CANADA – BRITISH COLUMBIA
WATER QUALITY MONITORING AGREEMENT

WATER QUALITY ASSESSMENT OF Columbia River AT WANETA (1979 – 2005)

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ENVIRONMENTAL CONSULTING Tri-Star

Prepared for:
B.C. Ministry of Environment
and
Environment Canada

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Environment Canada Environnement Canada

BRITISH COLUMBIA The Best Place on Earth — Ministry of Environment

Executive Summary

The Columbia River watershed is located in the southeast corner of British Columbia. Water quality measurements for the Columbia River at Waneta (16 km south from Trail, B.C.) are from samples collected at the Cominco water quality monitoring site from the left bank. The drainage area at this point is 102,852 km^2, with the Rocky Mountains to the east and the Purcell Mountains to the west. The river flows in the Rocky Mountain Trench and is used for drinking water, irrigation and industry and supports populations of cutthroat, rainbow, bull, and eastern trout and whitefish. Cirque glaciers in the high Purcell and Rocky mountains drain to the Columbia River and the glacial silt imparts a gray, muddy colour to the river at times. This is alleviated by the time the water reaches Waneta due to the settling provided behind the reservoirs constructed for electricity generation.

Water quality in this reach of the Columbia River is influenced by effluent discharges from the Teck-Cominco Metals Smelter and Fertilizer plant, primary-treated sewage from the City of Trail, and secondary-treated sewage from Fruitvale and Montrose, and upstream dams and reservoirs. There are also non-point source discharges from agriculture, urban development, forestry, transportation and stream bank erosion.

Conclusions

- Turbidity levels in this reach of the Columbia River are very low, due to the settling that occurs behind the hydro generation facilities.
- Several metals that exceeded guidelines on occasion had higher concentrations that correlated with higher turbidity levels. At those times, metals were likely in particulate form and not biologically available. Such metals included aluminum, chromium, copper, iron, lead, selenium, silver, and zinc.
- There appear to be a number of declining trends through time in the Columbia River at Waneta, notably for fluoride, cadmium, iron, lead, phosphorus, zinc and barium. All of these trends, with the exception of barium, were noted in a

previous report (Pommen, 2002). Declines in cadmium, fluoride, lead, phosphorus and zinc were at that time attributed to abatement measures at the upstream smelter and fertilizer plant. Decreases in aluminum and iron were potentially at last attributed to trapping effects of upstream dams. The reason for the barium trend, which was also noted upstream at Birchbank, is not known at this time. A number of other apparent changes (decreases) can also be seen, but are believed to be artifacts of decreasing detection limits.

- Water quality in the Columbia River at Waneta would be characterized as being good for both the protection of aquatic life and source waters used for drinking. This is likely due in large part to the settling out of particulate matter behind the upstream dams. There are often measureable fecal coliform counts at the site: water treatment would be required (as in all cases) prior to use as a drinking water source.

RECOMMENDATIONS

We recommend monitoring be continued for the Columbia River at Waneta since it serves as the last station on for the Columbia River before it crosses the International Boundary.

Water quality indicators that are important for future monitoring are:

- flow, water temperature, specific conductivity, pH, turbidity, nutrients, total dissolved gas and dissolved oxygen,
- appropriate forms of metals for comparison to their respective guidelines, and
- other variables related to drinking water such as colour.

ACKNOWLEDGEMENTS

The graphs in this report were prepared by Sacha Wassick of Environment Canada. The draft report was reviewed by Andrea Ryan of Environment Canada. We thank these individuals for their contributions to improving this document. Any errors or omissions are the responsibility of Tri-Star Environmental Consulting.

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INTRODUCTION

Since 1985, B.C. Ministry of Environment and Environment Canada have been cooperatively measuring water quality at a number of locations in British Columbia. The express purposes of this joint monitoring program have been to define the quality of the water and to determine whether there are any trends in water quality. The data are based on samples collected by local interested and committed residents called “lay collectors” who are trained by Environment Canada or B.C. Environment staff, provided training for safety, and audited every year to ensure that samples are collected according to standard protocols.

The Columbia River watershed is located in the southeast corner of British Columbia. Water quality measurements for the Columbia River at Waneta (16 km south from Trail, B.C.) are from samples collected at the Cominco water quality monitoring site from the left bank. Its coordinates are 49.016 N and 117.60” W. The drainage area at this point is 102,852 km^2, with the Rocky Mountains to the east and the Purcell Mountains to the west. The river flows in the Rocky Mountain Trench and is used for drinking water, irrigation and industry and supports populations of cutthroat, rainbow, bull, and eastern trout and whitefish. Cirque glaciers in the high Purcell and Rocky mountains drain to the Columbia River and the glacial silt imparts a gray, muddy colour to the river at times. This is alleviated by the time the water reaches Waneta due to the settling provided behind the reservoirs for electricity generation.

This assessment is based on up to 26 years of water quality data collected during 1979-2005. The data were plotted on a graph over time, along with the relevant water quality guidelines. The graphs were inspected for "environmentally significant" trends - where the measurements are increasing or decreasing over time and the levels are close to the guidelines, or are otherwise judged to represent an important change in water quality. These trends are further evaluated to ensure that they were not caused by measurement errors, and to identify their causes.

Water quality in this reach of the Columbia River is influenced by effluent discharges from the Cominco Metals Smelter and Fertilizer plant, primary-treated sewage from the City of Trail, and secondary-treated sewage from Fruitvale and Montrose, and upstream dams and reservoirs. There are also non-point source discharges from agriculture, urban development, forestry, transportation and stream bank erosion.

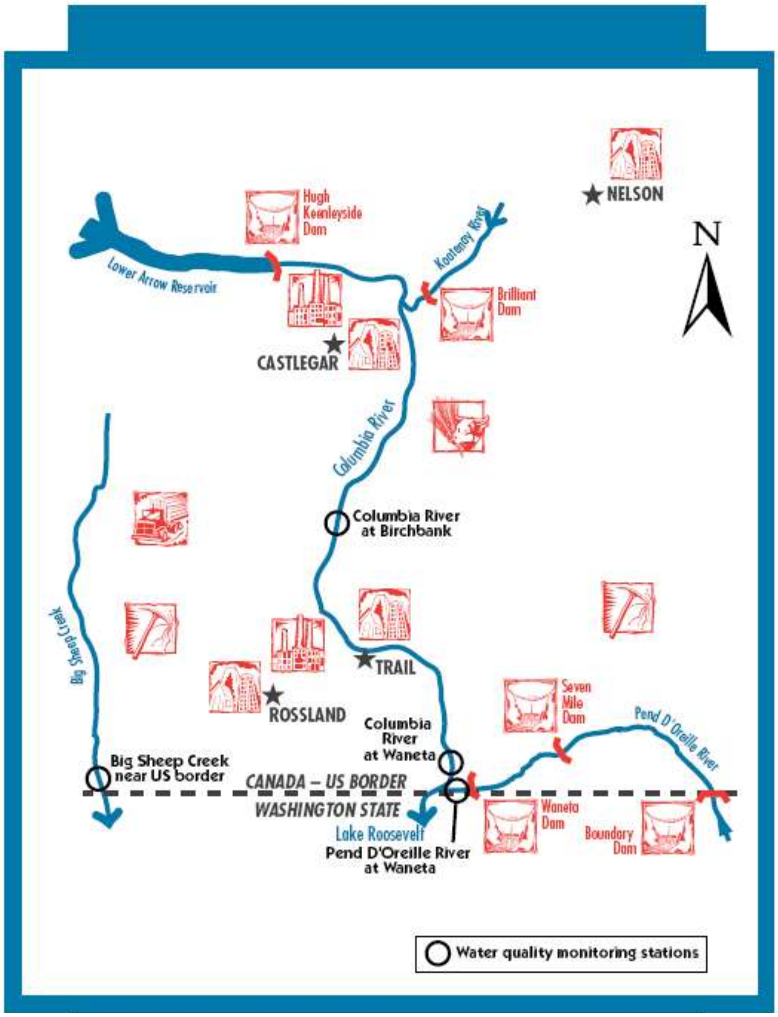


FIGURE 1: COLUMBIA RIVER AT WANETA

WATER QUALITY ASSESSMENT

Data for the Columbia River at Waneta have been collected on a weekly frequency for most of the period of record. In addition, quality assurance samples (blanks and replicates) are collected three times per year. These results for each variable were used in this assessment to identify potential outliers that should be removed form consideration of trends, and to "flag" questionable data in the database (www.waterquality.ec.gc.ca) as to possible or likely errors.

The state of the water quality was assessed by comparing the values to the B.C.'s approved and working guidelines (if guidelines exist for the variable) for water quality (B.C. Ministry of Environment, 2006a and b), 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 below.

When concentrations of a substance cannot be detected, we have plotted the concentration at the level of detection. We believe this to be a conservative approach for assessing possible trends. We have normally plotted each variable against either turbidity levels or specific conductivity, whichever we believe from experience may be correlated with the particular variable of interest. Sometimes, we have plotted the same variable for two or three different periods of time, usually to highlight periods of time when analytical detection limits may have improved. In such cases, one plot will include the entire period of record for the variable. As well, there are times when measurements were not taken for some reason. In these cases, straight lines will join the two consecutive points and may give the illusion on the graph of a trend that does not exist.

In some cases, testing for the presence of a variable has been terminated after a certain period. In general, this has been because a previous data assessment and review has indicated that collections of these data are not warranted for this station. For other variables, concerns about concentrations may have only arisen in recent years.

The following water quality indicators were not discussed as they met all water quality guidelines (if guidelines exist) and showed no clearly visible trends: ammonia, boron, bromine, nitrite, and tin.

The following water quality indicators seemed to fluctuate through the year according to turbidity concentrations, but were below guideline values (if guidelines exist) and had no other trends: antimony, arsenic, barium, beryllium, bismuth, dissolved organic carbon, cadmium, cobalt, gallium, lanthanum, nickel, phosphorus, non-filterable residue, thallium, 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 (if guidelines exist) included: dissolved inorganic carbon, calcium, chloride, fluoride, potassium, lithium, molybdenum, nitrate/nitrite, dissolved nitrogen, niobium, rubidium, filterable residue, fixed filterable residue, extractable silicon, silica, sodium, strontium, and uranium.

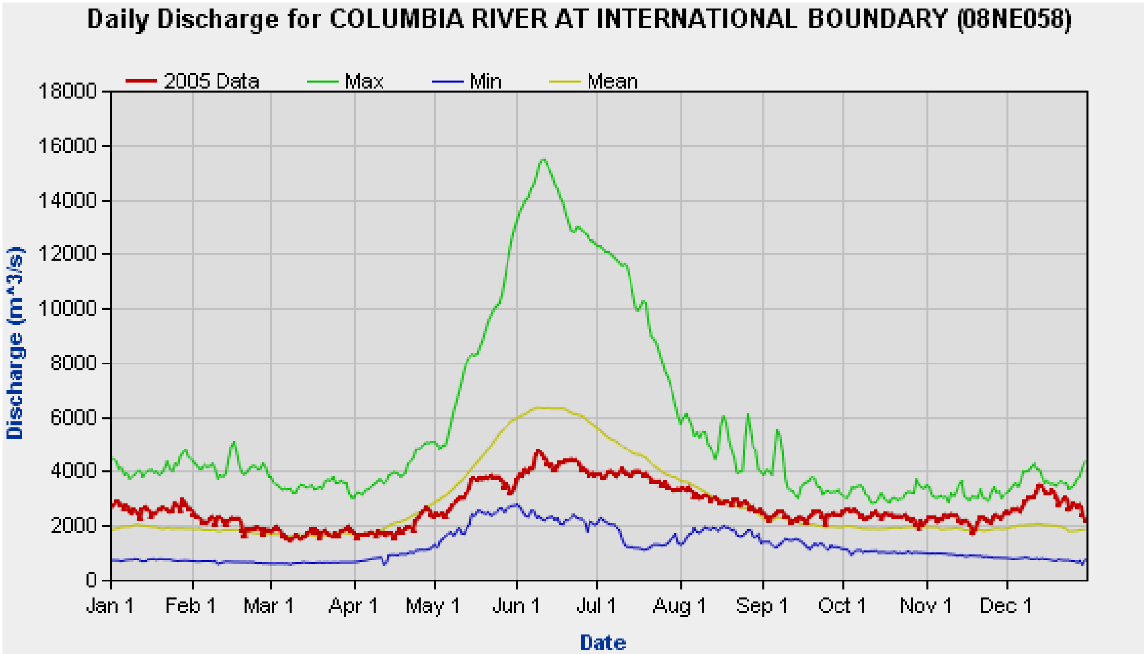


FIGURE 2: WATER SURVEY OF CANADA FLOW DATA FOR COLUMBIA RIVER AT INTERNATIONAL BOUNDARY (1938-2006)

Flow (Figure 2) values are controlled by releases from the dams upstream. Peak flows occur during the months from May through August, with lowest flows being recorded in the November through April period. Maximum flows can exceed 6,000 m^3/s and be as high as about 15,000 m^3/s.

Aluminum (Figures 3 and 4) concentrations are related to turbidity, with highest total and extractable concentrations being measured during periods of higher turbidity. (Turbidity is generally quite low in the river.) Total and extractable concentrations occasionally exceed the guidelines to protect aquatic life; however, the guidelines are expressed as dissolved aluminum. For this reason there is likely no concern in the river with respect to aluminum. An apparent downward trend in aluminum was noted over time, which had identified in a previous (Pommen, 2002). This trend may in part be due to the trapping effect of upstream dams and reservoirs.

Alkalinity (Figure 5) concentrations generally fluctuated with specific conductivity as would be expected. Alkalinity was usually greater than 40 mg/L, indicating that the river is well buffered for acidic inputs.

Cadmium (Figures 17 and 18) concentrations exhibit a declining trend that had been noted in a previous report and attributed to abatement measures at the upstream smelter and fertilizer plant in Trail (Pommen, 2002).

Colour (True) (Figure 23) concentrations generally met the drinking water guideline for source waters; however, one value in the late 1980's exceeded the guideline. Colour is not considered to be a concern in the Columbia River.

Chromium (Figures 24 and 25) concentrations appeared to fluctuate with turbidity levels. When it was measured as total chromium, it occasionally exceeded the guideline for hexavalent chromium in 2001; however, when improved detection limits were available all total and extractable concentrations met the guideline. Chromium is therefore not likely a concern in the river.

Copper (Figure 26) concentrations generally fluctuated with turbidity. Some values exceeded the B.C. guideline for maximum concentrations; however, the frequency of values that exceed the guideline has been reduced in recent years when the analytical detection limit was lowered. This is an expected outcome from reducing detection limits.

Fluoride (Figure 27) concentrations exhibit a declining trend that had been noted in a previous report and attributed to abatement measures at the upstream smelter and fertilizer plant (Pommen, 2002).

Iron (Figures 28 and 29) concentrations fluctuate with turbidity and occasionally exceeded guidelines for the protection of aquatic life and source waters used for drinking.

The frequency of values that exceed the guideline has been reduced in recent years when the analytical detection limit was lowered. This is an expected outcome from reducing detection limits. An apparent declining trend in iron was noted, and had been identified in a previous report (Pommen, 2002). At that time the trend was attributed potentially at least in part to the trapping effect of upstream dams.

Lead (Figures 34 and 35) concentrations fluctuated with turbidity but occasionally exceeded the guideline for maximum concentrations. As with other variables, the frequency at which values exceeded the guideline was reduced considerably when analytical detection limits were reduced. No values have exceeded the guideline since about 1994. A declining trend in lead at Waneta had been noted in a previous report and attributed to abatement measures at the upstream smelter and fertilizer plant in Trail (Pommen, 2002).

Selenium (Figures 51 and 52) concentrations usually met all guidelines; however, one extractable value in 2003 exceeded the CCME guideline. This may be erroneous since all total values were about one-third this value. Selenium values generally fluctuated with turbidity.

Silver (Figures 55 and 56) concentrations were generally low and fluctuated with turbidity levels. Values often exceeded the CCME guideline when higher detection limits were used to measure silver; however, since 2003 when detection limits were lowered significantly, only one total and one extractable concentration exceeded the guideline. The CCME guideline is set at the same level as the B.C. guideline for the mean concentration over a 30-day period: this latter guideline that was met.

Temperature - Water (Figure 60) fluctuated with air temperatures, and peaked in the summer months near 20^{o} C. Peak values generally were below the maximum weekly average guideline for streams with unknown fish populations; however, these warm summer temperatures at times were the guideline for source waters used for drinking.

Turbidity (Figure 64) often exceeded the guideline for source waters used for drinking with no treatment other than disinfection. Values are generally low for a river the size of the Columbia; however, the levels are ameliorated by the dams and reservoirs upstream from Waneta.

Zinc (Figures 69 and 70) values fluctuated with turbidity. Individual values often exceeded the B.C. guideline for mean concentrations that are to be averaged during a 30-day period. Values appear to have declined from those values measured in 1995 and those in 2005. This declining trend had been noted in a previous report and attributed to abatement measures at the upstream smelter and fertilizer plant in Trail (Pommen, 2002).

REFERENCES

Ministry of Environment. 2006a. British Columbia Approved Water Quality Guidelines (Criteria). Environmental Protection Division, Ministry of Environment. Victoria, B.C.

Ministry of Environment. 2006a. British Columbia. A Compendium of Working Water Quality Guidelines for British Columbia. Environmental Protection Division, Ministry of Environment. Victoria, B.C.

Pommen, L.W. 2002. Water Quality Assessment of Columbia River at Waneta (1979 - 2000). Ministry of Water, Land and Air Protection and Environment Canada.

Figure 3
Columbia River at Waneta
Aluminum Total and Extractable

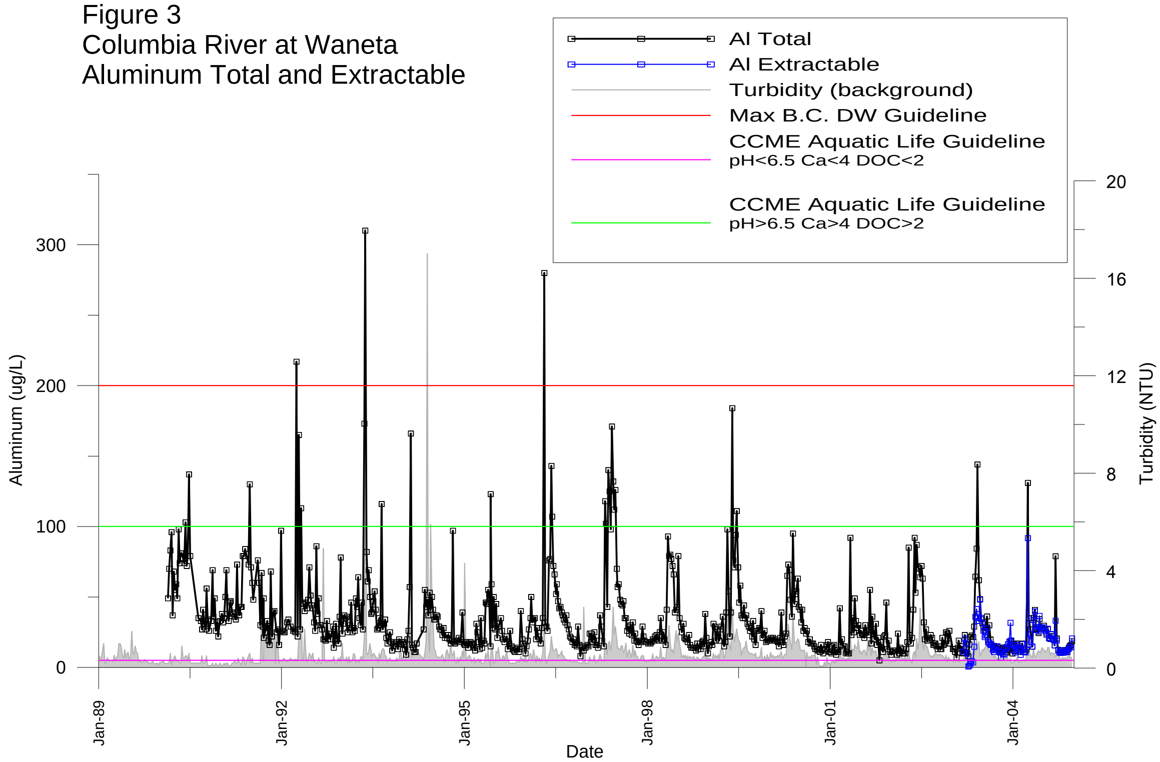
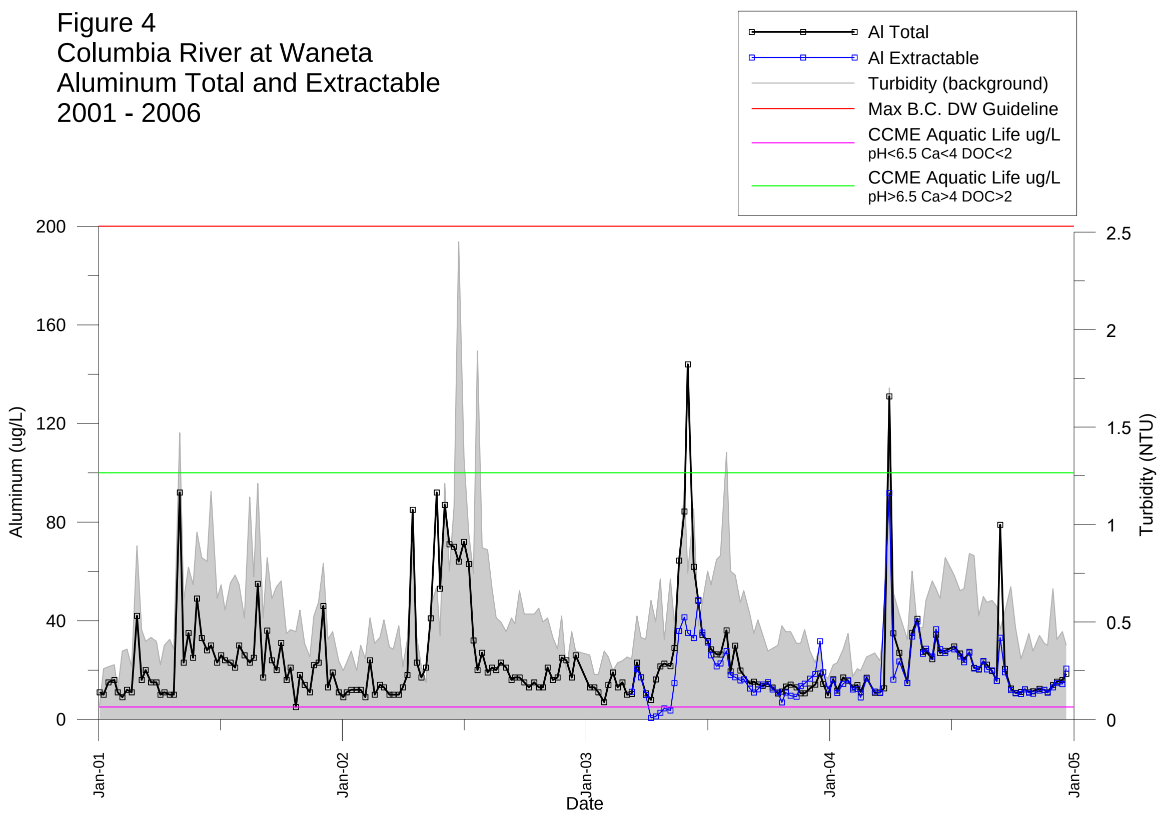


Figure 4
Columbia River at Waneta
Aluminum Total and Extractable
2001 - 2006



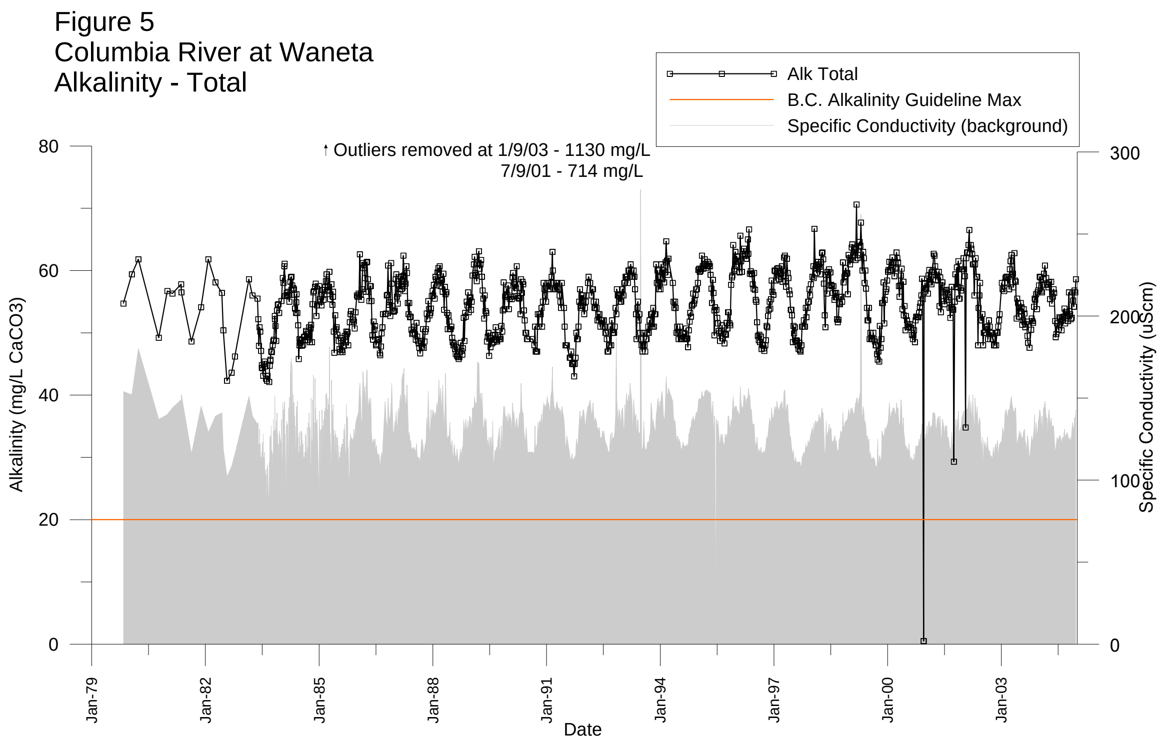


Figure 5
Columbia River at Waneta
Alkalinity - Total
Alk Total
B.C. Alkalinity Guideline Max
Specific Conductivity (background)
↑ Outliers removed at 1/9/03 - 1130 mg/L
7/9/01 - 714 mg/L
Alkalinity (mg/L CaCO3)
Specific Conductivity (uScm)
Date
0
20
40
60
80
0
100
200
300
Jan-79
Jan-82
Jan-85
Jan-88
Jan-91
Jan-94
Jan-97
Jan-00
Jan-03

