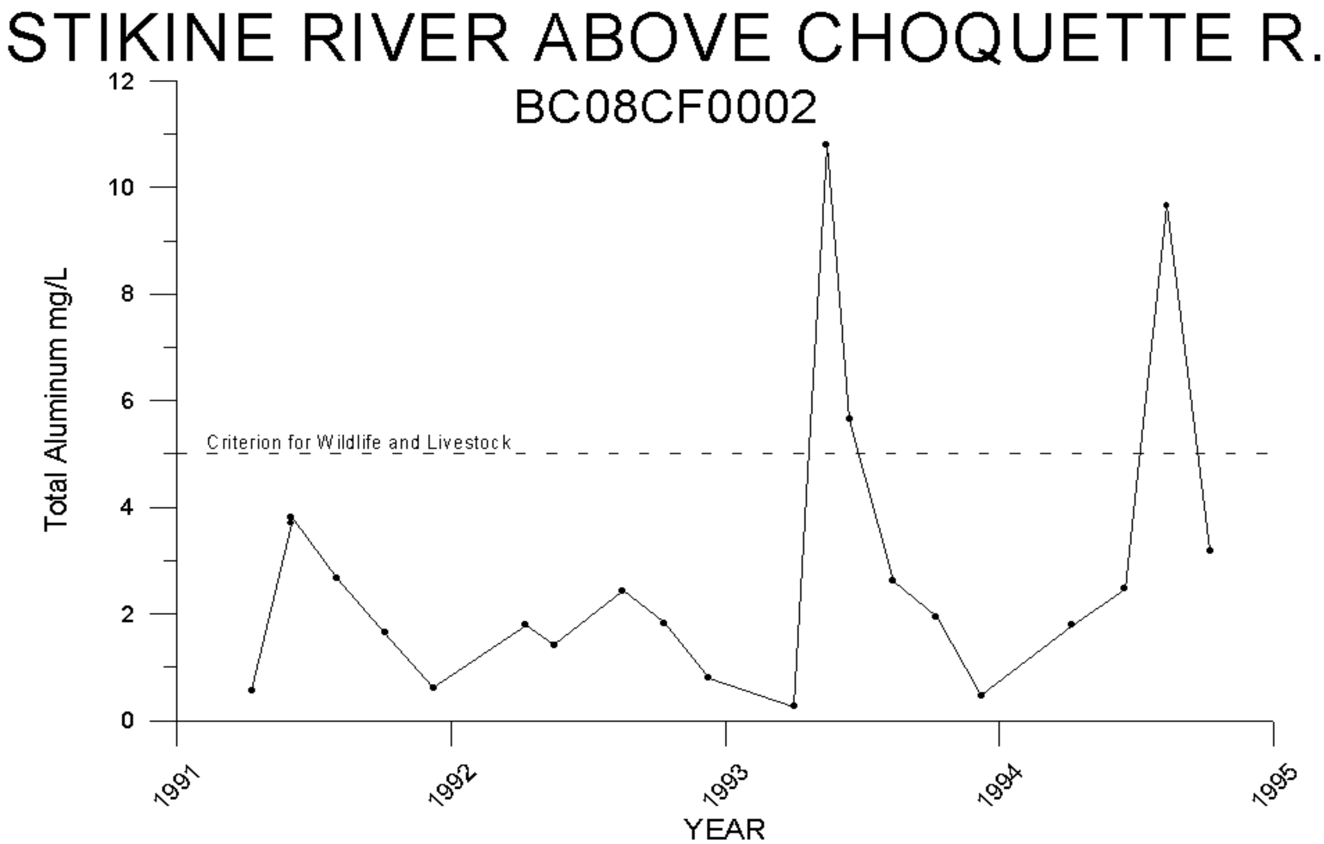


Figure 5 Total Arsenic

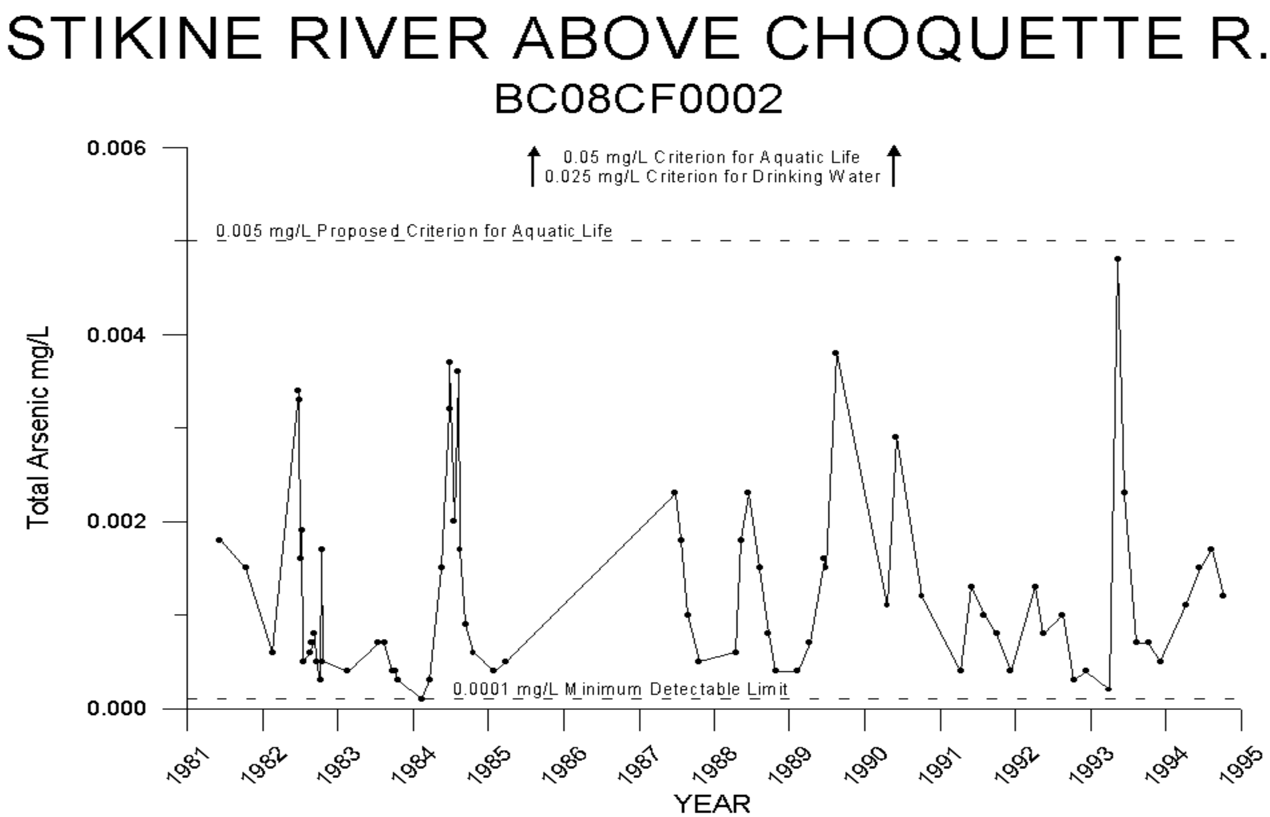


Figure 6 Total Barium

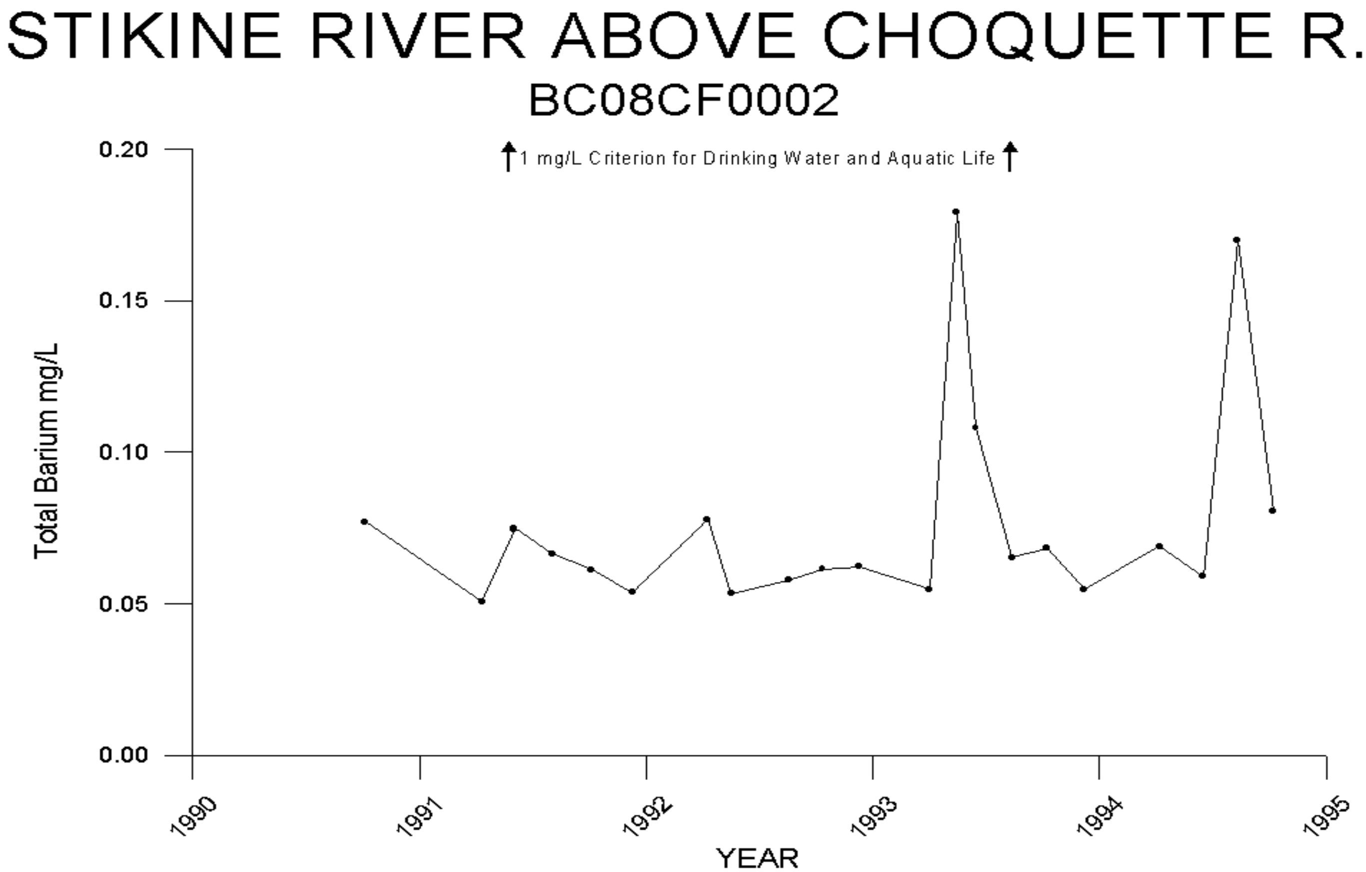


Figure 7 Total Beryllium

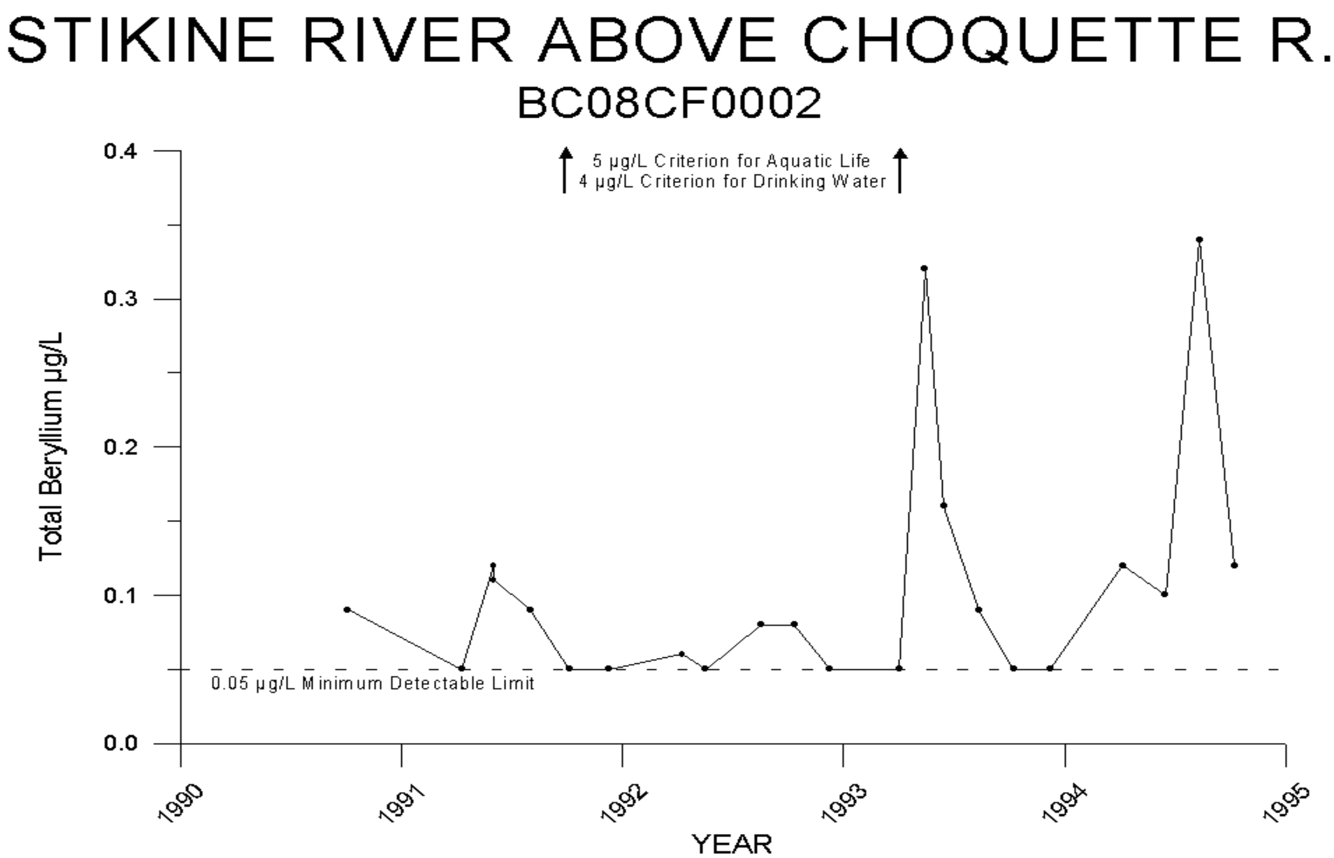


Figure 8 Total Cadmium

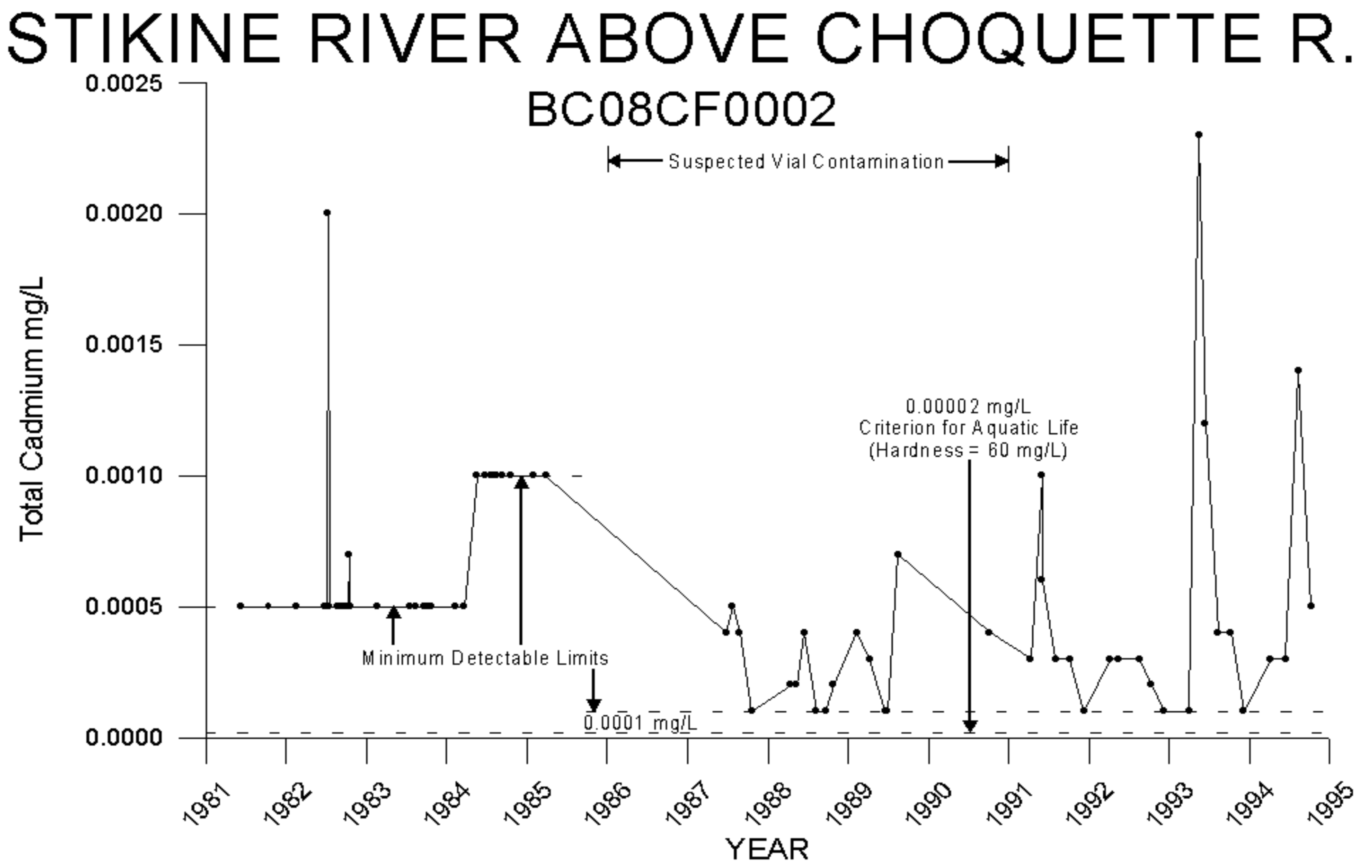


Figure 9 Calcium

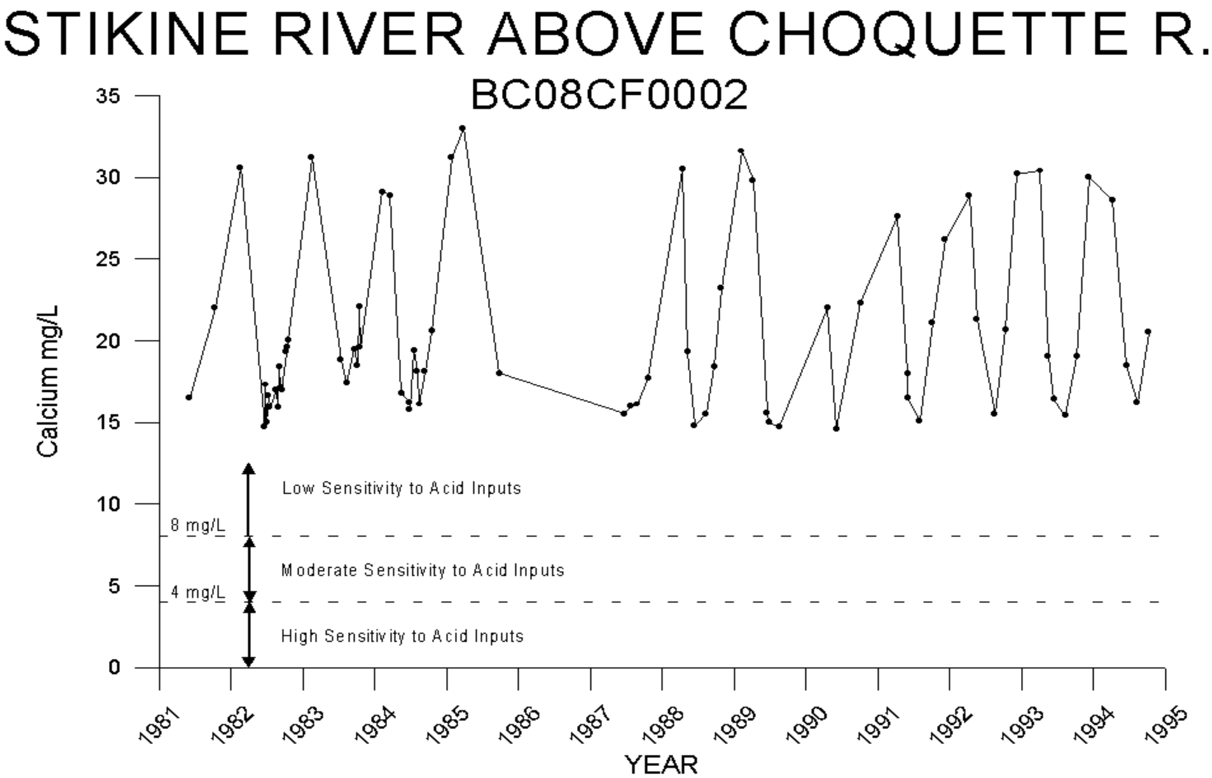


