TOWNSHIP OF HURON-KINLOSS

BASELINE SURFACE WATER QUALITY MONITORING PROGRAM

2024 ANNUAL REPORT

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2024 ANNUAL REPORT

January 15, 2025

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File No. 01124

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1.0 PURPOSE OF MONITORING

The Township of Huron-Kinloss has long supported environmental stewardship activities and has conducted surface water quality monitoring on watercourses throughout the municipality for over two decades. The purpose of the Pine River monitoring program is to establish and maintain a dataset of water quality information that will assist the Township of Huron-Kinloss in the future evaluation of development proposals. The water quality dataset will allow for the tracking of water quality changes over time and will provide information to assist the Township in making decisions on how to protect its surface water and beach resources. The dataset will enable comparison of results and facilitate specific opportunities for water quality improvement, such as identifying specific impaired stream lengths and highlighting areas of interest for stewardship projects.

The Risk Assessment Study for Continued Development on Septic Systems in the Lakeshore Area, completed on October 19, 1997, identified that the principal risk associated with the continued use of private sewage disposal systems is the potential for contamination of beach areas by harmful microorganisms. Risk Management Guidelines that formed part of the document, included the establishment of a Monitoring Program for Surface Water Quality in the Point Clark North sub-area. The commitment to continue the Point Clark program (now integrated into the Baseline Monitoring Program) has been maintained since then, and has provided useful data which has also served to support the Septic Reinspection Program.

The program is comprehensive in that the sampling will be undertaken on a regular basis and will be continuous from year to year, allowing for the accumulation of results for comparative use. The latest sampling year, 2024, was the twenty-fourth year of the continuous monitoring program for Pine River and the twenty-fifth year for sample collection in Point Clark.

2.0 DESCRIPTION OF MONITORING PROGRAM

2.1 Pine River Program History

The Pine River Surface Water Monitoring Program was initiated in June of 2001 at twenty-six locations throughout the Pine River Watershed. Thirteen of the locations were previously sampled as part of a 1990 study of the watershed carried out by the Saugeen Valley Conservation Authority (SVCA). Seven additional lake sites and six in-stream sites were added to the 13 SVCA sites which filled in gaps in the study area, resulting in the original twenty-six locations. In 2002, eight additional sites which originate in Huron-Kinloss and discharge into the former Township of Ashfield and eventually into Lake Huron were added for comparative purposes; four along each of the Eighteen Mile Creek and Boyd Creek watercourses. The Ashfield-Colborne Lakefront Association has also carried out water quality sampling on both creeks at locations where they cross Highway 21.

In 2004, nine locations were removed from the program, as the relatively dense distribution of monitoring sites was not highlighting potential source areas of pollution. The remaining sites were deemed sufficient for monitoring water quality in the streams.

To take advantage of the long term monitoring data from the program, at the end of the tenth year in 2011, BMROSS prepared a summary report comparing the twelve stream sites in the Pine River Watershed. Two sites were observed to have significantly higher nutrients (nitrate and phosphorus). One was Site 17 on the Nesbitt Municipal Drain and the second was Site 18 on the McMurchie Drain. Both of these drains meet and flow into the Pine River shortly before Lake Huron. Under the Research Initiative of the Bruce Clean Water Program, Huron-Kinloss partnered with Bruce County in 2013 and 2014 to further investigate this sub-watershed of the Pine River. This sampling highlighted regions that could be contributing a larger proportion of nutrients, and working with property owners the project completed additional sampling in 2014. This has resulted in an information transfer to property owners for their interpretation.

In 2013 the Township of Huron-Kinloss and the SVCA submitted a proposal to the Bruce Clean Water Program – Research Initiative, for funding in support of monitoring activities in the Pine River Watershed, with the purpose of using the monitoring data to contribute to the calibration of their rural storm water model. Extra sites and parameters were sampled for two years.

Two sites, PR37 and PR38, were added in 2016 as part of an initiative to assist in identifying loading sources towards PR11 and were removed from the program in 2018 due to intermittent flow at the two sites.

2.2 Point Clark Program History

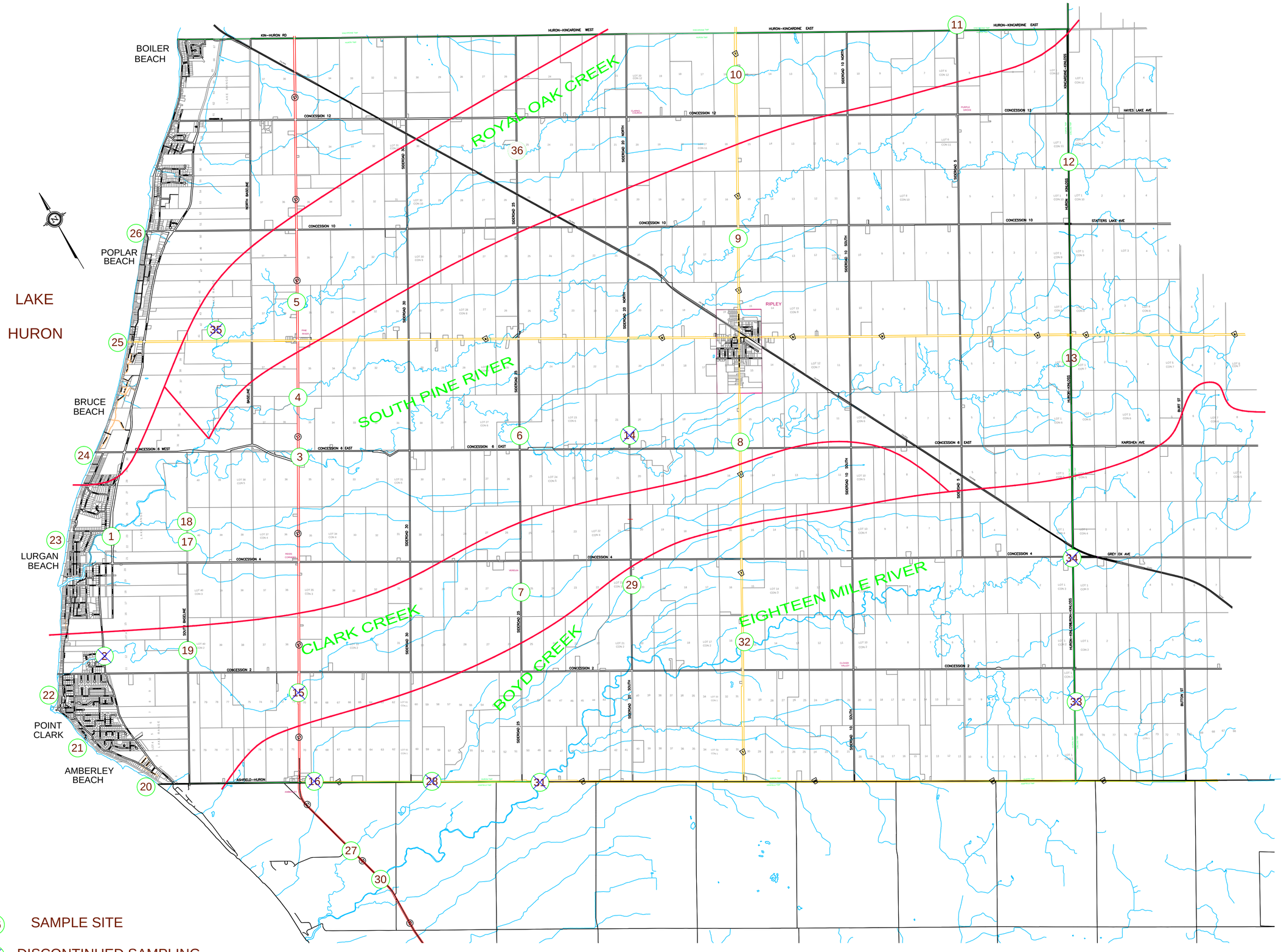
The Point Clark Monitoring program was initiated in 1998. Originally, samples were taken at 7 sites that were consistent with sites previously sampled as part of the Risk Assessment Study. Throughout the program, additional sites have been added in an effort to track specific contributing sources of contamination in Jardine Creek, as well as to characterize water quality in the area.