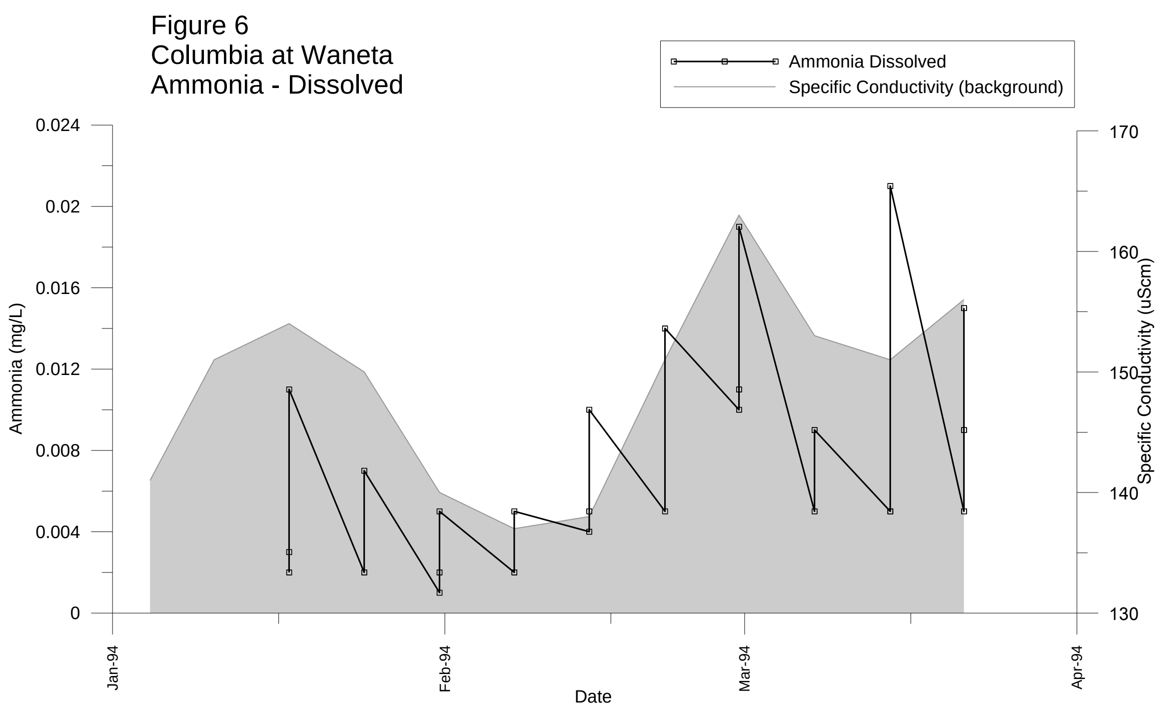


Figure 6
Columbia at Waneta
Ammonia - Dissolved
Ammonia Dissolved
Specific Conductivity (background)
Ammonia (mg/L)
Specific Conductivity (uScm)
Date
0
0.004
0.008
0.012
0.016
0.02
0.024
130
140
150
160
170
Jan-94
Feb-94
Mar-94
Apr-94

Figure 7
Columbia River at Waneta
Antimony - Total and Extractable

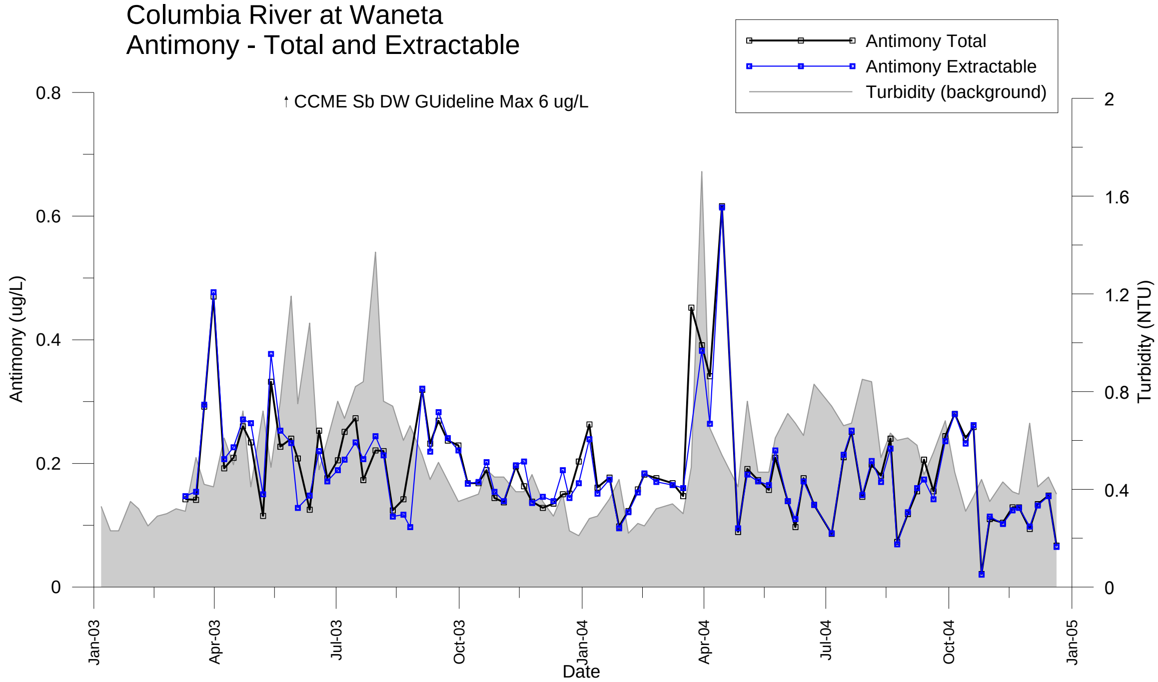


Figure 8
Columbia River at Waneta
Arsenic - Total and Extractable
1979 - 2005

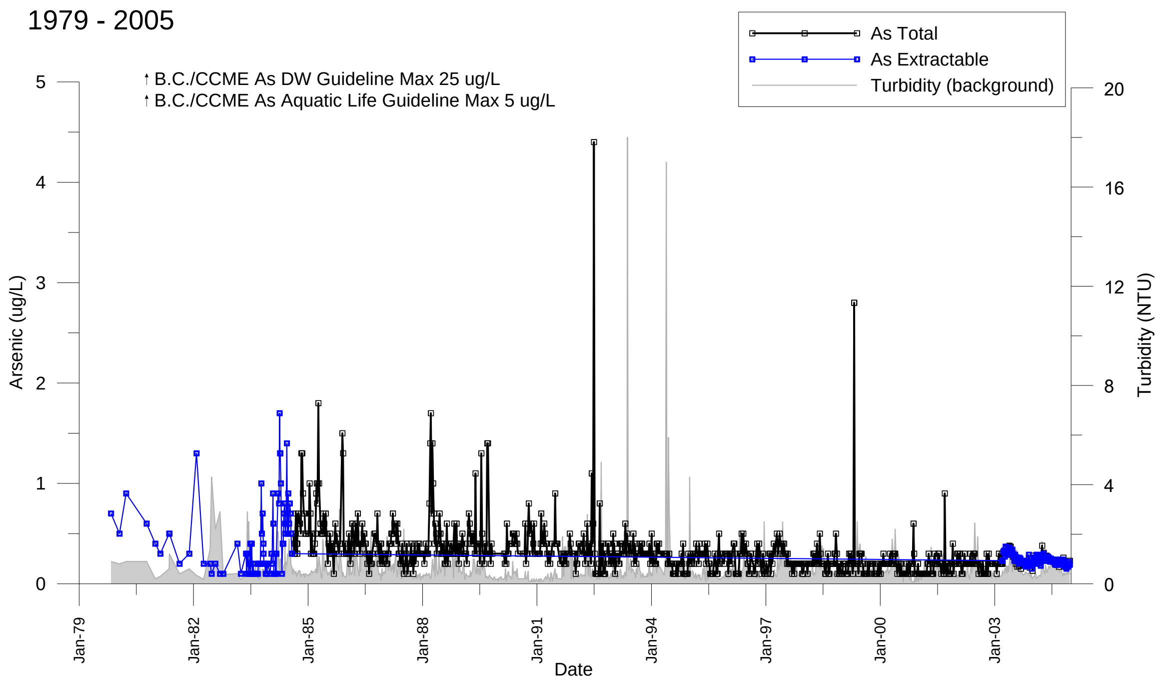


Figure 9
Columbia River at Waneta
Boron - Total and Extractable
2003 - 2005

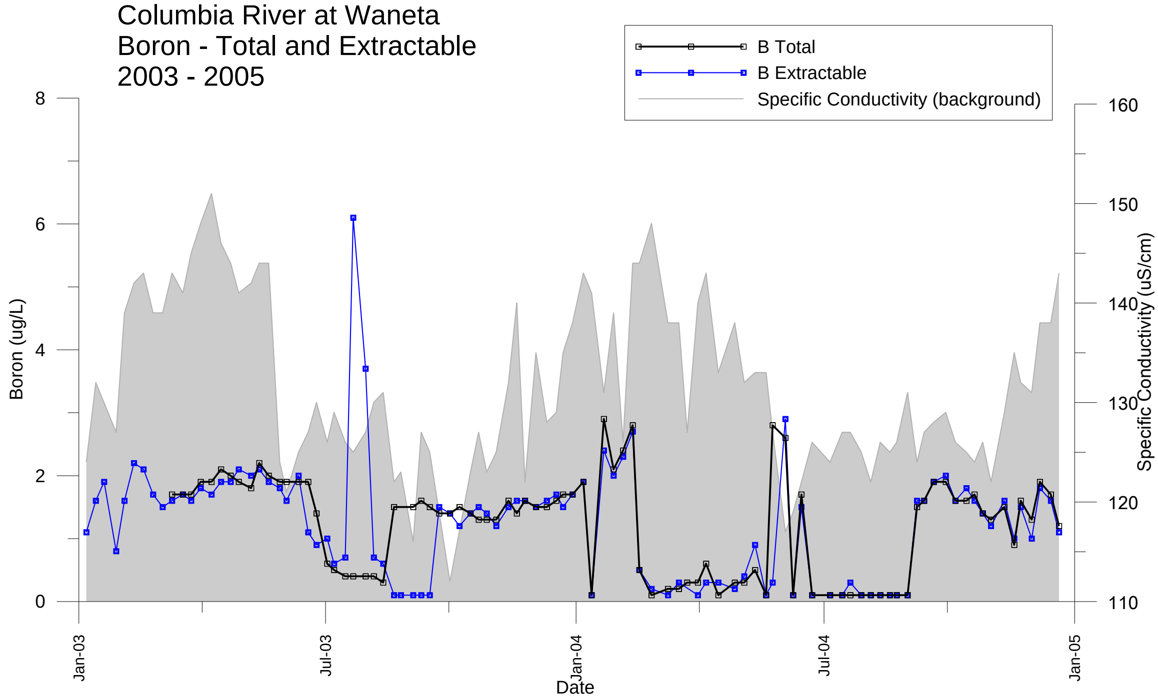


Figure 10
Columbia River at Waneta
Barium - Total and Extractable
1990 - 2005

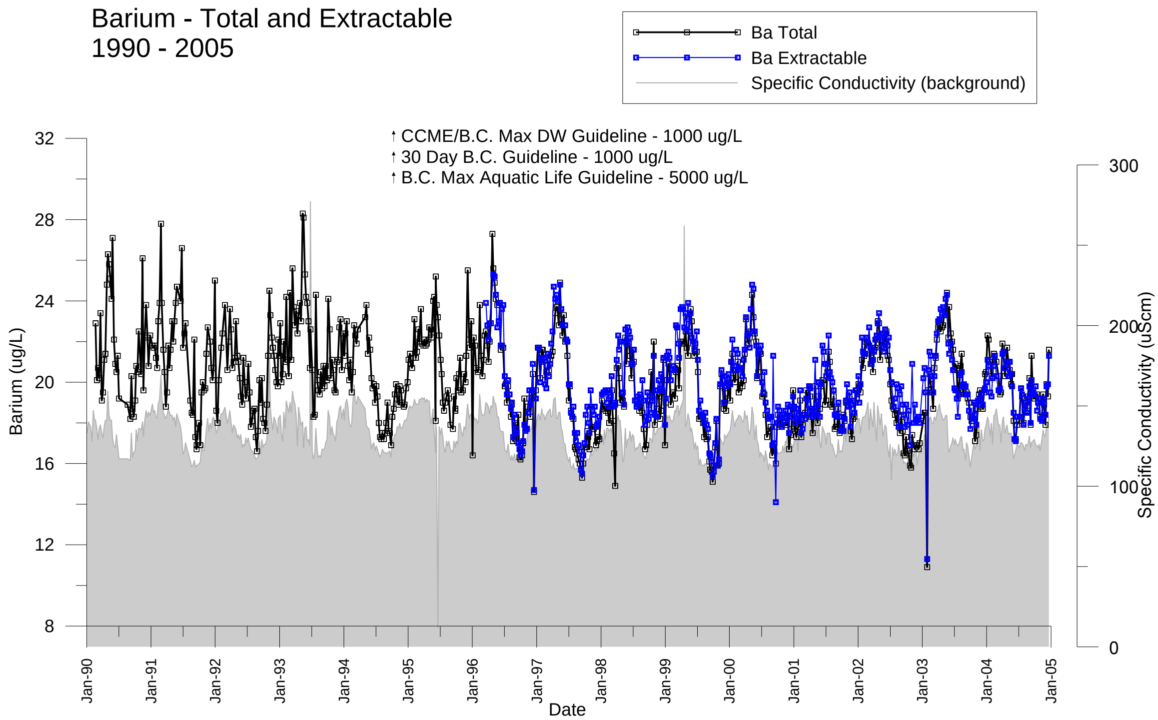


Figure 11
Columbia River at Waneta
Beryllium - Total and Extractable
1990 - 2005

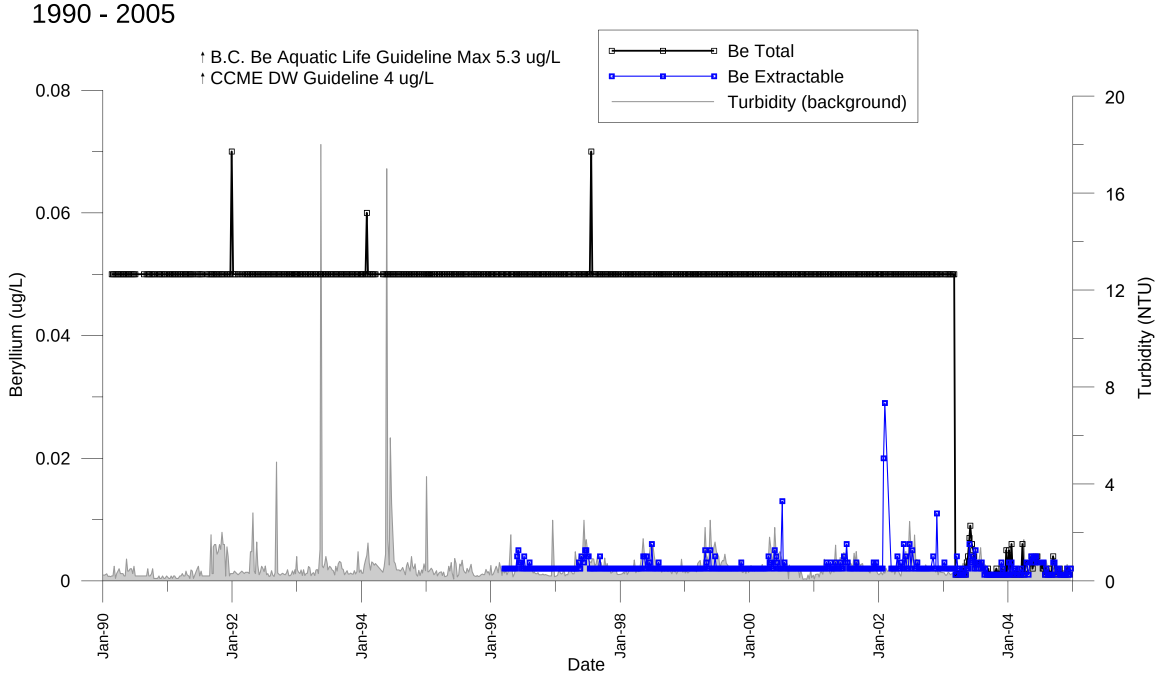


Figure 12
Columbia River at Waneta
Beryllium - Total and Extractable
2003-2005

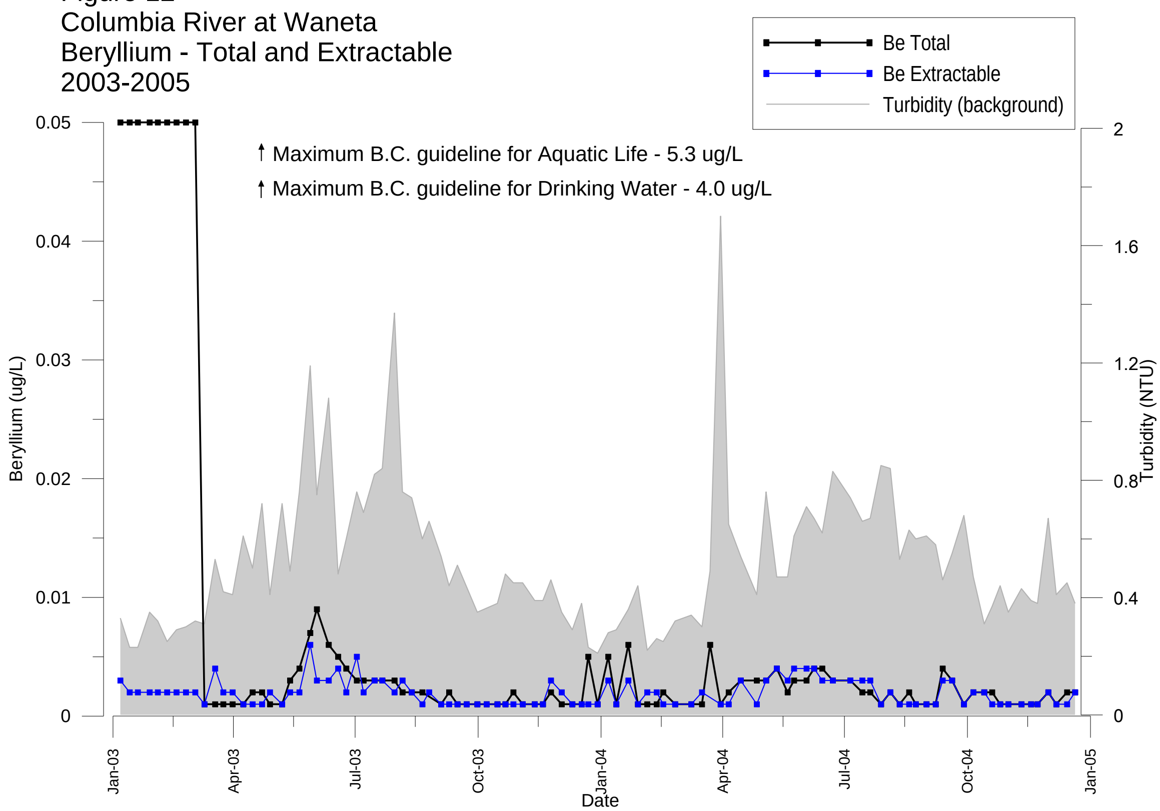


Figure 13
Columbia River at Waneta
Bismuth - Total and Extractable

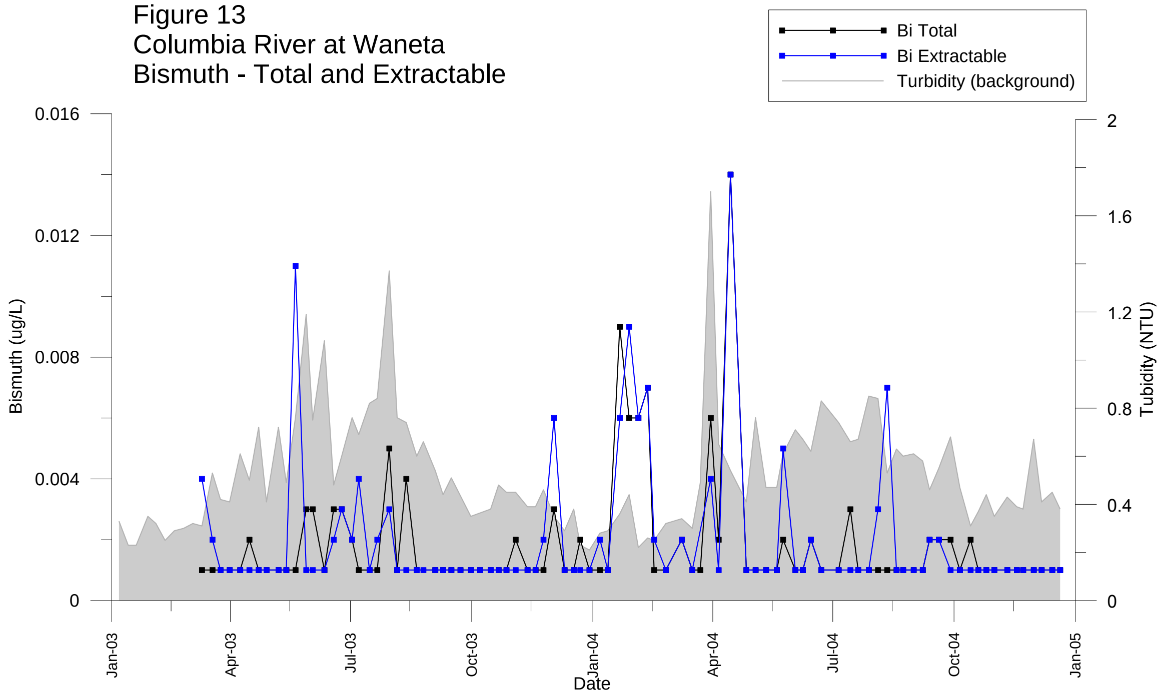
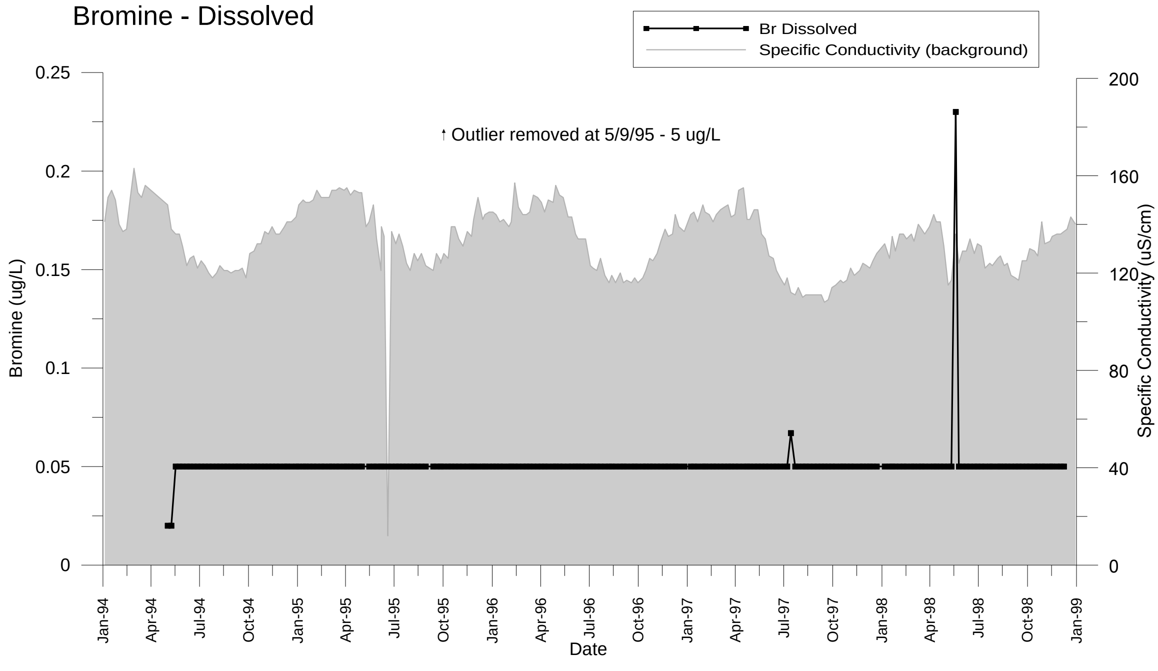


