Environmental Monitoring and Analysis Branch

Ministry of Environment and Parks

Cowichan Bay and Tributaries 2022 Water Quality Objectives Attainment Report

June 2026

Purpose

Cowichan Bay and tributaries water quality data collected in 2022 were compared to site-specific provisional Water Quality Objectives (WQOs) to determine whether the objectives were met for the protection of the most sensitive uses in the marine and freshwater environments. Temporal differences were assessed by comparing the data from 2012 and 2017 to the 2022 data.

Introduction

Cowichan Bay is located near the City of Duncan about 40 km north of Victoria on Vancouver Island and lies within the traditional lands of Cowichan Tribes. Numerous freshwater tributaries flow into the bay including the Cowichan and Koksilah rivers, which run through heavily populated areas including the City of Duncan. Population growth was estimated to be 8% between 2018 to 2024, contributing to increased water use.

The water values to be protected in Cowichan Bay include aquatic life, wildlife, recreational and cultural uses, and shellfish harvesting. Currently the harvesting of shellfish is closed due to sanitary contamination. Indigenous nations have expressed a desire to improve water quality to restore their traditional community practice of harvesting shellfish for sustenance and cultural purposes within their territory. Freshwater tributaries in this area provide important fish and wildlife habitat, and water for human uses.

Changes since 2016 which will likely improve water quality in the watershed include the closure of the log sorting and storage facility, termination of discharge from the Chevron Canada Ltd. site, and the estuary restoration project.

Several authorized point-source discharges, mostly wastewater from municipalities and one hatchery, go to Cowichan River. One municipal wastewater facility discharges to Cowichan Bay. While many float homes in Cowichan Bay discharge untreated domestic sewage directly to the bay, constituting unauthorized point-source inputs.

***Figure 1**. Cowichan Bay marina float homes, Vancouver Island, B.C.*

The primary water quality concerns relate to point-source inputs of marinas and float home sewage (Hemmera, 2013) to Cowichan Bay. Possible contamination to the bay and its tributaries can also come from non-point-source inputs from residential developments and agricultural activities such as urban and agricultural runoff, septic fields, fertilizers, and pesticides. Commercial and industrial land use, and forestry related activities can also contribute non-point-source pollution.

The goal of the water quality objectives is to provide benchmarks to maintain existing water values and uses, and to improve water quality for future uses such as bivalve shellfish harvesting.

2022 Water Quality Monitoring Program

Water quality data collected during the 2022 sampling program were compared to provisional WQOs (Obee, 2011 and Prov. of BC, 2023) to provide a snapshot of current conditions.

The program included collecting samples at nine marine sites distributed from Genoa Bay in the north to those in proximity to the southwest shoreline from Wessex Creek to above the Lambourn sewage treatment plant, and at ten freshwater tributaries in proximity to the southwest shoreline of the bay from Treffery Creek to Manley Creek (**Appendix Figure A1 and Table A1**).

Parameters and sample frequency for the marine and freshwater tributary sites were guided by the recommended monitoring program for the Cowichan Bay and Tributaries WQOs (Smorong *et al*., 2021). Marine samples were analyzed for Enterococci and fecal coliforms with comparisons to WQOs. At freshwater tributary sites, field measurements included dissolved oxygen (DO), pH, and specific conductance, while laboratory analysis included turbidity, total phosphorus, total copper, total zinc and *Escherichia coli.* Results were compared to WQOs. Total suspended solids (TSS) were not collected, and additional parameters (chloride, other nutrients and metals, and hardness) are not discussed as there are no objectives for these parameters.

Marine water quality in Cowichan Bay was sampled five times over a 30-day period in both August–September and October–November 2022 to capture seasonal variation. The same schedule was used for the freshwater tributaries to represent low and high flow conditions with the following exceptions. During low flow conditions, no samples were collected from the storm drain at Cherry Point Marina (CB04) and Vessex Creek at Vessex Inn (CB08); Treffery Creek at the Hwy Crossing (CB12) was sampled once and no DO was collected; and only three (instead of five) DO measurements were collected at all tributary sites. During the high flow conditions two sampling were collected at CB04, and four DO measurements were collected at (CB12).

Water Quality Objective Attainment

The following sections provide information about the 2022 results compared to the WQO for the marine waters of Cowichan Bay (**Table 1**) and the provisional WQO for the freshwater tributaries (**Table 2**).

Table 1. WQO attainment summary for microbiological indicators at Cowichan Bay marine sites, 2022.