Additional sites were sampled from 2001-2004 to fill gaps in the study area. Since 2005, 16 sites have defined the program; three sites along Lake Huron beaches, three along Clark Creek, and eight along Jardine Creek. In 2017, in an effort to identify sections between Jardine Creek sites 9 and 8 that could be contributing to elevated recorded *E. coli* levels, sampling sites 14 and 15 were reactivated and these four sites were tested for additional parameters. Intermittent flow throughout the sampling season as well as the nature of the tested parameters produced inconclusive results with regard to highlighting specific sections of increased bacteria loading along Jardine Creek. Sites 14, 15 and the additional parameters for sites 9 and 8 were discontinued at the end of the 2017 season.

2.3 Amalgamated Baseline Surface Water Quality Monitoring Program

In March of 2018 consideration to decreasing the cost of the sampling program was requested by Huron-Kinloss council. BMROSS presented a consolidated sampling program which would continue to capture the general health of the watershed with respect to nutrient and bacteria levels. The existing Pine River sampling sites could remain in the program, 6 Point Clark sites could be retired, with the remaining Point Clark sites sampling frequency changed from bi-weekly to monthly. The Point Clark sites would continue to capture the general water quality conditions of the area as well as capture increased detail through Jardine Creek, which has historically displayed increased bacteria concentrations. The consolidated program tests for bacteria as well as the nutrients nitrate and phosphorus. Nitrate and phosphorus are additional parameters for the Point Clark sites and can be used to inform water quality and bacteria trends through the Point Clark watershed.

The Baseline Surface Water Monitoring Program consists of 34 sampling locations; 7 Lake Huron sites, 19 in-stream sites consistent with the Pine River program, and 8 inland sites throughout Point Clark. The sites are presented in Figure 2.1 and 2.2. Water quality results for all monitoring years are included in Appendix A. An inventory of sample locations can be found in Appendix B.



16 SAMPLE SITE

~~16~~ DISCONTINUED SAMPLING

SUBWATERSHED BOUNDARY

CAD FILE \01124\01124-Sample Program 2002.DWG PLOT SCALE TO FIT

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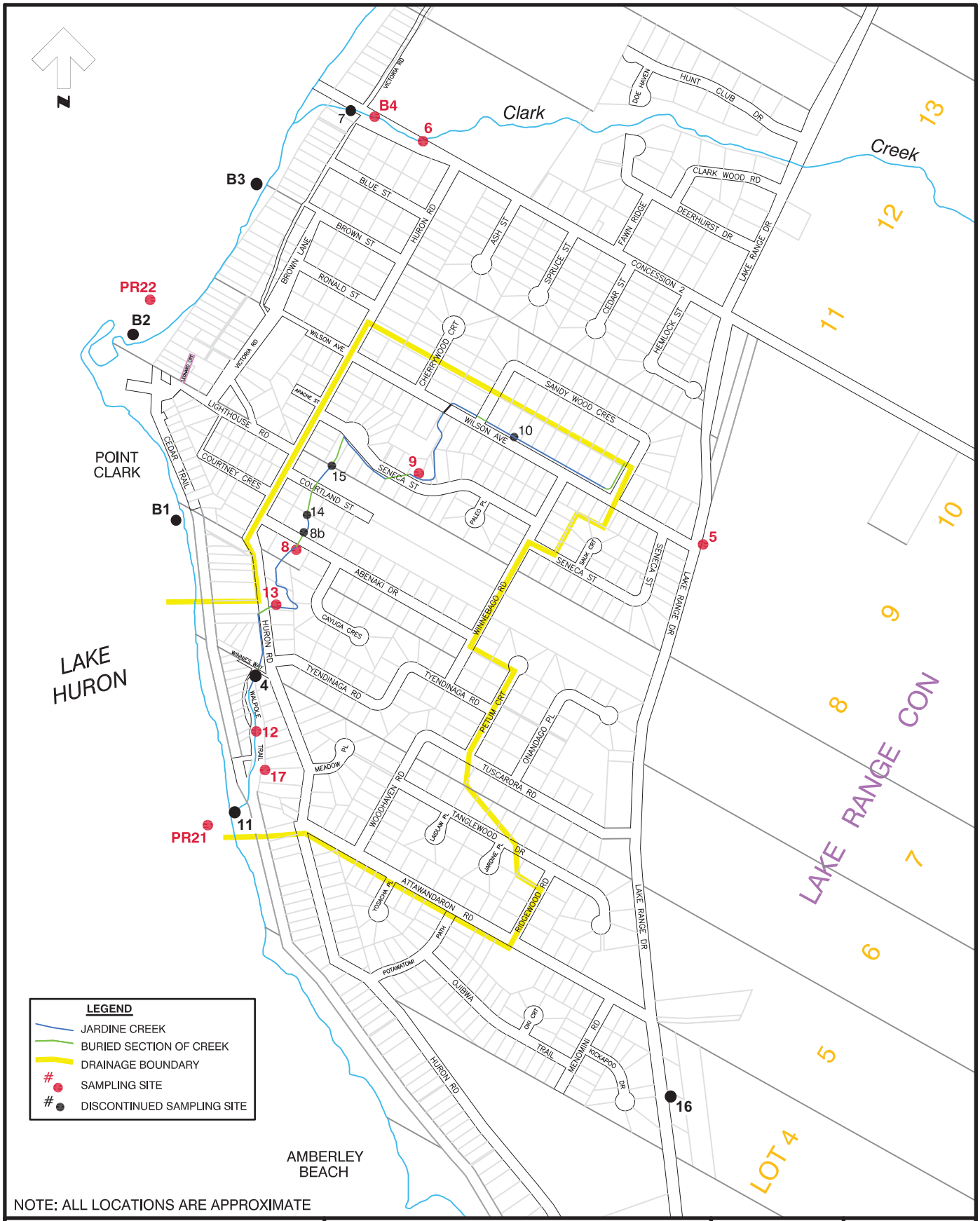
TOWNSHIP OF HURON-KINLOSS

PINE RIVER WATER QUALITY MONITORING PROGRAM (2013)

FIG. No. 2.1



NOTE: ALL LOCATIONS ARE APPROXIMATE

BMROSS engineering better communities

Township of Huron-Kinloss

Point Clark Water Quality Monitoring Program

Monitoring Location Plan

DATE	PROJECT No.
Nov., 2018	93147
SCALE	FIGURE No.
1:10,000	2.2

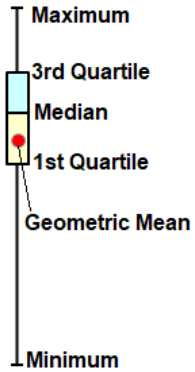
3.0 DISCUSSION AND RESULTS

Statistically confident statements about the condition of watercourses and locations of point sources of pollutants are typically not found through the Program data, but certain patterns can be described. Relationships between sample site results and their surrounding non-point source area and trends over time can be described. Variables including weather, the distribution and intensity of rainfall events, the nature of the pollution sources**,** and the nature of the sampling protocol are constraints that should be considered when evaluating results.

Water samples were taken on a monthly basis, occurring from March to November for a total of nine sampling events. Single grab samples are collected by BMROSS and sent to private labs where they are analyzed for total phosphorus and nitrate, which are plant nutrients, and *E. coli*, which is an indicator bacterium typically found in the digestive tract of warm-blooded animals. To help control the reporting of non-representative results, samples from stream sites are collected only if there has been recent or observable flow. Collection of representative lake samples consists of wading to a sample depth of about one metre and collecting a single grab sample using a reach pole and dip cup. Environmental conditions present at the time of sample collection are also recorded; wave height, water clarity, presence of algae, weather conditions, unusual odours and any other observations are noted in the sampler's log. This information is useful for exploring links between unusual sampling results and environmental factors.

