

2025 ANNUAL REPORT

Tetayut Watershed Water Quality Monitoring Program

Prepared for the District of Central Saanich

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Peninsula Streams & Shorelines
Since 2002

Abstract

Since 2011, Peninsula Streams & Shorelines (PSS), in partnership with the District of Central Saanich (DCS), has conducted long-term water quality monitoring throughout the Tetayut watershed to assess watershed health, particularly downstream of the Keating Industrial Area. Monthly monitoring at nine sites includes physical water quality parameters, nutrients, fecal coliforms, hydrocarbons, dissolved metals, and sediment-associated metals. This report effectively examines long term-trends in water quality conditions over the 15 year monitoring period of the program. Overall, physical water quality conditions remained relatively stable throughout the entire monitoring period, with few long-term trends observed for temperature, dissolved oxygen, pH, or turbidity. However, several contaminant-related concerns persisted. Elevated concentrations and guideline exceedances for copper, iron, phosphorus, zinc, nitrates, hydrocarbons, and several sediment-associated metals continued to occur throughout the watershed. While some parameters, including cadmium, mercury, ammonia, and polycyclic aromatic hydrocarbons (PAHs), showed evidence of improvement over time, total extractable hydrocarbons (TEH) and nitrate exceedances increased at some of the sites. Collectively, results indicate that while some aspects of water quality within the Tetayut watershed have remained stable or improved modestly over time, persistent pollutant inputs associated with urbanization, stormwater runoff, and industrial activity continue to affect watershed health. Continued long-term monitoring, source control initiatives, green stormwater infrastructure, habitat restoration, and community stewardship remain important for improving water quality and protecting aquatic habitat within the watershed.

Acknowledgements

We respectfully acknowledge that the study area for this project is located within the traditional territories of the W̱JOŁEŁP (Tsartlip), W̱SIKEM (Tseycum), and ST̓ÁUTW̱ (Tsawout) Nations. The W̱SÁNEĆ peoples describe this land as an intricate system where land, water, and humans are equal members, with all elements connected through cultural customs.

We would also like to acknowledge the immense support from the District of Central Saanich, Pacific Salmon Foundation and BC Gaming Association with whom the collection of this valuable information would not have been possible.

Executive Summary

Since 2011, Peninsula Streams & Shorelines (PSS), in partnership with the District of Central Saanich (DCS), has conducted water quality monitoring throughout the Tetayut watershed. The program was established to evaluate watershed health, particularly downstream of the Keating Industrial Area, where runoff has the potential to impact aquatic habitat and receiving watercourses. Monitoring currently includes nine sampling sites distributed throughout the watershed, with enhanced monitoring conducted at the Keating Industrial Park Outfall East (Site 2), including monthly water sampling and quarterly sediment sampling. Parameters assessed throughout the monitoring program include physical water quality properties, nutrients, fecal coliforms, dissolved metals, hydrocarbons, and sediment-associated metals.

This report summarizes water and sediment quality results collected between 2011 and 2025 and evaluates long-term temporal trends throughout the watershed. Overall, physical water quality conditions remained relatively stable over the monitoring period. Water temperatures, pH, dissolved oxygen, and conductivity generally remained within ranges supportive of aquatic life. High temperature exceedances above 19 °C were rare across all sites, while low dissolved oxygen events occurred most frequently at Sandhill Park (Site 1). Elevated turbidity events were common throughout the watershed, particularly at Mure Brook Downstream (Site 8) and the Unnamed Tributary (Site 5A), although only Site 1 exhibited a statistically significant decline in turbidity exceedances over time. Conductivity exceedances were most common at Kennel Creek (Site 4), with Mure Brook Upstream (Site 6) showing a statistically significant increase in elevated conductivity events over the monitoring period.

Water quality monitoring at the Keating Industrial Park Outfall (Site 2) identified several persistent contaminant concerns associated with urban and industrial stormwater runoff. Copper, iron, phosphorus, and zinc regularly exceeded applicable water quality guidelines throughout the monitoring period, with iron and phosphorus showing particularly frequent exceedances. Iron exceeded guidelines on 160 sampling occasions between 2011 and 2025, while phosphorus exceeded guidelines 153 times. Zinc and copper also remained persistent concerns, with 127 and 63 exceedances recorded respectively. Although exceedances remained common for these parameters, most did not exhibit statistically significant increasing or decreasing trends over time, suggesting relatively stable but chronically elevated conditions.

Some contaminants showed evidence of long-term improvement. Cadmium and mercury exceedance frequencies declined significantly over time, with no mercury exceedances recorded after 2021 and no cadmium exceedances observed since 2020. Polycyclic aromatic hydrocarbon (PAH) detections also declined substantially, with no detections recorded between 2017 and 2025. In contrast, total extractable hydrocarbons (TEH) exhibited a statistically significant increasing trend, with exceedances becoming more frequent in recent years and reaching their highest annual total in 2025. Arsenic concentrations also increased modestly over time; however, concentrations remained below applicable guideline thresholds throughout the monitoring period.

Fecal coliform concentrations at Site 2 remained highly variable throughout the monitoring period, with no statistically significant long-term trend identified. Elevated concentrations and repeated exceedances of the recreational guideline threshold of 200 CFU/100 mL indicate the continued presence of fecal contamination within stormwater runoff entering the watershed. However, a reduction in measured concentrations was observed following a laboratory transition in 2025.

Nutrient monitoring at Sandhill Park (Site 1) and Kennel Creek (Site 4) identified several ongoing concerns. Nitrate-N concentrations at Kennel Creek (Site 4) frequently approached or exceeded guideline thresholds and exhibited a statistically significant increase in exceedance frequency over time. Nitrite-N exceedances also increased modestly at Site 1. In contrast, ammonia-N exceedances declined over time at both sites, with exceedances becoming rare in recent years.

Sediment quality monitoring at Site 2 indicated that several sediment-associated metals remain persistently elevated. Nickel, copper, chromium, and zinc frequently exceeded sediment quality guidelines throughout the monitoring period, with nickel representing the most persistent concern parameter and exceeding guidelines in all sediment samples collected in 2025. Despite these elevated concentrations, most sediment metals did not exhibit statistically significant increasing or decreasing trends over time, suggesting relatively stable but chronically elevated conditions.

Overall, results from Tetayut's long-term monitoring program indicate that while many physical water quality conditions within the Tetayut watershed have remained relatively stable since monitoring began in 2011, persistent pollutant inputs associated with urbanization, stormwater runoff, and industrial activity continue to affect water and sediment quality, of the the Keating Industrial Area outfall site. At the same time, improvements observed for several parameters, including cadmium, mercury, ammonia, and PAHs, suggest that some aspects of watershed condition may be improving over time. Continued long-term monitoring, source control initiatives, stormwater treatment, green infrastructure implementation, habitat restoration, and community stewardship remain important for improving watershed health and protecting aquatic habitat within the Tetayut watershed.

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1.0 Introduction

Peninsula Streams & Shorelines (PSS) has been working to restore and protect aquatic ecosystems throughout Greater Victoria since its formation in 2002. Through research, habitat restoration, environmental monitoring, education, and community stewardship, PSS works to support healthy freshwater and marine environments capable of sustaining native species populations over the long term. A key component of this work is the collection and interpretation of long-term environmental data, particularly water quality information, which provides critical insight into watershed health and informs restoration and management priorities.

The Tetayut watershed is one of the larger watersheds within the District of Central Saanich and contains several creeks and tributaries that provide important habitat for aquatic species, including coastal cutthroat trout (CCT) and coho salmon. Both species are sensitive to changes in water quality and habitat condition, and many populations throughout British Columbia have experienced long-term declines associated with habitat degradation, urbanization, and other anthropogenic pressures. Within the Tetayut watershed, aquatic habitats are influenced by a range of land uses, including agriculture, transportation corridors, residential development, and industrial runoff associated with the Keating Industrial Area, all of which have the potential to affect watershed health and stream function.

Water quality monitoring within the Tetayut watershed was established as an extension of the long-term Hagan–Graham (ḰENNES) Water Quality Monitoring Program, which PSS has operated since 2005. Following the results of monitoring conducted downstream of the Keating Industrial Area within the Hagan–Graham watershed, PSS recommended that monitoring be expanded to include the watershed located north of the industrial area. Through collaboration with the District of Central Saanich (DCS), this led to the establishment of water quality monitoring within the Tetayut watershed in 2011, including focused monitoring at the Keating Industrial Park Stormwater Outfall East (Liedtke Tributary; Site 2), alongside supportive monitoring at additional sites throughout the watershed.

The Tetayut Water Quality Monitoring Program complements the Hagan–Graham monitoring program and provides a more comprehensive understanding of stormwater conditions and watershed health across the Saanich Peninsula. Supported by the District of Central Saanich and aligned with the Integrated Stormwater Management Plan (ISMP) adopted by Council in 2009, the program has generated a long-term dataset that can be used to identify trends, detect changes in water quality conditions over time, and evaluate the effectiveness of watershed management and restoration efforts. Since its establishment, PSS and its volunteers have conducted regular sampling throughout the watershed, measuring a range of physical, chemical, and biological parameters including nutrients, metals, fecal coliforms, hydrocarbons, and other indicators of aquatic ecosystem health.

This report provides a comprehensive review of the water quality data collected throughout the Tetayut watershed during the operation of the monitoring program, highlighting long-term trends, areas of concern, and the ongoing importance of sustained watershed monitoring in informing stewardship, restoration, and stormwater management initiatives within Central Saanich.

2.0 Methods

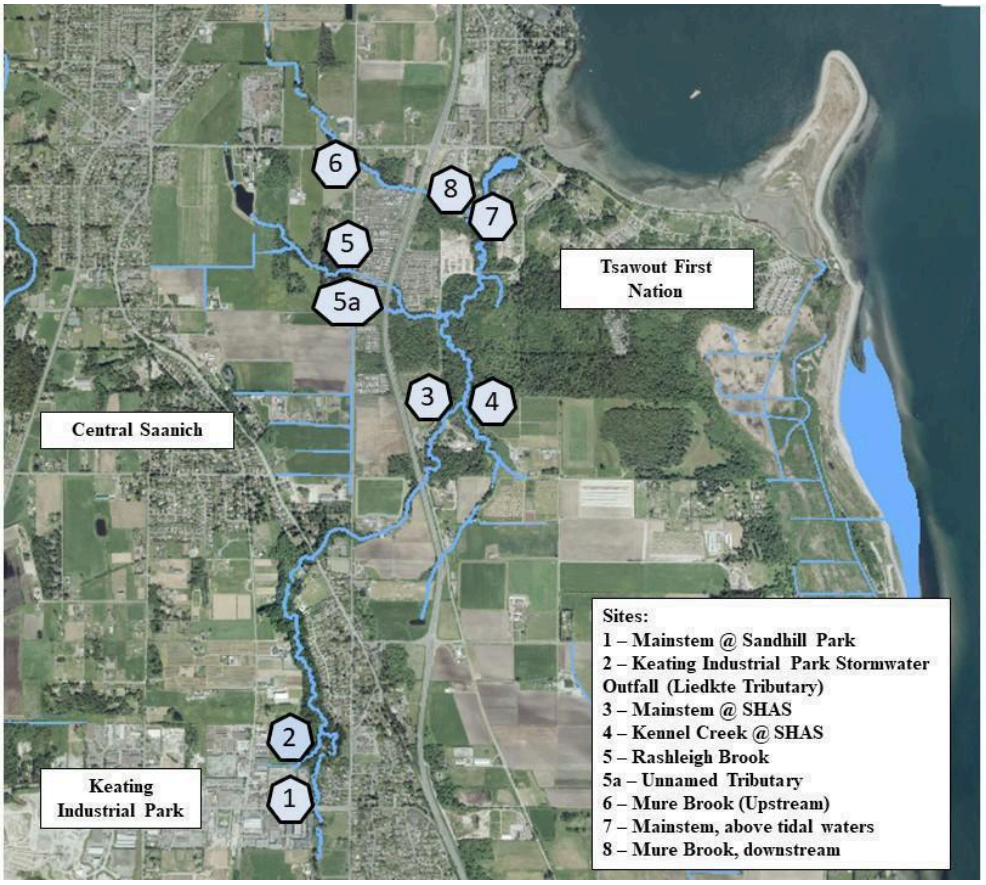


Figure 1. Map of Tetayut watershed sampling sites.

2.1 Sampling Sites and Parameters Measured

Water quality monitoring is conducted monthly at nine sites distributed throughout the Tetayut watershed (Figure 1):

Site 1: Tetayut Creek Mainstem at Sandhill Park
Site 2: Keating Outfall East
Site 3: Tetayut Creek Mainstem at Heritage Acres (HA)
Site 4: Kennel Creek at Heritage Acres (HA)
Site 5: Rashleigh Brook
Site 5a: Unnamed tributary
Site 6: Mure Brook Upstream
Site 7: Tetayut Creek Mainstem, above tidal waters
Site 8: Mure Brook Downstream

All nine sites are monitored for physical water quality parameters, including dissolved oxygen (% saturation), temperature (°C), electrical conductivity (µS/cm), pH, and turbidity (NTU).

Table 1: Description of the analytes included within each water quality parameter class.

Parameter Class	Analytes Included
Physical	Dissolved oxygen (%), temperature (°C), electrical conductivity, pH, turbidity
Nutrients	Nitrite (as N, as NO_2), nitrate (as N, as NO_3), ammonia (as N, as NH_3), total nitrogen, orthophosphate (as PO_4)
Metals	Arsenic, cadmium, copper, iron, lead, manganese, mercury, elemental phosphorus, zinc
Hydrocarbons	Total extractable hydrocarbons (TEH), polycyclic aromatic hydrocarbons (PAHs)
Fecal Coliforms	Fecal coliform bacteria

In addition to physical parameters, nutrient analyses are conducted monthly at two sites:

Site 1: Tetayut Creek Mainstem at Sandhill Park
Site 4: Kennel Creek at Heritage Acres

Nutrient parameters include nitrite (as N, as NO_2), nitrate (as N, as NO_3), ammonia (as N, as NH_3), total nitrogen, and orthophosphate (as PO_4).

Table 2: Parameters measured, by site.

Site	Physical	Metals	Nutrients	Fecal	Hydrocarbons	Sediment Metals
Site 1 Sandhill Park	**X**		**X**			
Site 2 Keating Outfall East	**X**	**X**		**X**	**X**	**X**
Site 3 Mainstem at HA	**X**					
Site 4 Kennel Creek	**X**		**X**			
Site 5 Rashleigh Brook	**X**					
Site 5a Unnamed Trib	**X**					
Site 6 Mure Brook Downstream	**X**					
Site 7 Mainstem above tidal	**X**					
Site 8 Mure Brook Downstream	**X**					

Enhanced monitoring is conducted at Site 2 (Keating Outfall East) due to its location downstream of the Keating Industrial Area. In addition to physical parameters, monthly grab samples are collected at this site for laboratory analysis of metals, hydrocarbons, and fecal coliforms. Sediment samples are also collected at Site 2 on a quarterly basis (every third month) and submitted for laboratory analysis of sediment-associated metals.

