CANADA – BRITISH COLUMBIA

WATER QUALITY MONITORING AGREEMENT

WATER QUALITY ASSESSMENT OF ISKUT RIVER BELOW JOHNSON RIVER (1969 – 2002)

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Environment Canada **Environnement Canada**

BRITISH COLUMBIA Ministry of Environment

EXECUTIVE SUMMARY

The Iskut River is located in northwest British Columbia, flowing from Kinaskan Lake to the Stikine River. From this point, the Stikine River flows through Alaska into the Pacific Ocean. Activities in the Iskut watershed include mining and, to a lesser extent, forestry.

This report assesses water quality data from Environment Canada at the monitoring station below Johnson River, 8 km upstream from the confluence with the Stikine River. Water quality samples were collected between 1980 and 2002 by Environment Canada. Flow was measured at a Water Survey of Canada flow gauge at the same location.

CONCLUSIONS

We concluded that:

- There were no obvious environmentally significant trends in water quality that could be identified through visual examination of the data.
- Maximum non-filterable residue and turbidity values occurred during peak flows, and were probably a natural occurrence.
- Turbidity removal and disinfection would be needed prior to drinking.
- Total aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese and zinc, organic carbon, apparent colour, non-filterable residue and turbidity values did not meet various water quality guidelines due to the high levels of suspended sediment in the water during freshet.
- High metals and suspended sediments occurred together in samples collected during periods of high flow. This indicates that the metals were in a particulate form, probably not biologically available and would be removed by the treatment needed to remove turbidity prior to drinking if it were being used for that purpose.
- Total barium, beryllium, cobalt, nickel, selenium and vanadium, dissolved chloride and sulphate, total alkalinity, calcium, magnesium, nitrate/nitrite, pH, potassium, filterable residue, sodium and specific conductivity met all guidelines.
- 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.

RECOMMENDATIONS

We recommend monitoring of water quality and flow for the Iskut River below the Johnson River be continued because the site is being used to: determine trans-boundary effects between British Columbia and Alaska, assess the environmental impacts of upstream activities (mining, forestry); and determine Iskut River water quality before its confluence with the Stikine River.

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INTRODUCTION

The Iskut River is located in northwest British Columbia and is the largest tributary of the Stikine River. Originating at Kinaskan Lake, the Iskut flows south and then west, where it joins the Stikine River, which flows out through the Alaskan panhandle and into the Pacific Ocean. The Iskut River is under ice from November to March.

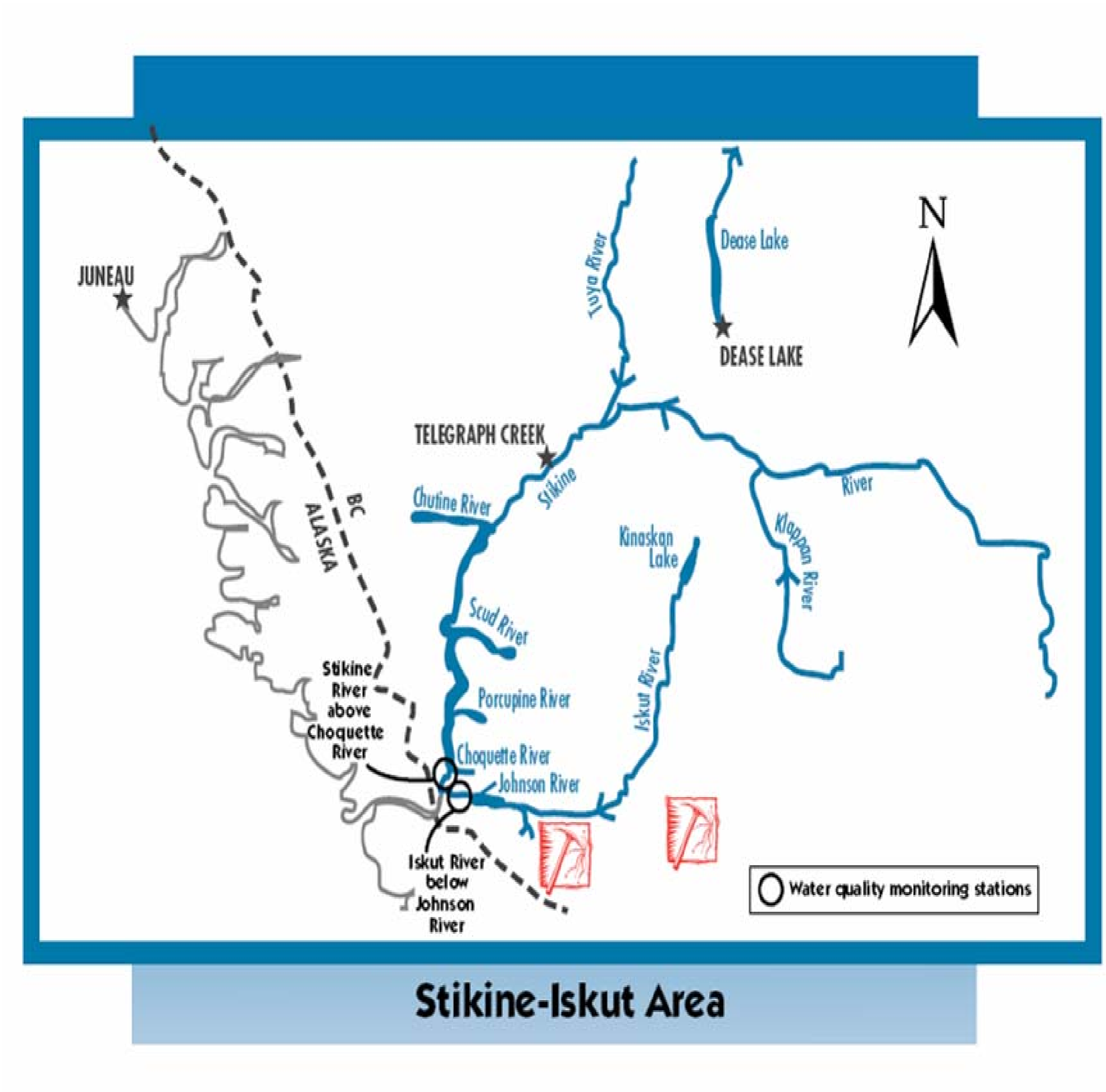
The water quality monitoring station is located 0.4 km below Johnson River and 8 km above the Iskut's confluence with the Stikine River. At this point, the drainage area is 9350 km^2. Mining has the greatest potential effect of all land uses in the Iskut, with several projects (Bronson, Eskay, and Snip mines) located south from the river. Forestry may also affect the river, but is not a major industry in the area due to the remote location. Finally, some commercial fisheries are located on the Iskut.

Data for this report were obtained from samples collected bi-monthly by Environment Canada, between 1980 and 2002; the data are stored under ENVIRODAT station number BC08CG0001. The water quality indicators are plotted in Figures 3 to 51. Water Survey of Canada operates a flow gauge at the water quality monitoring station (site number BC08CG001). Flow data from 1980 to 2001 are graphed in Figure 2.

QUALITY ASSURANCE

The water quality plots were reviewed, and values that were known to be in error or questionable were removed. The total mercury plot has been removed as it showed many detectable values which were probably errors due to false positives near the minimum detectable limits (MDLs) and artificial contamination due to the sample collection and laboratory measurement method used. Natural mercury levels in pristine areas are typically <1-2 ng/L and are 5-10 ng/L in grossly mercury-polluted waters (Pommen, 1994). These levels are at or below the lowest MDL used for mercury. Mercury monitoring in ambient water was terminated in 1994. Mercury in resident fish tissue should be monitored if there are any mercury concerns upstream in this watershed.

Figure 1. Iskut River below Johnson River



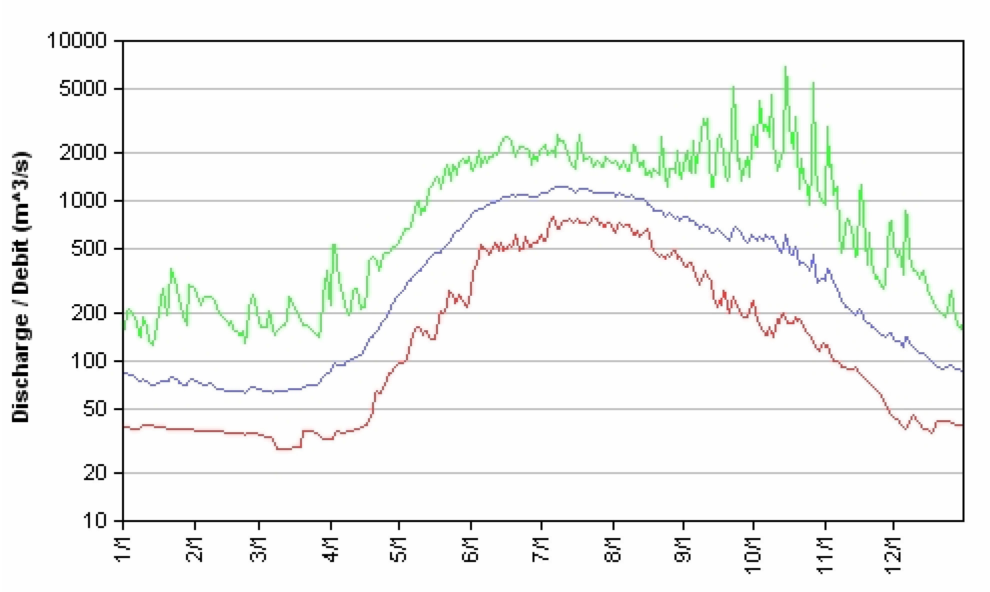


Figure 2. Range of daily flows (maximum, average, minimum) for Iskut River below Johnson River (1980 – 2002)

There were known quality assurance problems due to the gradual failure of the re-usable Teflon liners in the bakelite preservative vial caps. Over time, preservatives would leak and leach out contaminates from the bakelite vial caps and contaminate many of the 1986 to 1991 samples. This contamination problem was known to affect federal water quality data province-wide. The primary variables affected were cadmium, chromium, copper, cyanide, lead, mercury, and zinc during this sampling period. There were known problems due to pH methodology at the Environment Canada Laboratory in Vancouver from the about the beginning of 1986 to the end of 1988.

STATE OF THE WATER QUALITY

The state of the water quality was determined by comparing the values to B.C. Environment's *Approved and Working Criteria for Water Quality* (Nagpal *et al*., 2001a; 2001b). No site-specific water quality objectives have been developed for the Iskut River. The only existing water license for the Iskut River is for power generation, so it does not appear that uses such as drinking water, irrigation or livestock watering are currently a concern. Substances not discussed below met guidelines and displayed no environmentally significant trends. They include: barium, boron, bromide, carbon, chloride, specific conductivity, cyanide, gallium, lanthanum, lithium, magnesium, molybdenum, nitrogen, phosphorus, potassium, rubidium, selenium, silicon, silver, sodium, strontium, sulphate, thallium, uranium and vanadium.

Total alkalinity (Figure 3) and **dissolved calcium** (Figure 11) concentrations indicate that the Iskut River has a low sensitivity to acidic inputs (is well buffered).

Total aluminum concentrations were typically high, ranging from 0.012 mg/L to 21.1 mg/L. Eighty-two percent (67 of 82 samples) exceeded the aquatic life guideline of 0.1 mg/L, and 76% (62 of 82 samples) also exceeded the drinking water guideline of 0.2 mg/L (Figure 4). However, as these guidelines apply to the dissolved form only of aluminum and that form was not measured in this study, an accurate assessment of the guidelines cannot be made. The guideline for wildlife, irrigation and livestock watering of 5 mg/L total aluminum was exceeded by 33% of samples (27 of the 82 samples collected). There was a strong correlation between elevated aluminum levels and higher turbidity values (see Figure 4), suggesting that higher aluminum levels were associated with particulate matter and would therefore not be biologically available.

Total arsenic concentrations exceeded the aquatic life guideline of 0.005 mg/L on 10 occasions (10% of 100 samples collected) (Figure 5). Arsenic concentrations were closely correlated with turbidity values (see Figure 5), suggesting that the arsenic was bound to particulate matter and not toxic to biota.

Total beryllium concentrations were generally at or near detection limits (0.00005 mg/L), and therefore well below the chronic aquatic life guideline of 0.0053 mg/L (Figure 7). The exception to this were two values of 0.05 mg/L, on January 7, 2001. It is likely, considering the consistency of the remainder of the data, that this value is erroneous and no cause for concern. Similar exceedences were observed at other long-term sites throughout the province at about the same time, suggesting a laboratory reporting error.

Total cadmium concentrations invariably exceeded the aquatic life guideline of 0.0003 mg/L (Figure 10), but this was due in part to the fact that the detection limits used in the analyses were between 30 and 300 times the guideline limit. In order to properly assess cadmium concentrations, it is essential that analytical methods with a detection limit of no more than one-tenth the guideline level be employed when such methods become available. Cadmium concentrations were well correlated with turbidity, suggesting that higher levels of total cadmium were associated with particulate matter and therefore not a threat to biota.

Total chromium concentrations measured prior to 1991 may have been elevated due to suspected preservative vial contamination (Figure 16). Since that time, 51 values (68% of 75 values collected) exceeded the aquatic life guideline of 0.001 mg/L, and 32 of these values (43%) also exceeded the irrigation guideline of 0.005 mg/L. The maximum recorded concentration after 1991 was 0.0337 mg/L. Elevated levels of total chromium were associated with elevated turbidity levels (see Figure 16), suggesting that the chromium was associated with particulate matter and therefore not available to biota.

Total cobalt levels exceeded the aquatic life guideline of 0.0009 mg/L in 44 of 79 samples collected (56%) (Figure 17), but the irrigation guideline of 0.05 mg/L was not exceeded. The close relationship between cobalt and turbidity (see Figure 17) suggests that the majority of the cobalt present was in particulate form and not biologically available.

The drinking water quality objective for **colour** is expressed in terms of true colour. This method of measurement has been used only since 1997 for the Iskut River. Of the 35 samples collected between 1997 and 2002 and analyzed for true colour, 14 (or 40%) exceeded the drinking water guideline (Figure 18); however, this is not a concern because the water is not used as a drinking water supply. These exceedences invariably occurred between April and October, when the river wasn't covered with ice.

Total copper levels were elevated between 1986 and 1991 due to suspected preservative vial contamination (Figure 20). Since that time, 59% of values (44 of 75 samples) exceeded the 30-day average aquatic life objective, and 47% of values (35 of 75 samples) also exceeded the maximum aquatic life objective. The strong relationship between total copper and turbidity suggests that elevated levels of copper are associated with particulate matter and therefore not toxic to biota.

The guideline for the protection of aquatic life from **dissolved fluoride** is hardness-dependent. As hardness concentrations in the Iskut River are generally higher than 50 mg/L (see Figure 24), the applicable aquatic-life guideline is usually 0.3 mg/L. One sample (about 1% of 83 samples) collected between 1980 and 1998 exceeded this guideline (Figure 22). The drinking water guideline (1 mg/L) was not exceeded by any samples. Fluoride does not appear to be correlated with turbidity (see Figure 22).

Total hardness concentrations ranged from 43 mg/L to 130 mg/L, with values fluctuating seasonally (Figure 24). Peak hardness was measured during the winter when flows were lowest, likely due to the increased influence of groundwater on surface water concentrations, while lower hardness values were recorded during spring freshet.

Total iron concentrations were measured 109 times between 1969 and 2002, with 82 values (75% of samples) exceeding the aquatic life and aesthetic drinking water guideline of 0.3 mg/L (Figure 25). The irrigation guideline of 5 mg/L was exceeded by 47 samples (43% of all values measured). The exceedences occurred primarily during spring freshet, and the strong correlation between total iron and turbidity indicates that higher levels of iron are associated with particulate matter. This would mean that they were not biologically available and would be removed by treatment necessary for elevated turbidity levels prior to consumption in drinking water.

Concentrations of **total lead** measured between 1988 and 1991 are suspected to be contaminated as a result of faulty preservative vial seals. Outside of this period, 31 values (24% of 129 samples) exceeded the average hardness-dependent aquatic life guideline of approximately 0.004 mg/L and 8 samples also exceeded the drinking water guideline of 0.01 mg/L. No values exceeded the maximum guideline of 0.04 mg/L (Figure 27); however, this is not a concern because the water is not used for drinking. All exceedences of the average guideline occurred during periods of elevated turbidity (see Figure 27), suggesting that the lead was associated with particulate matter and would not be bio-available.

Total manganese was measured 113 times between 1969 and 2002. Sixty-three of the 113 values (56%) exceeded the drinking water guideline of 0.05 mg/L, 34 values exceeded the irrigation guideline of 0.2 mg/L (30%), and two values (2%) exceeded the aquatic life guideline of 0.8 mg/L (Figure 30). Elevated manganese concentrations occurred concurrently with elevated turbidity levels, suggesting that the manganese was bound to particulate matter and therefore not biologically available.

Total nickel concentrations exceeded the aquatic life guideline of 0.025 mg/L on four occasions (5% of the 79 samples collected) (Figure 32). These exceedences coincided with periods of elevated turbidity, suggesting that the nickel was not available to biota.

pH values in the Iskut River were generally slightly basic, with values typically between 7.5 and 8.2 pH units. Two very low values were reported (5.13 pH units and 5.17 pH units on June 6, 2001). These extreme values are very unlikely to represent actual conditions and are probably the result of either a laboratory or reporting error. Values reported between 1986 and 1988 were artificially low due to a problem with control in the laboratory.

Non-filterable residue (total suspended solids) concentrations frequently exceeded the general fisheries guideline of 25 mg/L (Figure 38). Increases in NFR were invariably associated with elevated flow levels (see Figure 38), and occurred primarily during spring freshet.

Water temperatures in the Iskut River regularly were generally low and remained below both the aesthetic drinking water guideline of 15°C and the general fisheries guideline of 19 °C (Figure 45). Temperatures seldom exceeded 10°C, and therefore waters were not warm enough for recreational use (< 15°C).

Turbidity levels in the Iskut River were closely associated with water flow (see Figure 48), with peak values generally occurring during spring freshet. Ninety-one percent of values (145 of 160 values collected between 1969 and 2002) exceeded the drinking water guideline of 1 NTU, while 72% also exceeded the aesthetic drinking water guideline of 5 NTU. Seventy-three values (46% of samples) exceeded the recreation guideline of 50 NTU. Turbidity values were typically quite low during the winter, when ice covered the river. The data indicate that there may be a trend to slightly increasing values; however this would have to be tested statistically

Total zinc concentrations were artificially elevated between 1986 and 1991 due to preservative vial contamination. Outside of that period, 50 samples exceeded the hardness-dependent average aquatic life guideline (approximately 0.012 mg/L) and 20 of these also exceeded the hardness-dependent maximum guideline (0.037 mg/L) (Figure 51). The strong correlation between elevated zinc concentrations and higher turbidity levels suggests that the zinc was bound to particulate matter and therefore not toxic to aquatic life.

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Nagpal, N.K., L.W. Pommen, and L.G. Swain. 2001b. A Compendium of Working Water Quality Guidelines for British Columbia. Water Quality Branch, Environmental Protection Department, Ministry of Environment, Lands and Parks, Victoria, B.C.

Pommen, L.W., 1994. Mercury Monitoring Issues (Mark II). Water Quality Branch, Environmental Protection Department, Ministry of Environment, Lands and Parks, Victoria, B.C.