The sampling protocol for testing bacteria consists of a single grab sample and differs from the Health Unit's beach sampling protocol, in which five grab samples are taken at a single location and a geometric mean calculated. The Health Unit's method reduces the potential deviation caused by the natural spatial distribution of bacteria in the water (bacteria tend to clump together and are not homogenous throughout a water sample). This program's single grab sample is meant to provide a "snapshot" of the water quality at the time of sampling and is not intended for use in determining beach swimming policy.

The results for *E. coli*, nitrate, and phosphorus are plotted to show the spatial trends of the measured indicators for the sampling season. Box and whisker type graphs are used to show the distribution of sampling results for each sample location. The median, minimum and maximum values, as well as a first and third quartile value are included in each box plot, for each site. The box length shows the central 50% of values, from the 25th percentile to the 75th percentile, with the median as a line within the box length. The lines above and below the box denotes the maximum and minimum values respectively. For *E. coli*, the geometric mean is included in the graphs, displayed as a circle usually within the box length. *E. coli* graphs are presented on a logarithmic scale due to their exponential growth potential and the large variation in reported values.



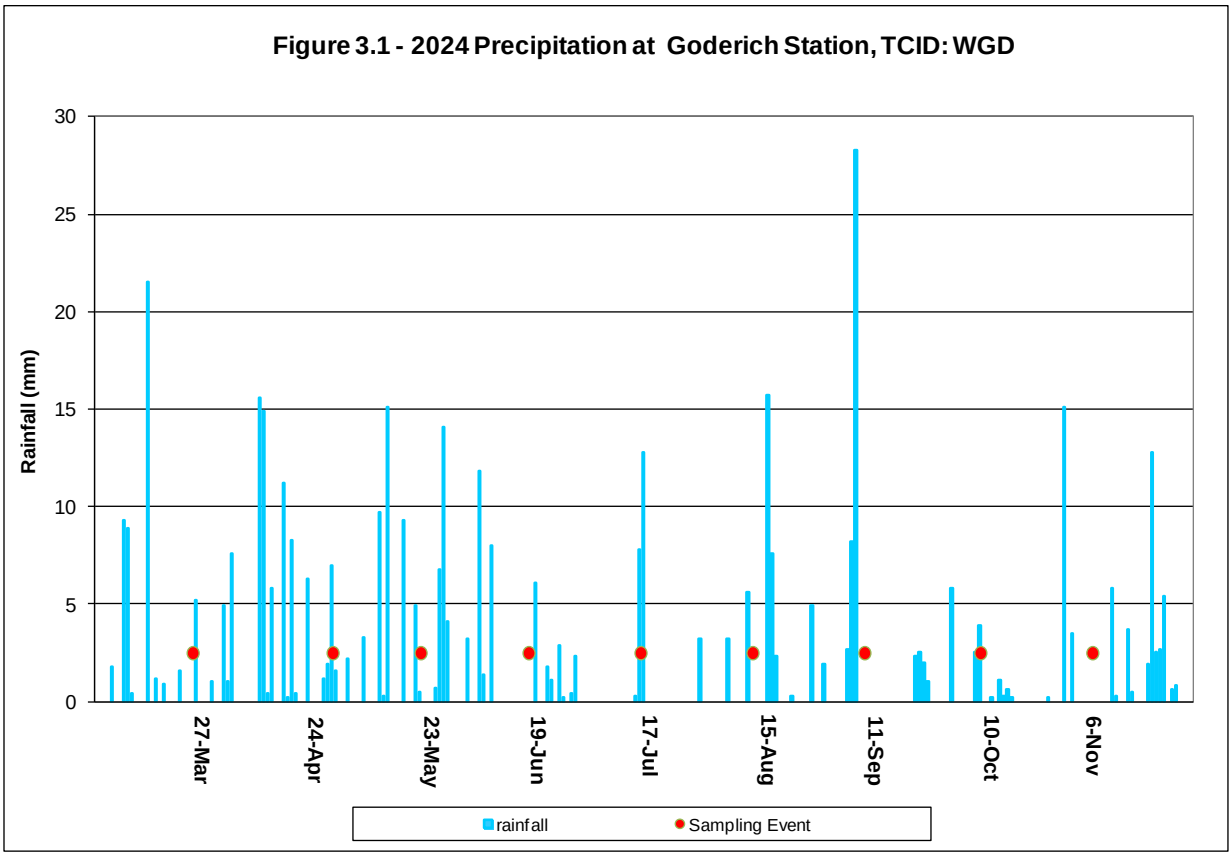
3.1 Weather, Rainfall and Water Levels

Weather and rainfall through the sampling season vary year to year and is reflected by the number of monitoring sites with insufficient flow at the time of sampling. Table 3.1 summarizes each year's sampling season rainfall from March through November. Peaks in precipitation are often linked to elevated levels of contaminants since various sources are collected through surface runoff and additionally for lakes, from wave and wind action. Specific relationships between increased results and weather conditions are not statistically correlated in this report, however for illustrative purposes the recorded rainfall for the Pine River area is presented in Figure 3.1. The data is obtained from the Goderich WMO weather station 71261. Water levels were previously obtained from the Environment Canada hydrometric station 02FD001 for Pine River at Lurgan Beach. Station 02FD001 has been decommissioned and data is unavailable after August 2020.

Increased water levels correspond to the timing of rainfall events, indicating overland and groundwater flow contributing to stream water levels, and may ultimately carry a greater amount of pollutants into Lake Huron through the increased flow. Large precipitation events are associated with runoff and increased river water levels and associated transport of contaminants, but not all rainfall produces runoff. Other factors that may influence results include sample depth, time of day, site conditions, adjacent land use, plant productivity and the stage of crop development in agricultural areas, and the sampling protocol. Time of day, sample depth and the sampling protocol are controlled by the field technician, and all factors should be considered when interpreting results.

Table 3.1
Summary of Sampling Season Precipitation

Sampling Year	Seasonal Precipitation (March-November)
2024	433.3 mm
2023	592.3 mm
2022	551.9 mm
2021	797.3 mm
2020	507.3 mm
2019	624.7 mm
2018	656.9 mm
2017	771.4 mm
2016	704.9 mm
2015	544.6 mm
2014	695.9 mm
2013	720.3 mm
2012	406.9 mm
2011	833.3 mm
2010	608.5 mm
2009	582.9 mm
2008	972.4 mm
2007	584.0 mm
2006	661.2 mm
2005	564.9 mm
2004	496.8 mm
2003	514.0 mm
2002	491.6 mm



3.2 Escherichia coli (*E. coli*)

E. coli are shed with warm-blooded animal waste and its presence can be used as an indicator for contamination. *E. coli* is not naturally mobile so once shed it will stay in its original location unless transported, usually through surface runoff and through waterbodies. *E. coli* typically can survive up to 48 hours once shed, but has been shown to survive for more than a week while traveling through water bodies, and can form perpetual colonies under proper conditions such as in shallow lake sediment and the swash zone, and other environments conducive to survival such as decomposing organic matter.