2.2 Field Sampling Methods and Laboratory Analyses

Given the long-term nature of this monitoring program, a number of field methods, analytical instruments, and laboratory service providers have been used over time. From 2011 to July 2025, laboratory analyses for fecal coliforms, metals, hydrocarbons, and sediment chemistry were conducted by MB Laboratories Ltd. in Sidney, British Columbia. Beginning in August 2025, these analyses transitioned to Bureau Veritas (BV). Nutrient analysis methods have also evolved over the duration of the program. From 2011 to 2017, nutrient concentrations were measured by PSS staff and volunteers using field testing kits. From 2017 to August 2025, nutrient analyses were conducted by MB

Laboratories. Since August 2025, nutrient testing has also been conducted by Bureau Veritas. Currently, PSS staff and trained volunteers collect monthly grab samples at designated sites and record physical water quality properties in the field. Samples are then transported to Bureau Veritas for laboratory analysis.

Physical parameters have been measured using several instruments over the course of the program. Historically, dissolved oxygen was measured using an OxyGuard Handy Polaris, while pH and conductivity were measured using HANNA handheld probes. The current field protocol uses a YSI DSS Pro for measurement of water temperature (°C), conductivity (µS/cm), pH, and dissolved oxygen (% saturation). Turbidity is measured in the field using a LaMotte 2020t Portable Turbidity Meter, which uses a radiometric method to report turbidity in Nephelometric Turbidity Units (NTU). All samples are collected using sterile sampling containers and standard field protocols consistent with Environment and Climate Change Canada procedures.

2.3 Data Interpretation, Quality Standards, and Trend Analysis

To support interpretation of long-term water quality trends, analytical results were compared against applicable provincial, national, and international water and sediment quality guidelines.

Guideline values were derived from multiple sources, including:

- Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines
- BC Ministry of Environment Approved Water Quality Guidelines (BCAWQG)
- United States Environmental Protection Agency (USEPA)

Priority was given to guidelines developed for British Columbia and Canada, particularly those intended for the protection of freshwater aquatic life. For several metals, including cadmium, copper, lead, manganese, and zinc, guideline values are hardness-dependent. For these parameters, site-specific water hardness values were used to calculate applicable thresholds. For fecal coliforms, a threshold of 200 CFU/100 mL was used, consistent with the recreational freshwater safe swimming guideline. Although no specific aquatic life guideline exists for creek systems, this threshold is used operationally within the monitoring program to identify potential contamination events and inform follow-up communication with partner agencies where necessary. Site-specific turbidity baselines were developed using historical background conditions observed at each monitoring location across the full sampling record beginning in 2011 (Table A27).

Because continuous flow data are not available for all sites, 48-hour precipitation totals (the day of sampling and preceding day) were compiled from Environment and Climate Change Canada records and paired with sampling results. Precipitation is used as a proxy for runoff and dilution conditions, providing important context for interpreting variability in contaminant concentrations and identifying potential storm-driven loading events.

All field and laboratory data undergo quality control and quality assurance (QA/QC) review by PSS staff prior to analysis and reporting. This includes review of field sheets, instrument readings, laboratory certificates of analysis, detection limits, metadata completeness, and data entry accuracy. Following QA/QC review, validated data are uploaded to Pacific DataStream, an open-access online

environmental data platform, where the full Tetayut watershed dataset is made publicly available to support transparency, long-term stewardship, and broader watershed management initiatives.

For this 15-year synthesis, long-term trends were assessed by examining temporal patterns in parameter concentrations, frequency of guideline exceedances, and site-specific changes over time. Where appropriate, annual and seasonal summary statistics, including means, medians, ranges, and exceedance frequencies, were used to evaluate changes in watershed condition and identify persistent or emerging water quality concern

3.0 Results

3.1 Physical Results, all sites

3.1.1 Temperature

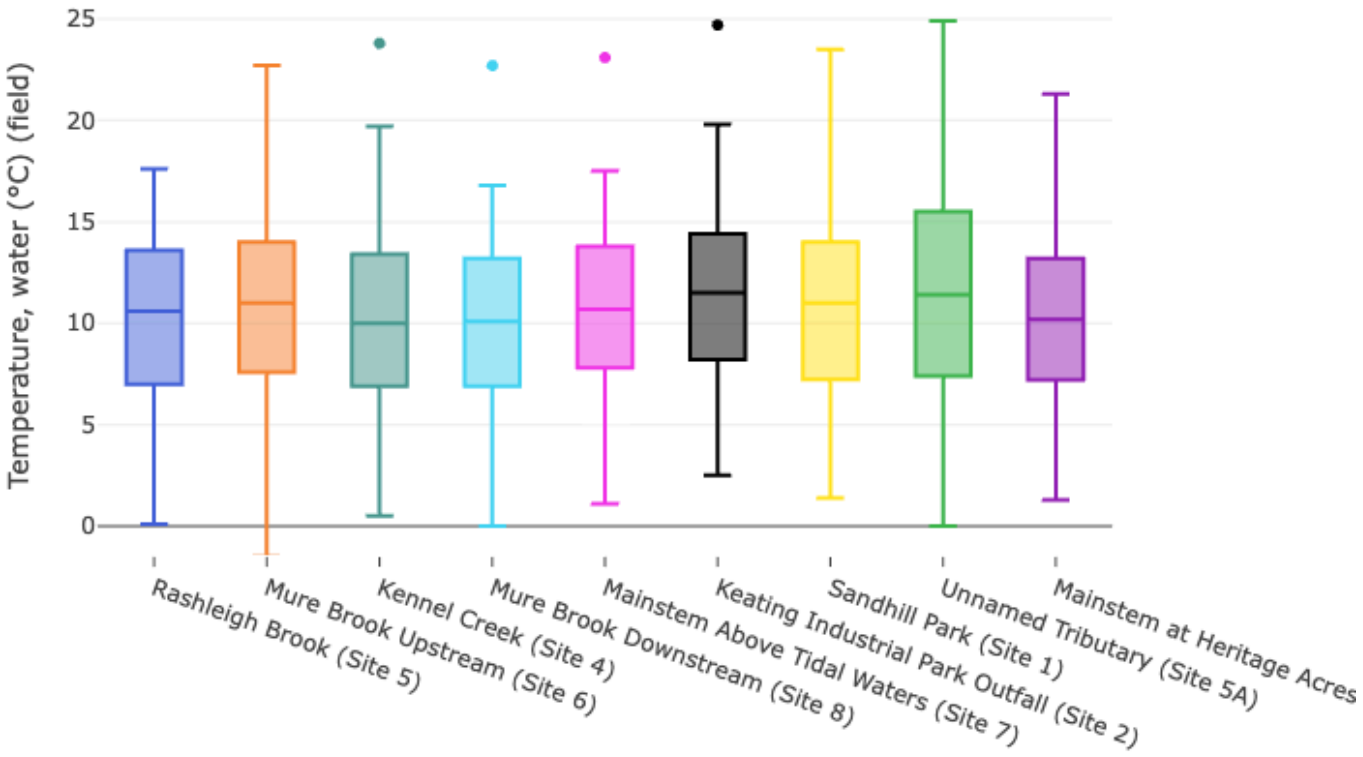


Figure 2. Boxplot comparison of water temperature (°C) across all sites over the 15 year monitoring period. Figure taken from Pacific Datastream.

Since 2011, median water temperatures were broadly similar across all monitoring sites, ranging from 10.0 °C at Kennel Creek (Site 4) to 11.5 °C at Keating Industrial Park Outfall (Site 2), indicating relatively consistent thermal conditions across the watershed. Median temperatures at the remaining sites were 11.0 °C at Sandhill Park (Site 1) and Mure Brook Upstream (Site 6), 10.2 °C at Mainstem at

Heritage Acres (Site 3), 10.6 °C at Rashleigh Brook (Site 5), 11.4 °C at Unnamed Tributary (Site 5A), 10.7 °C at Mainstream Above Tidal Waters (Site 7), and 10.1 °C at Mure Brook Downstream (Site 8; Figure X). High-temperature exceedances above 19 °C were infrequent across all sites over the monitoring record, with the greatest number occurring at Mure Brook Upstream (Site 6; 6 exceedances), followed by Unnamed Tributary (Site 5A; 3 exceedances). Sandhill Park (Site 1), Keating Industrial Park Outfall (Site 2), and Kennel Creek (Site 4) each recorded two exceedances, while Mainstem at Heritage Acres (Site 3), Mainstream Above Tidal Waters (Site 7), and Mure Brook Downstream (Site 8) each recorded one exceedance. No exceedances were observed at Rashleigh Brook (Site 5) over the full monitoring period. Trend analysis of annual exceedance counts indicated no clear temporal trend at any site. The annual frequency of high-temperature events was characterized by sporadic isolated occurrences separated by many years with zero exceedances, resulting in no consistent long-term increase or decrease in exceedance frequency. Overall, high-temperature events are best interpreted as rare and episodic rather than exhibiting a sustained temporal trend. In 2025, no temperature exceedances above 19 °C were recorded at any monitoring site.

3.1.2 Oxygen Saturation

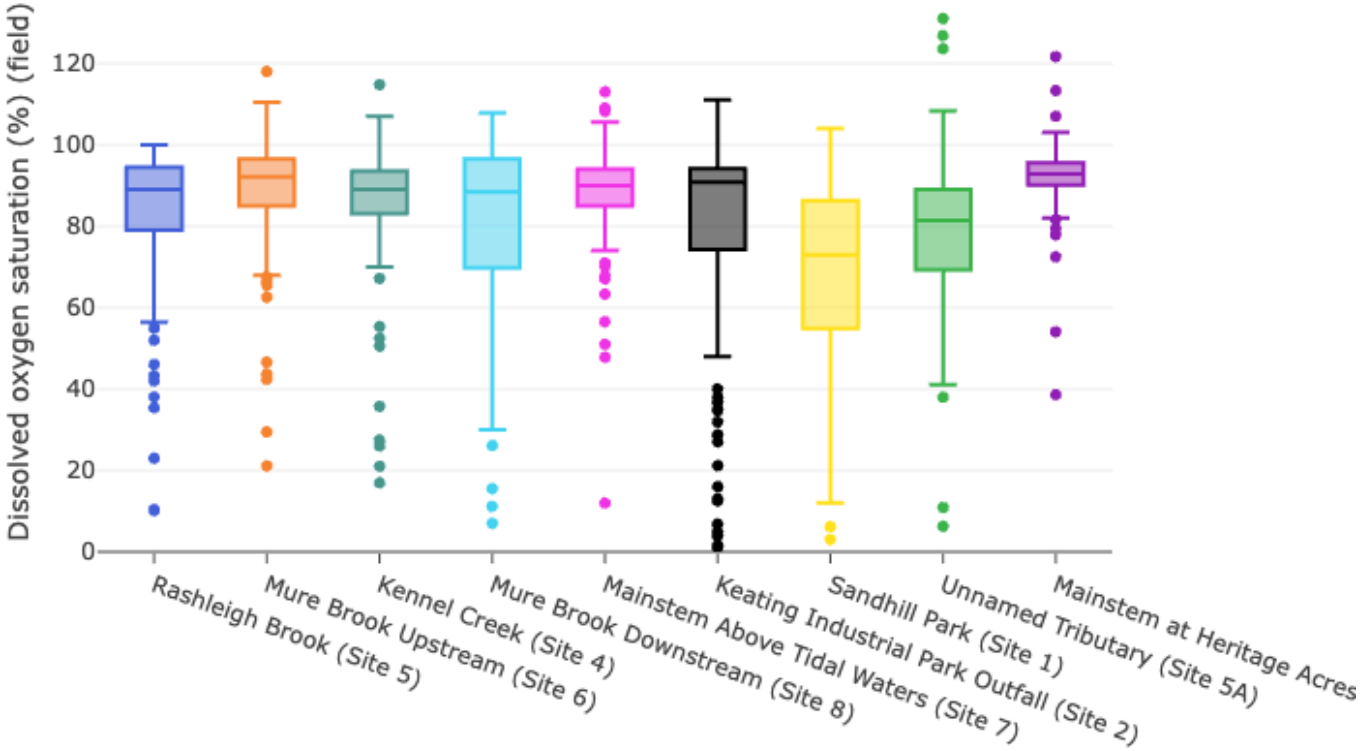


Figure 3. Boxplot comparison of % oxygen saturation across all sites over the 15 year monitoring period. Figure taken from Pacific Datastream.

Over the 2011–2025 monitoring period, median dissolved oxygen saturation varied more substantially across sites than temperature, ranging from 72.9% at Sandhill Park (Site 1) to 92.85% at Mainstem at Heritage Acres (Site 3), indicating that Site 1 consistently exhibited the lowest overall oxygen conditions across the watershed. Median dissolved oxygen saturation at the remaining sites was

90.8% at Keating Industrial Park Outfall (Site 2), 89.05% at Kennel Creek (Site 4), 89.0% at Rashleigh Brook (Site 5), 81.35% at Unnamed Tributary (Site 5A), 92.15% at Mure Brook Upstream (Site 6), 89.95% at Mainstream Above Tidal Waters (Site 7), and 88.4% at Mure Brook Downstream (Site 8; Figure 3). Consistent with this pattern, Sandhill Park (Site 1) exhibited the greatest number of low oxygen events (<50% saturation) over the monitoring record, with 34 occurrences, followed by Keating Industrial Park Outfall (Site 2; 21) and Mure Brook Downstream (Site 8; 13). The remaining sites recorded comparatively few low oxygen events, ranging from 1 event at Site 3 to 8 events at Site 5. Trend analysis of annual low oxygen exceedance counts using a non-parametric approach indicated no clear temporal trend at any site. Annual low oxygen events were characterized by substantial year-to-year variability, indicating no consistent long-term increase or decrease in exceedance frequency. Overall, low oxygen events are best interpreted as stable but variable over time, with no clear evidence of long-term improvement or deterioration at any site. In 2025, three low oxygen events were recorded, including two at Site 1 and one at Site 8.