Parameter	WQO	Marine Sites								
		Genoa Bay		Shoreline at Cowichan Bay Boat Launch	Float home marina				Near Botwood Lane storm drain	Above Lambourn STP
		CB001	CB057	1P3	CB062	CB063	CB064	CB065	CB039	10P3
Fecal coliforms- bivalve shellfish harvesting	≤14 MPN/100 mL[1]									
	≤43 MPN/100 mL[2]									
Enterococci – recreational and cultural uses	≤35 CFU **or** MPN/100 mL[1]									
	≤70 CFU **or** MPN/100 mL[3]									

[1] applies seasonal geomean of 5 samples in 30 days
[2] applies to the 90th percentile of all values
[3] applies to single sample maximum values

Legend
Summer- top left; Fall- bottom right
WQO not met
WQO met

In 2022, the Shoreline at Cowichan Bay Boat Launch (IP3) and the site above Lambourn STP (10P3) consistently met the WQO for microbiological indicators. The Float home marina locations demonstrate poor overall attainment for microbiological indicators. Genoa Bay (CB001, BC057) and the storm drain near Botwood Lane (CB039) demonstrated variable water quality, with WQO attainment rates of 50% and 37%, respectively.

Table 2. Attainment summary for provisional WQO parameters at freshwater tributary sites, 2022.

Parameter	Provisional WQO	Tributary Sites									
		Manly Creek at Manley Creek Park	Garnett Creek at Cherry Point Beach	Garnett Creek at Telegraph Road	Storm Drain at Cherry Point marina	Storm drain at Botwood Lane	Vessex Creek at Vessex Inn	Spiers Creek at Cowichan Bay Road	Spiers Creek at Hillbank Road	Treffery Creek at Hwy Crossing	Treffery Creek at Cowichan Bay Road
		CB01	CB02	CB03	CB04	CB07	CB08	CB10	CB11	CB12	CB13
Escherichia coli drinking water	≤10 CFU/100 mL [1]				ND		ND			ND	
Dissolved oxygen – aquatic life	≥8 mg/L [2]	ND	ND	ND	ND	ND	ND	ND	ND	ND	
	≥5 mg/L [3]				ND		ND			ND	
Turbidity – drinking water	<2 NTU (May-Sep) [4] <5 NTU (Oct-Apr) [4]				ND		ND				
Total phosphorus – aquatic life	≤5 µg/L [5,6] (May-Sept)				ND		ND			ND	
	≤10 µg/L [4]				ND		ND				
Total copper	≤2 µg/L [2]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	≤4 µg/L [3]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total zinc	≤7.5 µg/L [2]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	≤33 µg/L [3]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

[1] seasonal 90th percentile of 5 sample results in 30 days

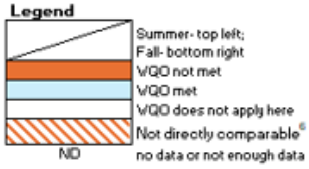
[2] the average of 5 sample results in 30 days

[3] instantanious maximum or minimum sample result at any time

[4] instantanious maximum sample result in identified period

[5] WQO is an average of 5 monthly sample results May to Sept.; <20% of results to exceed this value

[6] 2022 data average is 5 weekly sample collected Aug-Sept; not a direct comparison to WQO



Where sufficient data were collected from freshwater tributary sites in 2022 to assess WQO attainment, Vessex Creek (CB08) and Spiers Creek at Cowichan Bay Rd (CB10) exhibited high attainment (>65%) with moderate to high data availability. Manley Creek (CB01), Garnett Creek at Chery Point Beach (CB02), storm drain at Cherry Point Marina (CB04), storm drain at Botwood Lane (CB07), and Treffery Creek at Cowichan Bay Rd (CB13) showed moderate attainment (40–64%) with generally robust datasets, although data for CB04 were limited. Sites Garnett Creek at Telegraph Rd. (CB03), Spiers Creek at Hill Bank Rd. (CB11), and Treffery Creek at Hwy Crossing (CB12) had adequate data but low attainment (<31%). Overall, attainment was moderate, with fewer than half of assessed objectives met in 2022.

Marine and Freshwater Microbiological Indicators

Objectives for microbial indicators were not typically met in either the marine or tributary environments.

In late summer and fall 2022, excess fecal coliforms and Enterococci in Cowichan Bay's marine waters and *Escherichia coli (E. coli)* in its freshwater tributaries, were prevalent. The exceptions were the marine shoreline at Cowichan Bay boat launch and above the Lambourn sewage treatment plant (STP) where WQOs to protect bivalve shellfish harvesting and recreational and cultural uses were consistently met.

The presence of *E. coli*, a species of bacteria that constitutes most fecal coliforms in water, typically indicates fecal contamination and the potential for health risks to humans utilizing the water (Prov. of BC, 2023).

Comparing the 90th percentile of *E. coli* levels in fall and summer between 2012, 2017, and 2022 at all tributary sites for which sufficient samples were collected, shows that WQOs to protect drinking

water use were not met in any year, regardless of the season (**Figure A2**). These results indicate sources of fecal contamination affecting the tributary sites to Cowichan Bay persist and streams contribute microbiological contamination to Cowichan Bay although concentrations have declined.

Temporal comparisons showed that the magnitude of fall bacterial concentrations was highest in 2012 and declined in subsequent years, with further reduction in 2022 compared to 2017. Although 2022 E. coli levels were closer to the BC recreational guideline of 200 CFU/100 mL, exceedances still occurred during both late summer and fall.