Figure 3. Iskut River below Johnson River - Alkalinity, Total

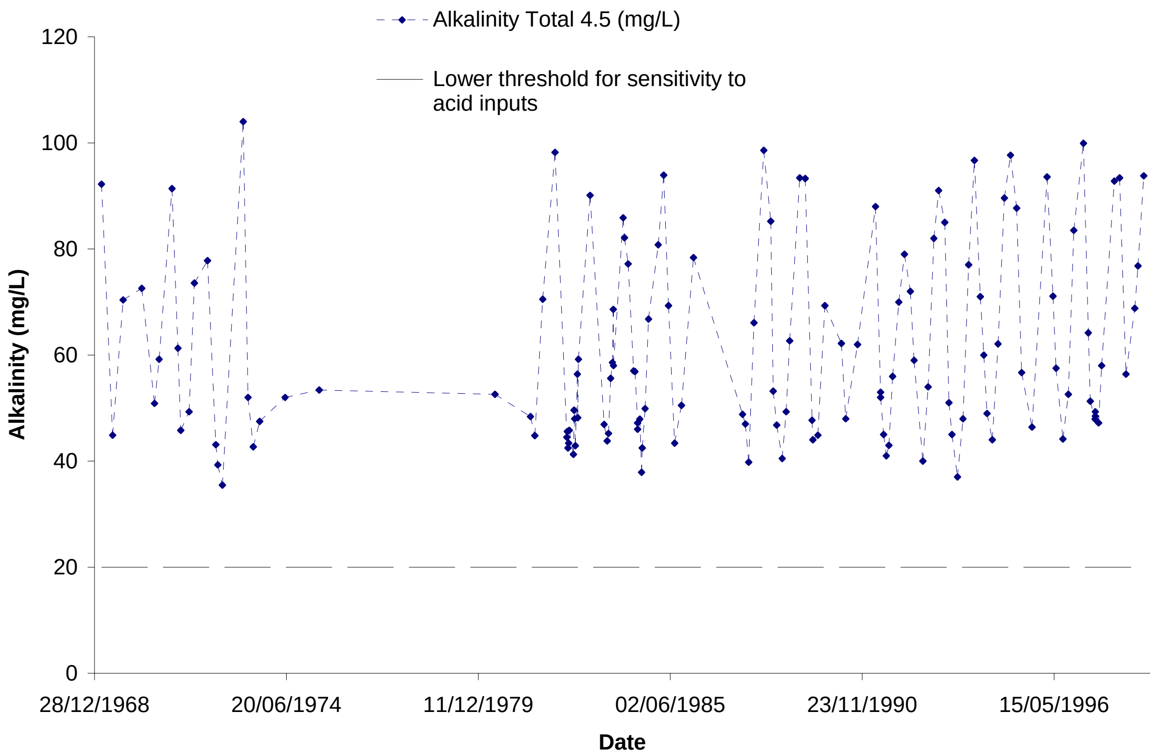

Figure 4. Iskut River below Johnson - Aluminum, Total

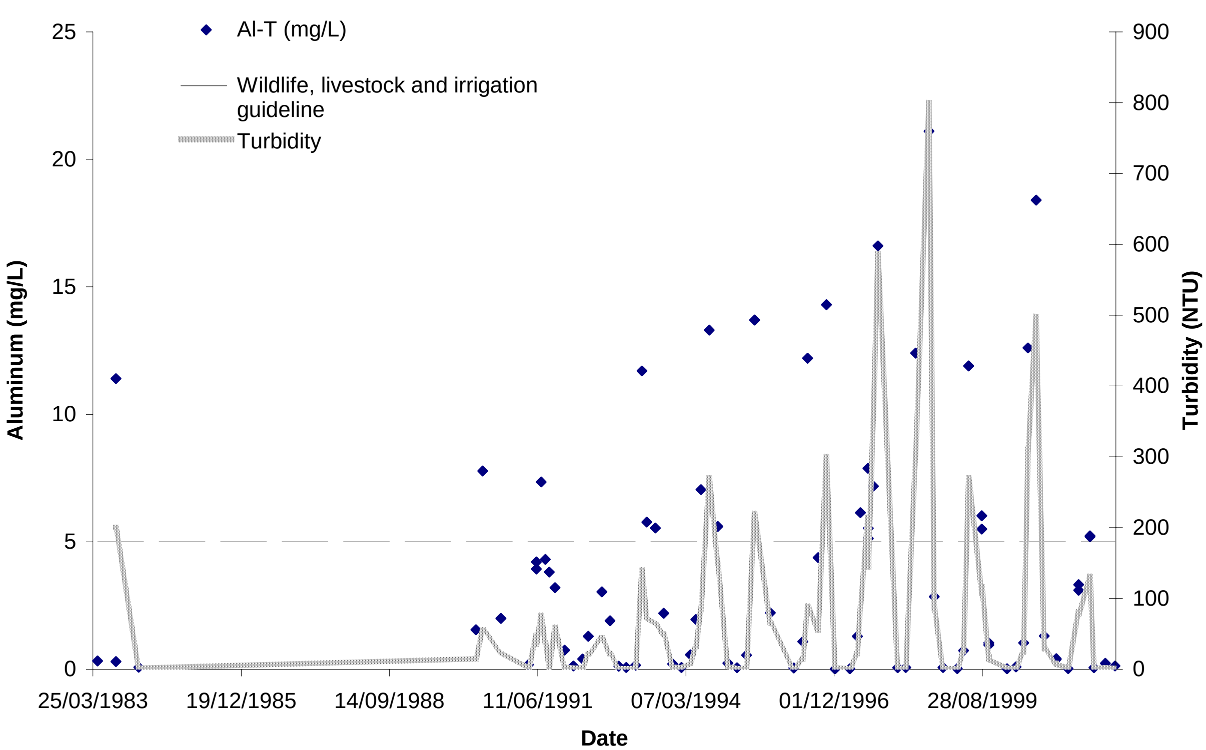

Figure 5. Iskut River below Johnson River - Arsenic, Total, Dissolved and Extractable