3.1.3 Turbidity

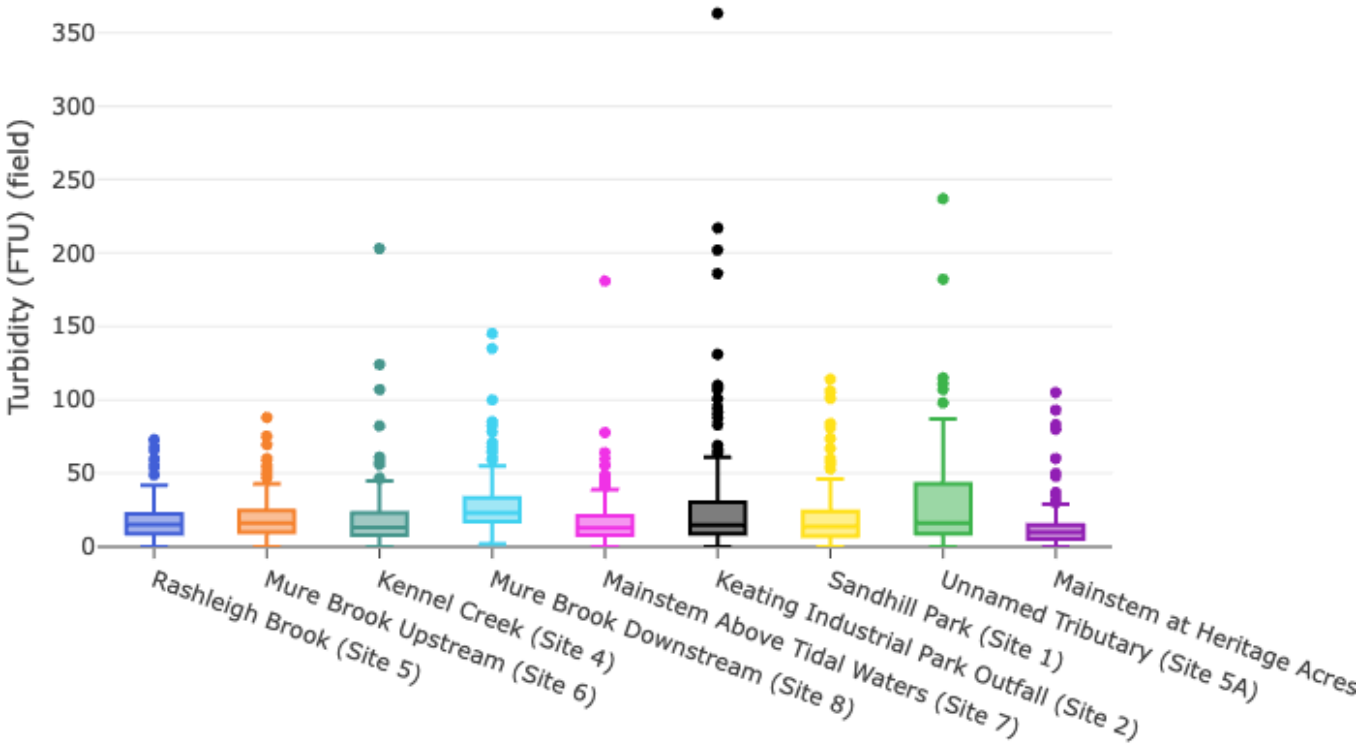


Figure 4. Boxplot comparison of turbidity across all sites over the 15 year monitoring period. Figure taken from Pacific Datastream.

Median turbidity varied across sites, ranging from 9.99 NTU at Mainstem at Heritage Acres (Site 3) to 23 NTU at Mure Brook Downstream (Site 8), indicating that Site 8 exhibited the highest overall turbidity conditions across the watershed. Median turbidity at the remaining sites was 14 NTU at Sandhill Park (Site 1), 15 NTU at Keating Industrial Park Outfall (Site 2), 13.2 NTU at Kennel Creek (Site

4), 15.05 NTU at Rashleigh Brook (Site 5), 16 NTU at Unnamed Tributary (Site 5A) and Mure Brook Upstream (Site 6), and 13 NTU at Mainstream Above Tidal Waters (Site 7; Figure X). A threshold of 25 NTU was selected as an indicator of elevated turbidity conditions to identify and compare extreme turbidity events across sites over the monitoring period. Although site-specific baseline thresholds were also calculated using each site's running mean turbidity ± standard error (Appendix Table A27), these thresholds were not used for the primary exceedance analysis presented here. This approach was chosen because sites with chronically elevated turbidity conditions would inherently have higher calculated baseline thresholds, potentially masking persistently poor water quality conditions and reducing comparability among sites. Instead, the fixed 25 NTU threshold was used to provide a consistent watershed-wide benchmark for identifying and comparing elevated turbidity events across all monitoring locations. Unnamed Tributary (Site 5A) and Mure Brook Downstream (Site 8) recorded the highest number of exceedance events over the monitoring period (65 and 62 events, respectively), followed by Keating Industrial Park Outfall (Site 2; 51), Sandhill Park (Site 1; 42), and Mure Brook Upstream (Site 6; 41). The remaining sites recorded between 19 and 36 exceedance events. Trend analysis of annual exceedance counts using a non-parametric approach indicated that only Site 1 exhibited a statistically significant decreasing trend over time (Sen's slope = −0.23 events year^{-1}; Kendall's τ = −0.4399; p = 0.029), suggesting a moderate reduction in high turbidity events at this site. In contrast, all other sites showed no statistically significant monotonic trend in exceedance frequency, with annual counts characterized by variability but no consistent long-term increase or decrease. In 2025, elevated turbidity events were recorded at all sites, with the highest number occurring at Site 8 (10 events) and Site 5A (8 events), likely reflecting naturally high turbidity conditions within the watershed during that year.

3.1.4 pH

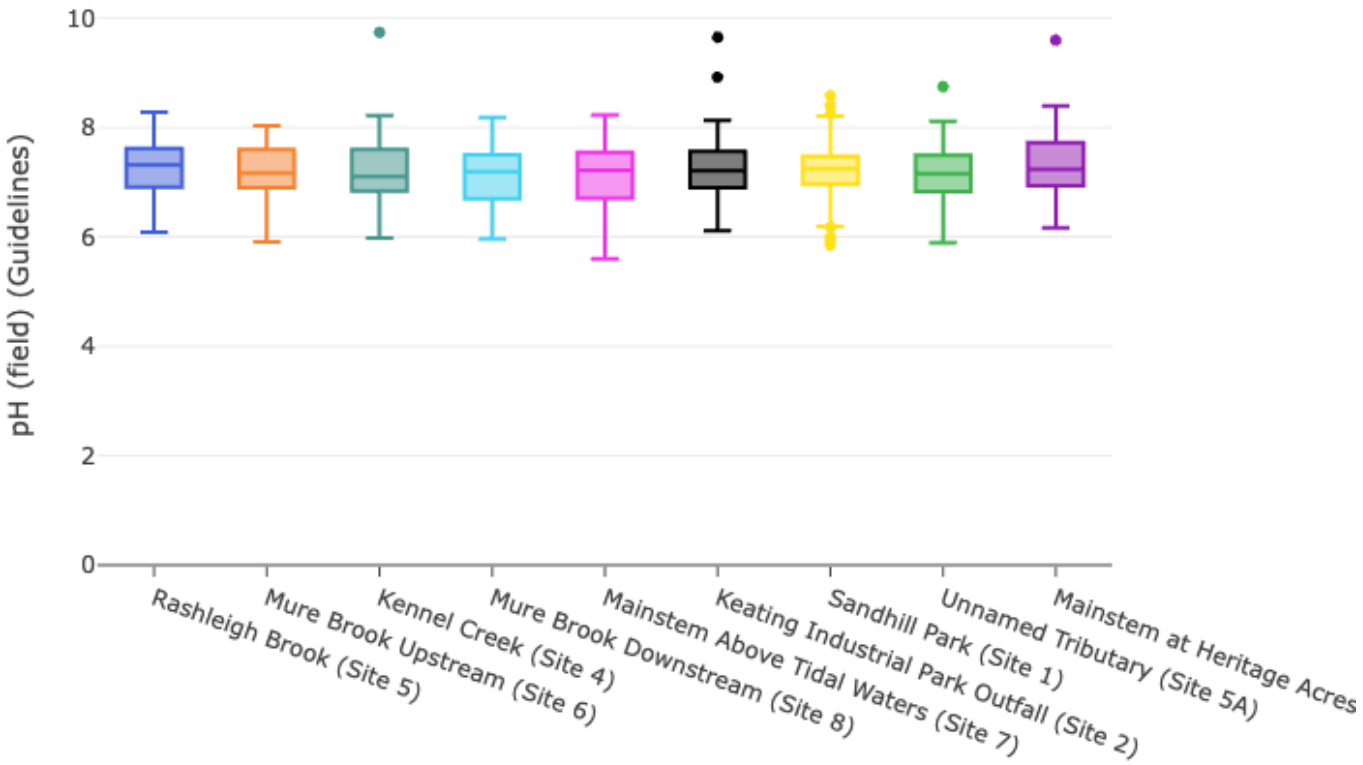


Figure 5. Boxplot comparison of pH across all sites over the 15 year monitoring period. Figure taken from Pacific Datastream.

Median pH remained consistent across all monitoring sites, ranging from 7.10 at Kennel Creek (Site 4) to 7.49 at Unnamed Tributary (Site 5A), indicating stable, near-neutral conditions throughout the watershed. Median pH at the remaining sites was 7.245 at Sandhill Park (Site 1), 7.21 at Keating Industrial Park Outfall (Site 2), 7.235 at Mainstem at Heritage Acres (Site 3), 7.315 at Rashleigh Brook (Site 5), 7.17 at Mure Brook Upstream (Site 6), 7.215 at Mainstream Above Tidal Waters (Site 7), and 7.19 at Mure Brook Downstream (Site 8; Figure X). Exceedances of pH thresholds were rare over the monitoring record. High pH events (>9) were observed only once at Sites 2, 3, and 4, all occurring as isolated events in 2020, while no high pH exceedances were recorded at the remaining sites. Low pH events (<6) were also infrequent, with the greatest number occurring at Sandhill Park (Site 1; 2 events), and single events recorded at Sites 4, 5A, 6, and 8; no low pH exceedances were observed at the other sites. Trend analysis indicated no clear long-term temporal pattern in either high or low pH exceedances, with events occurring sporadically in isolated years rather than showing consistent increases or decreases over time. Overall, pH conditions across the watershed are best described as stable and well-buffered, with only occasional exceedances and no evidence of long-term deterioration or improvement. No high or low pH exceedances have been recorded since 2023.

3.1.5 Conductivity

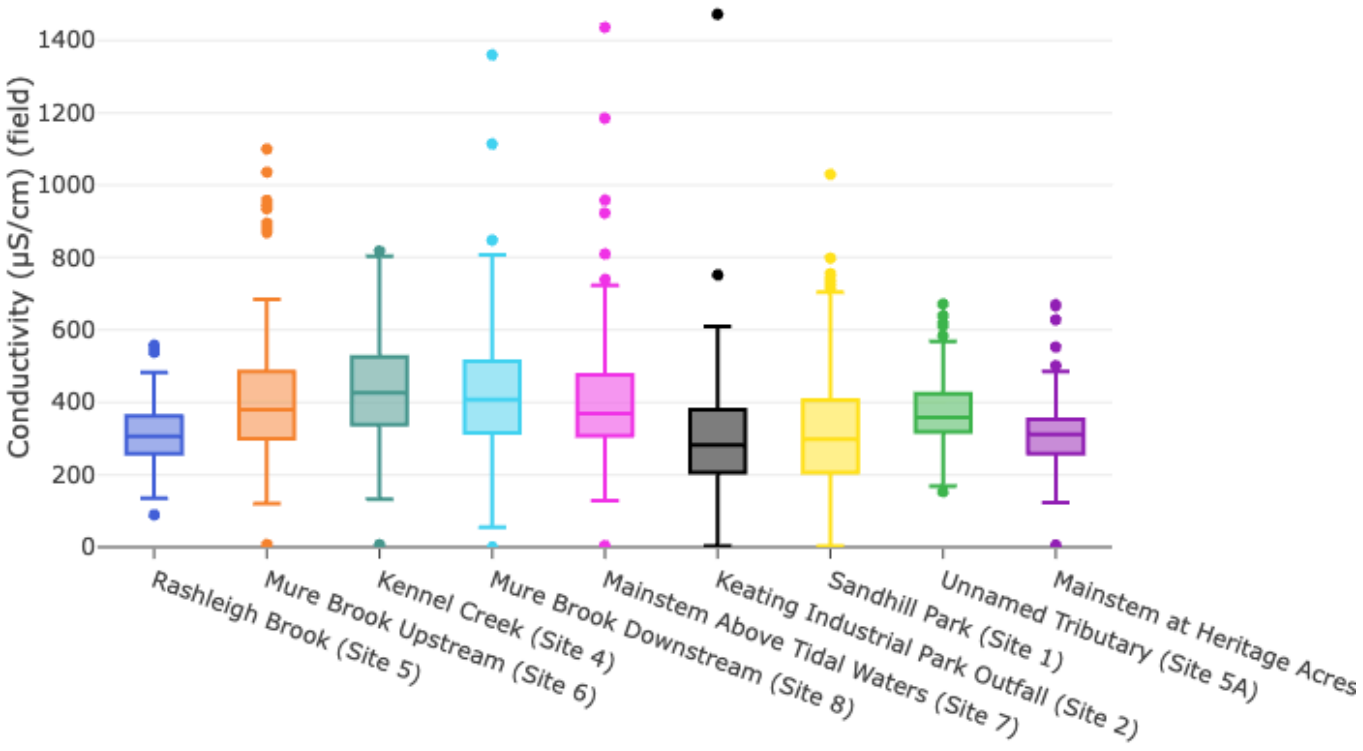


Figure 6. Boxplot comparison of conductivity (µS/cm) across all sites over the 15 year monitoring period. Figure taken from Pacific Datastream.

Conductivity varied across sites, ranging from 282 µS/cm at Keating Industrial Park Outfall (Site 2) to 426.5 µS/cm at Kennel Creek (Site 4), indicating generally higher conductivity conditions at downstream and urban-influenced sites. Median conductivity at the remaining sites was 298 µS/cm at Sandhill Park (Site 1), 311.5 µS/cm at Mainstem at Heritage Acres (Site 3), 306.65 µS/cm at Rashleigh Brook (Site 5), 358.6 µS/cm at Unnamed Tributary (Site 5A), 380 µS/cm at Mure Brook Upstream (Site 6), 369 µS/cm at Mainstream Above Tidal Waters (Site 7), and 407.5 µS/cm at Mure Brook Downstream (Site 8; Figure X). Using thresholds of >500 µS/cm and <150 µS/cm to identify elevated and reduced conductivity conditions, high conductivity exceedances were most frequent at Kennel Creek (Site 4; 51 events), followed by Mure Brook Downstream (Site 8; 41), Mainstream Above Tidal Waters (Site 7; 39), and Mure Brook Upstream (Site 6; 35), while low conductivity events were relatively infrequent across all sites. Trend analysis of annual exceedance counts using a non-parametric Kendall and Theil–Sen approach indicated that only Site 6 exhibited a statistically significant increasing trend in high conductivity events (Sen's slope = 0.25 events year^{-1}; p = 0.0121), suggesting a gradual rise in elevated conductivity occurrences at this site over time. All other sites showed no statistically significant monotonic trend in high conductivity events, and no sites exhibited a significant trend in low conductivity events. Overall, conductivity exceedances across the watershed are best described as stable over time, with the exception of increasing high conductivity events at Site 6. In 2025, both high and low conductivity exceedances were recorded at multiple sites, with the highest number of high conductivity events occurring at Site 6 (4 events), while low conductivity events remained infrequent across the watershed.