Freshwater Tributary Parameters

Total Phosphorus (TP)

Phosphorus is a key nutrient for algae growth and excessive algae can lead to poor water quality for aquatic life, clog filters and impede water treatment, and in extreme cases, produce toxins that are harmful to humans and wildlife (Barlak, 2014). TP levels were recorded at eight freshwater tributary sites in the summer and ten in the fall and all sites greatly exceeded the maximum WQO (10 µg/L) for the protection of aquatic life habitat. Although the sampling frequency during the summer was reduced and prevented a direct comparison to the average WQO, the consistently high TP values suggest that the average WQO was likely exceeded during the summer as well.

Over the last three sampling periods - 2012 (Smorong *et al*., 2021), 2017 (Preikshot, 2018), and 2022 - TP concentrations have remained consistently high, failing to meet the maximum WQO established for the tributary sites (**Figure A3)** which is intended to keep nutrient levels low enough to prevent algal issues during low-flow summer periods.

Dissolved Oxygen (DO)

DO is the amount of oxygen available in water for aquatic organisms that utilize aerobic respiration. In freshwater rivers and creeks phytoplankton, aquatic plants, and algae produce oxygen during photosynthesis, increasing DO levels during the day. Aquatic organisms, including fish, invertebrates, and microorganisms consume oxygen for respiration.

In 2022, fall DO concentrations remained above the minimum WQO (5 mg/L) at all ten tributary sites and at four of seven sites in the summer where readings were collected. Exceptions occurred at both Garnett Creek sites (CB02 and CB03) on August 29th and September 19th and at Spiers Creek at Hillbank Road (CB11) on September 19th. The summer average WQO (8mg/L) was met at all sites except Garnett Creek at Telegraph Road (CB03). Despite insufficient summer data to compare with the WQO average at CB03 and CB11, it is unlikely that these sites met the objective, given the low dissolved oxygen levels recorded.

Turbidity

Turbidity, a measure of water clarity, refers to the presence of substances in water that interfere with light passage. In high flowing rivers, most turbidity is due to sediment mobilization from runoff, erosion, and turbulence scouring bottom sediments and streambanks. In low flow conditions, turbidity can result from sediment disturbance from human, wildlife or livestock activities, and from increased algae growth in warm, slow-moving waters (CWT, 2004). Total suspended solids, which quantify the amount or mass of particles in water, were not collected in 2022.

From August 22 to September 19, turbidity concentrations at Manley Creek (CB01) and Garnett Creek (CB03) consistently exceeded the instantaneous maximum WQO of 2 NTU. In contrast, Spiers Creek at Cowichan Bay Road (CB10) consistently met the summer objective with all results below 1.16 NTU. Other sites did not meet the objective on a few occasions in the summer. The number of exceedances at each site is identified in summary **Table A2a & b**.

From October 1st to April 30th, the maximum turbidity WQO is 5 NTU. On October 31st, all sites except Garnet Creek (CB02) and Spiers Creek (CB10) exceeded this limit. On November 7th measurements at Garnett Creek (CB03), Storm drain at Botwood Lane (CB07) and Spiers Creek (CB11) remained above the maximum objective. For the rest of the fall sampling period the turbidity objective was met at all sites sampled (**Table A3**). Despite the occasional exceedances, most sites had moderate average turbidity, with higher variability observed at Garnett Creek (CB03) and Treffery Creek at Cowichan Bay Road (CB13), suggesting episodic events or disturbances as likely contributors.

A comparison of turbidity data from 2012, 2017, and 2022 shows a lot of variability across sites, seasons, and years. All sites had higher turbidity levels from October to December, coinciding with increased rainfall. Summer values were typically low (<10NTU)

with a few small spikes (15 – 30 NTU). In 2022, turbidity levels were considerably lower than those recorded in 2012 and 2017 (**Figure A4**).

Total Metals, Copper and Zinc

Total metals samples were collected from tributary sites between October 31st to November 29th, 2022, fall sampling period.

The total copper maximum WQO (4 µg/L) was not met early in the sampling period (Oct 31 and early November) at six tributary sites (CB03, CB04, CB07, CB11, CB 12, and CB 13), likely due to increased rainfall in the fall. The exceedances ranged from 4.11 µg/L to 11.7 µg/L. (**Figure A5**). The average WQO (2 µg/L) exceedances are more widespread, affecting eight sites (CB02, CB04, CB07, CB08, CB10, CB11, CB12, and CB13), and extending more of the sampling period. There is a clear temporal pattern of higher concentrations of copper earlier in the sampling period, followed by generally lower concentrations later in November. Some sites (e.g., CB01, CB08) show consistently low copper levels, suggesting localized sources or conditions influencing elevated sites. The exceedances ranged from 3.15 µg/L to 4.32 µg/L. (**Figure A5**).