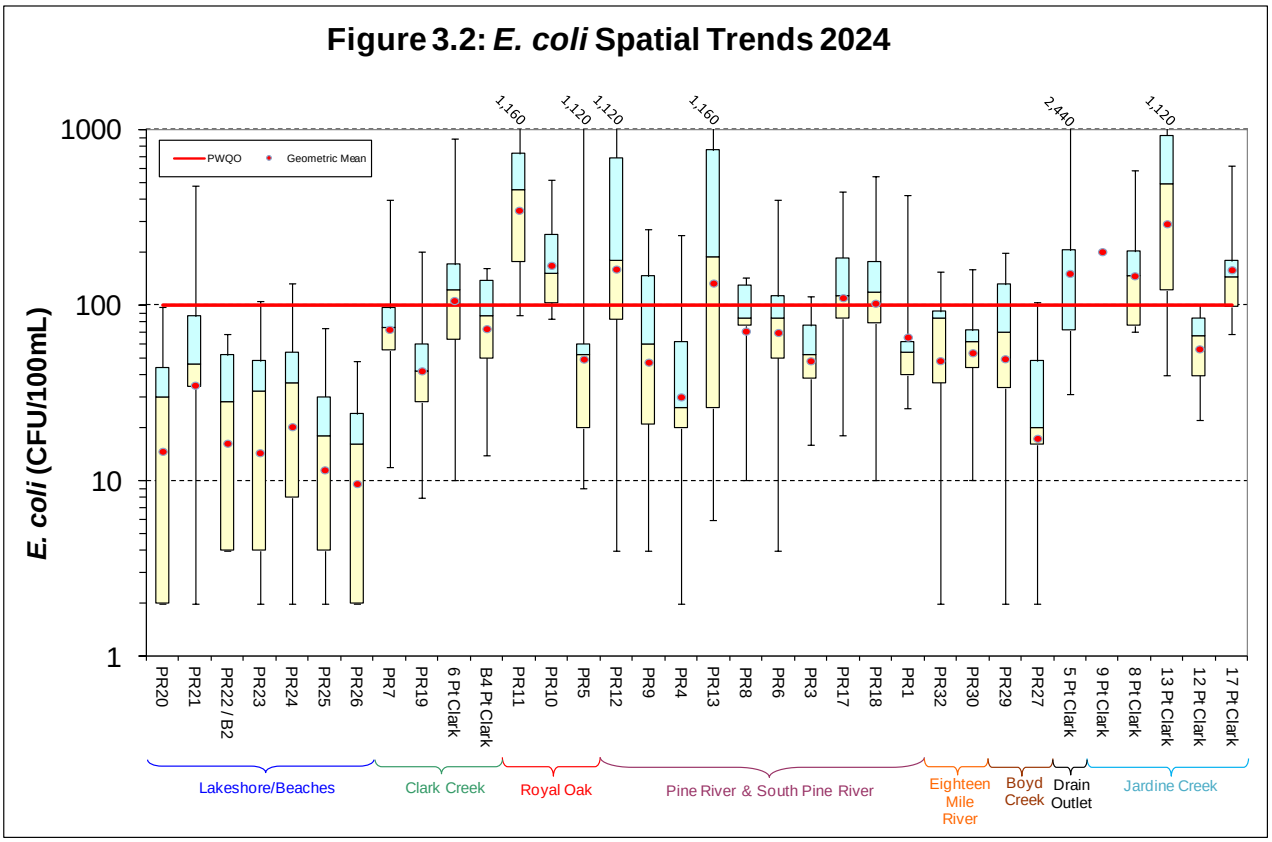
The Provincial Water Quality Objective (PWQO) for the concentration of *E. coli* in recreational waters is 100 cfu/100 mL (CFU). Other than the Lake Sites PR20 to PR26, water levels are too low and the sites are not conducive to recreational use. Figure 3.2 presents the spatial distribution box plot of *E. coli* for all samples in 2024. Sites are grouped by watershed group and are ordered from upstream to downstream within each watershed group. The box plot chart shows that *E. coli* levels vary within each monitoring site as well as between monitoring locations. Lake site results are generally well below the PWQO and lower than in-stream sites, while in-stream sites results are higher and regularly have a higher range of variability.

Lake sites PR20-PR26 results show geometric means below the PWQO, with the box-plot range showing nearly all individual results in 2024 were below the PWQO. Only four of the 63 lake samples collected were above the PWQO, ranging from just over 100 CFU to one sample with 480 CFU. No sample event was preceded by significant (over 15 mm) rainfall within 48h, and the four

high snapshot samples are less likely influenced by downstream attenuation and contributions from surface flows than a myriad of local factors. Environmentally based colonies can perpetuate and grow in warm, calm and survival conducive conditions. Rainfall mediated *E. Coli* transport is a loading factor for lakes, lake mixing and sediment upturn from wind works to distribute overland loading from rainfall events, wave upturn works to distribute the lake's own *E. Coli*. Local animal sources can also directly contribute, and single snapshot samples can show higher results than representative of the larger water column.

Figure 3.2 shows a typical range for inland site results of about 20-200 CFU, with some very large individual sample exceedances. Twelve of the 27 inland sites show geometric means above the PWQO and range from 102-348 CFU.

Figure 3.2: *E. coli* Spatial Trends 2024



Transport distance and survivability of *E.Coli* downstream is not defined and is difficult to determine. Assuming a factor of partial transport and survivability of *E. Coli* downstream, ignoring inputs along each reach we can expect a decrease downstream from an upstream location for sites within each watershed group. If all sites are elevated through a watershed group, inputs likely can come from anywhere within the catchment area, and stewardship opportunities likely exist anywhere along the stream catchment. Elevated results at single sites represent opportunities located within the more point-source area of that site, since inputs are not coming from far upstream or are not elevated downstream.

Clark Creek site PR7 is located within an agricultural landscape and shows attenuation downstream through PR19, with downstream sites 6 and B4 within the built-up area of Point Clark showing an increase upstream of Point Clark site 6. Royal Oak site PR11 is consistently elevated and is

adjacent to agricultural fields and downstream of livestock activity. Results generally attenuate through downstream site PR10 and at PR5 results are typically reported at low levels.

The Pine River group consists of multiple reaches. PR12 is the upstream site of a reach through PR9 and PR4. The 2024 results show attenuation through these sites, with PR12 almost consistently elevated and PR4 almost consistently below the PWQO. PR13, PR8, PR6 and PR3 are ordered sites within another reach of Pine River and show attenuation downstream, with upstream site PR13 typically elevated and downstream sites attenuating and typically below the PWQO. PR17 and PR18 are close proximity upstream sample points along separate small reaches and are in the vicinity of farming and homestead activity and were typically slightly elevated through the sample season. PR1 is located at the confluences of the upstream reaches and represents the attenuated loadings from all upstream catchments and showed nearly consistently excellent results through the 2024 sampling season.

Eighteen Mile River sites had nearly consistently low results through their reach. Boyd Creek sites PR29 and PR27 show attenuation downstream and had nearly consistently low results through their reach. Point Clark sites are in close proximity and were generally elevated through the catchment area. Site 5 is located outside of Point Clark in a roadside ditch at the outlet a large drainage area, where inputs are likely related to farming and wildlife activity within its catchment. Jardine Creek was generally elevated, with site 13 particularly elevated. Jardine Creek Site 8 was observed to have a white coloured streambed film and sewage like smell through much of the sampling season. Downstream Site 12 showed consistently low results through the 2024 sampling season.

The seasonal geometric means and percent of samples exceeding the PWQO for each sub-watershed's group of sites are presented in Table 3.2. In 2024 the Royal Oak and Jardine Creek group showed a combined seasonal geometric mean above the PWQO, with only the downstream sample sites having seasonal geometric means below the PWQO. Other individual sites that had seasonal geometric means above the PWQO include PR12, PR13, PR17, and PR18. All other sites' seasonal geometric means were below the PWQO.

Table 3.2
Watershed Group Geometric Means and Percent over Guideline for *E. coli* in 2024

Stream Group	Geometric Mean (cfu/100 mL)	Percent at or over PWQO
Lake – (PR20, PR21, PR22, PR23, PR24, PR25, PR26)	16	6%
Pine River – (**PR12**, PR9, PR4, **PR13**, PR8, PR6, PR3, **PR17**, **PR18**, PR1)	74	40%
Clark Creek – (PR7, PR19, **6**, B4)	70	39%
Royal Oak Creek – (**PR11**, **PR10**, PR5)	**113**	51%
Eighteen Mile River – (PR32, PR30)	51	17%
Boyd Creek – (PR29, PR27)	29	24%
Jardine Creek, Point Clark – (**9**, **8**, **13**, 12, **17**)	**136**	58%
Field Tile Drain at Point Clark – (**5**)	**152**	40%
Bold indicates geometric mean equals or exceeds PWQO		

Increased *E. coli* levels in surface water are influenced by many factors. Wildlife populations, including large groups such as waterfowl, can shed large amounts of *E. coli*. Homestead animal activity and pet care can also contribute loadings. Increased cottage use could elevate levels by way of under sized, improperly maintained or constructed, or malfunctioning private sewage treatment systems. Agricultural activity, specifically livestock operations through manure application and animal access to streams, can be a source of *E. coli*. Weather events and sample timing are also a significant factor, where runoff can transport *E. coli* and where high winds and wave action upturn lake sediment which mobilizes settled *E. coli*.