Figure 10 Total Inorganic Carbon

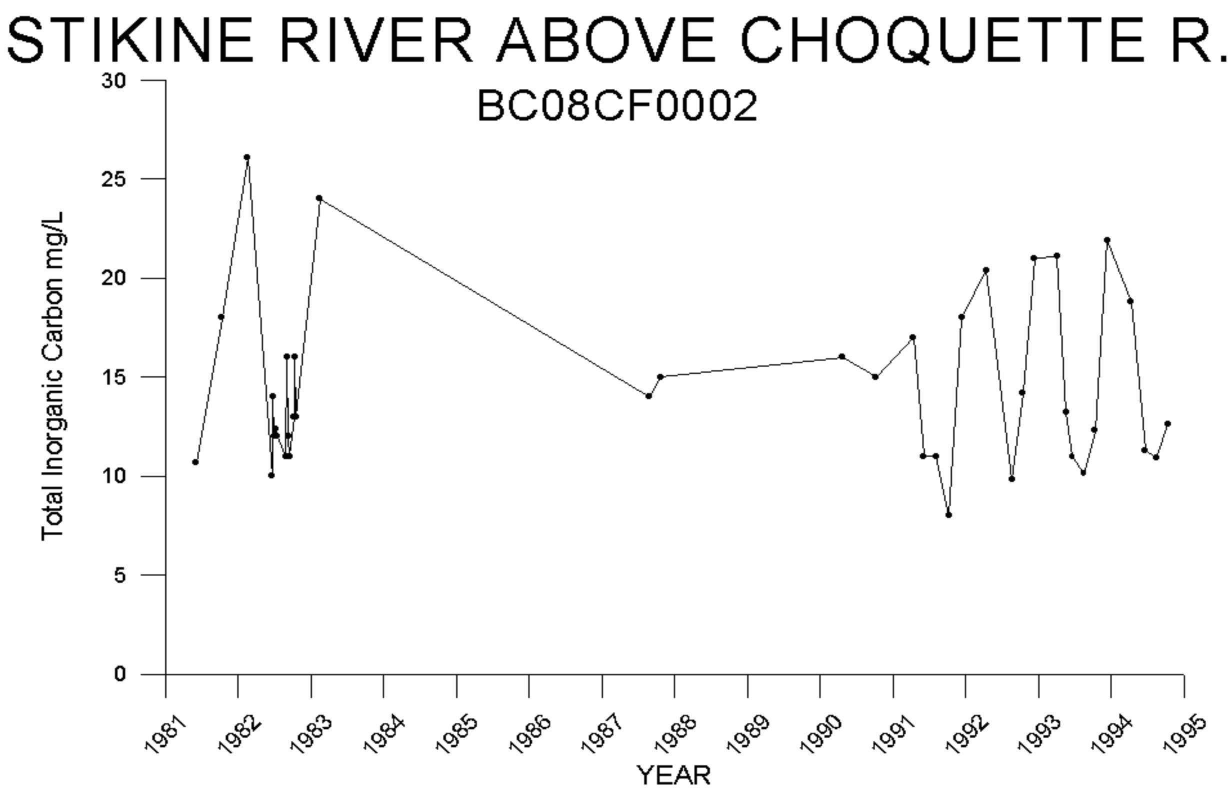


Figure 11 Total Organic Carbon

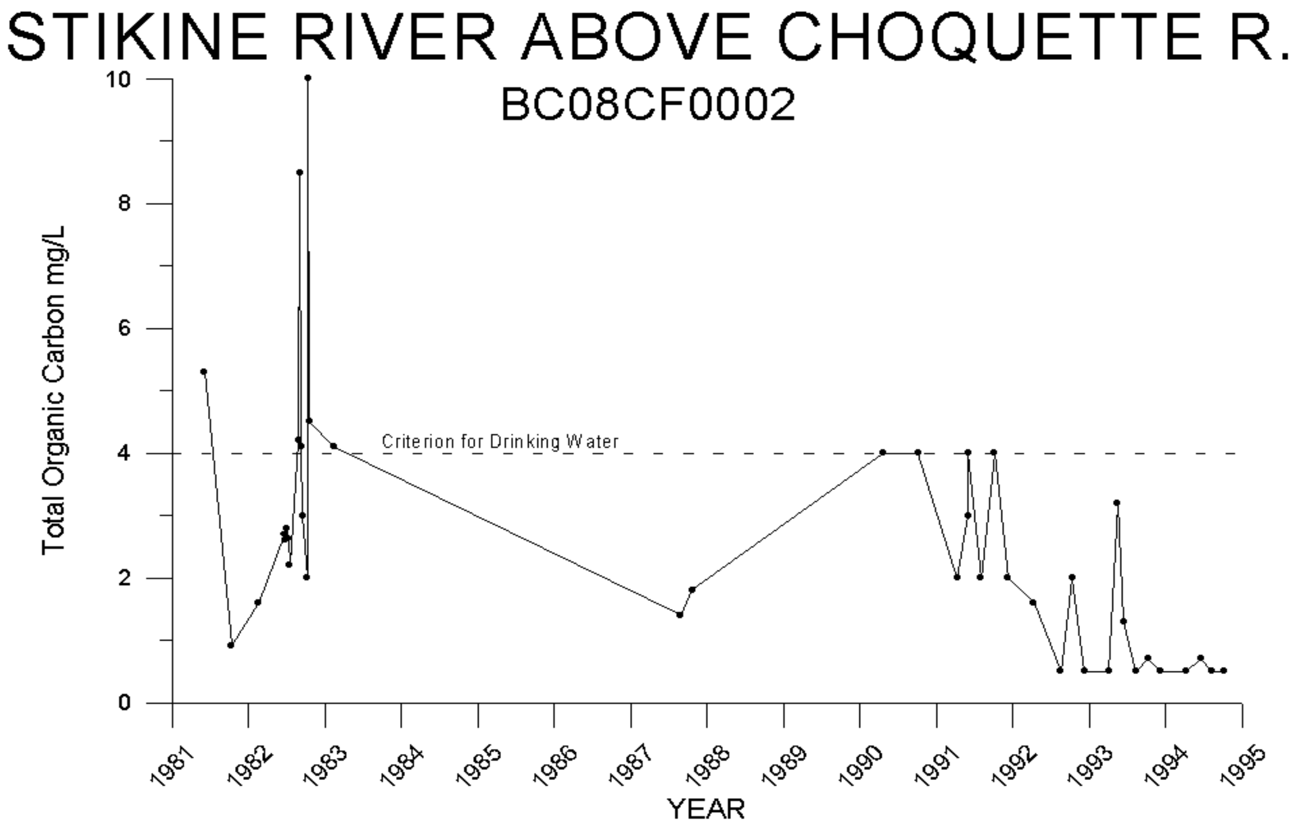


Figure 12 Dissolved Chloride

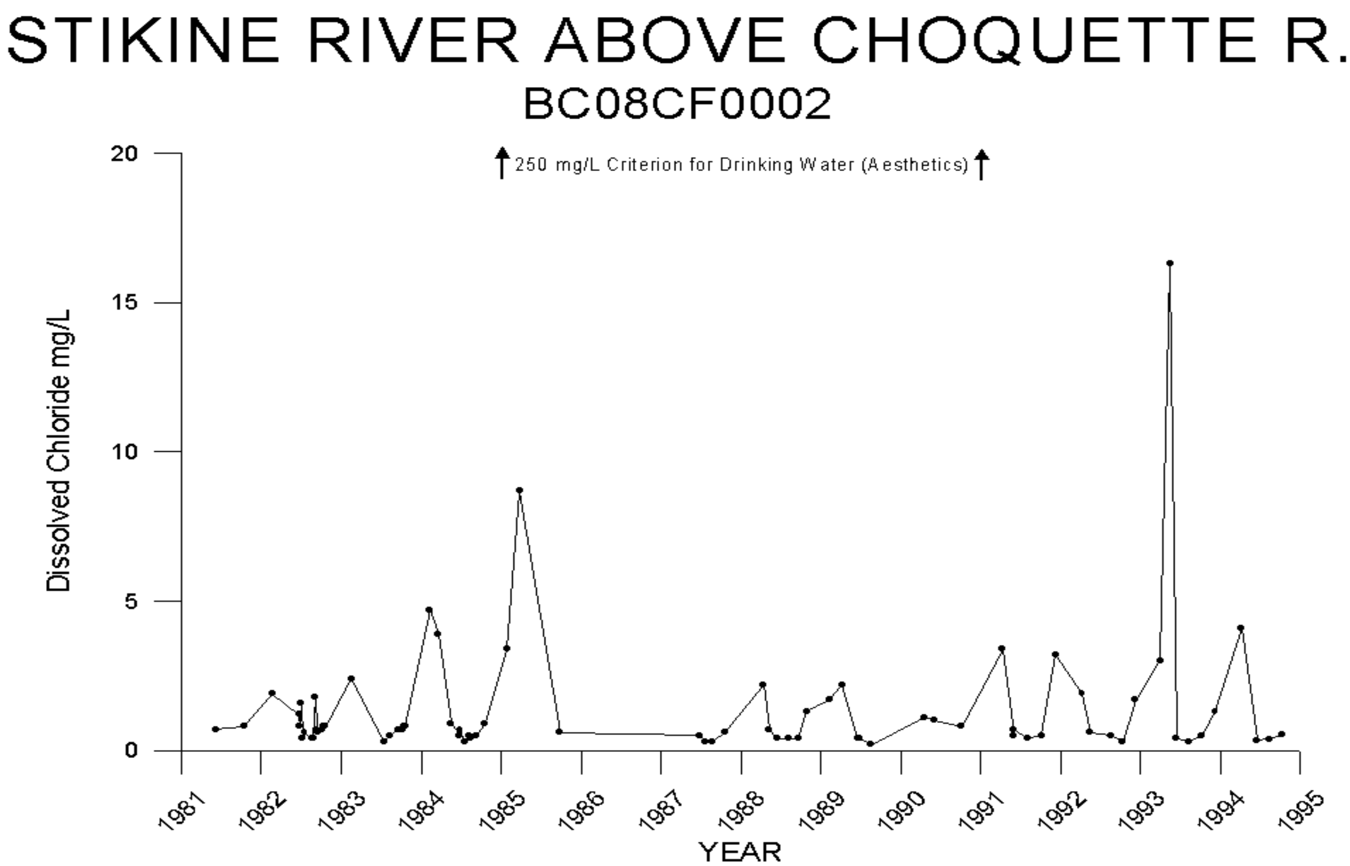


Figure 13 Total Chromium

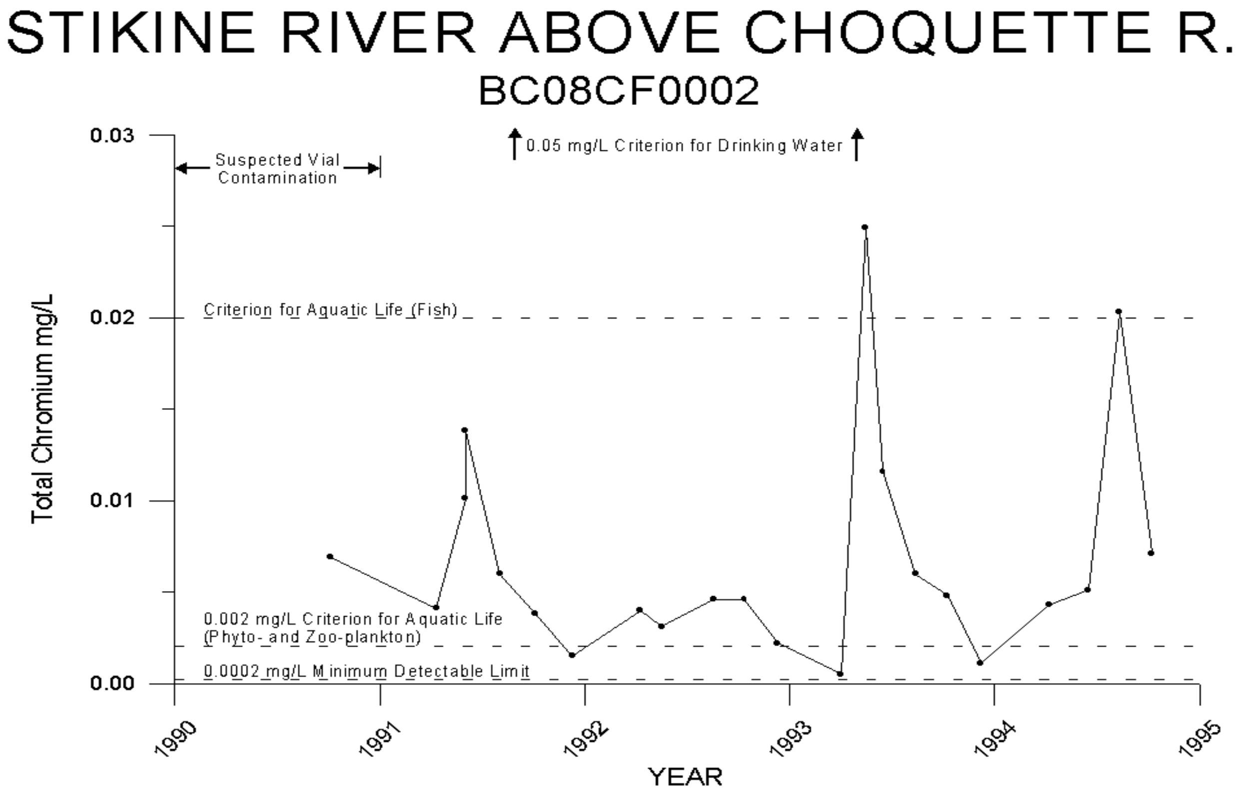


Figure 14 Total Cobalt

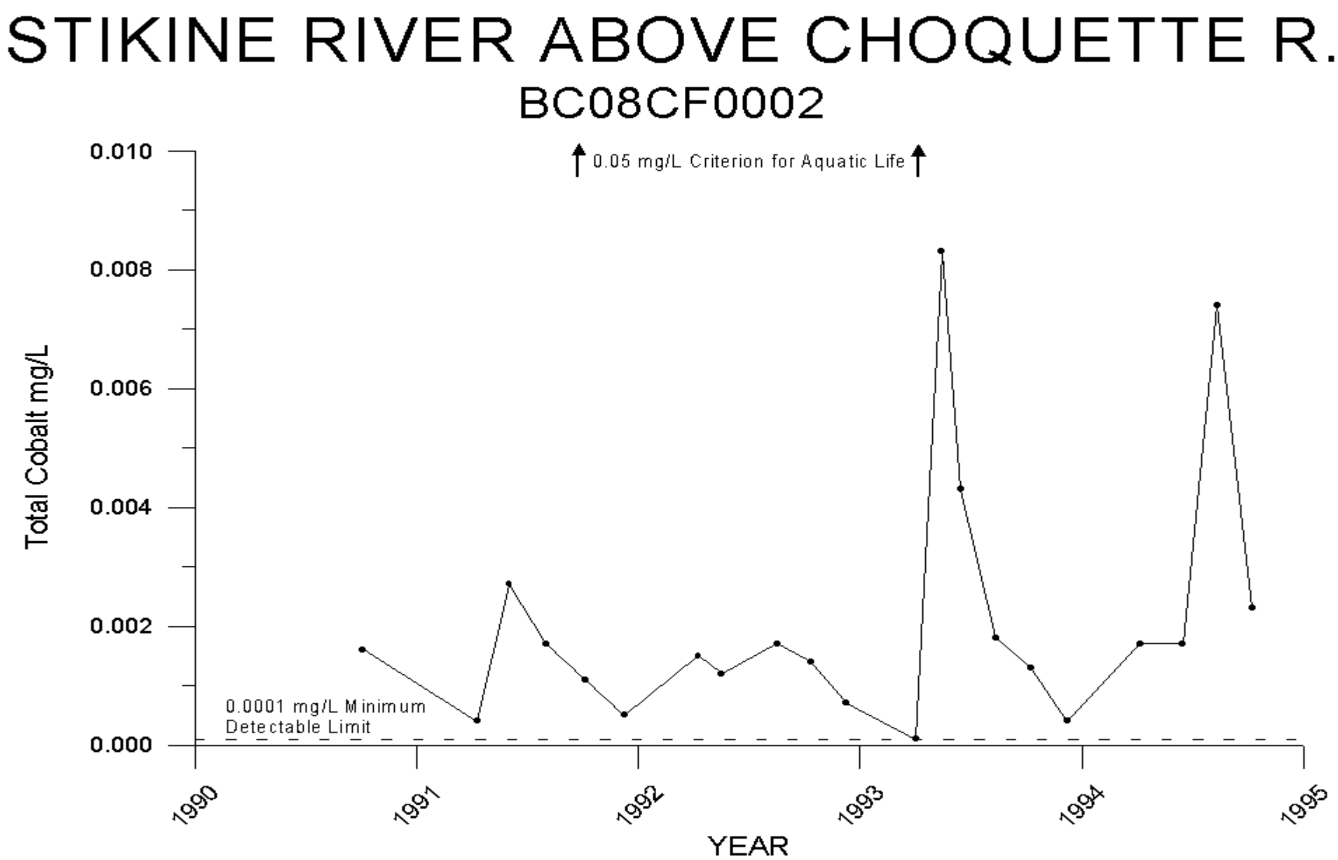


Figure 15 Apparent Colour