3.2 Fecal Coliforms

Annual median fecal coliform concentrations did not exhibit a clear long-term temporal trend. Linear and non-parametric analyses both indicated no statistically significant change over time, suggesting that concentrations have remained variable with no consistent increase or decrease. Similarly, annual exceedance counts above the safe swimming guideline of 200 CFU/100 mL showed no statistically significant trend, and are best interpreted as fluctuating from year to year without a clear long-term directional pattern. In 2025, seven exceedances were recorded. However, laboratory methods changed in August 2025, after which fecal coliform concentrations decreased substantially. Because only 5 of 12 months in 2025 were analyzed using the new laboratory, this shift was not fully captured in the annual trend analyses. While exceedances of the 200 CFU/100 mL guideline still occurred, the magnitude of concentration was reduced, as reflected in declining recent medians (e.g., 900 CFU/100 mL in 2024 to 250 in 2025, and 47 in 2026), suggesting a potential recent improvement in measured fecal coliform concentrations following the laboratory transition.

Table 3. Annual fecal coliform medians from 2020 onward.

Year	Annual Median Fecal Coliform Concentration (CFU/100mL)
2020	312
2021	700
2022	400
2023	400
2024	900
2025	250
2026	47

3.3 Heavy Metals

Figures for heavy metal data are not included within this report. However, exceedance occurrence tables for each parameter can be found in the appendix, and all data, with figures and statistics, can be found publicly available on Pacific Datastream: Peninsula Streams Society Central Saanich Water Quality Monitoring - Tetayut.

3.3.1 Arsenic

Over the 2011–2025 monitoring period, annual median arsenic concentrations exhibited a statistically significant increasing trend over time. Linear trend analysis estimated a slope of m =

+0.0445 µg/L year⁻¹ (p = 0.0024; R^2 = 0.522), while non-parametric analysis supported this result (Kendall's τ = 0.483, p = 0.015; Theil–Sen slope = +0.0379 µg/L year⁻¹), indicating a consistent upward trend despite year-to-year variability. This pattern appears to be driven by early years dominated by below-detection values (treated as zero), followed by more recent years with consistently measurable concentrations above zero. Despite this increasing trend in median concentrations, arsenic levels remained well below the applicable guideline threshold of 5.0 µg/L throughout the monitoring record. No exceedances were recorded between 2011 and 2025, and the maximum observed concentration (3.85 µg/L in 2020) remained below the guideline. Overall, arsenic concentrations at this site are increasing from previously non-detect levels but remain within acceptable limits and therefore are of little concern.

3.3.2 Cadmium

Annual median cadmium concentrations at Site 2 did not exhibit a clear long-term decreasing trend. While a linear trend analysis indicated a slight positive slope, this relationship was not statistically significant, and the data are best interpreted as showing variability over time rather than a consistent directional change. A non-parametric Kendall trend test suggested a positive monotonic association (Kendall's τ ≈ 0.49, p = 0.023), indicating that median concentrations were generally higher in later years compared to earlier years; however, the overall pattern reflects fluctuations, with low concentrations in the early years, increases in the mid-2010s, and declines in more recent years. In contrast, annual cadmium guideline exceedance counts showed a statistically significant downward trend over time (linear slope ≈ −0.08 exceedances year⁻¹; p = 0.0008; Kendall p = 0.0087), indicating that exceedances have become less frequent in recent years. However, exceedance frequency was very low throughout the monitoring period, typically occurring at most once per year between 2011 and 2018, followed by largely zero exceedances in subsequent years, with only a single event recorded in 2020 and none observed since. Overall, this pattern suggests that cadmium exceedances have not been a persistent or widespread issue at this site. In 2025, no cadmium exceedances were recorded.

3.3.3 Copper

Annual median copper concentrations at Site 2 did not exhibit a clear long-term decreasing trend. Linear and non-parametric analyses both indicated no statistically significant change over time, and the data are best interpreted as showing variability rather than a consistent directional pattern. Median concentrations were often at or near zero, with a period of elevated values between approximately 2015 and 2020, followed by a return to lower levels in recent years. Similarly, annual copper guideline exceedance counts showed no meaningful temporal trend from 2005 to 2025. Both linear and rank-based analyses indicated an essentially flat pattern, with yearly exceedance counts consistently remaining high, typically ranging between 8 and 12 events per year. This indicates that copper exceedances have persisted at elevated levels over time without evidence of improvement. In 2025, five copper guideline exceedances were recorded.

3.3.4 Iron

Annual median iron concentrations showed a slight upward tendency over time; however, this trend was weak and not statistically significant. Linear trend analysis estimated a slope of m ≈ +9.98 µg/L year⁻¹ (p = 0.460; R^2 = 0.043), while a non-parametric Kendall trend test similarly indicated a weak positive association (Kendall's τ = 0.172, p = 0.372). These results suggest that annual median iron

concentrations are highly variable from year to year, with no clear long-term increasing or decreasing trend. Over the same period, iron concentrations exceeded the 300 µg/L guideline a total of 161 times, indicating that high concentration events have been relatively common. Trend analysis of annual exceedance counts showed a slight upward directional signal, but this relationship was not statistically significant, and is therefore best interpreted as stable with year-to-year variability rather than a consistent increase. Overall, iron exceedances have remained high and persistent over time, with no clear evidence of long-term improvement. In 2025, 12 iron exceedances were recorded.

3.3.5 Lead

Annual median lead concentrations did not exhibit a clear long-term decreasing trend. Non-parametric analysis indicated a weak negative directional signal, supported by a near-zero linear slope, but this relationship was not statistically significant and is best interpreted as variability rather than a consistent decline. Similarly, annual lead guideline exceedance counts showed no statistically significant temporal trend. While simple linear analysis suggested a slight downward tendency, the Mann–Kendall test indicated no significant monotonic trend (Kendall's $\tau = -0.096$; $p = 0.640$; Sen's slope = 0.0), reflecting year-to-year fluctuations without a clear directional pattern. Exceedance frequency has also remained relatively low overall, averaging approximately 1.6 exceedances per year since 2011, suggesting that lead is not a major concern parameter at this site. In 2025, one lead guideline exceedance was recorded which was only 0.08 ug/L greater than the exceedance guidelines.

3.3.6 Manganese

Manganese concentrations did not exhibit a clear long-term temporal trend. Annual median concentrations showed a slight upward directional tendency, but this trend was weak and not statistically significant, and is therefore best interpreted as year-to-year variability rather than a consistent increase or decrease. Guideline exceedances were extremely rare, with only a single exceedance recorded over the entire monitoring period (in 2022) and none observed in any other year. Given the very low frequency of exceedances, no meaningful trend analysis of exceedance counts is warranted. Overall, manganese concentrations are best described as stable and low, with exceedances not representing a significant concern at this site.

3.3.7 Mercury

Annual median mercury concentrations remained consistently at 0 µg/L in every year, indicating no measurable change over time and no detectable long-term trend. In contrast, annual mercury guideline exceedance counts exhibited a statistically significant decreasing trend. Linear trend analysis estimated a slope of $m = -0.096$ exceedances year^{-1} ($p = 0.0059$), indicating that exceedances have declined by approximately 0.10 events per year on average. This pattern reflects more frequent exceedances in the early years of monitoring (2011–2015), including a peak of two events in 2013, followed by increasingly sporadic occurrences and no exceedances recorded from 2022 through 2025. Overall, these results indicate stable baseline mercury conditions with a clear reduction in exceedance frequency over time.

3.3.8 Phosphorus

Annual median phosphorus concentrations did not exhibit a decreasing trend over time. Linear trend analysis indicated a slight positive slope, and a non-parametric Kendall trend test similarly suggested a weak upward tendency; however, neither result was statistically significant, and the data are best interpreted as variable from year to year rather than showing a consistent directional change. Similarly, annual exceedance counts showed a slight upward tendency, but this trend was also not statistically significant, indicating no clear long-term increase or decrease in exceedance frequency. Overall, phosphorus concentrations and exceedances are best described as stable with interannual variability, with a possible but weak upward tendency that is not statistically supported. In 2025, 12 phosphorus exceedances were recorded, illustrating that elevated phosphorus appears to be a common issue.

3.3.9 Zinc

Annual median zinc concentrations at Site 2 exhibited a slight downward tendency following elevated values observed in the mid-2010s; however, this trend was not statistically significant. Linear regression indicated a weak negative slope, and a non-parametric Mann–Kendall test similarly showed no significant monotonic trend. These results suggest that, while concentrations appear lower in recent years compared to peak values around 2014–2015, the overall pattern is best interpreted as variable rather than a consistent long-term decline. Annual zinc exceedance counts also showed a weak downward tendency over time, but no statistically significant trend. Overall, zinc exceedances are best described as stable with interannual variability, with a slight but non-significant downward signal. Regardless, zinc concentrations frequently exceed guidelines. In 2025, 10 exceedances were recorded.

3.4 Nutrients

3.4.1 Ammonia as NH3-N

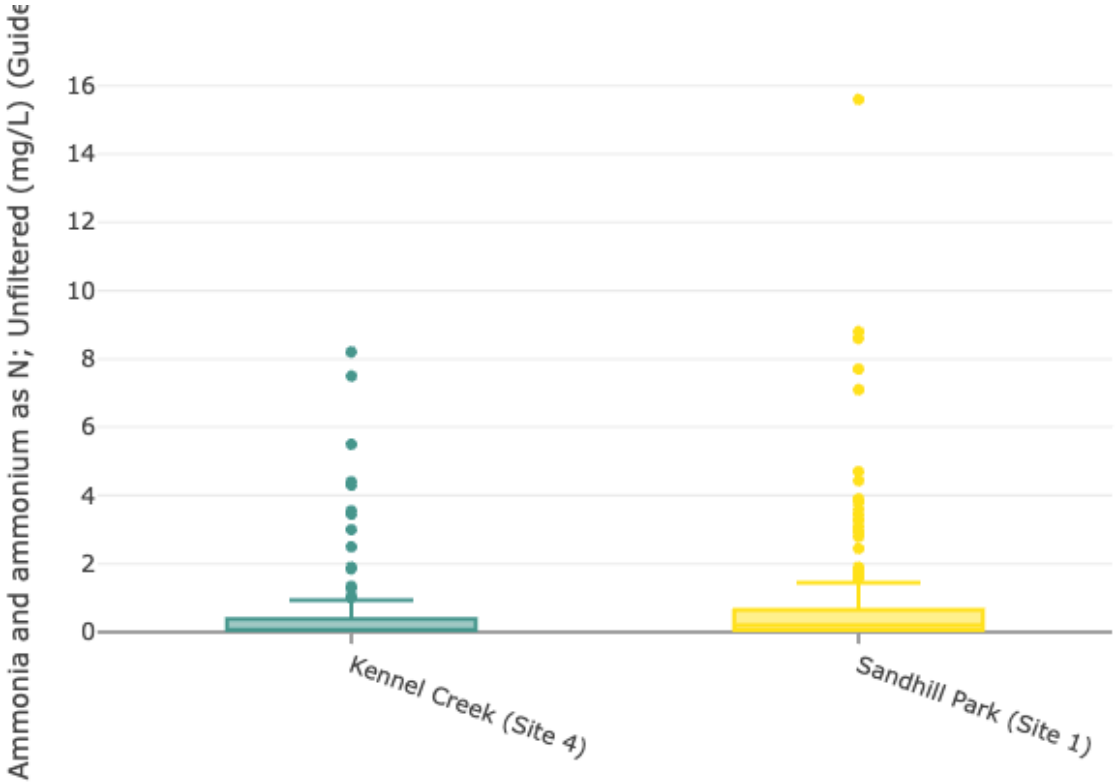


Figure 7. Boxplot comparison of ammonia-N across sites 1 and 4 over the 15 year monitoring period. Figure taken from Pacific Datastream.

Median ammonia-N (NH_3-N) concentrations differed between sites, with a median of 0.20 mg/L at Sandhill Park (Site 1) and 0.067 mg/L at Kennel Creek (Site 4), indicating higher baseline concentrations at Site 1. Guideline exceedances were assessed using threshold values calculated for each sampling day based on the corresponding temperature and pH conditions. Using these site-specific thresholds, Site 1 recorded a total of 13 exceedances over the monitoring period, while Site 4 recorded 6 exceedances. Trend analysis of annual exceedance counts indicated a statistically significant decreasing trend at Site 1 (m = −0.132 exceedances year^{-1}; p = 0.0308; Kendall's τ = −0.423, p = 0.0468; Sen's slope ≈ −0.11), suggesting a clear reduction in exceedance frequency over time. In contrast, Site 4 exhibited a strong practical decline, with exceedances occurring only in 2011 and 2014 and no exceedances recorded from 2015 onward; however, formal statistical tests indicated only a borderline non-significant trend (p ≈ 0.05), reflecting the influence of sparse data and many zero years. Overall, ammonia-N exceedances have decreased over time at both sites, with the strongest statistical support at Site 1 and a clear but not formally significant decline at Site 4. In 2025, one exceedance was recorded at Site 1, while no exceedances were observed at Site 4.

3.4.2 Nitrite as N

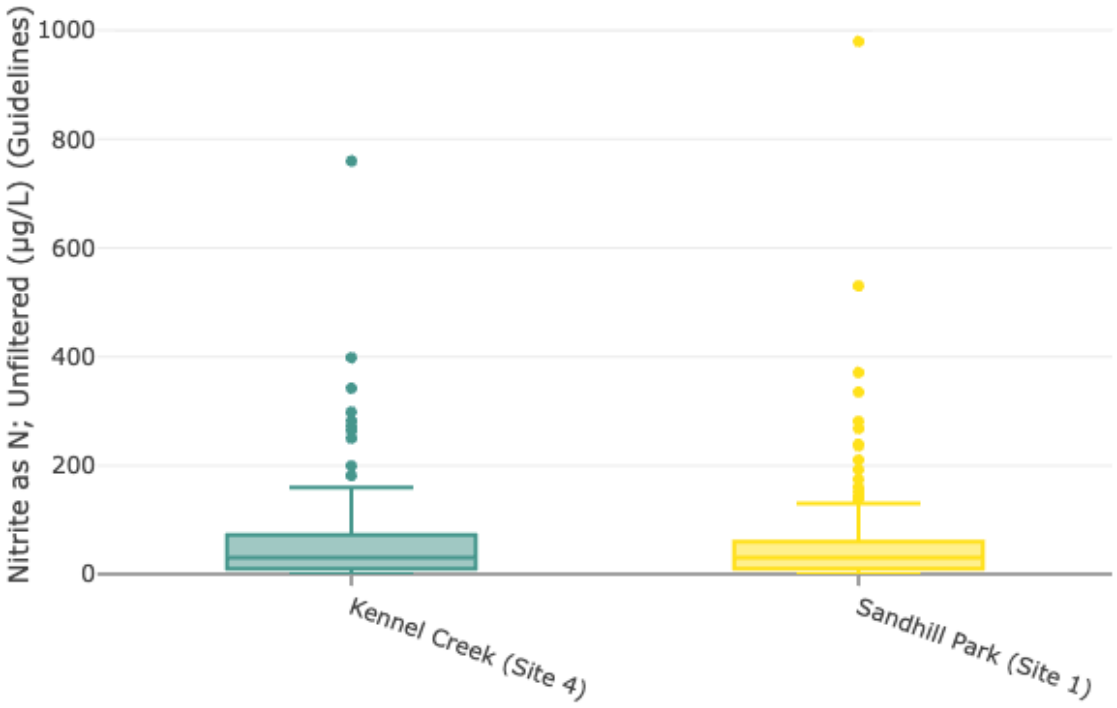


Figure 8. Boxplot comparison of nitrite-N across sites 1 and 4 over the 15 year monitoring period. Figure taken from Pacific Datastream.