Figure 14
Columbia at Waneta
Bromine - Dissolved



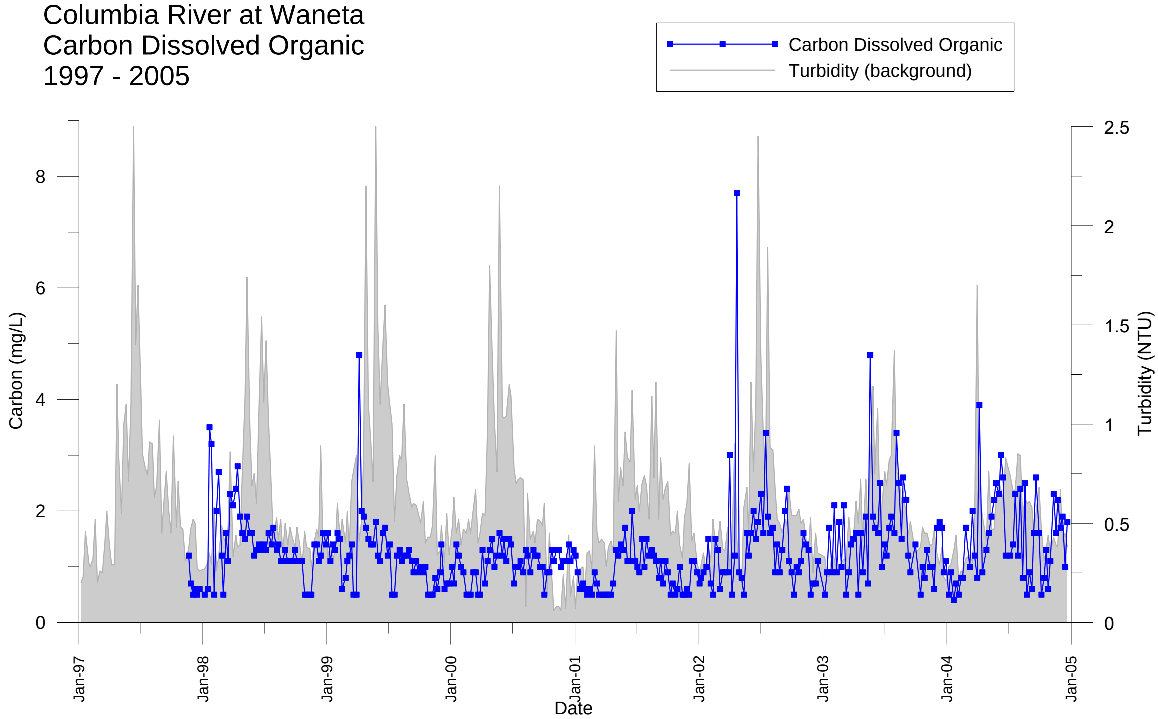


Figure 15
Columbia River at Waneta
Carbon Dissolved Organic
1997 - 2005

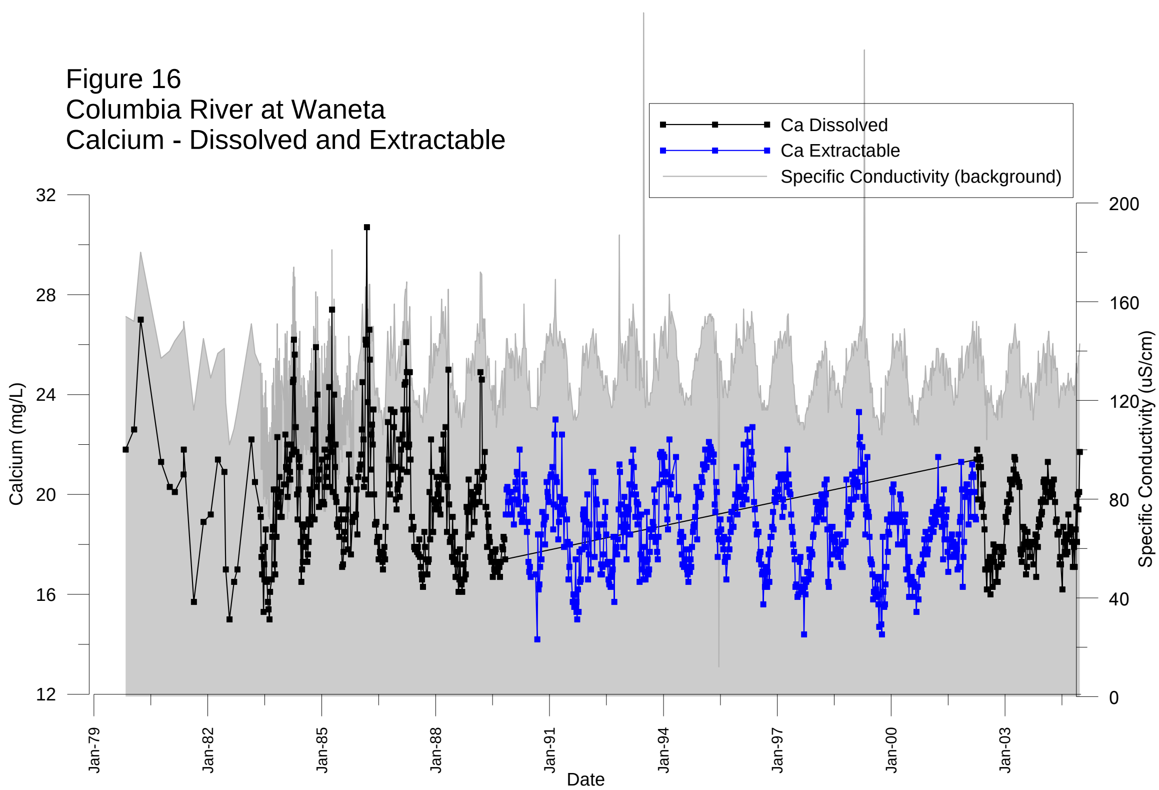


Figure 16
Columbia River at Waneta
Calcium - Dissolved and Extractable

Figure 17
Columbia River at Waneta
Cadmium - Total and Extractable
1979 - 2005

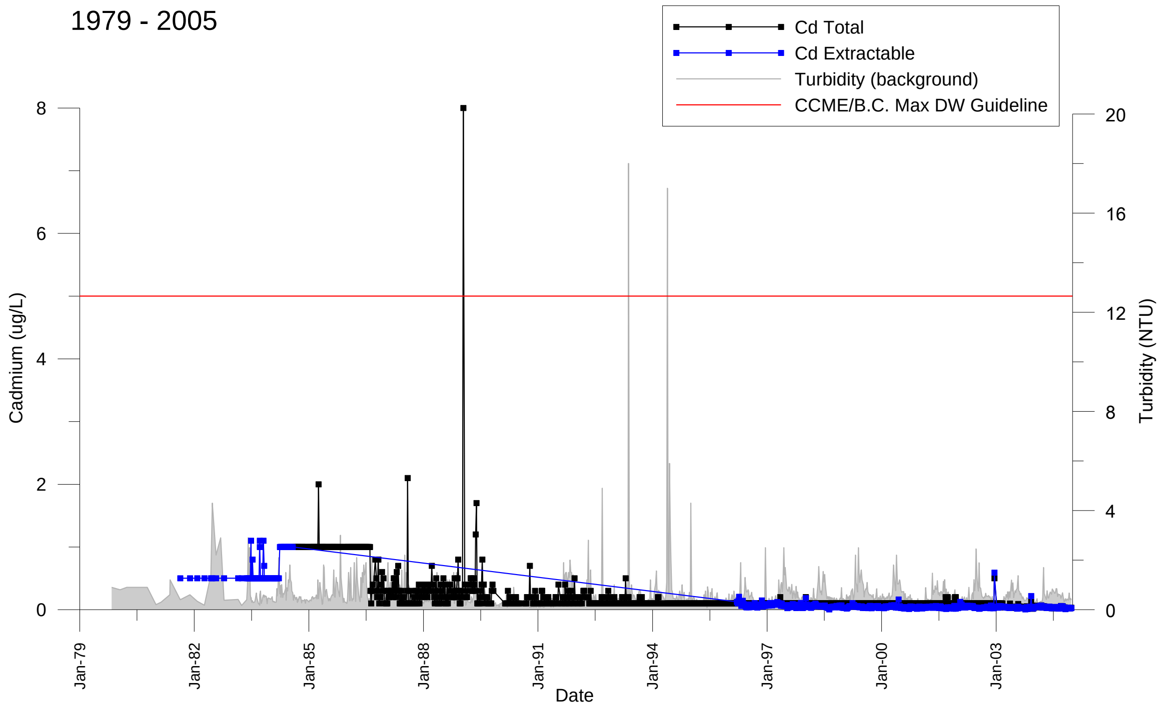
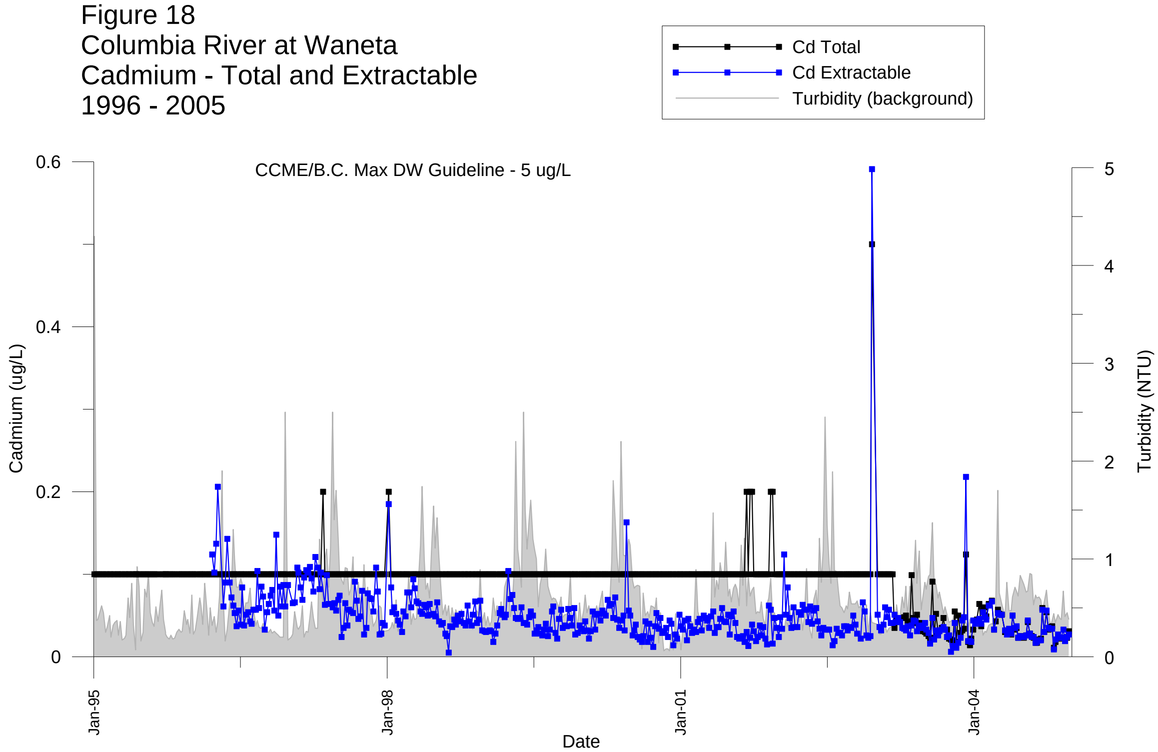


Figure 18
Columbia River at Waneta
Cadmium - Total and Extractable
1996 - 2005



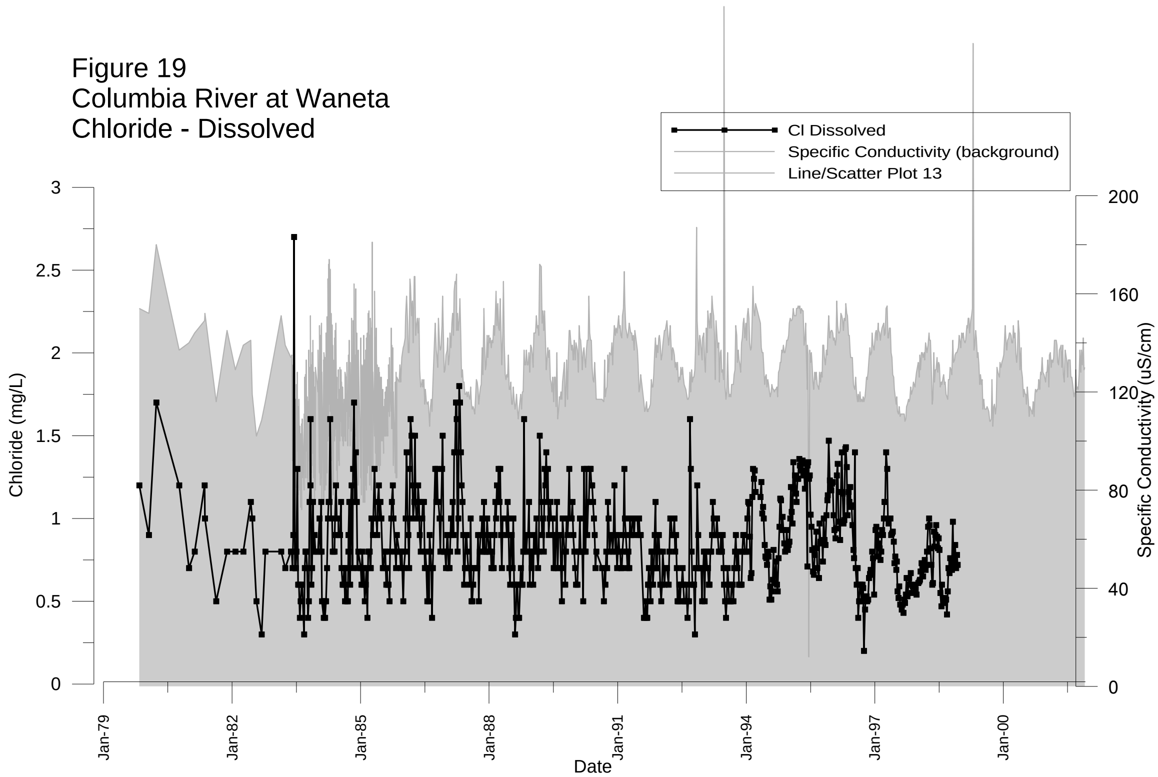


Figure 19
Columbia River at Waneta
Chloride - Dissolved
Cl Dissolved
Specific Conductivity (background)
Line/Scatter Plot 13
Chloride (mg/L)
Specific Conductivity (uS/cm)
Date
Jan-79
Jan-82
Jan-85
Jan-88
Jan-91
Jan-94
Jan-97
Jan-00

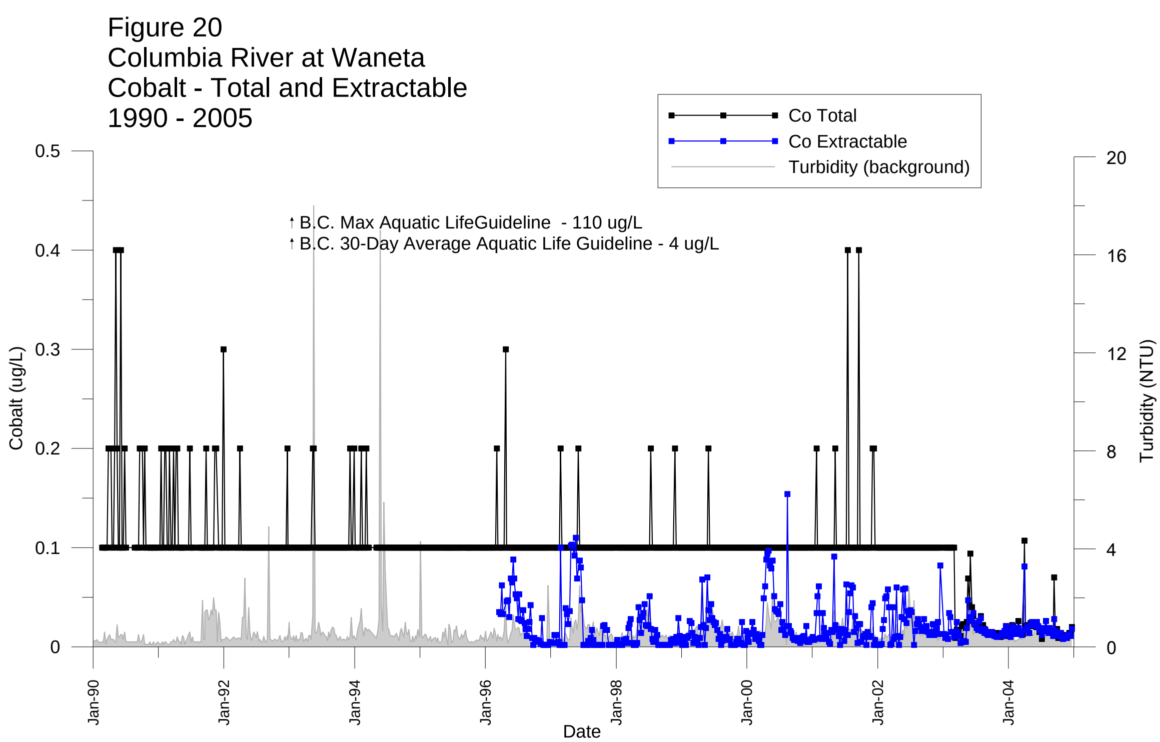


Figure 20
Columbia River at Waneta
Cobalt - Total and Extractable
1990 - 2005
Co Total
Co Extractable
Turbidity (background)
↑ B.C. Max Aquatic LifeGuideline - 110 ug/L
↑ B.C. 30-Day Average Aquatic Life Guideline - 4 ug/L
Cobalt (ug/L)
Turbidity (NTU)
Date
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Jan-04

Figure 21
Columbia River at Waneta
Cobalt - Total and Extractable
2003 - 2005

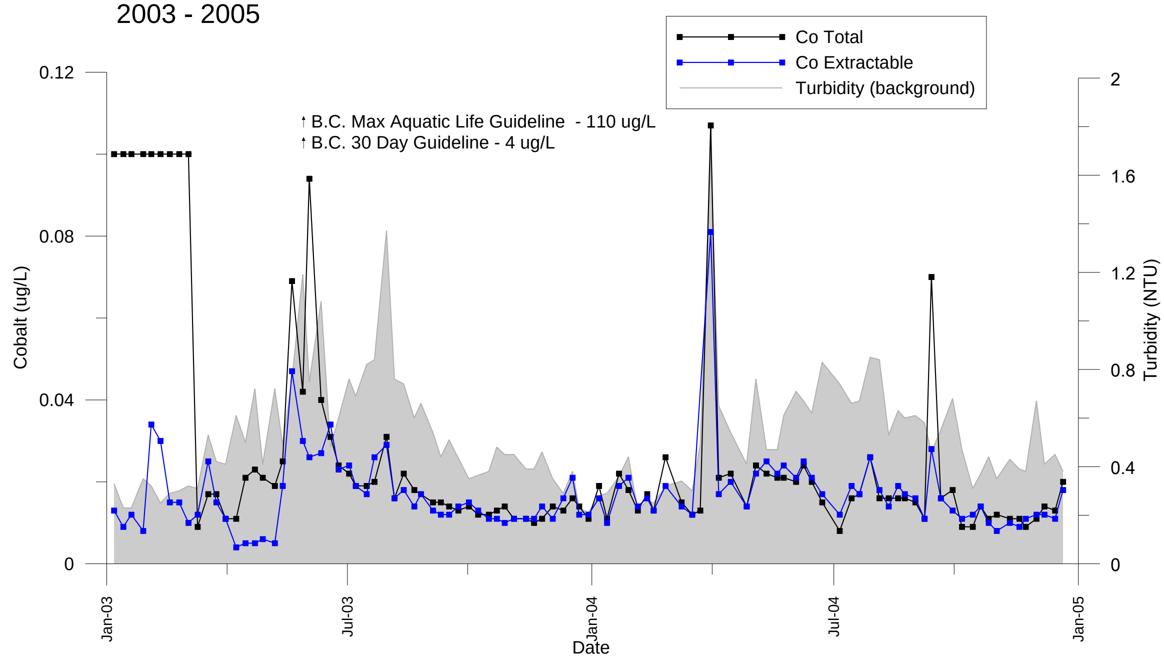
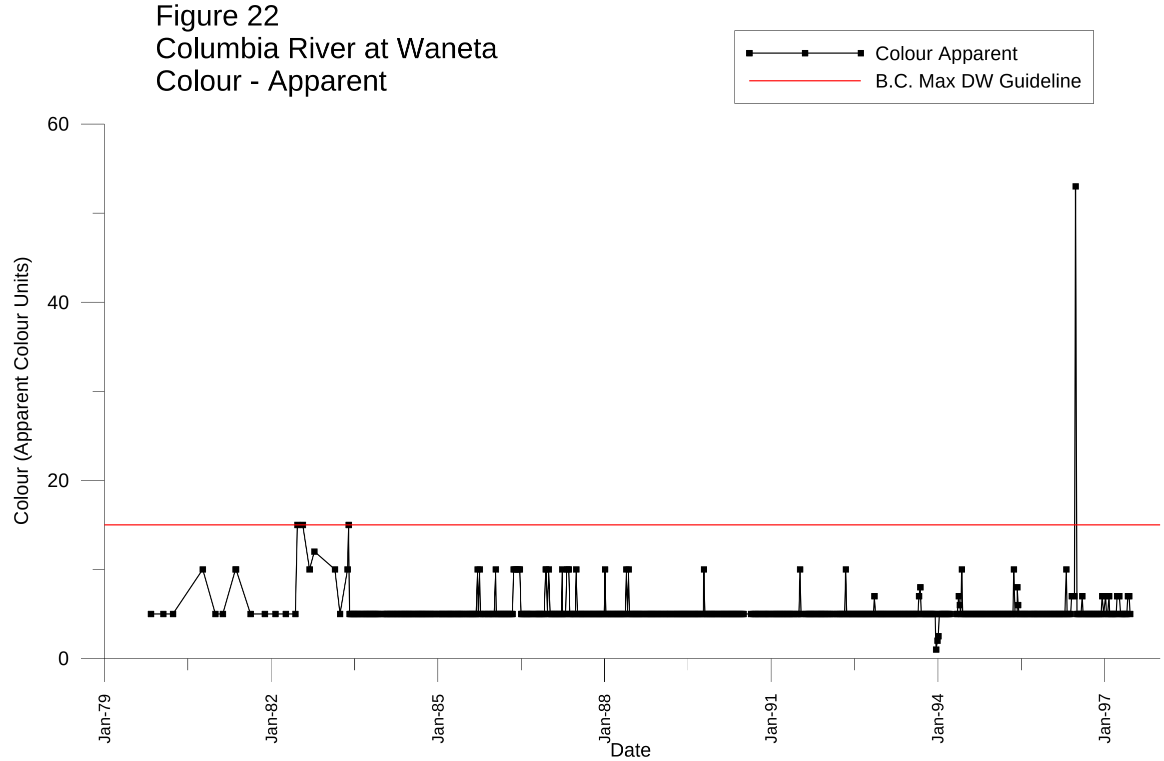


Figure 22
Columbia River at Waneta
Colour - Apparent



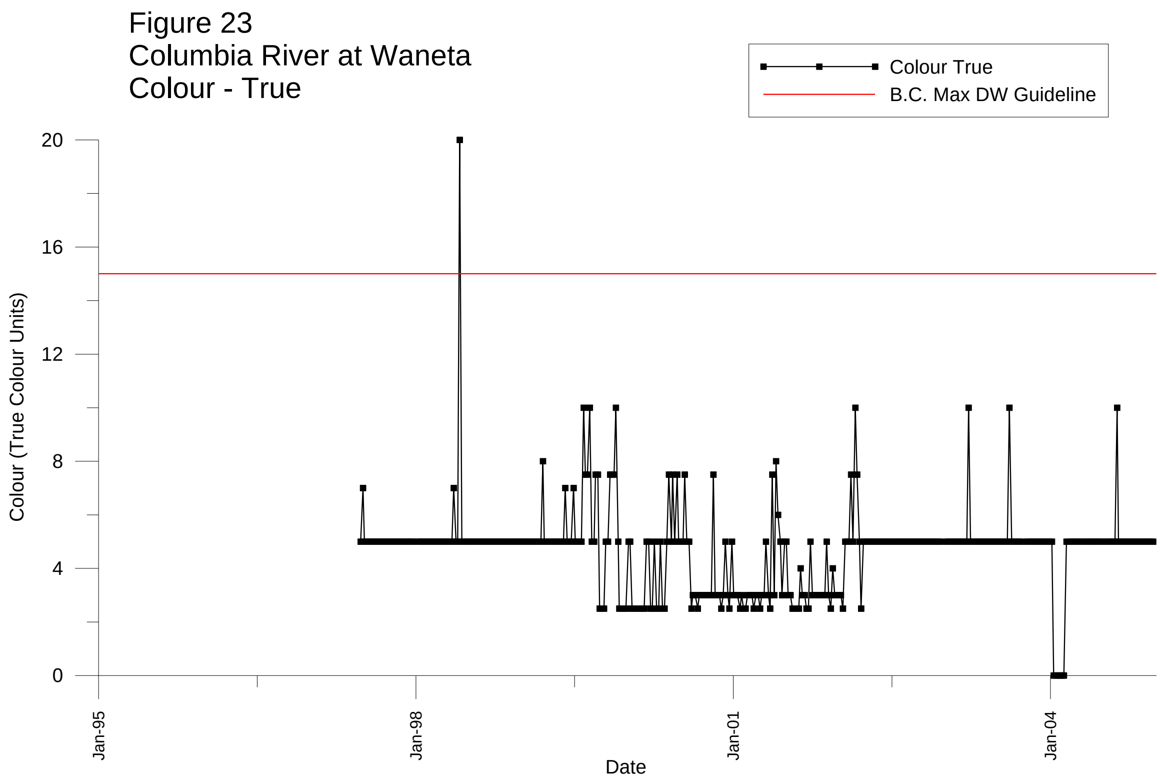


Figure 23
Columbia River at Waneta
Colour - True
Colour True
B.C. Max DW Guideline
Colour (True Colour Units)
20
16
12
8
4
0
Jan-95
Jan-98
Jan-01
Jan-04
Date