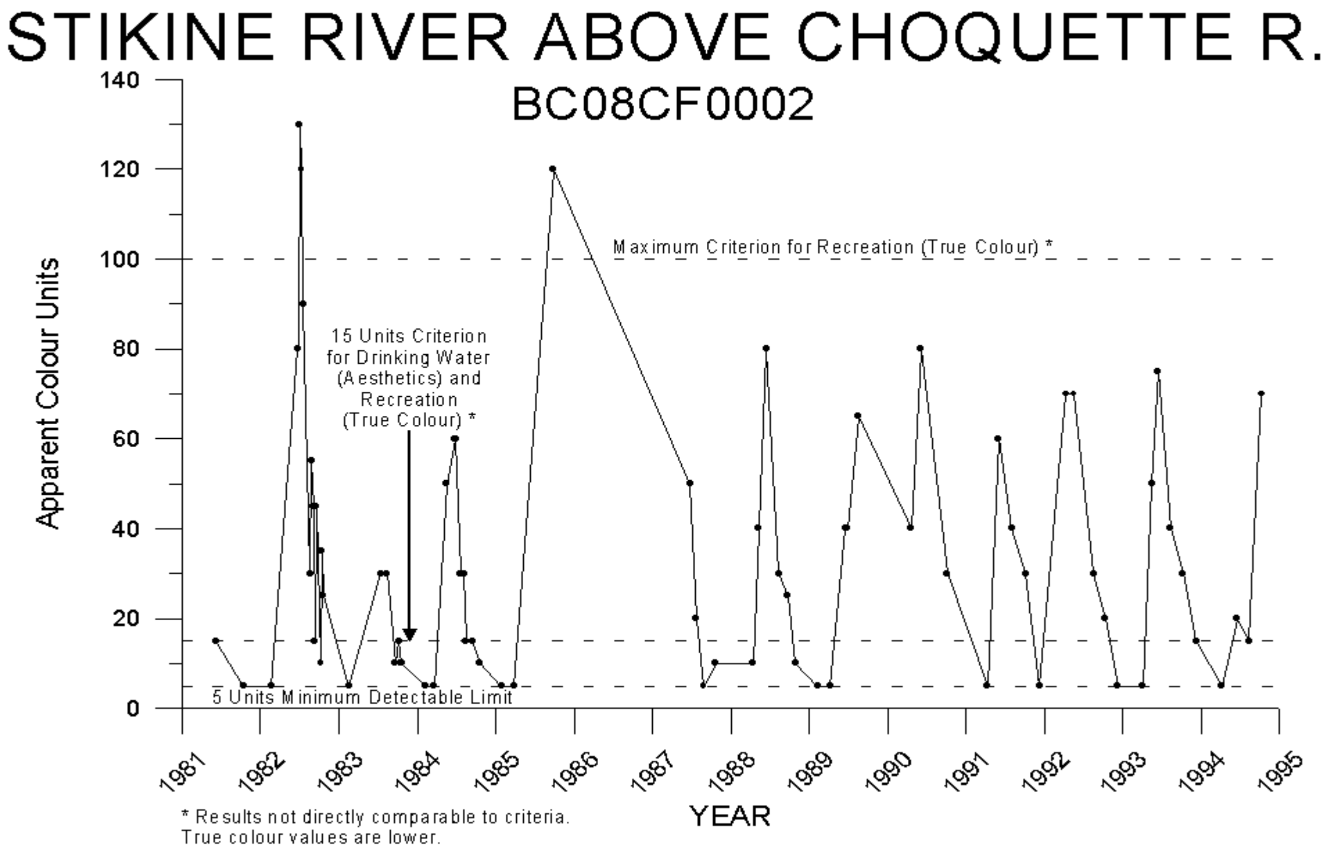


Figure 16 Total Copper

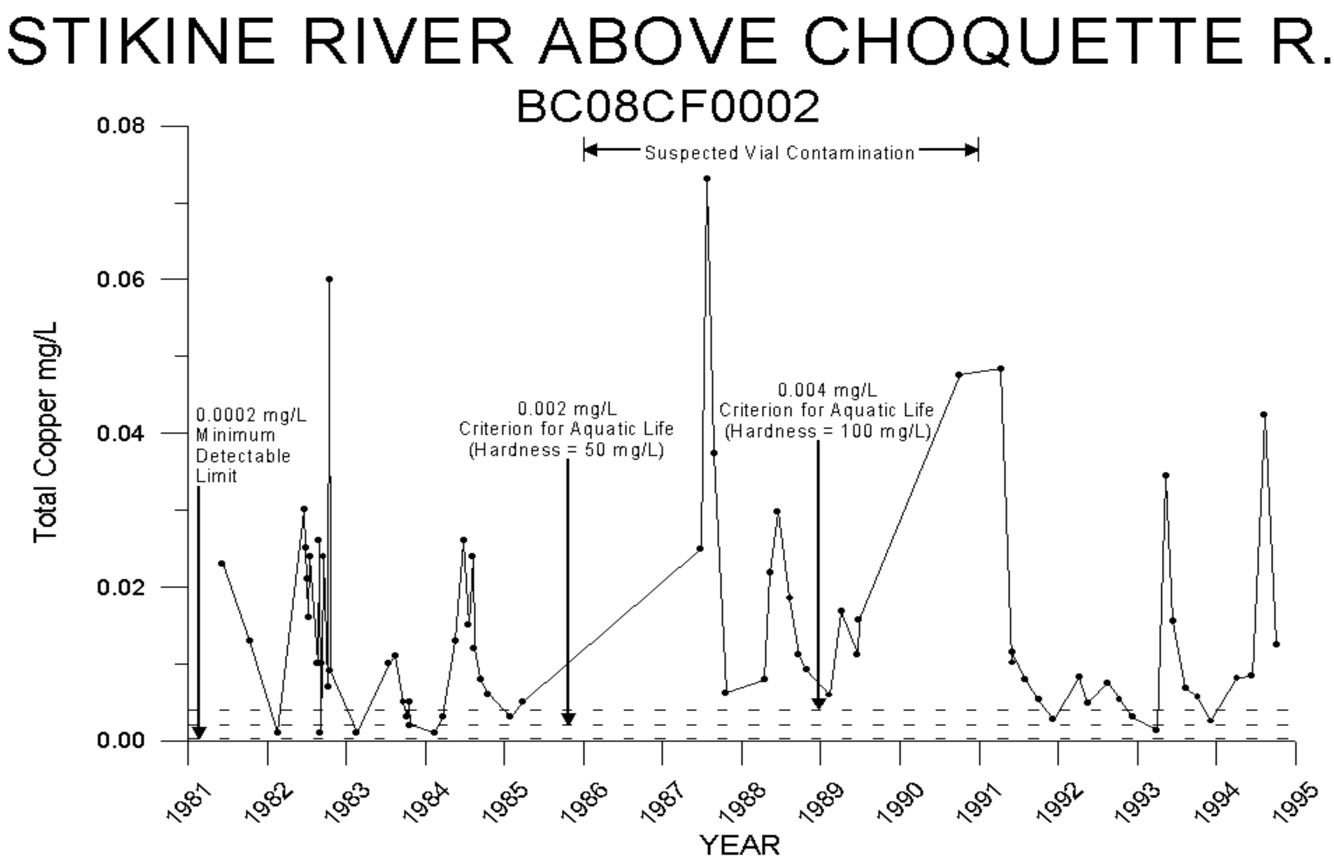


Figure 17 Dissolved Fluoride

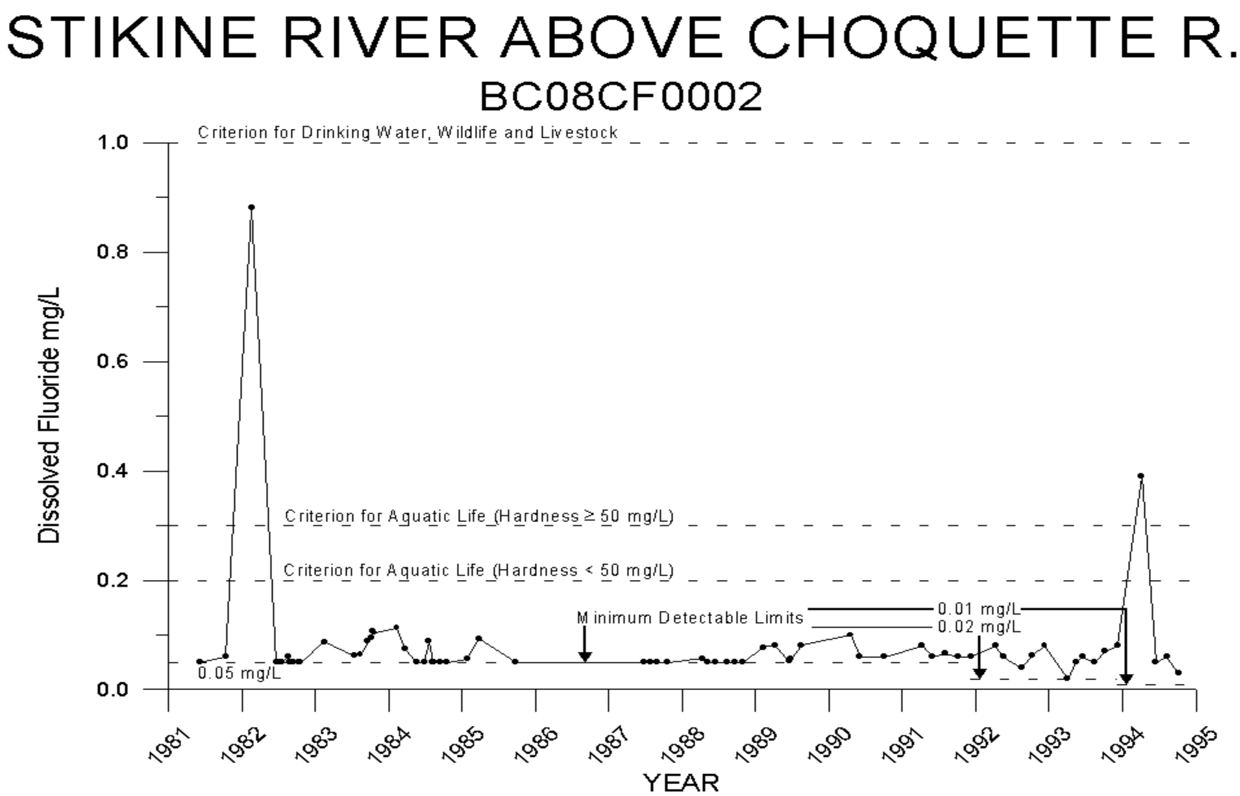


Figure 18 Hardness

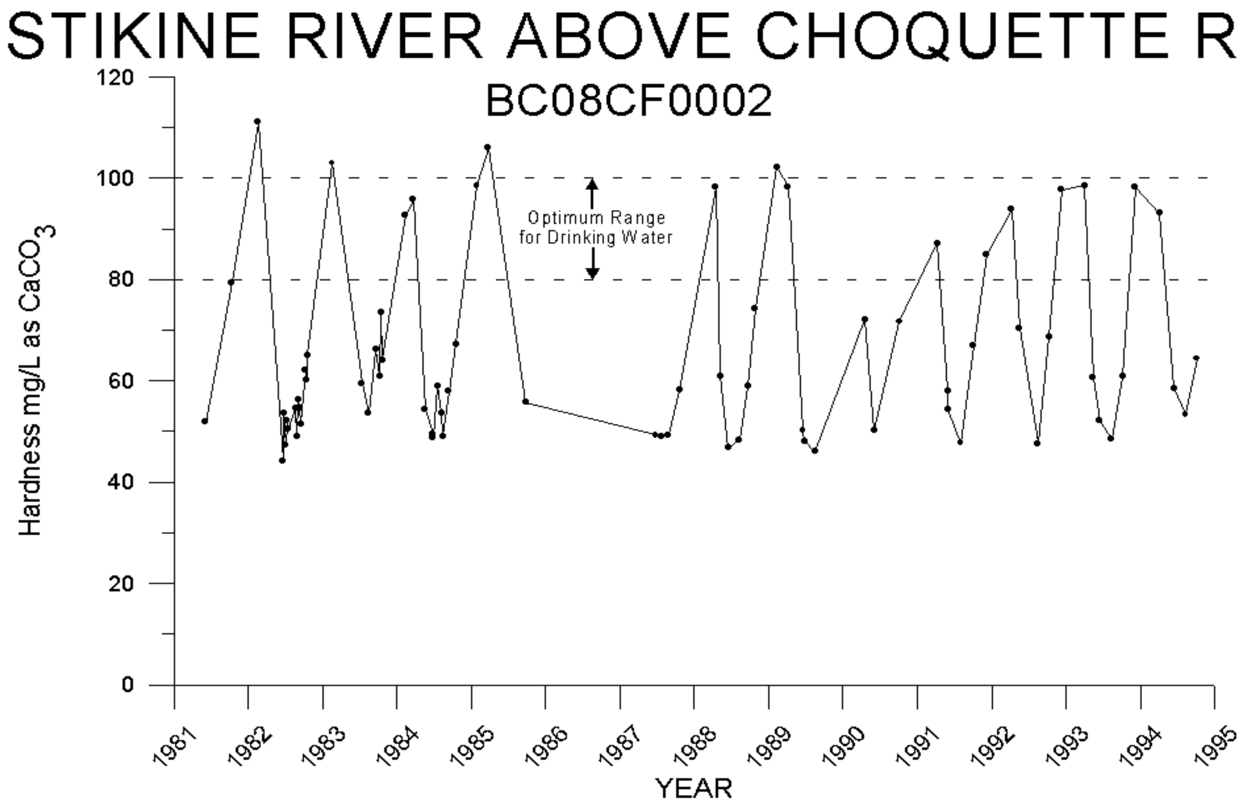


Figure 19 Total Iron

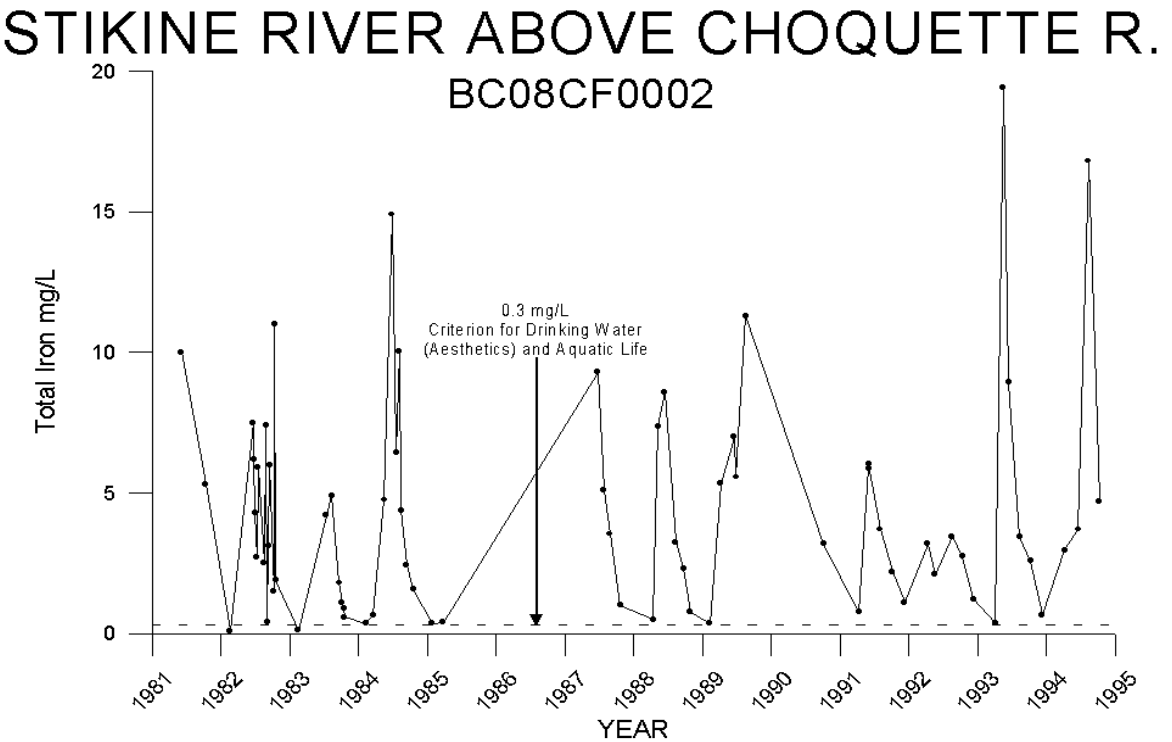


Figure 20 Total Lead

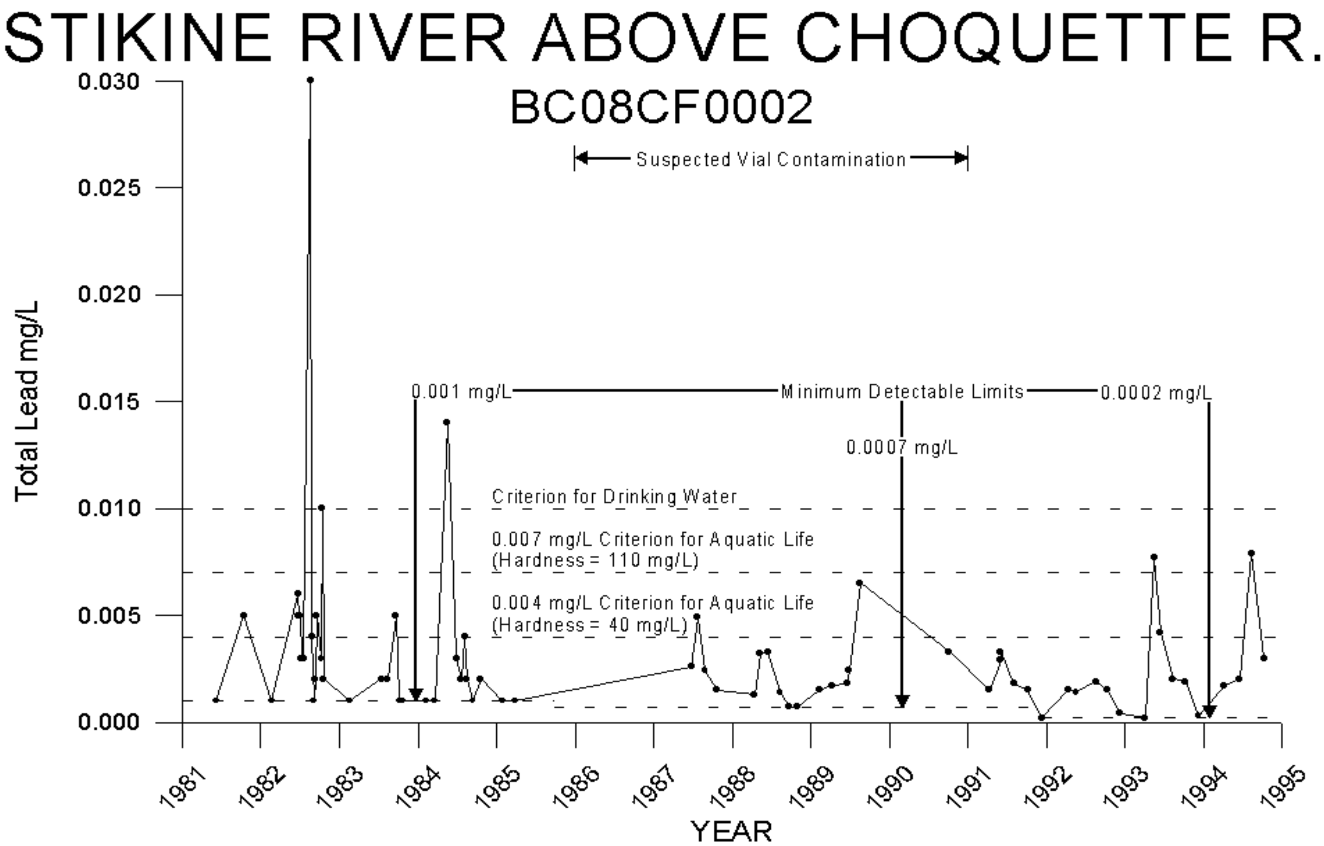