3.3 Nitrate

Nitrate is the most common, and one of the several forms of nitrogen that is present in surface waters. It is highly mobile in both ground and surface waters. It is naturally occurring in the environment at about 1 mg/L, and additional nitrate is introduced through agricultural fertilizers, manure, septic systems, and industrial waste. When it is not utilized as a nutrient through plant growth it can be carried away in surface runoff or groundwater. Nitrate is an essential plant nutrient and high levels can contribute to eutrophication of water systems through excessive growth of aquatic plants and algae, and can be toxic to fish and amphibians. In 2003 the Canadian Water Quality Guideline (CWQG) to protect freshwater is 2.93 mg/L for nitrate, expressed as N, was adopted. This guideline has been superseded by newer studies, such as the Canadian Council of Ministers of the Environment (CCME) 2007 study on nitrate for the long term protection of freshwater aquatic life which formed a Guiding Principle of 3.0 mg/L, which has been adopted as the CWQG.

The distribution of nitrate results for 2024 is presented in Figure 3.3. Lake sites show consistently excellent results, with only two samples exceeding the CWQG in all 2024.

Inland sites show a wide range of typical results, with most seasonal median values below the CWQG. For inland sites, the August, September, October and November events showed almost zero high results, with most results below the lab detection limit, and may highlight the relationship between loading, transport, and plant productivity changes. Inland results from March through July were typically elevated above the CWQG.

Clark Creek sites PR7, PR19, 6 and B4 show similar variability and a median of 2.2mg/L. Sites 6 and B4 are located at the edge of Point Clark and receive a relatively small proportion of loadings from Point Clark. Site 5 is located at the outlet of a large catchment of typically agricultural land-use within the Clark Creek Catchment but separate from Clark Creek. Site 5 had consistently very high results, indicating consistently elevated nitrate through its local catchment. A portion of samples were collected with assumed recent flow as well as had observations of thick algae blooms, where nitrate results could partially reflect a concentration effect during no flow as well as phosphorus limited algae growth. Royal Oak site PR11 is particularly elevated, with downstream sites PR10 and PR5 showing attenuation to medians below the CWQG, indicating a loading factor upstream of PR11 in the Royal Oak catchment.

Pine River and South Pine River site medians were all below the CWQG, except for PR17 and PR18. These two sites are within an agricultural landscape and could represent generally elevated conditions through their upstream catchments, or more local point-loading. Point Clark Jardine

Creek results show low variability generally below the CWQG, except for the most downstream Site 17. Site 17 is located just downstream of a large culvert outlet and is receiving inputs from the built-up area within Point Clark. The Eighteen Mile River and Boyd Creek groups show variable results with medians below the CWQG.

Medians and percent of samples exceeding the CWQG for each group are presented in Table 3.3. Lake sites display low results, with all median and average concentrations well below the CWQG. For inland sites, only the Royal Oak watershed and Site 5 had group medians above the CWQG. This represents generally lower results for the sampling year, especially in comparison to previous year's results. However, results showed a high range in Figure 3.2 and many group averages were above the CWQG, indicating results tend to be either above the CWQG or very low. Also, given the apparent seasonality with starkly decreased results, discounting results after the July event shows all groups except Jardine Creek and nearly all sites with seasonal medians above the CWQG through the first five events.

Nitrate in the Lake is partly sourced from overland inputs and it is apparent there is a reduction factor influencing the consistently low results at the lake group of sites. The groups with elevated medians highlight the soluble nature of nitrate in a mostly agricultural landscape, where it becomes mobilized through overland flow and the soil column and can remain elevated in streams as their discharge and water levels retain the ability to transport soil, particulate and soluble nutrients, and as plant productivity or nutrient application cycles change nutrient availability.

Figure 3.3: Nitrate Spatial Trends 2024

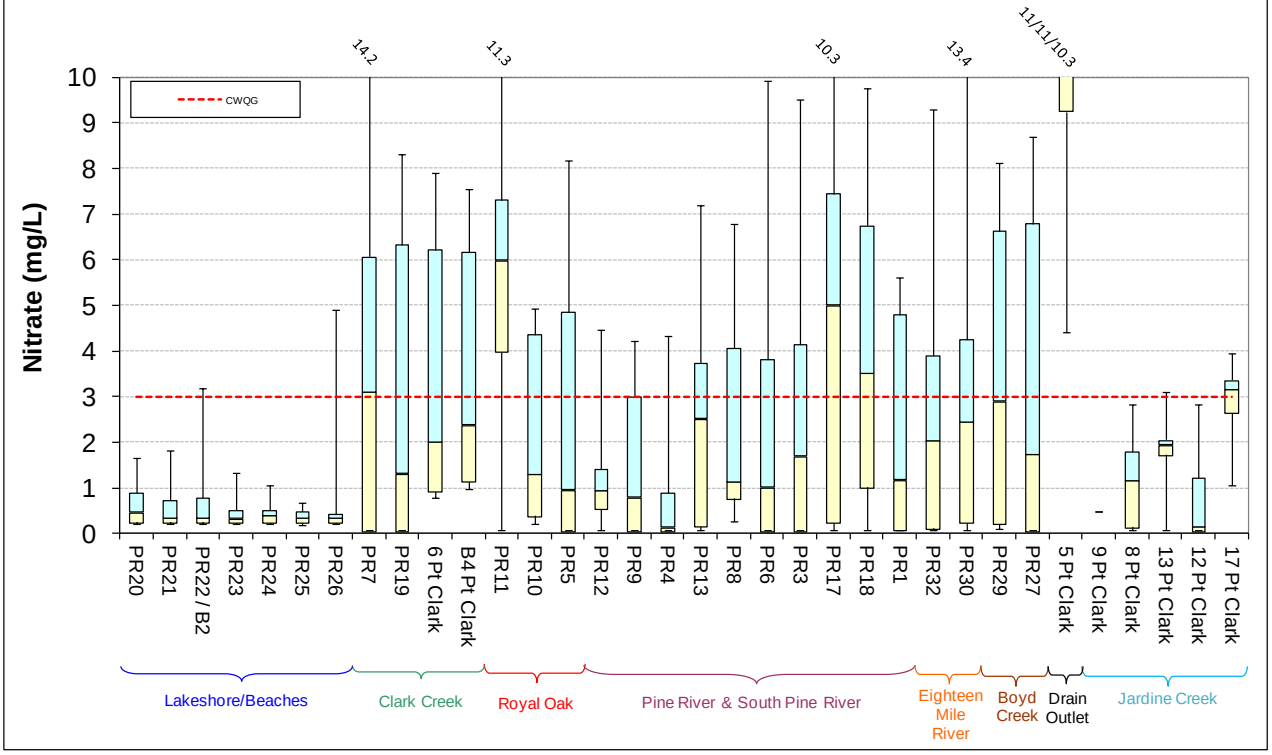


Table 3.3
Watershed Group Medians and Percent over Guideline for Nitrate in 2024

Stream Group	Median (mg/L)	Average (mg/L)	Percent over CWQG
Lake – (PR20, PR21, PR22, PR23, PR24, PR25, PR26)	0.36	0.60	3%
Pine River – (PR12, PR9, PR4, PR13, PR8, PR6, PR3, **PR17, PR18**, PR1)	1.15	2.50	35%
Clark Creek – (**PR7**, PR19, 6, B4)	2.20	**3.57**	47%
Royal Oak Creek – (**PR11**, PR10, PR5)	**4.24**	**4.11**	54%
Eighteen Mile River – (PR32, PR30)	2.25	2.89	33%
Boyd Creek – (PR29, PR27)	1.75	**3.36**	47%
Jardine Creek, Point Clark – (9, 8, 13, 12, **17**)	1.68	1.61	18%
Field Tile Drain at Point Clark – (**5**)	**10.3**	**9.19**	100%
Bold indicates median equals or exceeds CWQG			

3.4 Total Phosphorus

Phosphorus in the environment is usually bound to soil as phosphate and is not as water soluble as nitrate. Dissolved phosphorus and ortho-phosphorus are forms of soluble phosphorus that are also found in the landscape at various concentrations, depending on land use. Rain events tend to wash particulate, sediment, and soils into streams which elevate phosphorus levels during those events until it is rebounded, or particles settle in the waterbody. Phosphorus is also a plant nutrient and can stimulate algal growth in surface waters. Too much algal growth results in increased organic matter and depletion of oxygen levels, resulting in eutrophic waters which can threaten aquatic fauna and also reduce the aesthetic value of lakes and streams. Phosphorus is introduced to the environment from many sources, including agricultural chemicals, animal waste, and septic waste.