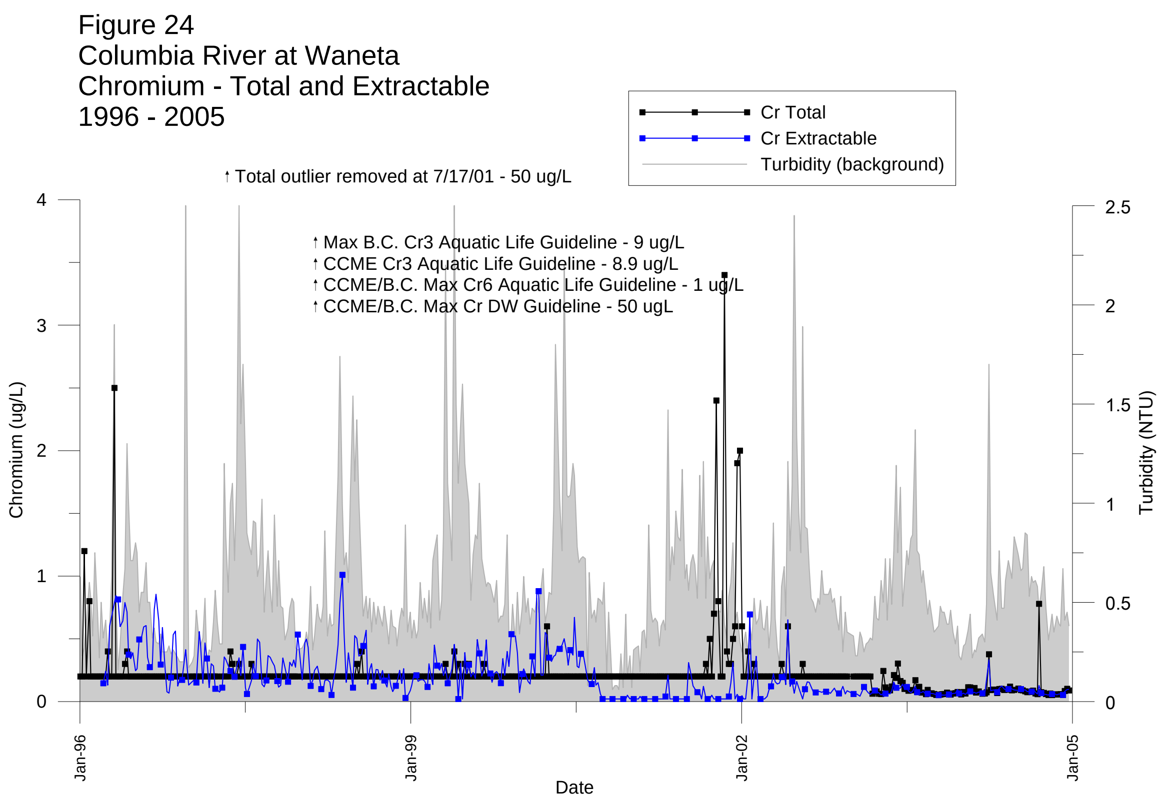


Figure 24
Columbia River at Waneta
Chromium - Total and Extractable
1996 - 2005
Cr Total
Cr Extractable
Turbidity (background)
↑ Total outlier removed at 7/17/01 - 50 ug/L
↑ Max B.C. Cr3 Aquatic Life Guideline - 9 ug/L
↑ CCME Cr3 Aquatic Life Guideline - 8.9 ug/L
↑ CCME/B.C. Max Cr6 Aquatic Life Guideline - 1 ug/L
↑ CCME/B.C. Max Cr DW Guideline - 50 ugL
Chromium (ug/L)
4
3
2
1
0
Turbidity (NTU)
2.5
2
1.5
1
0.5
0
Jan-96
Jan-99
Jan-02
Jan-05
Date

Figure 25
Columbia River at Waneta
Chromium - Total and Extractable
2003 - 2005

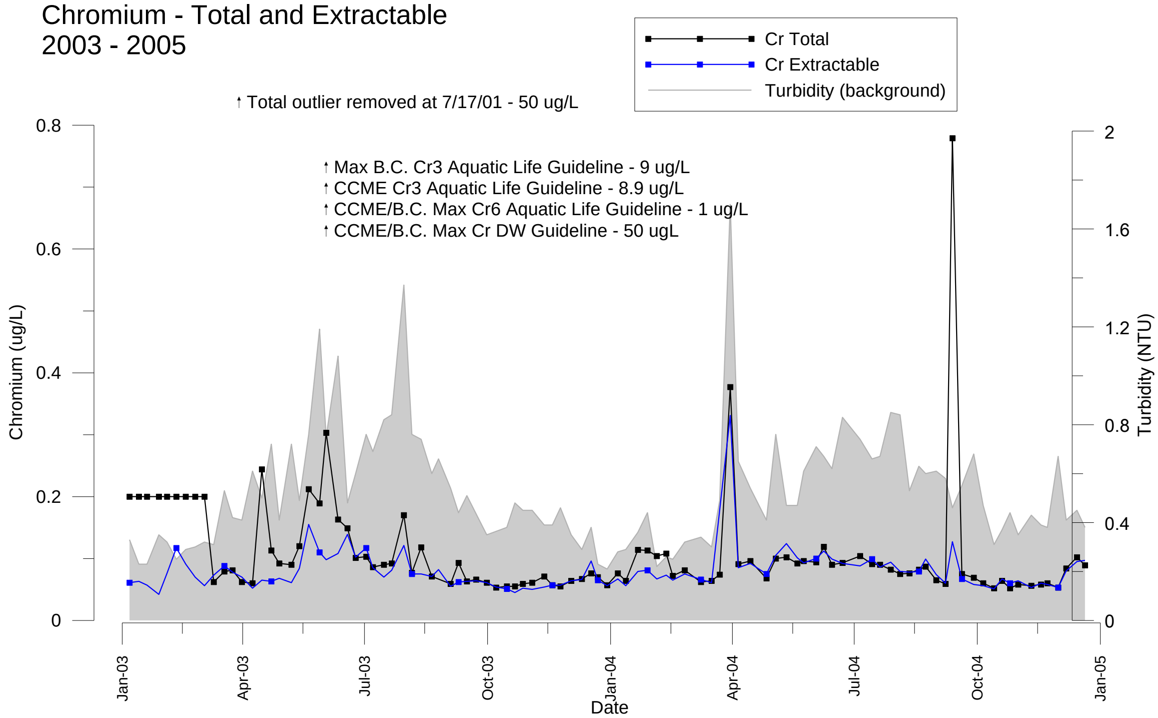


Figure 26
Columbia River at Waneta
Copper - Total and Extractable
1979 - 2005

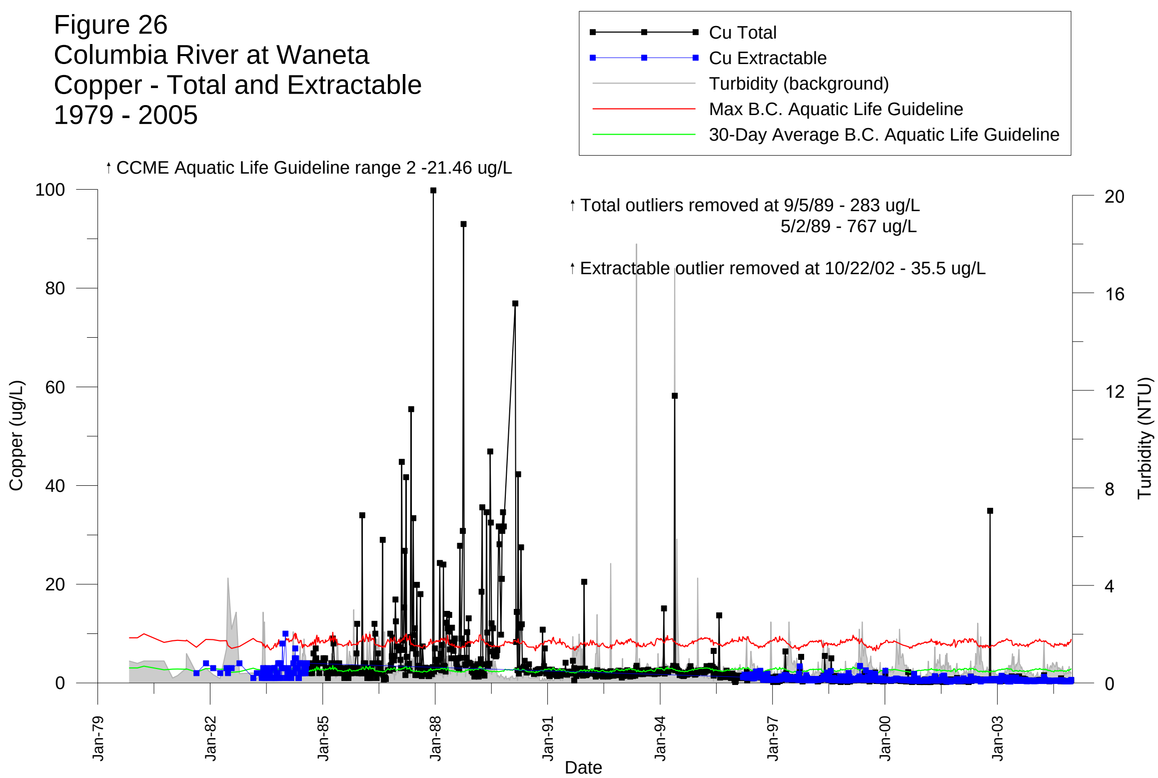


Figure 27
Columbia River at Waneta
Fluoride - Total and Dissolved

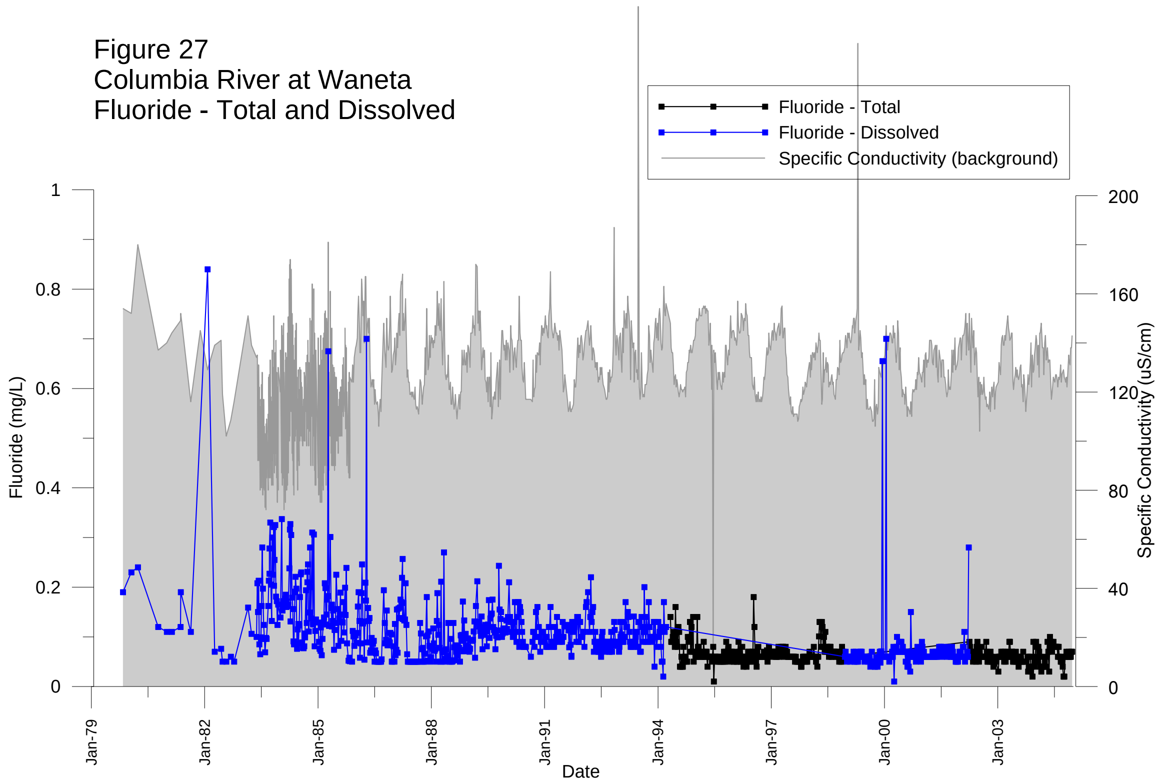


Figure 28
Columbia River at Waneta
Iron - Total and Extractable
1979 - 2005

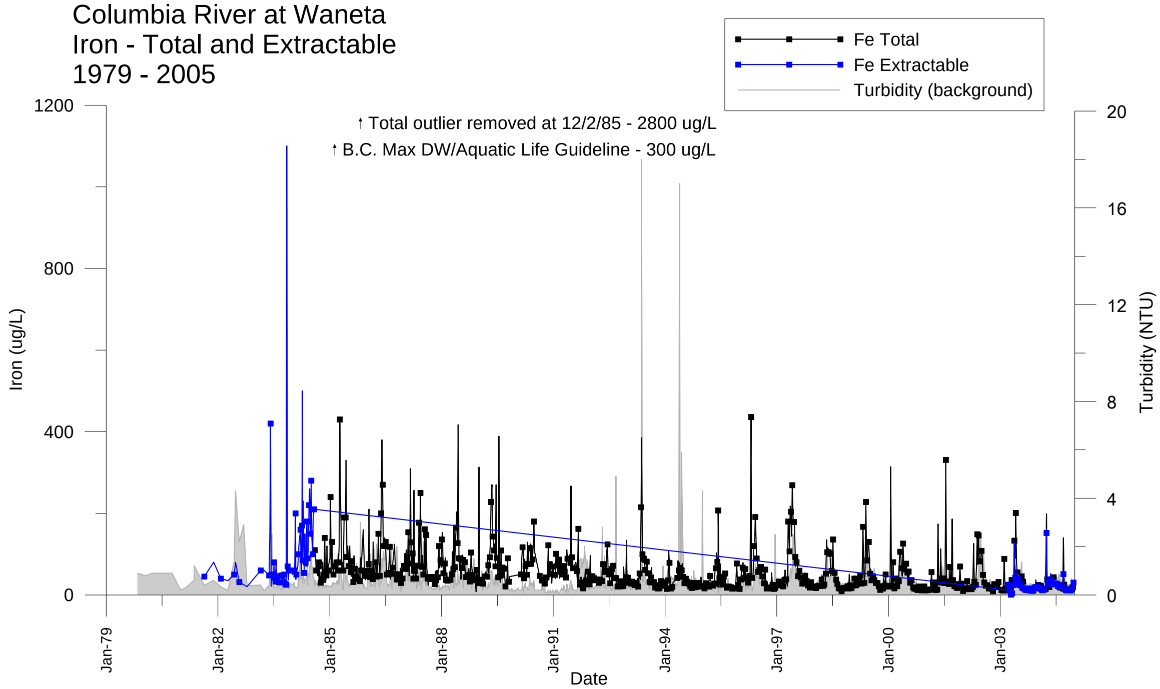


Figure 29
Columbia River at Waneta
Iron - Total and Extractable
2003 - 2005

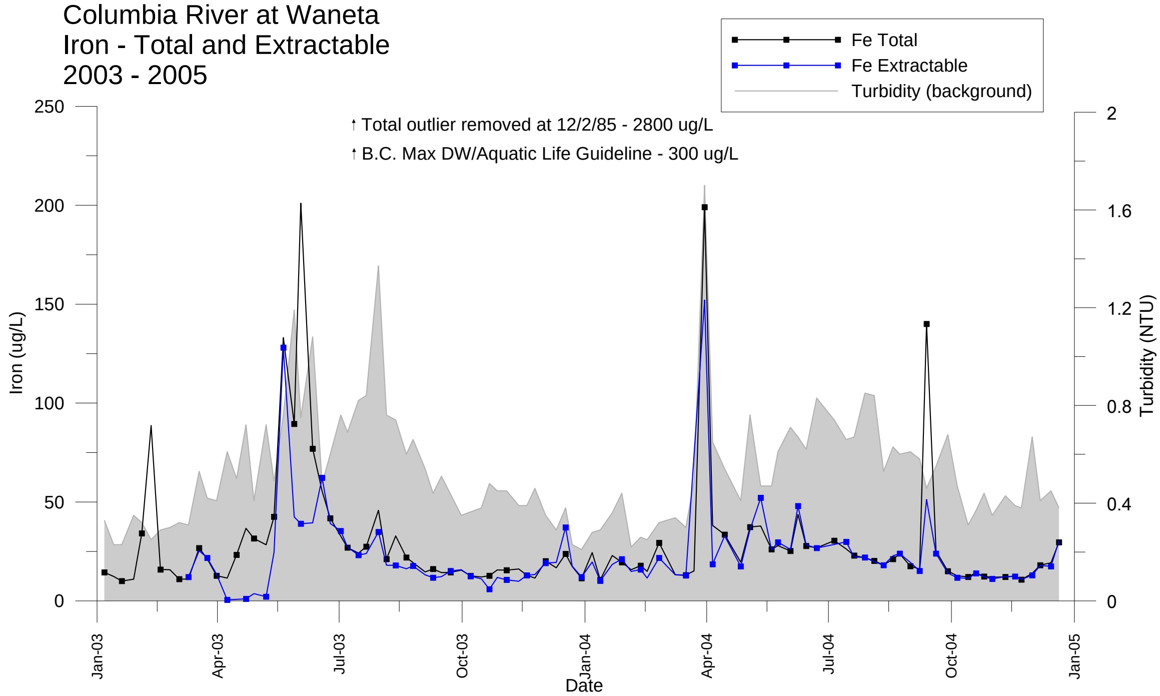
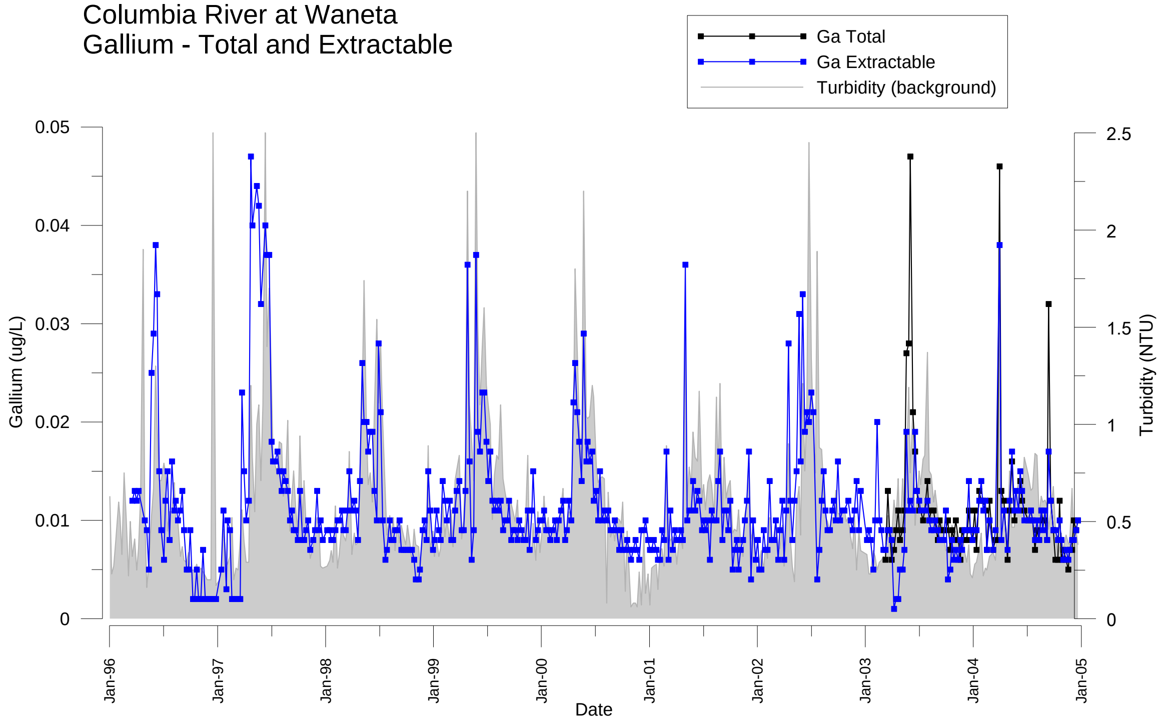


Figure 30
Columbia River at Waneta
Gallium - Total and Extractable



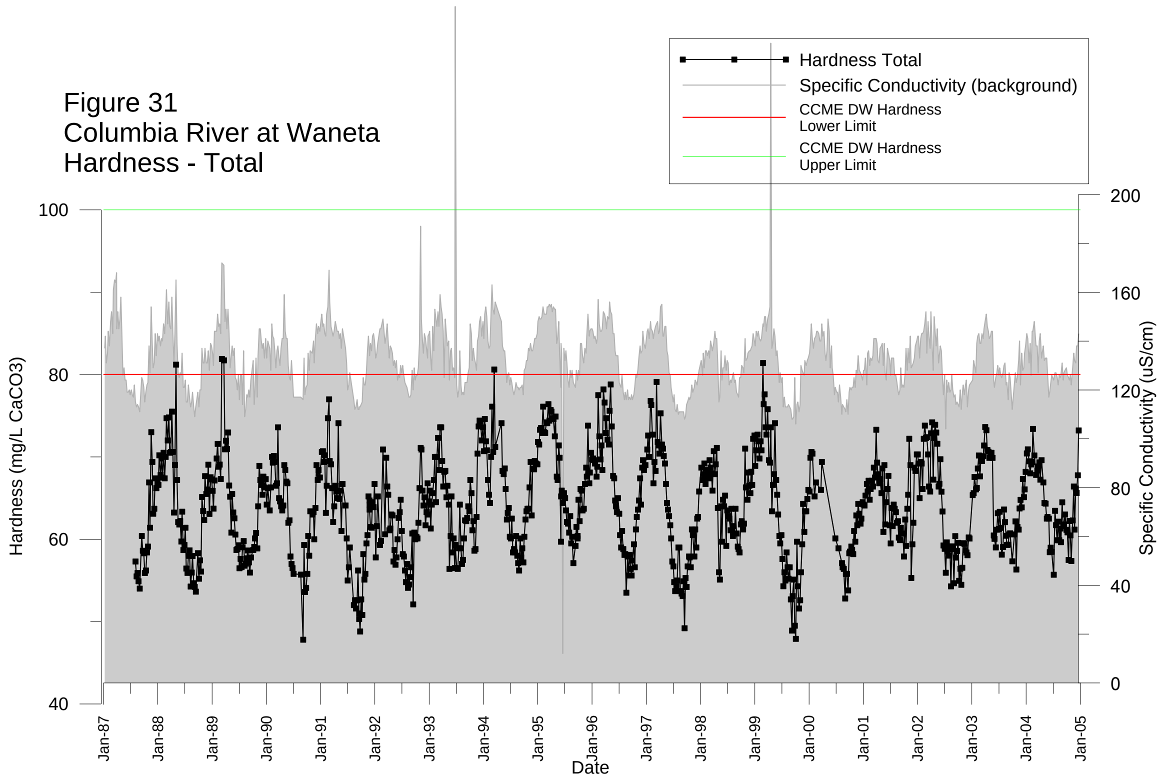


Figure 31
Columbia River at Waneta
Hardness - Total
Hardness Total
Specific Conductivity (background)
CCME DW Hardness Lower Limit
CCME DW Hardness Upper Limit
Hardness (mg/L CaCO3)
Specific Conductivity (uS/cm)
Date

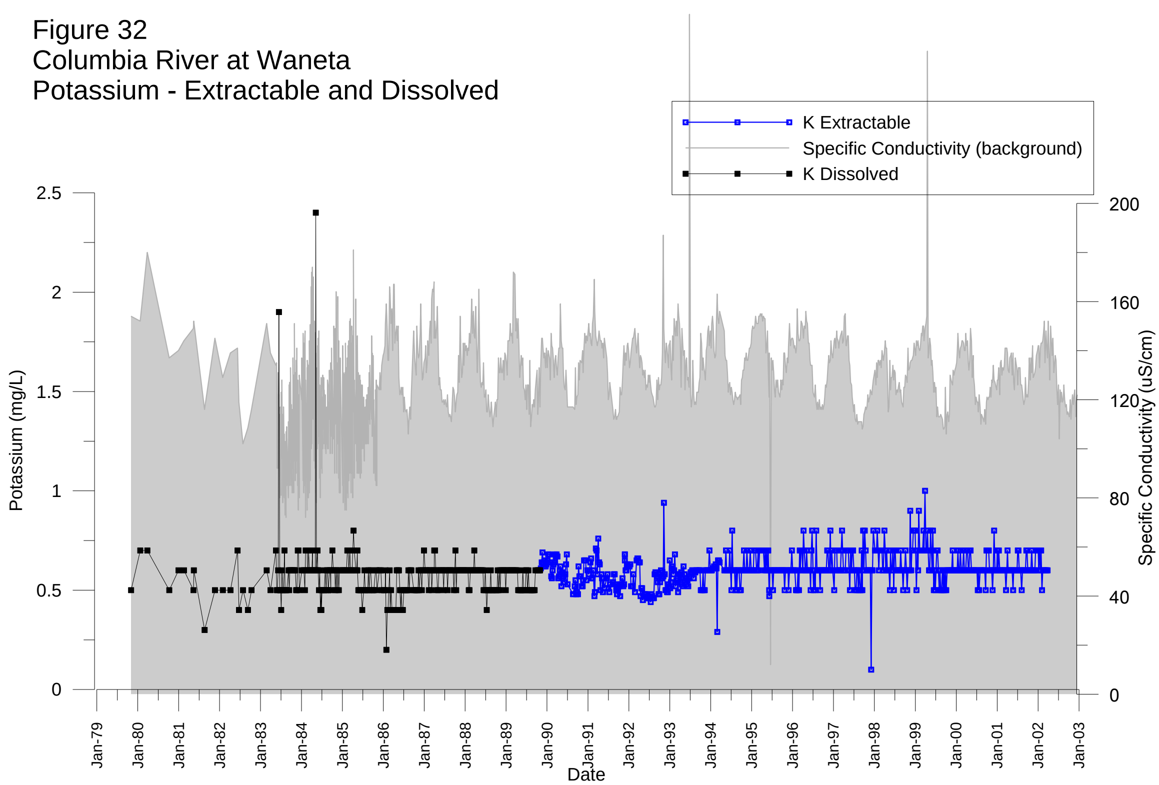


Figure 32
Columbia River at Waneta
Potassium - Extractable and Dissolved
K Extractable
Specific Conductivity (background)
K Dissolved
Potassium (mg/L)
Specific Conductivity (uS/cm)
Date