Figure 21 Total Lithium

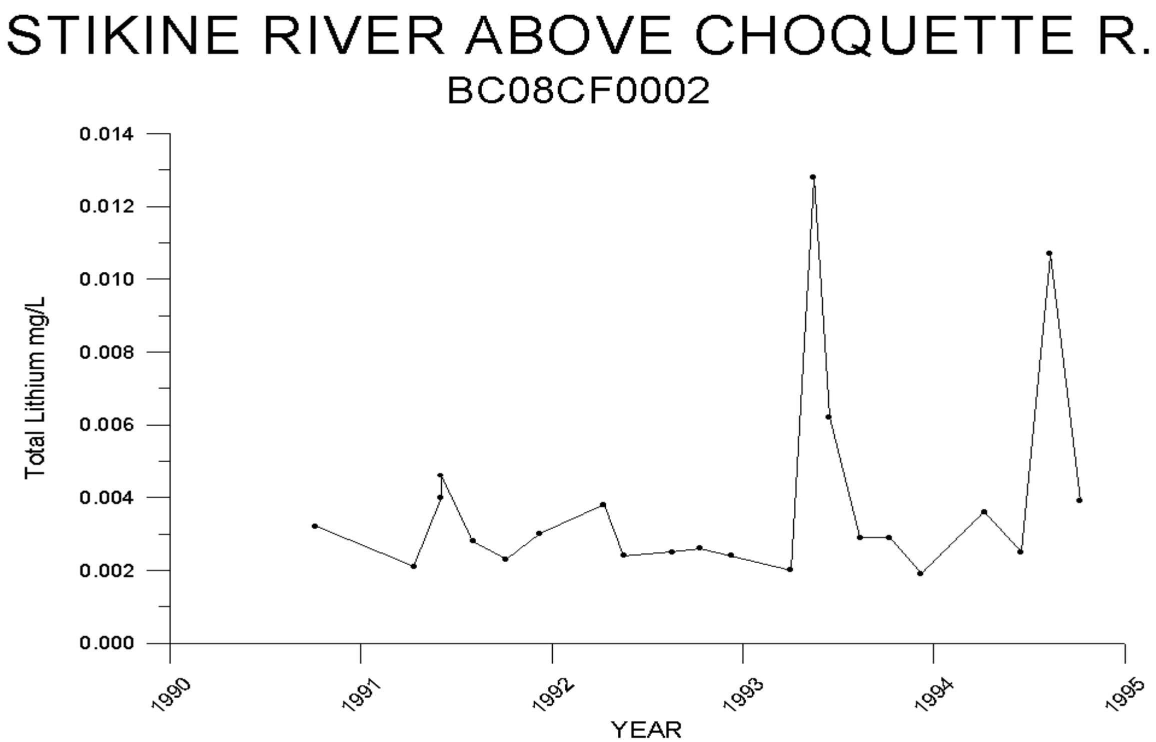


Figure 22 Magnesium

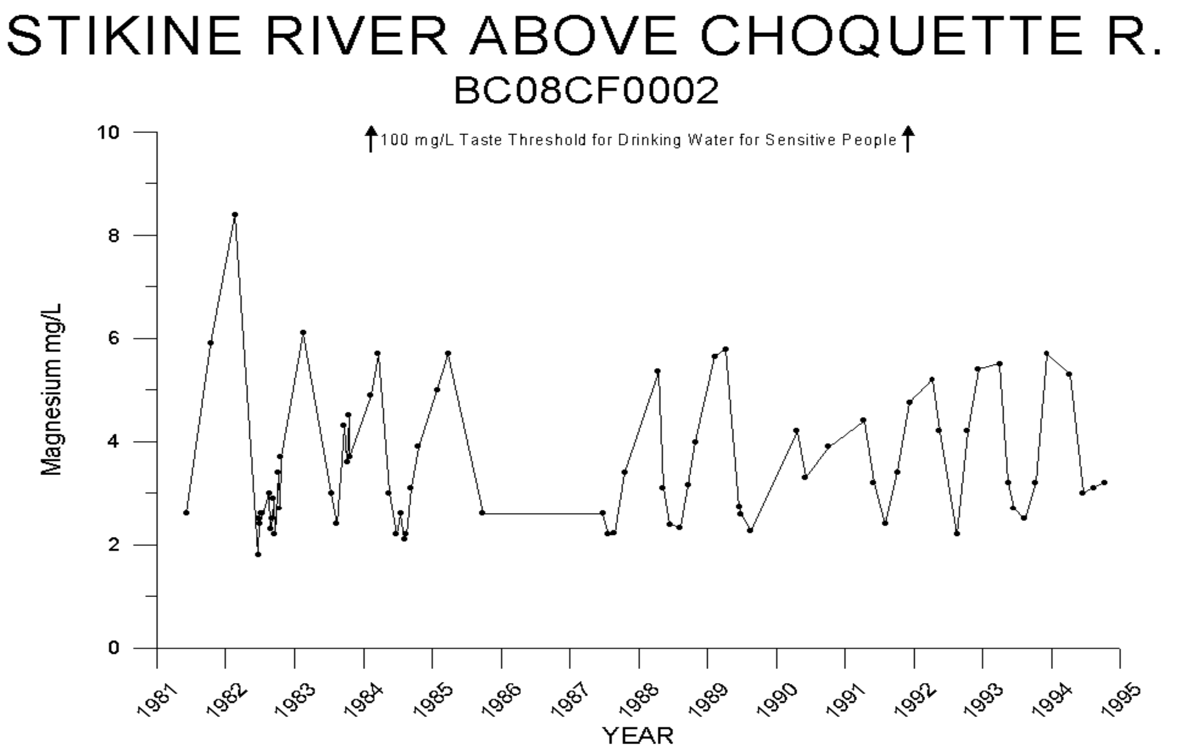


Figure 23 Total Manganese

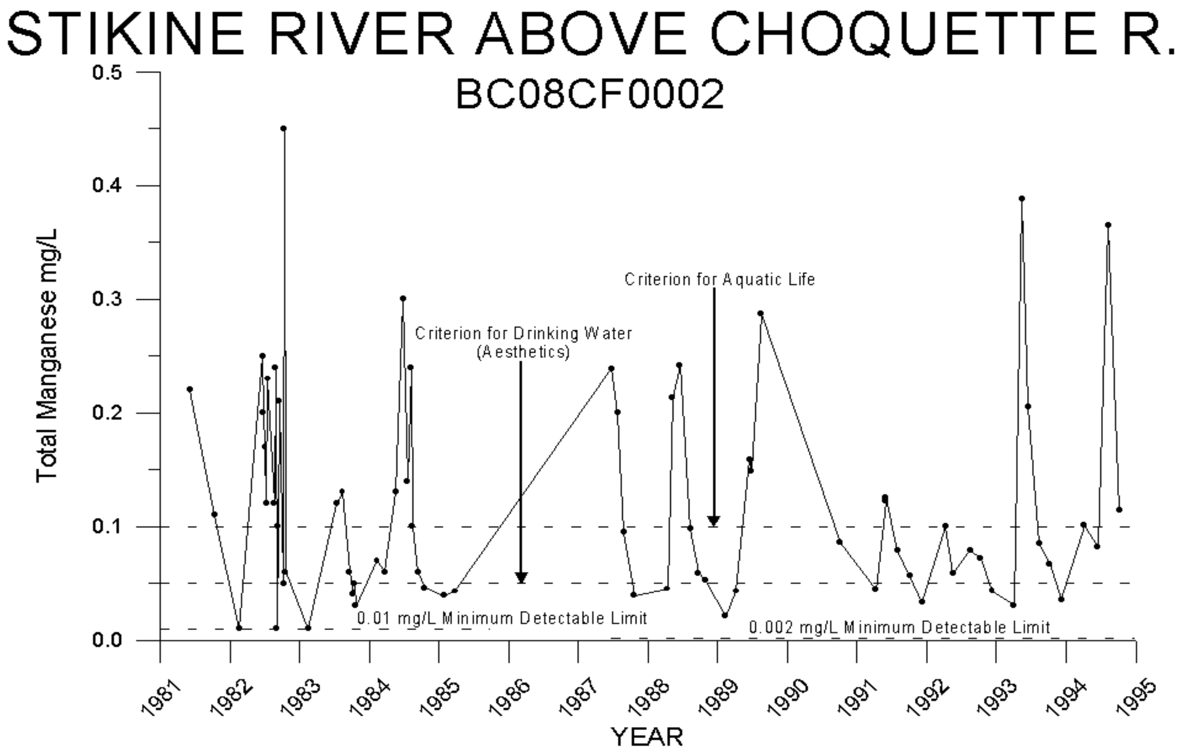


Figure 24 Total Molybdenum

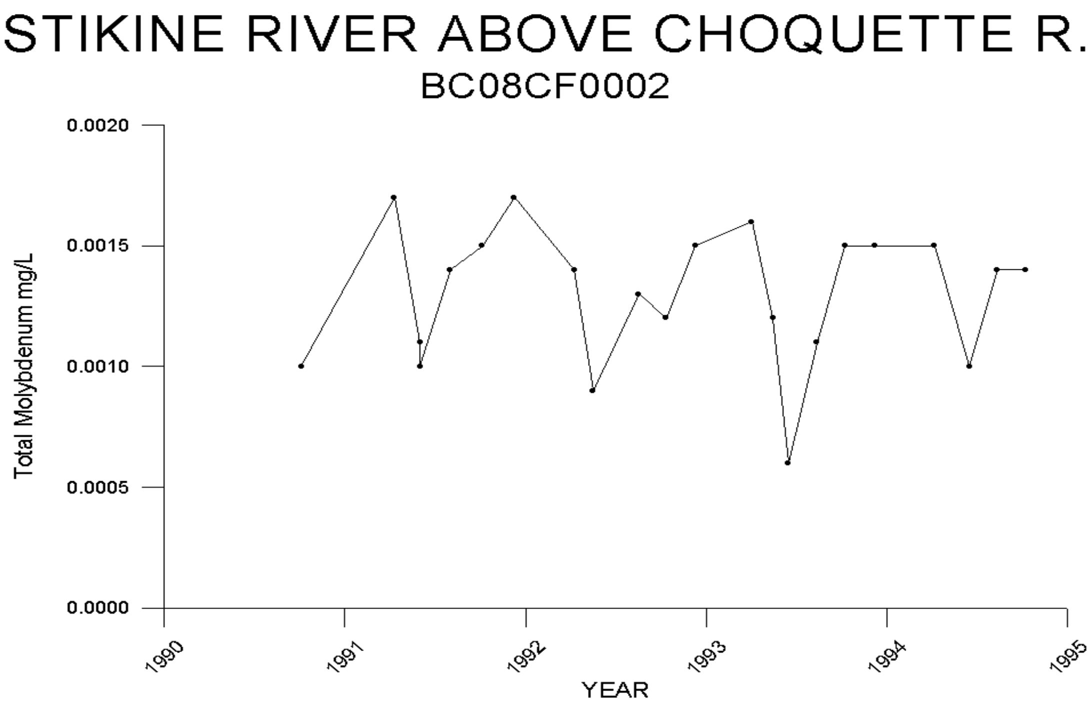


Figure 25 Total Nickel

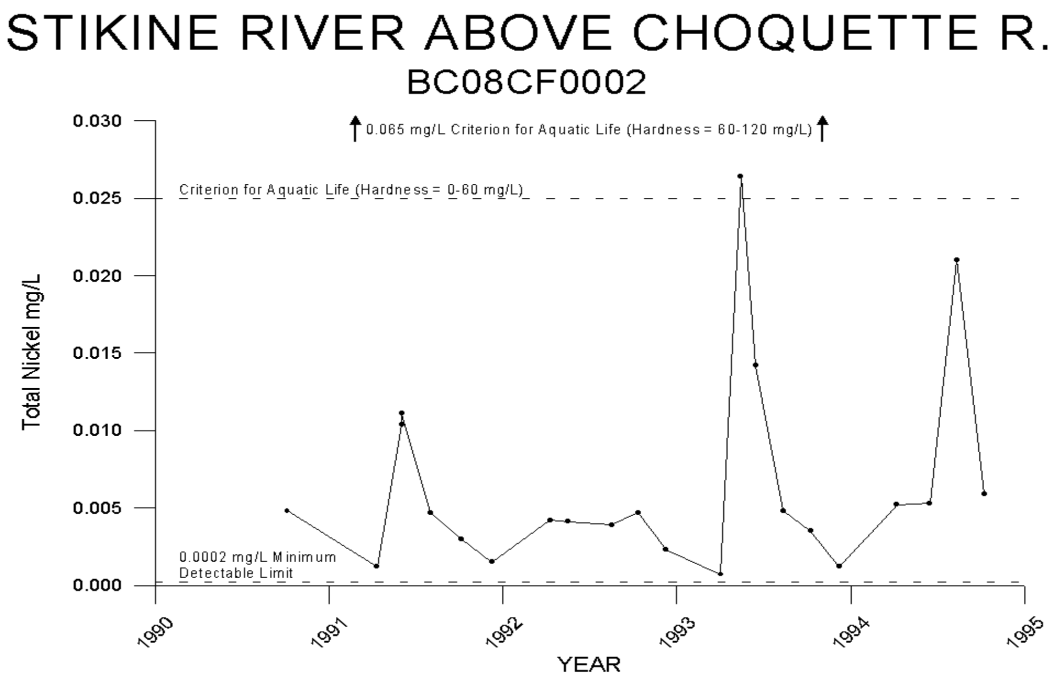


Figure 26 Nitrogen (Nitrate/Nitrite)