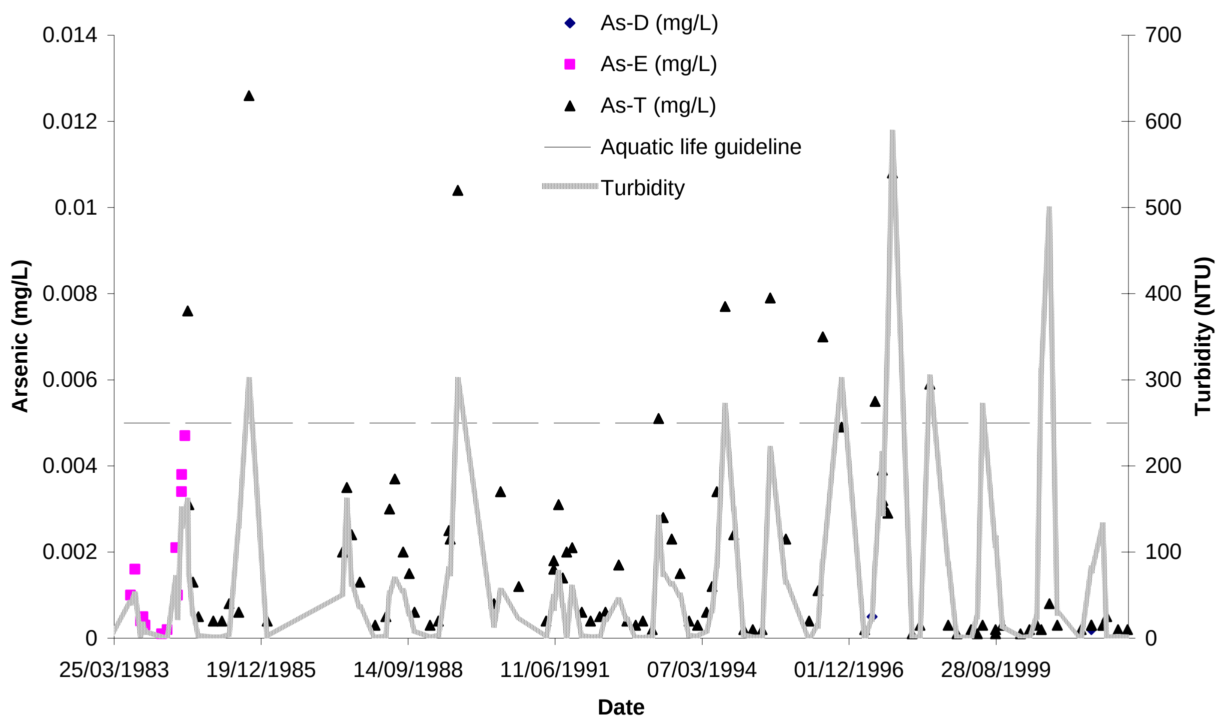

Figure 6. Iskut River below Johnson River - Barium, Total and Extractable

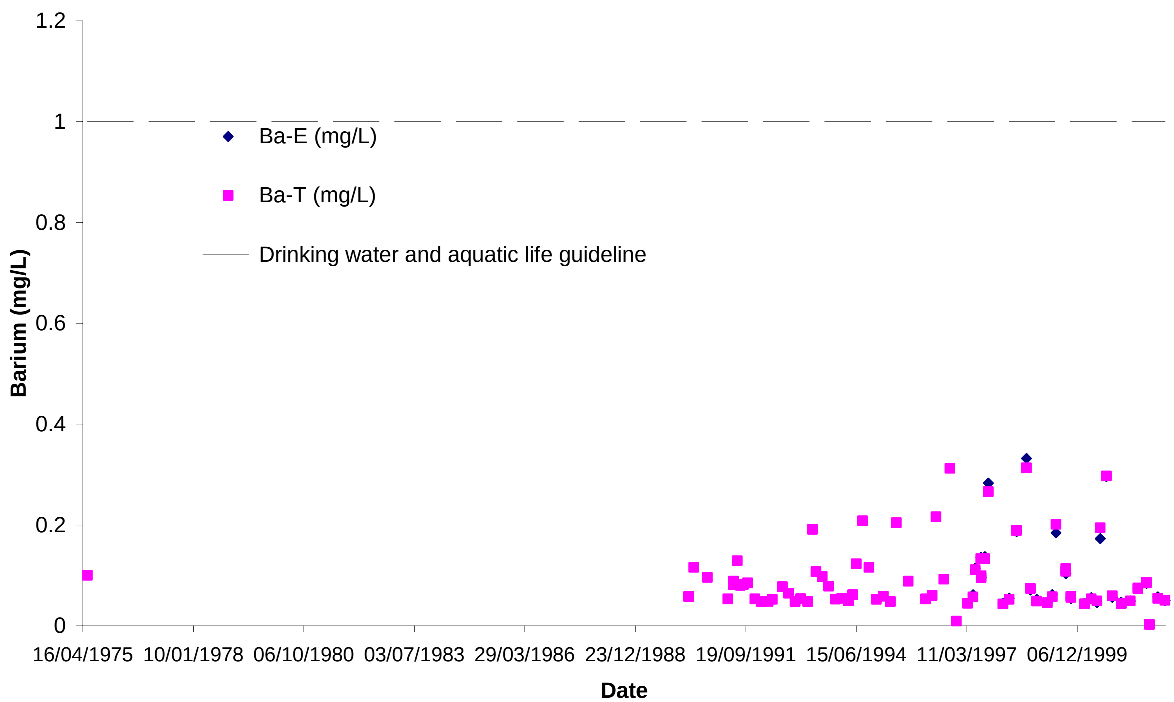

Figure 7. Iskut River below Johnson River - Beryllium, Total and Extractable

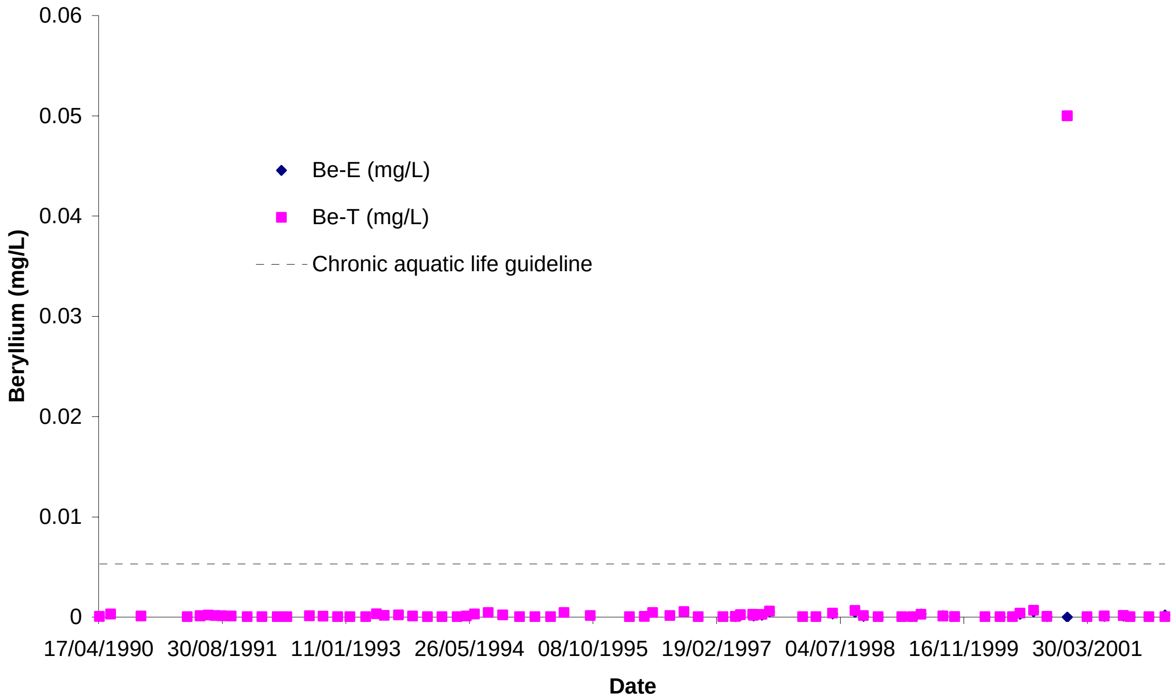

Figure 8. Iskut River below Johnson River - Boron, Dissolved and Extractable

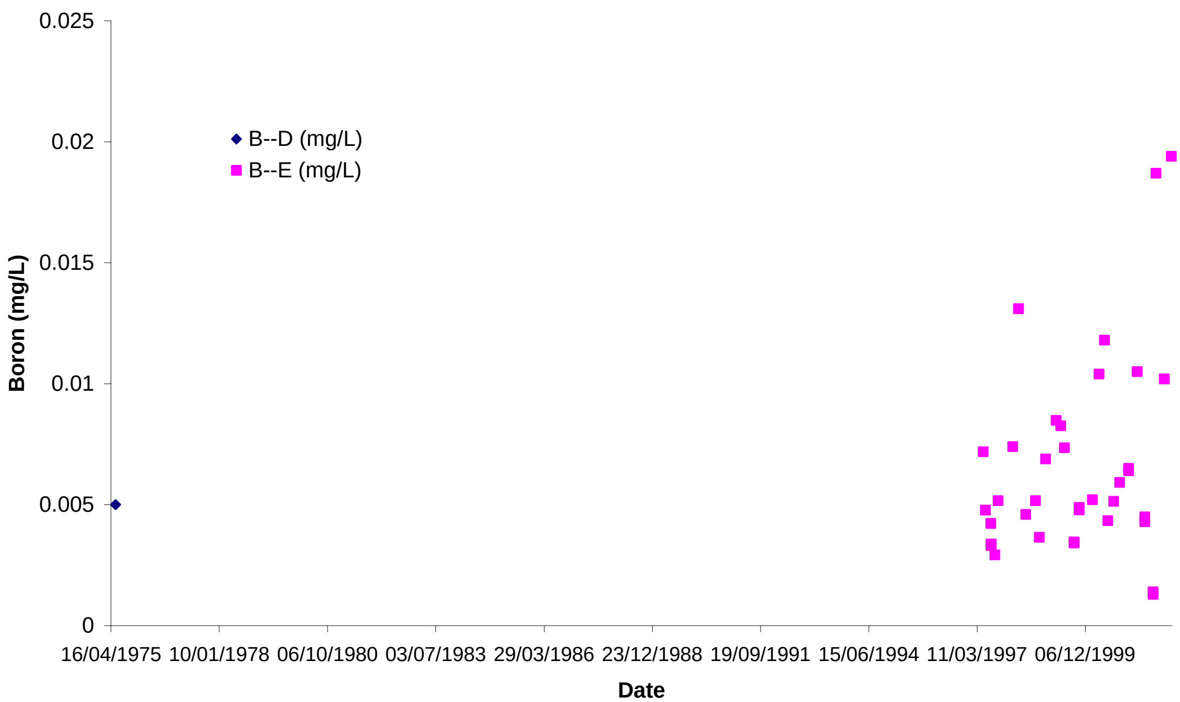

Figure 9. Iskut River below Johnson River - Bromide, Dissolved

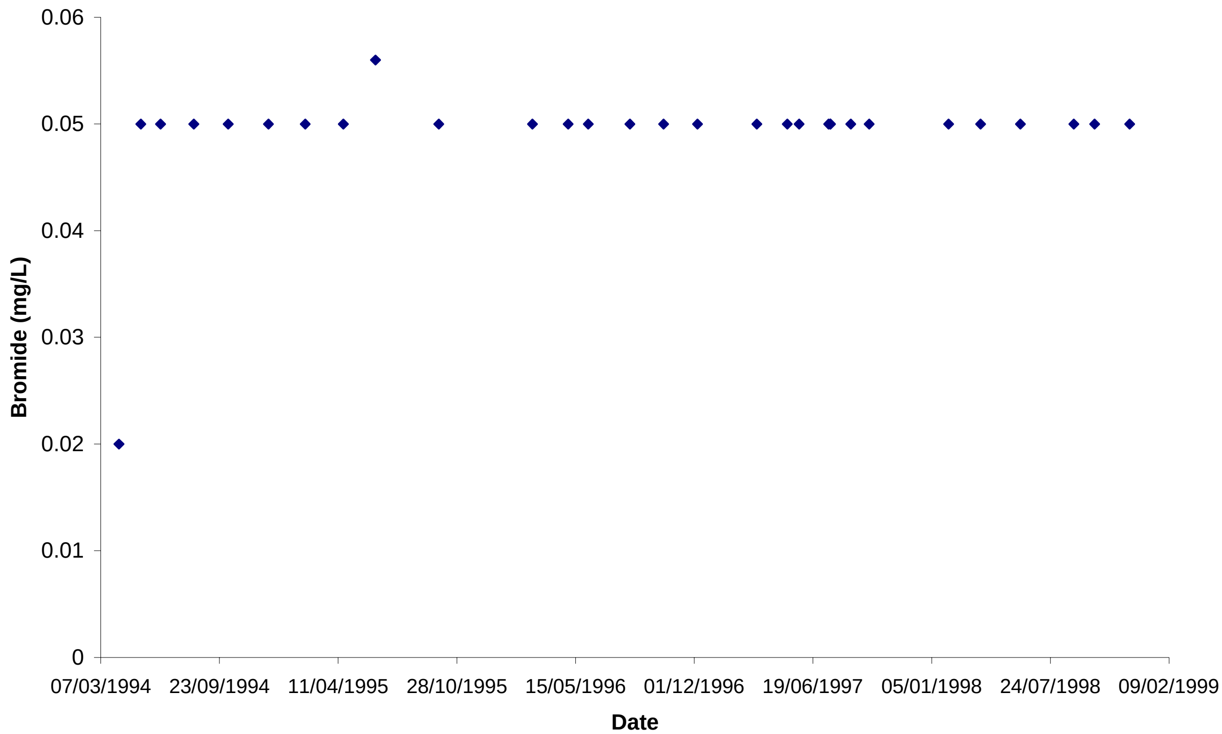

Figure 10. Iskut River below Johnson River - Cadmium, Total and Extractable

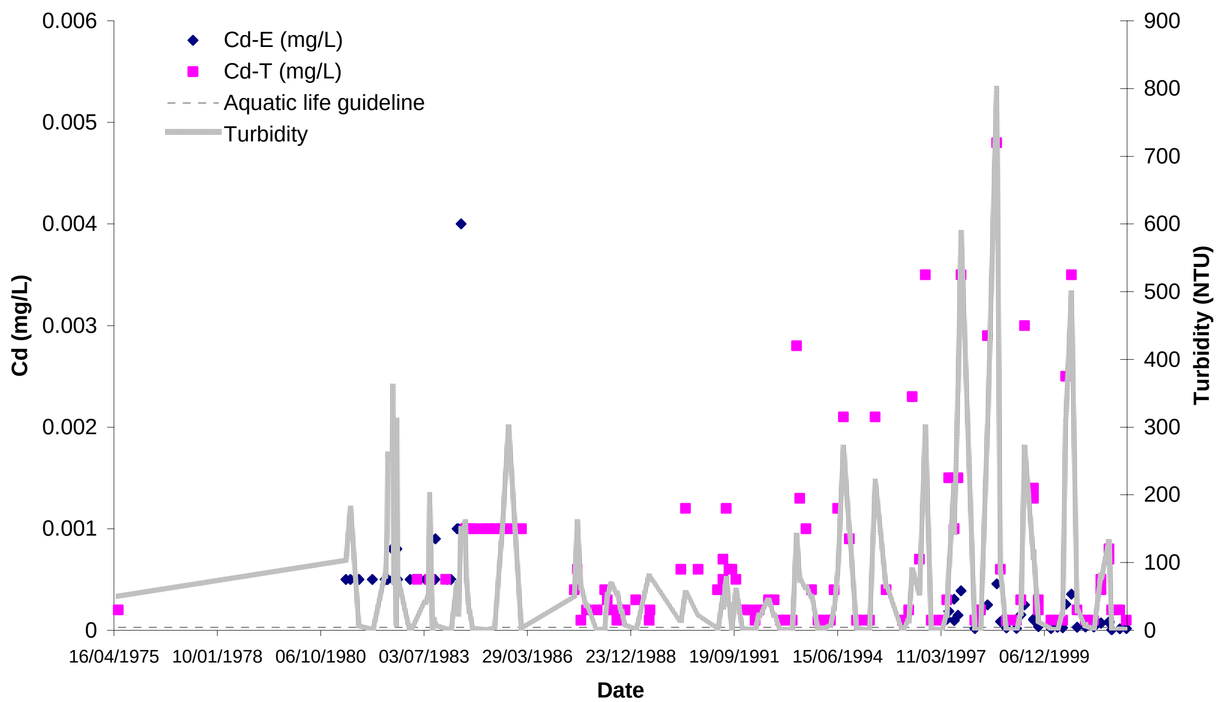

Figure 11. Iskut River below Johnson River - Calcium, Total, Dissolved and Extractable

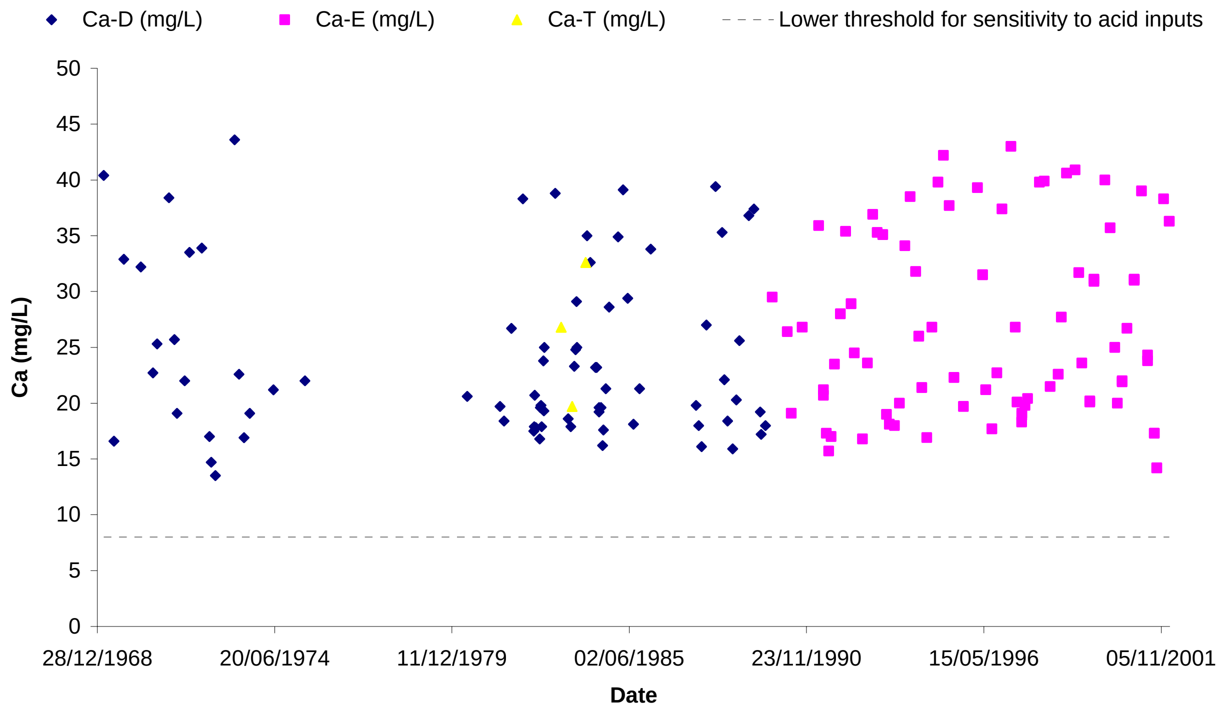

Figure 12. Iskut River below Johnson River - Carbon, Total and Total Dissolved

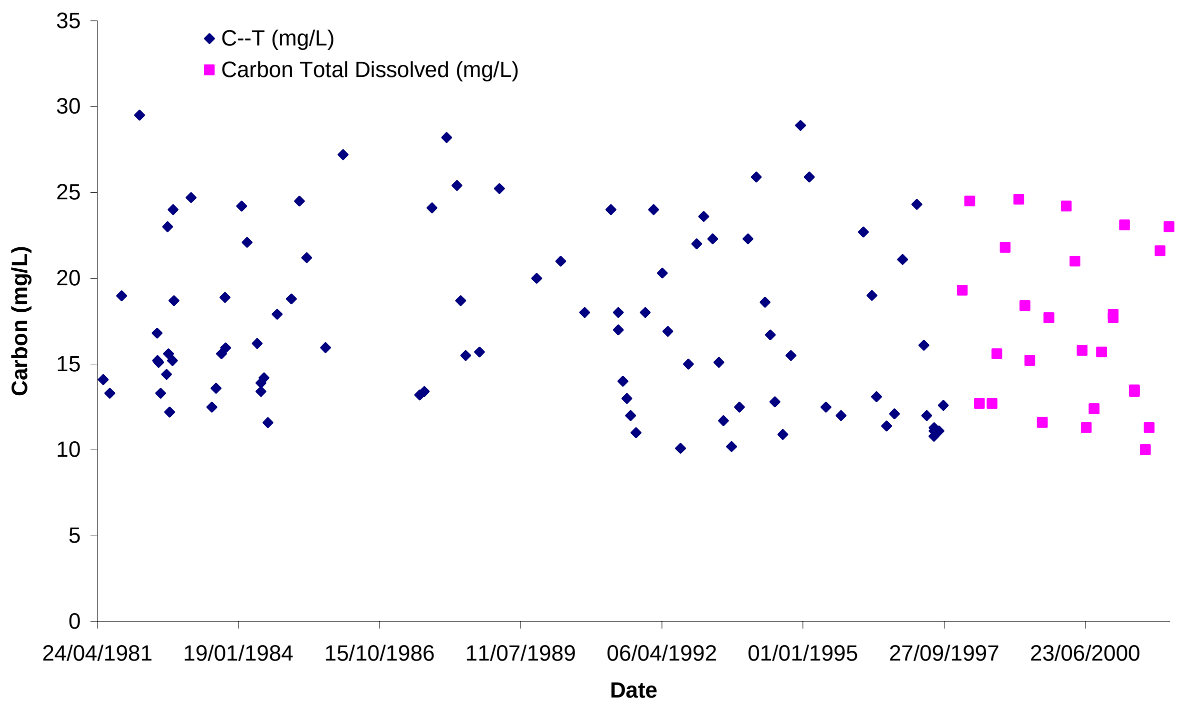

Figure 13. Iskut River below Johnson River - Carbon, Inorganic

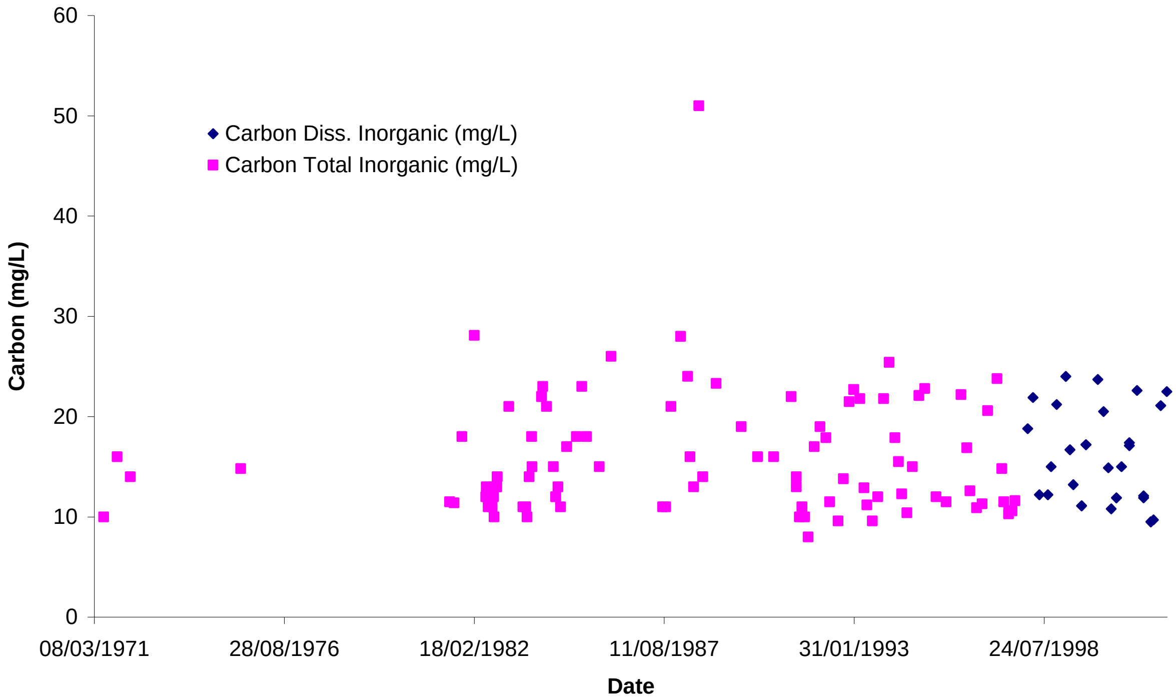

Figure 14. Iskut River below Johnson River - Carbon, Organic

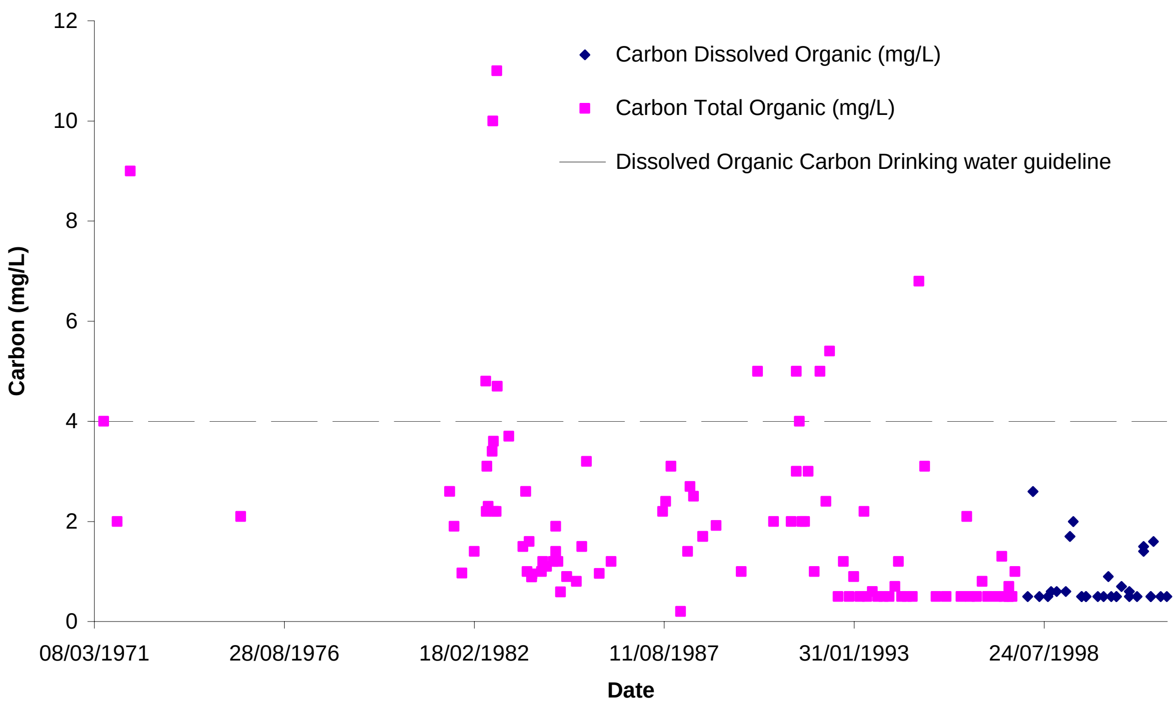

Figure 15. Iskut River below Johnson River - Chloride, Dissolved

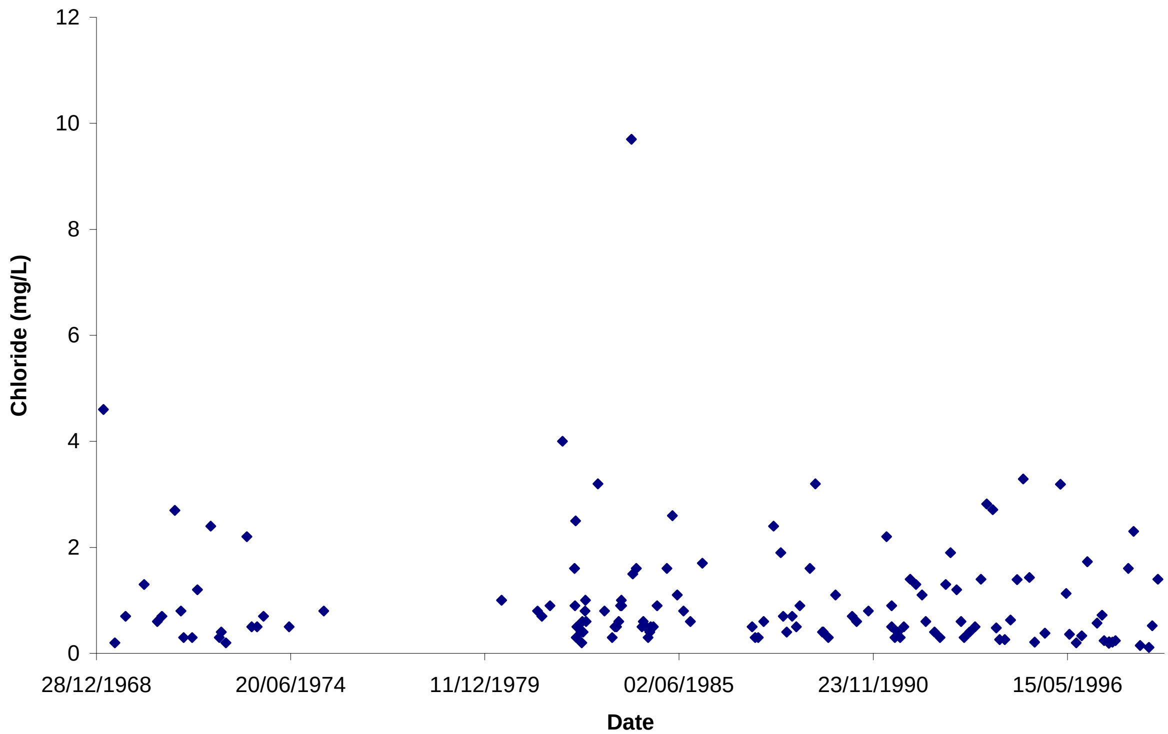

Figure 16. Iskut River below Johnson River - Chromium, Total and Extractable and Turbidity