Figure 33
Columbia River at Waneta
Lanthanum - Total and Extractable

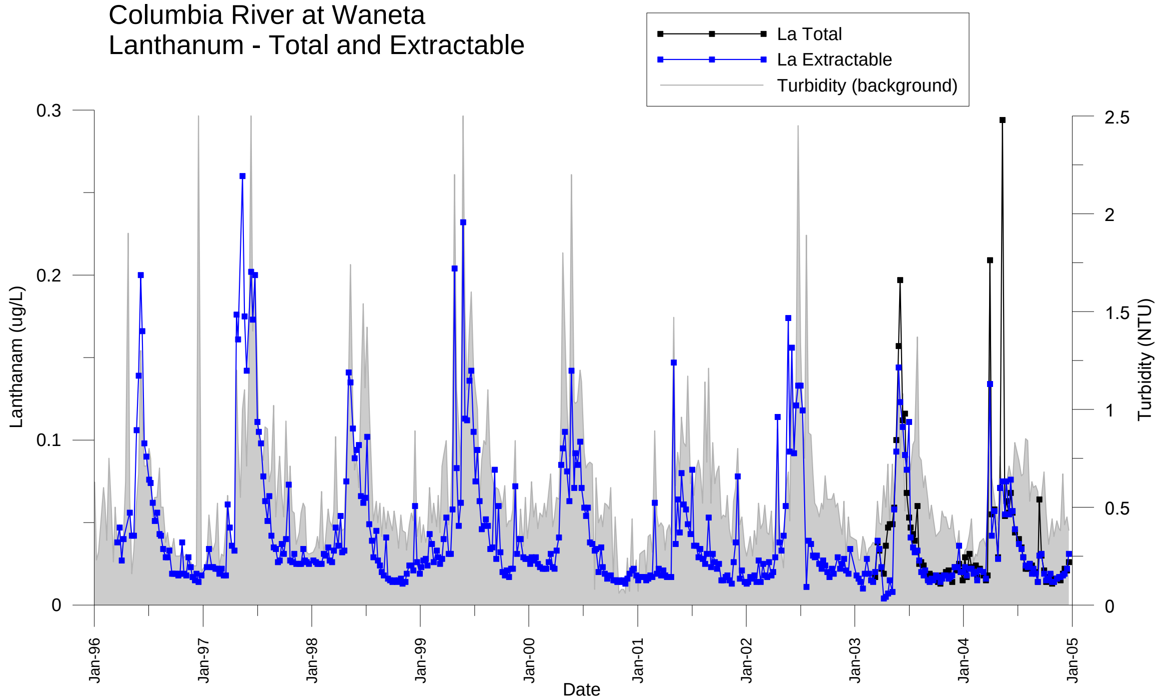


Figure 34
Columbia River at Waneta
Lead - Total and Extractable
1979 - 2005

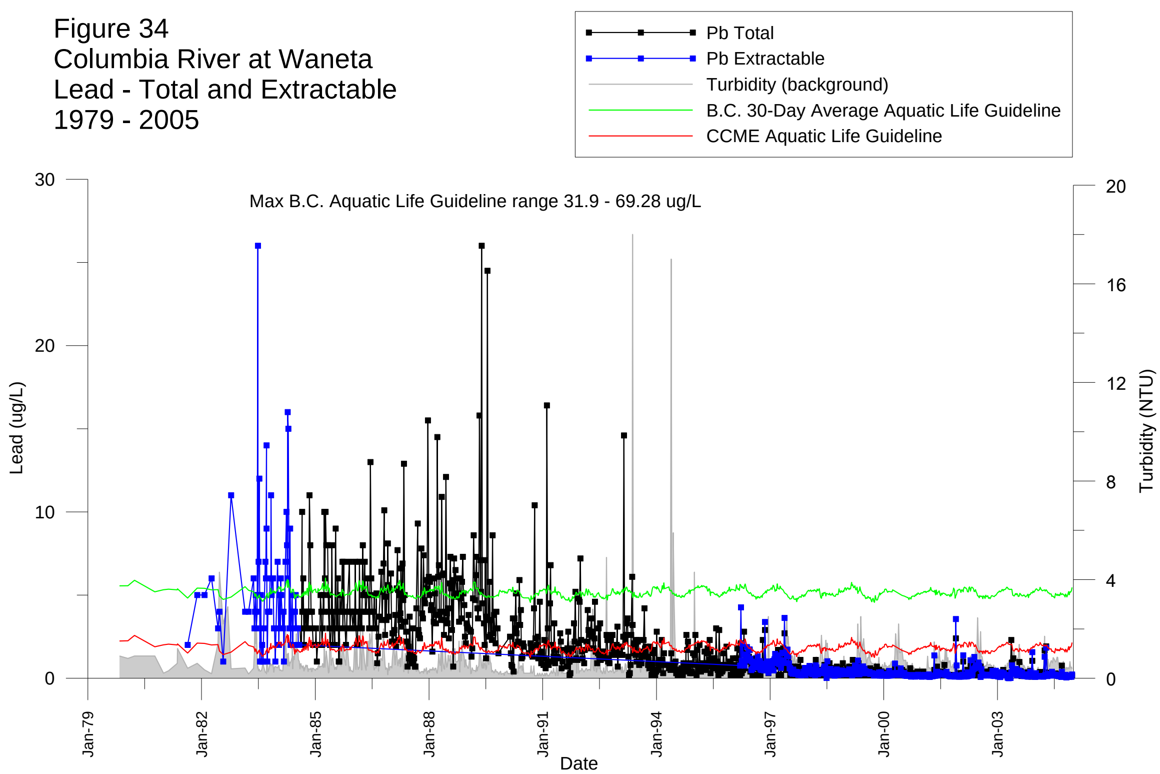


Figure 35
Columbia River at Waneta
Lead - Total and Extractable
1996 - 2005

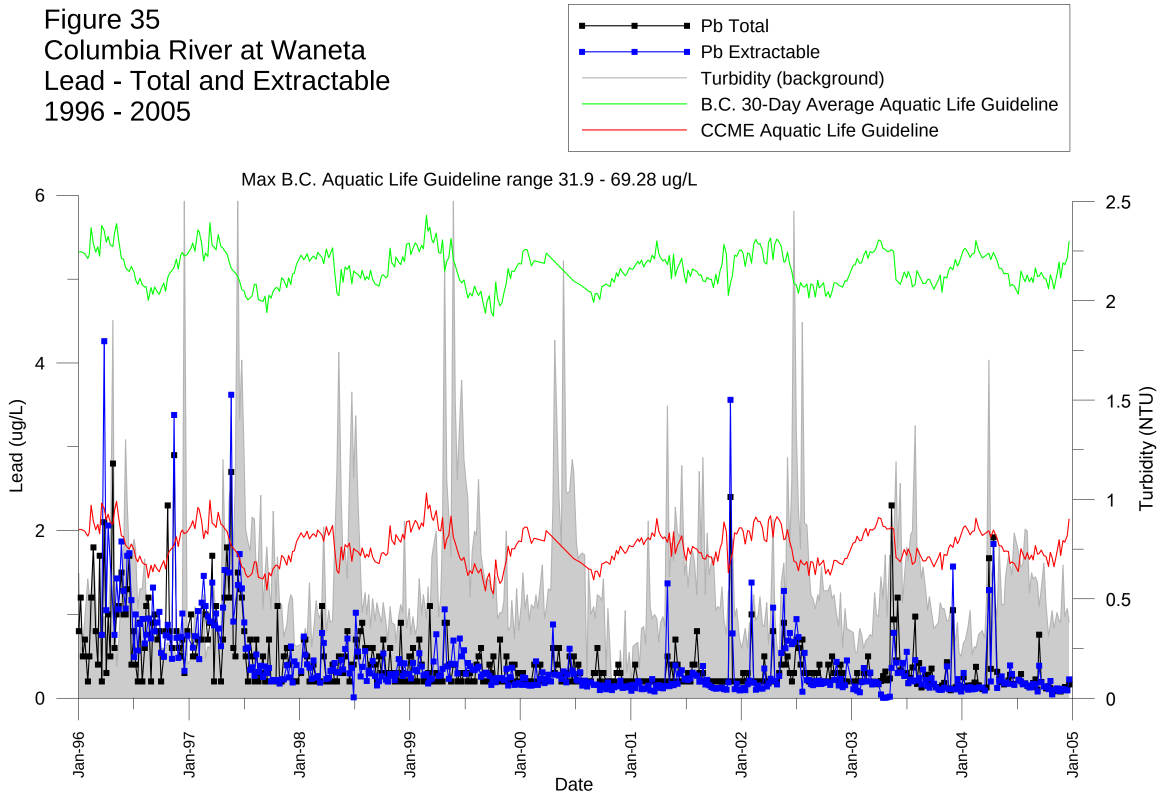


Figure 36
Columbia River at Waneta
Lithium - Total and Extractable

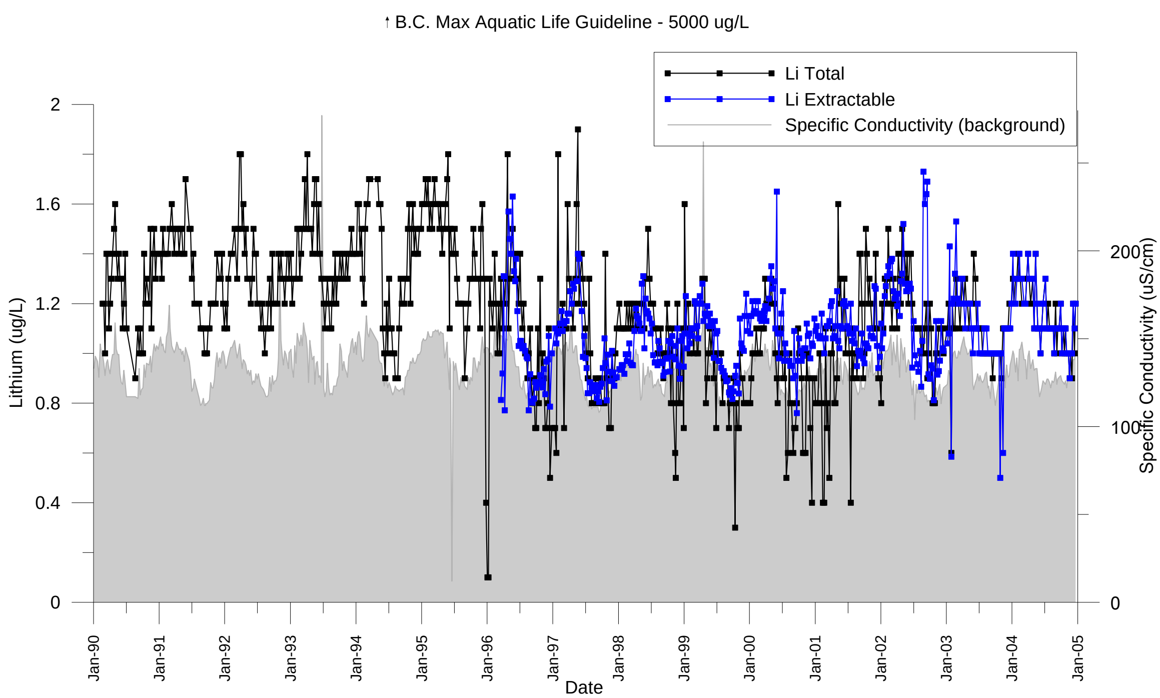


Figure 37
Columbia River at Waneta
Molybdenum - Total and Extractable
1989 - 2005

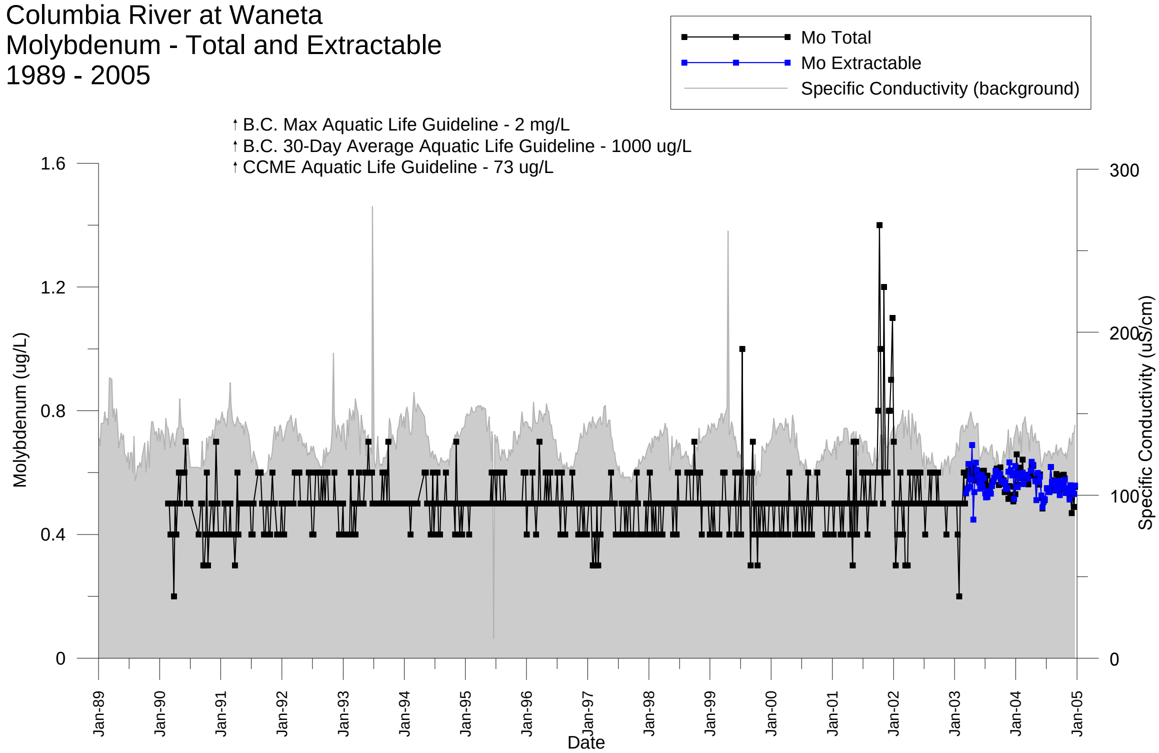


Figure 38
Columbia River at Waneta
Molybdenum - Total and Extractable
2003 - 2005