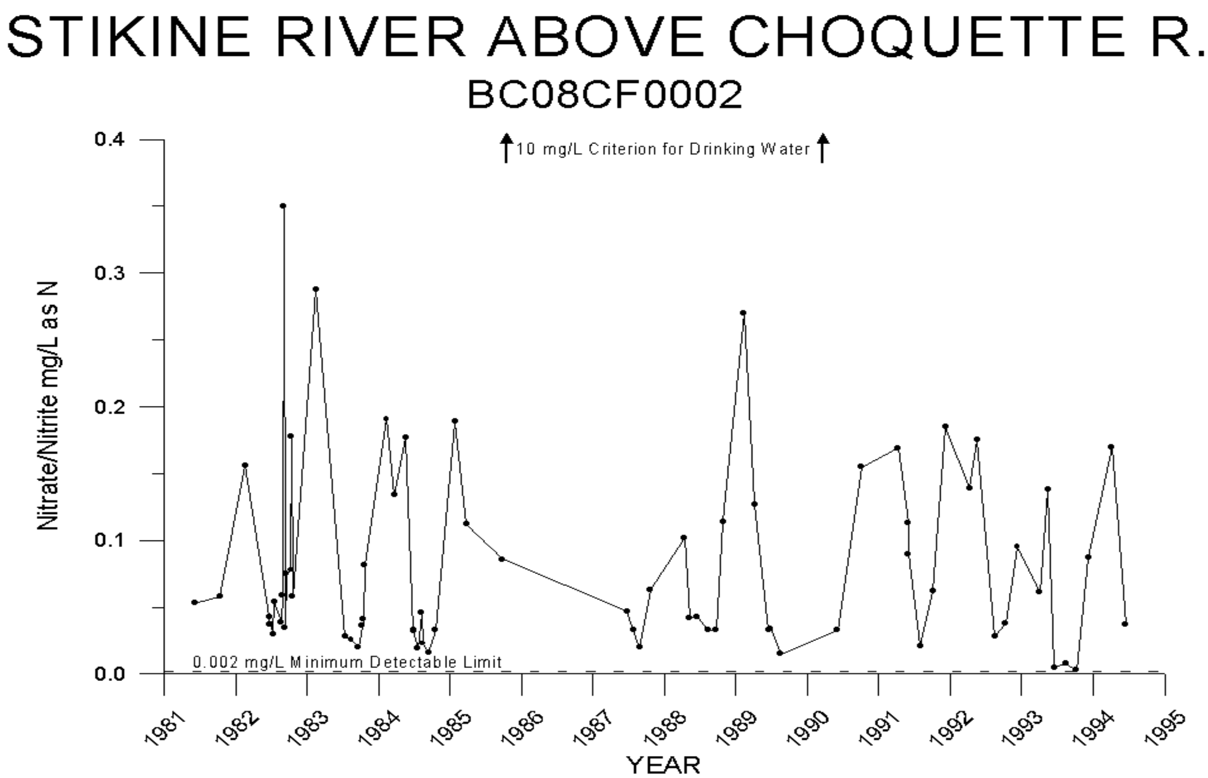


Figure 27 Total Dissolved Nitrogen

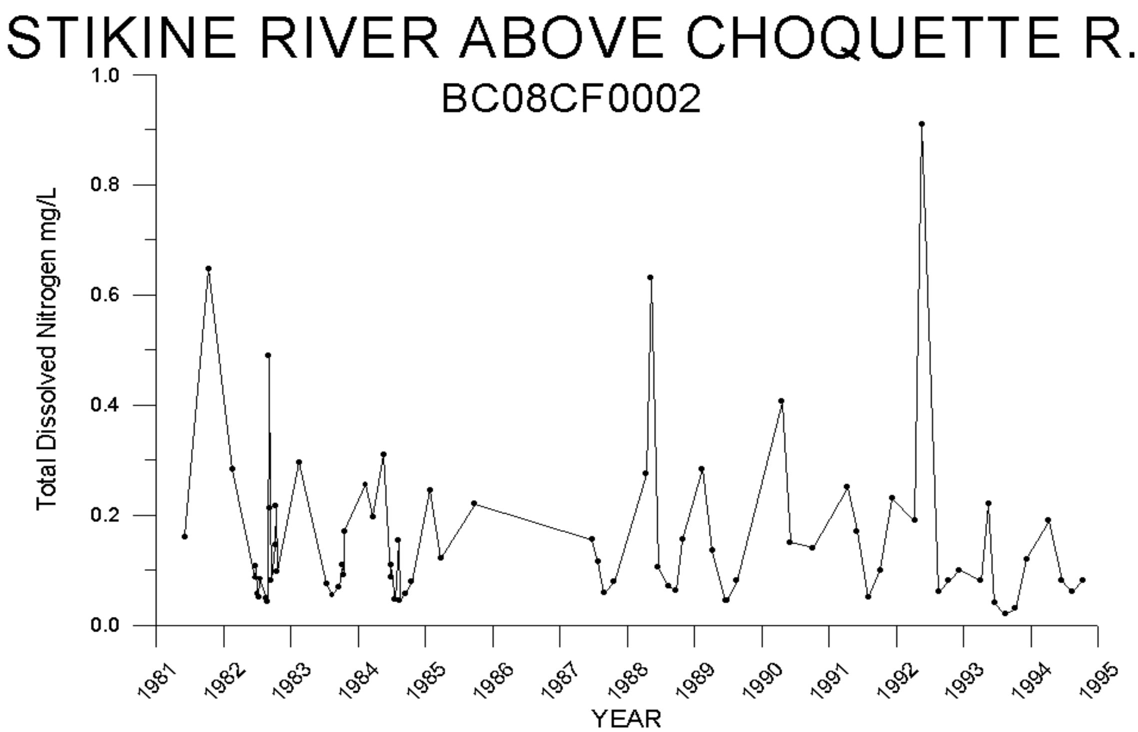


Figure 28 pH

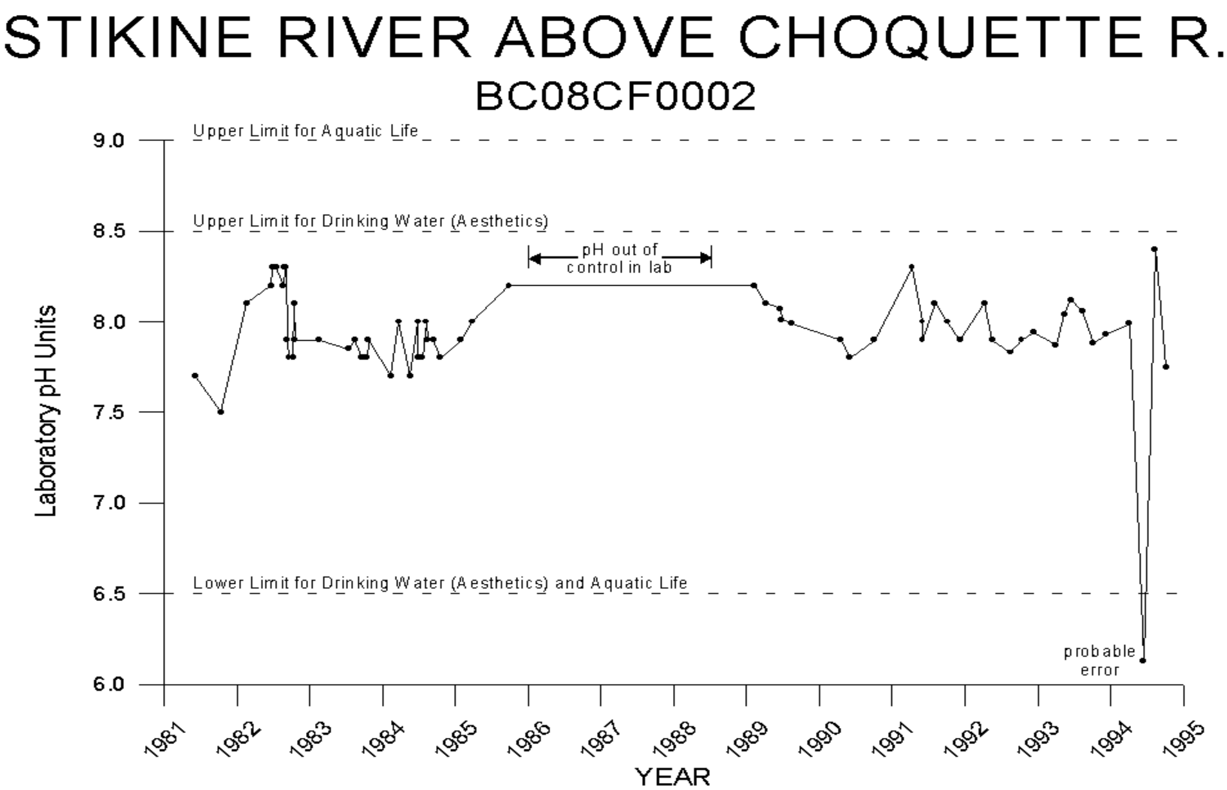

STIKINE RIVER ABOVE CHOQUETTE R.
BC08CF0002
Upper Limit for Aquatic Life
Upper Limit for Drinking Water (Aesthetics)
pH out of control in lab
Lower Limit for Drinking Water (Aesthetics) and Aquatic Life
probable error
Laboratory pH Units
9.0
8.5
8.0
7.5
7.0
6.5
6.0
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
YEAR