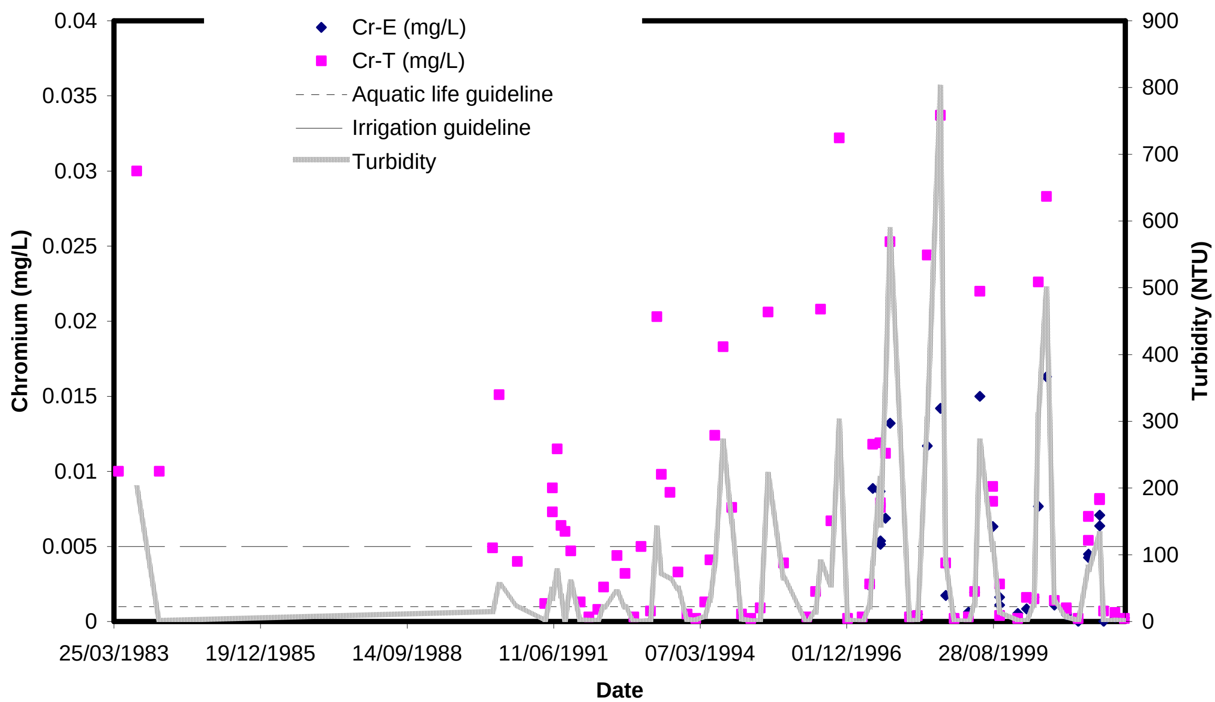

Figure 17. Iskut River below Johnson River - Cobalt, Total and Extractable

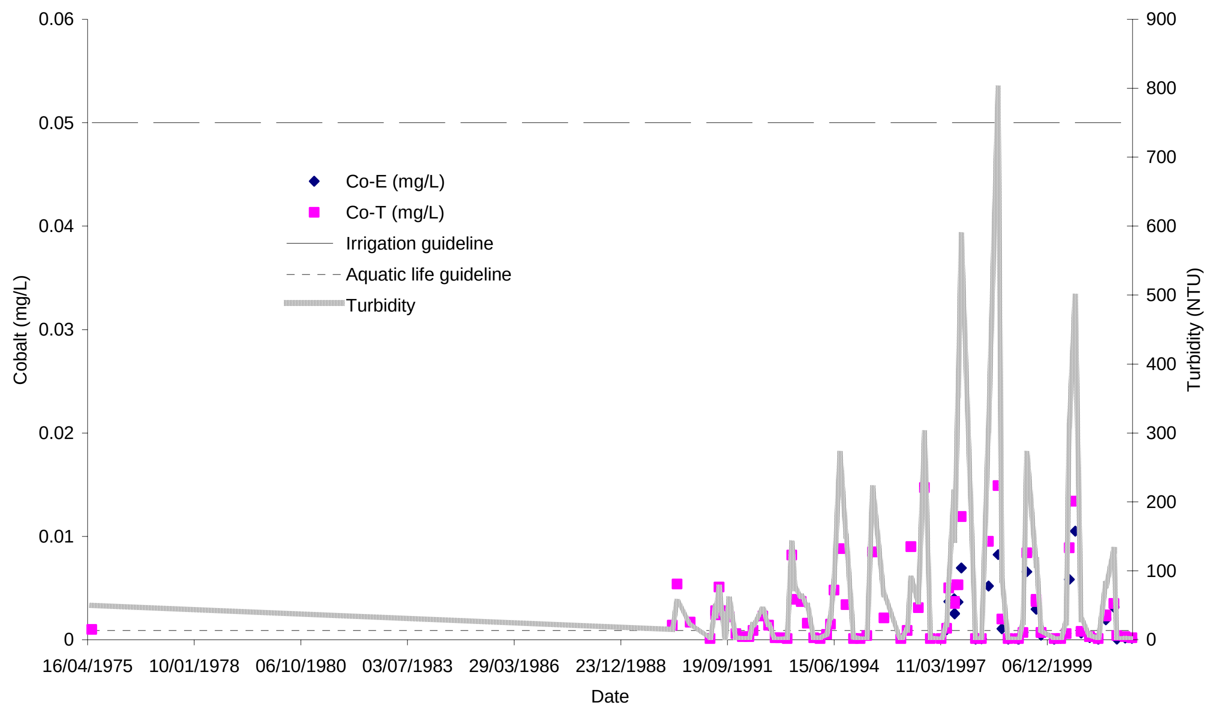

Figure 18. Iskut River below Johnson River - Colour, True and Apparent

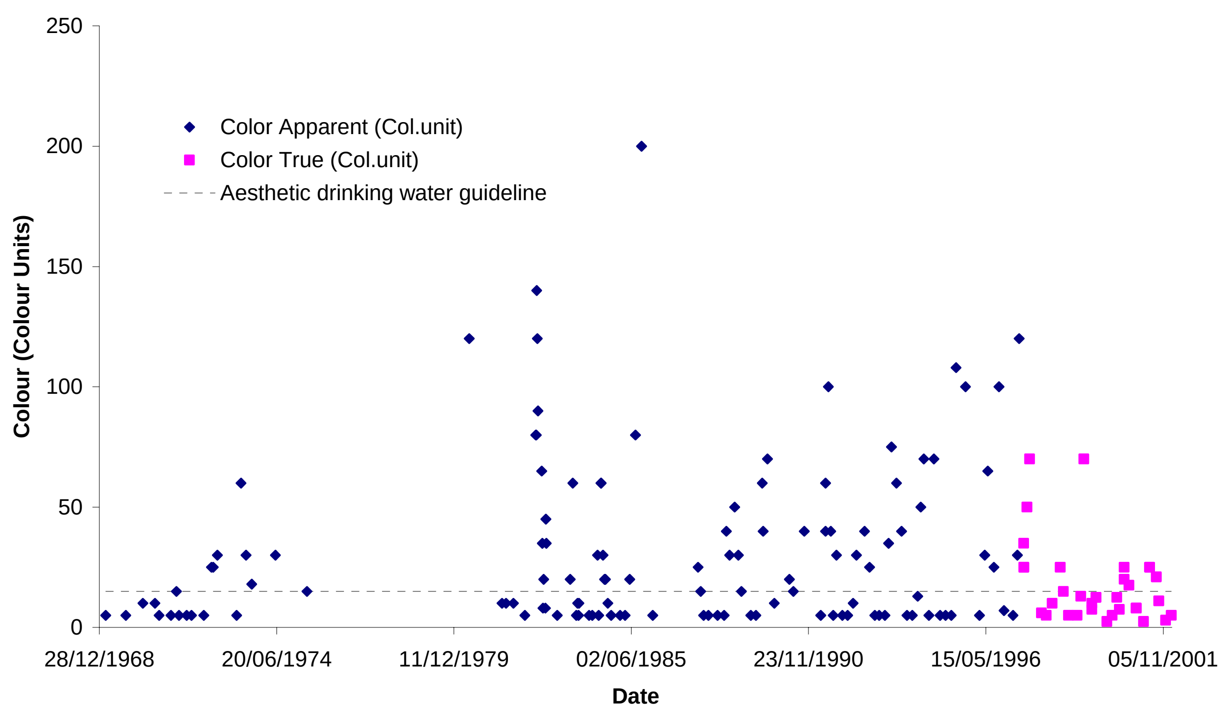

Figure 19. Iskut River below Johnson River - Conductivity, Specific

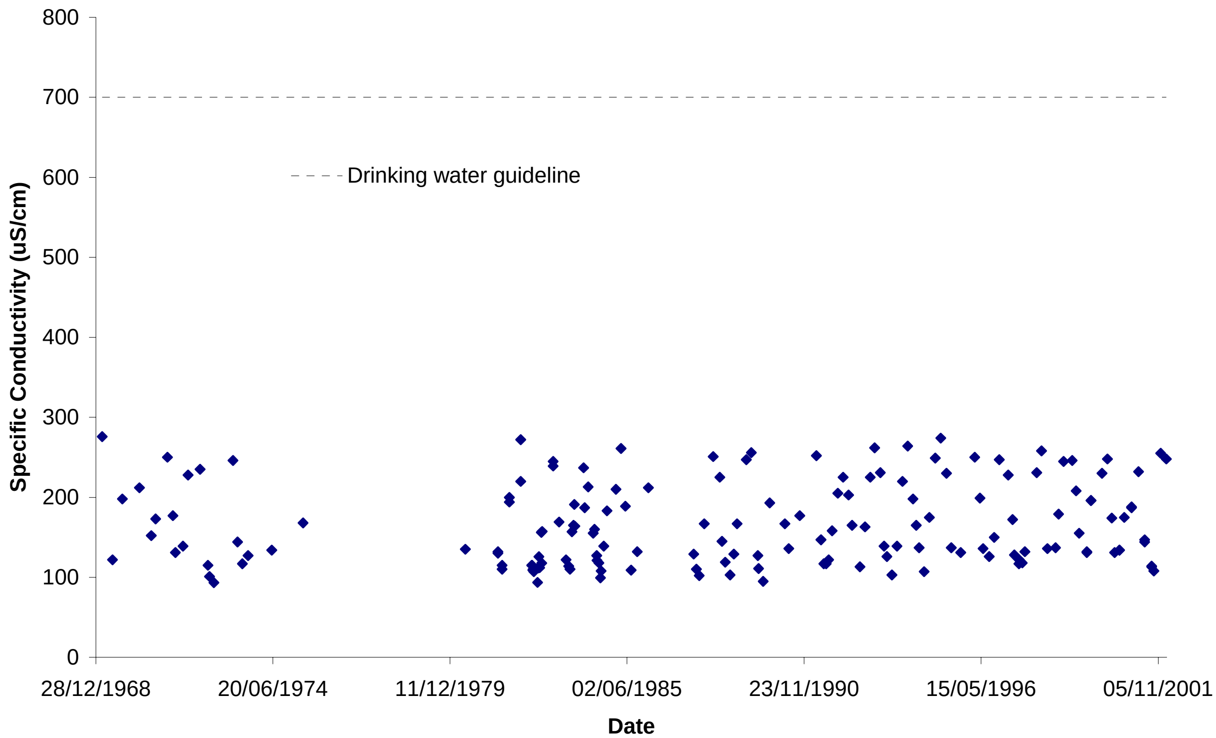

Figure 20. Iskut River below Johnson River - Copper, Total, Dissolved and Extractable, and Turbidity

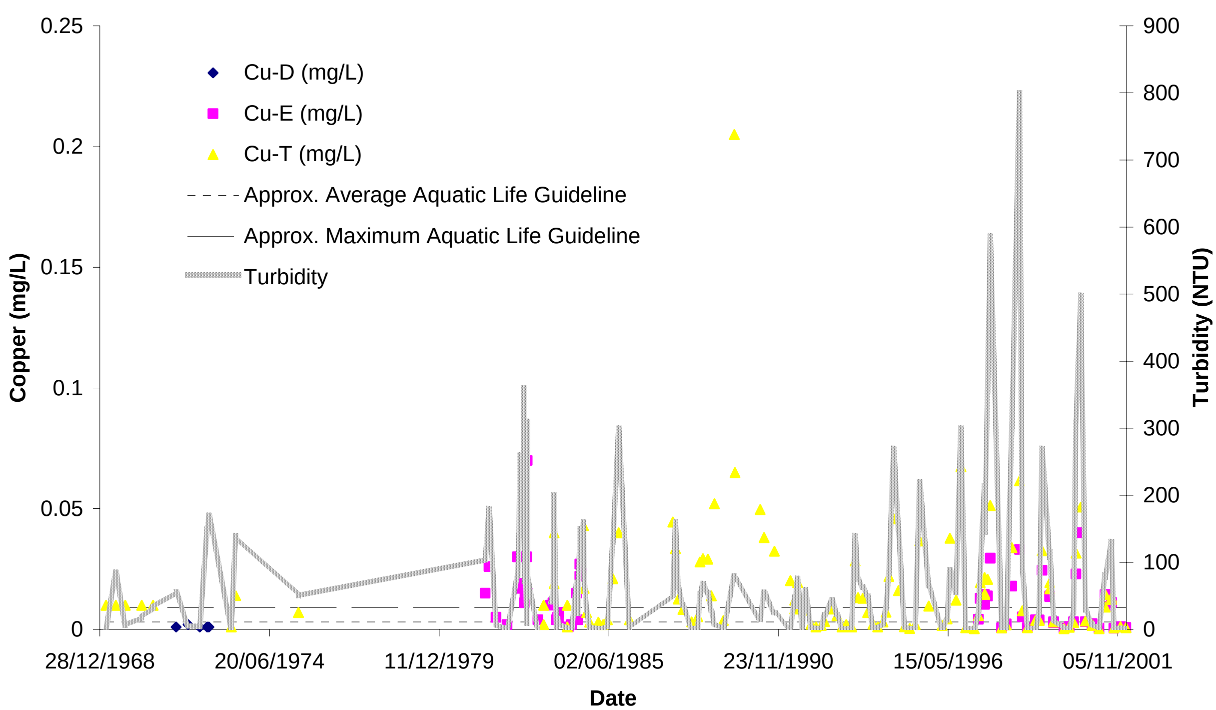

Figure 21. Iskut River below Johnson River - Cyanide, WAD and SAD+SCN

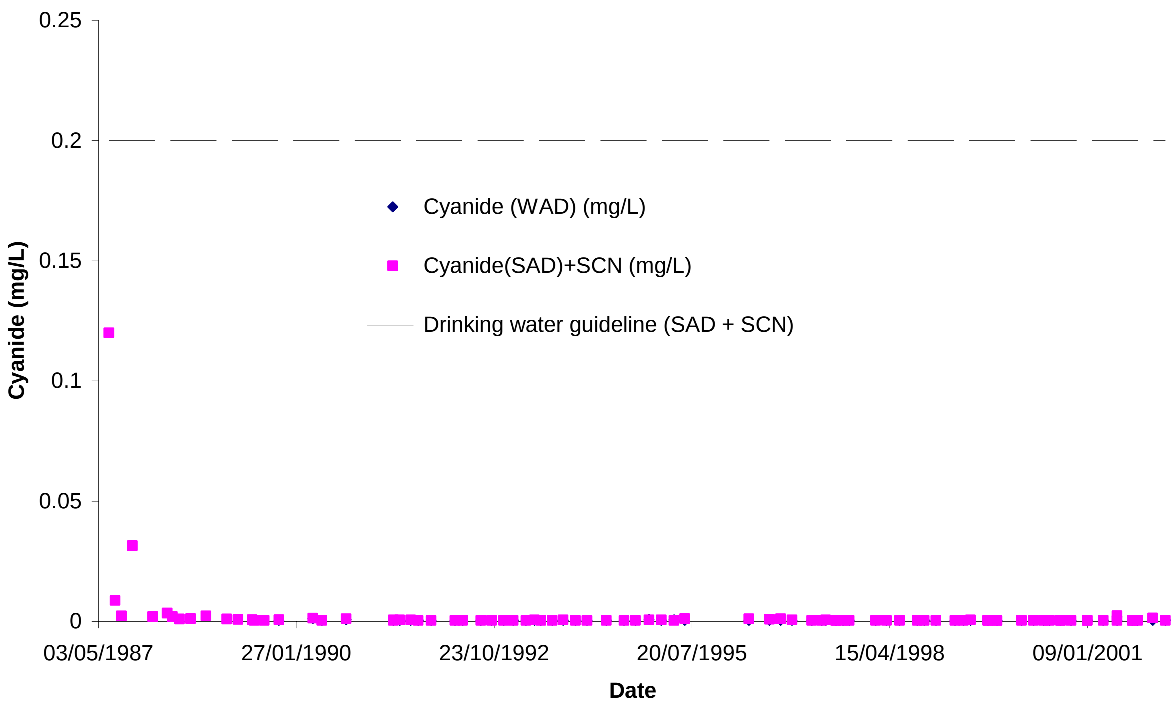

Figure 22. Iskut River below Johnson River - Fluoride, Total and Dissolved

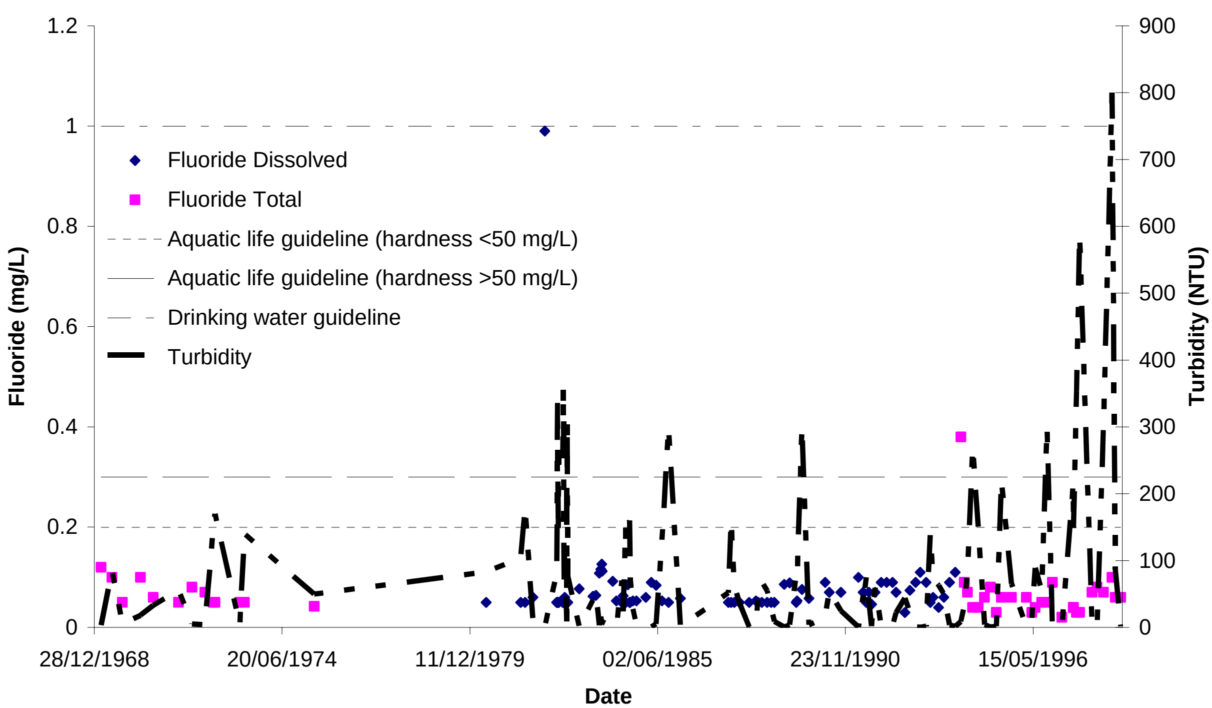

Figure 23. Iskut River below Johnson River - Gallium, Extractable

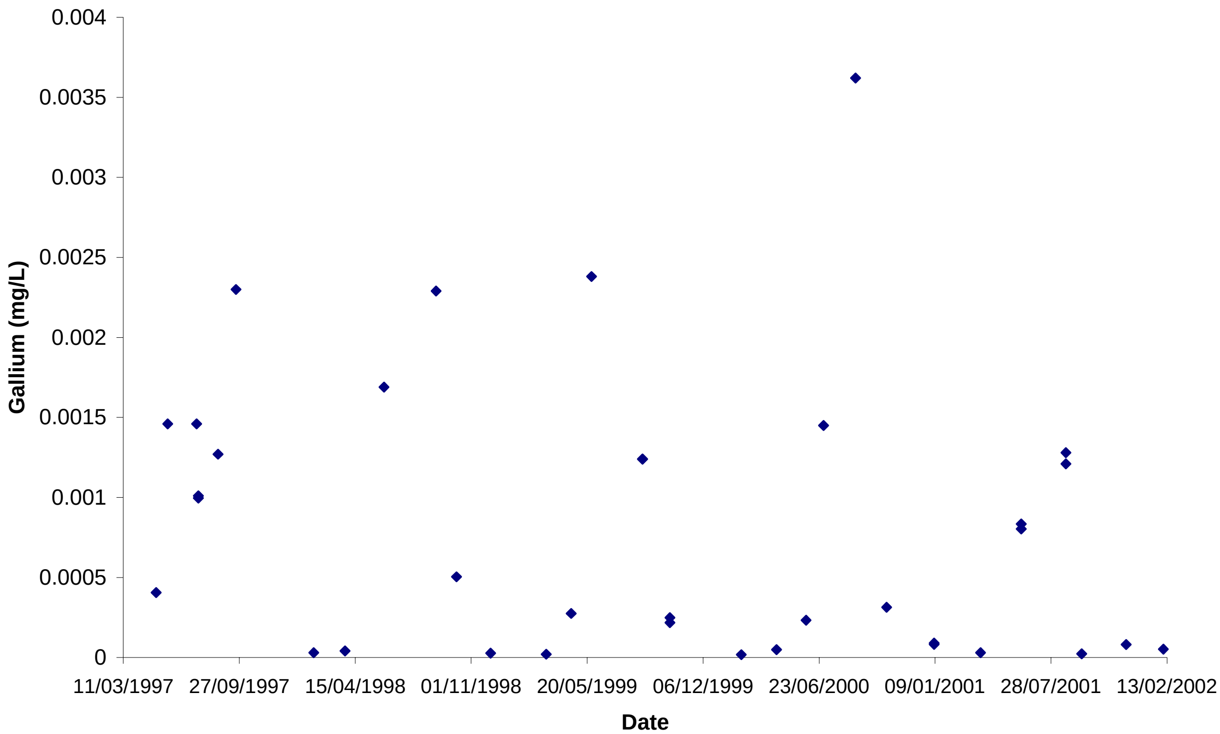

Figure 24. Iskut River below Johnson River - Hardness, Total, Dissolved and Extractable

