2025 St. John River Society Water Quality Monitoring and Wake Aware Program



This report is submitted to fulfil the 2025-26 New Brunswick Environmental Trust Fund project # 250087 entitled, "*Are You Wake Aware?: A two-part project including Heritage Wharf Water Quality Monitoring and the Boater Wake Aware Initiative*".

By:

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Executive Summary

The 2025 St. John River Society (SJRS) Water Quality Monitoring and Wake Aware Program assessed water quality, cyanobacteria risk, and boater wake impacts at eight heritage steamboat wharves between Fredericton and Westfield on the lower St. John (Wolastoq) River. Monitoring occurred from June to October 2025 and included field measurements, laboratory analysis of bacteria, nutrients, and metals, cyanobacteria and cyanotoxin monitoring, and educational outreach.

Core physical and chemical parameters indicated generally healthy conditions. Surface water temperatures followed a typical seasonal pattern, rising from 17–18 °C in June to 24–25 °C in mid-summer, then cooling to 11–12 °C by October. Despite warm conditions, dissolved oxygen concentrations averaged ~8.7 mg/L, and pH values were stable and slightly basic within recommended ranges. There was modest spatial variation among wharves, showing consistent conditions along the river.

Microbial water quality, assessed using E. coli, was very good, with seasonal averages ranging from 1.8 to 16.8 MPN/100 mL, well below recreational guidelines. Occasional short-term increases occurred at a few wharves, but no exceedances were observed. DNA-based source tracking identified multiple faecal sources, with some sites showing strong human and agricultural signatures, emphasizing the need for ongoing wastewater management and runoff control.

Nutrient results characterized the lower river as mesotrophic and moderately enriched. Total phosphorus concentrations were typically in the mesotrophic range (~0.024 mg/L), with occasional higher values in early summer. Nitrate concentrations remained low to moderate, well below guidelines. The system is productive but vulnerable to further enrichment from agriculture, development, degraded riparian areas, and wastewater, especially with a warming climate and extreme weather.

Clarity and salinity-related measures showed strong upstream–downstream gradients driven by estuarine processes. Turbidity was generally low, indicating clear water during the drought. Conductivity, dissolved solids, and major ions were higher at downstream, tidally influenced sites and lower upstream. Metal analyses found iron and manganese at typical levels, while potentially toxic trace metals were at very low concentrations, below guideline thresholds.

The CCME-based Water Quality Index (WQI) integrated these results, with 2025 values ranging from 86.4 to 92.5, rated as “Good” at all sites and averaging ~89.9. Upstream sites had lower dissolved solids and strong dissolved oxygen, while downstream sites had higher salinity-related parameters but still met key indicator guidelines.

Cyanobacteria monitoring using buoy sensors at three wharves logged frequent blooms in 2025, with Fox Wharf emerging as a hotspot for major bloom events. Belyea’s Wharf had intense but brief blooms, while Gerow’s Wharf showed relatively low algal biomass. Statistical analyses confirmed significant differences among the sites, supporting their management as distinct ecological zones.

Overall, the 2025 program shows the heritage steamboat wharf sites maintain Good water quality and meet aquatic life and recreational guidelines, even under drought and high temperatures. However, mesotrophic nutrient status, multi-source faecal inputs, and increased cyanobacteria blooms highlight ongoing vulnerability. Continued monitoring, targeted management, riparian protection, and stakeholder engagement are essential to maintaining water quality and ecosystem health.

Lastly, the 2025 field season was marked by historic drought and unusually high summer temperatures, which reduced flows and likely concentrated some constituents, but overall water quality at the monitored sites remained within Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of aquatic life and recreation.

Introduction

The St. John (Wolastoq) River spans approximately 55,000 km² and flows for 673 km, emptying into the Bay of Fundy. This project was conducted at sampling locations at eight heritage steamboat wharves within the lower river valley, between Fredericton and Westfield (Figure 1 & 2).

The objective of the Water Quality Monitoring Program is to provide the Society with water quality data that identifies changes over time, including periods of increased recreational boating, and seasonal agricultural practices. This data will enhance the Society's ability to adapt as necessary to improve and protect both the water quality and aquatic habitats and species. The targeted outcome of the project was to alter recreational boat traffic patterns or speed in the areas of concern. The intended impact of the program was to safeguard vulnerable areas of the river downstream of Fredericton.

The 2025 Water Quality Monitoring Program marks our second year of monitoring at heritage steamboat wharves, allowing us to determine the overall water quality index and, in turn, indicate potential areas for improvements to protect aquatic habitats and water resources for the future. Data collected from these wharf sites will help us gain a better understanding of long-term changes to water quality throughout the lower river.

Project Objectives

The objectives of this project were to:

1. Monitor surface water quality, *E.coli* and cyanobacteria levels At heritage wharves;
2. Monitor cyanobacteria blooms in the lower river to determine prevalence and potential effects on water quality and ecosystem health;
3. Deploy Algae Tracker sensor buoys at Gerow's, Fox and Belyeas Wharves to collect real-time data and gain a better understanding of factors influencing blooms in the River and its effects on water quality and ecosystem health within the lower watershed.
4. Conduct educational outreach to raise awareness of the negative impacts boat wakes have on wildlife, aquatic habitats and water quality in the lower river valley.
5. Provide, best practices information to recreational boaters to promote boating safety and stewardship on the river.
6. Use this data and understanding to plan future assessment, monitoring, and restoration work; and,
7. Increase community awareness of the environment and the importance of healthy aquatic ecosystems.

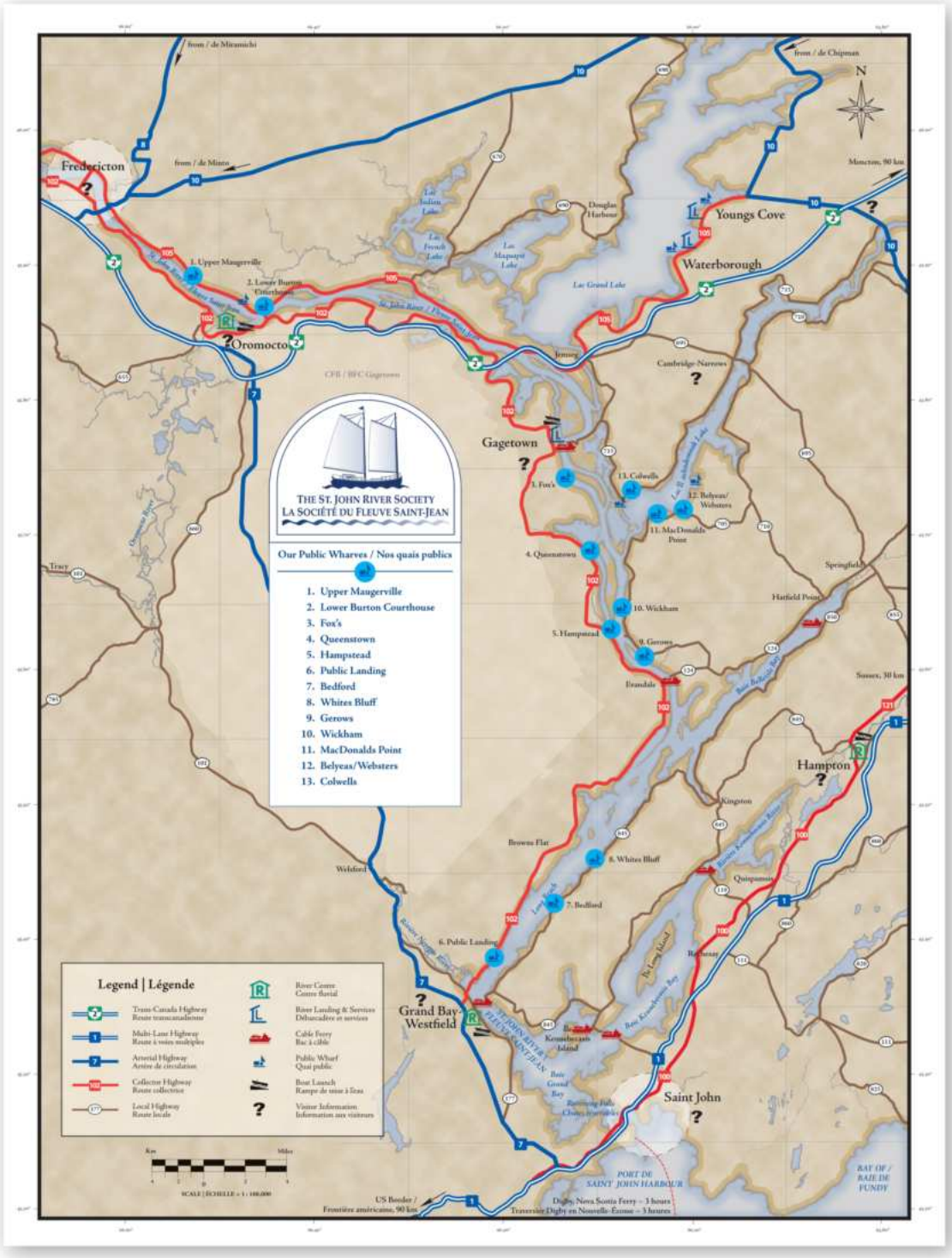


Figure 1: SJRS Map of the Heritage Steamboat Wharves in the Lower St. John (Wolastoq) River.

Water Quality Monitoring Program

Fieldwork was completed between June and October 2025 with the assistance of three summer students (Watershed Technicians) and dedicated volunteers. Surface water samples and field parameters were taken from eight sampling sites located at heritage steamboat wharves in the lower river five times throughout the field season from June to October. Sampling locations and GPS coordinates can be found in Figure 2 and Appendix 1, respectively.

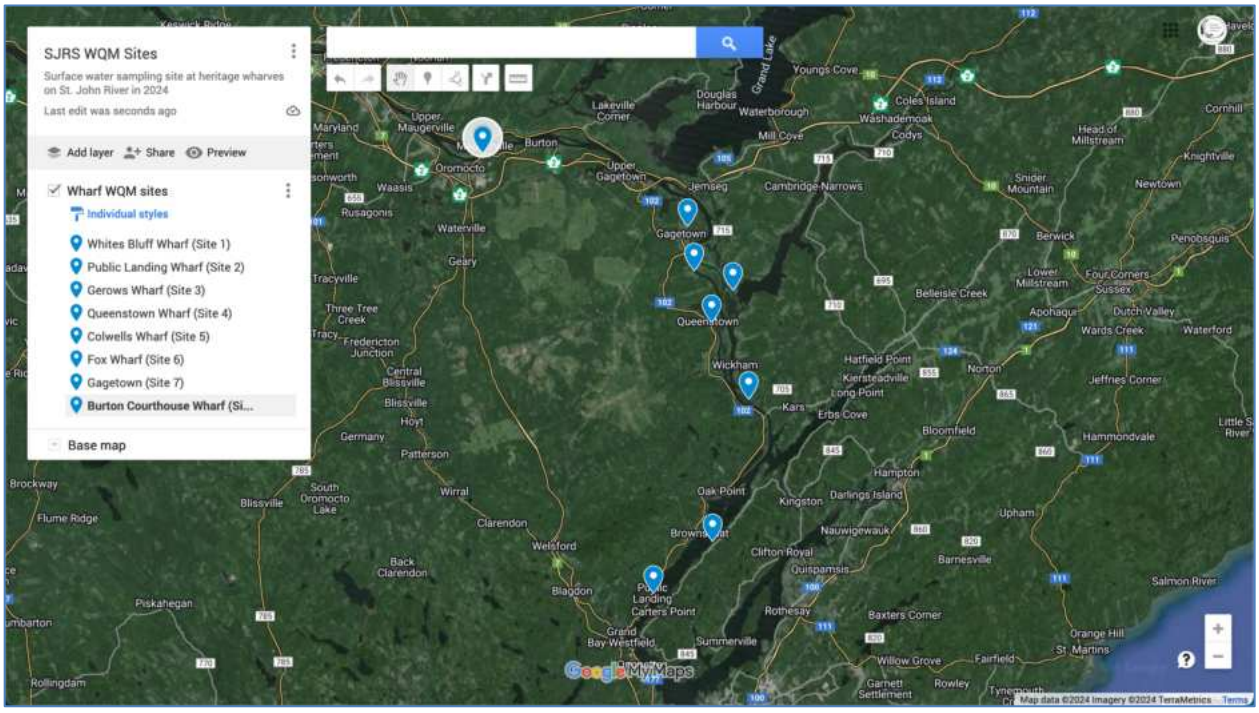


Figure 2: 2025 locations of surface water sampling in the Lower St. John (Wolastoq) River.

Chemical Parameters

Surface water samples for laboratory analysis were collected by lowering the appropriate plastic bottle to roughly 30 cm under the surface of the water and filling the bottle to the top or fill line depending on the bottle requirements. The bottles were then placed in a cooler with ice packs to keep the samples at roughly 4°C; if samples were not taken to the lab after sampling they were placed in the fridge overnight and delivered to the lab the following morning. The Research Productivity Council (RPC) in Fredericton analyzed samples for bacteria (*E.coli*), nutrients and metals as part of a surface water package.

Field Parameters

Water temperature (°C), dissolved oxygen (mg/L and %), pH, and conductivity (µs/cm) were determined at the surface level using a YSI Professional Plus multiprobe. The dissolved oxygen and pH probes were calibrated following manufactory methods. The turbidity of the surface waters was determined using a LUTU-2016 Lutron Turbidity Meter and following the manufacturer's methods. Lastly, water clarity was determined using a Secchi disk by lowering it into the water and marking the depth at which it was no longer visible.

E.coli Source Tracking

The laboratory employed quantitative PCR (qPCR) on environmental DNA (eDNA) extracted from water samples, using host-specific genetic markers to identify sources of contamination. Water was collected at precise GPS coordinates and specific times, with the volume of each sample noted, typically between 180 mL and 300 mL. This information enabled the laboratory to calculate DNA copies per 100 mL of water.

The assays targeted short DNA regions unique to each host: the ND5 gene for human, bovine, and swine samples, and the cytochrome b (Cytb) gene for dog, poultry, and sheep. Each assay used species-specific primers and probes, ensuring only DNA from the intended species was amplified. An E. coli–specific marker was also used to detect and quantify this bacterial indicator. Primers bind to the start and end of the target DNA region, while fluorescently labelled probes detect successful amplification.

For qPCR reactions, the lab used a commercial master mix (QuantaBio PerfeCTa Multiplex qPCR ToughMix Low ROX), with primers at 500 nM and probes at 300 nM. Each reaction included 4 µL of template DNA and a total volume of 20 µL. The QuantStudio 5 and Agilent AriaMx qPCR instruments were used for ND5 and Cytb assays, respectively. The thermal cycling protocol included an initial denaturation at 95°C for 5 minutes, followed by 50 cycles of 15 seconds at 95°C and 1 minute at 60°C.

To quantify DNA, the lab generated standard curves using serial dilutions of known DNA concentrations. Cq values (the cycle when fluorescence exceeds the threshold) were plotted against the log of copy number, and a linear regression was fitted. High R^2 values (around 0.99) and efficiencies between 88% and 101% indicated reliable assay performance. These curves allowed conversion of Cq values into DNA copies per reaction and, using sample volume, per 100 mL of water.

Detection limits were determined by the lowest positive value on the standard curve, though actual sensitivity could be slightly better. Replicates without amplification or with inconsistent results were considered zero or excluded as outliers, which explains why some replicates for the same sample may show zero while others are positive.

Results: Water Quality Monitoring

Surface Water quality monitoring was conducted at eight heritage steamboat wharf sampling sites along the lower St. John (Wolastoq) River monthly between June and October 2025. The results of the water quality analysis are described below. All water quality monitoring data can be obtained by contacting the SJRS via https://www.stjohnriver.org/. Full datasets collected during the 2025 field season for both field and laboratory parameters can also be found in Appendices 2, 3, 4 and 5.

Water Temperature

Surface water temperature was monitored in the field with other in situ measurements at all eight sites. Results show a typical summer–fall temperature pattern at all Heritage Wharves. Average temperatures by month rose from about 17.6 °C in June to nearly 24.6 °C in August, then cooled back down to around 11.4 °C in October (Figure 3). The seasonal average across sites is approximately 19.1 °C, with only minor differences between locations (Figure 3). The warmest monthly values usually occur in July and August at most wharves, reflecting typical summer heating of surface waters (Figure 3).

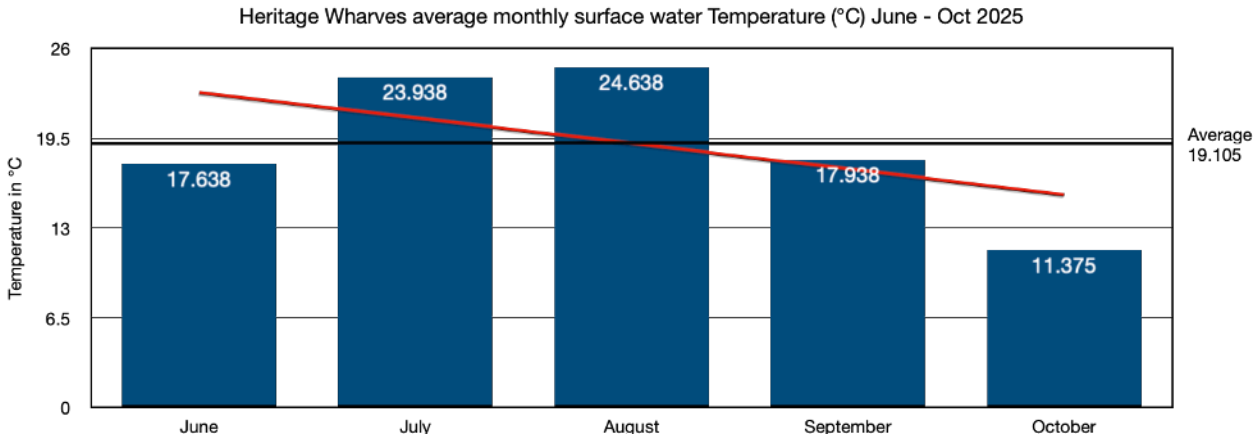


Figure 3: Average surface water temperature from June to October 2025.

Differences among sites are small but consistent: Colwell's, Fox, Gagetown, and Burton Courthouse Wharves tend to sit at the warmer end of the range (slightly higher seasonal averages), whereas Public Landing and Gerow's are marginally cooler, though still very similar (Figure 4). These modest differences likely relate to factors such as water depth, flow rate, shading, and local mixing with cooler tributaries or groundwater. From an ecological perspective, these temperatures are within expected seasonal ranges and, while warm enough in midsummer to affect oxygen levels and species composition, they do not on their own signal an obvious thermal stress issue.