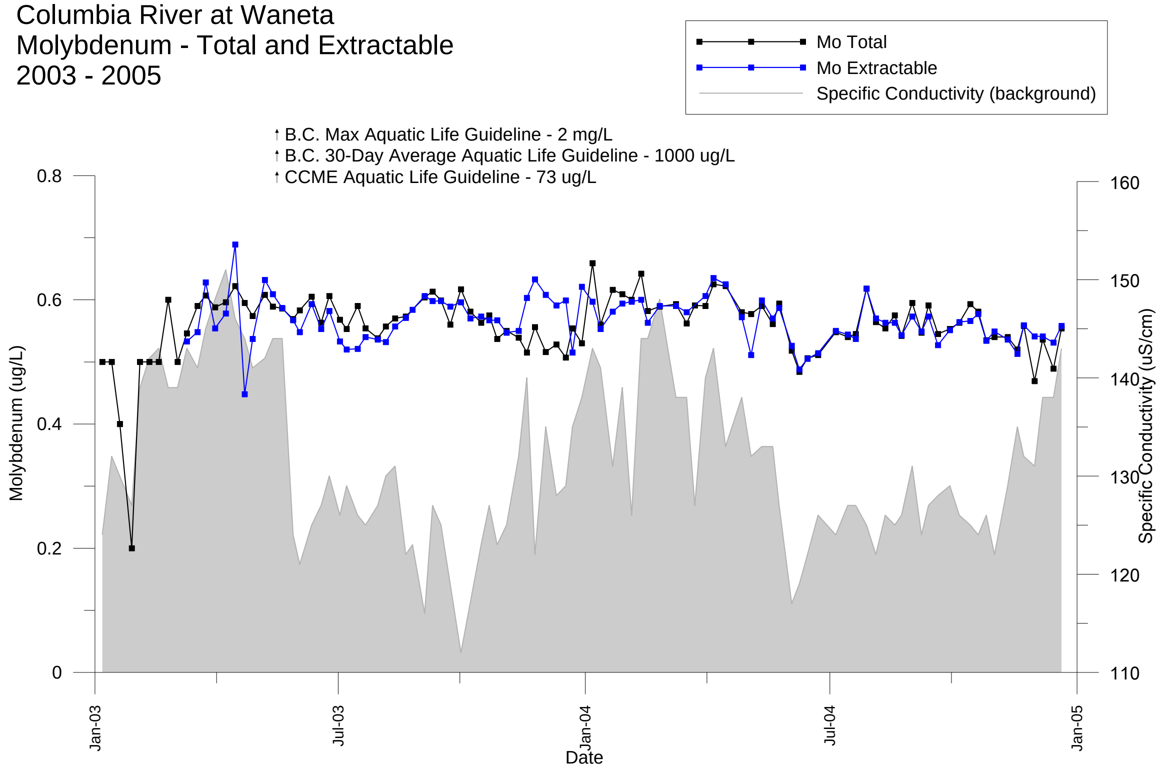


Figure 39
Columbia River at Waneta
Nitrogen - Dissolved NO3 and NO2
1979 - 1996

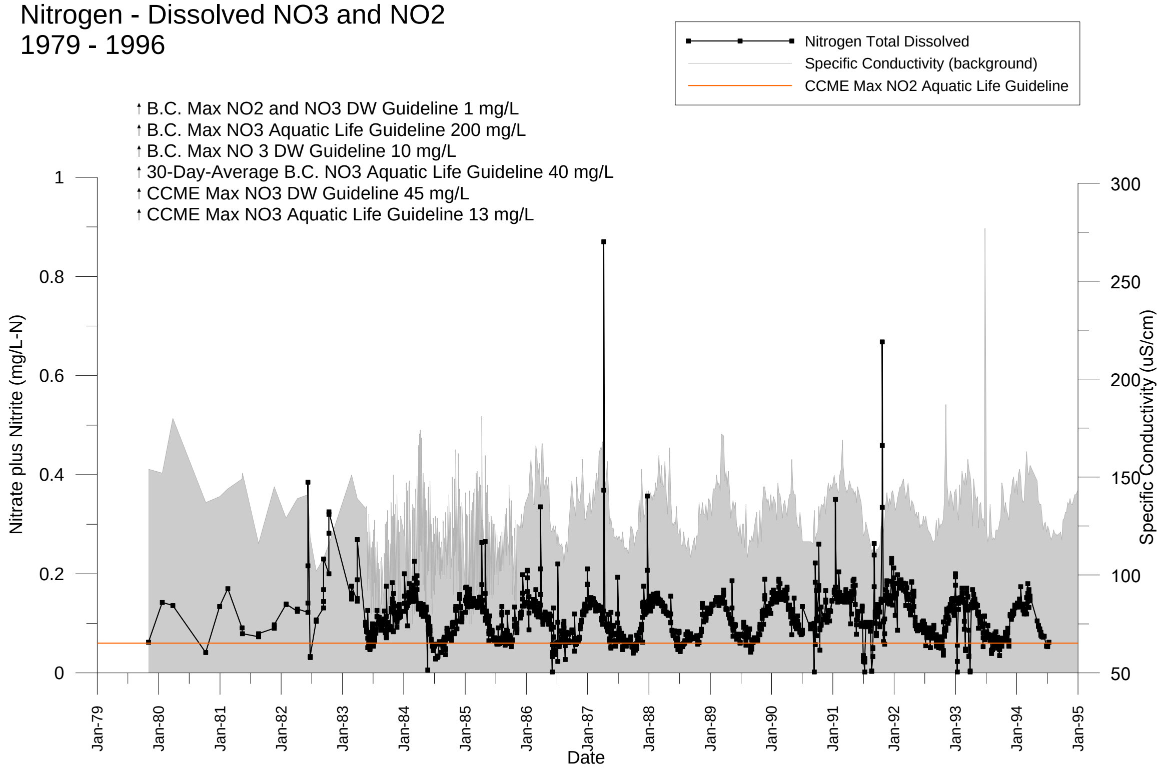


Figure 40
Columbia River at Waneta
Nitrogen - Total Dissolved

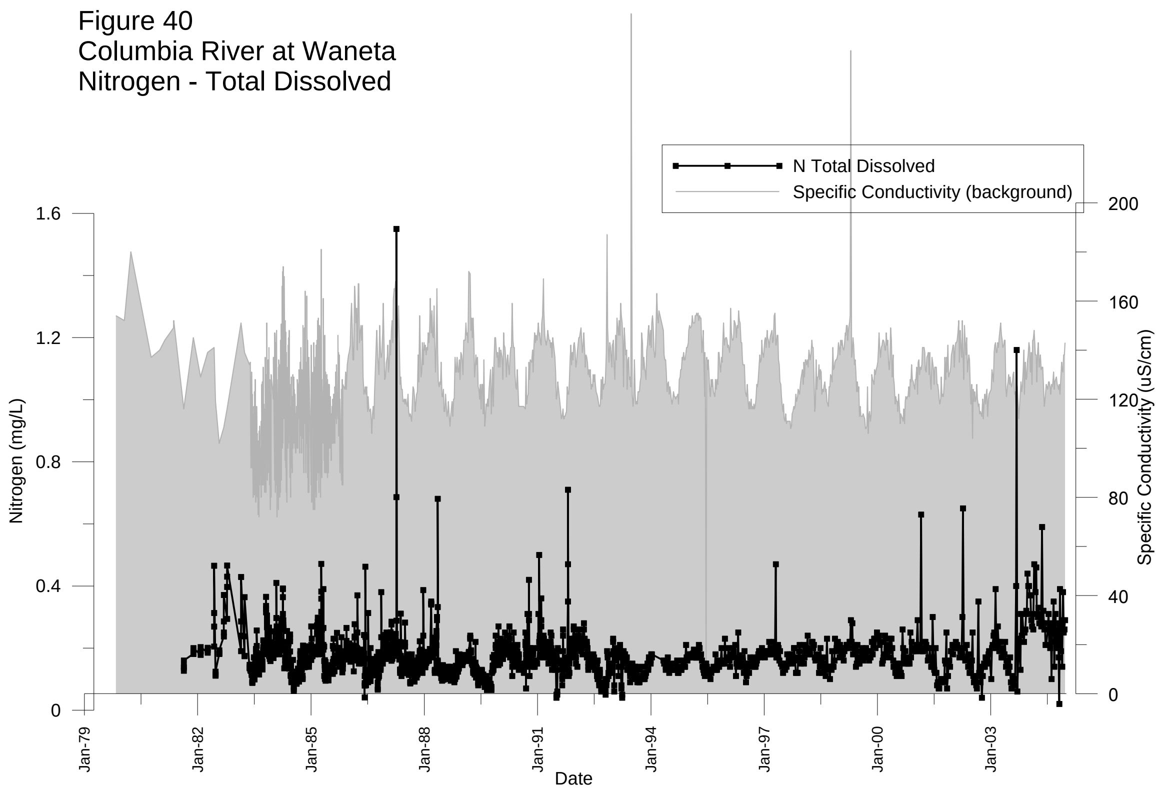


Figure 41
Columbia River at Waneta
Nitrogen - Dissolved Nitrate

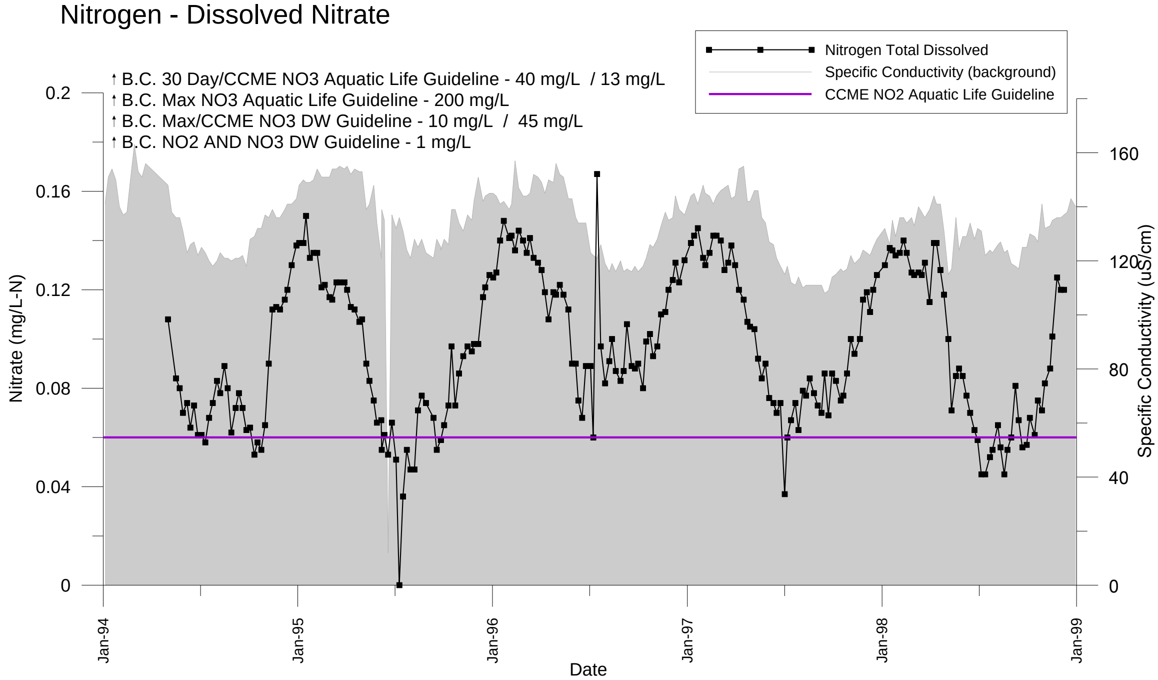


Figure 42
Columbia River at Waneta
Nickel - Total and Extractable
1987 - 2005

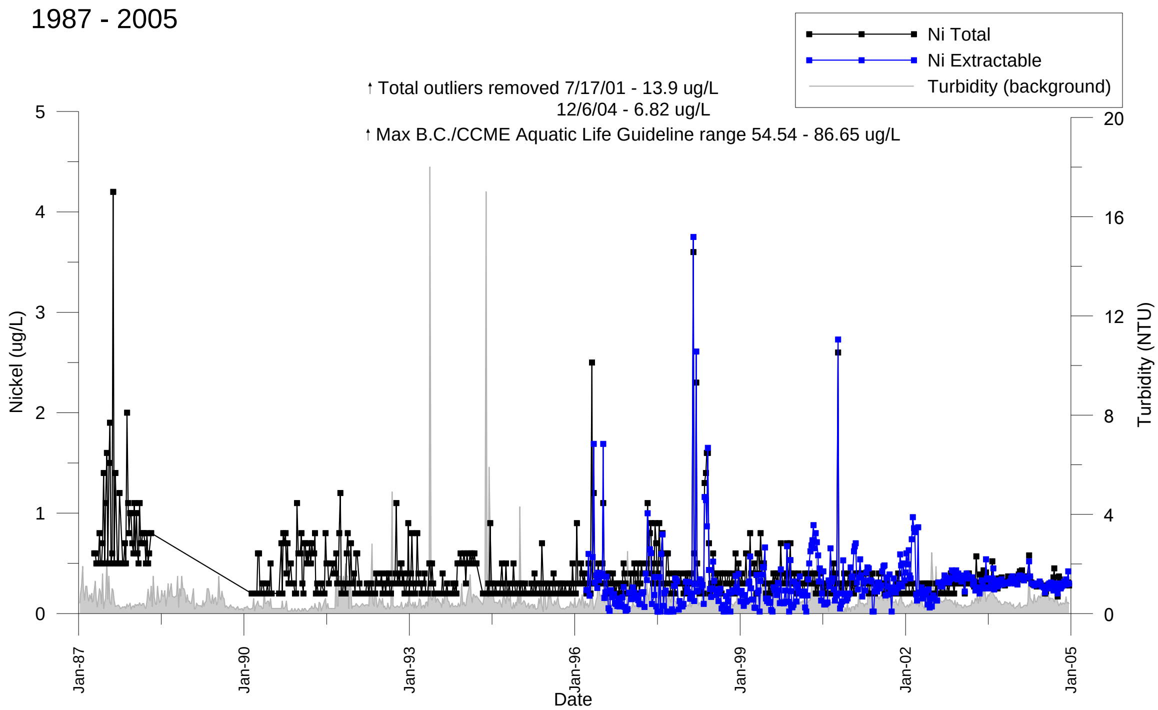


Figure 43
Columbia River at Waneta
Niobium - Extractable

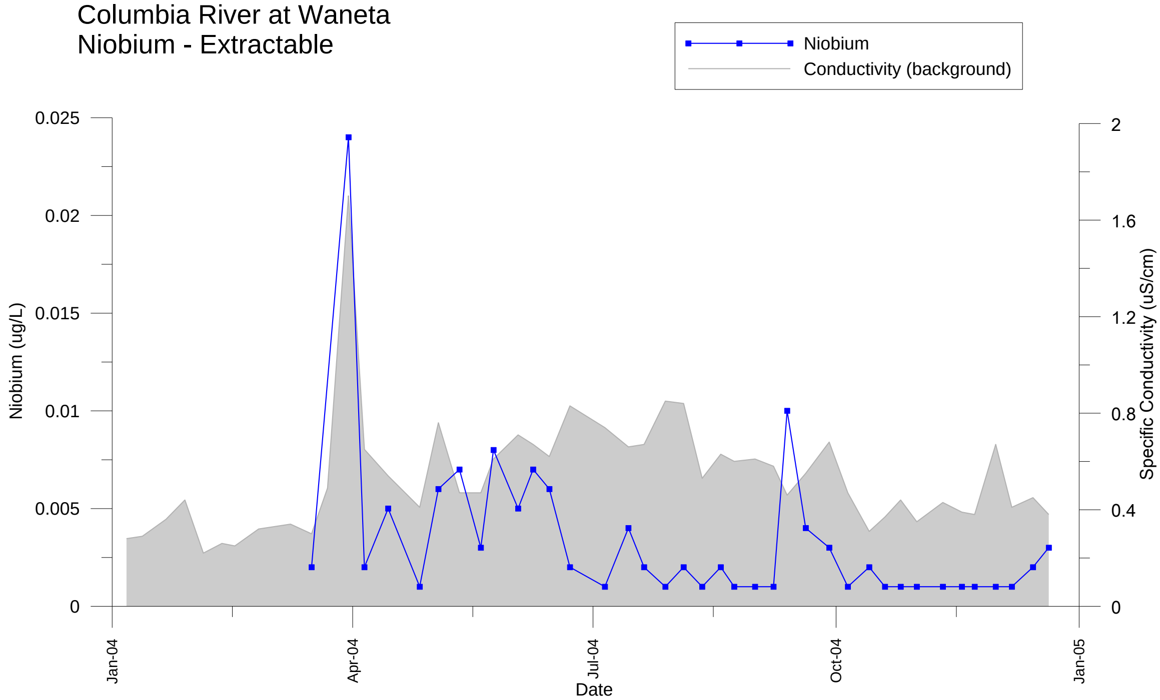


Figure 44
Columbia River at Waneta
Phosphorus - Total
1979 - 2003

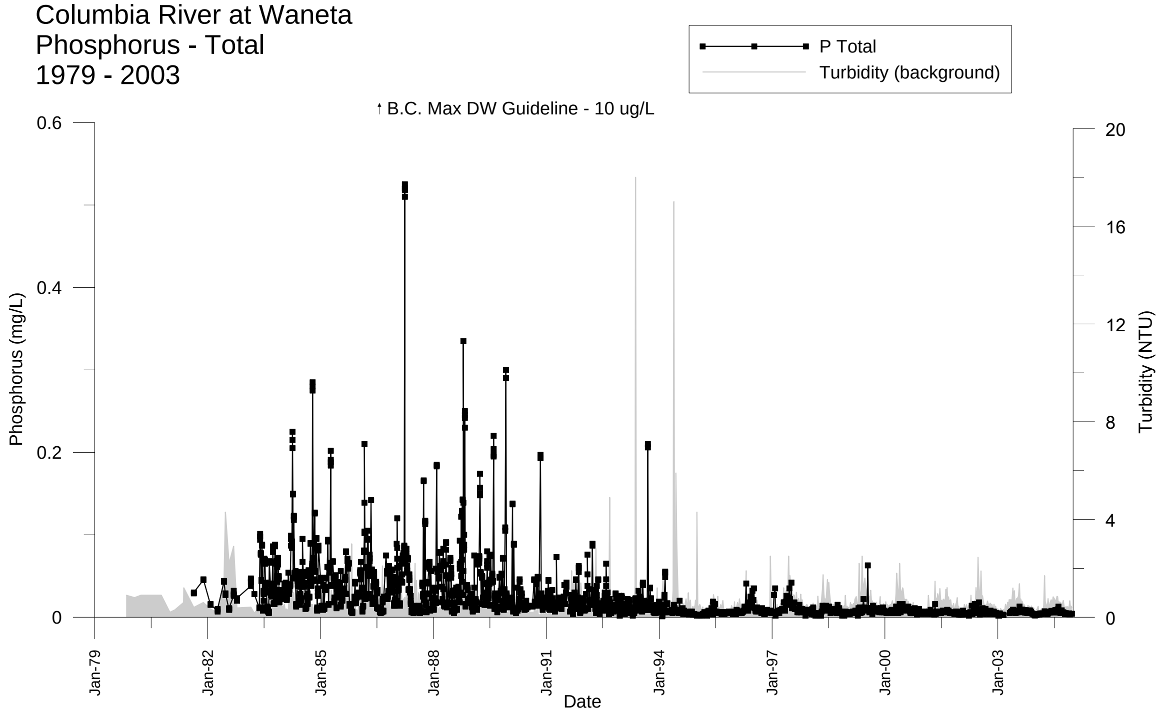


Figure 45
Columbia River at Waneta
Phosphorus - Total
2003 - 2005

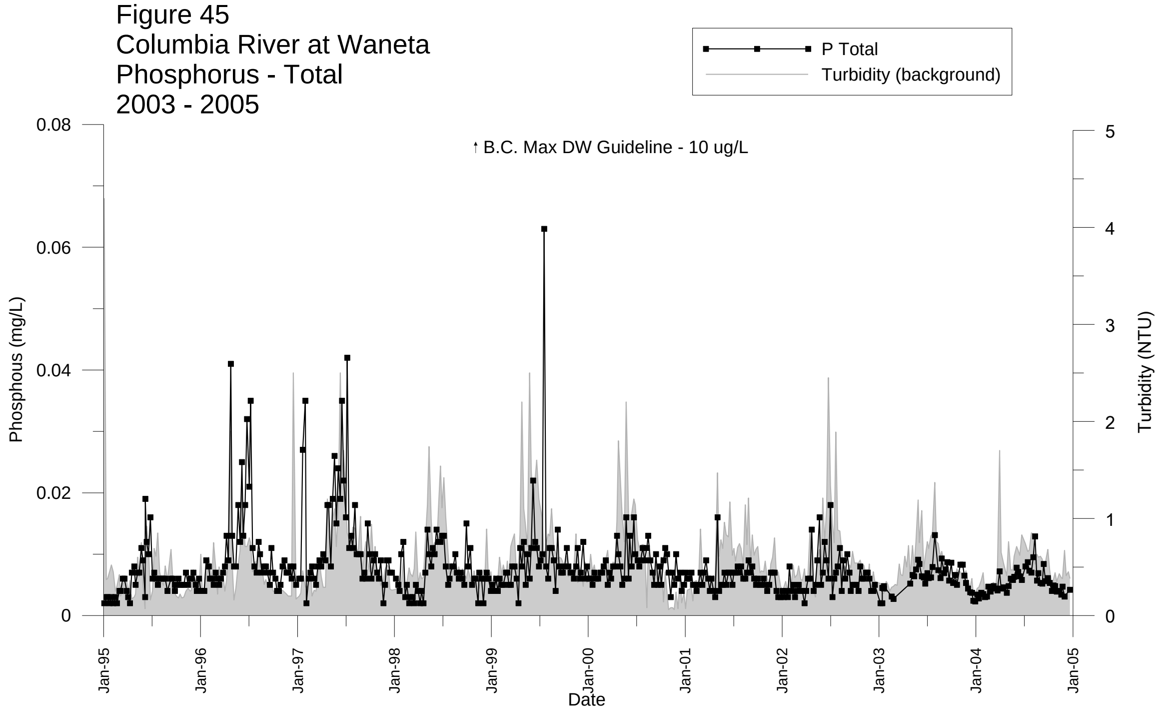
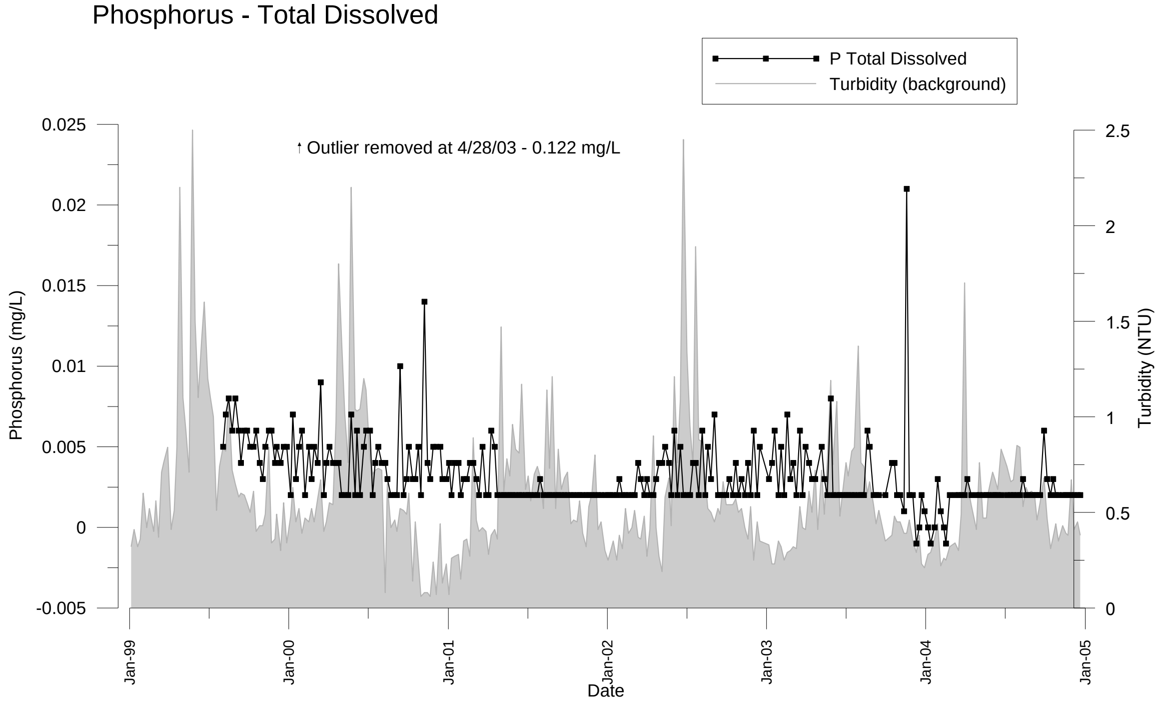


Figure 46
Columbia River at Waneta
Phosphorus - Total Dissolved



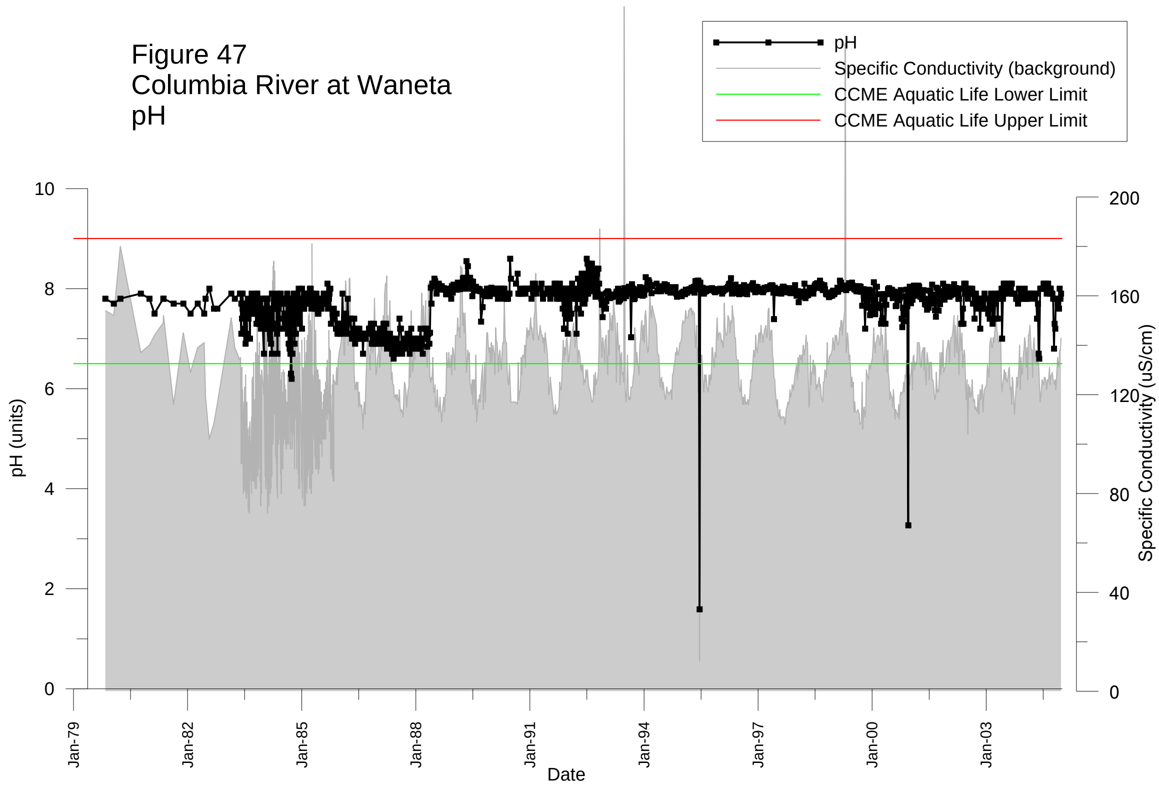


Figure 47
Columbia River at Waneta
pH
pH
Specific Conductivity (background)
CCME Aquatic Life Lower Limit
CCME Aquatic Life Upper Limit
pH (units)
Specific Conductivity (uS/cm)
Date
Jan-79
Jan-82
Jan-85
Jan-88
Jan-91
Jan-94
Jan-97
Jan-00
Jan-03

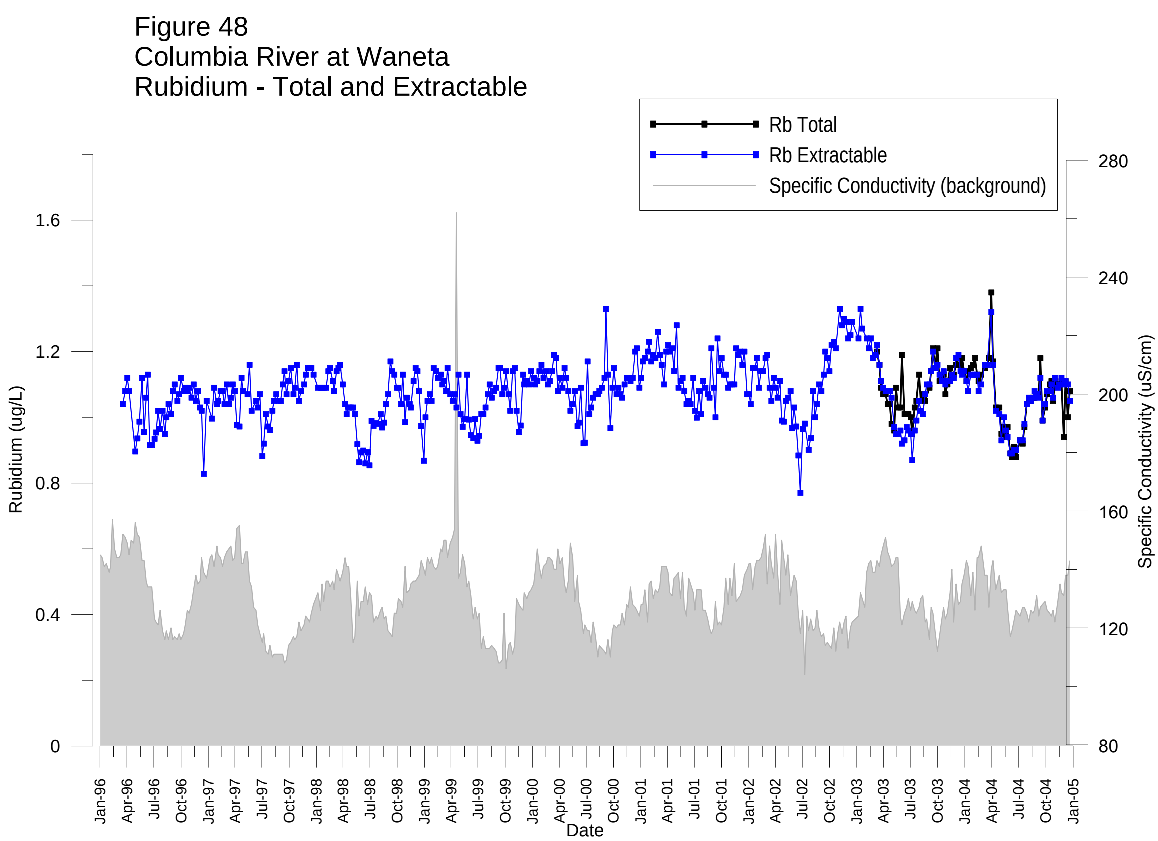


Figure 48
Columbia River at Waneta
Rubidium - Total and Extractable
Rb Total
Rb Extractable
Specific Conductivity (background)
Rubidium (ug/L)
Specific Conductivity (uS/cm)
Date

Figure 49
Columbia River at Waneta
Rubidium - Total and Extractable
2003 - 2006

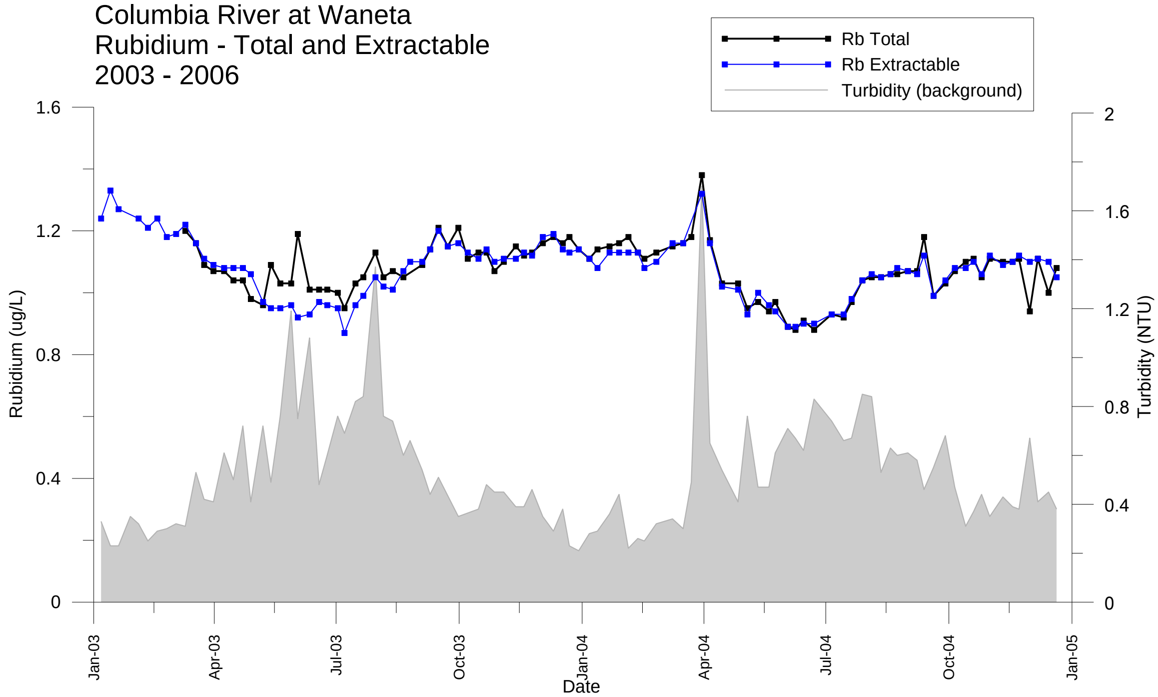
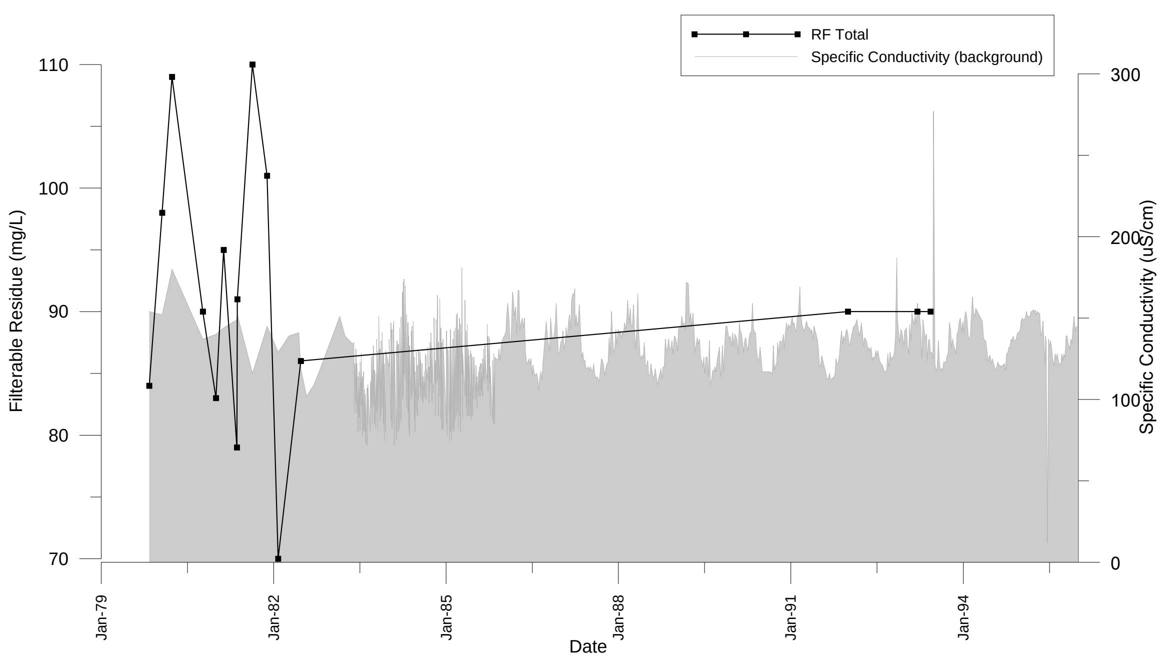


Figure 50
Columbia River at Waneta
Residue - Filterable



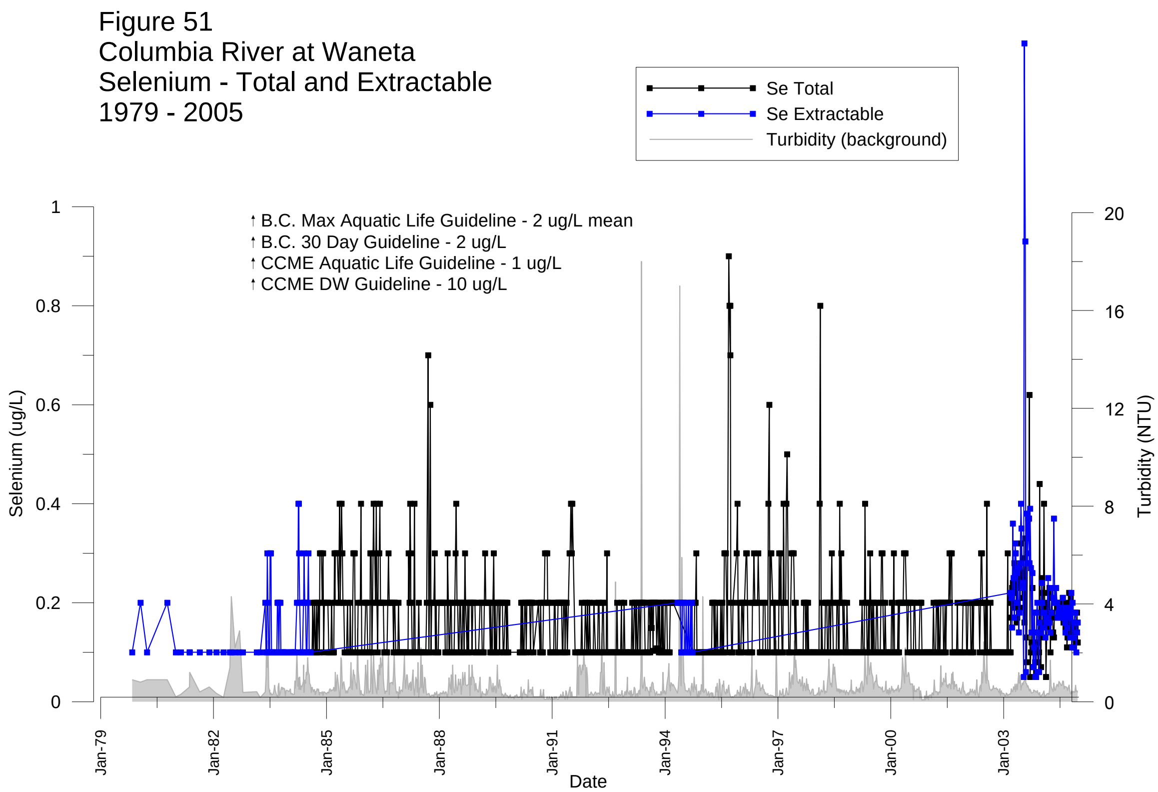


Figure 51
Columbia River at Waneta
Selenium - Total and Extractable
1979 - 2005
Se Total
Se Extractable
Turbidity (background)
↑ B.C. Max Aquatic Life Guideline - 2 ug/L mean
↑ B.C. 30 Day Guideline - 2 ug/L
↑ CCME Aquatic Life Guideline - 1 ug/L
↑ CCME DW Guideline - 10 ug/L
Selenium (ug/L)
Turbidity (NTU)
Date
0
0.2
0.4
0.6
0.8
1
4
8
12
16
20
Jan-79
Jan-82
Jan-85
Jan-88
Jan-91
Jan-94
Jan-97
Jan-00
Jan-03