Median nitrite-N concentrations were similar between sites, with both Sandhill Park (Site 1) and Kennel Creek (Site 4) exhibiting median values of approximately 30 µg/L. Using the guideline threshold of 60 µg/L to identify exceedances, Site 4 recorded a slightly higher total number of exceedances over the monitoring period (49 events) compared to Site 1 (46 events). Trend analysis of annual exceedance counts indicated a statistically significant increasing trend at Site 1 (slope ≈ +0.19 exceedances year^{-1}; p = 0.0417; Kendall's p = 0.0337), suggesting a gradual rise in exceedance frequency over time. In contrast, Site 4 exhibited a weaker pattern, with a slight upward tendency that was not statistically significant based on linear regression (p = 0.0776), although the Kendall test indicated a marginally significant monotonic trend (p = 0.0407). As such, Site 4 is best interpreted as relatively stable with a possible weak upward tendency. Overall, nitrite exceedances appear to be increasing modestly at Site 1, while remaining broadly stable at Site 4. In 2025, three exceedances were recorded at Site 4 and two at Site 1.

3.4.3 Nitrate as N

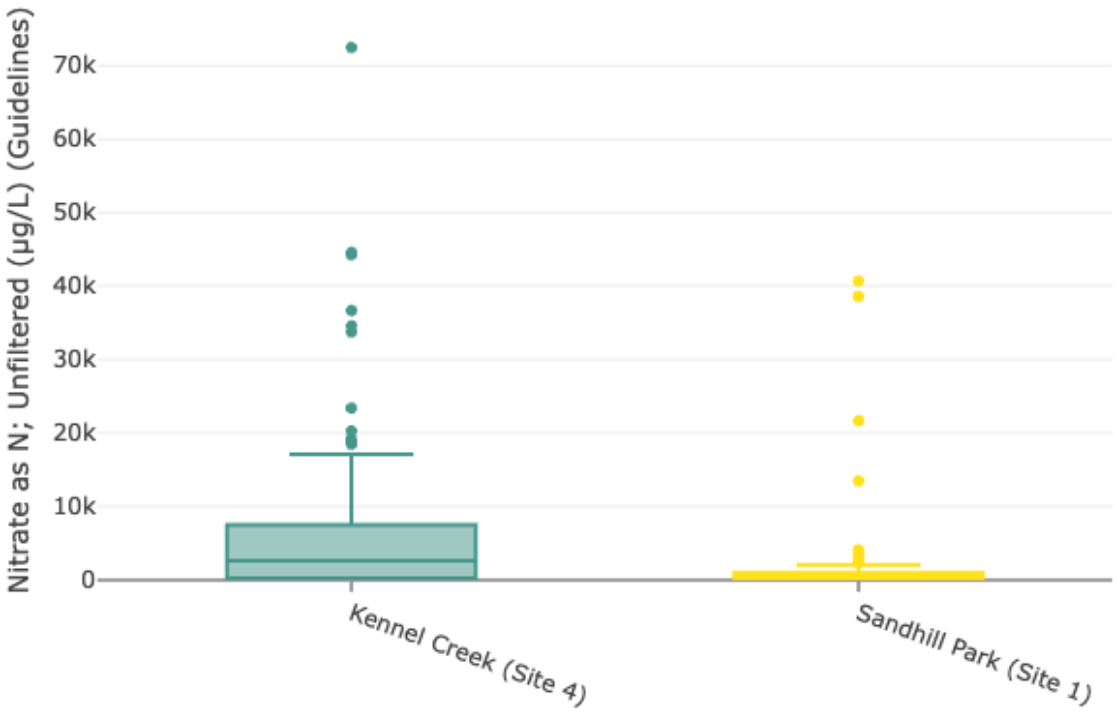


Figure 9. Boxplot comparison of nitrate-N across sites 1 and 4 over the 15 year monitoring period. Figure taken from Pacific Datastream.

Over the 2011–2025 monitoring period, median nitrate-N concentrations differed substantially between sites, with Sandhill Park (Site 1) exhibiting a median of 455 µg/L and Kennel Creek (Site 4) a much higher median of 2640 µg/L, approaching the CCME guideline of 3000 µg/L. Consistent with this pattern, Site 4 recorded a markedly higher number of exceedances over the monitoring period (81 events) compared to Site 1 (7 events). Trend analysis of annual exceedance counts indicated no statistically significant trend at Site 1, suggesting that exceedance frequency has remained stable over time. In contrast, Site 4 exhibited a statistically significant increasing trend (slope ≈ +0.396 exceedances year^{-1}; p = 0.0048; Kendall's τ = 0.538, p = 0.0068), indicating a clear rise in nitrate exceedances over the monitoring period. Overall, nitrate conditions at Site 1 appear stable and infrequently exceed guidelines, whereas Site 4 shows consistently elevated concentrations with increasing exceedance frequency over time. In 2025, no exceedances were recorded at Site 1, while six exceedances were observed at Site 4.

3.4.4 Orthophosphate

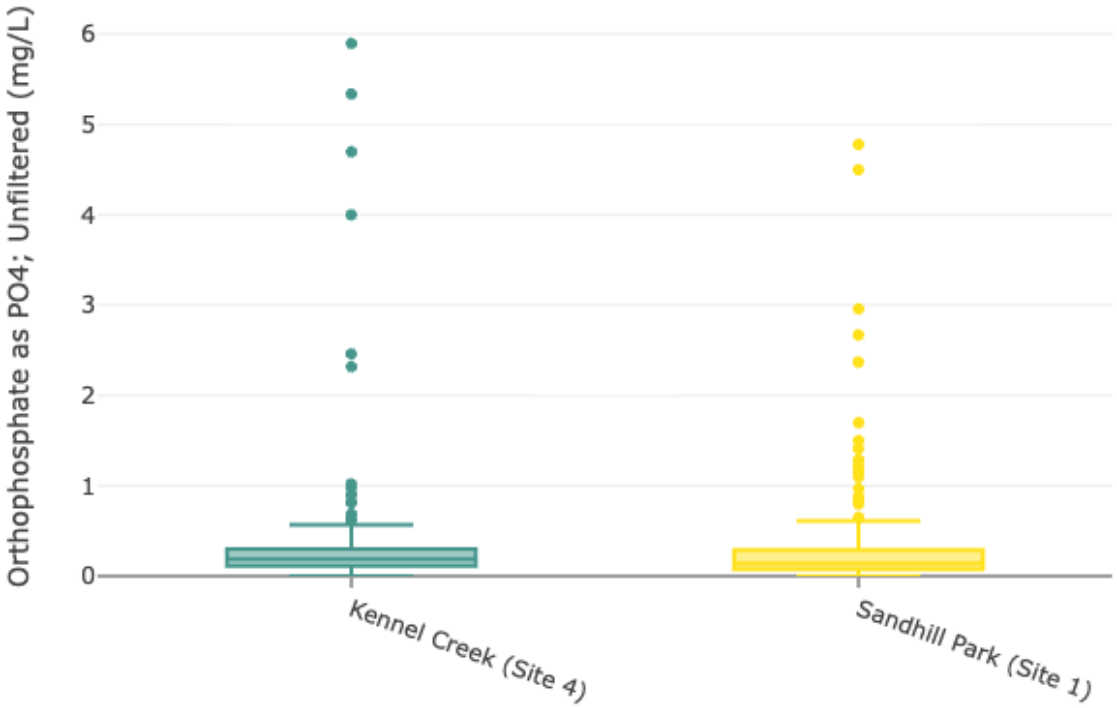


Figure 10. Boxplot comparison of orthophosphate across sites 1 and 4 over the 15 year monitoring period. Figure taken from Pacific Datastream.

Over the 2011–2025 monitoring period, median orthophosphate concentrations were relatively similar between sites, with Kennel Creek (Site 4) exhibiting a median of 0.185 mg/L and Sandhill Park (Site 1) a median of 0.14 mg/L. No officially recognized CCME water quality guideline exists for orthophosphate specifically; however, for the purposes of this analysis, a threshold of 100 µg/L (0.10 mg/L) was used as a benchmark for elevated concentrations, consistent with thresholds commonly referenced in freshwater nutrient assessments. Using this threshold to identify exceedances, both sites recorded a high number of exceedances over the monitoring period, with 136 events at Site 4 and 104 events at Site 1. Trend analysis of annual exceedance counts indicated a statistically significant decreasing trend at Site 1 (slope ≈ −0.54 exceedances year^{-1}; $p = 0.0083$; Kendall's $\tau = -0.441$, $p = 0.0247$; Theil–Sen slope ≈ −0.50), suggesting a consistent reduction in exceedance frequency over time. In contrast, Site 4 exhibited a weaker downward tendency, but this trend was not statistically significant, and is therefore best interpreted as stable with some variability. Overall, elevated orthophosphate concentrations appear to be decreasing at Site 1, while remaining persistently high with no clear trend at Site 4. In 2025, 10 exceedances were recorded at Site 4 and 7 at Site 1.

3.5 Hydrocarbons

Figures for hydrocarbon data are not included within this report. However, exceedance occurrence tables for each parameter can be found in the appendix, and all data, with figures and statistics, can be found publicly available on Pacific Datastream: Peninsula Streams Society Central Saanich Water Quality Monitoring - Tetayut.

3.5.1 Total Extractable Hydrocarbons

Total extractable hydrocarbons (TEH) concentrations were assessed against a guideline threshold of 0.5 mg/L. Trend analysis of annual exceedance counts indicated a statistically significant increasing trend over time (Kendall's $\tau = 0.473$, $p = 0.0243$; Sen's slope ≈ +0.10 exceedances year^{-1}), suggesting that TEH exceedances have become more frequent in recent years. Similarly, analysis of annual median TEH concentrations showed no evidence of a decreasing trend; instead, results indicated a statistically significant upward shift over time (Kendall's $\tau = 0.507$, $p = 0.0223$). While the Theil–Sen slope was estimated at 0.0 mg/L year^{-1} due to a high number of zero values in earlier years, this reflects a dataset characterized by many non-detects followed by more frequent detections in later years, rather than true stability. Overall, both exceedance frequency and median concentrations indicate increasing TEH presence over the monitoring period. In 2025, eight exceedances were recorded, representing the highest annual total observed to date.

3.5.2 Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbon (PAH) detections showed a statistically significant decreasing trend over time. A non-parametric Mann–Kendall analysis indicated a significant downward trend in annual detection counts ($p = 0.0059$), reflecting a clear reduction in detections, particularly with no detections recorded from 2017 through 2025. The Theil–Sen slope was estimated at 0.0 detections year^{-1}, which reflects the extended period of zero detections in recent years rather than a true absence of trend. Overall, the dataset indicates a meaningful decline in PAH detections over time, with conditions improving to the point of no recent detections. In 2025, no PAH detections were recorded.

3.6 Sediment Metals

Figures for sediment data are not included within this report. However, exceedance occurrence tables for each parameter can be found in the appendix, and all data, with figures and statistics, can be found publicly available on Pacific Datastream: Peninsula Streams Society Central Saanich Water Quality Monitoring - Tetayut.

3.6.1 Arsenic

Sediment arsenic concentrations did not exhibit a clear long-term temporal trend. Analysis of annual median concentrations indicated a slight downward tendency, but this trend was not statistically significant, and is best interpreted as stable with year-to-year variability. Similarly, analysis of annual percent exceedances suggested a decreasing pattern over time, but this trend was also not statistically significant ($p = 0.0787$), indicating only a weak and uncertain decline. Overall, sediment arsenic conditions appear relatively stable, with no strong evidence of increasing or decreasing concentrations or exceedance frequency over time. In 2025, one exceedance was recorded out of four sampling events.

3.6.2 Cadmium

Sediment cadmium concentrations did not exhibit a clear long-term temporal trend. Annual median concentrations showed a slight upward tendency, but this trend was not statistically significant (p

= 0.1128), and is best interpreted as variable over time rather than a consistent increase. Guideline exceedances were extremely rare, with only a single exceedance recorded in 2014 and none observed in other years, indicating that cadmium is not a concern parameter at this site. Given the very low frequency of exceedances, no meaningful trend analysis of exceedance counts was conducted. Overall, sediment cadmium conditions are best described as stable and low, with no evidence of long-term deterioration.

3.6.3 Chromium

Sediment chromium concentrations did not exhibit a clear long-term temporal trend. Analysis of annual median concentrations indicated a negligible downward tendency, but this trend was not statistically significant (p = 0.921) and is best interpreted as stable over time. Similarly, analysis of annual exceedance counts and percent exceedances showed no statistically significant trends, with Sen's slope estimates of 0.0 indicating no meaningful long-term change. Overall, sediment chromium exceedances and concentrations are best described as variable from year to year, with no evidence of consistent increase or decrease over time. In 2025, 2 of 4 samples exceeded the applicable guideline.

3.6.4 Copper

Sediment copper concentrations did not exhibit a clear long-term temporal trend. Analysis of annual median concentrations indicated a very weak upward tendency, but this trend was not statistically significant (p = 0.766) and is best interpreted as stable with year-to-year variability. Similarly, trend analysis of annual exceedance counts and percent exceedances, based on the guideline threshold of 35.7 µg/g, indicated a slight downward directional signal, but these trends were also not statistically significant (p = 0.599 and 0.539, respectively), indicating no clear long-term change in exceedance frequency. Overall, sediment copper conditions are best described as variable over time, with no statistically supported improvement or deterioration. In 2025, 75% of samples (3 of 4) exceeded the applicable guideline, indicating some concern with sediment copper concentrations.

3.6.5 Lead

Sediment lead concentrations did not exhibit a clear long-term temporal trend. Analysis of annual median concentrations indicated a slight downward tendency, but this trend was not statistically significant (p = 0.495) and is best interpreted as variable over time rather than a consistent decline. Similarly, analysis of annual exceedance counts and percent exceedances, based on the guideline threshold of 35 µg/g, indicated very weak upward directional signals, but these were not statistically significant (p = 0.354 and 0.520). Overall, sediment lead conditions are best described as stable with year-to-year variability, with no evidence of meaningful improvement or deterioration over time. In 2025, 25% of samples (1 of 4) exceeded the applicable guideline.