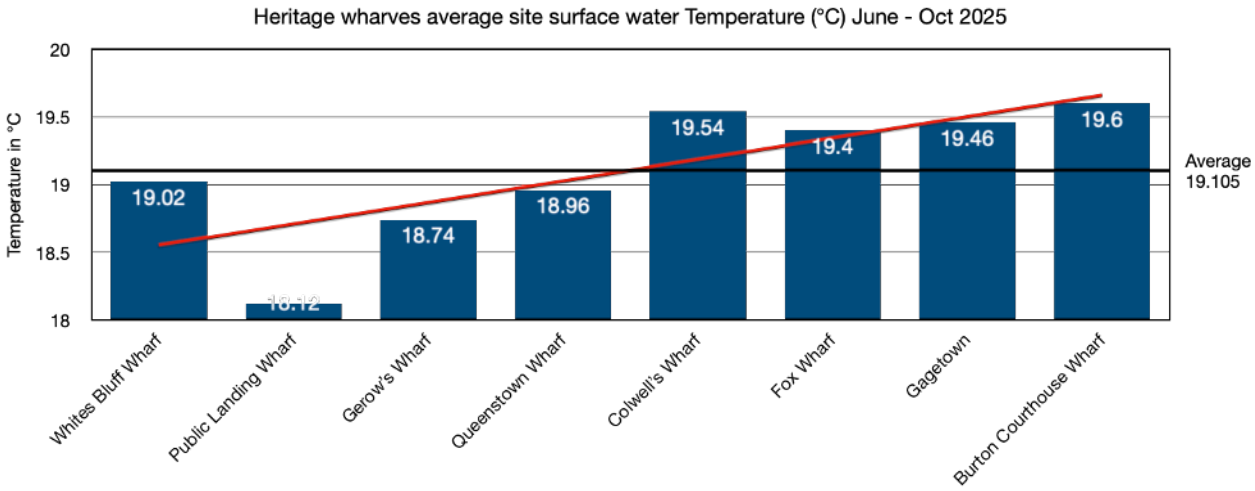


Figure 4: Average surface water temperature per site 2025.

Dissolved Oxygen

Dissolved oxygen is a significant factor in supporting healthy aquatic environments; it is vital in regulating biological processes for species' survival in aquatic ecosystems. The CCME guidelines for the protection of aquatic life state that dissolved oxygen should be above 6.5 mg/L for cold-water species and above 9.5 mg/L for early life stages of aquatic species (Canadian Council of Ministers of the Environment, 1999).

Results of water quality monitoring analysis indicated that Dissolved oxygen (DO) levels across the sites were strongly supportive of aquatic life. Monthly averages range from about 7.6 to 9.3 mg/L, and the overall seasonal average is roughly 8.7 mg/L (Figure 5). Most individual measurements at each wharf fall between 7 and 11 mg/L, which is well above the typical minimum thresholds used to protect fish and invertebrates (Figure 5). The lowest monthly average appears in July (about 7.6 mg/L) when water is warmest, and the highest in October (around 9.3 mg/L) when cooling water holds more oxygen (Figure 5).

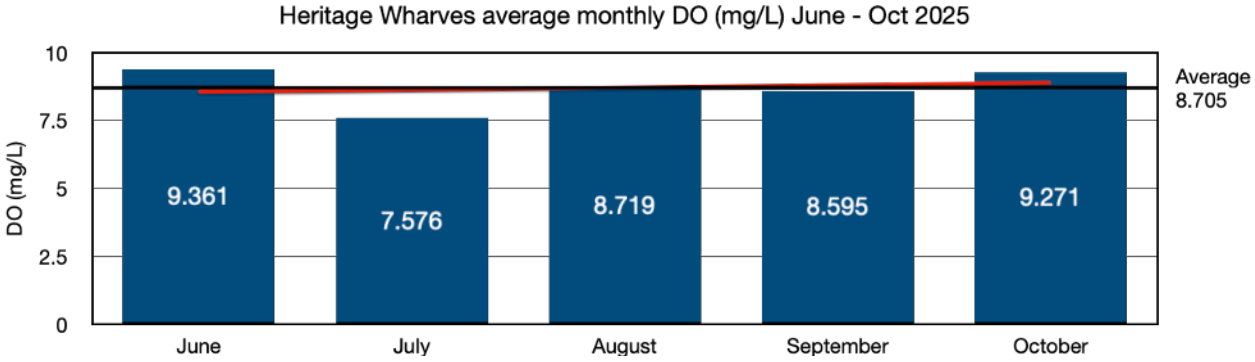


Figure 5: Average dissolved oxygen concentrations between June and October 2025.

Site differences are moderate but not alarming. Whites Bluff, Gerow's, Fox, and Burton Courthouse Wharves often record higher DO values (around 9–11 mg/L in several months), while

Gagetown and Public Landing show somewhat lower readings at times, with Gagetown dipping near 6 mg/L in July (Figure 6). Still, even these lower values remain within acceptable ranges for many species, especially if they are short-lived. Overall, the data suggest that oxygen conditions along this stretch of the river are healthy and resilient, with only modest seasonal declines during peak summer temperatures.

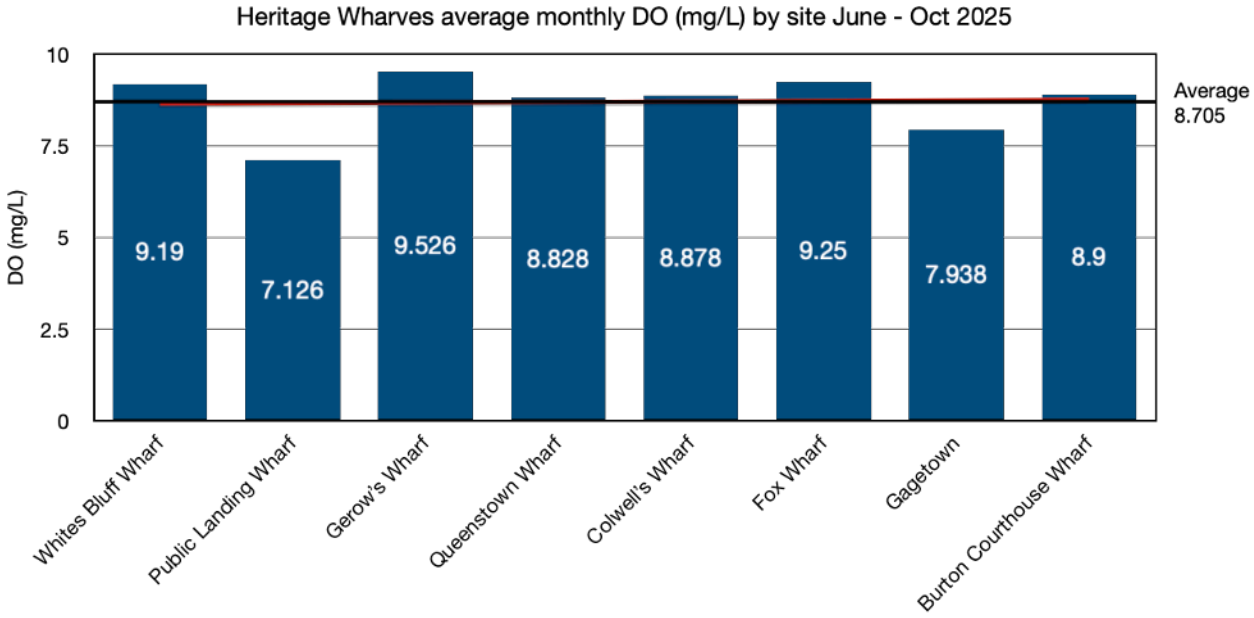


Figure 6: Average dissolved oxygen concentrations per site 2025.

Further, percent saturation values complement the DO data by accounting for temperature and pressure, and here they also show generally healthy conditions. Monthly averages ranged from about 90–99%, with a seasonal mean near 94%, indicating that the water is usually close to being fully saturated with oxygen (Figure 7). June tends to have the highest average saturation (97%), while July dips slightly (90%), again reflecting the influence of warmer summer temperatures on oxygen solubility (Figure 7).

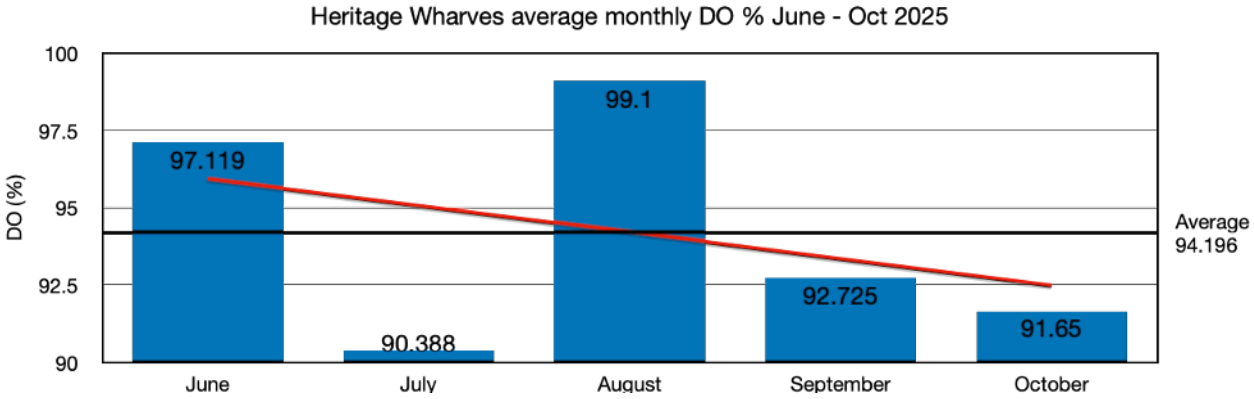


Figure 7: Average percent saturation of dissolved oxygen between June and October 2025.

At the site level, Whites Bluff, Gerow's, Colwell's, and Fox Wharves often show very high saturations (frequently above 95%, and sometimes above 110% in early summer), which can

indicate highly oxygenated conditions due to turbulence or photosynthesis (Figure 8). Gagetown and Queenstown, by contrast, have more values in the 70s and 80s in some months, suggesting slightly less favourable but still generally adequate oxygen conditions (Figure 8). None of the sites show a consistent pattern of chronically low saturation that would immediately suggest severe stress for aquatic life, though the modestly lower values at some sites justify continued attention.

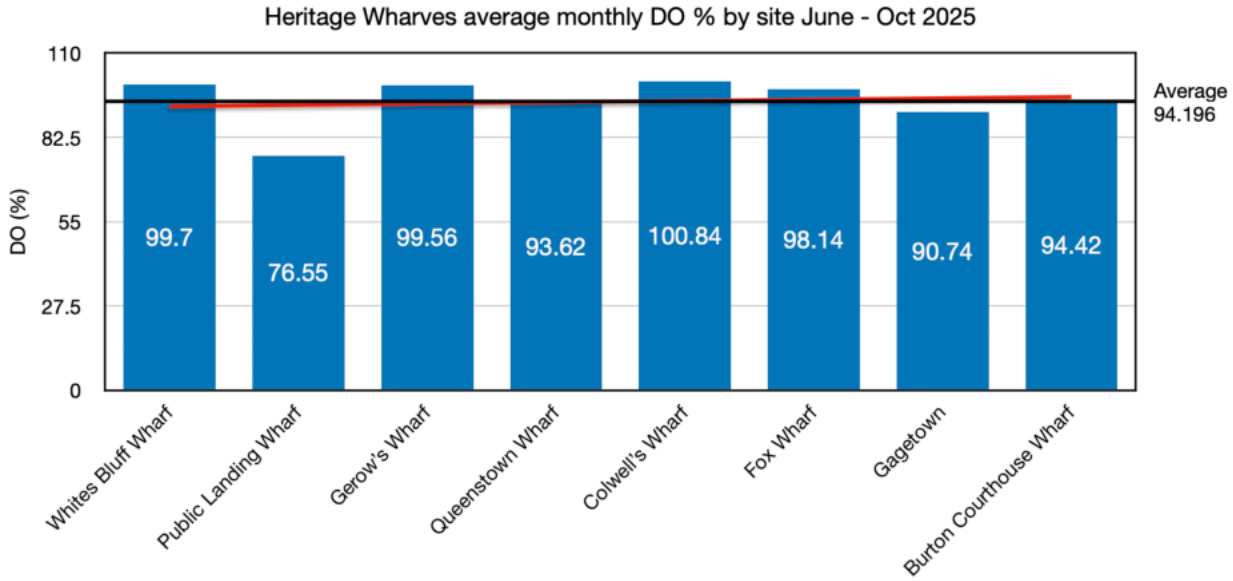


Figure 8: Average percent saturation of dissolved oxygen per site 2025.

pH

The acidity and alkalinity of the Lower River is an important indicator of the health of this aquatic ecosystem. To assist in determining this parameter the SJRS uses pH testing to measure the presence of hydrogen ions (H^+) in a solution. The measurements run on a logarithmic scale of 0 to 14 with a pH of 7 considered neutral. Therefore, a pH of 4 represents 10 times more hydrogen ions than a pH of 5 and 100 times that of a pH of 6. A pH reading of below 7 is increasingly acidic and a pH above 7 is increasingly alkaline. An acidic pH represents an increase in hydrogen ions and an alkaline pH reading represents a decrease in these ions.

Subtle changes in the pH concentration can have a significant effect on the chemistry of aquatic ecosystems. For example, metals trapped in suspended solids or bottom sediment can be released into the water with a slight lowering of the pH level. When this occurs, the water may increase the amount of metals dissolved in it and become toxic to many aquatic organisms. Similarly, an elevated pH can greatly increase the toxicity of ammonia to fish. The CCME guidelines for the protection of aquatic life state that the pH of freshwater should range between 6.5 and 9 (Canadian Council of Ministers of the Environment, 1987).

Results of water quality monitoring analysis determined that pH concentrations were consistent throughout the sampling period. All sites and months fall in a narrow band between about 7.3 and 7.9, with an overall average near 7.68, which is slightly basic but well within the typical healthy

range (6.5–9) for freshwater ecosystems (Figure 9). This stability suggests that no strong acid or base inputs are affecting these reaches of the river and that buffering capacity is good.

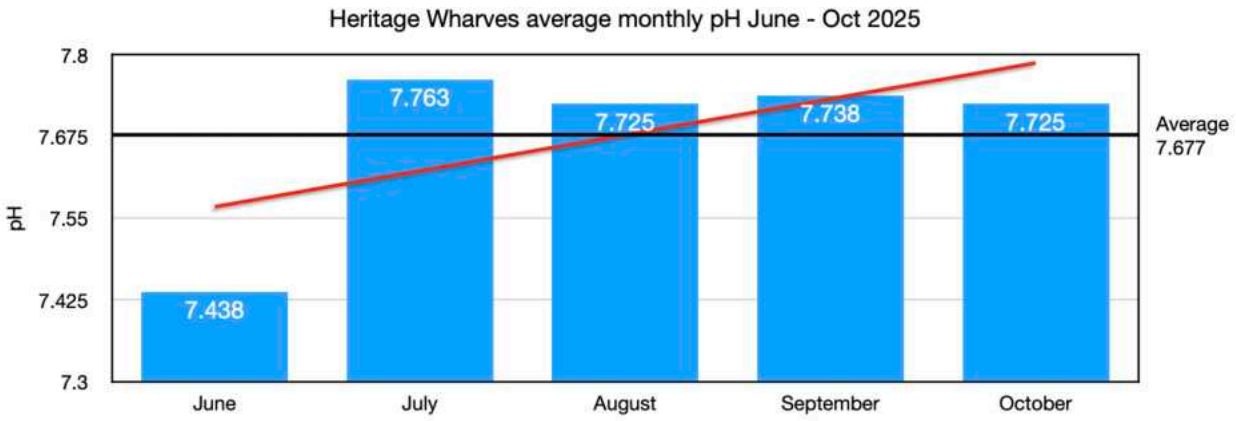


Figure 9: Average pH values from surface water sampling by month.

Spatially, there is very little difference between wharves: all eight locations show almost identical monthly pH patterns, with only minor fluctuations of a few tenths of a unit (Figure 10). Temporally, pH is also steady from June through October, indicating that seasonal processes such as algal growth or changes in runoff do not dramatically alter acidity/alkalinity (Figure 10). From a general-audience standpoint, this means the river's acidity is stable and suitable for most aquatic life, and pH is unlikely to be a limiting factor for water quality in this system.

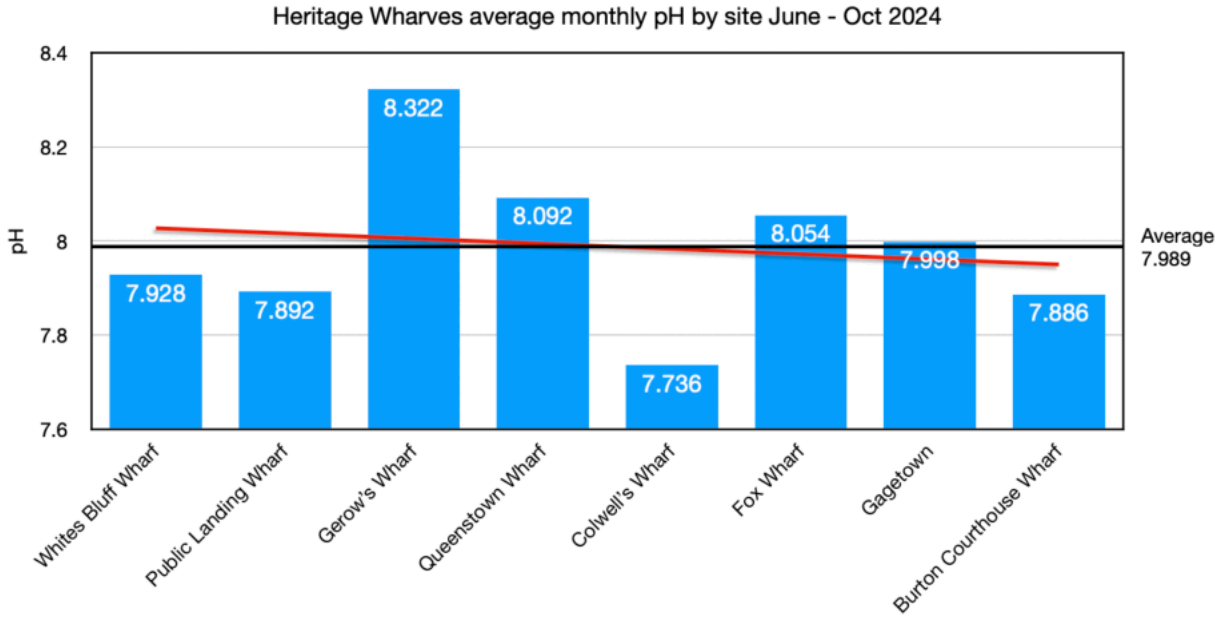


Figure 10: Average pH values from surface water sampling sites at Heritage Wharves.

As stated above the changes in pH observed in 2025 are likely the result of seasonal variations in weather and temperature over the sampling period. Additionally, land management activities including agriculture and forestry operations, increased shoreline development, degraded riparian areas, and runoff from residential lawns and wastewater discharges all contribute to altering pH concentrations in the River. Despite these activities, the results indicate that the lower River continues to have a good pH reading overall and is well within the parameters to support a diverse aquatic ecosystem. However, to ensure that this continues, the SJRS and its partners will continue to work to mitigate the anthropogenic pressures and practices that negatively impact the watershed now and in the future to foster the long-term sustainability and climate resilience of the watershed.

E. coli

Coliform bacteria (fecal coliform) originate in the intestinal tract of warm-blooded animals. This group of bacteria are the preferred indicator of contamination of water with possible intestinal parasites and pathogens. Coliform bacteria are relatively simple to identify, as they are present in a much larger quantity than the more dangerous pathogens and react to the natural environment and treatment process in a manner, and degree similar to pathogens. By observing the increase or decrease of coliform bacteria, many pathogenic bacteria can be estimated.