The total zinc maximum WQO (33 µg /L) was met at all sites, but the average WQO (7.5 µg/L) was not met at CB03 (7.59 µg/L) and CB12 (9.98 µg/L) (**Table 2**).

Conclusions

Overall, at the freshwater tributary sites fewer than half of the assessed objectives were met in 2022. While the Cowichan Bay marine waters quality can be described as unsuitable for shellfish harvesting at most sites and generally suitable for recreation, with localized concerns.

Enhancements to CVRD stormwater infrastructure since 2018 may be contributing to observed improvement in water quality. Though non-point source pollution continues to contribute contaminants to the Cowichan Bay watershed, with likely sources including runoff from farming activities, failing septic systems, vehicles and agricultural products.

Turbidity in Cowichan Bay tributaries was highest in the fall, likely due to increased precipitation and runoff from erosion and local land use.

Elevated phosphorus is primarily a concern during the summer low flow period when elevated nutrient levels are most likely to lead to algal overgrowth and subsequent decomposition, deterioration in aquatic life habitat and aesthetic problems. Increased productivity from excess nutrients will have cascading effects on dissolved oxygen levels, which showed particularly low levels in the summer at Garnett Creek (CB02, CB03) and Spiers Creek (CB11), which did not meet WQO limits for the protection of aquatic life. Alternatively, the low levels of dissolved oxygen could be the result of stagnant pools and reduced water aeration during low flows. Fish species such as cutthroat trout (*Oncorhynchus clarki*), coho salmon *(O. kisutch*) and chum salmon (*O. keta*) reported as present in these creeks are vulnerable to declining water quality.

Zinc and copper metals data for tributaries were limited. Zinc did not raise water quality concerns, but copper concentrations exceeded WQO limits at over half the tributary sites. These exceedances are likely due to runoff from local land uses associated with increased fall rainfall.

Microbial source tracking studies in 2012 and 2013 have already shown some fecal results have anthropogenic sources, evidenced by human markers found in the Bay and tributaries to the Bay (Smorong *et al*., 2021). In 2022, excess microbiological contaminants levels, specifically *Enterococci*, were prevalent in the marine waters of Genoa Bay and float home marina. Similarly, elevated *E. coli* concentrations were exhibited across multiple freshwater tributary sites.

The levels of the bacterial indicators signal a need to address bacterial sources, which are likely from a combination of recreational use, agricultural or industrial land use, residential properties with inappropriate, aging or poorly maintained septic systems and fecal waste discharged from boats or float homes.

Recommendations

- Efforts to reduce nutrients, bacteria, and metals should include enhancing the education of landowners and industries and promoting control measures for runoff into streams.
- Conduct future attainment monitoring at least once every five years subject to staff capacity and funding availability.
- When possible, include microbial source tracking (MST) as part of any bacteriological sampling program.

- Sampling in the fall is recommended during future attainment monitoring to compare results to the 2012-2013 study findings contained in Smorong *et al*., 2021, to confirm which sites may pose a risk to human health, and to determine if there have been improvements or deterioration in fecal concentrations.
- Where possible, work with others to share findings and combine efforts to effectively monitor Cowichan Bay and its tributaries for comparison to WQOs.

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Appendix A – Figures and Tables