3.6.6 Nickel

Sediment nickel concentrations did not exhibit a clear long-term temporal trend. Analysis of annual median concentrations indicated a very weak upward tendency, but this trend was not

statistically significant and is best interpreted as stable with year-to-year variability. Similarly, analysis of annual exceedance counts and percent exceedances showed no statistically significant trends, indicating no meaningful increase or decrease in exceedance frequency over time. Despite this lack of trend, exceedances were consistently high across the monitoring period, with many years exhibiting elevated exceedance rates. In 2025, 100% of samples (4 of 4) exceeded the applicable guideline. Overall, sediment nickel conditions are best described as persistently elevated with no evidence of long-term improvement.

3.6.7 Zinc

Sediment zinc concentrations did not exhibit a clear long-term temporal trend. Analysis of annual median concentrations indicated a very weak upward tendency, but this trend was not statistically significant (p = 0.923) and is best interpreted as stable with year-to-year variability. Similarly, analysis of annual exceedance counts and percent exceedances, based on the guideline threshold of 123 µg/g, indicated slight positive directional signals, but these trends were not statistically significant (p = 0.644 and 0.540, respectively). Overall, sediment zinc conditions are best described as variable over time, with no evidence of consistent improvement or deterioration. In 2025, 75% of samples (3 of 4) exceeded the applicable guideline, suggesting this parameter is frequently elevated.

4.0 Discussion

Overall, results from the 2011–2025 Tetayut watershed monitoring program indicate that while many physical water quality conditions have remained relatively stable over time, several contaminants continue to persist throughout the watershed. The long-term dataset suggests that some parameters have improved over the course of the monitoring program, while others have remained chronically elevated or, in some cases, shown increasing trends. These results highlight both the value of sustained long-term monitoring and the ongoing influence of anthropogenic activities within the watershed.

Physical water quality conditions throughout the watershed were generally consistent with conditions capable of supporting aquatic life. Water temperatures remained relatively stable across all sites and exceedances above 19 °C were rare and sporadic, with no evidence of increasing thermal stress over time. Similarly, pH conditions remained stable and well-buffered throughout the watershed, with only isolated exceedances observed over the monitoring period. Dissolved oxygen conditions also remained relatively stable overall, although some sites, particularly Sandhill Park (Site 1), experienced recurring low oxygen events. These low oxygen conditions may reflect localized organic enrichment, stagnant summer flow conditions, or elevated biological oxygen demand associated with nutrient enrichment and organic matter decomposition. Turbidity was one of the most consistently elevated physical parameters throughout the watershed, with all sites experiencing repeated exceedances over the monitoring period. Sites 5A (Unnamed Tributary) and 8 (Mure Brook Downstream) in particular exhibited persistently high turbidity conditions, likely reflecting a combination of naturally fine sediment conditions, low summer flows, channel instability, urban runoff, and storm-driven sediment inputs. Elevated turbidity is ecologically important because suspended sediments can damage fish gills, reduce feeding efficiency, smother spawning gravels, and transport attached contaminants such as metals and hydrocarbons (Kemp et al., 2011). Although turbidity exceedances remained common, only Site 1

exhibited a statistically significant decline in exceedance frequency over time, suggesting that turbidity conditions at most sites have remained relatively unchanged over the duration of the program.

Conductivity conditions were similarly stable overall, although elevated conductivity events were common at several sites, particularly Kennel Creek (Site 4), Mure Brook Downstream (Site 8), and Mainstream Above Tidal Waters (Site 7). Mure Brook Upstream (Site 6) exhibited a statistically significant increase in high conductivity events over time, which may indicate increasing influence from urban runoff, road salts, groundwater inputs, or other dissolved contaminants. Often these high events took place in winter suggesting that road salt influence may be the primary source. Continued monitoring will be important to determine whether this trend persists in future years.

Enhanced monitoring at Keating Outfall East (Site 2) continues to indicate that runoff originating from the Keating Industrial Area remains a significant source of contamination within the watershed. Copper, iron, phosphorus, and zinc consistently exceeded water quality guidelines throughout the monitoring period and remain the primary dissolved metal concerns at the site. Iron and phosphorus were particularly persistent, exceeding applicable guidelines during the majority of sampling events between 2011 and 2025. Copper and zinc exceedances also remained consistently elevated with little evidence of long-term improvement. While most of these parameters did not exhibit statistically significant increasing trends, the absence of meaningful declines over more than a decade of monitoring suggests that contaminant inputs remain ongoing and chronic in nature.

These elevated contaminant concentrations are ecologically important because many of these metals are known to negatively affect aquatic organisms, particularly salmonids and other sensitive fish species. Copper can impair olfactory function, predator avoidance behaviour, osmoregulation, and respiration in juvenile salmonids (Hecht et al., 2007; Price, 2013), while zinc and iron can contribute to physiological stress, gill damage, and reduced survival (Price, 2013). Additionally, elevated phosphorus concentrations may contribute to eutrophication and excessive algal growth, particularly under low-flow summer conditions.

Despite the persistence of several contaminants, some parameters showed evidence of long-term improvement. Cadmium and mercury exceedances both declined significantly over time, with no mercury exceedances observed after 2021 and no cadmium exceedances recorded since 2020. Similarly, polycyclic aromatic hydrocarbons (PAHs) exhibited a strong declining trend, with no detections observed between 2017 and 2025. These improvements may reflect changes in industrial practices, improved spill prevention measures, source control initiatives, or broader changes in land use and stormwater management within the watershed.

In contrast, total extractable hydrocarbons (TEH) exhibited a statistically significant increasing trend over the monitoring period and represented one of the clearest examples of worsening water quality conditions at Site 2. TEH exceedances became substantially more common in recent years, with 2025 recording the highest annual exceedance total observed to date. These results suggest that petroleum hydrocarbon contamination associated with industrial runoff, vehicle-related pollutants, spills, or stormwater transport remains an ongoing concern within the Keating Industrial Area. Hydrocarbon contamination can negatively affect aquatic ecosystems through direct toxicity, reduced water quality, and contamination of sediments and benthic habitat. Consequently, continued monitoring and research into potential sources of contamination and mitigation is necessary.

Fecal coliform concentrations at Site 2 also remained persistently elevated throughout much of the monitoring period, with repeated exceedances of the recreational guideline threshold of 200

CFU/100 mL. However, an important shift in measured concentrations occurred following the transition from MB Laboratories to Bureau Veritas in August 2025. Following this laboratory transition, measured fecal coliform concentrations declined substantially relative to previous years, resulting in markedly lower recent medians and exceedance magnitudes. For example, annual median concentrations declined from 900 CFU/100 mL in 2024 to 250 CFU/100 mL in 2025, while preliminary 2026 median concentrations are substantially lower still. It is possible that differences in analytical methods, laboratory procedures, detection techniques, or reporting practices between the two laboratories contributed to the observed shift. As such, caution should be exercised when interpreting recent fecal coliform trends across the laboratory transition period, and additional years of monitoring will be required to determine whether the apparent reduction represents a true environmental improvement.

Nutrient monitoring throughout the watershed identified several ongoing concerns, particularly at Kennel Creek (Site 4). Nitrate-N concentrations at this site were consistently elevated and exhibited a statistically significant increase in exceedance frequency over time, suggesting increasing nutrient enrichment within portions of the watershed. Nitrite exceedances also increased modestly at Site 1. In contrast, ammonia-N exceedances declined over time at both nutrient monitoring sites, representing one of the clearer improvements observed within the nutrient dataset. Elevated nutrient concentrations throughout the watershed are likely linked to a combination of agricultural runoff, fertilizers, organic waste inputs, urban stormwater runoff, and potentially cross-connections between sanitary and stormwater systems. These nutrient inputs may contribute to eutrophication, excessive growth of algae and duckweed, and subsequent oxygen depletion under low-flow conditions.

Sediment quality monitoring at Site 2 indicated that several sediment-associated metals remain chronically elevated. Nickel, chromium, copper, and zinc repeatedly exceeded sediment quality guidelines throughout the monitoring period, with nickel representing the most persistent concern parameter and exceeding guidelines in all sediment samples collected during 2025. Despite these persistently elevated concentrations, most sediment parameters did not exhibit statistically significant increasing or decreasing trends over time, suggesting relatively stable but chronically contaminated sediment conditions near the outfall. Sediment contamination is of particular ecological concern because contaminants can accumulate over time, remain biologically available to benthic organisms, and act as long-term contaminant reservoirs within aquatic systems.

To better contextualize the elevated contaminant concentrations observed within the Tetayut watershed, several of the parameters that were most frequently elevated throughout the monitoring program were compared against other available Vancouver Island and CRD-area stream datasets. The goal of this comparison was to assess whether the concentrations observed within Tetayut were broadly consistent with conditions commonly observed elsewhere across the region, or whether they appeared unusually elevated relative to other local stream systems. Tetayut exhibited elevated concentrations for several contaminants relative to regional comparison streams, although generally at lower levels than those observed within KENNES. Copper, fecal coliforms, and zinc were consistently elevated relative to regional conditions, with median copper concentrations approximately 5 times higher than the regional median, and zinc concentrations approximately 6 times higher. Phosphorus concentrations within Tetayut were moderately elevated relative to regional streams, although they remained closer to the broader regional range than those observed within KENNES; phosphorus has also been shown to be elevated in several urban streams across southern Vancouver Island. Iron concentrations within Tetayut were broadly comparable to typical regional stream conditions and did not appear unusually elevated. Similar to KENNES, hydrocarbon comparisons were constrained by differences in analytical parameters among datasets, particularly the lack of comparable TEH measurements within most regional datasets.

Nevertheless, Tetayut exhibited evidence of episodic petroleum hydrocarbon contamination, including occasional extreme TEH spikes comparable in magnitude to those observed within KENNES. PAH concentrations within Tetayut appeared broadly comparable to regional streams, again suggesting that petroleum contamination within the watershed may be more strongly associated with non-PAH petroleum hydrocarbons. Fecal coliform concentrations also appeared slightly elevated relative to regional comparison streams. However, concentrations measured following the transition from MB Laboratories to Bureau Veritas declined considerably and fell much closer to regional ranges, suggesting that previously elevated concentrations may have been influenced, at least in part, by differences in analytical methodology between laboratories.

Collectively, these results suggest that Tetayut exhibits a particularly strong urban and industrial contamination signal relative to many comparable regional streams (although not as strong as KENNES). Copper, zinc, and likely TEH associated with petroleum products appear to be consistently elevated beyond what may be considered regionally typical conditions. Copper and zinc commonly co-occur in urban runoff because both are strongly associated with roads, vehicles and general industrial activities. Copper is frequently linked to brake pad wear, while zinc can originate from tire wear, galvanized materials, brake components, and general vehicle corrosion. Additional potential sources for both metals include metal fabrication and machinery maintenance. The co-occurrence of elevated copper, zinc, and petroleum hydrocarbons within the watershed therefore suggests that runoff associated with transportation, vehicle wear, and industrial land use likely represents an important source of contamination within the watershed.

It is important to note, however, that these regional comparisons should be interpreted cautiously. The comparison datasets were collected using different sampling designs, analytical methodologies, detection limits, monitoring objectives, temporal coverage, and sampling frequencies, all of which can influence reported concentrations and comparability among datasets. Consequently, these comparisons are best interpreted as broad regional context rather than as precise one-to-one assessments of watershed condition.

Overall, the long-term Tetayut monitoring program demonstrates that while some aspects of watershed condition appear stable or have improved modestly over time, several indicators of urban and industrial stormwater contamination remain persistent. The continued occurrence of elevated metals, hydrocarbons, nutrients, fecal contamination, and sediment-associated contaminants suggests that ongoing pollutant inputs continue to affect aquatic habitat quality. At the same time, observed improvements in parameters such as cadmium, mercury, ammonia, and PAHs demonstrate that positive changes are possible and may reflect the benefits of source control initiatives, stormwater management improvements, and ongoing stewardship efforts. Continued long-term monitoring will remain critical for identifying emerging trends, evaluating management effectiveness, informing restoration priorities, and supporting the long-term protection of aquatic habitat within the Tetayut watershed.

5.0 Conclusion

The Tetayut Watershed Water Quality Monitoring Program has provided over 15 years of continuous environmental monitoring data, representing one of the longer-term watershed water quality datasets available on the Saanich Peninsula. Since monitoring began in 2011, the program has

generated important baseline information on physical water quality conditions, nutrients, fecal contamination, dissolved metals, hydrocarbons, and sediment-associated contaminants throughout the watershed, while also helping identify long-term trends and persistent areas of concern.

Overall, results from the 2011–2025 monitoring period indicate that many physical water quality parameters within the watershed have remained relatively stable over time. Water temperature, pH, dissolved oxygen, and conductivity conditions generally remained within ranges capable of supporting aquatic life, with relatively few statistically significant long-term changes observed. However, elevated turbidity remained a persistent issue across much of the watershed, particularly within smaller, shallower tributaries and downstream sites influenced by sediment-rich runoff and low summer flow conditions.

Despite the relative stability of many physical parameters, the monitoring program identified ongoing contaminant concerns associated with urban and industrial stormwater runoff at Keating Outfall East (Site 2). Dissolved copper, iron, phosphorus, zinc, hydrocarbons, fecal coliforms, and several sediment-associated metals repeatedly exceeded applicable guidelines throughout the monitoring period, indicating that chronic pollutant inputs continue to affect watershed conditions downstream of the Keating Industrial Area. Sediment quality results further demonstrated the persistence of elevated concentrations of nickel, chromium, copper, and zinc within depositional areas near the outfall.

At the same time, the long-term dataset also identified several encouraging trends. Cadmium, mercury, ammonia, and PAH detections all declined over time, suggesting that some aspects of watershed condition may be improving. These improvements may reflect the cumulative benefits of source control initiatives, improved industrial practices, stormwater management measures, and broader stewardship efforts occurring throughout the watershed over the past decade. In contrast, total extractable hydrocarbons (TEH) and nitrate exceedances increased over time at several locations, indicating that some pollutant pressures may be intensifying or remaining unresolved.

Interpretation of recent fecal coliform trends should be approached cautiously due to the transition from MB Laboratories to Bureau Veritas in 2025, which coincided with a substantial reduction in reported concentrations. Additional years of monitoring will be necessary to determine whether these lower concentrations reflect true environmental improvement or methodological differences between laboratories.