Bacterial pollution sources include runoff from agricultural operations and forestry activities; septic tanks and sewage plants; and wildlife. Most coliform bacteria enter natural watercourses by direct deposition of waste in the water from areas with high concentrations of animal and human activity. These bacteria are more likely to survive in deep, slow-moving, heavily polluted waters that have reduced dissolved oxygen levels and higher temperatures that increase growth rate. Water pollution resulting from faecal contamination has the potential to cause the transmission of diseases and make surface waters unsuitable for drinking, fishing and recreational activity. To help protect surface water the Government of Canada established guidelines for *E.coli* in recreational water bodies. This guideline states that *E.coli* concentrations should not exceed 200 faecal coliforms per 100 mL of water or 400 MPN/100 mL in a single sample.

Results of water quality monitoring analysis indicated that E. coli levels across the Heritage Wharves are generally low, with seasonal averages at individual sites ranging from about 1.8 to 16.8 MPN/100 mL, and a system-wide average of roughly 7.25 MPN/100 mL (Figure 11 & Table 1). These values are well below typical recreational water guidelines (often 200 MPN/100 mL or higher, depending on the standard), suggesting that overall bacterial contamination is low and the water is generally suitable for contact recreation from a microbiological perspective. The lowest average E. coli levels occur at Whites Bluff, Public Landing, and Colwell's Wharves, while Burton Courthouse Wharf has the highest average (16.8), though still modest in absolute terms (Figure 11).

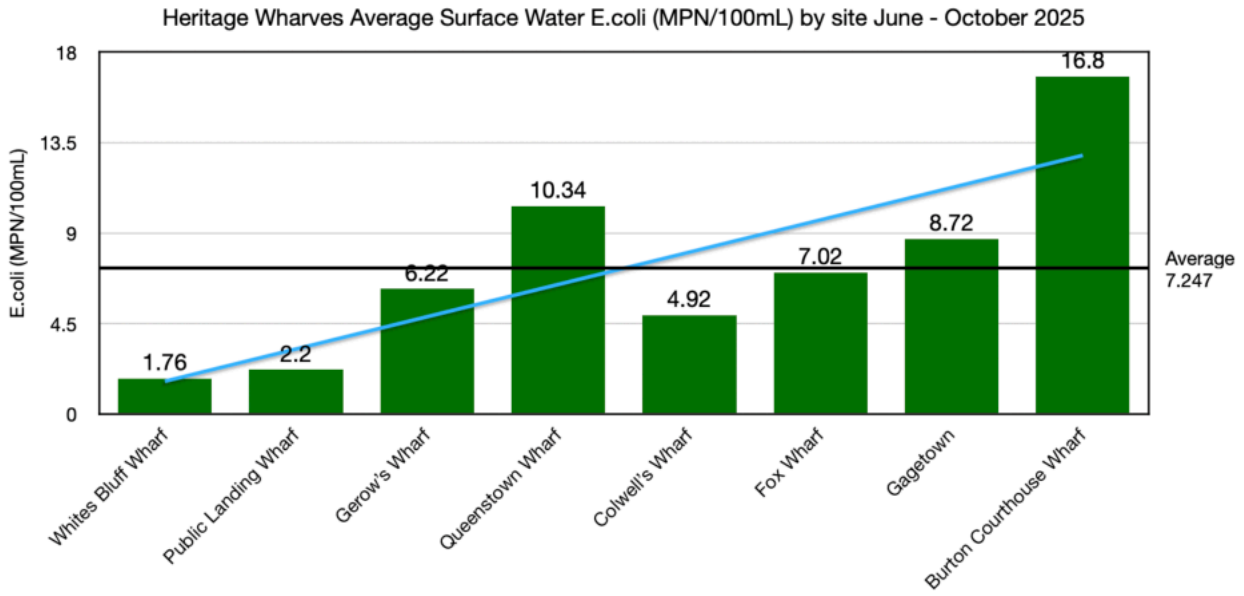


Figure 11: Average surface water *E. coli* counts at Heritage Wharves June – October 2025.

Month by month, there is some variation. June and July show slightly higher average E. coli (around 10.8 and 8.8 MPN/100 mL) than October (about 4 MPN/100 mL) (Figure 12 & Table 1). This fits with warmer temperatures and more runoff events in early summer, which often promote bacterial growth and transport. Some individual spikes are evident, for example, Queenstown (26.9 in July) and Burton Courthouse (20.9 in June/July and 26.2 in September), but even these remain below levels usually associated with swimming advisories (Table 1). Overall, the data indicate that fecal contamination is present but generally low, with occasional localized or short-lived increases that would merit continued monitoring but not immediate alarm. None of the results observed exceeded the established Health Canada guidelines for *E.coli* in recreational water bodies.

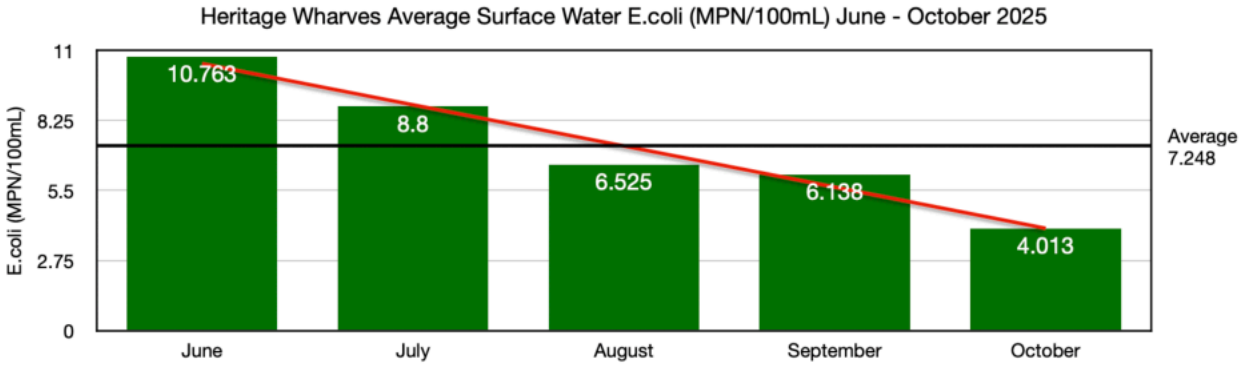


Figure 12: Average Monthly surface water *E. coli* counts June – October 2025.

Table 1: Heritage Wharves Surface Water E. coli June - Oct 2025.

	June	July	August	September	October	AVG
Whites Bluff Wharf	4.1	0.9	0.9	0.9	2	1.76
Public Landing Wharf	4.1	2	2	0.9	2	2.2
Gerow's Wharf	11	2	5.2	10.9	2	6.22
Queenstown Wharf	4.1	26.9	13.5	0.9	6.3	10.34
Colwell's Wharf	12.2	5.2	1.0	1	5.2	4.92
Fox Wharf	17.5	6.3	4.1	2	5.2	7.02
Gagetown	12.2	6.2	15.8	6.3	3.1	8.72
Burton Courthouse Wharf	20.9	20.9	9.7	26.2	6.3	16.8
						7.2475
AVG	10.7625	8.8	6.525	6.1375	4.0125	7.2475

During the 2025 field season, water samples were collected at three wharf sites that had observed higher e.coli levels during sampling in 2024. These samples were sent to a specialist laboratory for DNA-based testing. This analysis sought to detect trace amounts of DNA in the water to identify potential sources of faecal contamination. The laboratory tested for genetic markers associated with humans, cattle, poultry (chickens), pigs (swine), dogs, sheep, and E. coli, which is a common indicator of faecal pollution.

The results of these tests indicated DNA markers associated with humans were consistently detected in all water samples from Fox, Gerow's, and Gagetown Wharves. Levels were moderate at Fox Wharf, but very high at the other two sites (Figure 13). Every replicate tested positive, strongly indicating persistent human faecal input, likely from sewage discharge or septic overflows.

Cattle DNA signals were strong at Gerow's wharf, moderate at Gagetown Wharf, and weak at Fox Wharf. Swine markers were generally low, with the strongest presence at Gagetown Wharf (Figure 13). Poultry contamination was found at all sites, most notably at Gerow's wharf and Gagetown Wharf (Figure 13). Sheep markers were not detected at any site, suggesting little or no sheep-related input (Figure 13).

Dog-related DNA was not found at Fox Wharf, but was strongly detected at Gerow's and clearly present at Gagetown Wharf (Figure 13). This points to dog faecal inputs at these locations, possibly from runoff or recreational activities.

E. coli was detected in all samples, confirming overall faecal contamination. The highest levels were found at Gerow's, which also had strong human, dog, cattle, and poultry signals. Fox Wharf had E. coli at lower concentrations compared to the other sites (Figure 13).

Fox Wharf (9GLA2DJ8): Human contamination is clearly present, with minor contributions from cattle and poultry, and lower overall contamination than at other sites. Dog and sheep signals are absent, and E. coli levels are comparatively low (Figure 13).

Gerow's Wharf (CSYFKLK3): This site exhibits the highest overall faecal contamination, with substantial contributions from humans, cattle, poultry, and dogs, and some swine input. The pattern suggests intensive local human, agricultural, and residential activity (Figure 13).

Gagetown Wharf (PFKLOJM8): High levels of human and poultry contamination were detected alongside inputs from dogs, cattle, and swine. Overall contamination is considerable, though E. coli counts are lower than at Gerow's (Figure 13).

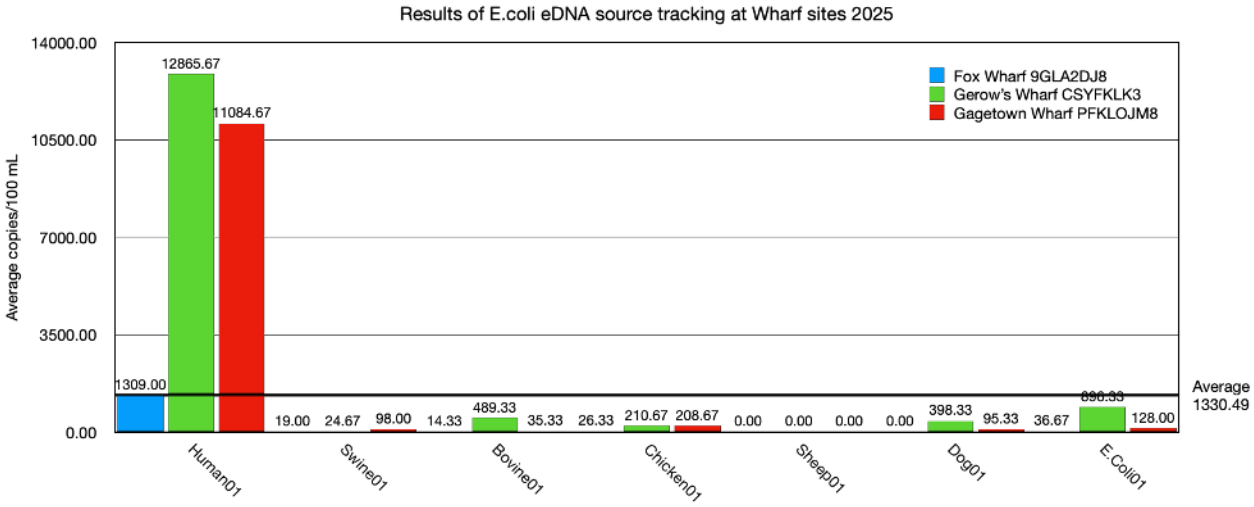


Figure 13: Results of E.coli eDNA source tracking lab analysis for 2025 wharf sites.

The laboratory ran technical replicates for each sample, showing average copy numbers and the percentage of positive reactions. Results with 100% positive replicates indicate strong, reliable detection, while lower percentages mean weaker but potentially real signals. The data indicate initial evidence for human, poultry, and dog contamination at several sites, strong cattle signals at Gerow's and Gagetown Wharf, weaker evidence for swine at Gagetown Wharf, and no sheep-related contamination. Further sampling and analysis over a multi-year period would need to be conducted to provide stronger evidence of contamination and potential water quality issues at these sites. E.coli eDNA source tracking laboratory data is available in Appendix 6.

Nutrients

Nutrients are vital in aquatic environments and dictate the amount of plant life (algae, cyanobacteria, emergent and submergent vegetation) that a waterbody can sustain. In aquatic environments like the St. John (Wolastoq) River, Phosphorus is the most limiting and therefore even small increases can support a spike in plant growth or a cyanobacteria bloom. The other common nutrient in aquatic systems is Nitrogen as Nitrate (NO_3) however, it is less limiting than Phosphorus generally in freshwater.

Phosphorus

Phosphorus is an essential plant and animal nutrient. Phosphate is the form of phosphorus used by aquatic plants. Phosphates may enter the watercourse from agricultural runoff and biological and industrial wastes. Since phosphorus is a nutrient normally in limited amounts in most freshwater ecosystems, even small increases can, under the right conditions, can cause detrimental effects in an aquatic ecosystem including accelerated plant growth, algae blooms (cyanobacteria) and low dissolved oxygen. This can cause the death of fish, invertebrates, and other aquatic biota degrading aquatic ecosystems over the long term. Additionally, this overabundance of phosphate in an aquatic ecosystem can contribute to eutrophication when high concentrations of nitrogen are also present.

Results of water quality analysis indicate that phosphate concentrations, as monthly averages for the whole network, ranged from 0.016 mg/L (September) to 0.040 mg/L (June) (Figure 14). These values indicate moderate nutrient levels, enough to support productive ecosystems but below those typically associated with severe algal blooms and heavy eutrophication in many systems.

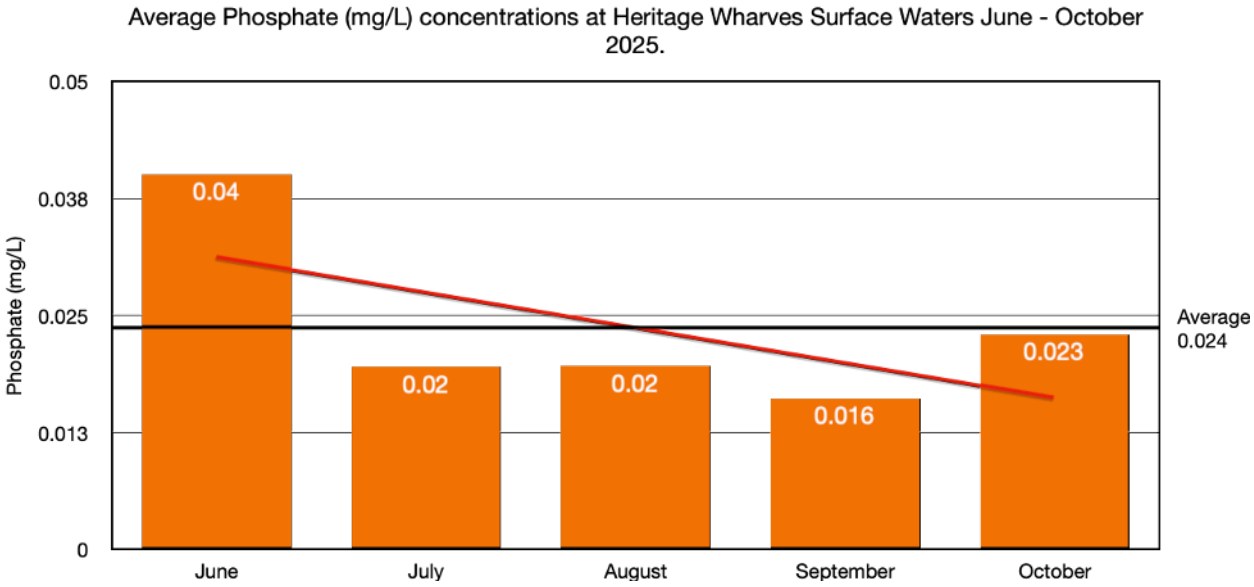


Figure 14: Average Phosphate (mg/L) concentrations in Surface Waters between June - October 2025.

Results at individual wharves range from 0.017 to 0.034 mg/L, with a system-wide average around 0.024 mg/L (Figure 15). Certain sites, such as Fox and Colwell's Wharves, show higher average phosphorus (around 0.027–0.034 mg/L), including single-month spikes like Fox at 0.090 mg/L in June and Colwell's at 0.065 mg/L in June (Figure 15). These peaks may relate to spring/early summer runoff, local land use, or nearshore processes. Other sites like Gagetown and Gerow's sit closer to the network average of 0.024 mg/L (Figure 15). The classification of all months and sites as mesotrophic tells a clear story: the river has moderate nutrient enrichment but, based on these phosphorus values alone, does not appear to be pushed into a consistently high-risk, hyper-eutrophic state.

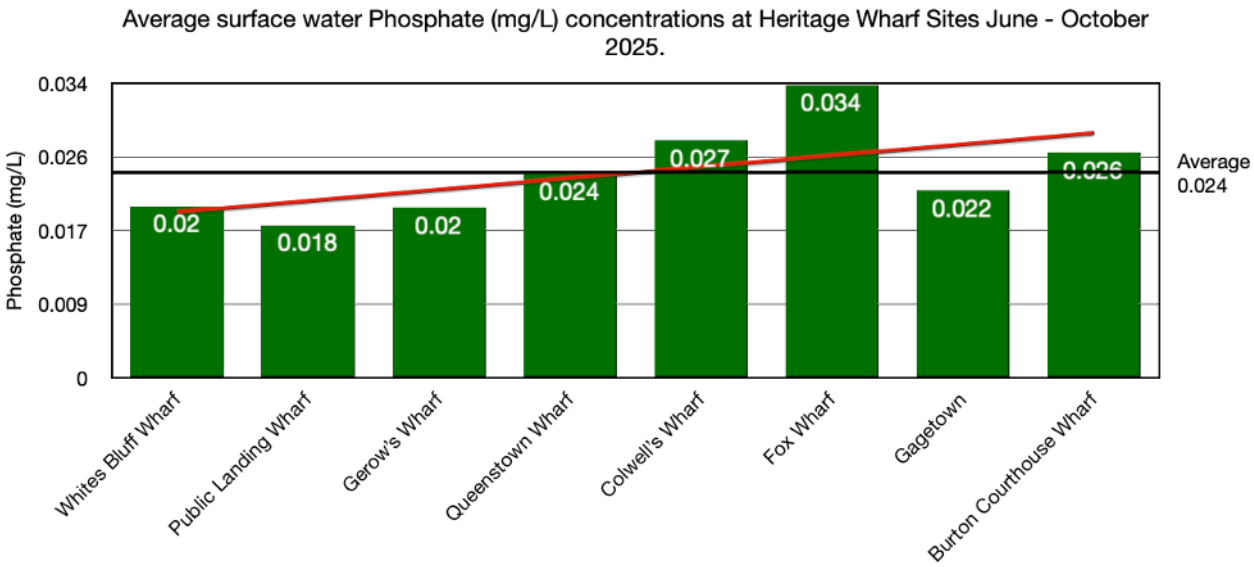


Figure 15: 2025 Average Phosphate (mg/L) Concentrations by Surface Water Sampling Site.