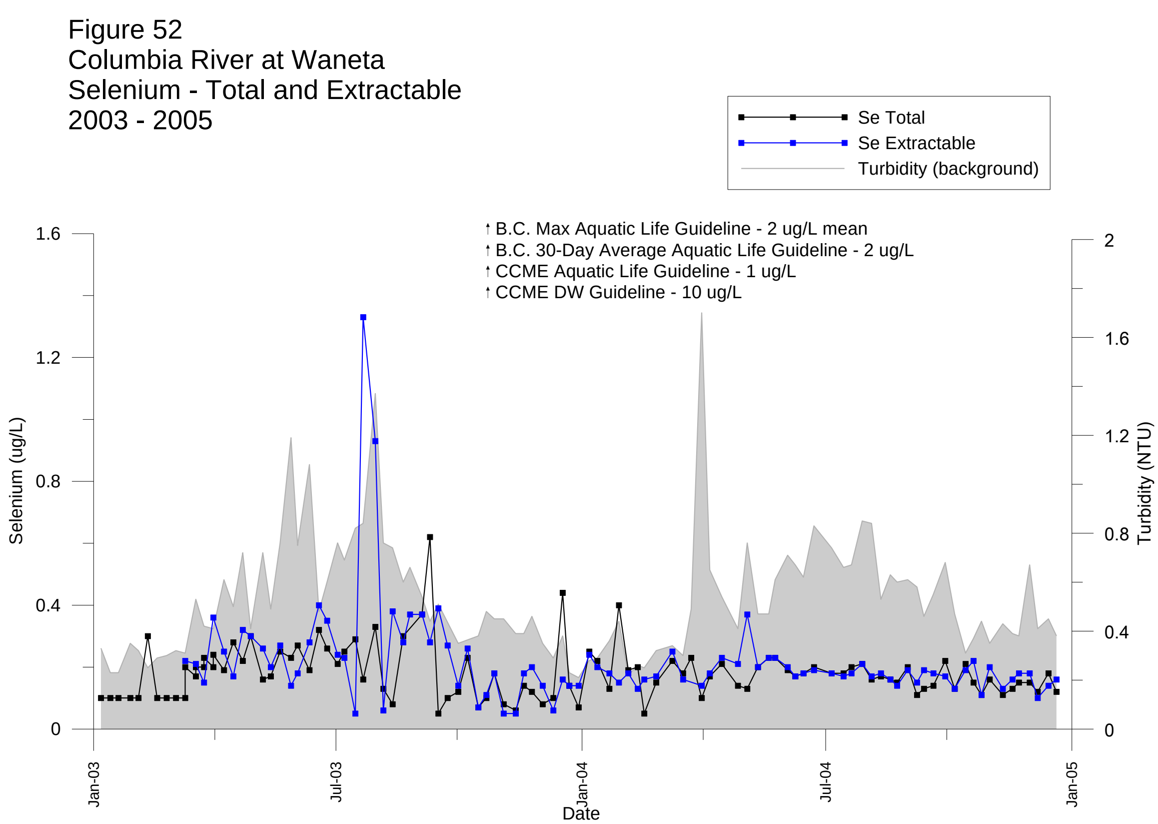


Figure 52
Columbia River at Waneta
Selenium - Total and Extractable
2003 - 2005
Se Total
Se Extractable
Turbidity (background)
↑ B.C. Max Aquatic Life Guideline - 2 ug/L mean
↑ B.C. 30-Day Average Aquatic Life Guideline - 2 ug/L
↑ CCME Aquatic Life Guideline - 1 ug/L
↑ CCME DW Guideline - 10 ug/L
Selenium (ug/L)
Turbidity (NTU)
Date
0
0.4
0.8
1.2
1.6
2
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05