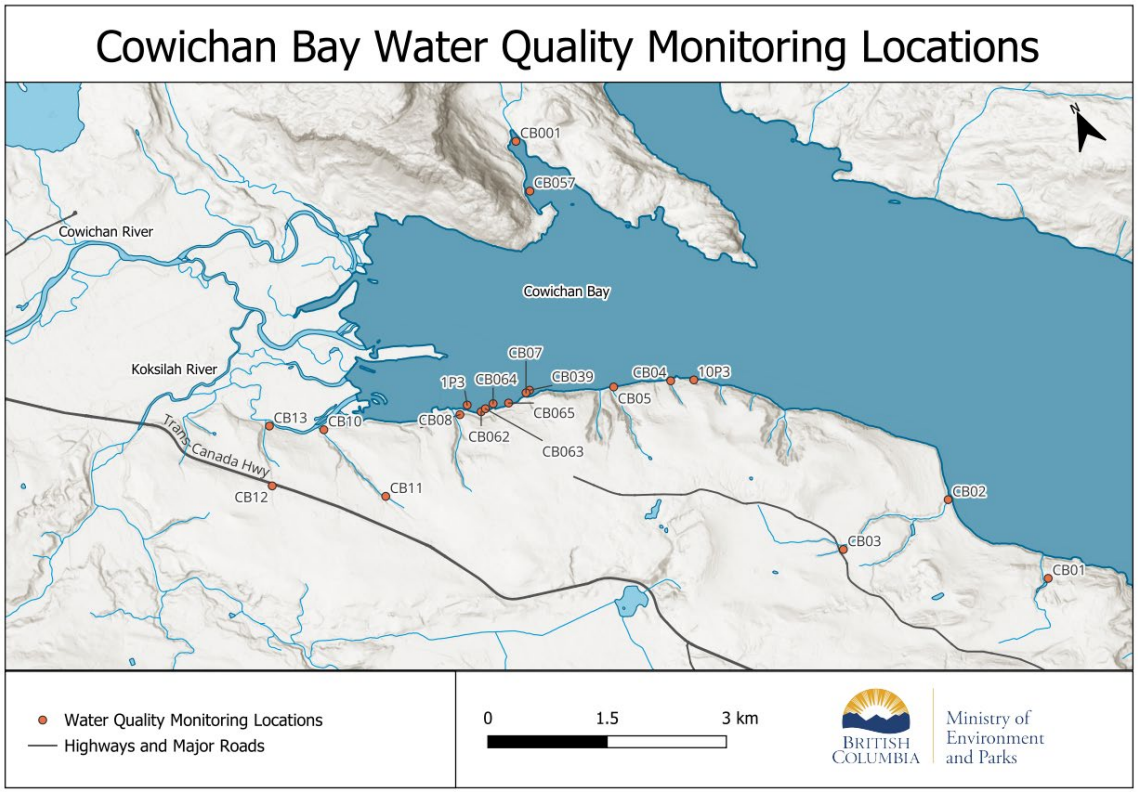

Figure A1. 2022 Cowichan Bay marine and freshwater tributary monitoring locations.

Table A1: Cowichan Bay and freshwater tributary site identifier, name and description.

Marine*		**Freshwater Tributaries**	
Site ID/(EMS#)	**Name, Description**	**Site ID/ (EMS#)**	**Name, Description**
1P3/ (0150360)	Shoreline at Cowichan Bay boat launch[1]	CB01/(E291149)	Manley Cr @Manley Creek Park
10P3/(E291128)	Above Lambourn STP (MWR103748)[2]	CB02/(E291150)	Garnett Cr @Cherry Point Beach
CB001/(E291134)	Head of Genoa Bay	CB03/(E291151)	Garnett Cr @ Telegraph Rd
CB039/(E291124)	By Botwood Lane storm drain	CB04/(E291152)	Storm Drain @ Cherry Pt Marina
CB057/(E291369)	Genoa Bay, 150m N of marina	CB07/(E291155)	Storm Drain @ Botwood Lane
CB062/(E294495)	Float Home #1, Marina #1	CB08/(E291158)	Wessex Cr @ Wessex Inn
CB063/(E294496)	Float Home #2, Marina #2	CB10/(E291160)	Spiers Cr @ Cowichan Bay Rd
CB064/(E294497)	Float Home #2, Marina #2	CB11/(E291161)	Spiers Cr @ Hill Bank Rd
CB065/(E294498)	Float Home #4, Marina #4	CB12/(E291162)	Treffery Cr @ Hwy Crossing
**Sites are in Cowichan Bay unless otherwise identified*		CB13/(E291163)	Treffery Cr @ Cowichan Bay Rd

[1] Formerly Shoreline at PE1538 in prior water quality reports. Sept 2002, permit cancelled, outfall decommissioned
[2] PE 3893 cancelled in 2016, replaced with MWR registration 103748 held by the CVRD, Lambourn Estates discharge to Cowichan Bay marine outfall.