Overall, the results of the second year of monitoring indicate that, on average, the wharf sites would be classified as mesotrophic. Aquatic ecosystems classified as mesotrophic have a moderate amount of dissolved nutrients, are fairly productive in terms of aquatic animal and plant life and are generally in good condition. When mesotrophic ecosystems are destabilised as a result of poor land management activities. These include runoff from agriculture and forestry operations, increased shoreline development, degraded riparian areas, and wastewater discharges. A waterbody under these stressors will start showing emerging signs of water quality problems. The results of the 2024 and 2025 sampling seasons indicate that the pressures from adjacent anthropogenic activity in the form of poor land and riparian management are providing vectors for increased nutrient inputs into the river that will decrease water quality without mitigating measures over the long term.

Nitrate

Nitrate is a form of nitrogen found naturally in aquatic environments and is an important indicator when assessing water quality. Nitrates like phosphates are plant nutrients and contribute to an increase in plant and algae growth in aquatic ecosystems. An increase in nitrate levels can come from numerous anthropogenic sources such as septic systems, fertilizer runoff and improperly treated wastewater. High levels of nitrate can decrease dissolved oxygen levels via rapid plant growth and decomposition creating anoxic and eutrophic conditions in aquatic ecosystems. The CCME guidelines state that nitrate concentrations in freshwater should not exceed 13 mg/L NO_3 for the protection of aquatic life (Canadian Council of Ministers of the Environment, 2012).

Results of water quality monitoring analysis indicate that Nitrate concentrations in the surface waters at the wharf sites are low to moderate, ranging from about 0.04 to 0.26 mg/L, with overall averages near 0.13 mg/L (Figure 16). Most monthly averages at each wharf fall under 0.2 mg/L, well below CCME Guidelines and below levels typically associated with severe nutrient pollution in many surface waters. June and July generally show slightly higher nitrate (around 0.13 to 0.18

mg/L) compared with August (0.09 mg/L), likely reflecting early-season runoff of fertilizers and other sources that then taper off (Figure 16).

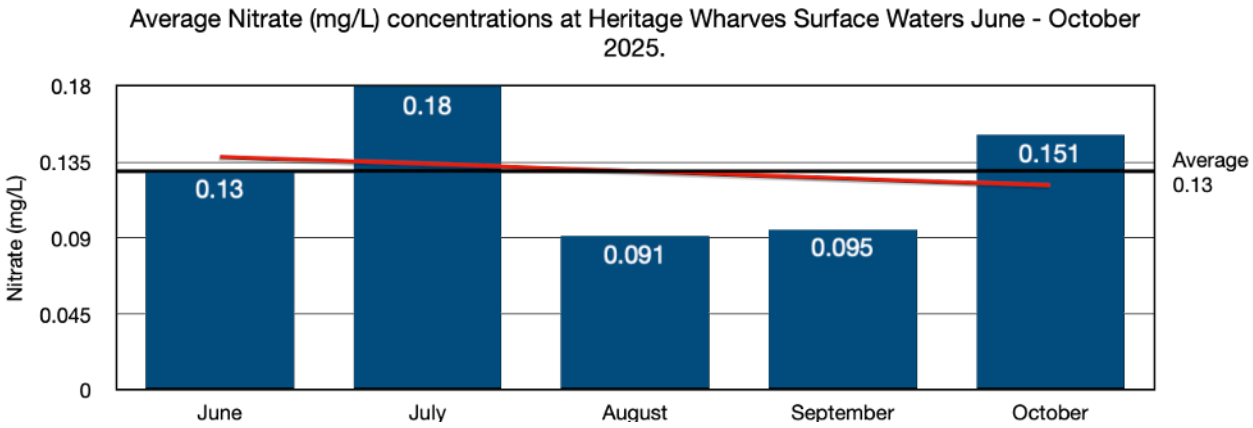


Figure 16: Average Nitrate (mg/L) concentrations in Surface Waters at wharf sites June - October 2025.

Spatially, Gagetown and Queenstown often show some of the higher nitrate values (e.g., Gagetown up to 0.26 mg/L in October; Queenstown up to 0.22 mg/L), while Colwell's and Whites Bluff tend to be a bit lower on average (Figure 17). Still, these differences are small in absolute terms. For general readers, the nitrate data suggest that nutrient inputs are present but relatively modest, consistent with a working, inhabited watershed that has not yet crossed into severe nitrate pollution. Together with phosphorus results, they depict a system that is nutrient-enriched enough to be productive but not obviously over-fertilized.

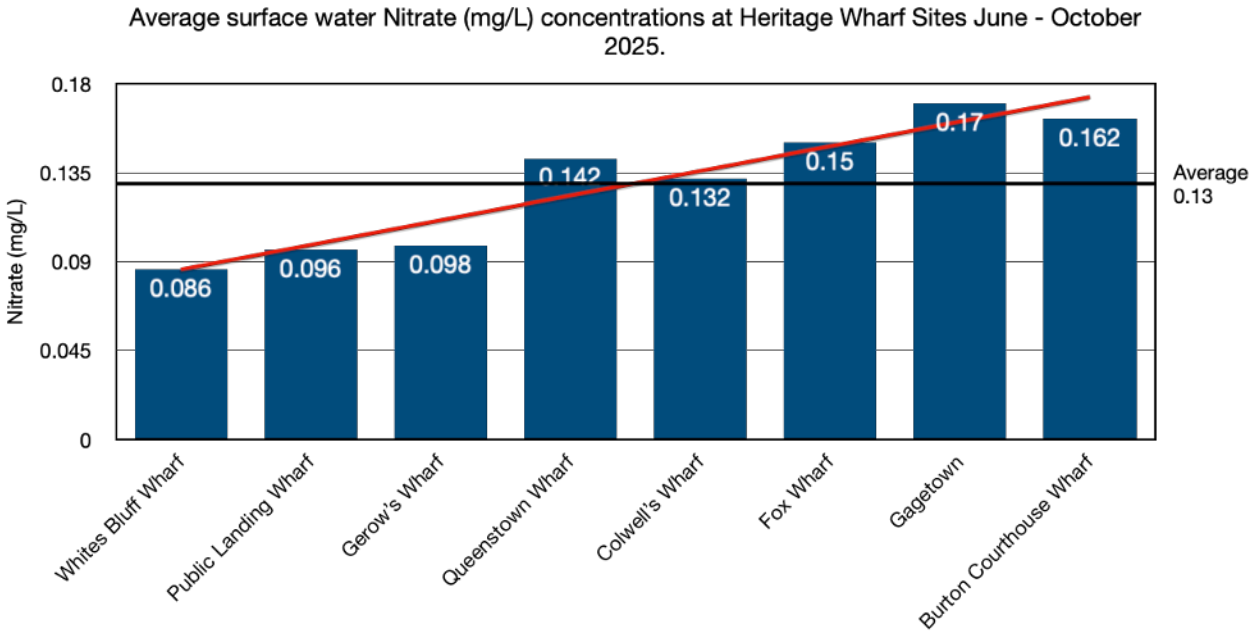


Figure 17: 2025 Average Nitrate (mg/L) Concentrations by Surface Water Sampling Site.

Nitrate levels at wharf sites were all well within the established CCME guidelines for the protection of aquatic life, (Canadian Council of Ministers of the Environment, 2012).

Metals

Metals occur naturally in aquatic ecosystems due to weathering of rocks and soils. Erosion via water is a primary source that transports metals into an aquatic ecosystem; other sources of metals include effluent discharge from wastewater, industry, and mining operations. Metals may be introduced into the atmosphere through burning and ore smelting and can be deposited in surface waters during rain events.

Several metals, including manganese (Mn), zinc (Zn), and copper (Cu), are essential to biochemical processes that sustain aquatic life. However, these same metals, and those such as arsenic (As), cadmium (Cd), lead (Pb) and mercury (Hg), can be severely toxic to aquatic organisms in high concentrations. The toxicity and bioavailability of many metals depend on their oxidation state and the form in which they occur. Dissolved metals are generally more bioavailable and toxic than metals bound in molecules or adsorbed to sediment particles. These characteristics of metals including solubility and toxicity are influenced by the chemical characteristics of water such as pH and dissolved oxygen levels.

As part of the SJRS's water quality monitoring program surface water samples were collected and analyzed for 31 metals often found in aquatic ecosystems. Most of the metals analyzed were in very low concentrations; however, some common metals found in groundwater such as iron (Fe), manganese (Mn), Magnesium (Mg), and Calcium (Ca), fluctuate over the field season due to rain events, freshet and groundwater influences in the river.

Analysis of calcium and magnesium levels revealed substantial variation across sites and seasons. Calcium ranged from approximately 10 mg/L to 160 mg/L, averaging 31.5 mg/L network-wide, with notably higher concentrations (up to 65 mg/L) at downstream, tidally influenced locations such as Whites Bluff and Public Landing, especially during late summer and early fall. Magnesium mirrored this pattern but with even more pronounced spikes, particularly at these same downstream sites, where averages reached 144–163 mg/L and individual values in October soared above 300 mg/L. Upstream areas like Gagetown and Burton Courthouse maintained much lower levels of both metals, indicating typical freshwater conditions and reflecting the strong influence of estuarine mixing at lower river sites (Figure 18).

Iron and manganese concentrations were generally low to moderate throughout the river network. Iron averaged around 0.19 mg/L, with most site-month values between 0.1 and 0.25 mg/L, within background levels for many rivers. Occasional spikes were noted, such as 0.62 mg/L at Fox Wharf, but these were isolated and not persistent. Manganese levels were even lower, with a network average of 0.034 mg/L and most sites falling between 0.016 and 0.041 mg/L. Slightly higher values occurred at Whites Bluff and Public Landing during June or October, likely due to seasonal hydrological changes, but overall, both metals were present at levels consistent with natural river systems and did not indicate contamination concerns (Figure 18).

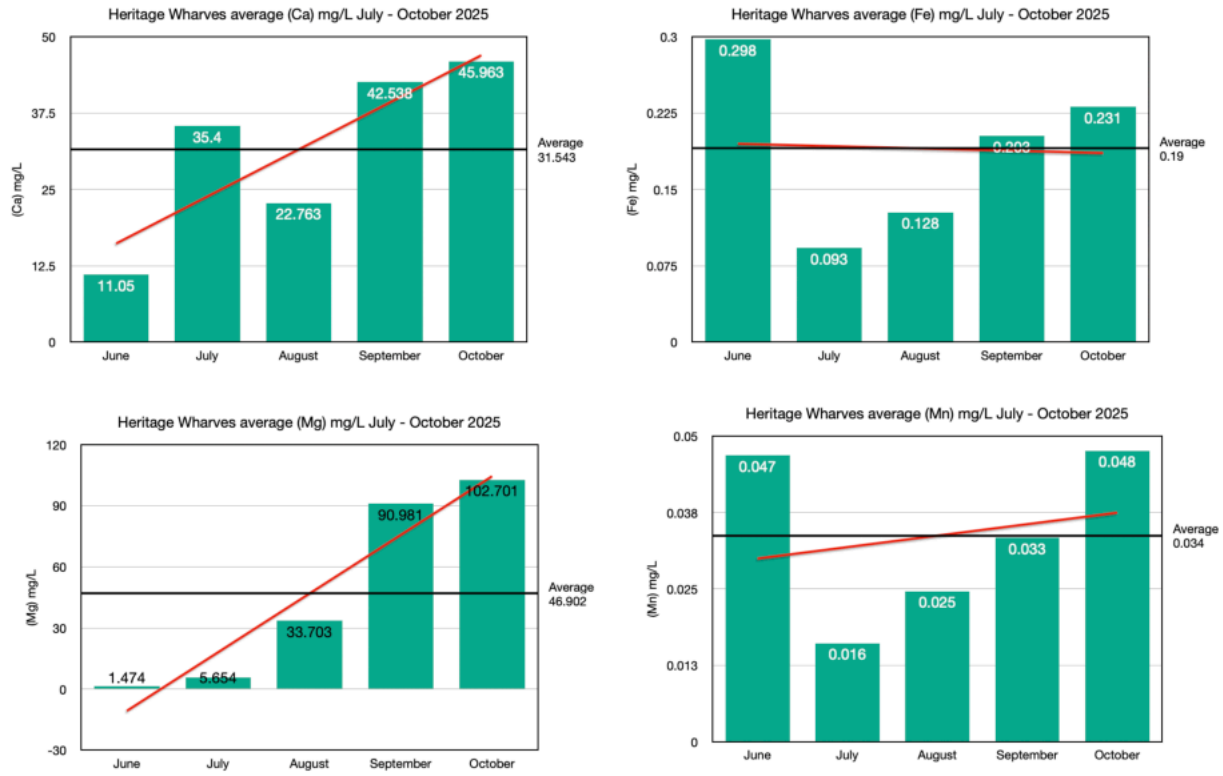


Figure 18: Average concentrations of Ca, Mg, Fe and Mn in surface waters at wharf sites July – October 2025.

Trace metals (arsenic, cadmium, and lead) were consistently found at extremely low concentrations across all sites and months. Arsenic typically measured in the microgram-per-liter range (0.0009–0.01 mg/L), with a network average of 0.0028 mg/L, and only minor, isolated increases observed at certain sites. Cadmium levels were mostly at or near the detection limit (0.000009–0.0001 mg/L), averaging just 0.0000266 mg/L, and lead concentrations were similarly low (0.00009–0.001 mg/L), with a network average of 0.00030 mg/L (Figure 19). These findings indicate that, while these metals are detectable, their concentrations remain well below guideline thresholds and do not point to any significant contamination, supporting the conclusion that metal management in the watershed is effective.

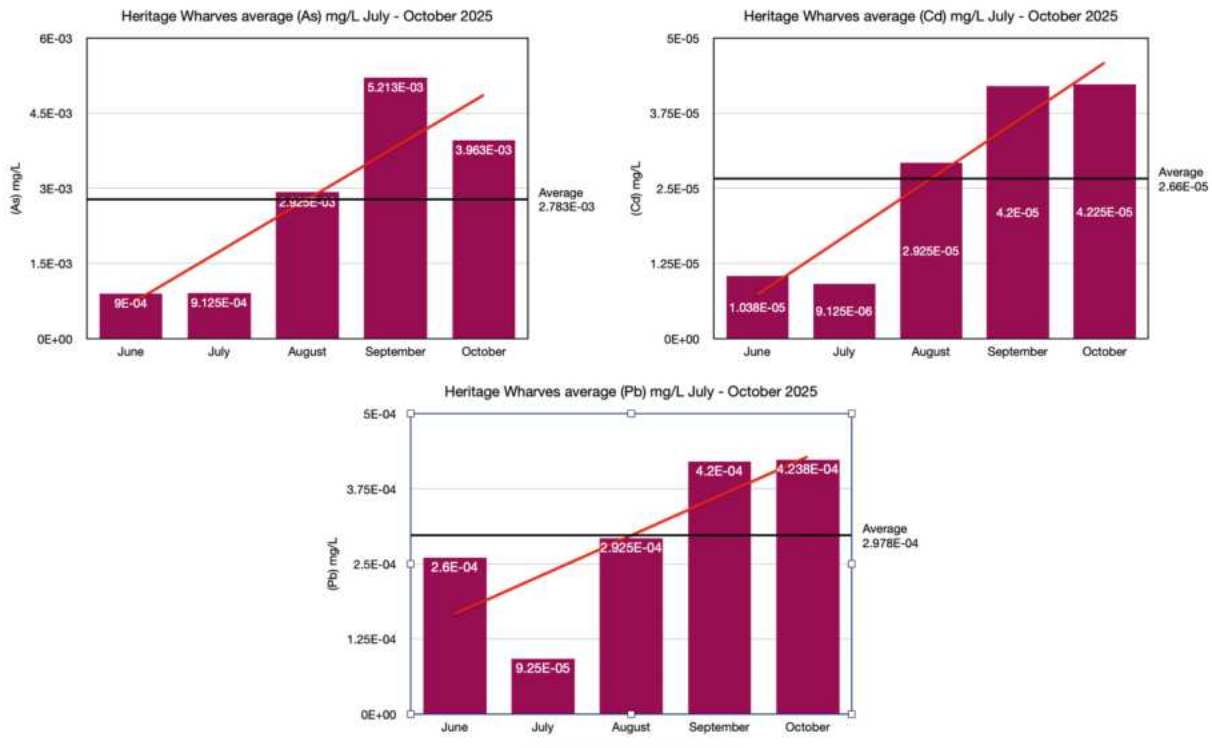


Figure 19: Average concentrations of As, Cd and Pb at wharf sites June – October 2025.

Water Quality Index

The Society employs a water quality index (WQI) to condense water quality data into a single score. The WQI for the Heritage Steamboat Wharves we examined in the Lower St. John (Wolastoq) River was determined using data collected throughout the field season by assessing the number of exceedances beyond guideline concentrations for the measured parameters. The index is categorized into five distinct levels based on the calculated score: excellent (95-100), good (80-94), fair (65-79), marginal (45-64), and poor (0-44).

In 2025, the Water Quality Index (WQI) values across the Heritage Steamboat Wharves ranged from approximately 86.4 to 92.5, with all sites falling within the "Good" category as defined by the CCME WQI classification. Fox Wharf achieved the highest score at 92.5, while Public Landing recorded the lowest at 86.4, resulting in an overall average WQI of 89.86 for the year (Figure 20). This represents a slight improvement compared to the 2024 average WQI of 87.1 (also Good), suggesting water quality remained robust along this stretch of the St. John River. Key physical and chemical parameters, such as temperatures around 18 to 20 °C, dissolved oxygen (DO) between 8 and 9.5 mg/L, and pH stable in the 7.6 to 7.8 range, all remained within thresholds generally considered healthy for aquatic life.

Examining the results by location, upstream or less-impacted sites such as Fox Wharf, Colwell's Wharf, Gagetown, and Burton Courthouse typically exhibited lower total dissolved solids (TDS) and conductivity, indicating fewer dissolved minerals and salts and reflecting a generally high

water quality. In contrast, more urban or estuarine-influenced sites like Whites Bluff Wharf and Public Landing Wharf displayed TDS values exceeding 4,000 mg/L and conductivity over 8,000 µS/cm, a sign of increased mineral and salt content due to tidal estuary influence and potential seawater intrusion. Despite these pronounced differences in salinity-related parameters, all sites maintained a Good WQI, demonstrating that, even where mineral content is high, other critical indicators such as dissolved oxygen, nutrients, bacteria, and metals remain within acceptable limits.