There are interim objectives for phosphorus under the Provincial Water Quality Objectives (PWQO), (1994). The Provincial Water Quality Objectives (PWQO):

- To avoid nuisance concentrations of algae in lakes, average total phosphorus concentrations for the ice-free period should not exceed 0.02 mg/L.

- Excessive plant growth in rivers and streams should be eliminated at a total phosphorus concentration below 0.03 mg/L.

The distribution of phosphorus results for 2024 is presented in Figure 3.4 and the medians and percent of samples in above the PWQO for each watershed group are presented in Table 3.4.

Lake sites were nearly consistently excellent in 2024 and had a combined median of 0.014 mg/L, with the PWQO exceeded in 25% of samples. Inland site results were variable, with nineteen of the twenty-seven inland sites and five group watersheds having elevated seasonal medians, with 76% of individual inland samples exceeding the PWQO.

Upstream Clark Creek Sites PR7 and PR19 results were variable and generally slightly elevated, where results appear to attenuate and generally reduce in variability through downstream sites. Downstream Sites 6 and B4 are located at the edge of Point Clark and receive a relatively small proportion of loadings from the built-up area. Point Clark Site 5 is at the outlet of agricultural drainage within the Clark Creek catchment, was generally variable and had a mean below the PWQO. Site 5 was dry from August to November, was observed to have thick algae growth and assumed recent flow, where its two elevated results in June and July may be influenced by a concentration effect and release of phosphorus through the end of the algae lifecycle.

The Royal Oak group was variable while also consistently very elevated. Upstream Site PR11 was consistently very high, with downstream results attenuating through PR10 and PR5. Higher upstream results could reflect upstream or site adjacent landscape factors or land use practices, with the downstream attenuation factors including soil uptake and plant productivity, and settling through waterways and the landscape including buffers and tree stands. Pine River and South Pine River results had some variability, with seven site season medians above the PWQO. PR17 was particularly consistently highly elevated, with PR18 slightly elevated with variability reaching very high levels. Downstream of PR17 and PR18 is PR1, which had low variability and a median just above the PWQO, indicating loading factors upstream of PR18 and particularly the PR17 catchment.

The Jardine Creek group phosphorus results contrast to their generally low nitrate results. Their results may be mediated by factors different than the predominantly rural sites of the program, such as lawn fertilizer, septic activity, or other organic material such as leaf litter. Initiatives to improve results at elevated sites could improve the downstream watershed and decrease group watershed medians toward levels below the CWQG.

With large catchment areas between elevated sites, opportunities for mitigation and attenuation projects exist anywhere along the stream reaches and catchments, including identifying source areas through additional sampling locations or frequency. PR17 has an opportunity to add a sampling location on Concession 4, PR18 has opportunities at Highway 21 and Sideroad 30. PR11 has additional sampling opportunities that in the past have been shown to have intermittent flow.

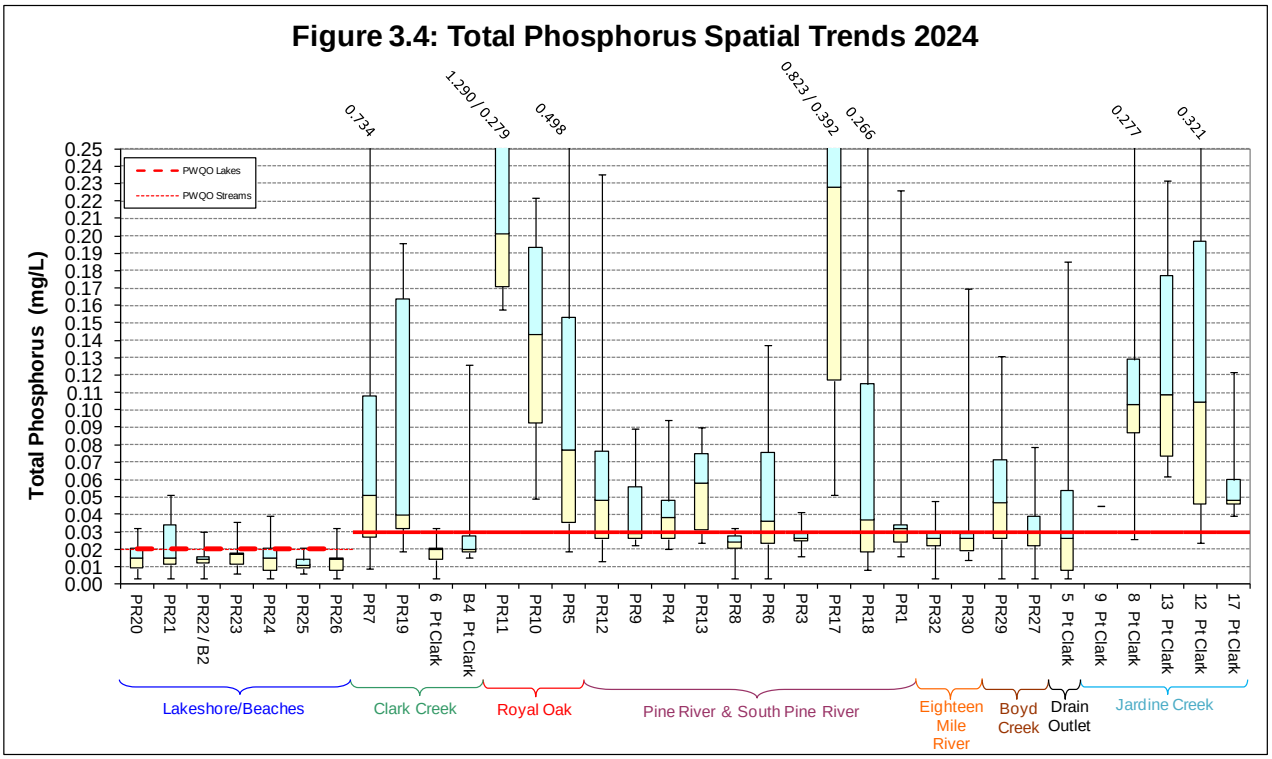


Table 3.4
Watershed Group Medians and Percent over Guidelines for Phosphorus in 2024

Stream Group	Median (mg/L)	Average (mg/L)	Percent over PWQO
Lake – (PR20, PR21, PR22, PR23, PR24, PR25, PR26)	0.014	0.016	25%
Pine River – (PR12, PR9, PR4, PR13, PR8, PR6, PR3, PR17, PR18, PR1)	**0.033**	**0.078**	56%
Clark Creek – (PR7, PR19, 6, B4)	0.028	**0.069**	44%
Royal Oak Creek – (PR11, PR10, PR5)	**0.085**	**0.147**	70%
Eighteen Mile River – (PR32, PR30)	0.026	**0.032**	28%
Boyd Creek – (PR29, PR27)	**0.031**	**0.042**	59%
Jardine Creek, Point Clark – (9, 8, 13, 12, 17)	**0.073**	**0.105**	91%
Field Tile Drain at Point Clark – (5)	0.026	**0.055**	40%
Bold indicates median equals or exceeds PWQO			

4.0 COMPARISONS WITH HISTORIC RESULTS

4.1 General

The Pine River Watershed Study, conducted in 1990 for the SVCA, contained some historic data on contaminant levels in the Pine River. There is bacterial sampling information from 1972 to 1978, and nutrient information from 1965 to 1978. Samples were taken at the bridge over Pine River on Lake Range Drive, which coincides with the sampling site PR1. At this point, Pine River and South Pine River merge into one watercourse. The current dataset for PR1 was started in 2000 and continues through 2024.