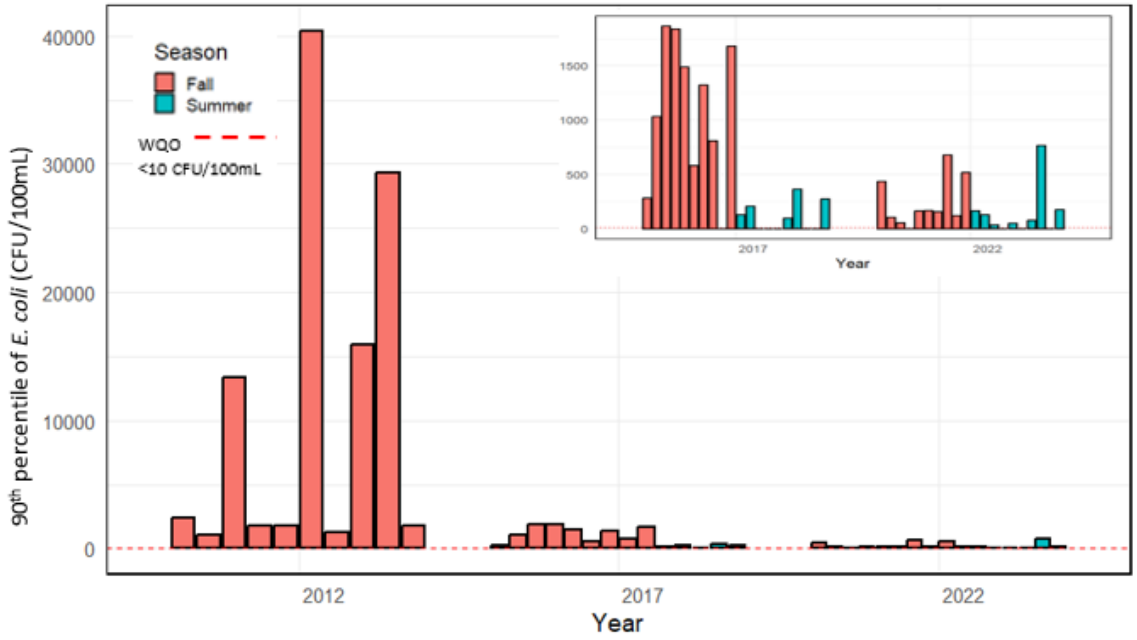

Figure A2. Seasonal 90th percentile 2012, 2017 and 2022 E. coli data from the tributary sites. The inset presents only data for 2017 and 2022. For each year and season, sites are plotted in numerical order left to right (CB01 – CB13).

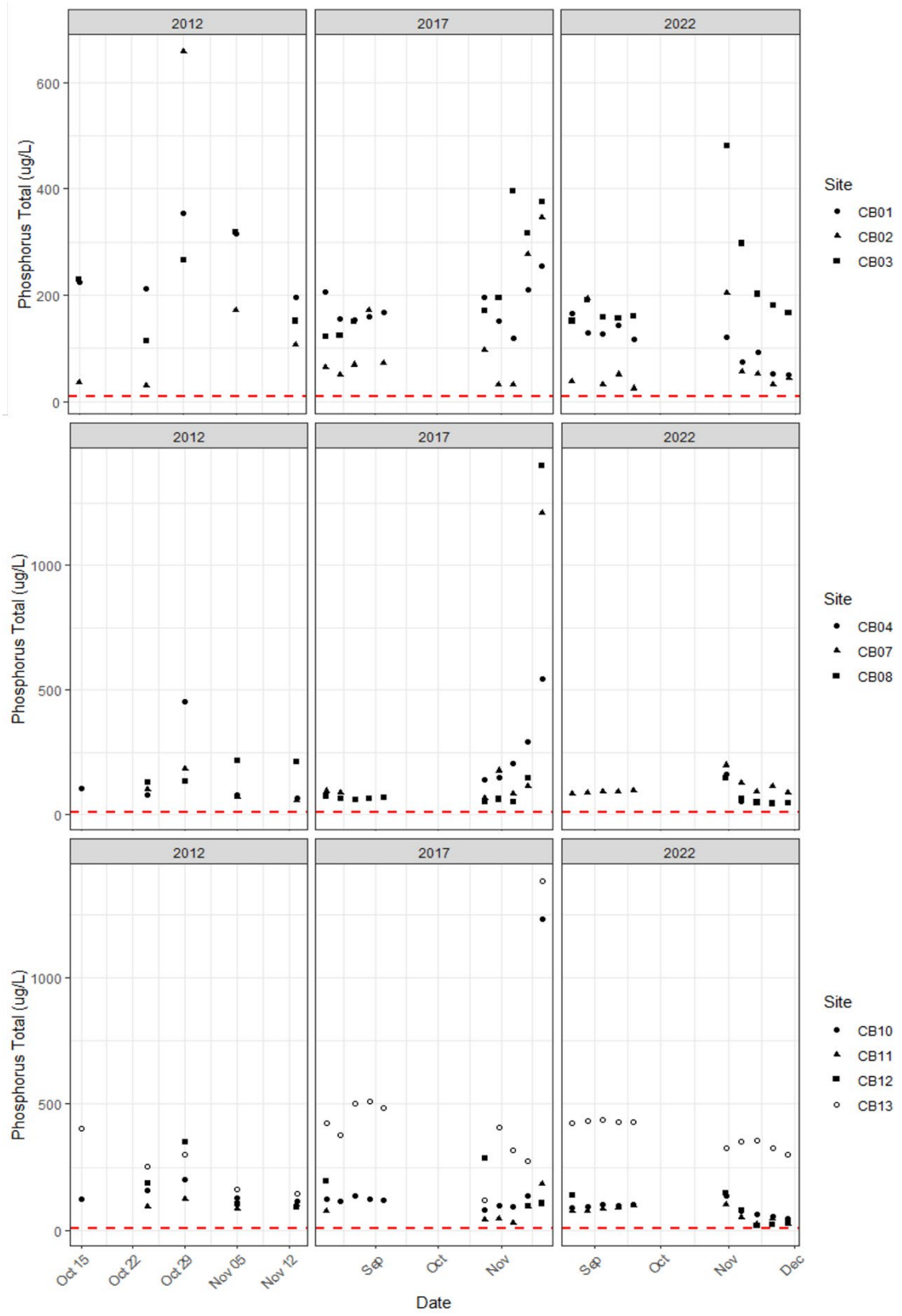

Figure A3. Comparison of tributary Total Phosphorus over time. The red line denotes 10 µg/L, the maximum allowable WQO. Note y-axis scale differs for some locations to better denote values.

Table A2a: Summary of tributary turbidity (NTU) sampling, Aug 22 to Sept 19, 2022.