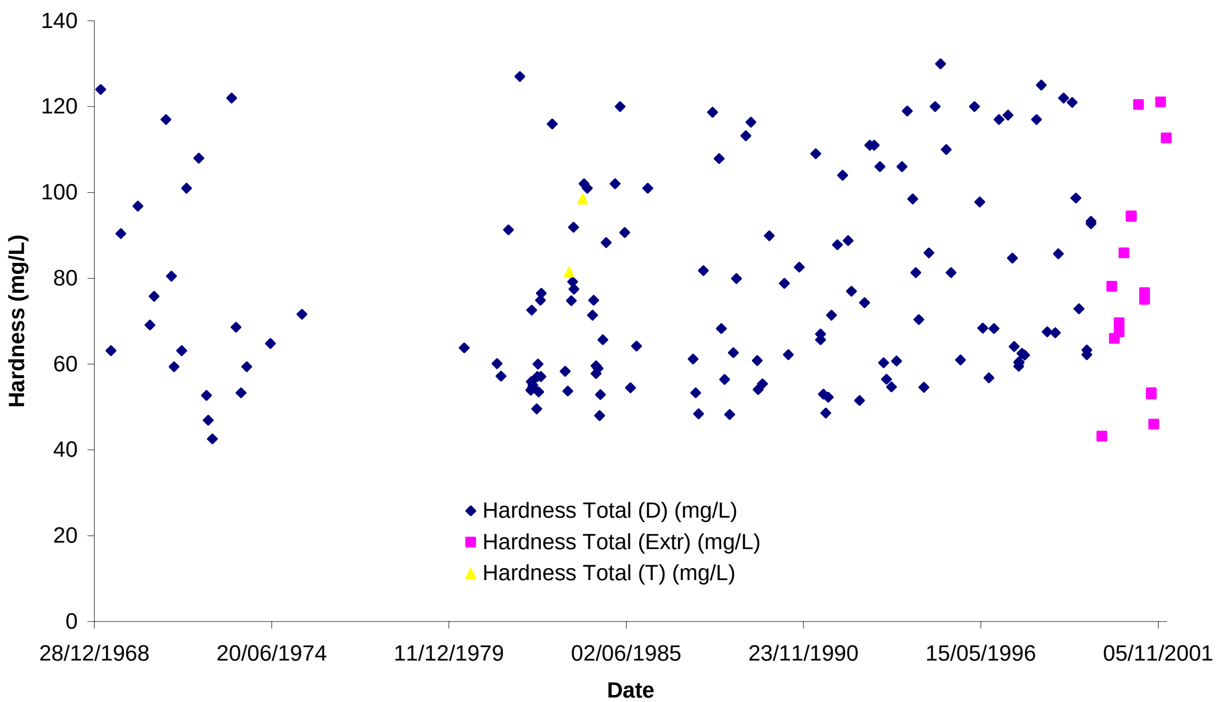

Figure 25. Iskut River below Johnson River - Iron, Total, Dissolved and Extractable and Turbidity

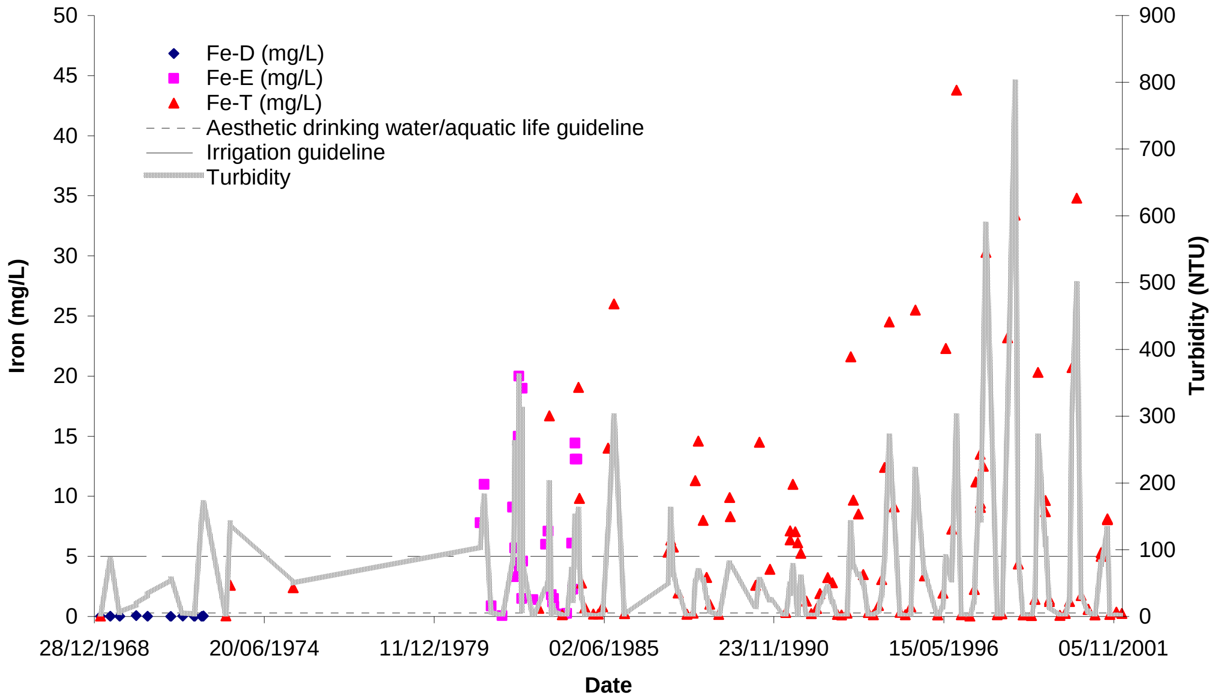

Figure 26. Iskut River below Johnson River - Lanthanum, Extractable

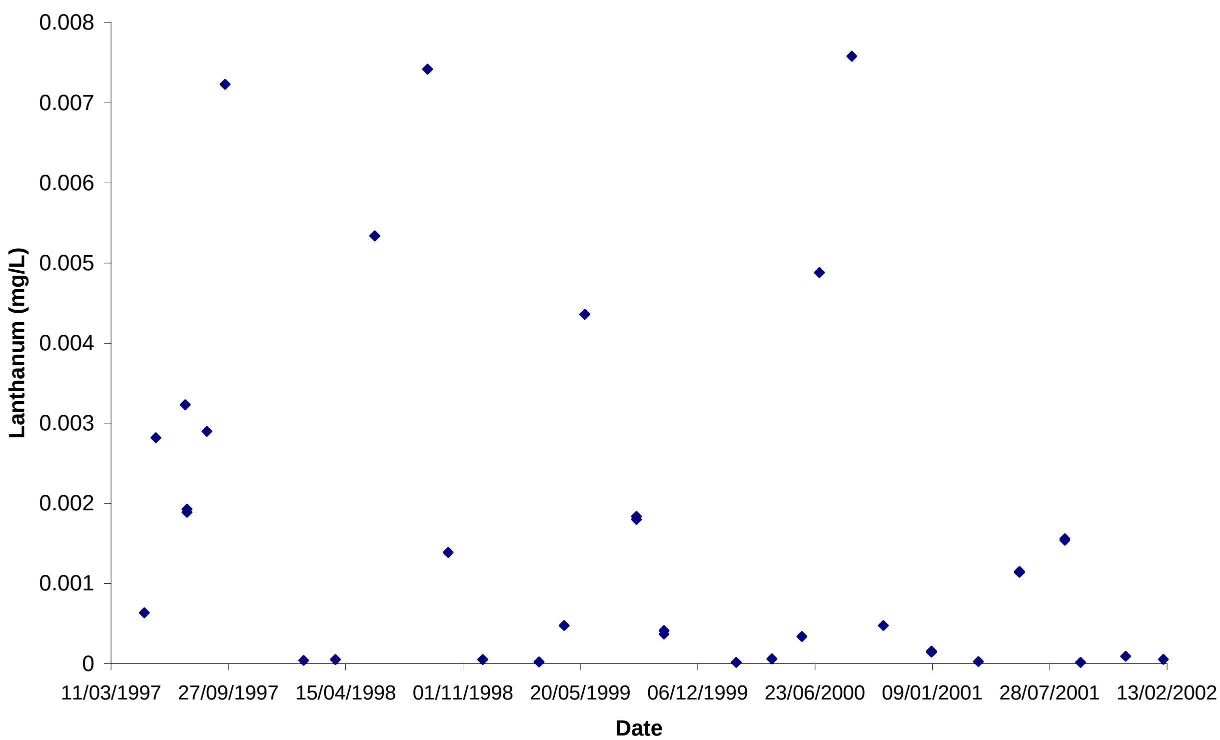

Figure 27. Iskut River below Johnson River - Lead, Total, Dissolved and Extractable, and Turbidity

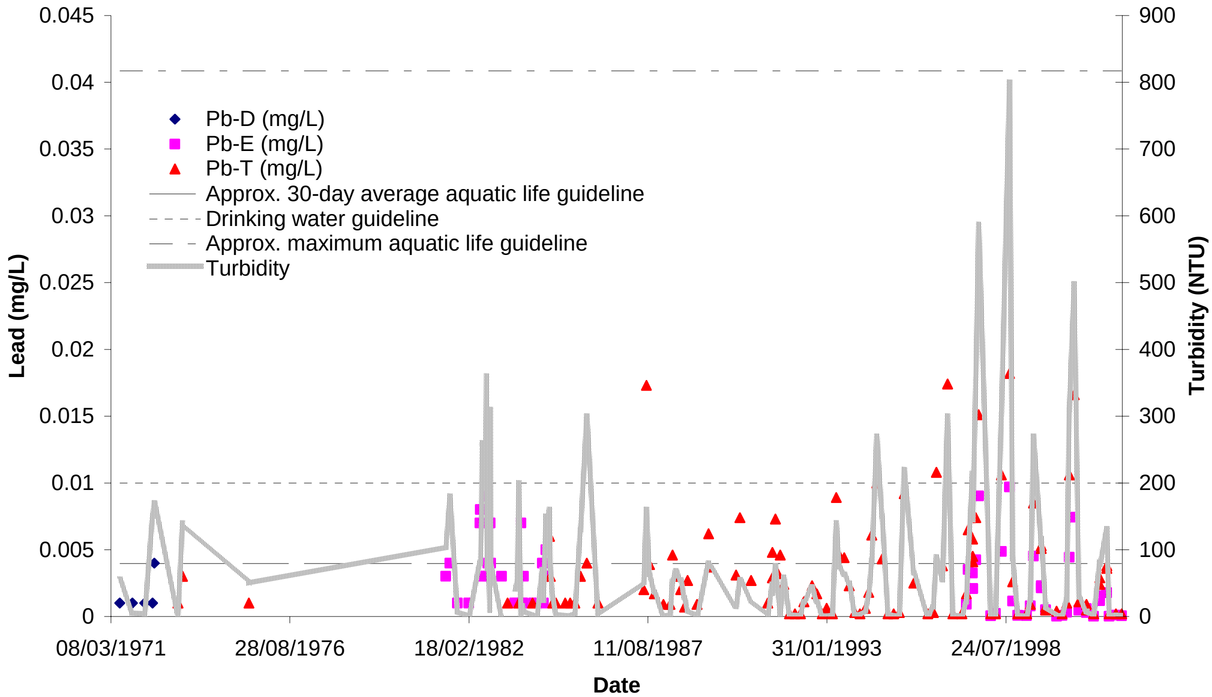

Figure 28. Iskut River below Johnson River - Lithium, Total and Extractable

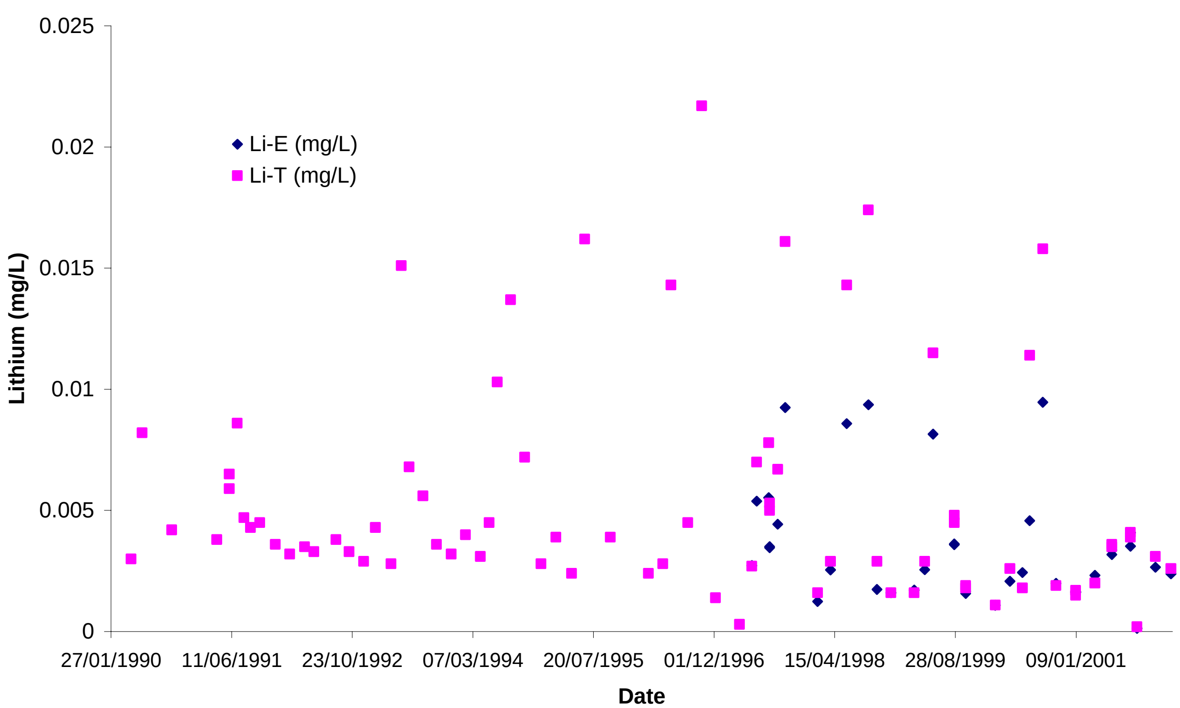

Figure 29. Iskut River below Johnson River - Magnesium, Total, Dissolved and Extractable

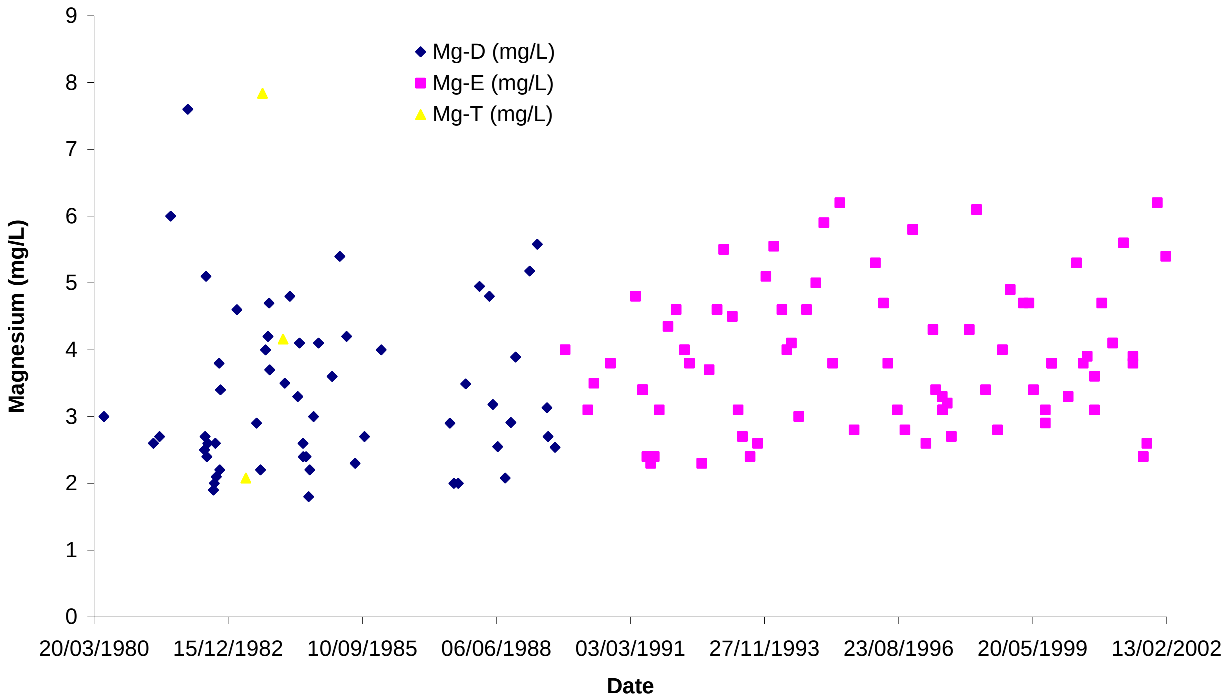

Figure 30. Iskut River below Johnson River - Manganese, Total, Dissolved and Extractable and Turbidity