Figure 29 Total Phosphorus

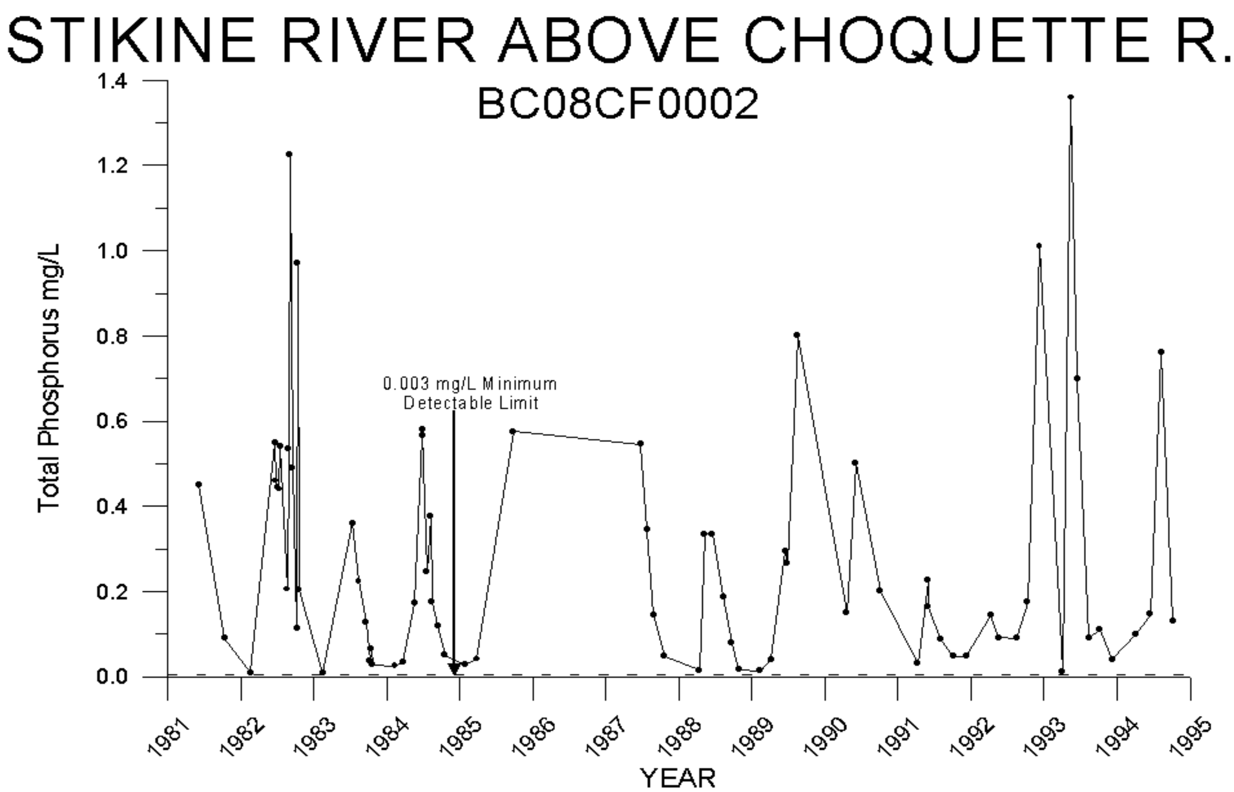


Figure 30 Potassium

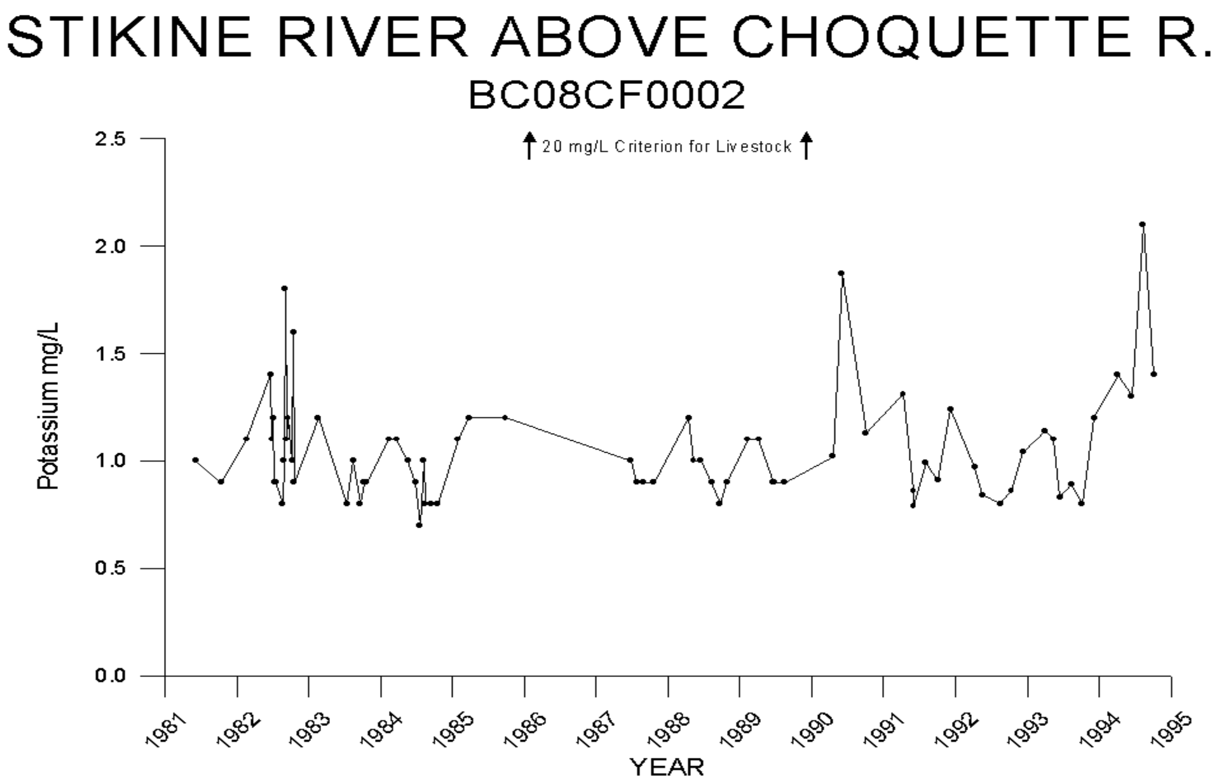


Figure 31 Filterable Residue

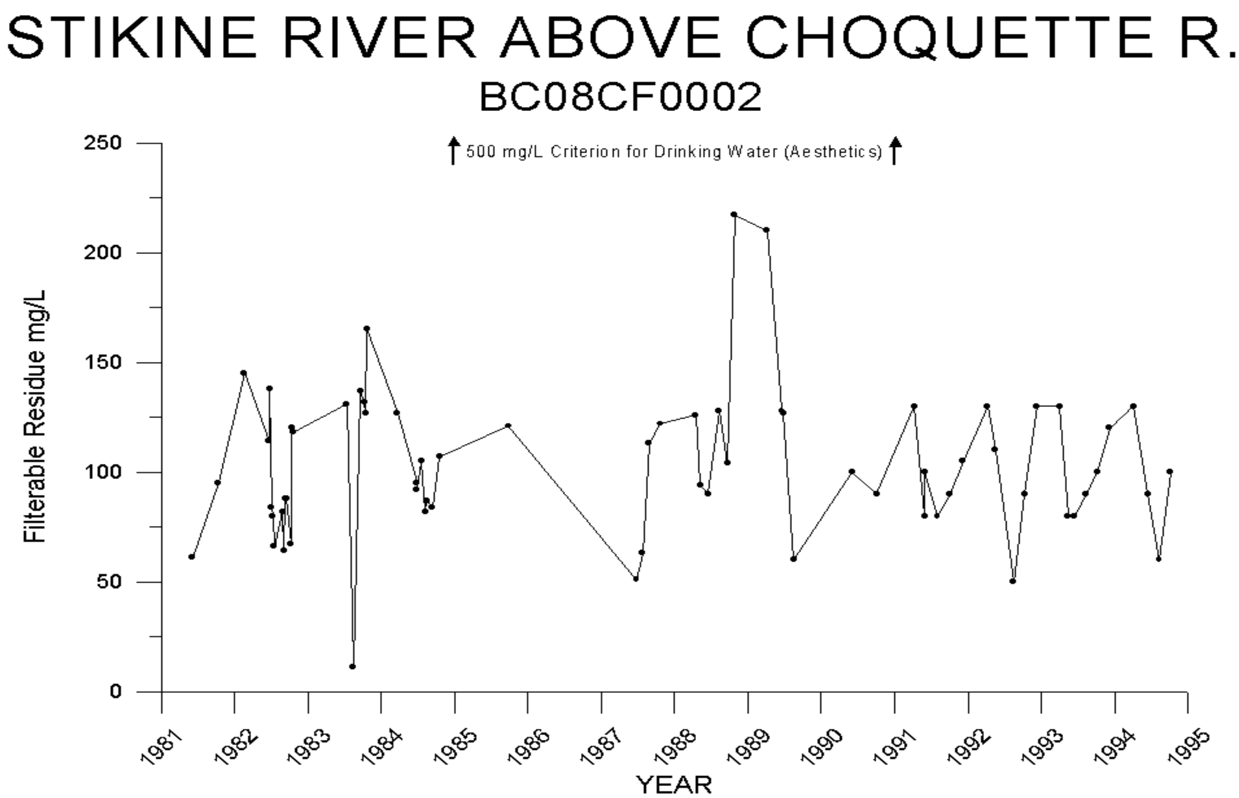


Figure 32 Non-Filterable Residue

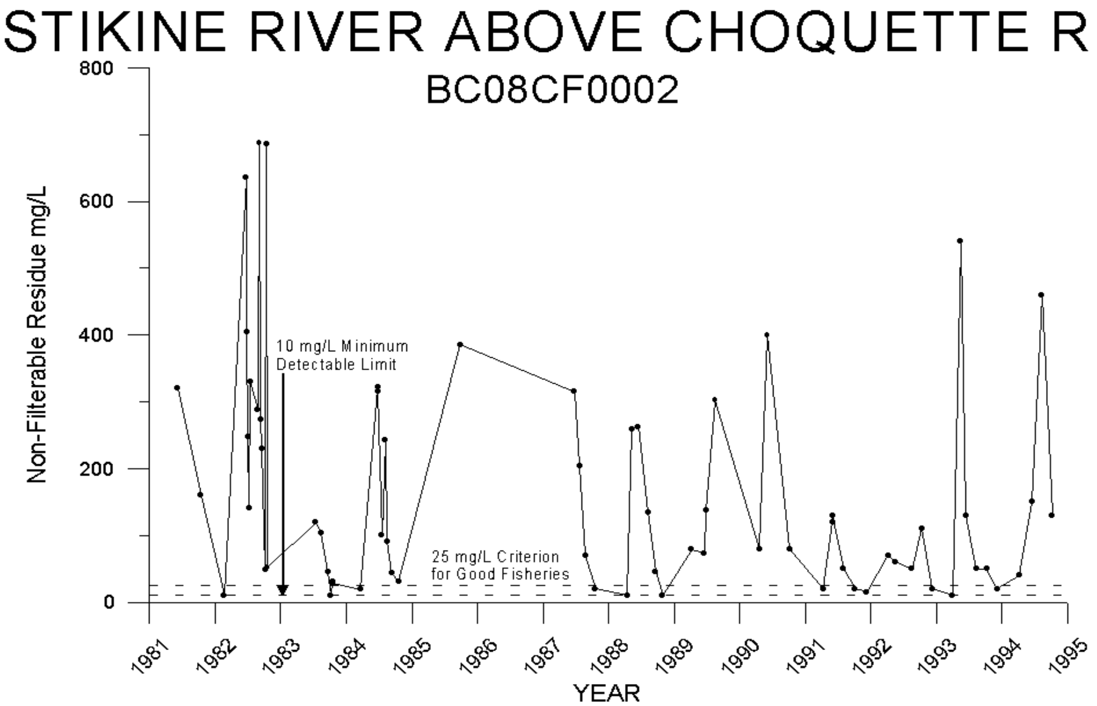


Figure 33 Non-Filterable Residue (with Flow)