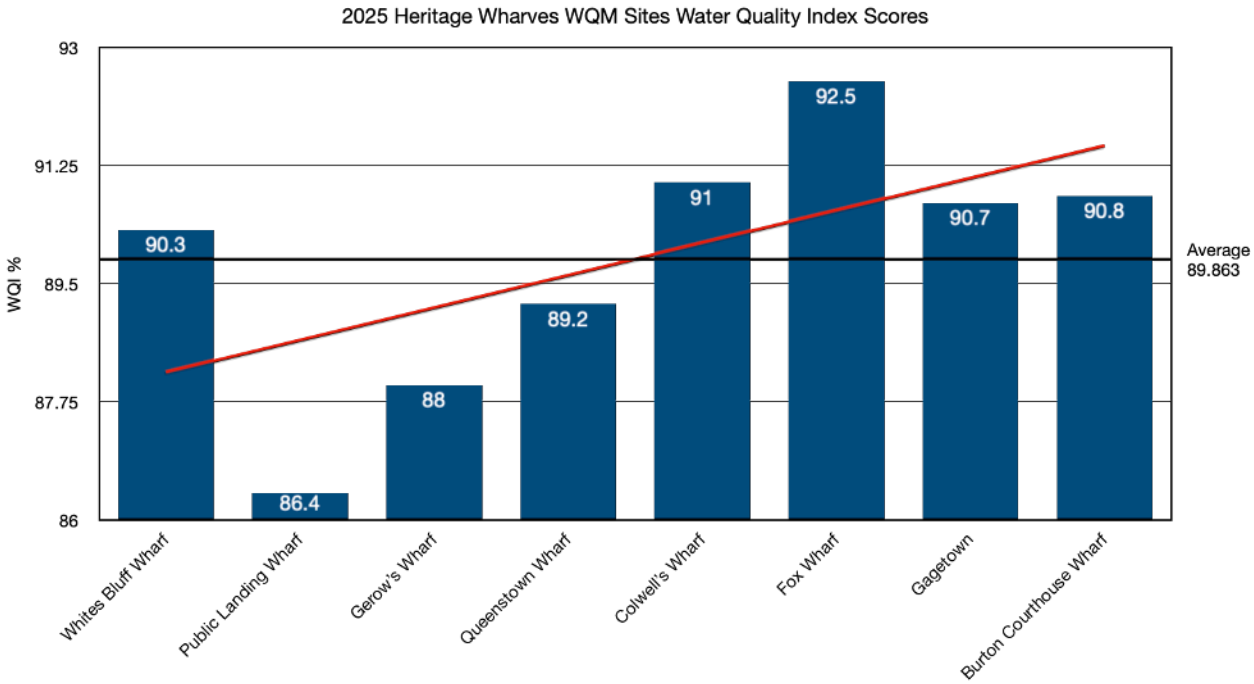


Figure 20: 2025 Heritage Steamboat Wharves Water Quality Index Scores by Sampling Site.

The summer of 2025 was marked by a historic drought in southern New Brunswick, which likely influenced these results. Prolonged dry conditions can lead to reduced river flows, concentrating dissolved substances such as minerals, nutrients, and even trace contaminants, particularly at downstream sites where tidal influences are already prominent. Lower water levels may have contributed to the observed increases in TDS and conductivity at estuarine locations and could have affected temperature and dissolved oxygen levels by reducing mixing and increasing water residence time. Conversely, the drought may also have limited nutrient and contaminant inputs from surface runoff, which tend to spike during wetter periods. Overall, while the WQI scores remained in the 'Good' range, it is essential to interpret these results in the context of the unusual hydrological conditions of 2025, recognising that drought can both mask and accentuate certain water quality trends.

Cyanobacteria Monitoring

Introduction: Cyanobacteria Monitoring

Cyanobacteria, also called blue-green algae, are a type of microscopic bacteria that occur in aquatic ecosystems. They are native and a natural part of aquatic ecosystems and can be found in New Brunswick's lakes, rivers, wetlands and marine ecosystems. As such, they are an essential part of aquatic ecosystems and form the basis of local food chains. Although cyanobacteria are present in aquatic ecosystems all the time, they are most conspicuous when they form large blooms on surface waters or mats on the substrate. These blooms and mats are the results of a combination of light, temperature, and primarily excess nutrients such as phosphorus and nitrogen that can build up in the water when rain events result in nutrient-rich run-off from agricultural fertilisers, septic systems and clear-cutting and development washing them into receiving waters like St. John (Wolastoq) River. In the lower River, blooms and mats likely occur in June and through to November when rain is prevalent and excess nutrients from runoff are transported into the River.

To assist the Society in this endeavour, we continued to employ Cyano sensor buoys provided by the HRAA. These buoys help monitor, detect, and collect data on cyanobacteria blooms. The sensor buoy provided real-time monitoring and data collection of key water quality parameters, including chlorophyll-a, phycocyanin, turbidity and water temperatures. The collection of these parameters can help us understand under what conditions and thresholds cyanobacteria blooms may form so that we can provide early warning to those using the river of a potential bloom event.

This sensor buoy was anchored in situ from June to October. The sensor buoy provided real-time monitoring and early detection of potentially harmful algal blooms (HABs) in this part of the river through the measurement of chlorophyll, phycocyanin, turbidity, water temperatures and other parameters. This monitoring and early warning system provides the Society with a new tool to better communicate and understand when and under what conditions promote the formation of cyanobacteria blooms and the risks associated with the cyanotoxin produced in the Lower River.

Methods: Cyanobacteria Monitoring Analysis

Between June and October 2025, the Society conducted cyanobacteria bloom monitoring at three heritage wharves: Gerow's, Belyea's and Fox, in the watershed to monitor cyanobacteria blooms occurring at these sites. At these sites, current environmental conditions were recorded, and water quality parameters were collected and determined with a YSI multi-parameter meter. The sampling location and GPS coordinates can be found in (Figure 21 and Appendix 1, Table 3,) respectively.

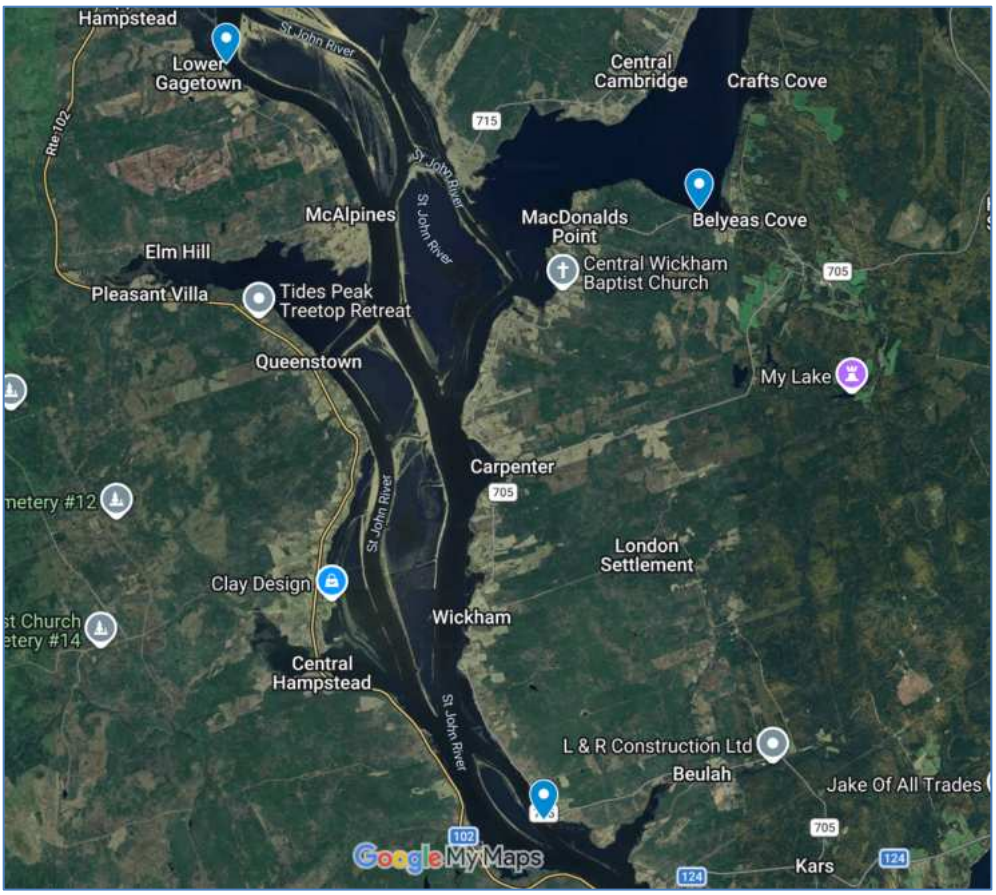


Figure 21: 2025 locations of cyanobacteria Bloom monitoring at heritage wharf sites.

To assist the Society in this endeavour, we continued to employ agal tracker sensor buoys provided by the HRAA. These buoys help monitor, detect, and collect data on cyanobacteria blooms. The sensor buoy provided real-time monitoring and data collection of key water quality parameters, including chlorophyll-a, phycocyanin, turbidity and water temperatures. The collection of these parameters can help us understand under what conditions and thresholds cyanobacteria blooms may form so that we can provide early warning to those using the river of a potential bloom event.

By measuring concentrations of phycocyanin concentrations. Phycocyanin is a blue pigment, and like chlorophyll-a, it captures light that plants use for photosynthesis. Specifically, phycocyanin assists the function of chlorophyll in photosynthesis, especially during low-light conditions. However, unlike chlorophyll-a, phycocyanin is only found in freshwater cyanobacteria (blue-green algae), whereas chlorophyll-a is found in all of plant life. By monitoring phycocyanin concentrations in the river's surface waters with the sensor buoy, we can detect increases in phycocyanin concentrations as a precursor to cyanobacteria bloom formation and provide early warning to the public.

To help us predict blooms, we also monitor Chlorophyll-a, a photosynthetic green pigment present in plants, phytoplankton, and cyanobacteria. Chlorophyll-a concentrations increase in the River when conditions are right (high nutrients, warm water, and sunny days). Monitoring and measuring Chlorophyll-a trends can help us predict when a bloom may be forming in the River at the three wharf locations.

Another factor in the formation of cyanobacteria blooms is turbidity. Turbidity is the measure of the relative clarity of surface water. The clearer the water, the lower the turbidity. Conversely, the cloudier the water, the higher the turbidity. Material that causes water to be turbid include clay and silt, inorganic and organic matter, algae, plankton, and other microscopic organisms. High concentrations of this material affect light penetration and ecological productivity, recreational values, water, and habitat quality. High turbidity helps heat the water, which aids bacteria and algae to grow. For this reason, turbidity readings can be used as an indicator of potential cyanobacteria blooms at the wharf sites. Turbidity is measured utilising a turbidity meter, giving nephelometric turbidity units (NTUs). For the health of aquatic life, turbidity should be lower than 10 NTU. A high turbidity measurement would be >100 NTU. Higher turbidity measurements are associated with cyanobacteria blooms and can be used with other measurements to predict potential cyanobacteria blooms.

Water temperature also plays a role in the formation of cyanobacteria blooms. Warmer water above 15 ^{o}C can promote the growth of algae and cyanobacteria. By monitoring surface water temperatures in conjunction with the other parameters, including chlorophyll-a, phycocyanin, and turbidity, can help us predict when a cyanobacteria bloom may form.

Results

Cyanobacteria blooms are of increasing concern in the St. John (Wolastoq) River. This concern was highlighted at our monitoring sites in 2025, with 285 unconfirmed cyanobacteria blooms based on the data from the three cyanobacteria buoys (Figure 22 & Appendix 7). This may indicate an increase in blooms. These unconfirmed blooms may originate upstream and are carried downstream by currents and are trapped by the steamboat wharves. Further, the river and lake in these areas are comparatively shallow. And potentially have higher surface water temperatures and nutrient content that create conducive conditions for blooms to occur. It should also be noted that the buoy sensors can potentially be affected by aquatic vegetation in shallow areas, which may help account for the high frequency of blooms reported.

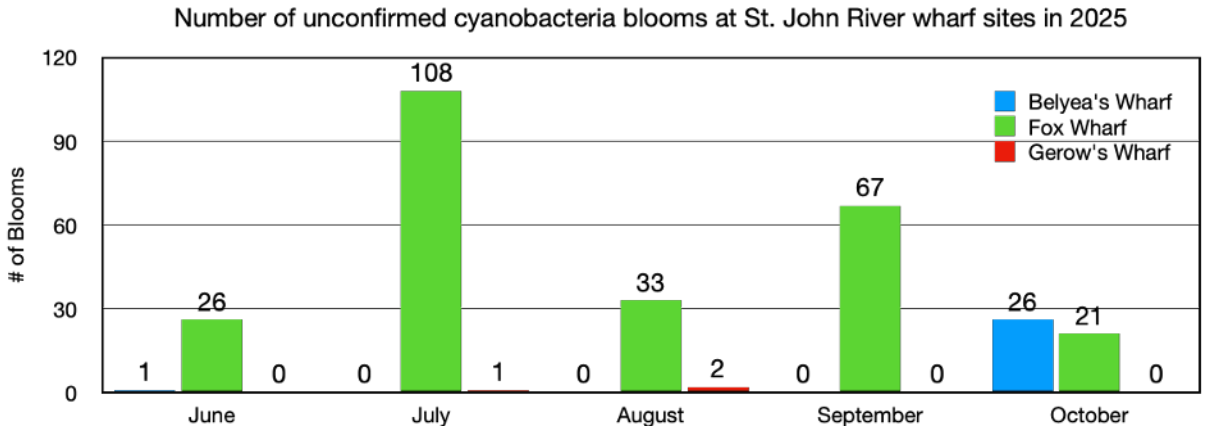


Figure 22: Number of Unconfirmed Cyanobacteria Blooms Observed at Wharf sites between June and November 2025.

The results highlight differences between the three sites. Fox Wharf stands out as the most biologically active and impacted location, characterized by much higher concentrations of algae and cyanobacterial pigments. Specifically, Fox Wharf consistently exhibits average Chlorophyll-A levels five times greater and Phycocyanin concentrations fifteen times higher than those measured at Gerow's Wharf. This site was identified as a "hotspot" for algal activity, with frequent and at times intense blooms dominating its water column Figures 23 & 24.

In contrast, Gerow's Wharf records the highest average surface water temperatures among the three sites. Despite these warmer conditions, it maintains the lowest overall algal biomass. This suggests that factors other than temperature, such as nutrient availability or water flushing, are likely restricting phytoplankton growth at this location.

Fox Wharf displayed heightened algal activity, with the analysis identifying several major bloom events where Phycocyanin concentrations exceeded 500 RFU. Notable among these were a mid-July bloom, peaking on July 17 with Phycocyanin levels reaching 1,257 RFU, and a late-season bloom in mid-October (October 16), which saw Phycocyanin spike to 1,162 RFU despite the water temperature dropping to around 10°C. These findings highlight Fox Wharf's susceptibility to blooms even during cooler periods, pointing to the influence of factors such as nutrient influx or seasonal cycles.

Belyea's Wharf, on the other hand, experienced episodic bloom events. The most significant was observed in early June (June 11–12), when Phycocyanin concentrations increased to 1,144 RFU. While these blooms were shorter in duration than those seen at Fox Wharf, their intensity was comparable, indicating that Belyea's is prone to sporadic yet significant cyanobacterial outbreaks. Gerow's Wharf displayed minimal bloom activity. The most notable event occurred in late August (August 30), with Phycocyanin peaking at 216 RFU and Chlorophyll-A reaching 312 RFU. These values are significantly lower than those observed at Fox and Belyea's, underscoring the relative stability of Gerow's Wharf and its limited algal productivity, which is largely restricted to the warmest weeks of summer.

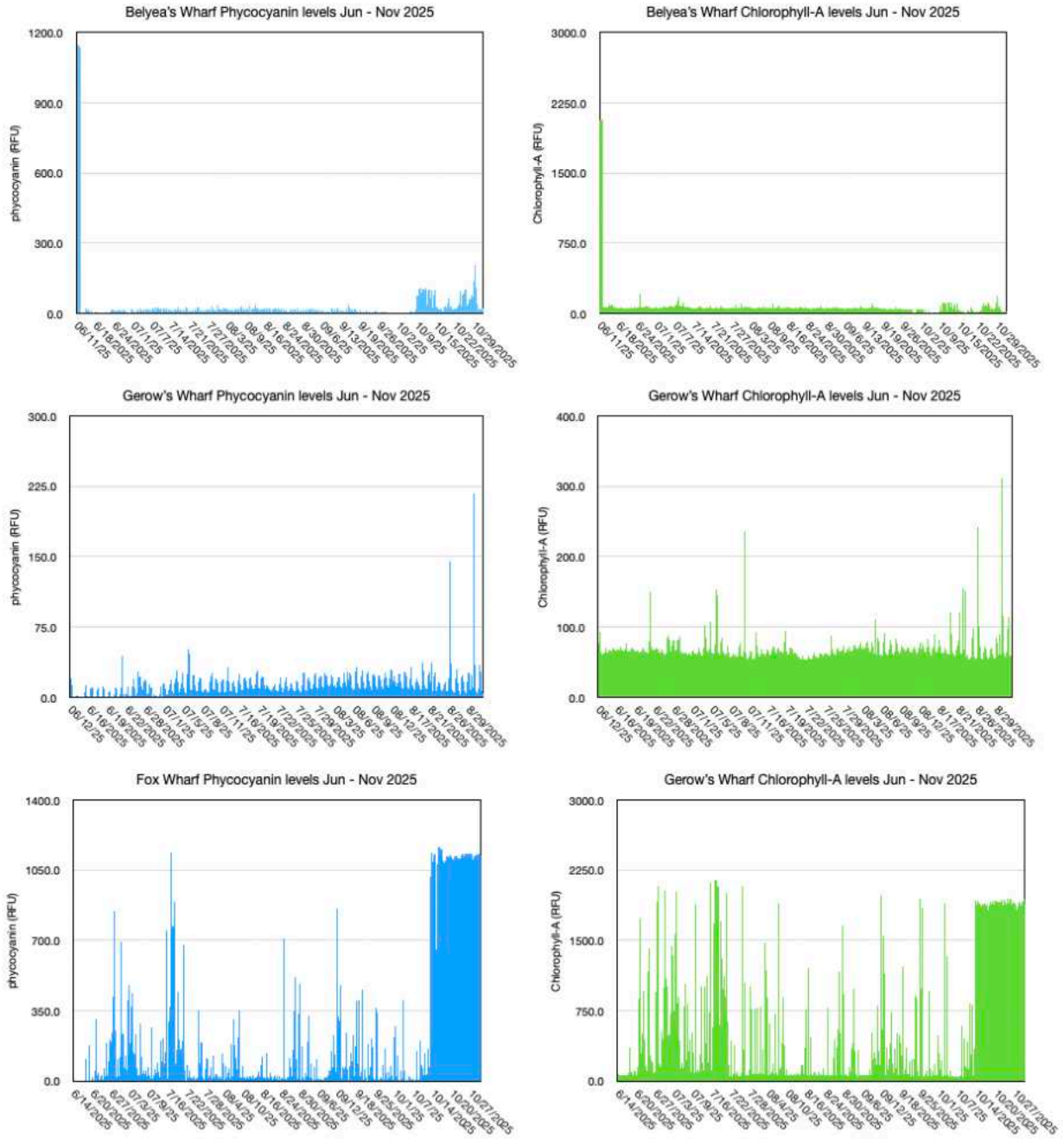


Figure 23: Cyanobacteria Buoys Phycocyanin and Chlorophyll-A levels observed in surface water from June to Nov 2025.