Figure 53
Columbia River at Waneta
Silicon - Extractable

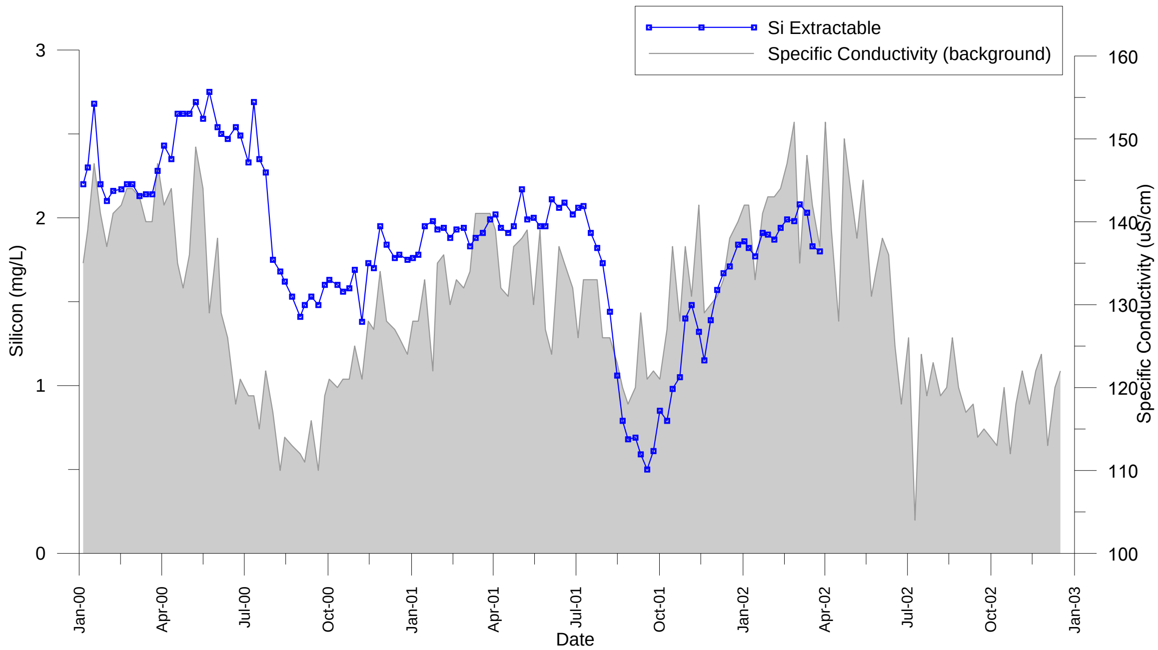


Figure 54
Columbia River at Waneta
Silica - Reactive and Dissolved

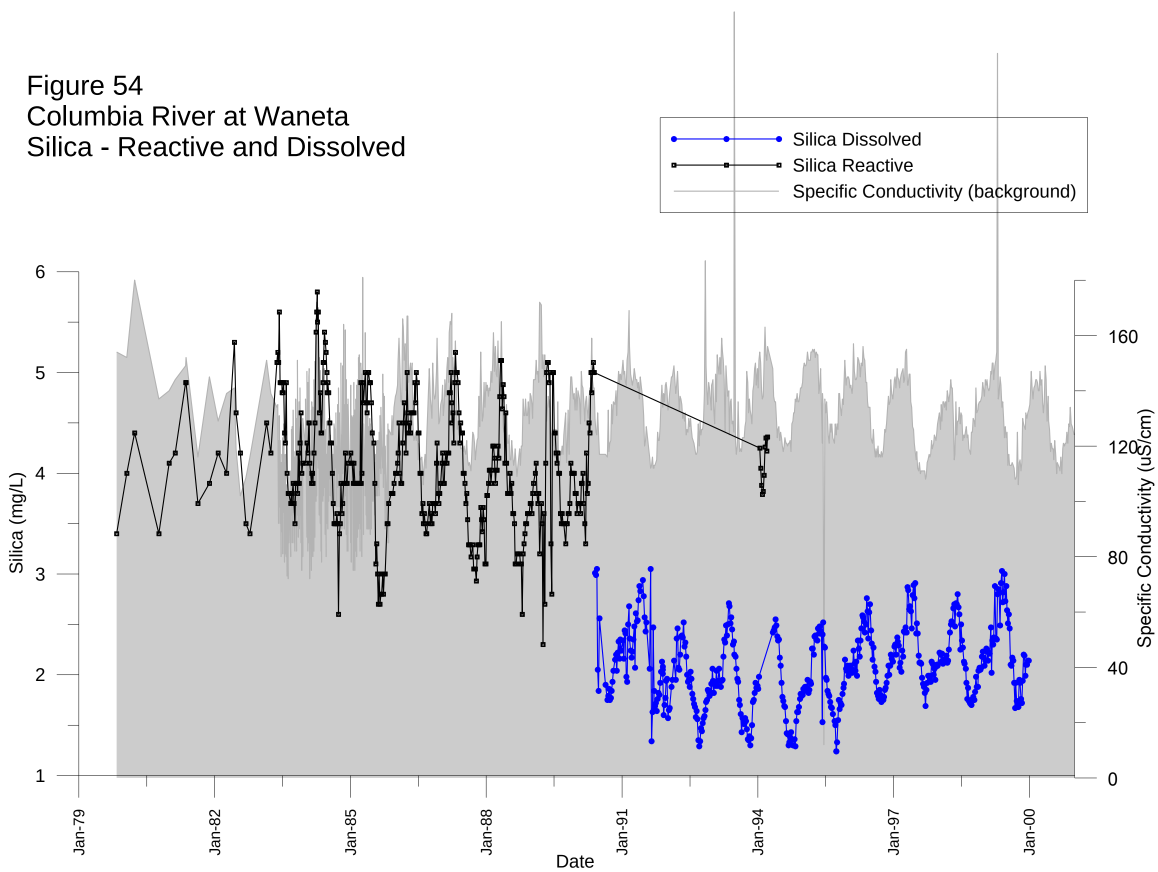


Figure 55
Columbia River at Waneta
Silver - Total and Extractable

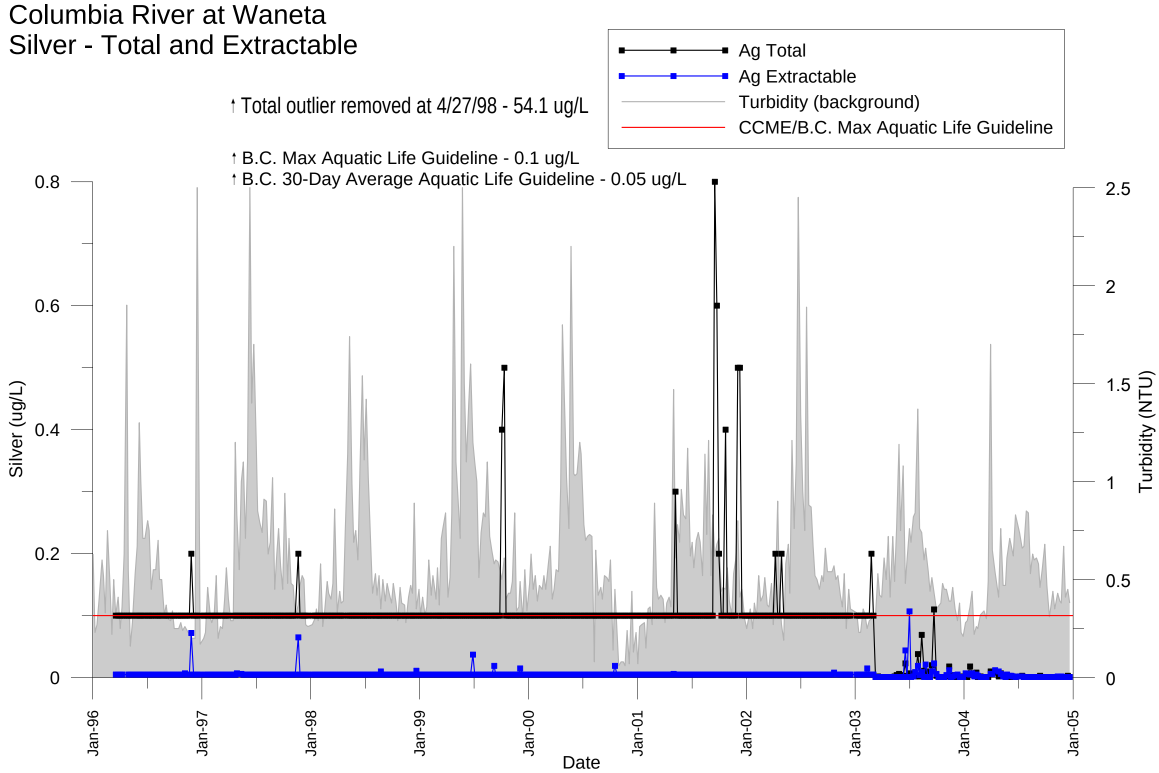


Figure 56
Columbia River at Waneta
Silver - Total and Extractable
2003 - 2005

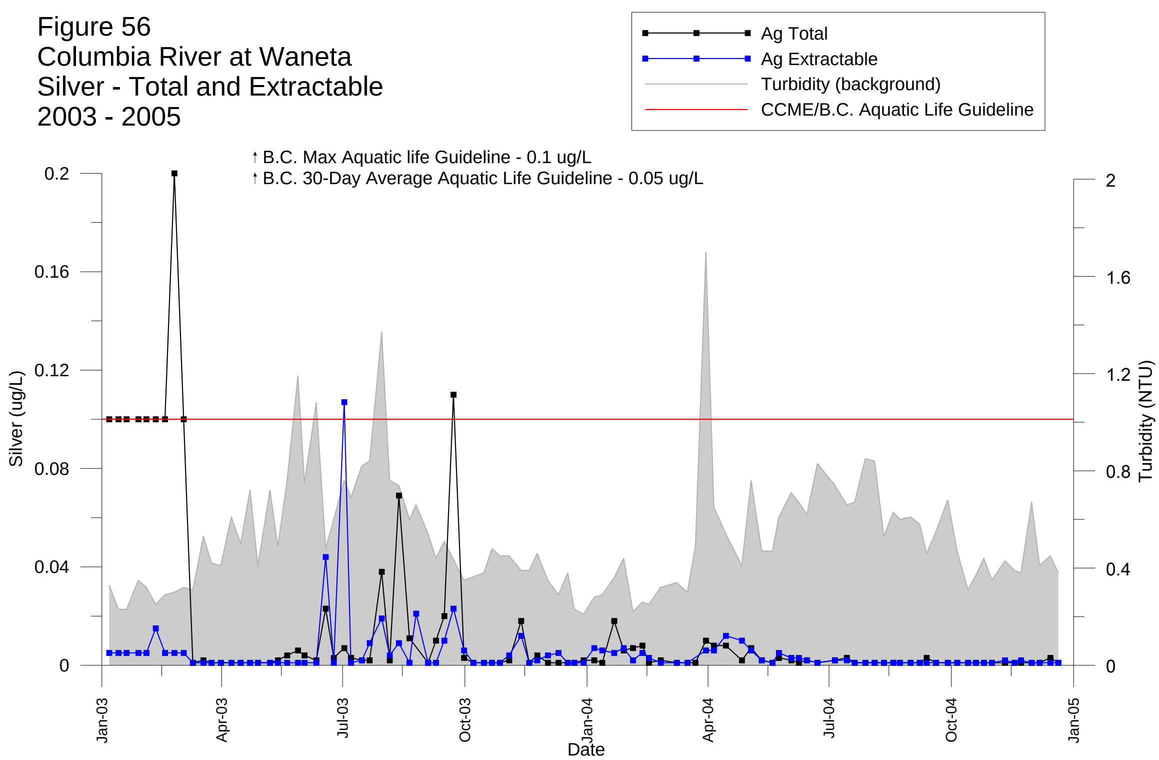


Figure 57
Columbia River at Waneta
Sodium - Dissolved and Extractable

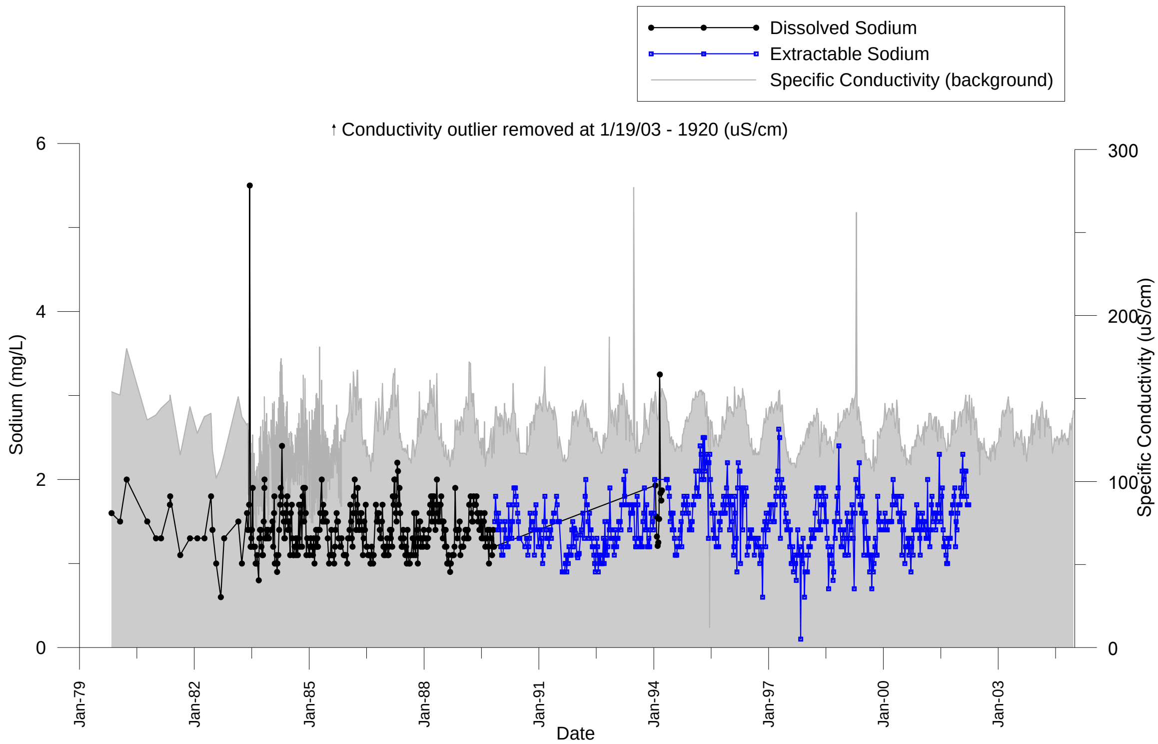


Figure 58
Columbia River at Waneta
Specific Conductivity

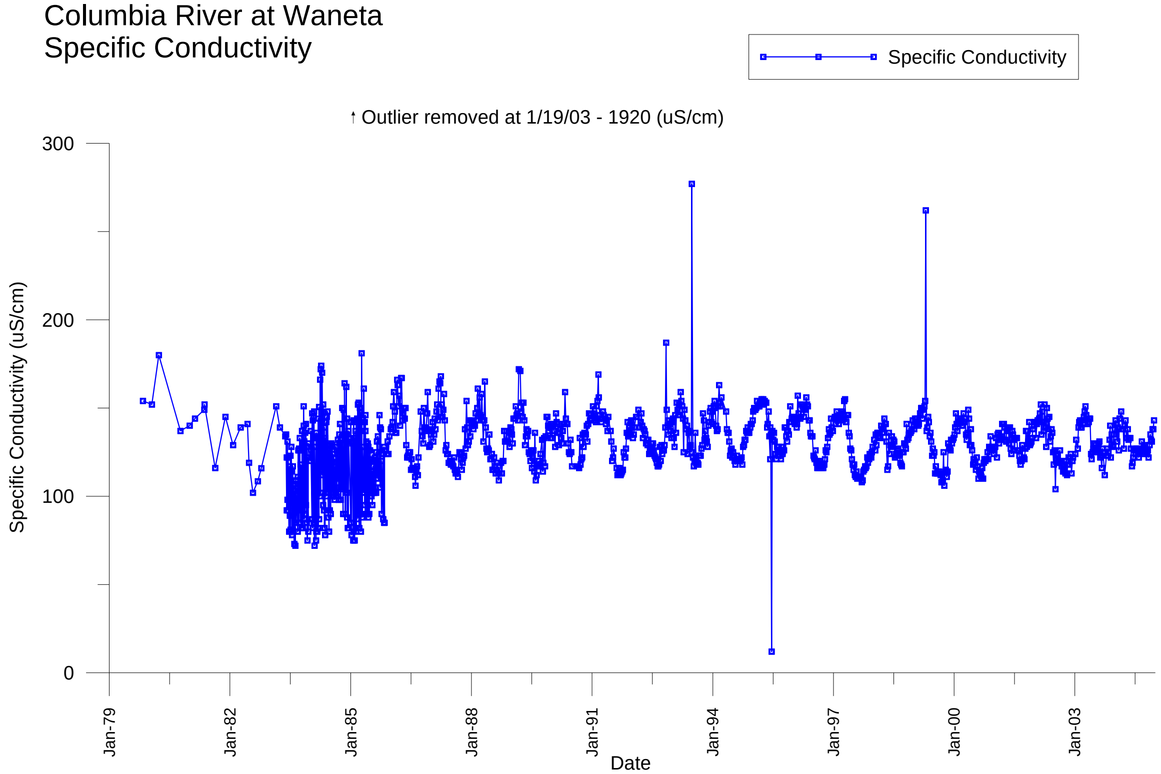


Figure 59
Columbia River at Waneta
Strontium - Total and Extractable
1989 - 2005

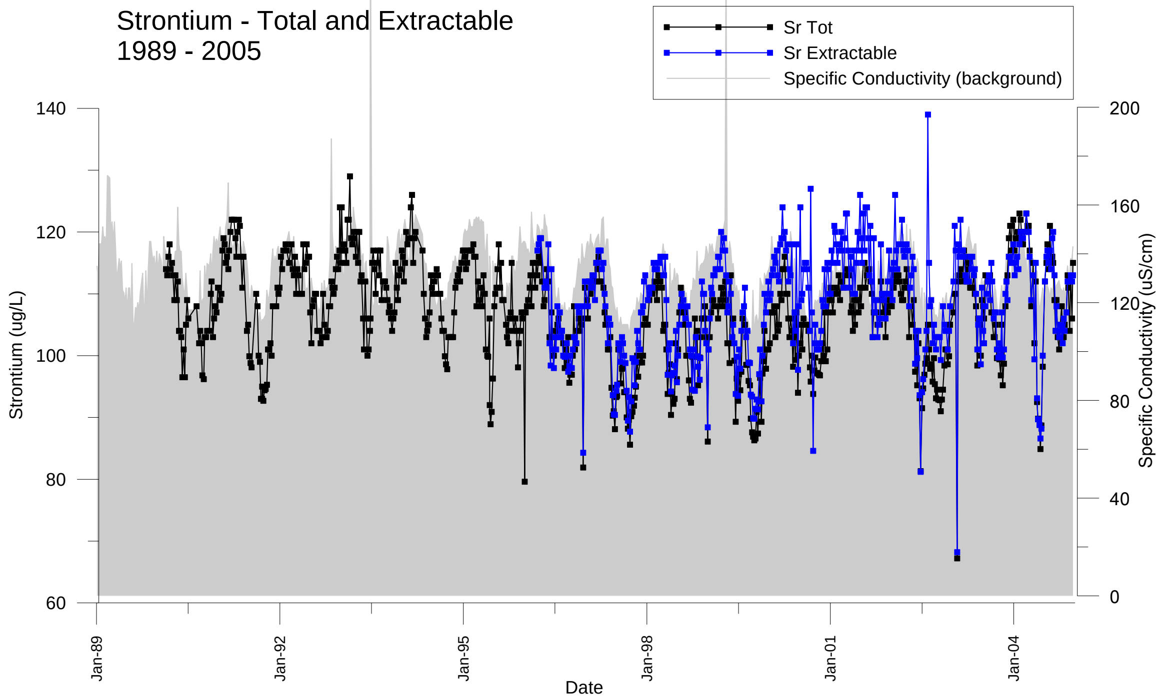


Figure 60
Columbia River at Waneta
Temperature - Air and Water

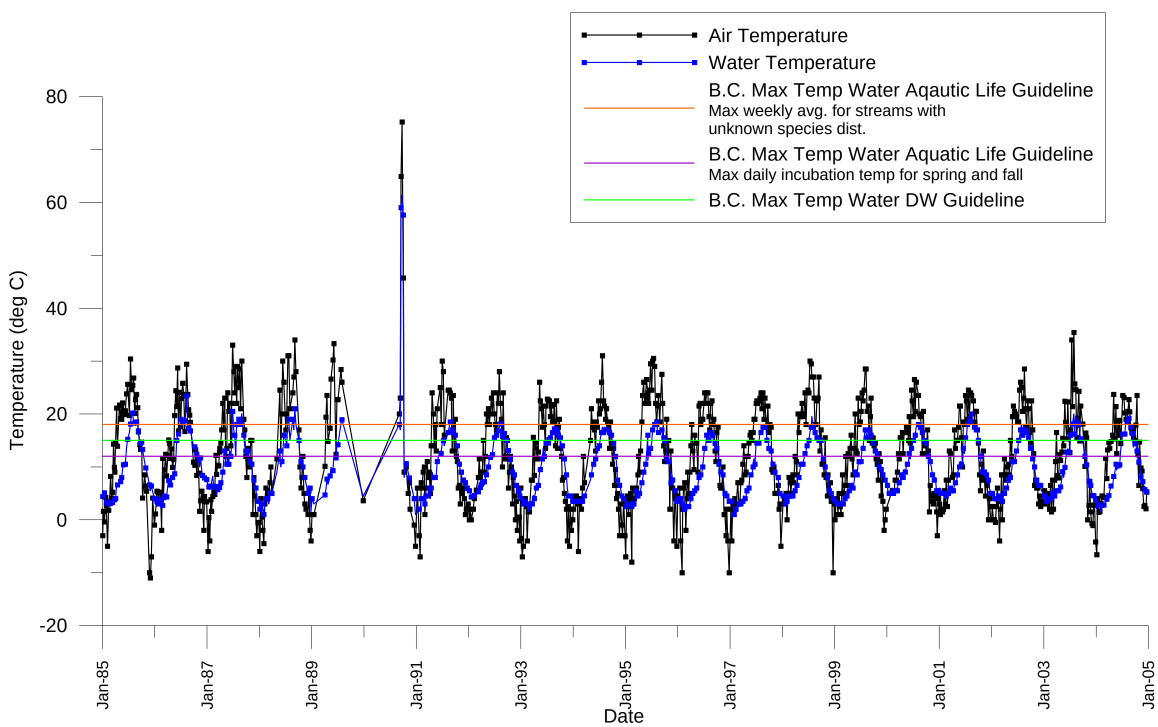


Figure 61
Columbia River at Waneta
Tin - Total and Extractable

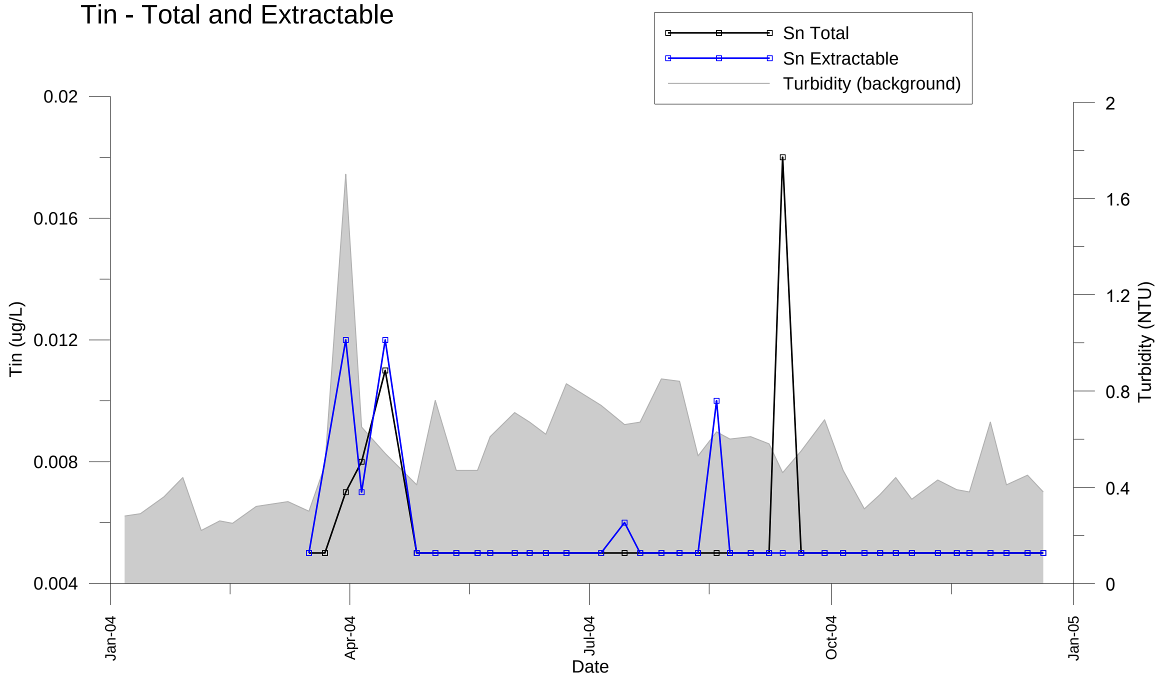
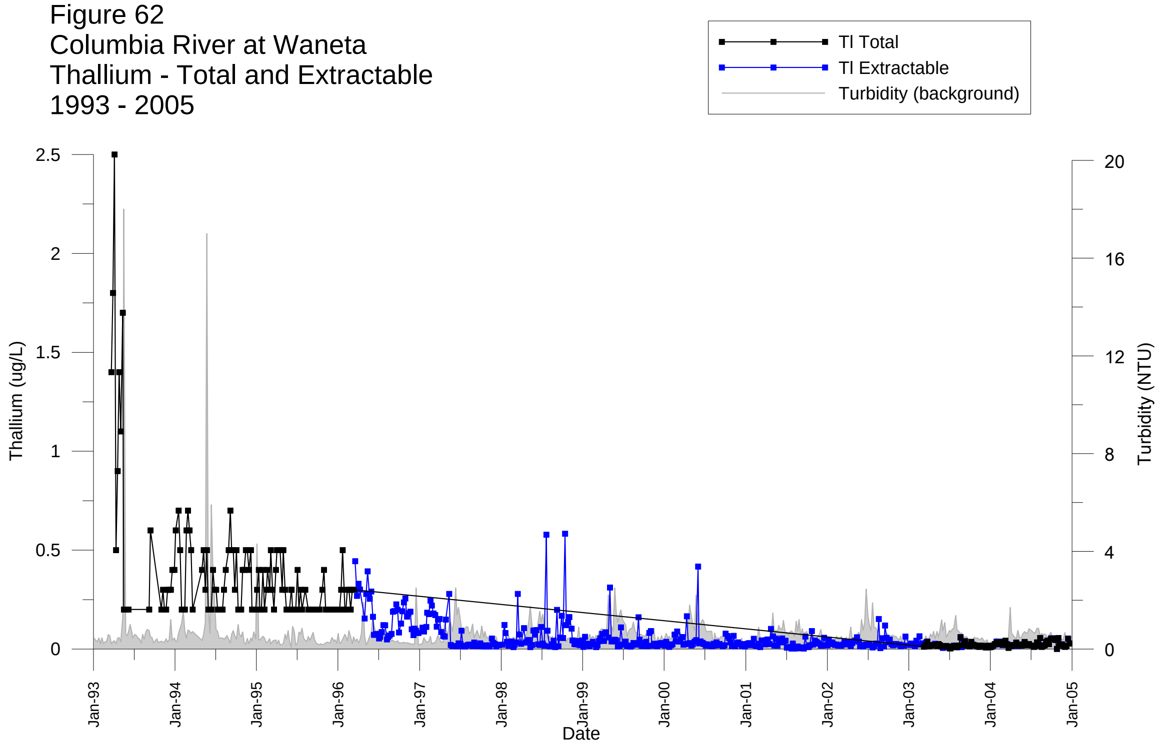


Figure 62
Columbia River at Waneta
Thallium - Total and Extractable
1993 - 2005



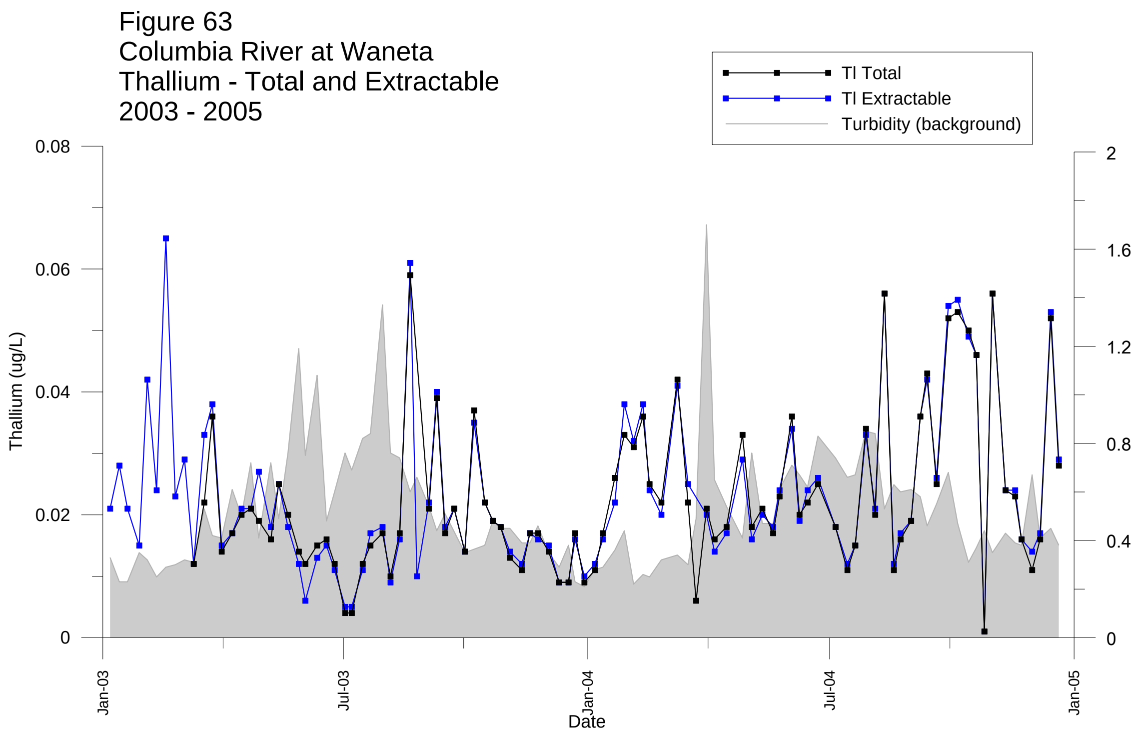


Figure 63
Columbia River at Waneta
Thallium - Total and Extractable
2003 - 2005
Tl Total
Tl Extractable
Turbidity (background)
Thallium (ug/L)
Turbidity (NTU)
0.08
0.06
0.04
0.02
0
2
1.6
1.2
0.8
0.4
0
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Date

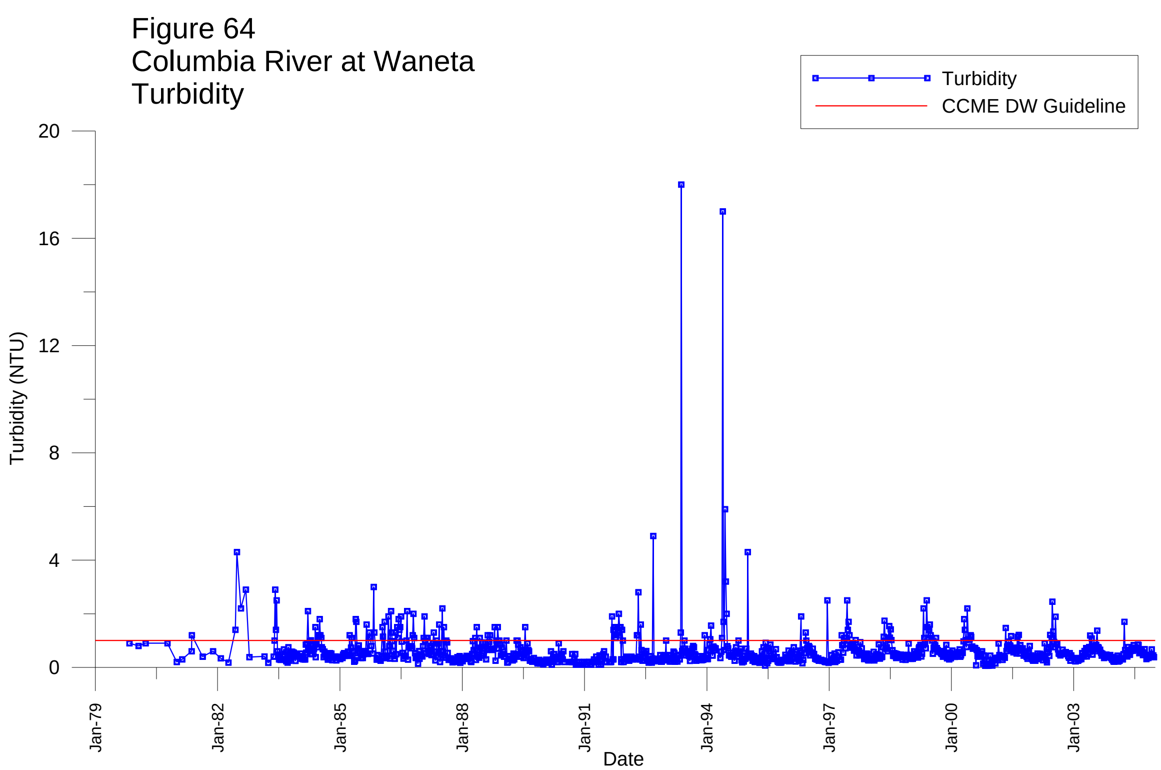


Figure 64
Columbia River at Waneta
Turbidity
Turbidity
CCME DW Guideline
Turbidity (NTU)
20
16
12
8
4
0
Jan-79
Jan-82
Jan-85
Jan-88
Jan-91
Jan-94
Jan-97
Jan-00
Jan-03
Date

Figure 65
Columbia River at Waneta
Uranium - Total and Extractable
1996 - 2005

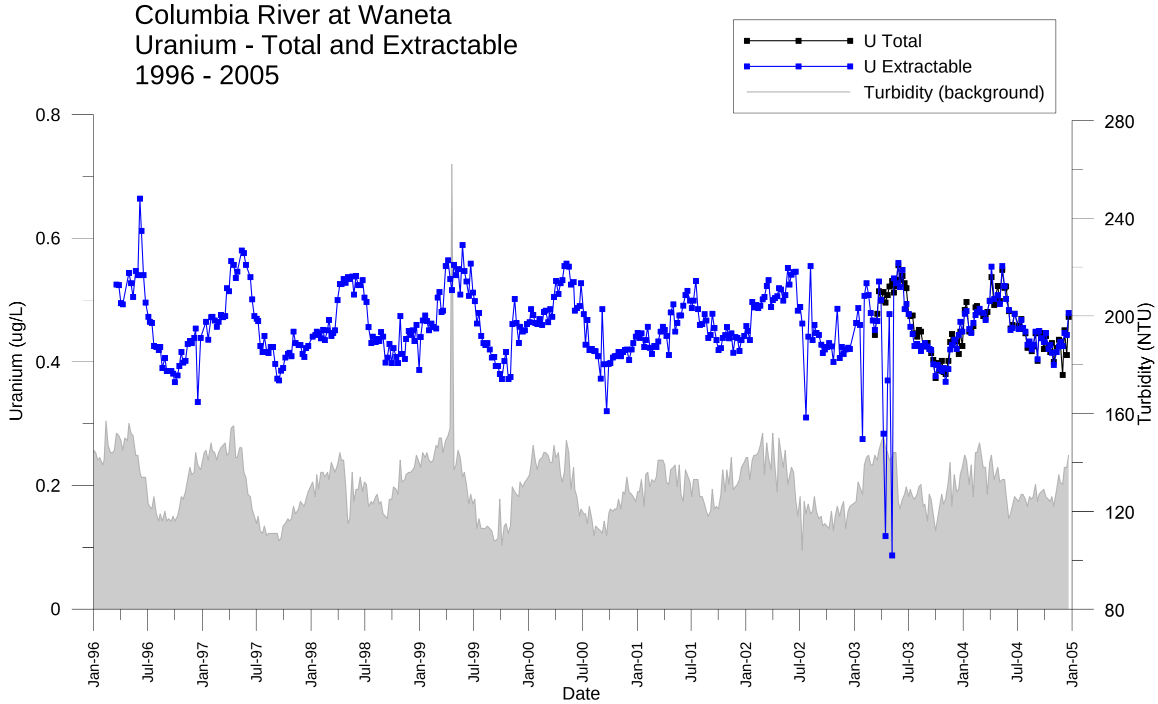


Figure 66
Columbia River at Waneta
Uranium - Total and Extractable
2003 - 2005

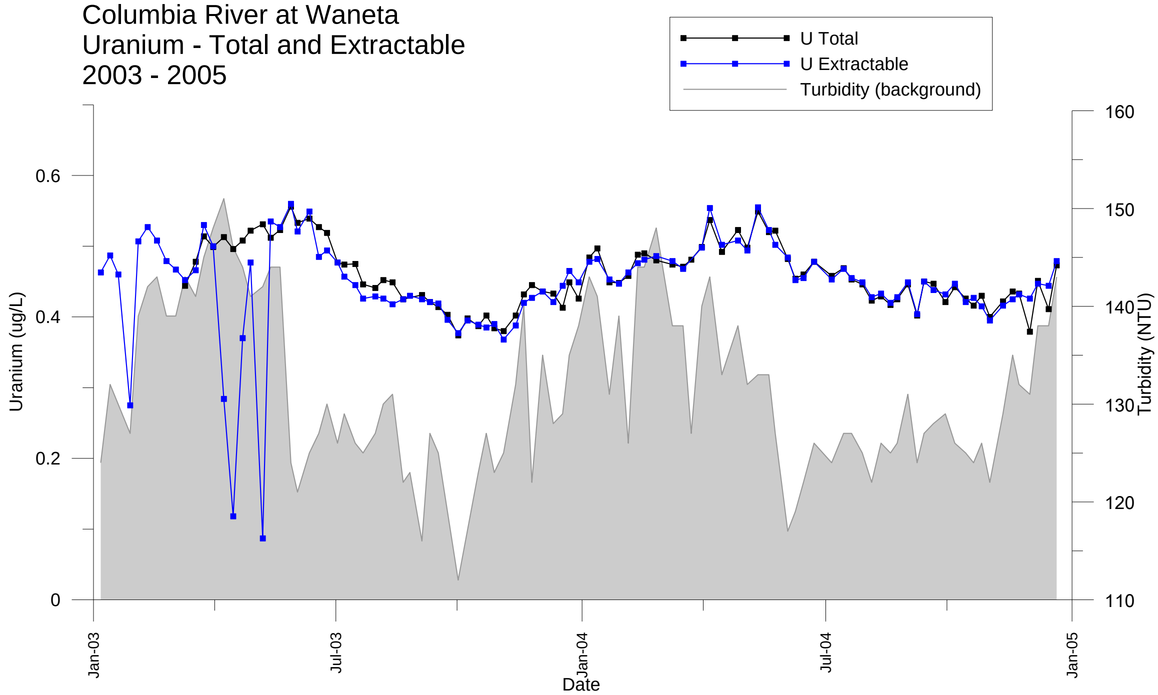


Figure 67
Columbia River at Waneta
Vanadium - Total and Extractable
1990 - 2005

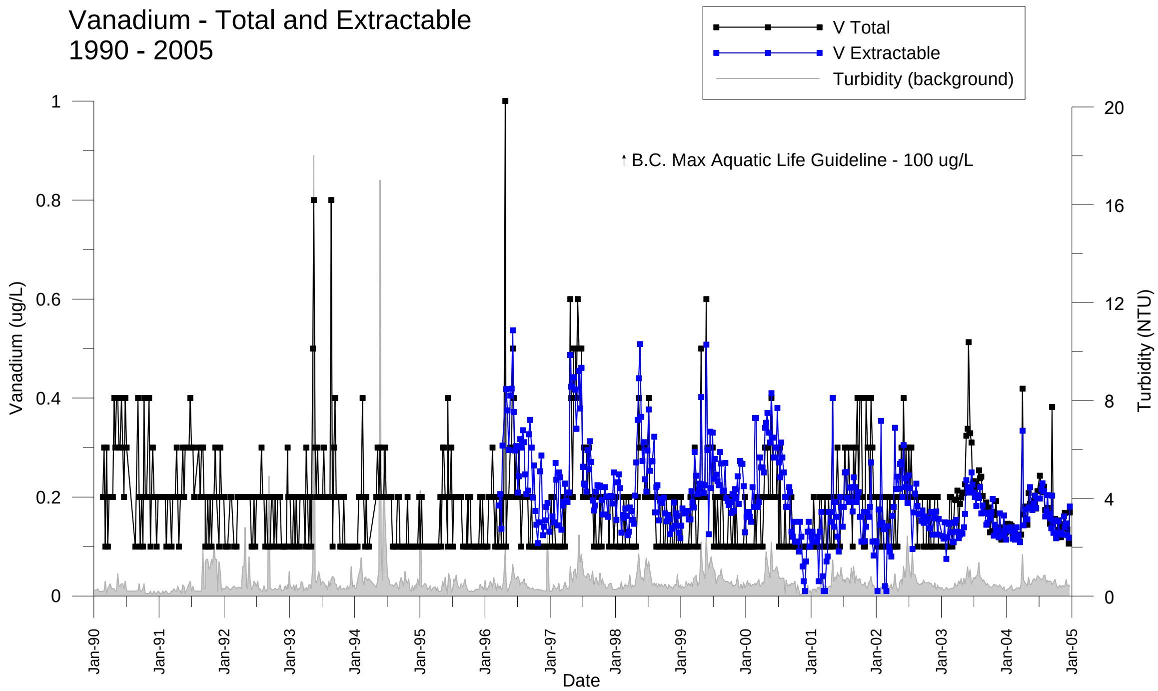


Figure 68
Columbia River at Waneta
Vanadium - Total and Extractable
2003 - 2005

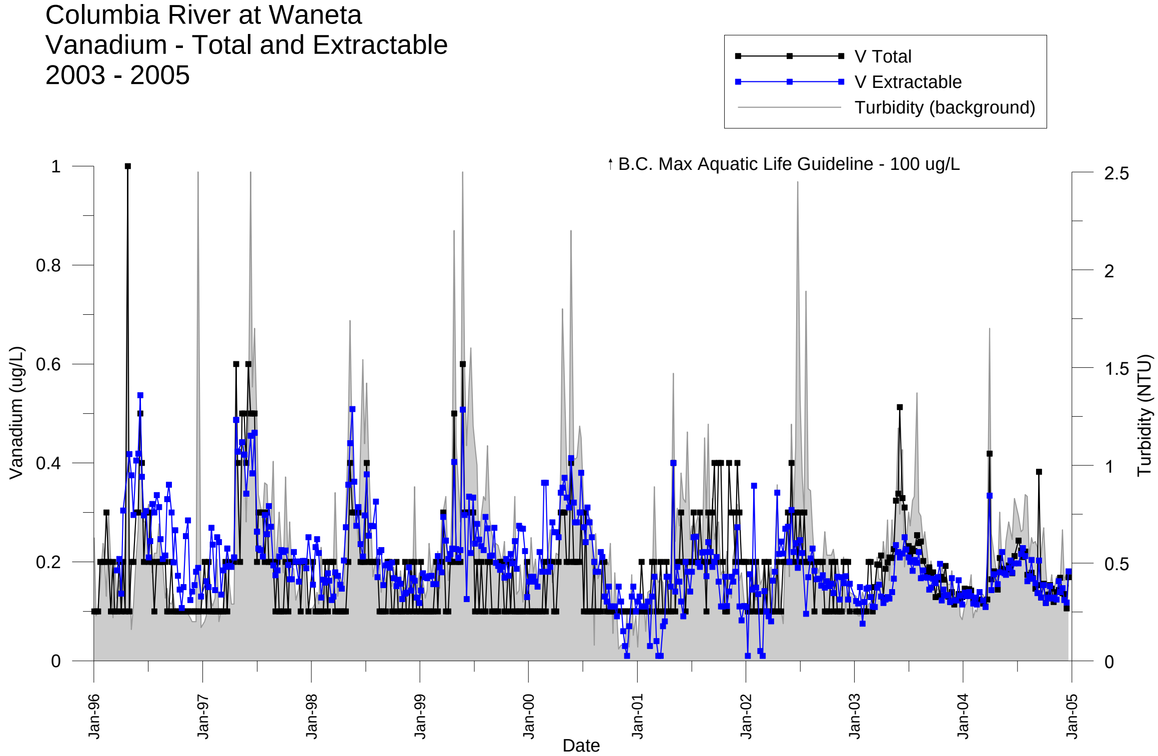


Figure 69
Columbia River at Waneta
Zinc - Total and Extractable
1979 - 2003

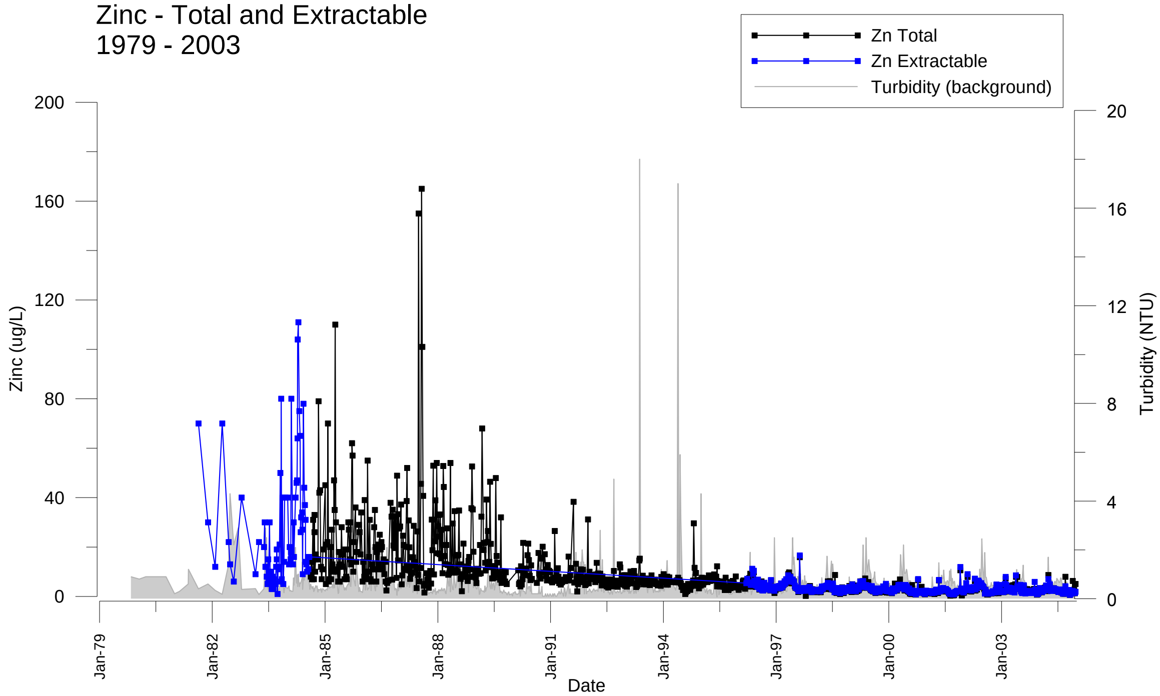


Figure 70
Columbia River at Waneta
Zinc - Total and Extractable
1995 - 2005