Summer Turbidity (NTU) - Aug 22 to Sept 19, 2022					
SITE	**Min**	**Max**	**Mean**	**StDev**	**WQO not met[1]**
					Max >2 NTU
CB01	**2.53**	**4.22**	3.17	0.64	5/5
CB02	1.76	**5.76**	2.89	1.63	4/5
CB03	**2.11**	**7.89**	4.65	2.09	5/5
CB07	0.42	**3.92**	1.20	1.52	1/5
CB10	0.72	1.16	0.92	0.16	0/5
CB11	1.32	**16.20**	4.61	6.49	2/5
CB12	**31.10**	**31.10**	na	na	1/1
CB13	1.62	**2.35**	2.01	0.32	3/5
[1]For each site, these are the number of times the minimum objective was not met and the total number of samples **Bold** values exceed the maximum WQO <2 NTU (May 1 to Sept 30)					

Table A2b: Summary of tributary turbidity (NTU) sampling, Oct 31 to Nov 28, 2022

Fall Turbidity (NTU) - Oct 31 to Nov 28, 2022					
SITE	**Min**	**Max**	**Mean**	**StDev**	**WQO not met[1]**
					Max >5NTU
CB01	1.35	**5.01**	2.27	1.56	1/5
CB02	0.59	3.75	1.80	1.19	0/5
CB03	2.25	**17.5**	8.51	8.90	2/5
CB04	1.20	**7.92**	4.56	4.74	1/2
CB07	0.57	**9.16**	3.95	4.12	2/5
CB08	0.22	**8.48**	2.10	3.27	1/5
CB10	0.53	4.27	1.59	1.74	0/5
CB11	2.42	**10.70**	5.04	3.27	2/5
CB12	1.11	**6.82**	2.87	2.32	1/5
CB13	1.22	**30.20**	7.61	9.26	1/5
[1]For each site, these are the number of times the minimum objective was not met and the total number of samples **Bold** values exceed the maximum WQO <5 NTU (Oct 1 to April 30)					