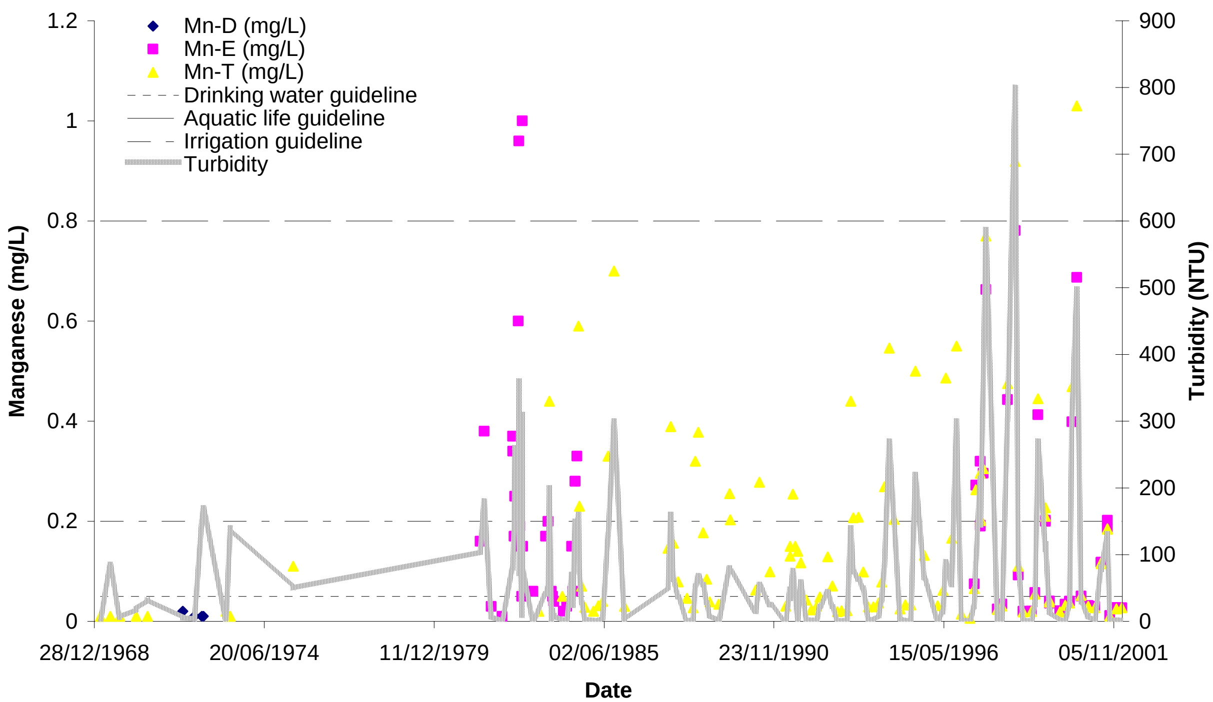

Figure 31. Iskut River below Johnson River - Molybdenum, Total

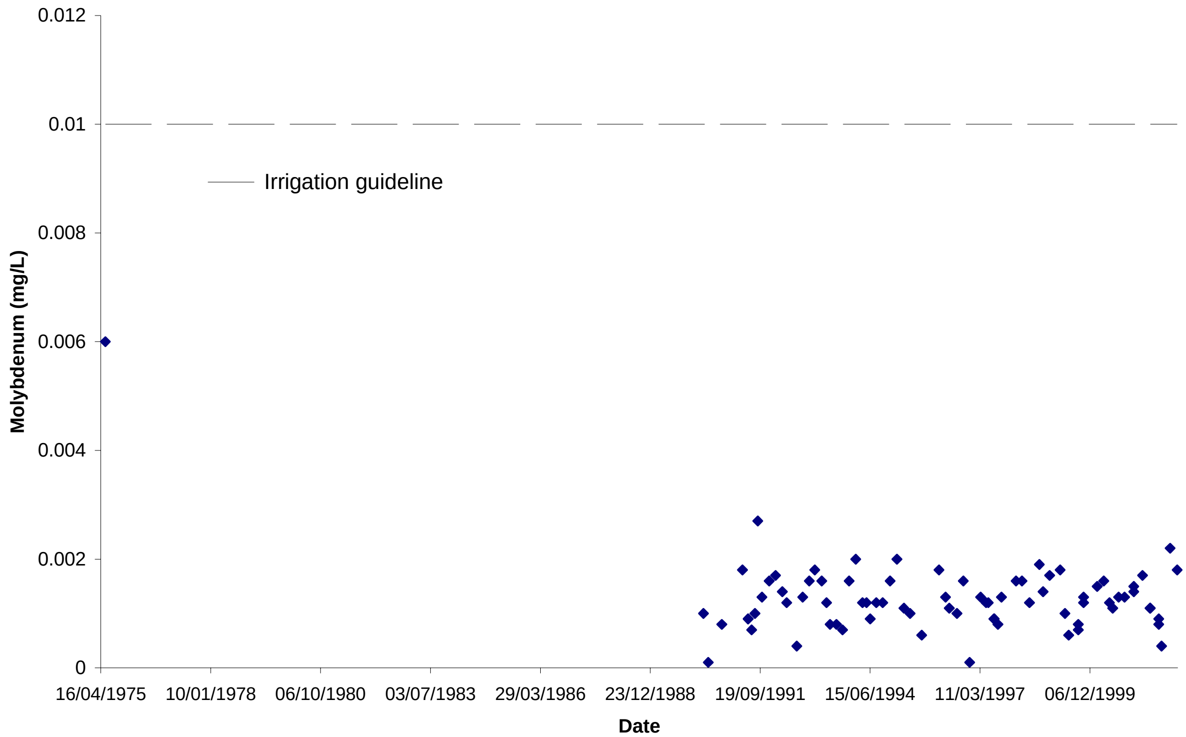

Figure 32. Iskut River below Johnson River - Nickel, Total and Extractable and Turbidity

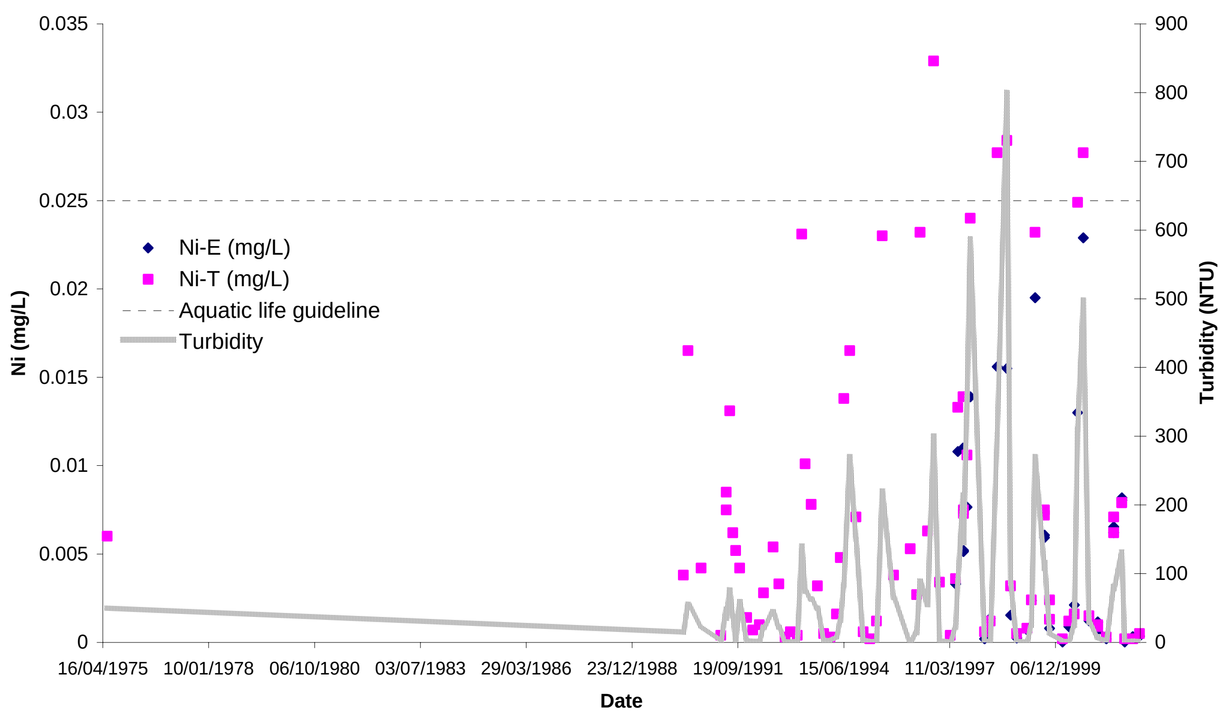

Figure 33. Iskut River below Johnson River - Nitrate and Nitrite

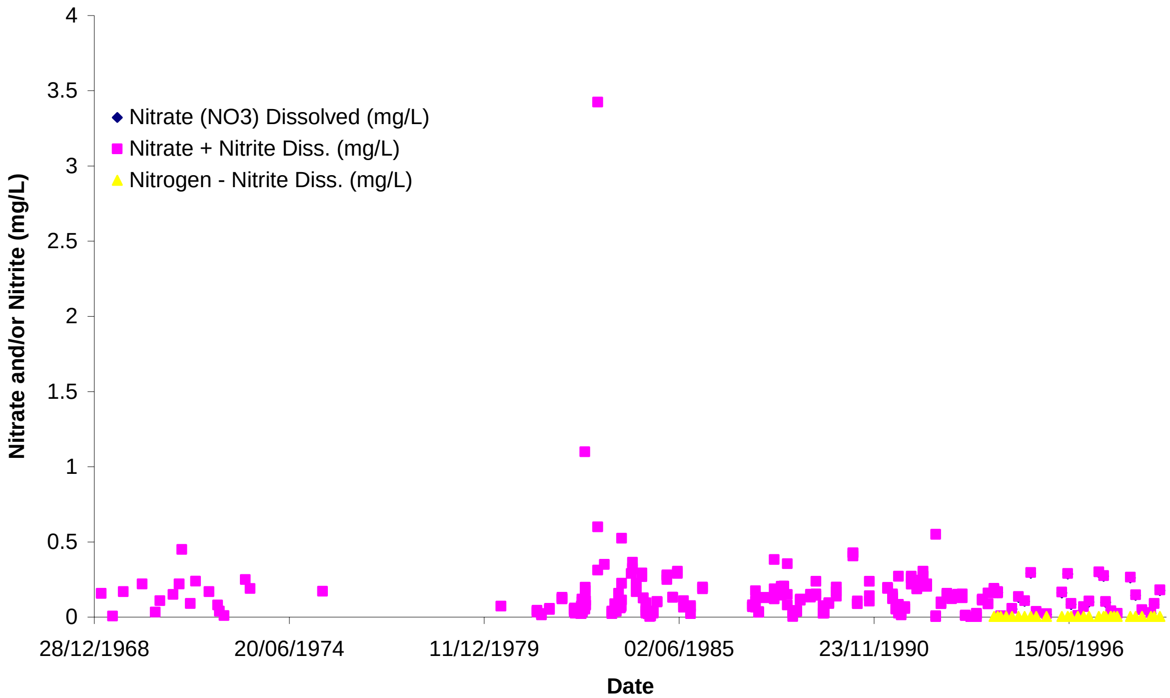

Figure 34. Iskut River below Johnson River - Nitrogen, Total and Total Dissolved

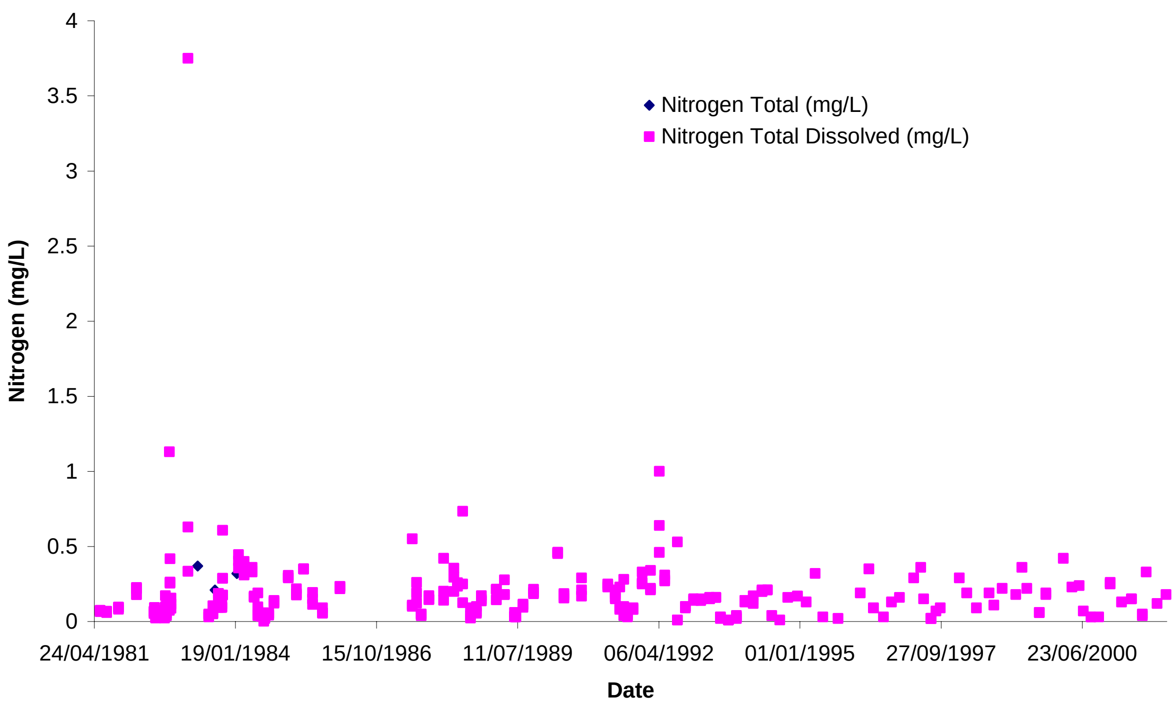

Figure 35. Iskut River below Johnson River - pH

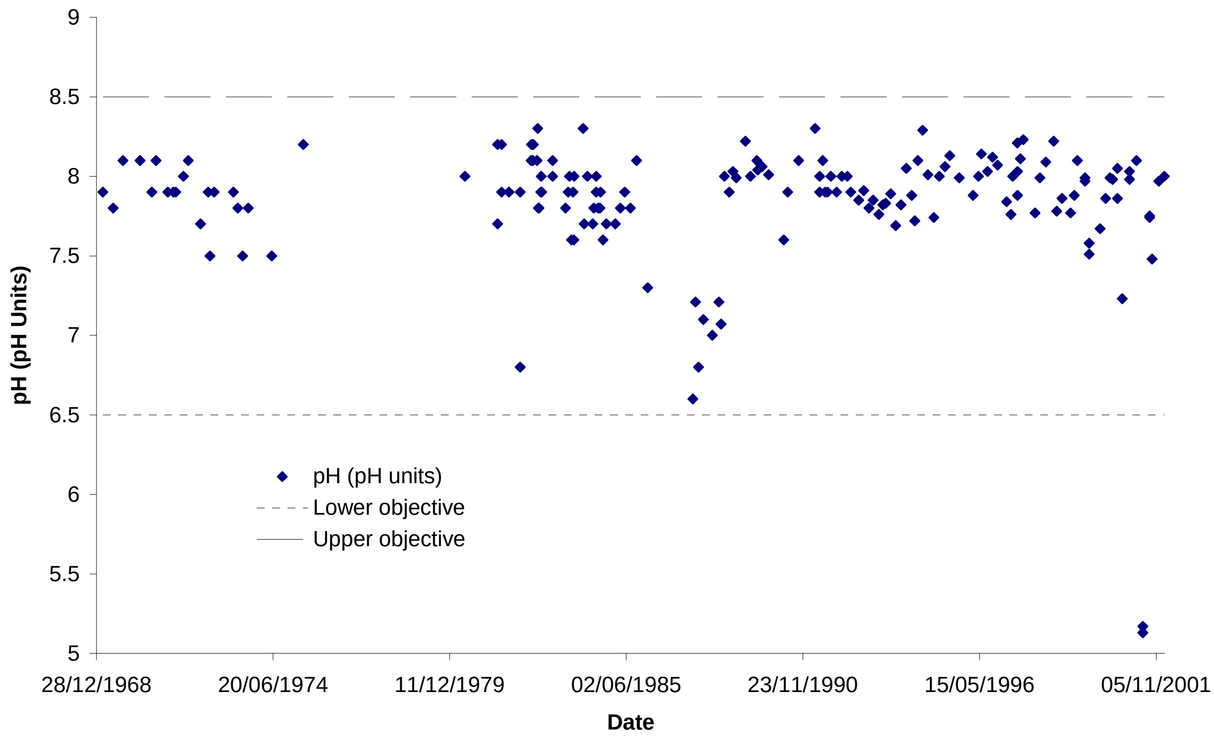

Figure 36. Iskut River below Johnson River - Phosphorus, Total and Total Dissolved

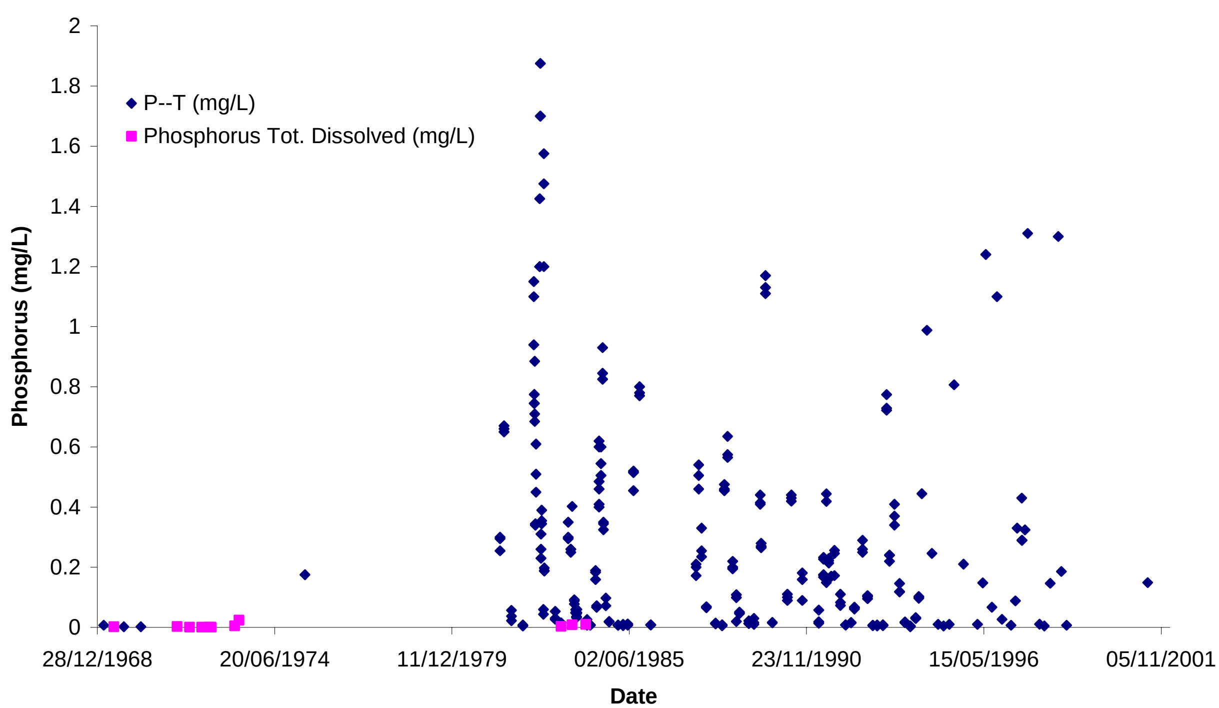

Figure 37. Iskut River below Johnson River - Potassium, Total, Dissolved and Extractable