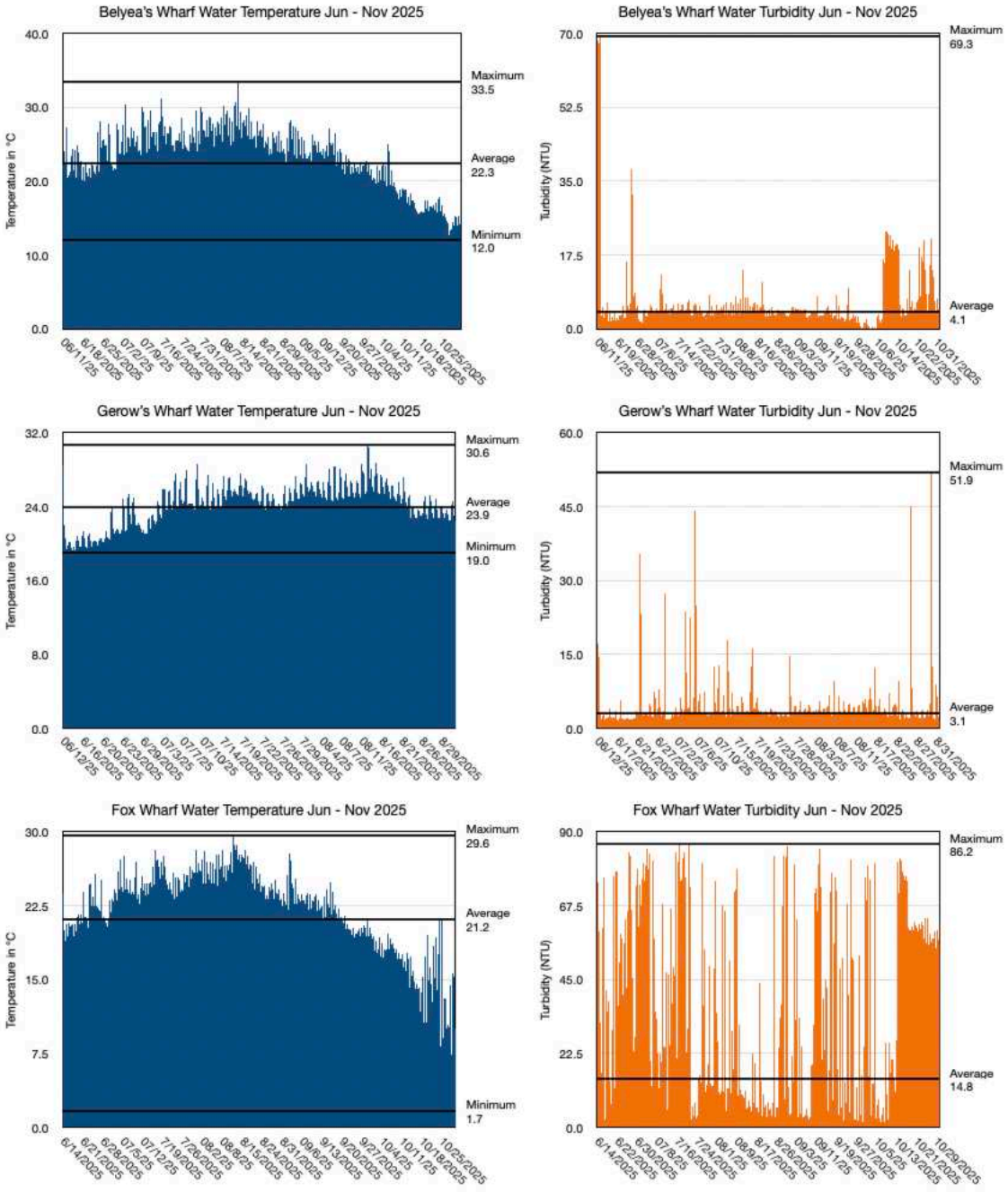


Figure 24: Cyanobacteria Buoys Temperature and Turbidity levels observed in surface water from June to Nov 2025.

Statistical analysis of the relationships between key parameters provides insight into the drivers of water quality at each site. Across all locations, a strong positive correlation (r = 0.78 to 0.92) exists between Phycocyanin/Chlorophyll-A and Turbidity, indicating that the cloudiness of the water is possibly due to organic algal biomass rather than suspended solids such as mud or silt (Figure 25). Though this is unlikely regularly as wave, wind and boat activity are more likely candidates as driver of turbidity in the river system. At sites with high biomass, such as Fox and Belyea's, Phycocyanin and Chlorophyll-A are nearly perfectly correlated (r > 0.96), suggesting that cyanobacteria dominate the phytoplankton community during bloom periods (Figure 25).

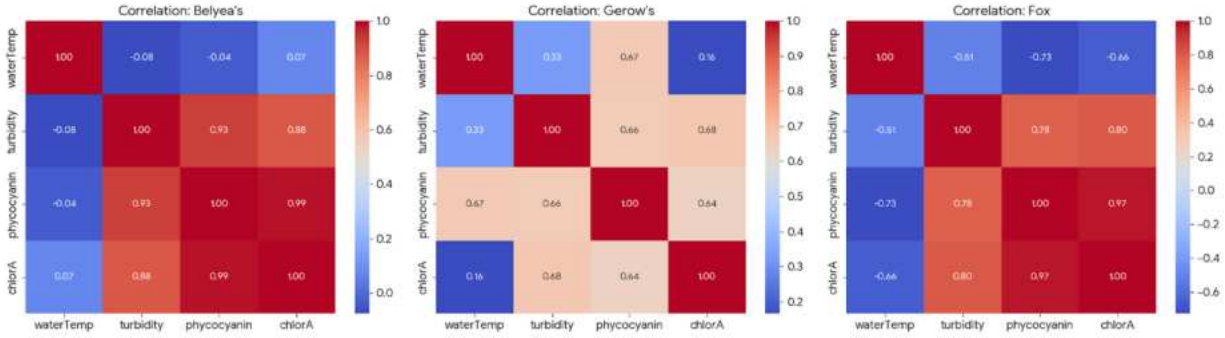


Figure 25: Results of Pearson Product Correlation of key parameters from Cyano Buoys at Wharf sites along the St. John River in 2025.

Temperature also plays a nuanced role. At Gerow's Wharf, there is a strong positive correlation between Phycocyanin and surface water temperature (r = 0.67), indicating that heat is potentially a key driver of the smaller summer blooms. Conversely, at Fox Wharf, a strong negative correlation (r = -0.73) is observed, likely because the most significant blooms occurred during colder autumn conditions, suggesting that nutrient availability or seasonal cycles are more influential than temperature at this site (Figure 25).

Additionally, a One-Way ANOVA (Analysis of Variance) was conducted to determine if there are statistically significant differences between the three buoy sites (Belyea's Wharf, Fox Wharf, and Gerow's Wharf) for each of the core water quality parameters. Results of this analysis indicate that:

1. Highly Significant Differences: For all four parameters, the p-values are extremely close to zero (Table 2). This indicates that the variations in water quality (algal concentrations, clarity, and temperature) are not random; they are strongly tied to the specific geographic location and local environmental conditions of each wharf.

2. Turbidity & Chlorophyll-A: These variables show the highest F-statistics (1185.0 and 854.35, respectively) (Table 2). This indicates that the most dramatic differences between the three sites are related to water clarity and total phytoplankton biomass, primarily driven by the high levels found at Fox Wharf.

3. Degrees of Freedom (*df*): The high "Within-Group" degrees of freedom (*df*) reflects the large volume of data points analyzed (30-minute intervals over several months), which provides high statistical power to detect even small differences between the sites (Table 2).

Table 2: 2025 Results of one-way ANOVA conducted for wharf cyanobacteria bloom monitoring sites.

Variable	df (Between, Within)	F-Statistic	P-Value	Significance
Water Temperature	(2, 16658)	554.95	4.78 \times 10^{-234}	p<0.001
Turbidity	(2, 16658)	1185.10	< 0.0001	p<0.001
Phycocyanin	(2, 16658)	680.40	9.06 \times 10^{-285}	p<0.001
Chlorophyll-A	(2, 16658)	854.35	< 0.0001	p<0.001

Overall, monitoring at Belyea's Wharf, Fox Wharf, and Gerow's Wharf in 2025 shows that Fox Wharf is a potential hotspot with by far the greatest algal and cyanobacterial biomass, driving severe, frequent blooms and strongly elevated turbidity, including significant events that continue into cooler autumn conditions. Belyea's Wharf experiences more episodic but sometimes very intense blooms, while Gerow's Wharf remains comparatively stable and low-biomass despite being the warmest site, implying that factors like nutrient supply or flushing, rather than temperature alone, limit productivity there. Strong positive correlations between pigments (Chlorophyll-A and Phycocyanin) and turbidity indicate that the cloudiness of the water is possibly due to organic algal biomass rather than suspended solids such as mud or silt. Though this is unlikely to occur regularly, as wave, wind and boat activity are more likely candidates as drivers of turbidity in the river system. Further, a tight coupling between pigments at high-biomass sites indicates cyanobacteria dominance during bloom conditions. ANOVA tests confirm statistically significant differences among all three sites ($p < 0.001$) support managing them as distinct ecological zones, with Fox Wharf requiring particular attention due to its persistent, high-intensity bloom risk. It is recommended that further monitoring be conducted to clarify the links or lack thereof, between sites and parameters.



Conclusions

The 2025 St. John River Society Water Quality Monitoring and Wake Aware Program builds on the inaugural 2024 season and provides a more robust picture of conditions at the heritage steamboat wharves in the lower St. John (Wolastoq) River between Fredericton and Westfield. Despite historic drought, unusually high summer air temperatures, and reduced river flows in 2025, water quality at the monitored wharf sites generally remained within Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of aquatic life and recreational use.

Across the eight heritage wharf sites, water temperature, dissolved oxygen, pH, and microbial water quality (E. coli) collectively indicate a system that is stressed by climate variability but still resilient. Surface water temperatures followed a typical seasonal pattern, rising from approximately 17–18 °C in June to 24–25 °C in midsummer, then declining to around 11–12 °C by October. These elevated summer temperatures did not translate into chronic oxygen depletion: dissolved oxygen concentrations averaged around 8.7 mg/L and remained largely above guideline thresholds, with percent saturation typically near or above 90%. This combination suggests that, even under drought and heat, oxygen availability was generally sufficient to support aquatic life.

Microbial indicators showed similarly encouraging results. Average E. coli concentrations at all wharves were well below Health Canada recreational guidelines, and no site recorded exceedances of the single-sample guideline value. Although short-term increases were observed at some locations (e.g., Burton Courthouse and Queenstown), these were modest and episodic rather than chronically elevated. DNA-based source tracking at selected sites (Fox, Gerow's, and Gagetown Wharves) did, however, indicate the presence of human, livestock, poultry, and dog-related markers, indicating that multiple faecal sources contribute to background contamination. In particular, Gerow's and Gagetown Wharves exhibited strong human and agricultural signals, underscoring the importance of managing wastewater and runoff inputs even where E. coli counts remain within recreational standards.

Nutrient data continue to characterise the lower river as moderately enriched (mesotrophic). Total phosphorus concentrations at the wharf sites were consistently in the mesotrophic range, with higher values and occasional spikes at some locations (notably Fox and Colwell's Wharves during early summer). Nitrate concentrations remained low to moderate and well below CCME guidelines, with slightly higher levels at mid-river sites such as Gagetown and Queenstown. Together, these results indicate a system that is productive but not yet experiencing widespread, severe eutrophication. Nevertheless, the combination of mesotrophic nutrient status, warming temperatures, and ongoing land-use pressures (agriculture, shoreline development, degraded riparian zones, and wastewater discharges) suggests that the system is vulnerable to further enrichment and associated water quality declines if mitigations are not pursued.

Physical and chemical indicators of clarity and mineral content also highlight important spatial patterns. Turbidity remained low overall, with most values near or below 2 NTU, pointing to generally clear water and limited sediment loading during the drought-dominated 2025 season. In contrast, total dissolved solids, conductivity, and major ions (e.g., calcium, magnesium, sodium, chloride) showed very strong gradients from upstream to downstream, with markedly higher

concentrations at Whites Bluff and Public Landing compared to sites such as Gagetown and Burton Courthouse. These patterns are consistent with estuarine mixing and increased marine influence in the lower river rather than localised pollution. The drought likely accentuated these gradients by reducing freshwater inflow and dilution but did not result in guideline exceedances for key parameters.

Metal analyses further support the conclusion that, at present, industrial or mining-related metal contamination is not a dominant stressor at the heritage wharves. Calcium and magnesium exhibited large spatial variation driven largely by natural geology and estuarine processes, while iron and manganese remained generally low to moderate and within ranges typical of mineral-rich river systems. Potentially toxic trace metals (arsenic, cadmium, lead) were consistently detected at very low concentrations, often near analytical detection limits and well below water quality guideline values.

Water Quality Index (WQI) scores integrate these multiple lines of evidence into a single metric. In 2025, WQI values across the wharf network ranged from roughly 86.4 to 92.5, with all sites classified as "Good" and the system-wide average (≈89.9) slightly higher than the 2024 average (87.1). Upstream or less estuarine-influenced sites (Fox, Colwell's, Gagetown, Burton Courthouse) tended to combine lower dissolved solids and conductivity with consistently strong dissolved oxygen and acceptable nutrient and bacteria levels, whereas downstream sites (Whites Bluff and Public Landing) displayed much higher conductivity and TDS due to tidal influence and seawater intrusion. Importantly, even where salinity-related parameters were elevated, other indicators remained within guideline ranges, supporting the overall "Good" classification.

In parallel with the core water quality monitoring, the Society's cyanobacteria program and use of Cyanobacteria monitoring buoys provided new insight into bloom dynamics and bloom risk at Gerow's, Fox, and Belyea's Wharves. In 2025, 285 unconfirmed cyanobacteria blooms were logged across the three buoy sites, indicating frequent bloom-like conditions and suggesting that the lower river is increasingly susceptible to cyanobacterial proliferation. Fox Wharf emerged as a clear hotspot, with chlorophyll-a concentrations approximately five times higher and phycocyanin concentrations roughly fifteen times higher than at Gerow's Wharf, and multiple major bloom events where phycocyanin exceeded 500 RFU (including large events in mid-July and mid-October). Belyea's Wharf experienced shorter but intense episodic blooms, while Gerow's Wharf showed comparatively low algal biomass despite having the highest average surface water temperatures.

Statistical analyses reinforce the picture of site-specific bloom drivers. Strong positive correlations between pigments (chlorophyll-a and phycocyanin) and turbidity suggest that, during bloom periods, water cloudiness is often driven by algal biomass rather than suspended sediments, particularly at Fox and Belyea's Wharves. At high-biomass sites, pigments are tightly coupled ($r > 0.96$), indicating cyanobacterial dominance during bloom conditions. Temperature–pigment relationships differ among sites: at Gerow's, phycocyanin correlates positively with temperature, implying that warmth is an important driver of the smaller blooms observed there, whereas at Fox Wharf, a negative correlation between bloom intensity and temperature points to the influence of nutrient availability, hydrodynamics, and seasonal cycles, with substantial blooms occurring even as temperatures decline in autumn.

Taken together, the 2025 results show that:

1. The monitored heritage wharf sites currently exhibit Good overall water quality and generally meet aquatic life and recreational guidelines.
2. The river is nutrient-enriched but not yet severely eutrophic, with mesotrophic conditions that support productivity while leaving limited buffer against further nutrient inputs.
3. Climate extremes (drought, heat) and estuarine processes are important modifiers of water quality, affecting temperature, salinity, and dilution capacity.
4. Localized faecal inputs from human, agricultural, and domestic animal sources are present and detectable via eDNA, even where E. coli counts remain below recreational thresholds.

In conclusion, the success of our projects in 2025 highlights the importance of stakeholder involvement in environmental stewardship. By fostering a deeper understanding of water quality issues and their implications, we can empower stakeholders to take meaningful action in the protection and restoration of the St. John (Wolastoq) River. A collaborative approach is essential for mitigating the effects of development and ensuring the long-term health of our aquatic ecosystems. Through concerted efforts, we can work towards a more sustainable future for the St. John (Wolastoq) River, wherein all stakeholders actively contribute to the preservation of their river and its natural and water resources for future generations.

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Appendix 1 – Locations and GPS coordinates for 2025 sampling and monitoring sites.

Table 3: Locations and GPS coordinates in Decimal Degrees for the eight heritage steamboat wharves' water quality monitoring sampling sites.

WQ Site #	Watercourse	Location Description	GPS Coordinates (Decimal Degrees)
Site 1	St. John River	Whites Bluff Wharf	45.46077, -66.10787
Site 2	St. John River	Public Landing Wharf	45.40682, -66.19475
Site 3	St. John River	Gerows Wharf (Replicate Sample Collected Here) (E.coli eDNA Site)	45.60907, -66.05431
Site 4	St. John River	Queenstown Wharf	45.68882, -66.10834
Site 5	St. John River	Colwells Wharf	45.72237, -66.07713
Site 6	St. John River	Fox Wharf (E.coli eDNA Site)	45.74233, -66.13471
Site 7	St. John River	Gagetown (E.coli eDNA Site)	45.78817, -66.14431
Site 8	St. John River	Burton Courthouse Wharf	45.86399, -66.44915

Table 4: Locations and GPS coordinates in Decimal Degrees for the Cyanobacteria monitoring Buoys.

CB Site #	Watercourse	Location Description	GPS Coordinates (Decimal Degrees)
Site 1	St. John River	Gerows Wharf	45.60907, -66.05431
Site 2	Washedamoak Lake	Belyea's Wharf	45.71674, -66.01549
Site 3	St. John River	Fox Wharf	45.74237, -66.13475

Appendix 2 – 2025 field data collected from the eight water quality monitoring sites on the St. John (Wolastoq) River

Table 5: 2025water quality field data.