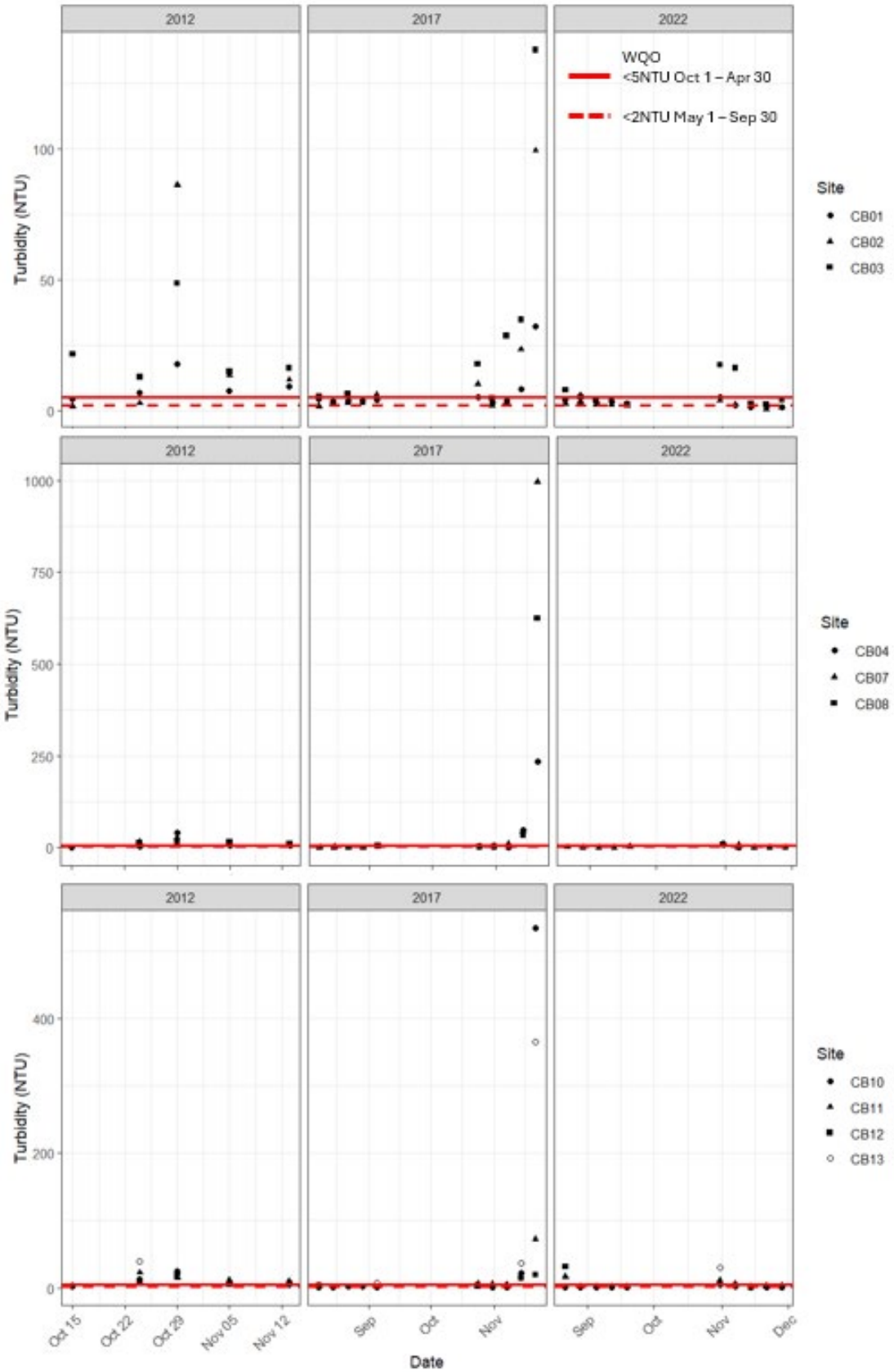

Figure A4: Comparison of tributary turbidity over time (2012, 2017 and 2022). Note y-axis scale differs for some locations to better denote values.

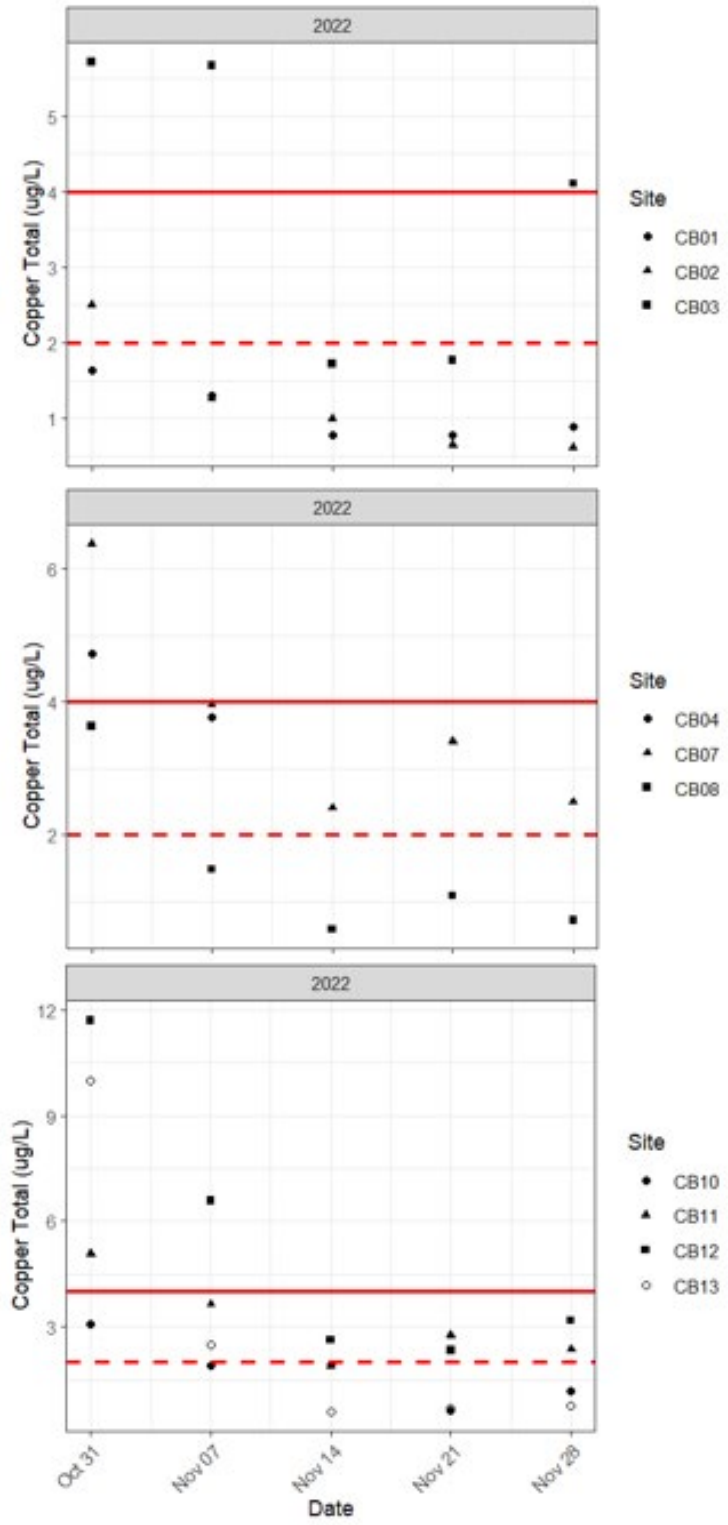

Figure A5: Comparison of tributary total copper in 2022. The solid line denotes 4 µg/L, the maximum WQO, and the dashed line denotes 2 µg/L the average WQO. Average values are not shown on these plots.