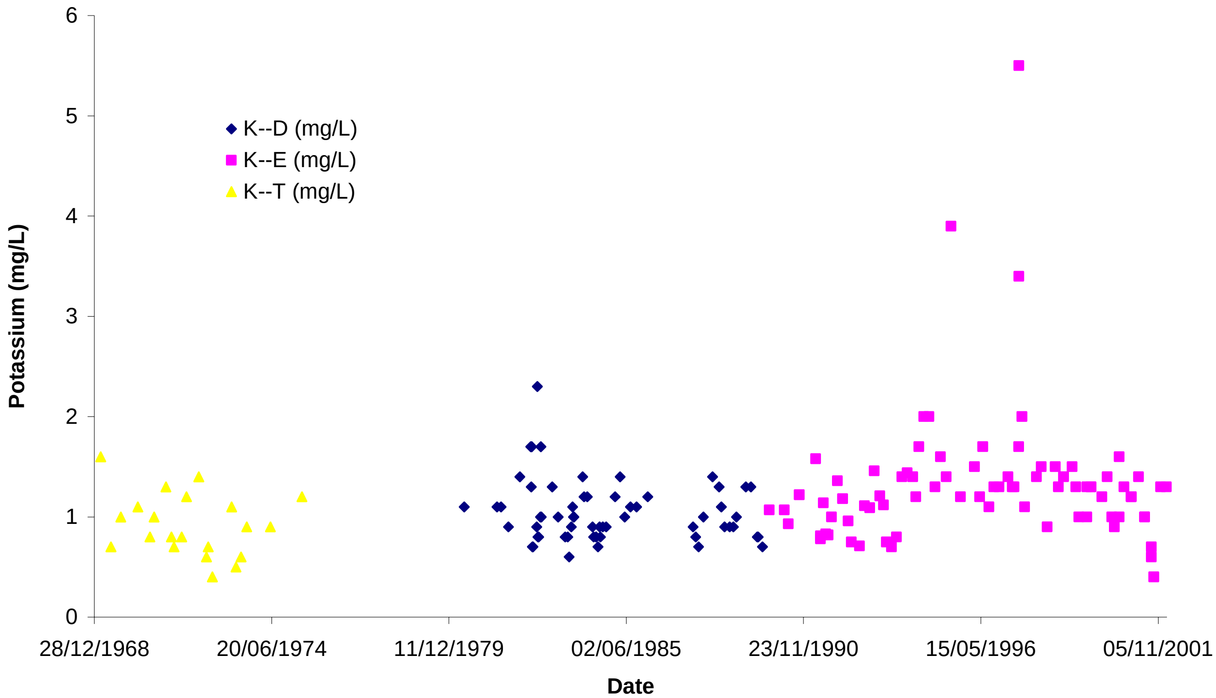

Figure 38. Iskut River below Johnson River - Residue, Non-Filterable

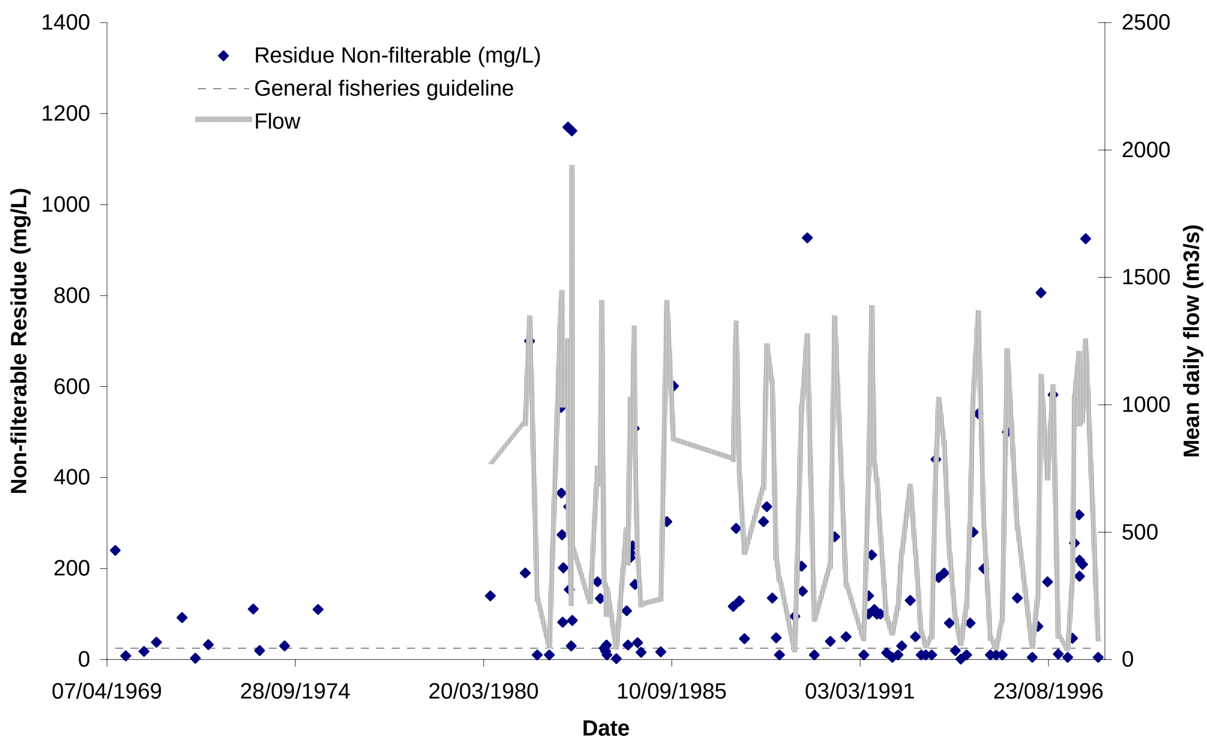

Figure 39. Iskut River below Johnson River - Rubidium, Extractable

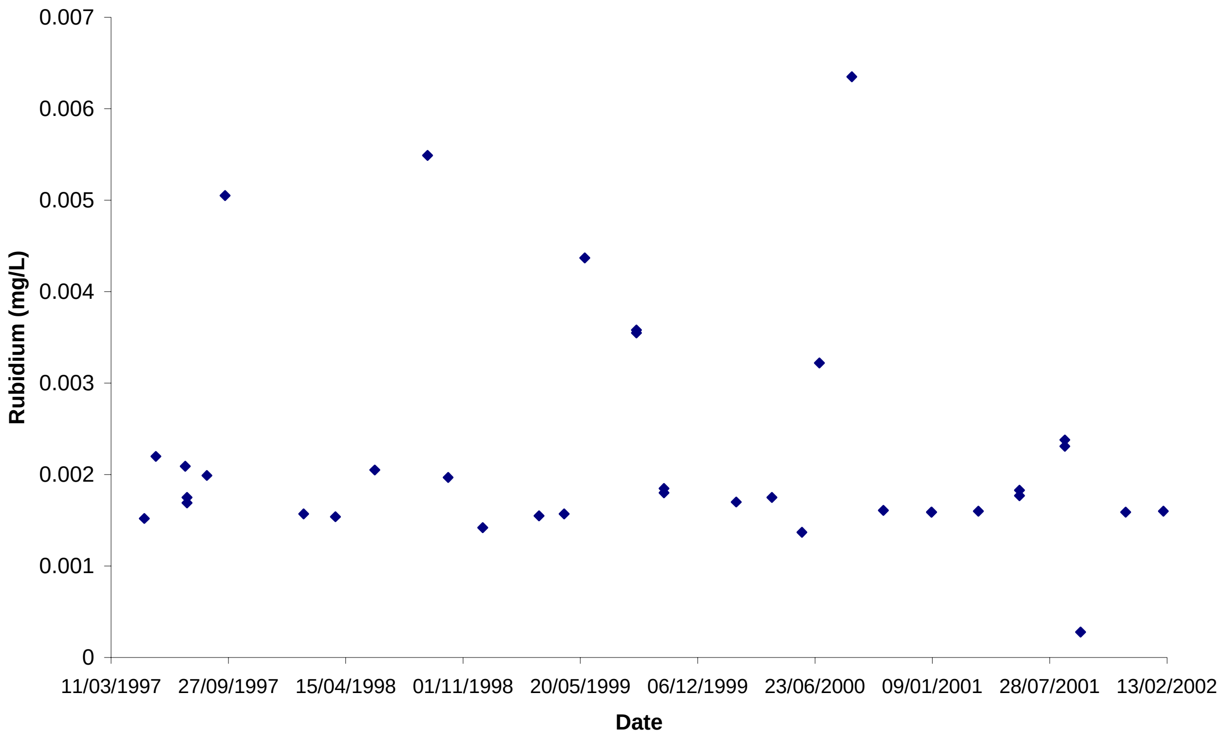

Figure 40. Iskut River below Johnson River - Selenium, Total, Dissolved and Extractable

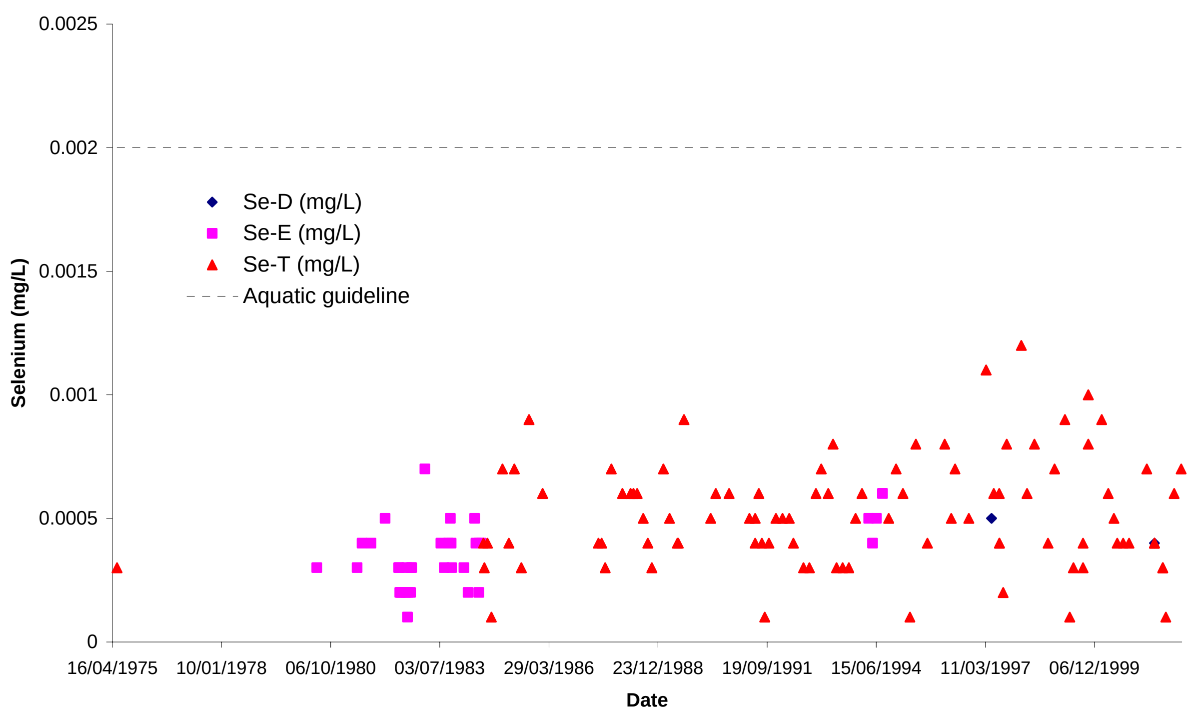

Figure 41. Iskut River below Johnson River - Silicon, Dissolved and Extractable, and Silica, Dissolved