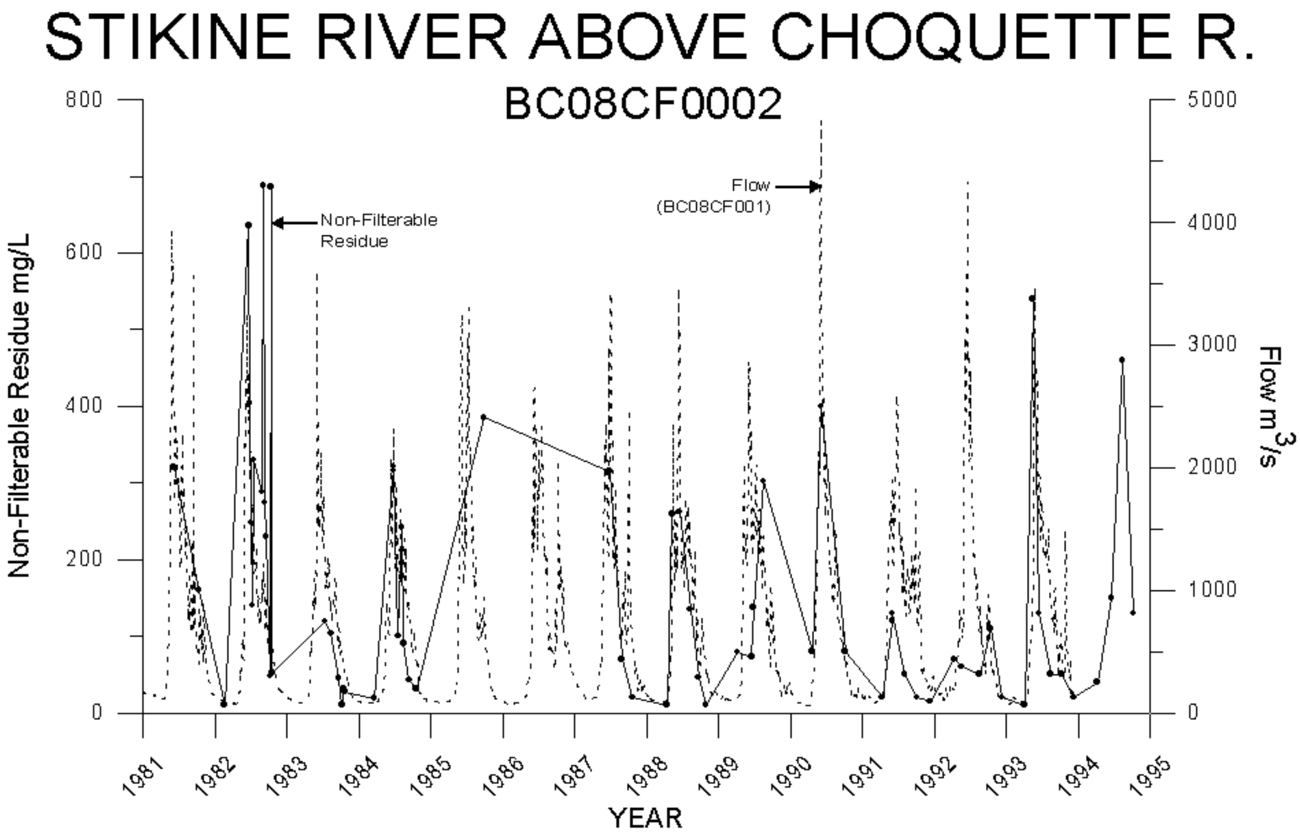


Figure 34 Fixed Filterable Residue

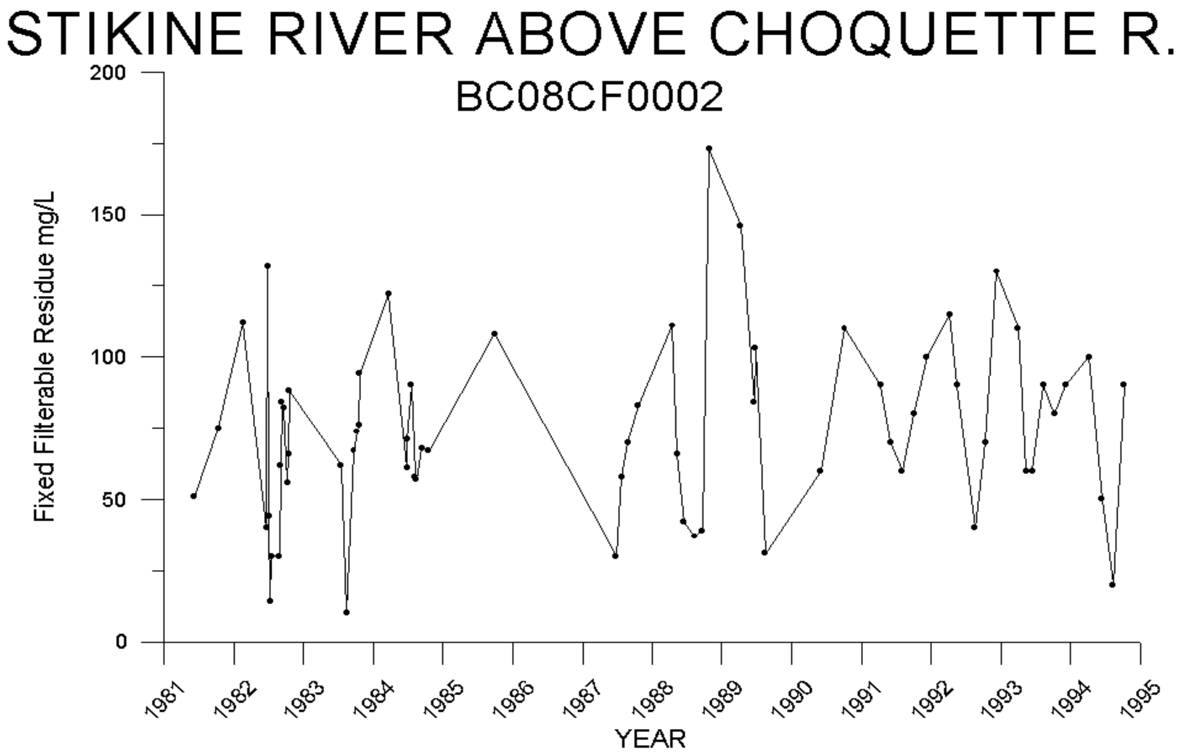


Figure 35 Fixed Non-Filterable Residue

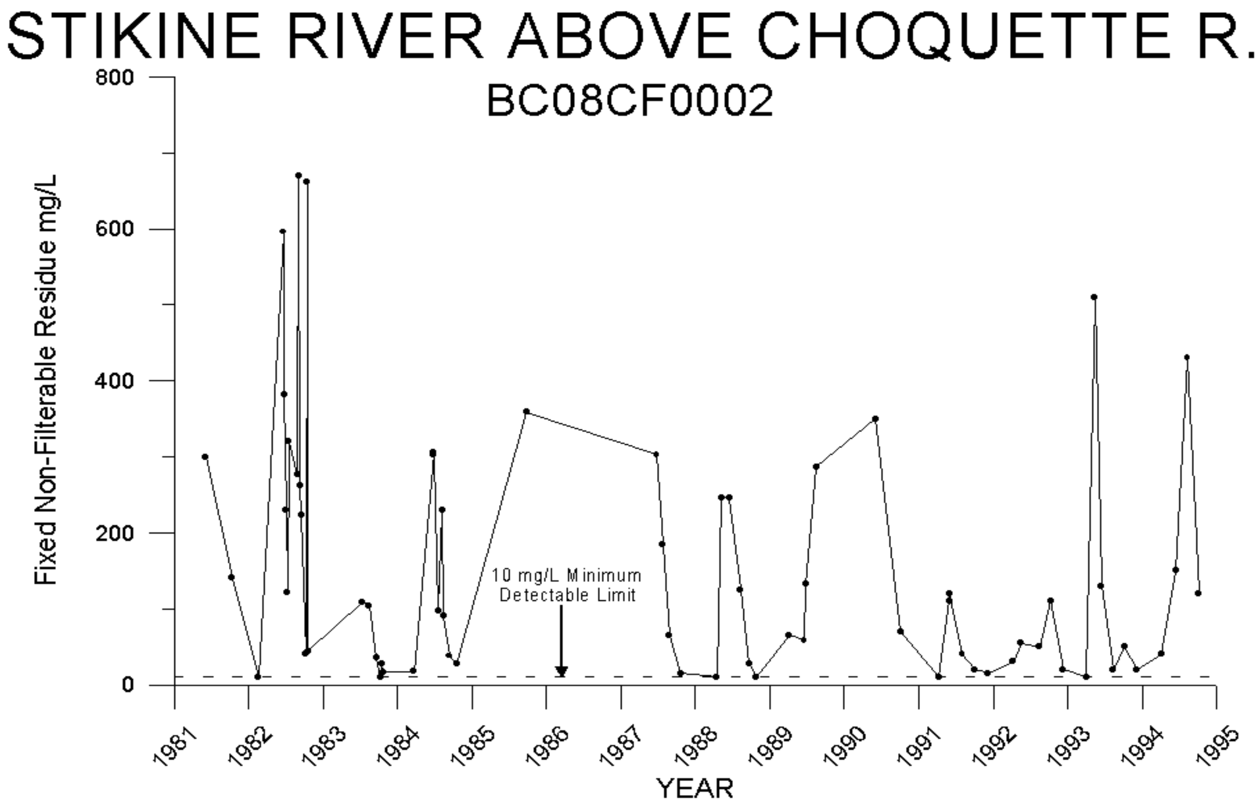


Figure 36 Total Selenium

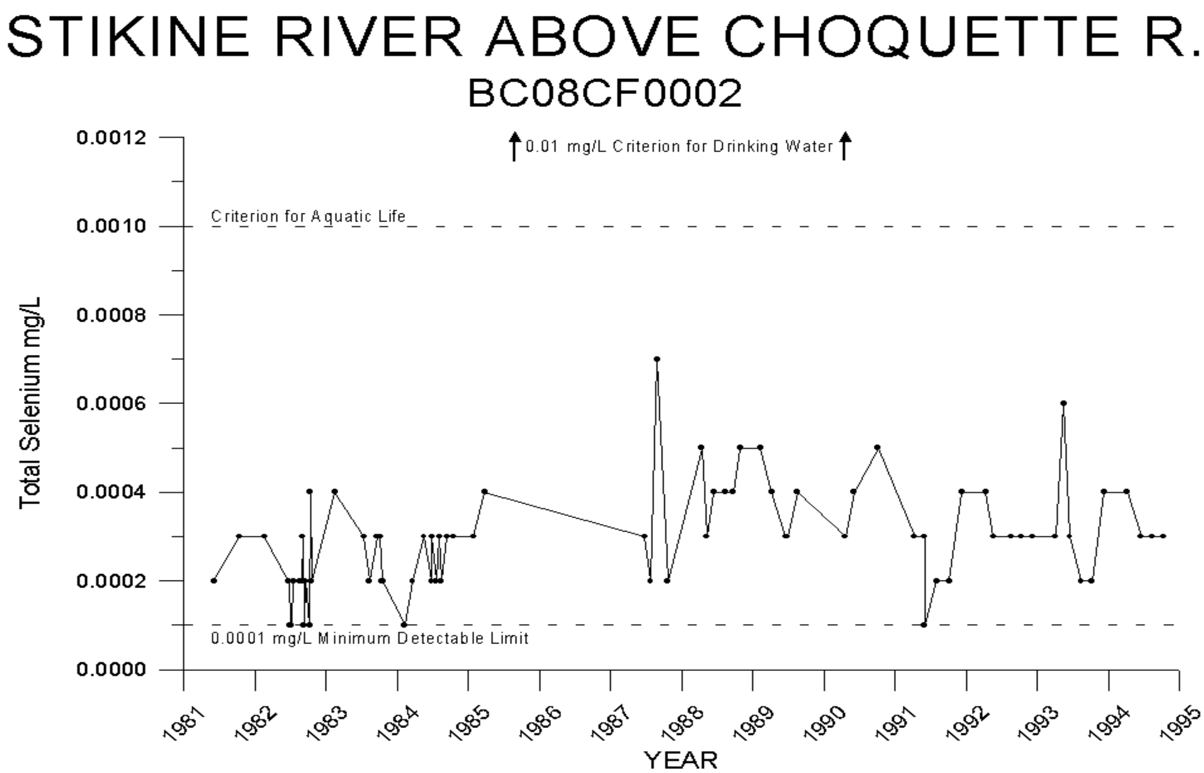


Figure 37 Silica

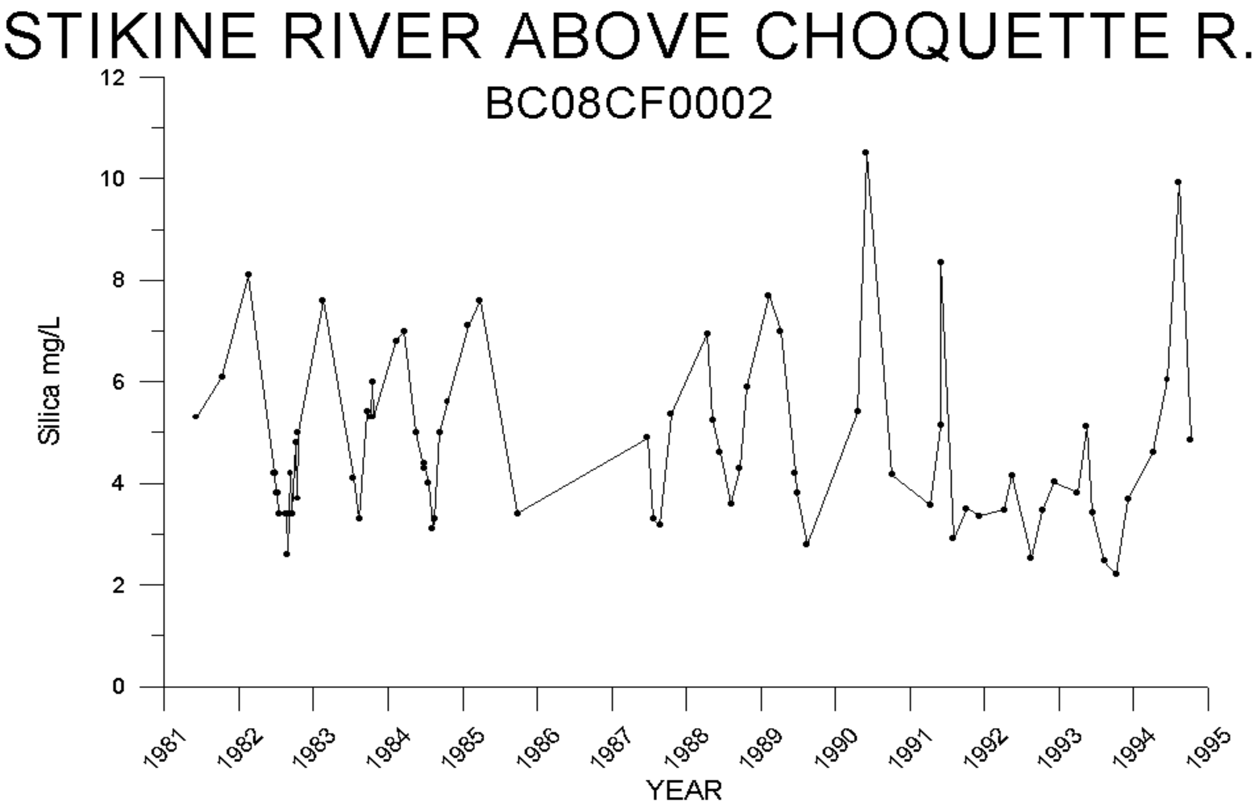


Figure 38 Sodium

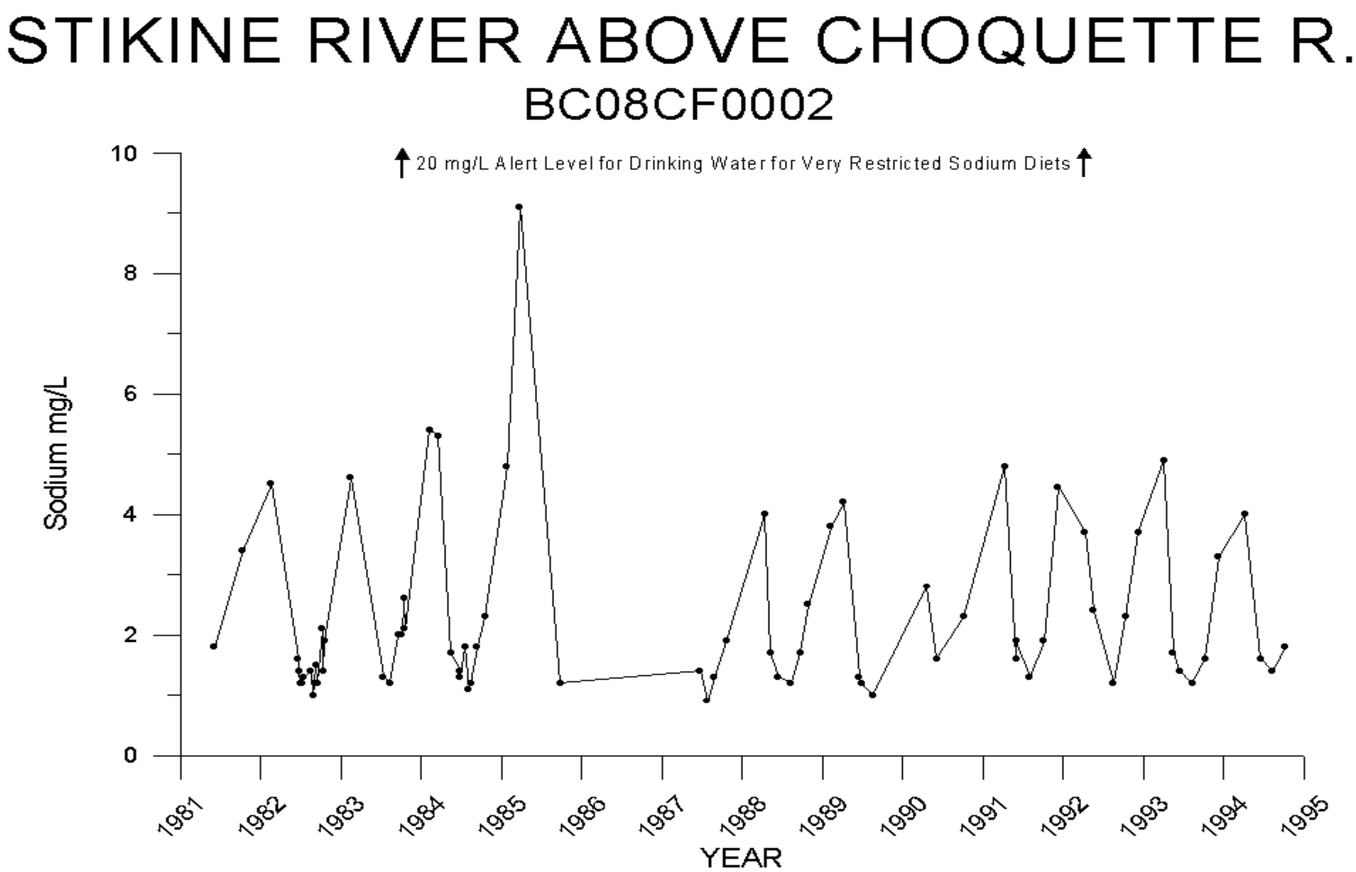


Figure 39 Specific Conductivity

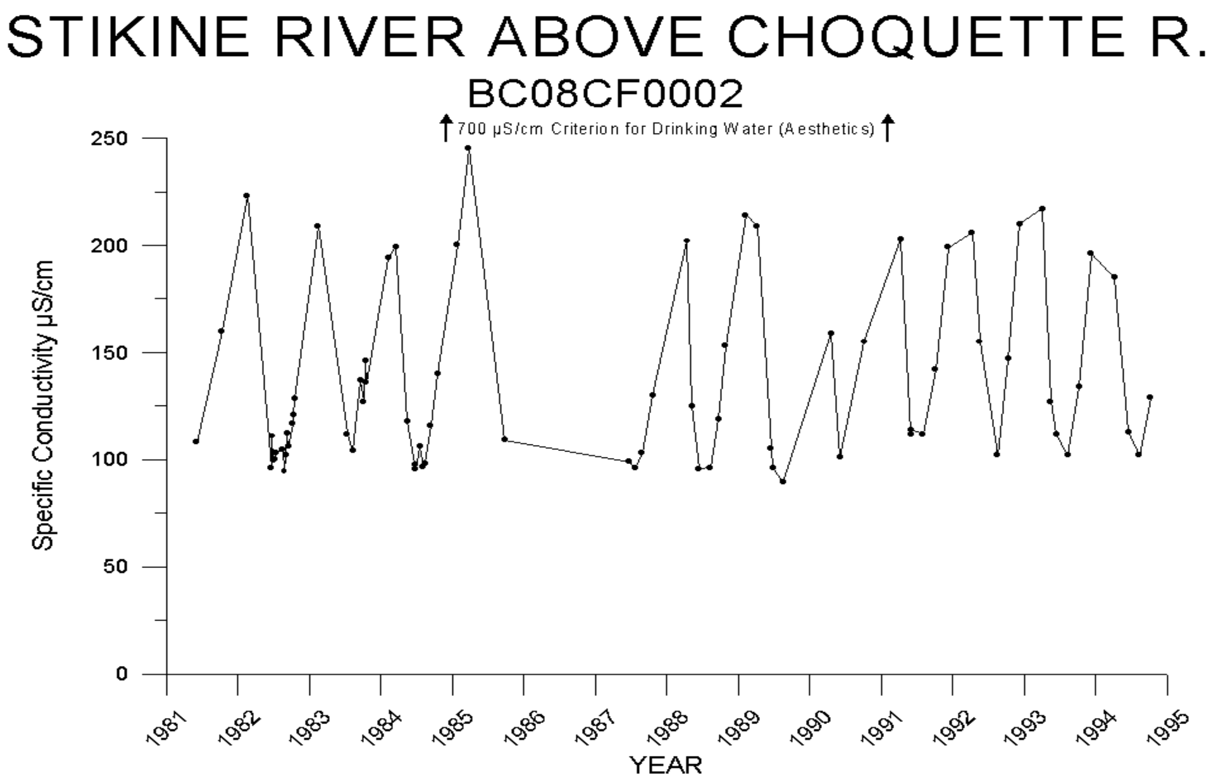


Figure 40 Total Strontium

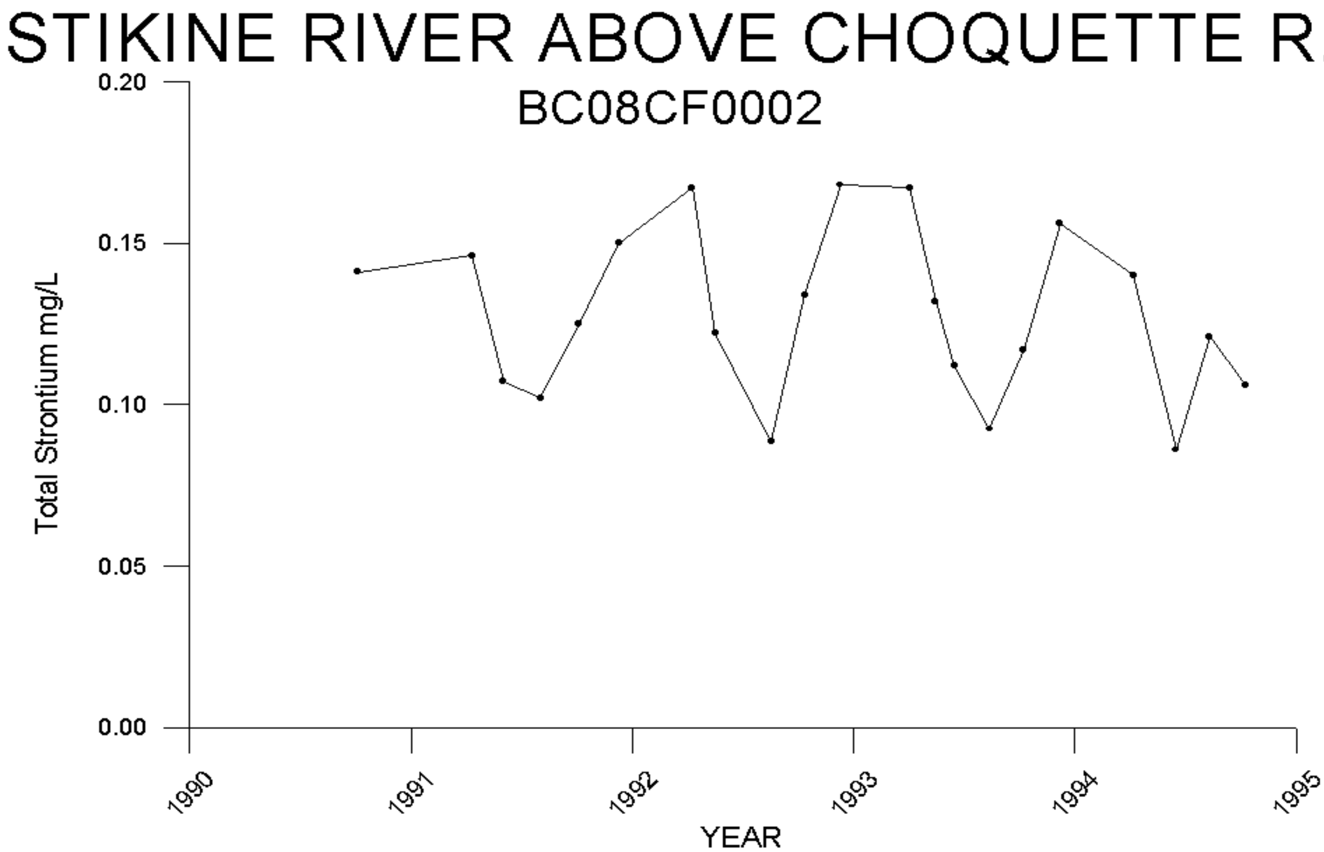