4.2 *E. coli*

Figure 4.1 presents the 1972 to 1978 historical sample data, the 1990 data, and the data from the current monitoring period Site PR1. The Figure shows that the current and historic group of samples have similar variability, likely due to the influence of the timing of loading factors and weather conditions on measured populations. The variability of geometric means slightly above and below the PWQO throughout the entire monitoring history do not indicate consistent or high concentration loading factors, or a change in inputs between time periods, and may represent a snapshot of the typical natural and agricultural landscape in the monitoring area.

Figure 4.2 shows the results of beach site PR23 (Lurgan Beach) in comparison to PR1 (Pine River). Lurgan Beach is located near the outflow of the Pine River into Lake Huron. The 2024 sample results are similar to previous years; the stream site continues to have higher bacteria counts than the lake site. Figure 4.2 also shows PR1's seasonal geometric mean typically below or just above the PWQO. *E. coli* levels are highly variable and have many factors contributing to their origins, transport, survivability, and measured concentrations. The lake dilution factor, the isolation from direct sources of input, as well as site conditions at lake sites that are conducive to bacteria sterilization may partially account for the difference between the in-stream and lake site.

Site conditions and associated sources of bacteria change depending on sampling location, however taking PR1 and PR23 as representatives of in-stream and lake sampling sites, we can assume this relationship generally exists between the program's in-stream and lake sites. PR1 results are generally higher than the lake site and have been marginally elevated above the PWQO, with many years, especially recently, showing seasonal medians below the PWQO. PR1 is located at the downstream confluence of the Pine River group of sampling sites and is typically in the low range of group results. Given an expectation of attenuation with no other loading factors, downstream confluence sites may be generalized to represent minimum baseline concentrations for a watershed group.

Figure 4.1
***E. coli* Concentrations at Site PR1**

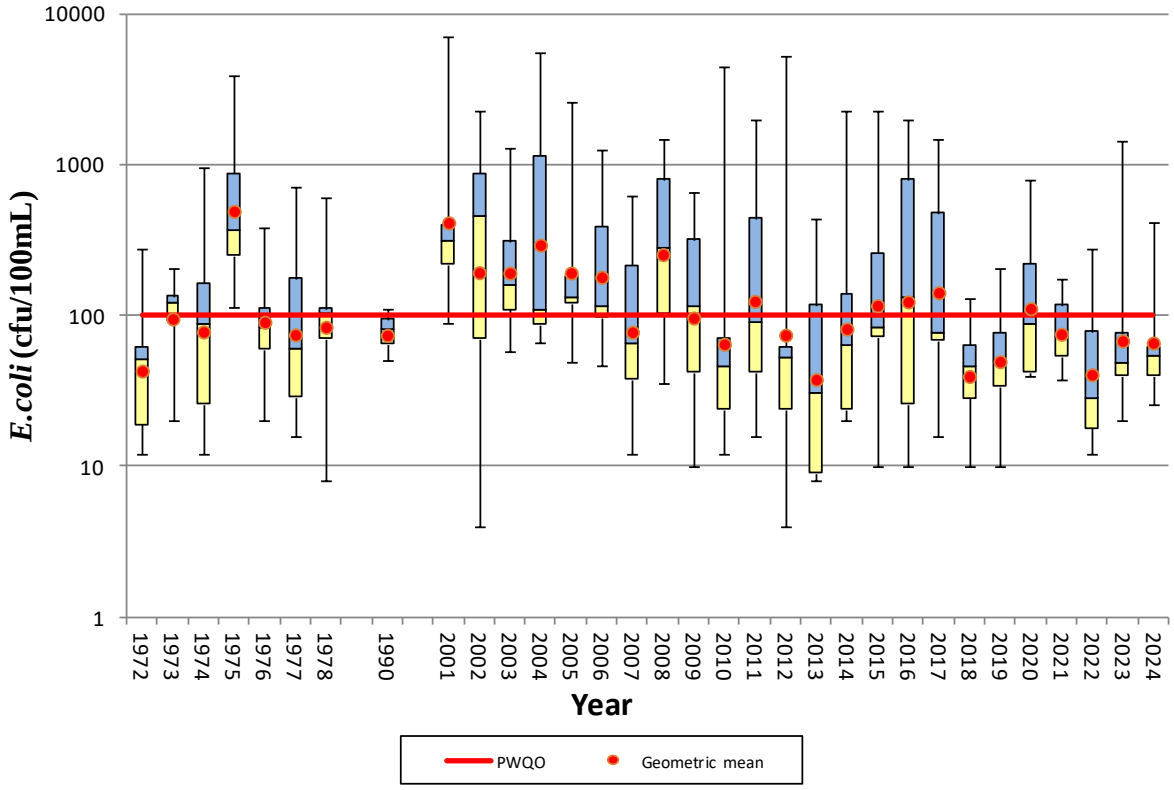
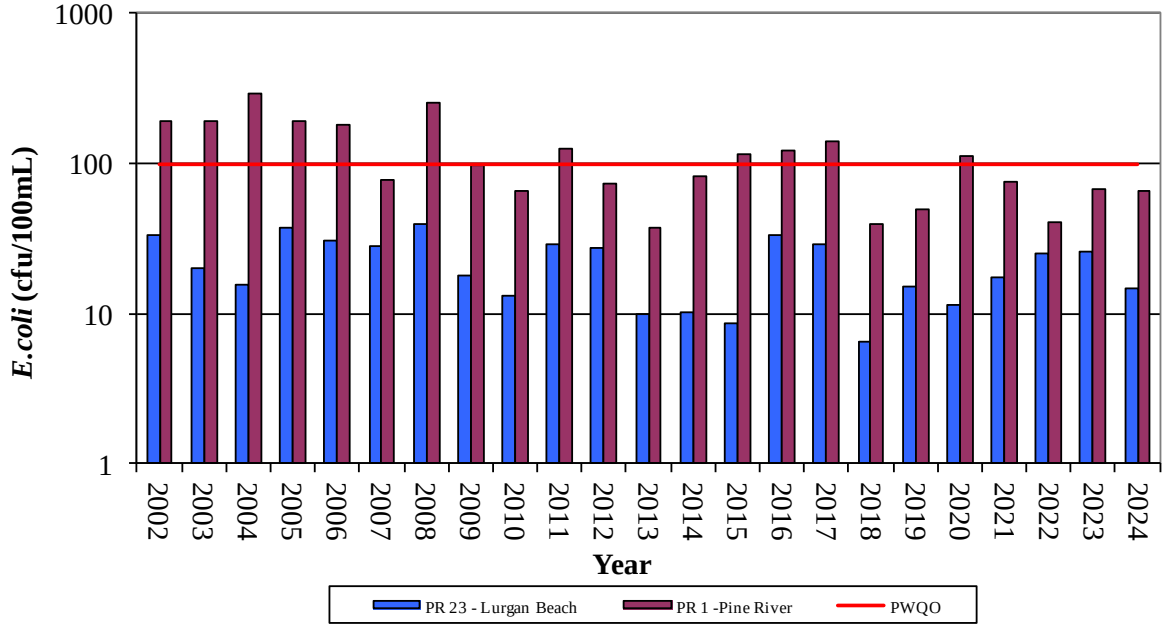