Results from both the Hagan–Graham (ḰENNES) and Tetayut watershed monitoring programs indicate that the two watersheds experience many similar water quality challenges associated with urbanization, stormwater runoff, industrial activity, and surrounding land use. Both watersheds exhibited generally stable physical water quality conditions over time, while also experiencing persistent turbidity, fecal coliform exceedances, nutrient enrichment, dissolved metal contamination, hydrocarbon contamination, and elevated sediment-associated metals near outfalls draining the Keating Industrial Area. Copper, iron, phosphorus, zinc, hydrocarbons, and sediment-associated chromium, copper, nickel, and zinc emerged as consistent concerns in both systems. At the same time, both watersheds showed evidence of improvement for several parameters over time, including cadmium exceedances, ammonia, and PAH detections, suggesting that some aspects of watershed condition may be gradually improving. Despite these similarities, several notable differences were observed between the watersheds. The Hagan–Graham (ḰENNES) watershed generally exhibited more severe dissolved metal contamination at the primary industrial outfall site, particularly for copper, phosphorus, and zinc, while Tetayut exhibited stronger nutrient-related concerns, especially increasing nitrate exceedances at Kennel Creek (Site 4). Tetayut also showed a statistically significant increase in total extractable hydrocarbon (TEH)

exceedances over time, whereas the KENNES watershed exhibited persistently elevated but more variable TEH conditions. In contrast, the KENNES watershed experienced poorer dissolved oxygen conditions at Stelly's Road Culvert (Site 5), while Tetayut generally exhibited higher conductivity conditions at several downstream urban-influenced sites. Collectively, these results suggest that although both watersheds are affected by similar anthropogenic pressures, the severity and type of water quality impacts vary depending on watershed characteristics, hydrology, and surrounding land use.

Comparison of the Tetayut watershed to other Vancouver Island and CRD-area stream datasets further suggests that several contaminants, particularly copper, and zinc and likely petroleum hydrocarbons, occur at concentrations substantially elevated relative to many comparable regional streams. Copper and zinc concentrations appeared consistently higher than regional medians, indicating a strong urban and industrial stormwater contamination signal associated with runoff draining the Keating Industrial Area. While these regional comparisons should be interpreted cautiously due to differences in monitoring design and analytical methodologies among datasets, the results nevertheless suggest that contaminant concentrations within portions of the Tetayut watershed may be elevated beyond what is typically observed in many other streams across the region.

In conclusion, this long-term monitoring program demonstrates the importance of sustained watershed-scale environmental monitoring in identifying chronic pollution sources, evaluating temporal trends, and informing management priorities. The results indicate that while portions of the Tetayut watershed remain in relatively good physical condition, persistent contaminant inputs associated with urbanization, industrial activity, and stormwater runoff continue to affect water and sediment quality in several areas. Continued long-term monitoring, source control initiatives, green stormwater infrastructure implementation, habitat restoration, and community stewardship including local First Nations will remain important for improving watershed health and protecting aquatic habitat within the Tetayut watershed into the future.

The data collected here would not have been possible without the support of our volunteers. Together, water quality sampling for the Hagan-Graham and Tetayut watersheds amassed a total of 163 volunteer hours in 2025, and over 3,500 hours over the course of the entire PSS Central Saanich Water Quality Program.



Volunteers, staff, and Tsartlip stewardship team, testing water quality in the Tetayut watershed.

6.0 Appendix

6.1 Physical Parameters Exceedance Tables

Table A1: Number of low oxygen events (below 50% saturation) per year, by site.

Year	Site 1	Site 2	Site 3	Site 4	Site 5	Site 5A	Site 6	Site 7	Site 8
2011	3	0	0	0	0	0	1	0	0
2012	3	0	0	1	1	0	1	0	0
2013	1	0	0	0	0	0	0	0	0
2014	0	3	0	0	0	0	1	0	1
2015	0	5	0	1	2	1	0	0	0
2016	4	3	0	1	1	2	0	0	3
2017	3	1	0	0	0	0	0	0	0
2018	3	3	0	0	1	0	0	0	2
2019	2	2	0	0	1	1	0	0	0
2020	2	2	0	1	0	1	0	0	2
2021	3	1	1	1	0	0	1	0	2
2022	2	0	0	0	0	1	0	0	0
2023	5	0	0	0	1	0	1	2	2
2024	1	1	0	0	1	0	1	0	0
2025	2	0	0	0	0	0	1	0	1
Total	34	21	1	5	8	6	7	2	13

Table A2: Number of high temperature events (greater than 19 °C) per year, by site.

Year	Site 1	Site 2	Site 3	Site 4	Site 5	Site 5A	Site 6	Site 7	Site 8
2011	0	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0	0
2014	0	0	0	0	0	1	0	0	0
2015	0	0	0	1	0	1	0	0	0
2016	0	0	0	0	0	0	0	0	0
2017	0	0	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0	0

2021	1	0	0	0	0	0	0	0	0
2022	1	2	1	1	0	1	1	1	1
2023	0	0	0	0	0	0	0	0	0
2024	0	0	0	0	0	0	0	0	0
2025	0	0	0	0	0	0	0	0	0
Total	2	2	1	2	0	3	1	1	1

Table A3: Number of high turbidity events (greater than 25 NTU) per year, by site.

Year	Site 1	Site 2	Site 3	Site 4	Site 5	Site 5A	Site 6	Site 7	Site 8
2011	5	2	1	5	0	2	3	2	4
2012	5	3	2	2	3	5	4	4	5
2013	4	3	1	0	1	4	1	1	3
2014	2	3	2	2	1	6	3	2	4
2015	3	6	0	1	0	5	4	2	4
2016	2	4	0	1	4	6	2	1	2
2017	1	5	0	5	1	5	1	1	2
2018	7	4	1	2	3	3	2	2	5
2019	3	2	2	4	1	2	2	4	4
2020	4	6	4	5	4	7	4	4	6
2021	2	2	1	1	2	2	2	1	2
2022	0	2	0	2	1	1	0	1	2
2023	1	1	0	0	3	2	4	0	3
2024	2	4	1	3	1	6	3	2	6
2025	2	4	4	3	3	8	6	6	10
Total	43	51	19	36	28	65	41	33	62

Table A4: Number of low conductivity events (less than 150 uS/cm) per year, by site.

Year	Site 1	Site 2	Site 3	Site 4	Site 5	Site 5A	Site 6	Site 7	Site 8
2011	1	4	0	0	0	0	0	0	0
2012	0	2	0	0	0	0	0	0	0
2013	1	1	0	0	0	0	0	0	0
2014	0	0	1	0	0	0	1	0	0
2015	0	0	0	0	0	0	0	0	0
2016	0	0	1	0	1	0	0	0	0

2017	0	1	0	0	0	0	0	0	0
2018	1	1	0	0	0	0	0	0	0
2019	0	0	0	0	0	0	0	1	0
2020	1	2	1	0	1	0	0	1	2
2021	0	1	0	0	0	0	0	0	0
2022	0	0	0	1	0	0	1	0	0
2023	0	0	1	0	0	0	1	1	1
2024	3	1	0	0	1	0	0	0	0
2025	1	2	1	1	1	0	1	0	1
Total	8	15	5	2	4	0	4	3	4

Table A5: Number of high conductivity events (greater than 500 uS/cm) per year, by site.

Year	Site 1	Site 2	Site 3	Site 4	Site 5	Site 5A	Site 6	Site 7	Site 8
2011	3	0	0	3	0	1	0	0	0
2012	6	0	1	2	0	4	0	0	0
2013	2	0	2	5	1	4	3	2	3
2014	1	2	1	4	0	1	2	5	3
2015	0	0	0	2	0	0	0	5	4
2016	1	1	0	3	0	0	0	4	3
2017	1	1	0	5	0	1	0	0	0
2018	1	1	0	3	0	0	3	4	3
2019	0	0	0	3	0	0	3	3	3
2020	2	2	1	1	0	1	3	1	2
2021	0	1	0	4	0	1	6	4	4
2022	2	1	0	5	1	1	5	7	9
2023	3	0	0	6	1	2	4	4	3
2024	0	1	0	3	0	0	2	0	2
2025	2	0	0	2	0	0	4	0	2
Total	24	10	5	51	3	16	35	39	41

6.2 Heavy Metal Exceedance Tables

Table A6: Number of cadmium guideline (hardness dependent) exceedances at Site 2, by year.

Year	Site 2
2011	1

2012	1
2013	1
2014	1
2015	1
2016	1
2017	1
2018	1
2019	0
2020	1
2021	0
2022	0
2023	0
2024	0
2025	0
Total	9

Table A7: Number of copper guideline (hardness dependent) exceedances at Site 2, by year.

Year	Site 2
2011	1
2012	4
2013	2
2014	4
2015	6
2016	8
2017	5
2018	5
2019	6
2020	8
2021	2
2022	3
2023	0
2024	4
2025	5
Total	63

Table A8: Number of iron guideline (300 ug/L) exceedances at Site 2, by year.

Year	Site 2
2011	8
2012	11
2013	8
2014	12
2015	12
2016	10
2017	11
2018	9
2019	11
2020	11
2021	12
2022	12
2023	11
2024	10
2025	12
Total	160

Table A9: Number of lead guideline (hardness dependent) exceedances at Site 2, by year.

Year	Site 2
2011	1
2012	0
2013	6
2014	4
2015	2
2016	0
2017	2
2018	1
2019	2
2020	3
2021	1
2022	1
2023	1
2024	2
2025	1

Total	27

Table A10: Number of manganese guideline (hardness dependent) exceedances at Site 2, by year.

Year	Site 2
2011	0
2012	0
2013	0
2014	0
2015	0
2016	0
2017	0
2018	0
2019	0
2020	0
2021	0
2022	1
2023	0
2024	0
2025	0
Total	1

Table A11: Number of mercury guideline (0.026 ug/L) exceedances at Site 2, by year.

Year	Site 2
2011	1
2012	1
2013	2
2014	1
2015	1
2016	0
2017	0
2018	1
2019	0
2020	0
2021	1

2022	0
2023	0
2024	0
2025	0
Total	8

Table A12: Number of phosphorus guideline (10 ug/L) exceedances at Site 2, by year.

Year	Site 2
2011	3
2012	10
2013	11
2014	12
2015	8
2016	11
2017	12
2018	9
2019	11
2020	12
2021	11
2022	10
2023	10
2024	11
2025	12
Total	153

Table A13: Number of zinc guideline (hardness dependent) exceedances at Site 2, by year.

Year	Site 2
2011	7
2012	10
2013	7
2014	11
2015	11
2016	11
2017	9

2018	9
2019	8
2020	7
2021	8
2022	5
2023	6
2024	8
2025	10
Total	127

6.3 Nutrient Exceedance Tables

Table A14: Number of ammonia-N guideline (temperature and pH dependent) exceedances at Sites 1 and 4.

Year	Site 1	Site 4
2011	3	4
2012	0	0
2013	1	0
2014	3	2
2015	1	0
2016	2	0
2017	1	0
2018	0	0
2019	0	0
2020	1	0
2021	0	0
2022	0	0
2023	0	0
2024	0	0
2025	1	0
Total	13	6

Table A15: Number of Nitrite-N guideline (0.06 mg/L) exceedances at Sites 1 and 4.

Year	Site 1	Site 4
2011	2	5
2012	0	1
2013	3	2
2014	2	2
2015	1	2
2016	3	4
2017	4	3
2018	6	2
2019	2	2
2020	4	3
2021	3	3
2022	4	4
2023	5	7
2024	5	6
2025	2	3
Total	46	49

Table A16: Number of Nitrate-N guideline (13 mg/L) exceedances at Sites 1 and 4.

Year	Site 1	Site 4
2011	1	2
2012	0	3
2013	0	2
2014	0	3
2015	0	4
2016	0	6
2017	1	8
2018	1	7
2019	0	4
2020	1	7
2021	1	3
2022	1	9
2023	0	10
2024	1	7
2025	0	6

Total	7	81

6.4 Hydrocarbon Exceedance Tables

Table A17: Number of total extractable hydrocarbon threshold (0.5 mg/L) exceedances at Sites 1 and 4.

Year	Site 6
2011	1
2012	0
2013	0
2014	0
2015	0
2016	0
2017	0
2018	0
2019	0
2020	5
2021	2
2022	0
2023	1
2024	7
2025	8
Total	24

Table A18: Number of polycyclic aromatic hydrocarbon detections at Sites 1 and 4.

Year	Site 6
2011	3
2012	0
2013	3
2014	1
2015	3
2016	1
2017	0

2018	0
2019	0
2020	0
2021	0
2022	0
2023	0
2024	0
2025	0
Total	11

6.5 Sediment Metals Exceedance Tables

Table A19: Number of sediment arsenic guideline (5.9 µg/g) exceedances per year. Note that only four sediment samples are collected per year.

Year	# of Exceedances	% Exceedances
2011	1	25.00%
2012	1	33.30%
2013	1	33.30%
2014	5	100.00%
2015	2	50.00%
2016	1	25.00%
2017	0	0.00%
2018	3	75.00%
2019	0	0.00%
2020	0	0.00%
2021	1	25.00%
2022	1	25.00%
2023	0	0.00%
2024	0	0.00%
2025	1	25.00%
Total	17	

Table A20: Number of sediment cadmium guideline (0.6 µg/g) exceedances per year. Note that only four sediment samples are collected per year.

Year	# of Exceedances	% Exceedances

2011	0	0%
2012	0	0%
2013	0	0%
2014	1	20%
2015	0	0%
2016	0	0%
2017	0	0%
2018	0	0%
2019	0	0%
2020	0	0%
2021	0	0%
2022	0	0%
2023	0	0%
2024	0	0%
2025	0	0%
Total	1	

Table A21: Number of sediment chromium guideline (37.3 µg/g) exceedances per year. Note that only four sediment samples are collected per year.

Year	# of Exceedances	% Exceedances
2011	1	25.00%
2012	1	33.30%
2013	1	33.30%
2014	3	60.00%
2015	3	75.00%
2016	2	50.00%
2017	2	50.00%
2018	0	0.00%
2019	1	25.00%
2020	1	25.00%
2021	2	50.00%
2022	1	25.00%
2023	1	25.00%
2024	3	75.00%
2025	2	50.00%
Total	24	

Table A22: Number of sediment copper guideline (35.7 µg/g) exceedances per year. Note that only four sediment samples are collected per year.

Year	# of Exceedances	% Exceedances
2011	3	75.00%
2012	1	33.30%
2013	2	66.70%
2014	4	80.00%
2015	4	100.00%
2016	4	100.00%
2017	4	100.00%
2018	2	50.00%
2019	4	100.00%
2020	1	25.00%
2021	2	50.00%
2022	2	50.00%
2023	2	50.00%
2024	2	50.00%
2025	3	75.00%
Total	40	

Table A23: Number of sediment lead guideline (35.7 µg/g) exceedances per year. Note that only four sediment samples are collected per year.

Year	# of Exceedances	% Exceedances
2011	0	0.00%
2012	1	33.30%
2013	0	0.00%
2014	2	40.00%
2015	3	75.00%
2016	0	0.00%
2017	0	0.00%
2018	0	0.00%
2019	0	0.00%
2020	0	0.00%
2021	1	25.00%

2022	1	25.00%
2023	1	25.00%
2024	1	25.00%
2025	1	25.00%
Total	11	

Table A24: Number of sediment nickel guideline (16 µg/g) exceedances per year. Note that only four sediment samples are collected per year.