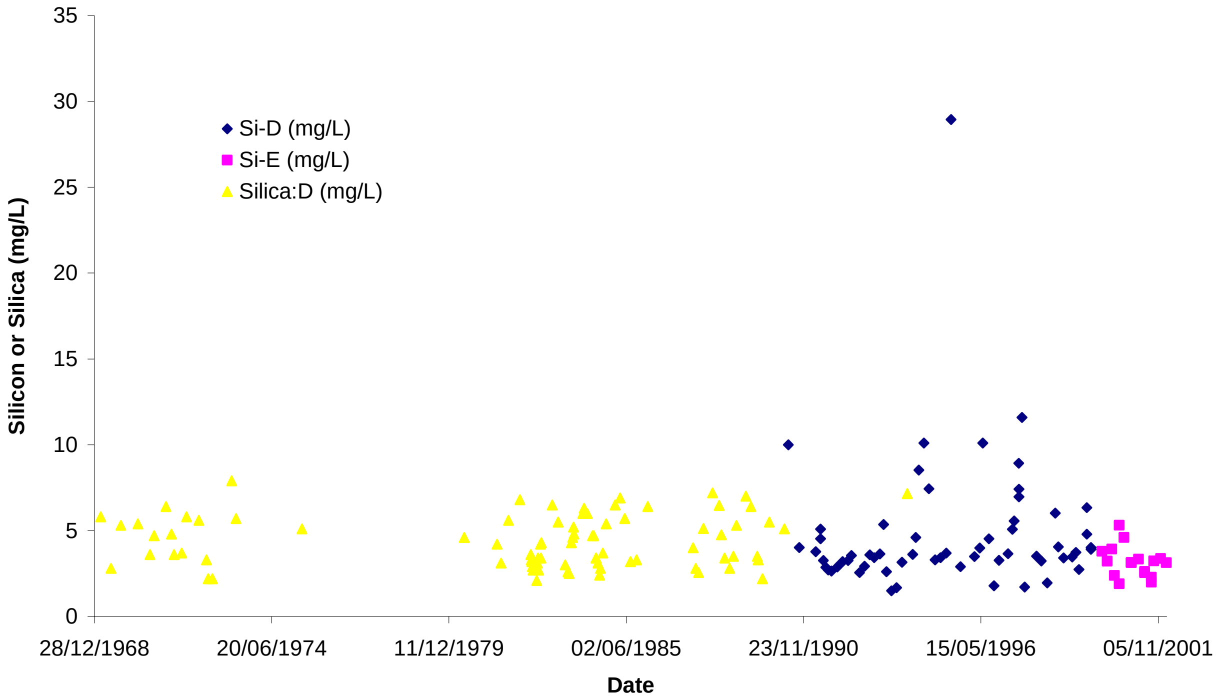

Figure 42. Iskut River below Johnson River - Silver, Total and Extractable

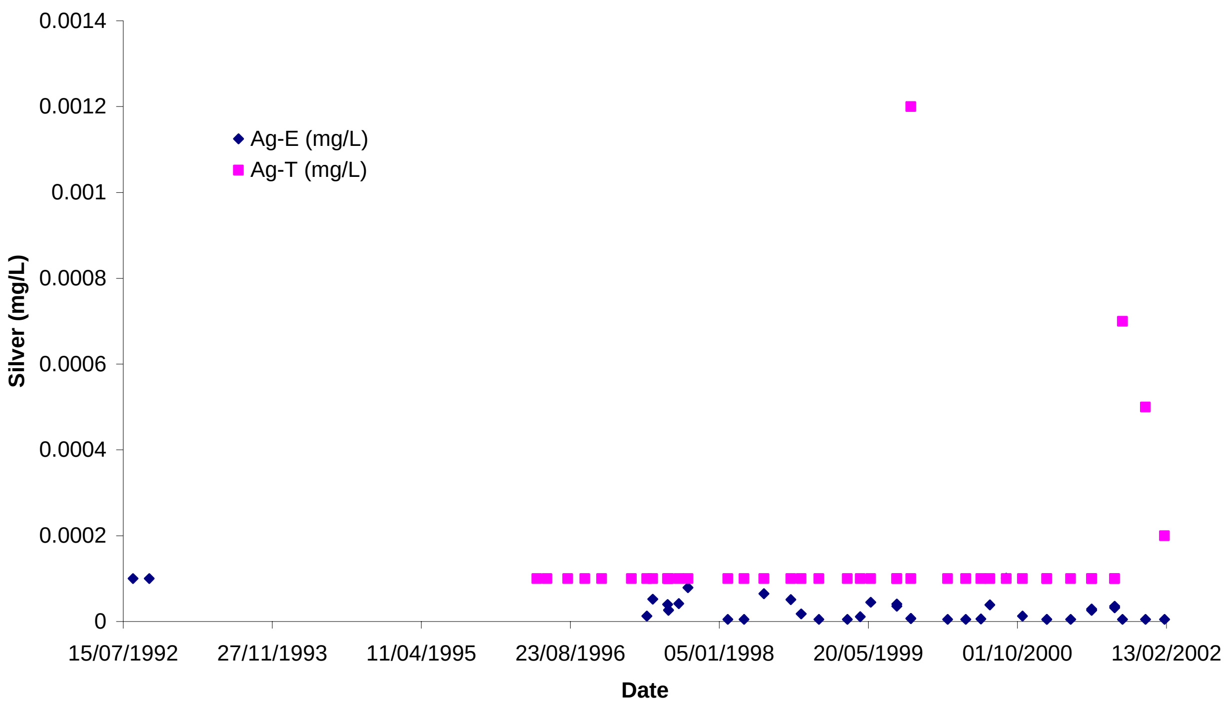

Figure 43. Iskut River below Johnson River - Sodium, Dissolved and Extractable

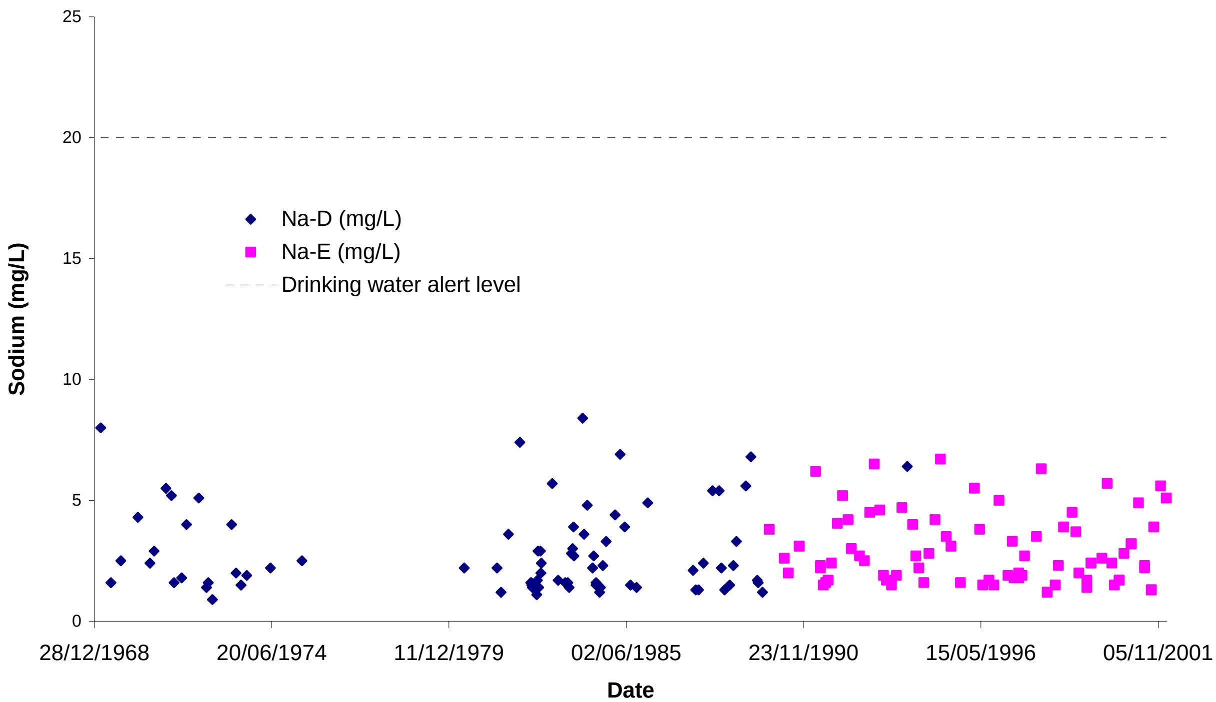

Figure 44. Iskut River below Johnson River - Strontium, Total and Extractable

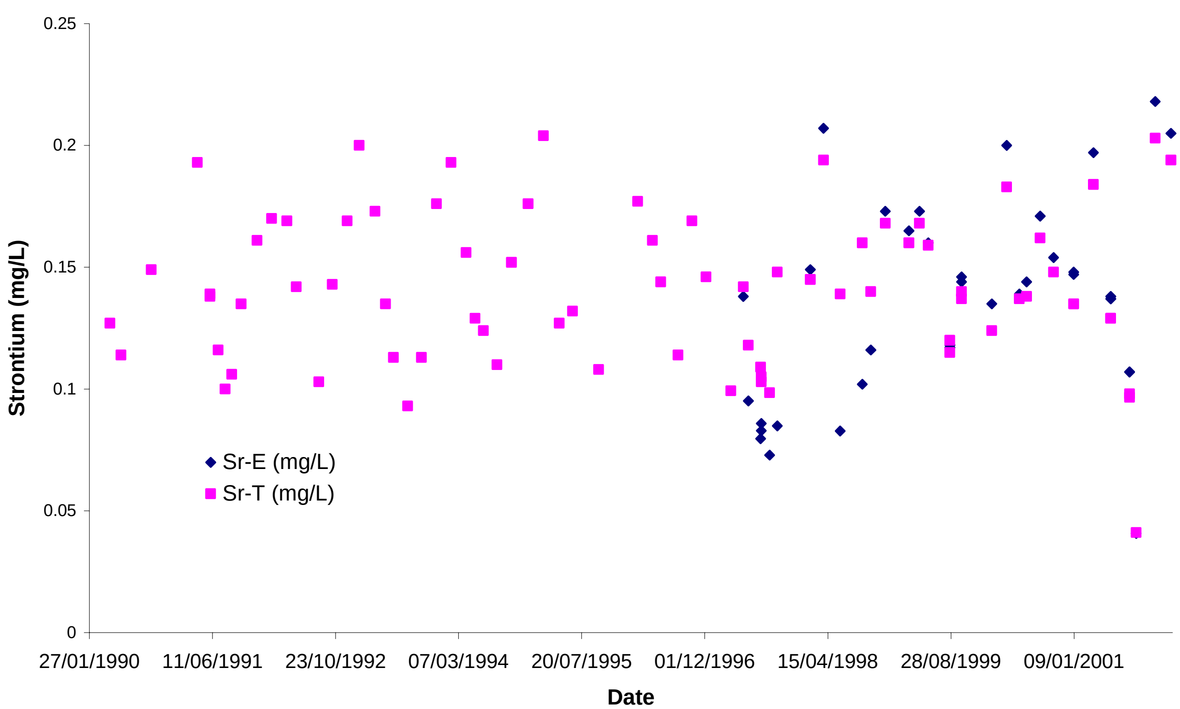

Figure 45. Iskut River below Johnson River - Sulphate, Total and Dissolved

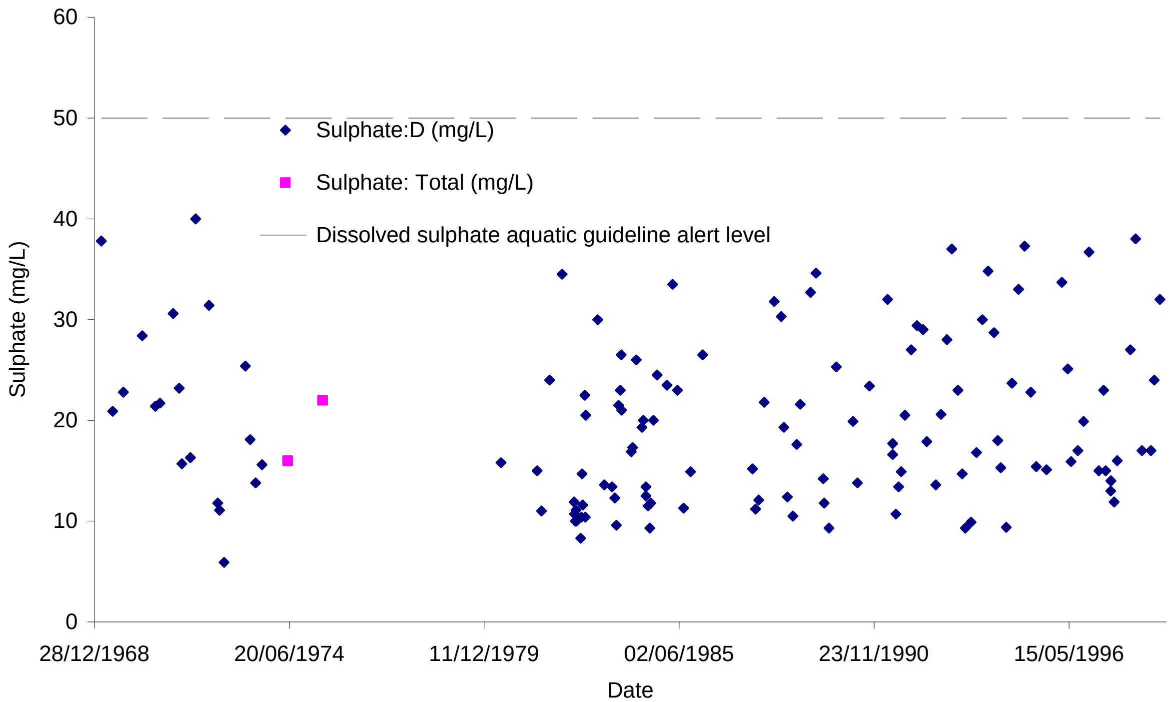

Figure 46. Iskut River below Johnson River - Temperature, Water

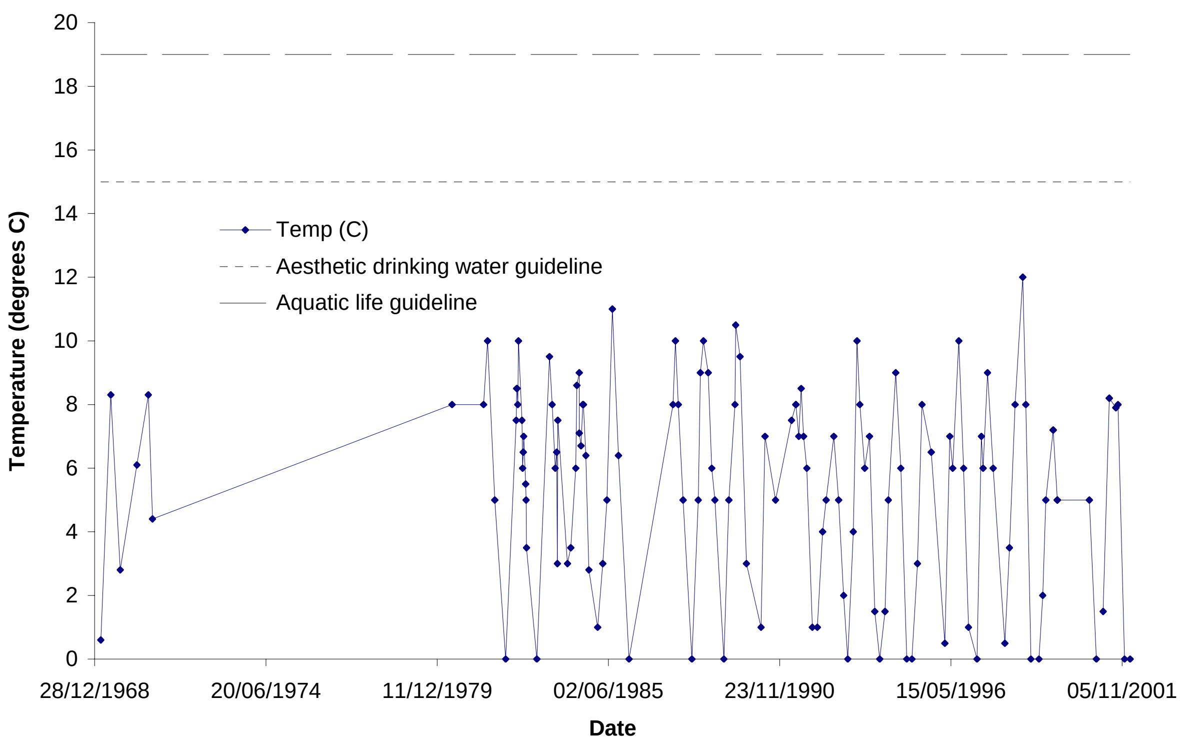

Figure 47. Iskut River below Johnson River - Thallium, Extractable

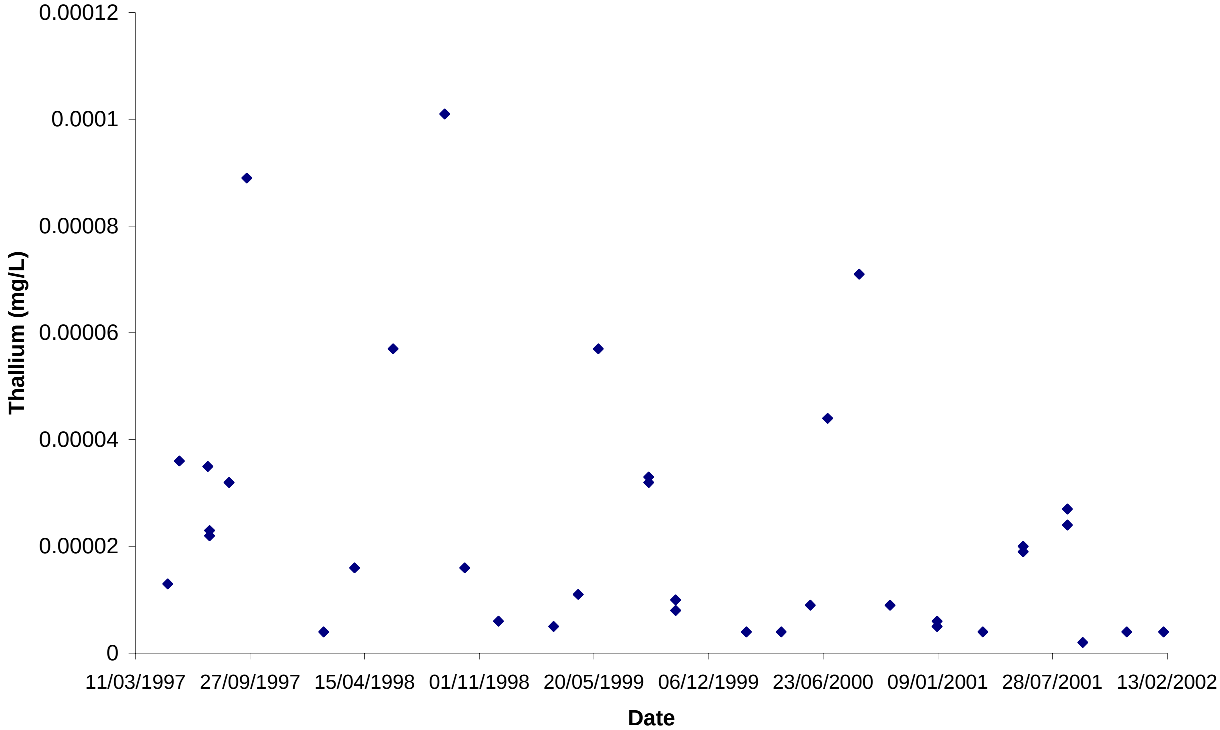

Figure 48. Iskut River below Johnson River - Turbidity

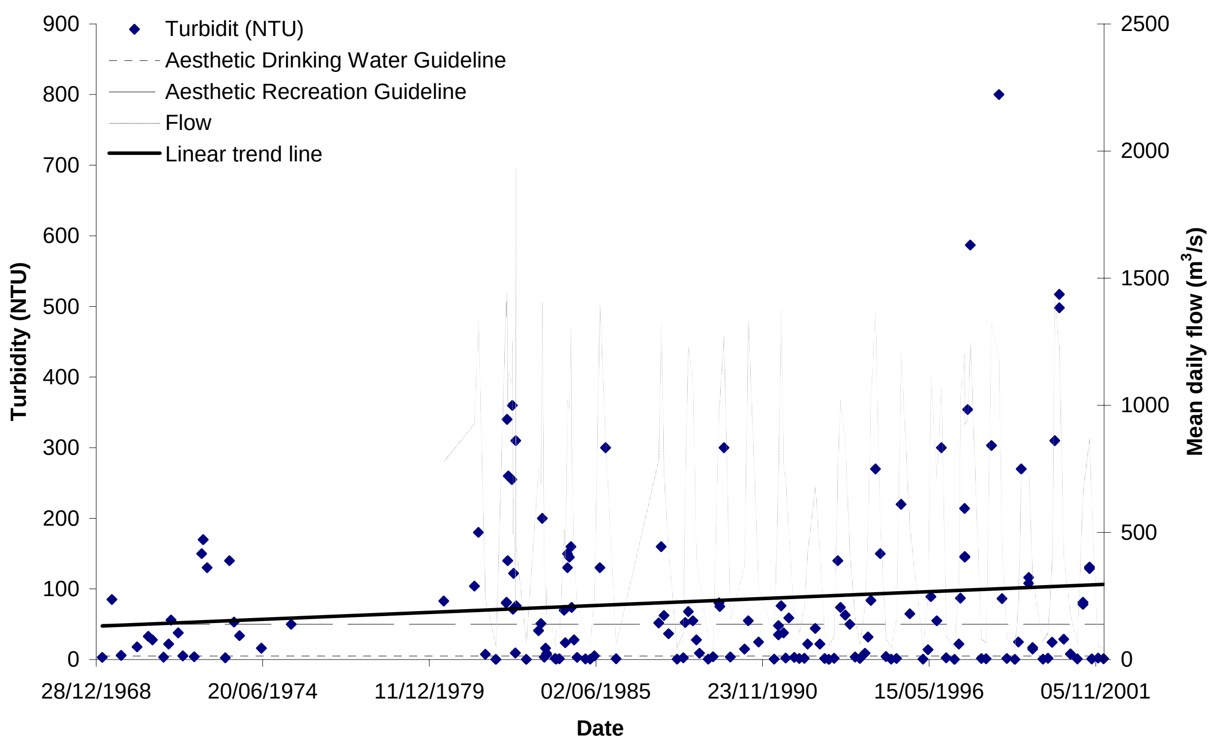

Figure 49. Iskut River below Johnson River - Uranium, Extractable

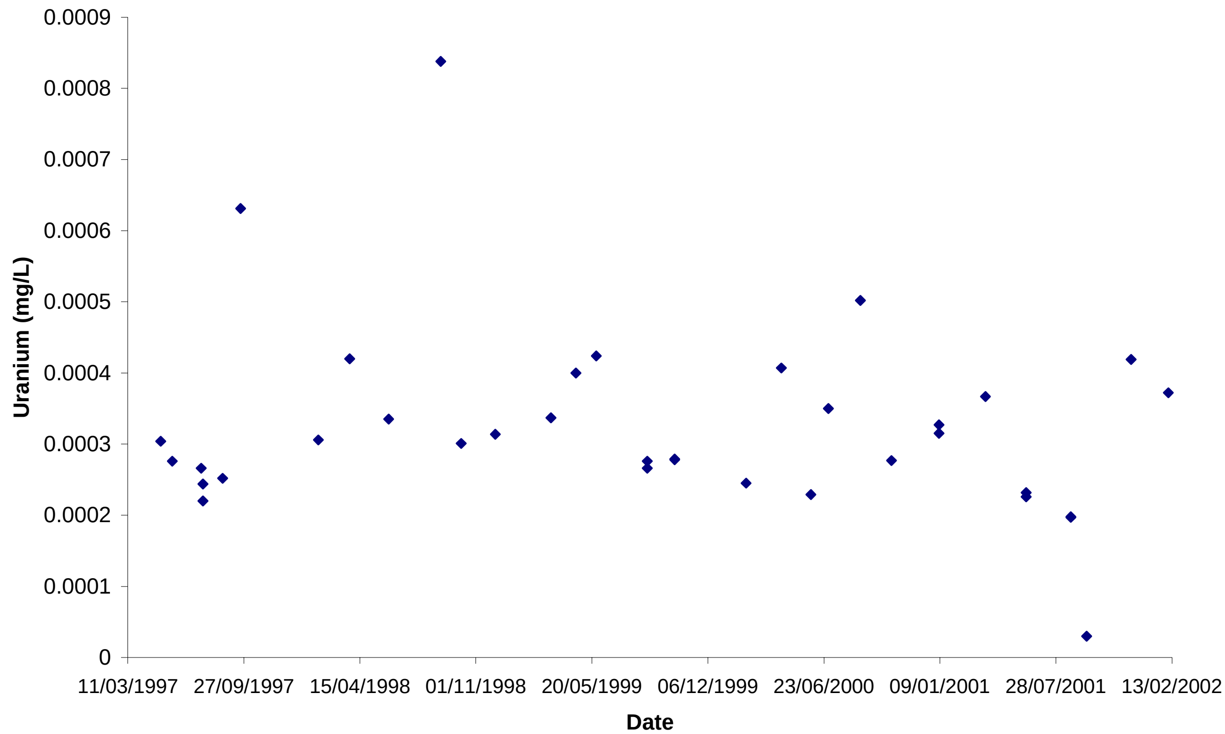

Figure 50. Iskut River below Johnson River - Vanadium, Total and Extractable

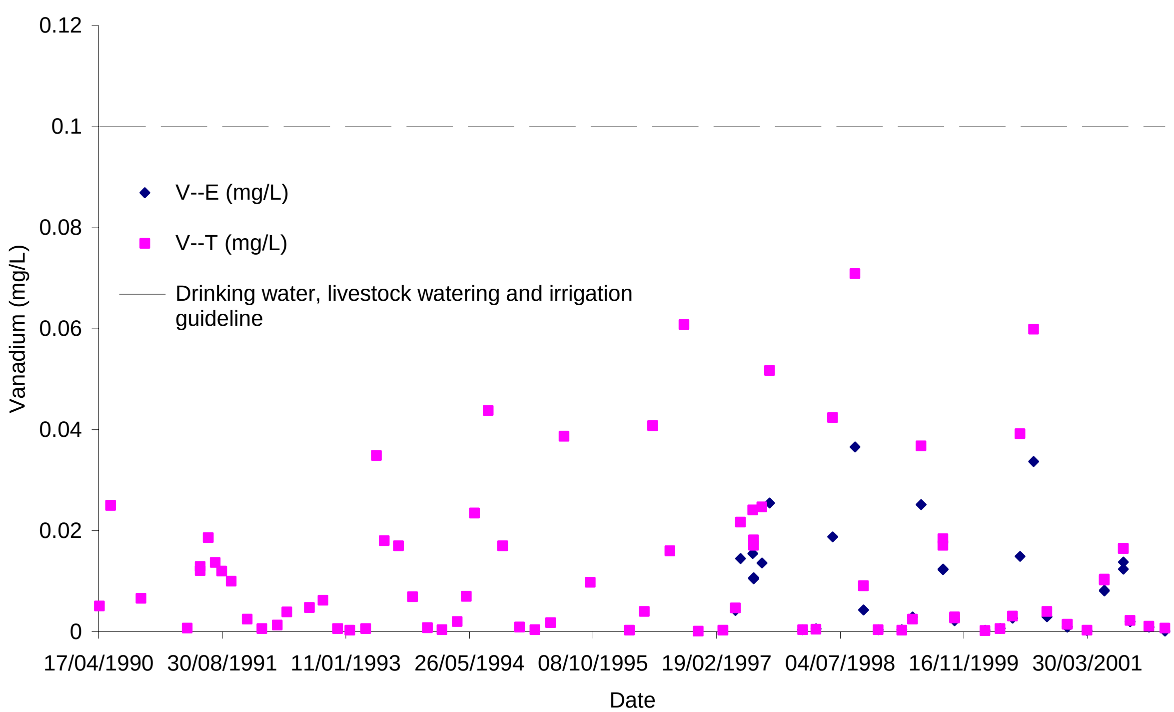

Figure 51. Iskut River below Johnson River - Zinc, Total, Dissolved and Extractable, and Turbidity