Site	Date	DELG Number	Temperature (°C)	Conductivity (µs/cm)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	pH	Secchi Depth (m)	Turbidity (NTU)
Site 1	June 13, 2025	17/25/22000	17.3	116	123.4	11.80	7.3	2.0	2.4
Site 2	June 13, 2025	17/25/22001	17.5	112	0.05	0.05	7.3	2.0	1.3
Site 3	June 13, 2025	17/25/22002/3	17.3	79	114.1	10.92	7.5	2.0	1.4
Site 4	June 13, 2025	17/25/22004	18.0	78	112.0	10.57	7.5	2.0	2.2
Site 5	June 13, 2025	17/25/22005	17.3	81	116.4	11.44	7.5	2.0	5.0
Site 6	June 13, 2025	17/25/22006	17.8	82	112.2	11.43	7.5	2.0	4.4
Site 7	June 13, 2025	17/25/22007	17.7	93	107.1	10.12	7.5	2.0	2.1
Site 8	June 13, 2025	17/25/22008	18.2	78	91.7	8.56	7.4	2.0	2.5
Site 1	July 18, 2025	17/25/22009	25.5	827	91.5	8.06	7.7	2.0	0.8
Site 2	July 18, 2025	17/25/22010	22.5	1050	86.9	7.64	7.7	2.0	0.5
Site 3	July 18, 2025	17/25/22011/12	23.2	112	85.6	7.36	7.7	2.0	0.9
Site 4	July 18, 2025	17/25/22013	23.9	115	90.6	7.81	7.8	2.0	0.7
Site 5	July 18, 2025	17/25/22014	24.0	115	80.9	7.68	7.8	2.0	0.8
Site 6	July 18, 2025	17/25/22015	24.0	115	96.8	7.87	7.8	2.0	1.0
Site 7	July 18, 2025	17/25/22016	24.1	115	95.7	6.12	7.8	2.0	0.7
Site 8	July 18, 2025	17/25/22017	24.3	118	95.1	8.07	7.8	1.5	1.6
Site 1	August 14, 2025	17/25/22018	23.5	6090	96.7	8.26	7.7	2.0	1.6
Site 2	August 14, 2025	17/25/22019	22.5	7700	103.7	9.36	7.7	2.0	1.6
Site 3	August 14, 2025	17/25/22020/21	23.9	719	110.6	10.6	7.6	2.0	1.0
Site 4	August 14, 2025	17/25/22022	24.8	91	105.7	9.3	7.8	2.0	0.8
Site 5	August 14, 2025	17/25/22023	25.5	94	89.0	7.4	7.6	2.0	1.1
Site 6	August 14, 2025	17/25/22024	25.6	94	101.5	8.7	7.8	2.0	0.7
Site 7	August 14, 2025	17/25/22025	25.8	94	87.9	7.05	7.8	2.0	0.9
Site 8	August 14, 2025	17/25/22026	25.5	95	97.7	9.08	7.8	2.0	1.2

Site 1	September 22, 2025	17/25/22027	17.1	15400	98.2	9.08	7.7	2.0	0.9
Site 2	September 22, 2025	17/25/22028	17.1	16100	101.4	9.12	7.8	2.0	1.1
Site 3	September 22, 2025	17/25/22029/30	17.9	6620	97.3	9.02	7.6	2.0	1.0
Site 4	September 22, 2025	17/25/22031	16.8	1050	83.2	7.96	7.7	1.0	3.1
Site 5	September 22, 2025	17/25/22032	19.3	847	91.7	8.39	7.7	2.0	0.9
Site 6	September 22, 2025	17/25/22033	18.7	186	92.7	8.69	7.8	2.0	0.7
Site 7	September 22, 2025	17/25/22034	18.2	102	87.9	8.24	7.8	2.0	0.8
Site 8	September 22, 2025	17/25/22035	18.4	103	89.4	8.26	7.8	2.0	0.8
Site 1	October 30, 2025	17/25/22036	11.7	18400	88.7	8.75	7.6	2.0	1.7
Site 2	October 30, 2025	17/25/22037	11.0	18500	90.7	9.46	7.8	2.0	1.2
Site 3	October 30, 2025	17/25/22038/39	11.4	3830	90.2	9.73	7.7	2.0	0.8
Site 4	October 30, 2025	17/25/22040	11.3	1810	76.6	8.50	7.6	2.0	1.3
Site 5	October 30, 2025	17/25/22041	11.6	2050	126.2	9.48	7.6	2.0	1.4
Site 6	October 30, 2025	17/25/22042	10.9	210	87.5	9.56	7.8	2.0	1.8
Site 7	October 30, 2025	17/25/22043	11.5	127	75.1	8.16	7.9	2.0	1.1
Site 8	October 30, 2025	17/25/22044	11.6	116	98.2	10.53	7.8	2.0	1.2

Appendix 3 – 2025 Water chemistry data from the analysis of surface water samples collected from the eight-water quality monitoring sites on the St. John (Wolastoq) River

Table 6: Steamboat Wharf RPC water chemistry data 2025.

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Units	Reporting Limit
Date Sampled:	June 13, 2025	June 13, 2025	June 13, 2025	June 13, 2025	June 13, 2025	June 13, 2025	June 13, 2025	June 13, 2025		
Analytes										
Sodium	8.18	7.05	3.16	2.93	2.94	3.07	3.07	3.46	**mg/L**	**0.05**
Potassium	0.74	0.59	0.44	0.41	0.42	0.45	0.43	0.44	**mg/L**	**0.02**
Calcium	10.9	11.5	10.4	10.5	10.9	11.8	12.6	9.84	**mg/L**	**0.05**
Magnesium	1.92	1.83	1.30	1.29	1.31	1.41	1.49	1.24	**mg/L**	**0.01**
Alkalinity (as $CaCO_3$)	30	31	28	28	30	32	36	28	**mg/L**	**2**
Chloride	13.8	12.9	4.3	4.0	4.1	4.3	4.7	5.2	**mg/L**	**0.5**
Fluoride	0.21	0.23	0.21	0.20	0.21	0.23	0.30	0.25	**mg/L**	**0.05**
Sulfate	4	2	5	4	5	4	< 1	< 1	**mg/L**	**1**
Bromine	0.04	0.04	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	**mg/L**	**0.01**
Ammonia (as N)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	**mg/L**	**0.05**
Un-ionized @ 20ºC	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**-**
Nitrate + Nitrite (as N)	0.14	0.16	0.13	0.11	0.09	0.13	0.17	0.11	**mg/L**	**0.05**
Nitrite (as N)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	**mg/L**	**0.05**
Nitrate (as N)	0.14	0.16	0.13	0.11	0.09	0.13	0.17	0.11	**mg/L**	**0.05**
Nitrogen - Total	0.6	0.6	0.6	0.9	0.8	0.7	0.7	0.7	**mg/L**	**0.2**
Phosphorus - Total	0.028	0.024	0.027	0.028	0.065	0.090	0.025	0.034	**mg/L**	**0.002**
Carbon - Total Organic	6.8	6.6	7.0	7.0	7.2	7.2	6.8	8.7	**mg/L**	**0.5**
Colour	48	42	52	51	48	55	43	82	**TCU**	**5**
Conductivity	116	112	79	78	81	82	93	78	**µS/cm**	**1**
pH	7.3	7.3	7.5	7.5	7.5	7.5	7.5	7.4	**units**	**-**
Turbidity	2.4	1.3	1.4	2.2	5.0	4.4	2.1	2.5	**NTU**	**0.1**
Calculated Parameters										
Bicarbonate (as $CaCO_3$)	29.9	30.9	27.9	27.9	27.9	29.9	31.9	35.9	**mg/L**	**-**
Carbonate (as $CaCO_3$)	0.056	0.058	0.083	0.083	0.083	0.089	0.095	0.107	**mg/L**	**-**
Hardness (as $CaCO_3$)	35.1	36.3	31.3	31.5	31.5	32.6	35.3	37.6	**mg/L**	**0.2**
TDS (calc)	66	62	50	50	48	51	53	52	**mg/L**	**-**
Saturation pH (20°C)	8.8	8.8	8.9	8.8	8.8	8.8	8.7	8.7	**units**	**-**
Langelier Index (20°C)	-1.51	-1.47	-1.35	-1.35	-1.34	-1.30	-1.24	-1.16	**-**	**-**
Date Sampled:	July 18, 2025	July 18, 2025	July 18, 2025	July 18, 2025	July 18, 2025	July 18, 2025	July 18, 2025	July 18, 2025		

Analytes										
Sodium	112.	147.	3.92	3.73	3.68	3.65	3.83	4.07	**mg/L**	**0.05**
Potassium	4.46	5.62	0.54	0.53	0.55	0.53	0.58	0.57	**mg/L**	**0.02**
Calcium	19.8	21.2	16.0	16.5	16.5	16.0	16.2	17.0	**mg/L**	**0.05**
Magnesium	14.8	18.5	2.01	2.00	1.97	1.95	1.97	2.03	**mg/L**	**0.01**
Alkalinity (as $CaCO_3$)	43	44	44	46	49	47	47	48	**mg/L**	**2**
Chloride	205	261	5.7	4.4	4.4	4.7	4.6	5.2	**mg/L**	**0.5**
Fluoride	0.39	0.45	0.31	0.28	0.24	0.27	0.28	0.27	**mg/L**	**0.05**
Sulfate	34	41	4	5	4	4	5	5	**mg/L**	**1**
Bromine	0.67	0.86	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	**mg/L**	**0.01**
Ammonia (as N)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	**mg/L**	**0.05**
Un-ionized @ 20ºC	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**-**
Nitrate + Nitrite (as N)	0.17	0.20	0.17	0.17	0.18	0.19	0.18	0.18	**mg/L**	**0.05**
Nitrite (as N)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	**mg/L**	**0.05**
Nitrate (as N)	0.17	0.20	0.17	0.17	0.18	0.19	0.18	0.18	**mg/L**	**0.05**
Nitrogen - Total	0.4	0.4	0.4	0.4	0.4	0.5	0.4	0.4	**mg/L**	**0.2**
Phosphorus - Total	0.021	0.017	0.016	0.017	0.016	0.024	0.022	0.023	**mg/L**	**0.002**
Carbon - Total Organic	7.2	7.1	7.4	7.7	7.6	7.6	7.8	7.9	**mg/L**	**0.5**
Colour	31	29	32	30	33	30	33	33	**TCU**	**5**
Conductivity	827	1050	112	115	115	115	115	118	**µS/cm**	**1**
pH	7.7	7.7	7.7	7.8	7.8	7.8	7.8	7.8	**units**	**-**
Turbidity	0.8	0.5	0.9	0.7	0.8	1.0	0.7	1.6	**NTU**	**0.1**
Calculated Parameters										
Bicarbonate (as $CaCO_3$)	42.8	43.8	43.8	45.7	48.7	46.7	46.7	47.7	**mg/L**	**-**
Carbonate (as $CaCO_3$)	0.202	0.206	0.206	0.271	0.289	0.277	0.277	0.283	**mg/L**	**-**
Hardness (as $CaCO_3$)	110	129	48.2	49.4	49.3	48.0	48.6	50.8	**mg/L**	**0.2**
TDS (calc)	425	530	68	69	70	68	70	72	**mg/L**	**-**
Saturation pH (20°C)	8.5	8.5	8.5	8.5	8.4	8.5	8.5	8.4	**units**	**-**
Langelier Index (20°C)	-0.81	-0.79	-0.78	-0.65	-0.62	-0.66	-0.65	-0.62	**-**	**-**
Date Sampled:	August 14, 2025	August 14, 2025	August 14, 2025	August 14, 2025	August 14, 2025	August 14, 2025	August 14, 2025	August 14, 2025		
Analytes										
Sodium	964.	1190	97.9	3.47	3.32	3.26	3.13	3.20	**mg/L**	**0.05**
Potassium	34.3	44.4	4.04	0.50	0.52	0.53	0.49	0.58	**mg/L**	**0.02**
Calcium	47.2	58.2	14.3	12.1	12.6	12.5	12.0	13.2	**mg/L**	**0.05**
Magnesium	109.	140.	12.6	1.61	1.63	1.59	1.56	1.63	**mg/L**	**0.01**
Alkalinity (as $CaCO_3$)	46	45	33	36	37	39	39	39	**mg/L**	**2**
Chloride	1610	1930	189	4.3	4.5	4.4	4.7	4.1	**mg/L**	**0.5**
Fluoride	1.00	2.2	0.40	0.36	0.42	0.40	0.42	0.39	**mg/L**	**0.05**

Sulfate	240	300	33	< 1	< 1	< 1	< 1	< 1	**mg/L**	**1**
Bromine	5.3	7.0	0.58	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	**mg/L**	**0.01**
Ammonia (as N)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.06	< 0.05	< 0.05	**mg/L**	**0.05**
Un-ionized @ 20ºC	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	**mg/L**	**-**
Nitrate + Nitrite (as N)	< 0.05	< 0.05	0.11	0.09	0.10	0.11	0.11	0.13	**mg/L**	**0.05**
Nitrite (as N)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	**mg/L**	**0.05**
Nitrate (as N)	< 0.05	< 0.05	0.11	0.09	0.10	0.11	0.11	0.13	**mg/L**	**0.05**
Nitrogen - Total	0.4	0.5	0.5	0.4	0.5	0.5	0.6	0.5	**mg/L**	**0.2**
Phosphorus - Total	0.016	0.017	0.021	0.020	0.019	0.019	0.019	0.026	**mg/L**	**0.002**
Carbon - Total Organic	9.0	9.2	10.0	10.4	11.0	10.7	11.8	11.0	**mg/L**	**0.5**
Colour	33	33	43	50	54	55	62	59	**TCU**	**5**
Conductivity	6090	7700	719	91	94	94	94	95	**µS/cm**	**1**
pH	7.7	7.7	7.6	7.8	7.6	7.8	7.8	7.8	**units**	**-**
Turbidity	1.6	1.6	1.0	0.8	1.1	0.7	0.9	1.2	**NTU**	**0.1**
Calculated Parameters										
Bicarbonate (as $CaCO_3$)	45.8	44.8	32.9	35.8	36.8	38.7	38.7	38.7	**mg/L**	**-**
Carbonate (as $CaCO_3$)	0.216	0.211	0.123	0.212	0.138	0.230	0.230	0.230	**mg/L**	**-**
Hardness (as $CaCO_3$)	567	722	87.6	36.8	38.2	37.8	36.4	39.7	**mg/L**	**0.2**
TDS (calc)	3040	3700	382	55	57	58	58	59	**mg/L**	**-**
Saturation pH (20°C)	8.3	8.2	8.8	8.7	8.7	8.6	8.7	8.6	**units**	**-**
Langelier Index (20°C)	-0.61	-0.55	-1.15	-0.88	-1.05	-0.83	-0.85	-0.81	**-**	**-**
Date Sampled:	September 22, 2025	September 22, 2025	September 22, 2025	September 22, 2025	September 22, 2025	September 22, 2025	September 22, 2025	September 22, 2025		
Analytes										
Sodium	2440	2500	983.	148.	116.	16.9	3.56	3.91	**mg/L**	**0.05**
Potassium	89.1	93.1	35.5	5.53	4.40	1.03	0.54	0.58	**mg/L**	**0.02**
Calcium	103	107	50.8	19.2	17.4	14.4	14.1	14.4	**mg/L**	**0.05**
Magnesium	284.	292.	113.	17.9	14.2	3.28	1.74	1.73	**mg/L**	**0.01**
Alkalinity (as $CaCO_3$)	54	60	46	39	36	39	39	40	**mg/L**	**2**
Chloride	4250	4360	1680	261	214	31.0	4.7	5.1	**mg/L**	**0.5**
Fluoride	2.7	2.7	0.87	0.42	0.61	0.36	0.31	0.32	**mg/L**	**0.05**
Sulfate	600	620	250	42	36	10	6	< 1	**mg/L**	**1**
Bromine	14.6	14.7	5.8	0.85	0.69	0.09	< 0.01	< 0.01	**mg/L**	**0.01**
Ammonia (as N)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	**mg/L**	**0.05**
Un-ionized @ 20ºC	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**-**
Nitrate + Nitrite (as N)	< 0.05	< 0.05	< 0.05	0.12	0.09	0.13	0.13	0.17	**mg/L**	**0.05**
Nitrite (as N)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	**mg/L**	**0.05**

Nitrate (as N)	< 0.05	< 0.05	< 0.05	0.12	0.09	0.13	0.13	0.17	**mg/L**	**0.05**
Nitrogen - Total	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.5	**mg/L**	**0.2**
Phosphorus - Total	0.013	0.012	0.013	0.031	0.013	0.014	0.016	0.017	**mg/L**	**0.002**
Carbon - Total Organic	7.6	7.8	9.0	9.9	9.2	9.9	9.9	9.4	**mg/L**	**0.5**
Colour	25	23	35	40	38	46	47	48	**TCU**	**5**
Conductivity	15400	16100	6620	1050	847	186	102	103	**µS/cm**	**1**
pH	7.7	7.8	7.6	7.7	7.7	7.8	7.8	7.8	**units**	**-**
Turbidity	0.9	1.1	1.0	3.1	0.9	0.7	0.8	0.8	**NTU**	**0.1**
Calculated Parameters										
Bicarbonate (as $CaCO_3$)	53.7	59.6	45.8	38.8	35.8	38.7	38.7	39.7	**mg/L**	**-**
Carbonate (as $CaCO_3$)	0.253	0.353	0.171	0.183	0.169	0.230	0.230	0.235	**mg/L**	**-**
Hardness (as $CaCO_3$)	1430	1470	592	122	102	49.5	42.4	43.1	**mg/L**	**0.2**
TDS (calc)	7810	8020	3150	529	434	111	65	61	**mg/L**	**-**
Saturation pH (20°C)	8.0	7.9	8.3	8.6	8.6	8.6	8.6	8.6	**units**	**-**
Langelier Index (20°C)	-0.27	-0.11	-0.68	-0.88	-0.94	-0.80	-0.79	-0.76	**-**	**-**
Date Sampled:	October 30, 2025	October 30, 2025	October 30, 2025	October 30, 2025	October 30, 2025	October 30, 2025	October 30, 2025	October 30, 2025		
Analytes		October 30, 2025	October 30, 2025	October 30, 2025	October 30, 2025	October 30, 2025	October 30, 2025	October 30, 2025		
Sodium	2780	2,980	615.	273.	292	18	5.40	5.21	**mg/L**	**0.05**
Potassium	96.7	120	22.6	9.79	11.3	1.04	0.81	0.67	**mg/L**	**0.02**
Calcium	117	124	37.1	23.1	23	13.3	15.9	14.3	**mg/L**	**0.05**
Magnesium	311.	365	71.3	31.3	36.1	3.23	1.95	1.73	**mg/L**	**0.01**
Alkalinity (as $CaCO_3$)	61	63	39	34	34	34	46	41	**mg/L**	**2**
Chloride	4890	5860	995	446	483	33.7	6.9	6.7	**mg/L**	**0.5**
Fluoride	3.2	3.1	0.74	0.59	0.62	0.34	0.42	0.33	**mg/L**	**0.05**
Sulfate	700	710	158	74	86	12	6	5	**mg/L**	**1**
Bromine	18.1	19.1	4.06	1.73	1.98	0.10	0.01	0.01	**mg/L**	**0.01**
Ammonia (as N)	< 0.05	< 0.05	0.07	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	**mg/L**	**0.05**
Un-ionized @ 20ºC	< 0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**-**
Nitrate + Nitrite (as N)	< 0.05	< 0.05	< 0.05	0.22	0.20	0.19	0.26	0.22	**mg/L**	**0.05**
Nitrite (as N)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	**mg/L**	**0.05**
Nitrate (as N)	< 0.05	< 0.05	< 0.05	0.22	0.20	0.19	0.26	0.22	**mg/L**	**0.05**
Nitrogen - Total	0.6	0.5	0.4	0.4	0.5	0.4	0.7	0.6	**mg/L**	**0.2**
Phosphorus - Total	0.020	0.019	0.021	0.022	0.024	0.022	0.026	0.030	**mg/L**	**0.002**
Carbon - Total Organic	6.9	6.5	7.3	6.7	7.0	6.8	7.7	7.4	**mg/L**	**0.5**
Colour	21	21	29	26	27	29	37	37	**TCU**	**5**

Conductivity	18400	18500	3830	1810	2050	210	127	116	**µS/cm**	**1**
pH	7.6	7.8	7.7	7.6	7.6	7.8	7.9	7.8	**units**	**-**
Turbidity	1.7	1.2	0.8	1.3	1.4	1.8	1.1	1.2	**NTU**	**0.1**
Calculated Parameters										
Bicarbonate (as $CaCO_3$)	60.8	62.6	38.8	33.9	33.9	33.8	45.6	40.7	**mg/L**	**-**
Carbonate (as $CaCO_3$)	0.228	0.371	0.183	0.127	0.127	0.200	0.340	0.241	**mg/L**	**-**
Hardness (as $CaCO_3$)	1570	1810	386	187	206	46.5	47.7	42.8	**mg/L**	**0.2**
TDS (calc)	8940	10200	1930	886	961	110	74	68	**mg/L**	**-**
Saturation pH (20°C)	7.9	7.8	8.4	8.6	8.6	8.7	8.5	8.6	**units**	**-**
Langelier Index (20°C)	-0.26	-0.02	-0.73	-1.01	-1.02	-0.89	-0.57	-0.76	**-**	**-**

Appendix 4 – 2025 *E.coli* data from the analysis of surface water samples collected from the eight water quality monitoring sites on the St. John (Wolastoq) River.

Table 7: Steamboat Wharves RPC E.coli data 2025.