Year	# of Exceedances	% Exceedances
2011	4	100.00%
2012	2	66.70%
2013	3	100.00%
2014	4	80.00%
2015	4	100.00%
2016	4	100.00%
2017	4	100.00%
2018	3	75.00%
2019	4	100.00%
2020	3	100.00%
2021	2	50.00%
2022	3	75.00%
2023	3	75.00%
2024	4	100.00%
2025	4	100.00%
Total	51	

Table A25: Number of sediment zinc guideline (123 µg/g) exceedances per year. Note that only four sediment samples are collected per year.

Year	# of Exceedances	% Exceedances
2011	1	25%
2012	0	0%
2013	0	0%
2014	2	40%
2015	2	50%

2016	3	75%
2017	4	100%
2018	1	25%
2019	2	50%
2020	1	25%
2021	1	25%
2022	2	50%
2023	1	25%
2024	0	0%
2025	3	75%
Total	23	

6.6 Sampling Sites within the Tetayut Watershed



Figure A1. Mainstem @ Sandhill Park (Site 1).



Figure A2. Keating Industrial Park Stormwater Outfall (Liedtke Tributary) (Site 2).

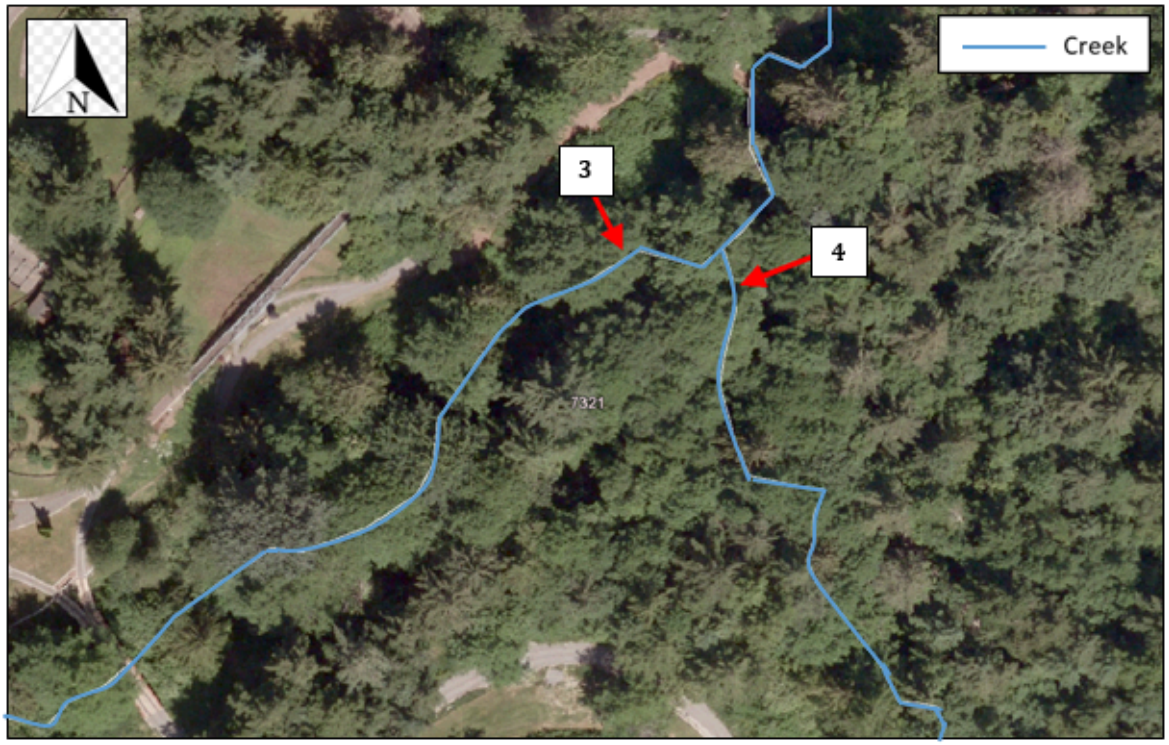


Figure A3. Mainstem @ Saanich Historical Artifacts Society (Site 3) and Kennel Creek @ Saanich Historical Artifacts Society (Site 4).



Figure A4. Rashleigh Brook (Site 5).



Figure A5. Unnamed Tributary (Site 5a).

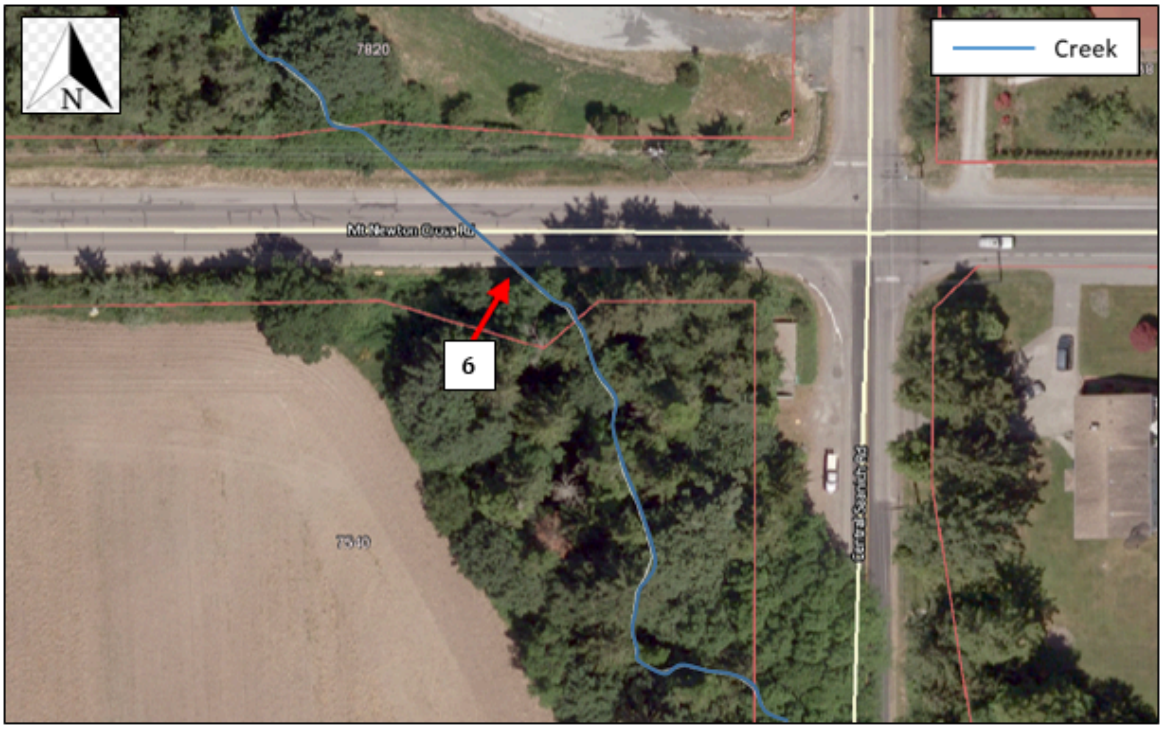


Figure A6. Mure Brook (upstream) (Site 6).

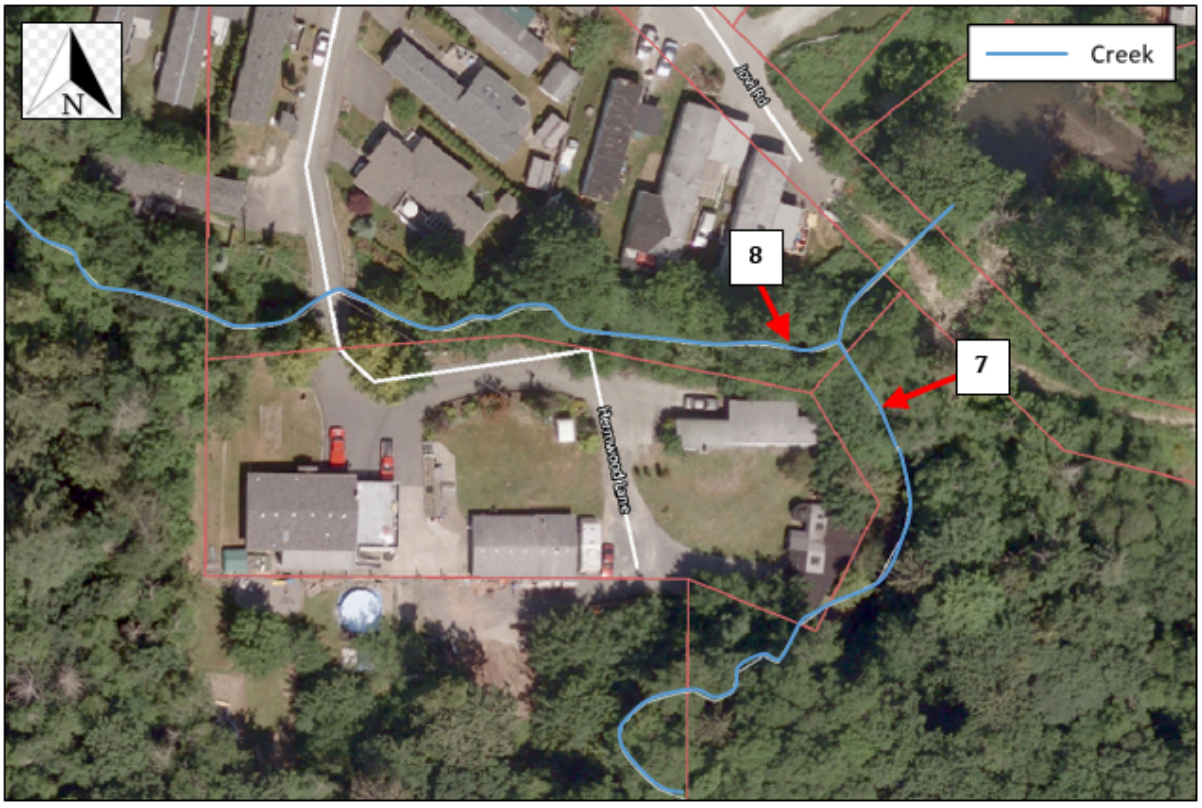


Figure A7. Mainstem, above tidal waters (Site 7) and Mure Brook, downstream (Site 8).

Table A26. Parameters and Water Quality Guidelines and Sources

Type	Parameter	Guideline	Source

Water	Fecal Coliforms	200 CFU/100mL	Guideline for Canadian Recreational Water Quality
Heavy Metals			
Water	Arsenic	5 µg/L	CCME Freshwater Chronic
	Cadmium	When the water hardness is > 0 to < 17 mg/L, the CWQG is 0.04 µg/L At hardness ≥ 17 to ≤ 280 mg/L, the CWQG is calculated using this equation: CWQG (µg/L) = 10^{0.83(log[hardness]) – 2.46 } At hardness > 280 mg/L, the CWQG is 0.37 µg/L	CCME Freshwater Chronic
	Copper	When water hardness is 0 to <82 mg/L, the CWQG is 2 µg/L. At hardness ≥82 to ≤180 mg/L the CWQG is calculated using this equation: CWQG (µg/L) = 0.2 * e^{0.8545[ln(hardness)]-1.465} At hardness >180 mg/L, the CWQG is 4 µg/L	CCME Freshwater Chronic
	Iron	300 µg/L	CCME Freshwater Chronic
	Lead	When the hardness is 0 to ≤ 60 mg/L, the CWQG is 1 µg/L At hardness >60 to ≤ 180 mg/L the CWQG is calculated using this equation: CWQG (µg/L)= e{1.273[ln(hardness)]-4.705} At hardness >180 mg/L, the CWQG is 7 µg/L	CCME
	Mercury	0.026 µg/L	CCME Freshwater Chronic
	Phosphorus	0.01 mg/L	BC Govt - Phosphorus Management in Vancouver Island Streams
	Zinc	If water hardness is </= 90, CWQG is 7.5 ug/L, if hardness if > 90, use this equation: =0.75*(hardness - 60)	1997 BC Water Quality Guidelines Chronic*
Hydrocarbon Parameters			
	TEH	0.5 mg/L	Screening value, not an actual guideline limit, used for detection of general hydrocarbon contamination.
	PAH	Guidelines are specific to the type of PAH.	
Physical Parameters			
	Water Temperature	19°C, daily maximum	BC Approved Water Quality Guidelines
	Conductivity	No specific CCME guidelines exist for conductivity in freshwater; generally, <150 or >500 µS/cm is considered harmful to aquatic organisms.	

	pH	6.5-9	CCME Freshwater Chronic
	Turbidity	Site Specific, see turbidity site specific baseline table (Table A27).	
	Oxygen Saturation	Below 50% saturation is generally considered harmful to aquatic life. CCME guidelines are specific to baseline habitat water temperature and organism life stage.	
Nutrient Parameters			
	Un-ionized Ammonia	19 µg/L	CCME Freshwater Chronic
	Total Ammonia Nitrogen	pH and temperature dependent: =0.0156256*(10^((0.0901821+(2729.92/(temperature in C+273.15)))-pH)+1)	BC Approved Water Quality Guidelines
	Nitrate for NO3-N	3.0 mg/L	CCME Freshwater Chronic
	Nitrite, as NO2-N	0.06 mg/L	CCME Freshwater Chronic
	Phosphate	No official guideline exists for orthophosphate (PO4) specifically.	
Sediment Heavy Metals			
	Arsenic	5.9 µg/g	CCME Freshwater Threshold Effect Level
	Cadmium	0.6 µg/g	CCME Freshwater Threshold Effect Level
	Chromium	37.3 µg/g	CCME Freshwater Threshold Effect Level
	Copper	35.7 µg/g	CCME Freshwater Threshold Effect Level
	Lead	35 µg/g	CCME Freshwater Threshold Effect Level
	Nickel	15.9 µg/g	CCME Interim Sediment Quality Guideline - out dated**
	Zinc	123 µg/g	CCME Freshwater Threshold Effect Level

*For total zinc in water we are using the 1997 BC Freshwater Guidelines Chronic as the updated CCME and BC Approved Water Quality Guidelines are based on Dissolved Organic Carbon, which we do not measure.

** In the past, CCME used a long term guideline of 15.9 µg/g. Currently, no CCME freshwater sediment quality guidelines (ISQG/PEL) are currently published for nickel in the CCME summary tables. For the sake of this report, we have used the previous, older guideline limits.

Table A27. Calculated baselines for each site. Baselines are based on running averages plus or minus standard error. The site specific baseline is the upper limit of the average with standard error.

Site	Calculated Site Specific Baseline
Site 1 Sandhill Park	21.75
Site 2 Keating Outfall East	28.92
Site 3 Mainstem at HA	15.16
Site 4 Kennel Creek	19.81
Site 5 Rashleigh Brook	19.66
Site 5a Unnamed Trib	33.19
Site 6 Mure Brook Downstream	22.38
Site 7 Mainstem above tidal	18.82
Site 8 Mure Brook Downstream	33.91

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