Figure 41 Dissolved Sulphate

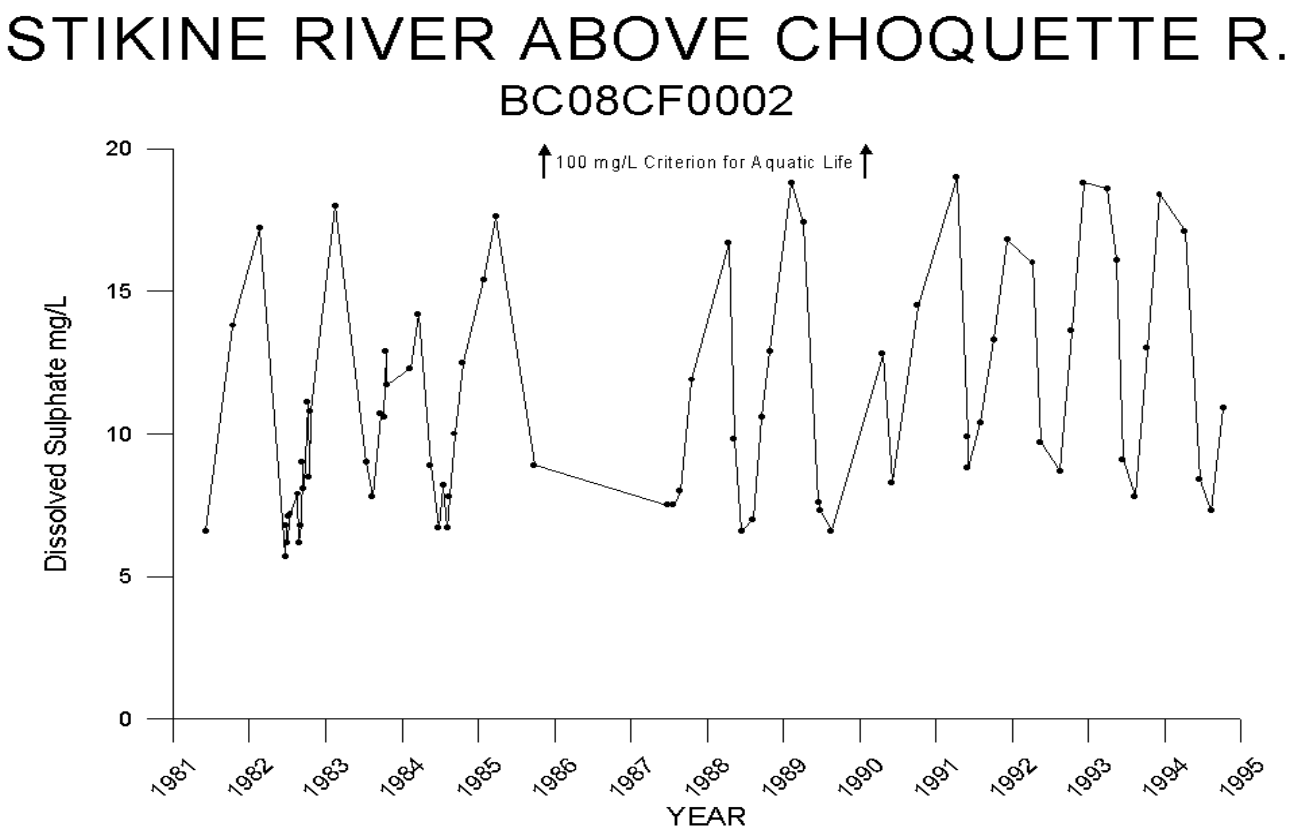


Figure 42 Air Temperature

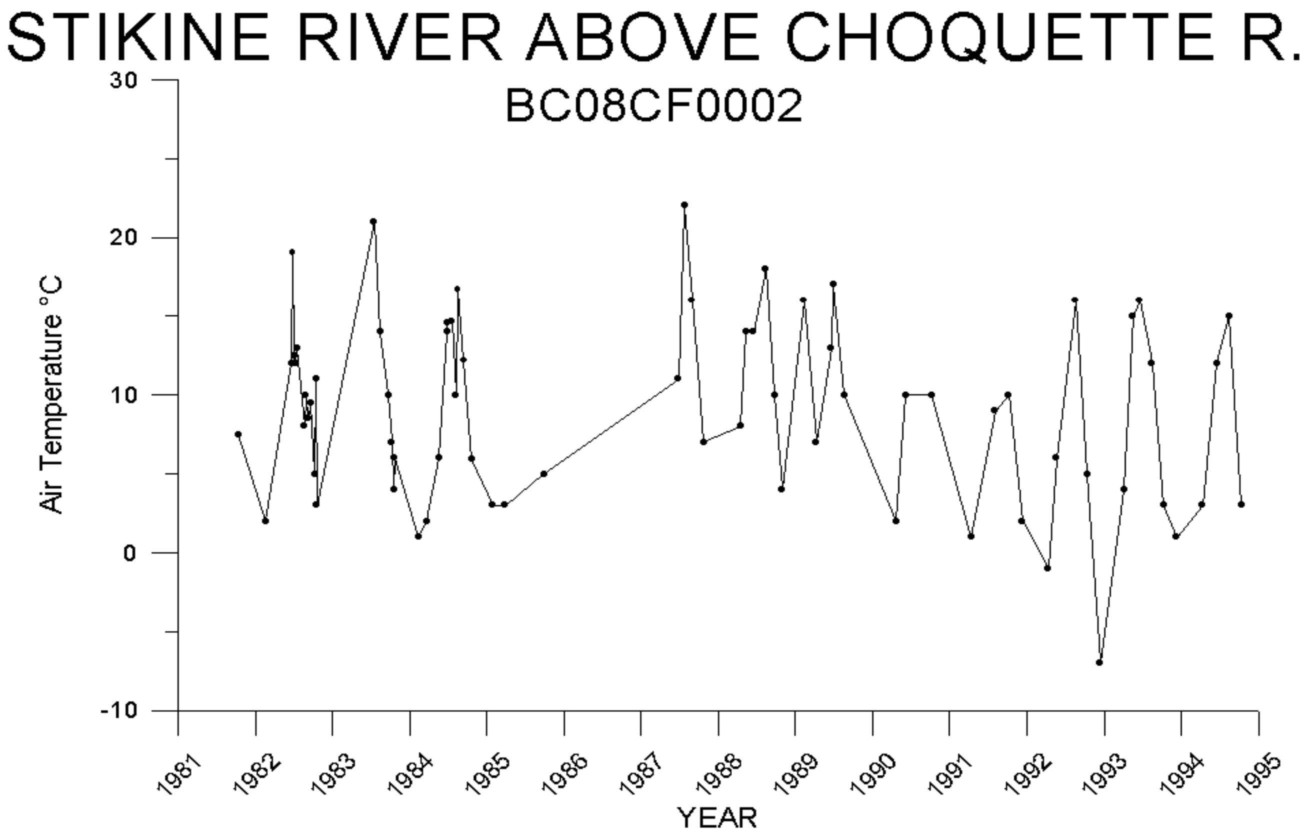


Figure 43 Water Temperature

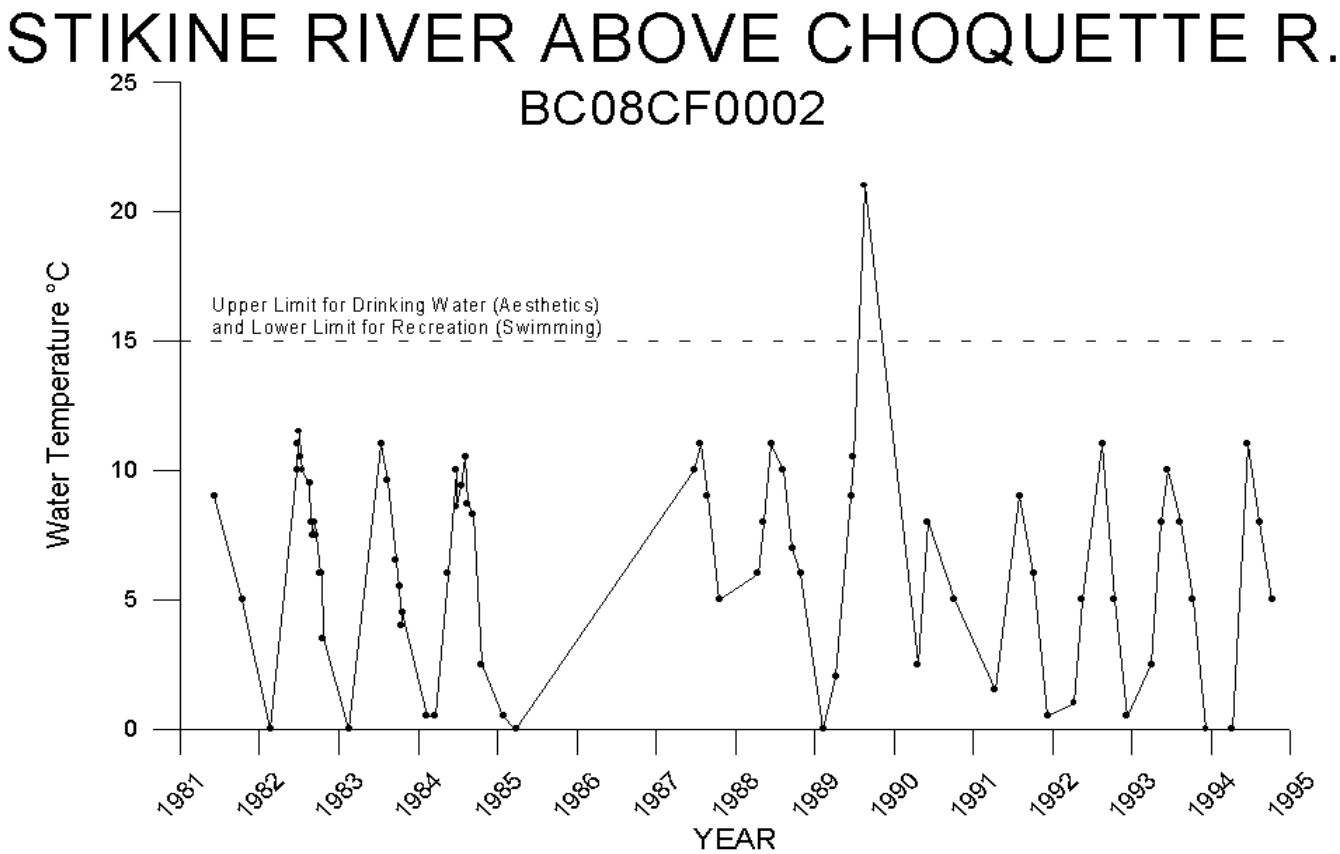


Figure 44 Turbidity

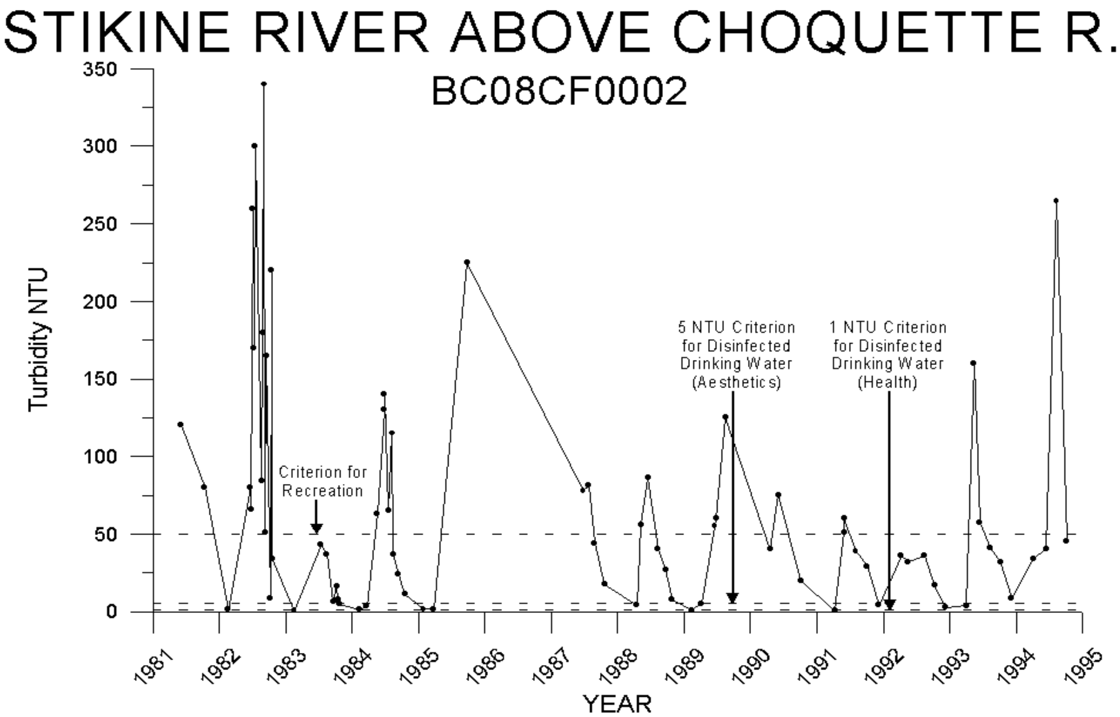


Figure 45 Turbidity (with Flow)

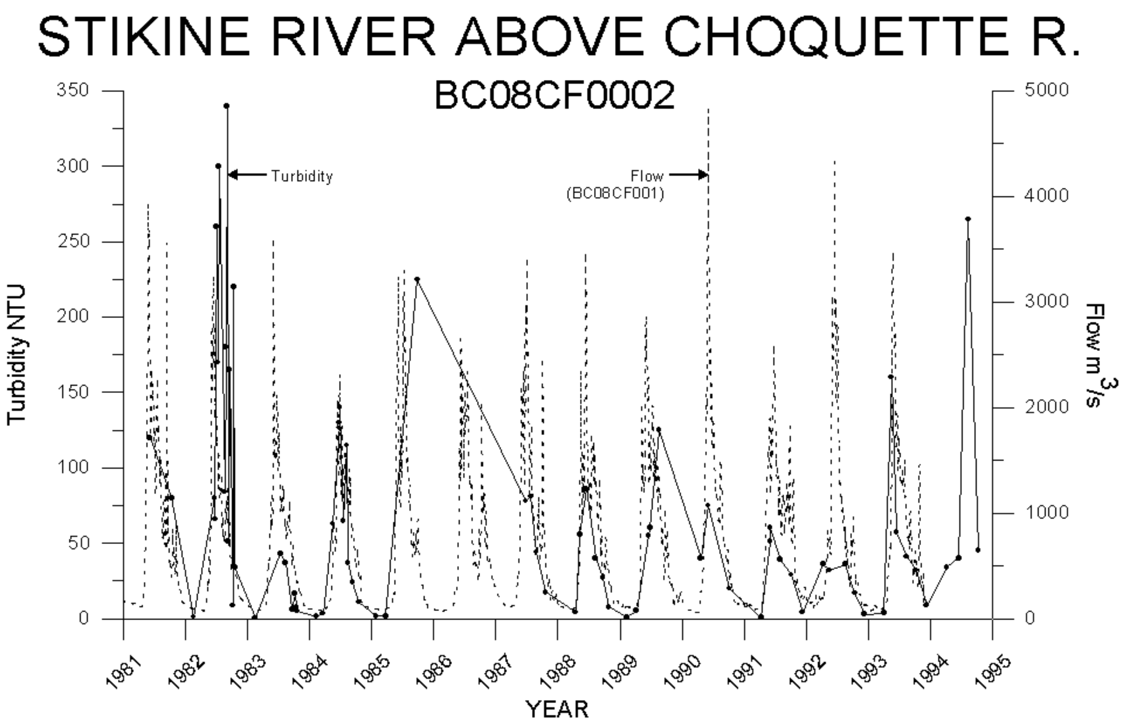


Figure 46 Total Vanadium

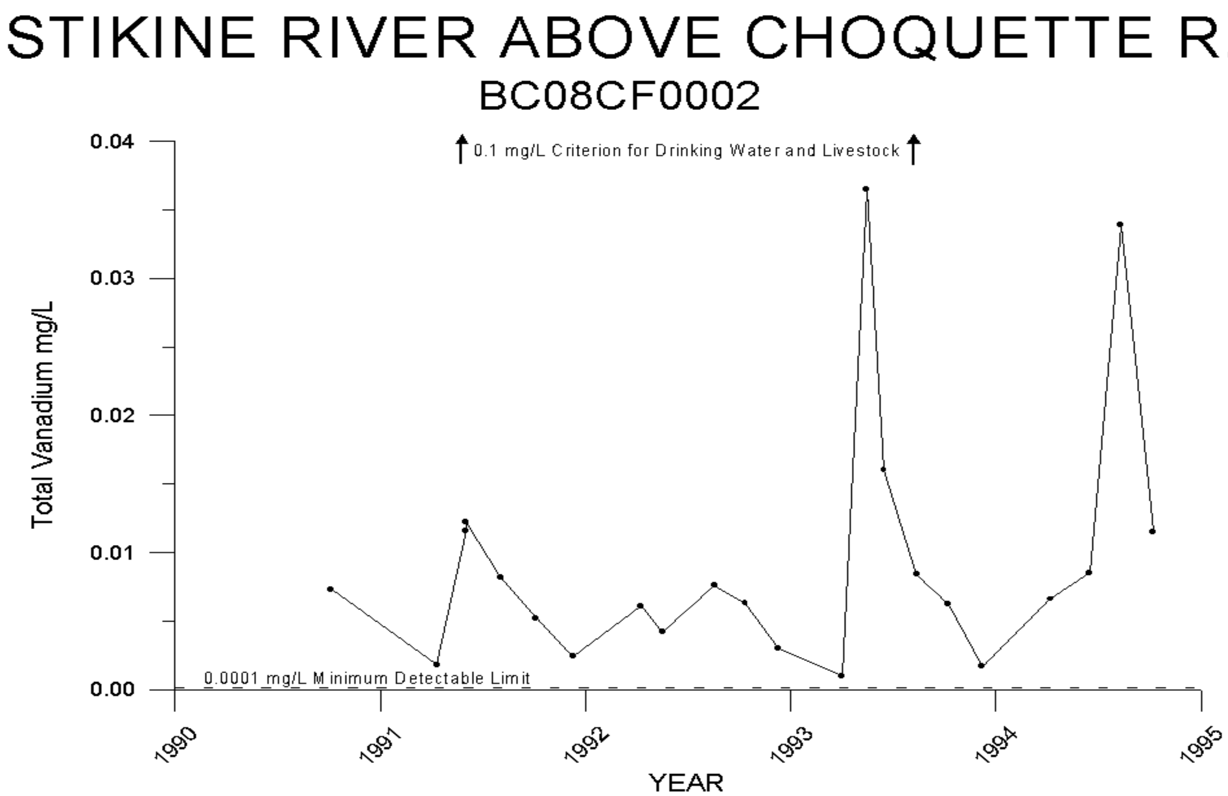
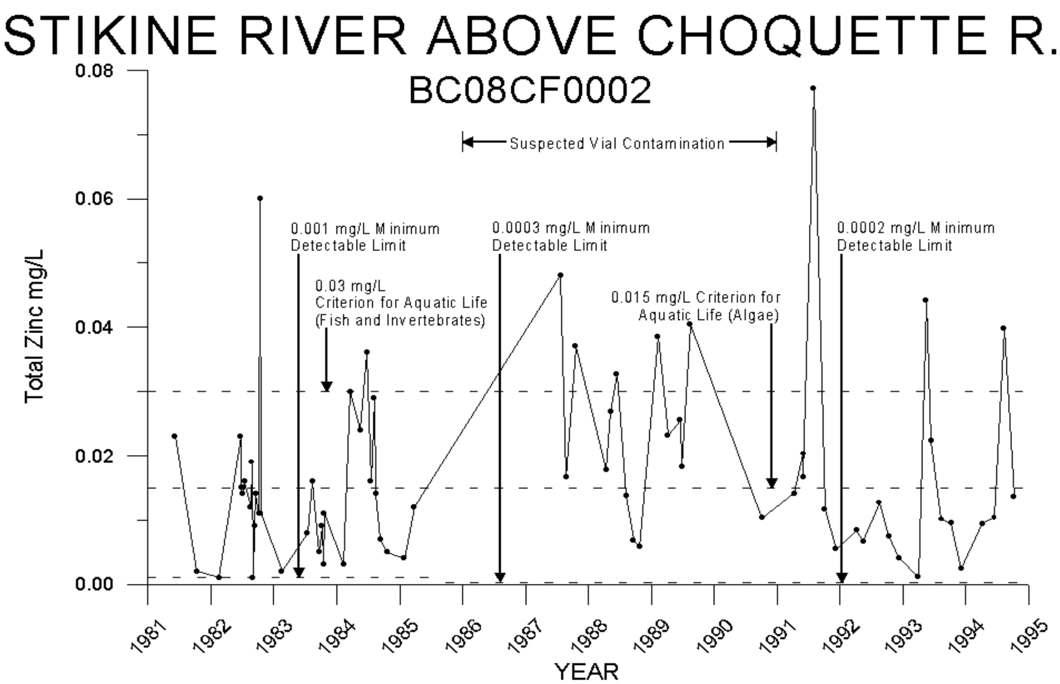


Figure 47 Total Zinc



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