	Date Sampled	E.coli (MPN/100mL)
Site 1	June 13, 2025	4.1
Site 2	June 13, 2025	4.1
Site 3	June 13, 2025	11
Site 4	June 13, 2025	4.1
Site 5	June 13, 2025	12.2
Site 6	June 13, 2025	17.5
Site 7	June 13, 2025	12.2
Site 8	June 13, 2025	20.9
Site 1	July 18, 2025	<1.0
Site 2	July 18, 2025	2
Site 3	July 18, 2025	2
Site 4	July 18, 2025	26.9
Site 5	July 18, 2025	5.2
Site 6	July 18, 2025	6.3
Site 7	July 18, 2025	6.2
Site 8	July 18, 2025	20.9
Site 1	August 14, 2025	<1.0
Site 2	August 14, 2025	2
Site 3	August 14, 2025	5.2
Site 4	August 14, 2025	13.5
Site 5	August 14, 2025	1.0
Site 6	August 14, 2025	4.1
Site 7	August 14, 2025	15.8
Site 8	August 14, 2025	9.7
Site 1	September 22, 2025	<1.0
Site 2	September 22, 2025	<1.0
Site 3	September 22, 2025	10.9

Site 4	September 22, 2025	<1.0
Site 5	September 22, 2025	1
Site 6	September 22, 2025	2
Site 7	September 22, 2025	6.3
Site 8	September 22, 2025	26.2
Site 1	October 30, 2025	2
Site 2	October 30, 2025	2
Site 3	October 30, 2025	2
Site 4	October 30, 2025	6.3
Site 5	October 30, 2025	5.2
Site 6	October 30, 2025	5.2
Site 7	October 30, 2025	3.1
Site 8	October 30, 2025	6.3

Appendix 5 – 2025 Metal data from the analysis of surface water samples collected from the eight water quality monitoring sites in the St. John (Wolastoq) River.

Table 8: Steamboat Wharves RPC metal data 2025.

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Units	Reporting Limit
Date Sampled:	June 13, 2025	June 13, 2025	June 13, 2025	June 13, 2025	June 13, 2025	June 13, 2025	June 13, 2025	June 13, 2025		
Analytes										
Aluminum	0.064	0.054	0.076	0.072	0.110	0.238	0.058	0.133	**mg/L**	**0.001**
Antimony	0.0003	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Arsenic	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Barium	0.009	0.008	0.010	0.009	0.011	0.015	0.008	0.008	**mg/L**	**0.001**
Beryllium	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Bismuth	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Boron	0.007	0.007	0.004	0.004	0.004	0.004	0.004	0.004	**mg/L**	**0.001**
Cadmium	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	0.00002	< 0.00001	< 0.00001	**mg/L**	**0.00001**
Calcium	10.9	11.5	10.4	10.5	10.9	11.8	12.6	9.84	**mg/L**	**0.05**
Chromium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Cobalt	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.0002	0.0004	< 0.0001	0.0002	**mg/L**	**0.0001**
Copper	0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Iron	0.17	0.12	0.22	0.22	0.37	0.62	0.18	0.48	**mg/L**	**0.02**
Lead	0.0001	< 0.0001	0.0001	0.0002	0.0003	0.0010	< 0.0001	0.0002	**mg/L**	**0.0001**
Lithium	0.0006	0.0005	0.0005	0.0004	0.0005	0.0006	0.0004	0.0005	**mg/L**	**0.0001**
Magnesium	1.92	1.83	1.30	1.29	1.31	1.41	1.49	1.24	**mg/L**	**0.01**
Manganese	0.022	0.018	0.030	0.027	0.079	0.127	0.025	0.047	**mg/L**	**0.001**
Molybdenum	0.0003	0.0001	0.0001	< 0.0001	< 0.0001	0.0001	0.0001	0.0001	**mg/L**	**0.0001**
Nickel	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Potassium	0.74	0.59	0.44	0.41	0.42	0.45	0.43	0.44	**mg/L**	**0.02**
Rubidium	0.0007	0.0005	0.0006	0.0005	0.0006	0.0008	0.0005	0.0007	**mg/L**	**0.0001**
Selenium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Silver	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Sodium	8.18	7.05	3.16	2.93	2.94	3.07	3.07	3.46	**mg/L**	**0.05**
Strontium	0.075	0.077	0.073	0.069	0.074	0.076	0.081	0.064	**mg/L**	**0.001**
Tellurium	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Thallium	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Tin	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Uranium	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Vanadium	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Zinc	0.003	< 0.001	0.001	< 0.001	0.001	0.004	0.001	0.002	**mg/L**	**0.001**
Date Sampled:	July 18, 2025	July 18, 2025	July 18, 2025	July 18, 2025	July 18, 2025	July 18, 2025	July 18, 2025	July 18, 2025		
Analytes										
Aluminum	0.035	0.028	0.030	0.027	0.040	0.027	0.030	0.048	**mg/L**	**0.001**
Antimony	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Arsenic	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Barium	0.009	0.009	0.009	0.008	0.009	0.008	0.008	0.009	**mg/L**	**0.001**
Beryllium	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Bismuth	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Boron	0.051	0.065	0.005	0.005	0.005	0.005	0.005	0.005	**mg/L**	**0.001**
Cadmium	< 0.00001	< 0.00002	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	**mg/L**	**0.00001**
Calcium	19.8	21.2	16.0	16.5	16.5	16.0	16.2	17.0	**mg/L**	**0.05**
Chromium	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Cobalt	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Copper	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Iron	0.09	0.07	0.08	0.07	0.12	0.08	0.09	0.14	**mg/L**	**0.02**
Lead	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.0001	**mg/L**	**0.0001**
Lithium	0.0023	0.0028	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	**mg/L**	**0.0001**

Magnesium	14.8	18.5	2.01	2.00	1.97	1.95	1.97	2.03	**mg/L**	**0.01**
Manganese	0.023	0.018	0.013	0.009	0.019	0.013	0.012	0.022	**mg/L**	**0.001**
Molybdenum	0.0002	0.0003	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	**mg/L**	**0.0001**
Nickel	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Potassium	4.46	5.62	0.54	0.53	0.55	0.53	0.58	0.57	**mg/L**	**0.02**
Rubidium	0.0017	0.0020	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	**mg/L**	**0.0001**
Selenium	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Silver	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Sodium	112.	147.	3.92	3.73	3.68	3.65	3.83	4.07	**mg/L**	**0.05**
Strontium	0.184	0.198	0.101	0.104	0.103	0.101	0.103	0.107	**mg/L**	**0.001**
Tellurium	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Thallium	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Tin	< 0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Uranium	0.0001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Vanadium	< 0.001	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Zinc	0.002	< 0.002	0.002	0.001	0.002	0.001	0.002	0.002	**mg/L**	**0.001**
Date Sampled:	August 14, 2025	August 14, 2025	August 14, 2025	August 14, 2025	August 14, 2025	August 14, 2025	August 14, 2025	August 14, 2025		
Analytes										
Aluminum	0.03	0.03	0.036	0.031	0.029	0.031	0.028	0.044	**mg/L**	**0.001**
Antimony	< 0.001	< 0.001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.0001	**mg/L**	**0.0001**
Arsenic	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Barium	0.02	0.02	0.012	0.008	0.008	0.007	0.007	0.007	**mg/L**	**0.001**
Beryllium	< 0.001	< 0.001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Bismuth	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Boron	0.39	0.51	0.044	0.004	0.004	0.004	0.004	0.005	**mg/L**	**0.001**
Cadmium	< 0.0001	< 0.0001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	**mg/L**	**0.00001**
Calcium	47.2	58.2	14.3	12.1	12.6	12.5	12.0	13.2	**mg/L**	**0.05**
Chromium	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Cobalt	< 0.001	< 0.001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Copper	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.001	**mg/L**	**0.001**
Iron	< 0.2	< 0.2	0.13	0.11	0.10	0.10	0.10	0.10	**mg/L**	**0.02**
Lead	< 0.001	< 0.001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Lithium	0.016	0.020	0.0020	0.0005	0.0004	0.0004	0.0004	0.0004	**mg/L**	**0.0001**
Magnesium	109.	140.	12.6	1.61	1.63	1.59	1.56	1.63	**mg/L**	**0.01**
Manganese	0.05	0.06	0.020	0.014	0.012	0.012	0.011	0.018	**mg/L**	**0.001**
Molybdenum	0.001	0.001	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	**mg/L**	**0.0001**
Nickel	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Potassium	34.3	44.4	4.04	0.50	0.52	0.53	0.49	0.58	**mg/L**	**0.02**
Rubidium	0.010	0.013	0.0016	0.0006	0.0006	0.0006	0.0006	0.0007	**mg/L**	**0.0001**
Selenium	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Silver	< 0.001	< 0.001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Sodium	964.	1190	97.9	3.47	3.32	3.26	3.13	3.20	**mg/L**	**0.05**
Strontium	0.74	0.93	0.149	0.087	0.087	0.085	0.083	0.088	**mg/L**	**0.001**
Tellurium	< 0.001	< 0.001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Thallium	< 0.001	< 0.001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Tin	< 0.001	< 0.001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Uranium	< 0.001	< 0.001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Vanadium	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Zinc	< 0.01	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.002	**mg/L**	**0.001**
Date Sampled:	September 22, 2025	September 22, 2025	September 22, 2025	September 22, 2025	September 22, 2025	September 22, 2025	September 22, 2025	September 22, 2025		
Analytes										
Aluminum	< 0.02	< 0.02	0.03	0.062	0.028	0.026	0.031	0.032	**mg/L**	**0.001**
Antimony	< 0.002	< 0.002	< 0.001	< 0.0002	< 0.0001	< 0.0001	0.0001	< 0.0001	**mg/L**	**0.0001**
Arsenic	< 0.02	< 0.02	< 0.01	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Barium	< 0.02	< 0.02	0.02	0.016	0.014	0.009	0.008	0.007	**mg/L**	**0.001**
Beryllium	< 0.002	< 0.002	< 0.001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Bismuth	< 0.02	< 0.02	< 0.01	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Boron	1.01	1.02	0.41	0.063	0.051	0.011	0.005	0.005	**mg/L**	**0.001**

Cadmium	< 0.0002	< 0.0002	< 0.0001	< 0.00002	< 0.00001	< 0.00001	< 0.00001	< 0.00001	**mg/L**	**0.00001**
Calcium	103	107	50.8	19.2	17.4	14.4	14.1	14.4	**mg/L**	**0.05**
Chromium	< 0.02	< 0.02	< 0.01	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Cobalt	< 0.002	< 0.002	< 0.001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Copper	< 0.02	< 0.02	< 0.01	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Iron	< 0.4	< 0.4	< 0.2	0.21	0.11	0.10	0.11	0.12	**mg/L**	**0.02**
Lead	< 0.002	< 0.002	< 0.001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Lithium	0.038	0.039	0.015	0.0024	0.0020	0.0006	0.0004	0.0004	**mg/L**	**0.0001**
Magnesium	284.	292.	113.	17.9	14.2	3.28	1.74	1.73	**mg/L**	**0.01**
Manganese	0.04	0.03	0.05	0.073	0.031	0.014	0.014	0.015	**mg/L**	**0.001**
Molybdenum	0.003	0.003	0.001	0.0003	0.0002	0.0001	0.0002	0.0001	**mg/L**	**0.0001**
Nickel	< 0.02	< 0.02	< 0.01	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Potassium	89.1	93.1	35.5	5.53	4.40	1.03	0.54	0.58	**mg/L**	**0.02**
Rubidium	0.025	0.026	0.011	0.0023	0.0018	0.0008	0.0007	0.0007	**mg/L**	**0.0001**
Selenium	< 0.02	< 0.02	< 0.01	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Silver	< 0.002	< 0.002	< 0.001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Sodium	2440	2500	983.	148.	116.	16.9	3.56	3.91	**mg/L**	**0.05**
Strontium	1.76	1.81	0.75	0.194	0.163	0.102	0.092	0.091	**mg/L**	**0.001**
Tellurium	< 0.002	< 0.002	< 0.001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Thallium	< 0.002	< 0.002	< 0.001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Tin	< 0.002	< 0.002	< 0.001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Uranium	< 0.002	< 0.002	< 0.001	< 0.0002	< 0.0001	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Vanadium	< 0.02	< 0.02	< 0.01	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Zinc	< 0.02	< 0.02	< 0.01	< 0.002	< 0.001	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Date Sampled:	October 30, 2025	October 30, 2025	October 30, 2025	October 30, 2025	October 30, 2025	October 30, 2025	October 30, 2025	October 30, 2025		
Analytes										
Aluminum	0.03	0.03	0.038	0.035	0.040	0.036	0.036	0.037	**mg/L**	**0.001**
Antimony	< 0.002	< 0.002	< 0.0005	< 0.0002	< 0.0005	< 0.0001	0.0001	0.0002	**mg/L**	**0.0001**
Arsenic	< 0.02	< 0.02	< 0.005	< 0.002	< 0.005	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Barium	0.02	0.02	0.022	0.018	0.019	0.013	0.009	0.008	**mg/L**	**0.001**
Beryllium	< 0.002	< 0.002	< 0.0005	< 0.0002	< 0.0005	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Bismuth	< 0.02	< 0.02	< 0.005	< 0.002	< 0.005	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Boron	1.12	1.19	0.253	0.111	0.130	0.009	0.005	0.005	**mg/L**	**0.001**
Cadmium	< 0.0002	< 0.0002	< 0.00005	< 0.00002	< 0.00005	< 0.00001	0.00002	< 0.00001	**mg/L**	**0.00001**
Calcium	117	124	37.1	23.1	23.0	13.3	15.9	14.3	**mg/L**	**0.05**
Chromium	< 0.02	< 0.02	< 0.005	< 0.002	< 0.005	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Cobalt	< 0.002	< 0.002	< 0.0005	< 0.0002	< 0.0005	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Copper	< 0.02	< 0.02	< 0.005	< 0.002	< 0.005	< 0.001	0.004	0.004	**mg/L**	**0.001**
Iron	< 0.4	< 0.4	0.2	0.14	0.2	0.16	0.14	0.23	**mg/L**	**0.02**
Lead	< 0.002	< 0.002	< 0.0005	< 0.0002	< 0.0005	< 0.0001	0.0002	0.0002	**mg/L**	**0.0001**
Lithium	0.043	0.045	0.0097	0.0044	0.0050	0.0007	0.0004	0.0004	**mg/L**	**0.0001**
Magnesium	311.	365	71.3	31.3	36.1	3.23	1.95	1.73	**mg/L**	**0.01**
Manganese	0.07	0.08	0.077	0.043	0.050	0.021	0.022	0.018	**mg/L**	**0.001**
Molybdenum	0.003	0.003	0.0007	0.0004	< 0.0005	0.0002	0.0002	0.0002	**mg/L**	**0.0001**
Nickel	< 0.02	< 0.02	< 0.005	< 0.002	< 0.005	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Potassium	96.7	120	22.6	9.79	11.3	1.04	0.81	0.67	**mg/L**	**0.02**
Rubidium	0.029	0.031	0.0074	0.0034	0.0041	0.0009	0.0009	0.0008	**mg/L**	**0.0001**
Selenium	< 0.02	< 0.02	< 0.005	< 0.002	< 0.005	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Silver	< 0.002	< 0.002	< 0.0005	< 0.0002	< 0.0005	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Sodium	2780	2980	615.	273.	292	18.0	5.40	5.21	**mg/L**	**0.05**
Strontium	2.01	2.10	0.530	0.280	0.306	0.106	0.103	0.091	**mg/L**	**0.001**
Tellurium	< 0.002	< 0.002	< 0.0005	< 0.0002	< 0.0005	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Thallium	< 0.002	< 0.002	< 0.0005	< 0.0002	< 0.0005	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Tin	< 0.002	< 0.002	< 0.0005	< 0.0002	< 0.0005	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Uranium	< 0.002	< 0.002	< 0.0005	< 0.0002	< 0.0005	< 0.0001	< 0.0001	< 0.0001	**mg/L**	**0.0001**
Vanadium	< 0.02	< 0.02	< 0.005	< 0.002	< 0.005	< 0.001	< 0.001	< 0.001	**mg/L**	**0.001**
Zinc	< 0.02	< 0.02	< 0.005	< 0.002	< 0.005	< 0.001	0.005	0.003	**mg/L**	**0.001**

Appendix 6 – 2025 QPCR data collected from wharf sites e.coli eDNA source tracking.

Table 9: 2025 qpcr tabulated data from wharf eDNA analysis.

BatchId	SampleId	Assay	Rep1	Rep2	Rep3	AvgCopyNum	PctDetection
JVB5819	Fox Wharf 9GLA2DJ8	Human01	1136	1218	1573	1309.00	100.00
JVB5819	Fox Wharf 9GLA2DJ8	Swine01	0	0	57	19.00	33.33
JVB5819	Fox Wharf 9GLA2DJ8	Bovine01	0	43	0	14.33	33.33
JVB5819	Fox Wharf 9GLA2DJ8	Chicken01	27	26	26	26.33	100.00
JVB5819	Fox Wharf 9GLA2DJ8	Sheep01	0	0	0	0.00	0.00
JVB5819	Fox Wharf 9GLA2DJ8	Dog01	0	0	0	0.00	0.00
JVB5819	Fox Wharf 9GLA2DJ8	E.Coli01	17	24	69	36.67	100.00
JVB5819	Gerow's Wharf CSYFKLK3	Human01	13287	12592	12718	12865.67	100.00
JVB5819	Gerow's Wharf CSYFKLK3	Swine01	0	74	0	24.67	33.33
JVB5819	Gerow's Wharf CSYFKLK3	Bovine01	194	645	629	489.33	100.00
JVB5819	Gerow's Wharf CSYFKLK3	Chicken01	301	116	215	210.67	100.00
JVB5819	Gerow's Wharf CSYFKLK3	Sheep01	0	0	0	0.00	0.00
JVB5819	Gerow's Wharf CSYFKLK3	Dog01	276	423	496	398.33	100.00
JVB5819	Gerow's Wharf CSYFKLK3	E.Coli01	605	1093	991	896.33	100.00
JVB5819	Gagetown Wharf PFKLOJM8	Human01	10726	10858	11670	11084.67	100.00
JVB5819	Gagetown Wharf PFKLOJM8	Swine01	0	107	187	98.00	66.67
JVB5819	Gagetown Wharf PFKLOJM8	Bovine01	32	36	38	35.33	100.00
JVB5819	Gagetown Wharf PFKLOJM8	Chicken01	102	383	141	208.67	100.00
JVB5819	Gagetown Wharf PFKLOJM8	Sheep01	0	0	0	0.00	0.00
JVB5819	Gagetown Wharf PFKLOJM8	Dog01	89	27	170	95.33	100.00
JVB5819	Gagetown Wharf PFKLOJM8	E.Coli01	160	112	112	128.00	100.00

Appendix 7 – 2025 Unconfirmed cyanobacteria bloom monitoring field data collected from the cyanobacteria monitoring buoys at wharf sites.

Table 10: Unconfirmed Cyanobacteria Blooms data by month 2025.

Month	Belyea's Wharf	Fox Wharf	Gerow's Wharf	Monthly Totals
June	1	26	0	27
July	0	108	1	109
August	0	33	2	35
September	0	67	0	67
October	26	21	0	47
Wharf Total	27	255	3	285