Figure 4.2
Geometric Mean of *E. coli* 2002-2024
Lake vs. Stream Site

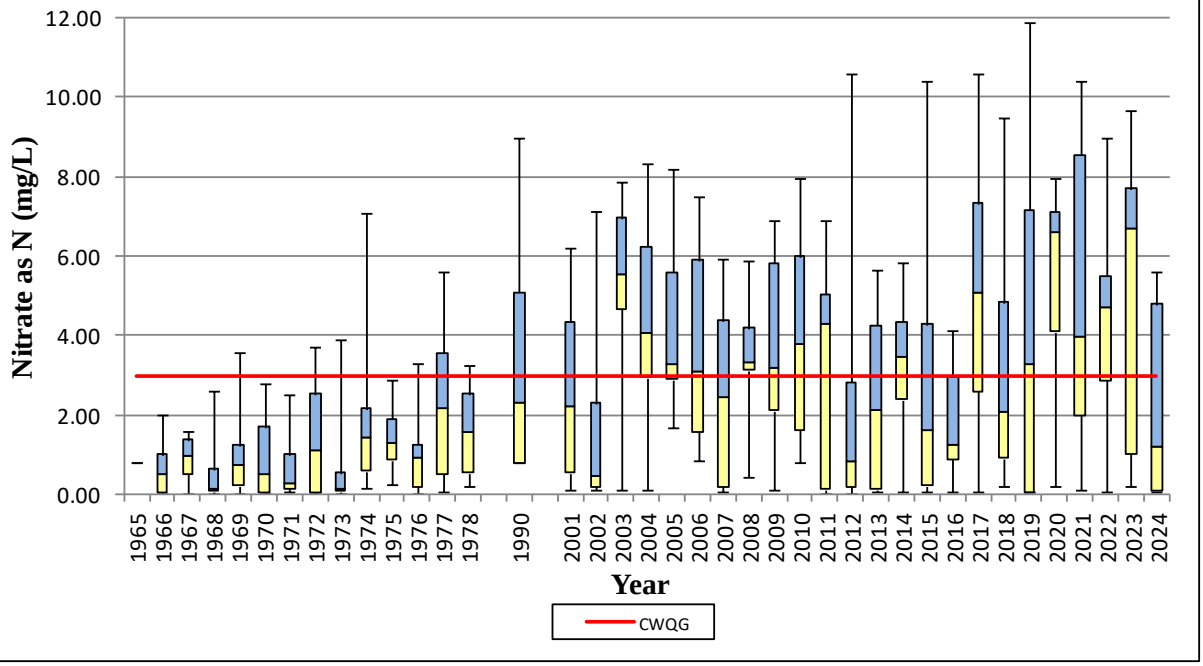


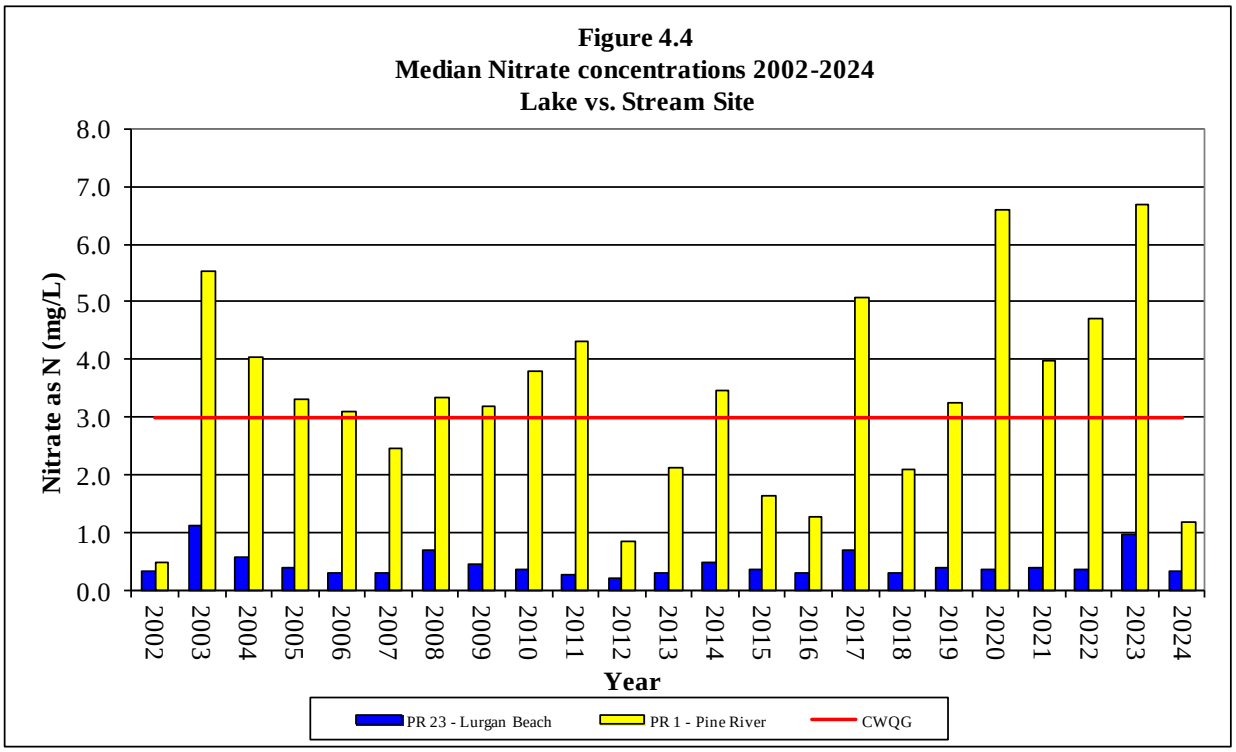
4.3 Nitrate

Figure 4.3 presents the historical and current nitrate data for sample Site PR1. Throughout the current sampling program, PR1's nitrate levels have generally been higher than historical data, with a combined median of over 3 mg/L compared to 0.78 mg/L, and with no historic year median above the CWQG. The median values for the current sampling period have been within the range of those found historically, however the current period's large variability towards higher results, as well as with the majority of medians being above the CWQG, indicate the current sampling period results for PR1 are elevated from those found historically at inland sites. Expanding PR1's current elevated state to all most inland sites, there is a wide range of stewardship opportunities to mediate improvements throughout the watershed with respect to nitrate loadings, transport, and availability. PR1's 2024 results were nearly consistently low and had a median just above 1 mg/L, and is a contrast to recent history and represents a near best case for the mitigation opportunities that exist throughout the watershed.

Figure 4.4 compares the nitrate concentrations between a representative stream and lake site. It is apparent that concentrations at the lake site, most likely due to a dilution factor, almost consistently remain below the CWQG while in-stream the stream site can have concentrations well above the lake site, though not necessarily over the CWQG. Using the two as representative sites, it can be assumed that this relationship exists between in-stream and lake sampling sites.

Figure 4.3
Nitrate Concentrations at PR-1





4.4 Total Phosphorus

Figure 4.5 presents the accumulated phosphorus data for sample Site PR1. Historically the results have been variable while remaining well above the interim PWQO. Concentrations for the current sampling program group of sites are lower than the historical results but have generally remained above the interim PWQO, with intermittent years displaying seasonal medians below the objective. Possible contributing factors for the lower concentration in the current group may be related to adoption of best management practices including improvements in soil management to reduce soil erosion, improvements in fertilizer management and application, as well as the updating of septic systems.

Figure 4.6 compares PR23 and PR1 phosphorus results. Results have been variable from year to year, with the lake site consistently lower than the in-stream site. Lake phosphorus levels reflect landscape level inputs as well as the lakes own storage in the phosphorus cycle, where similar to nitrate, landscape level inputs can be diluted in large waterbodies. Assuming a downstream attenuation factor and PR1 to be representative of minimum baseline concentration, this relationship could be assumed for all downstream confluence sites for the watershed groups.

Figure 4.5
Total Phosphorus Concentrations at PR-1

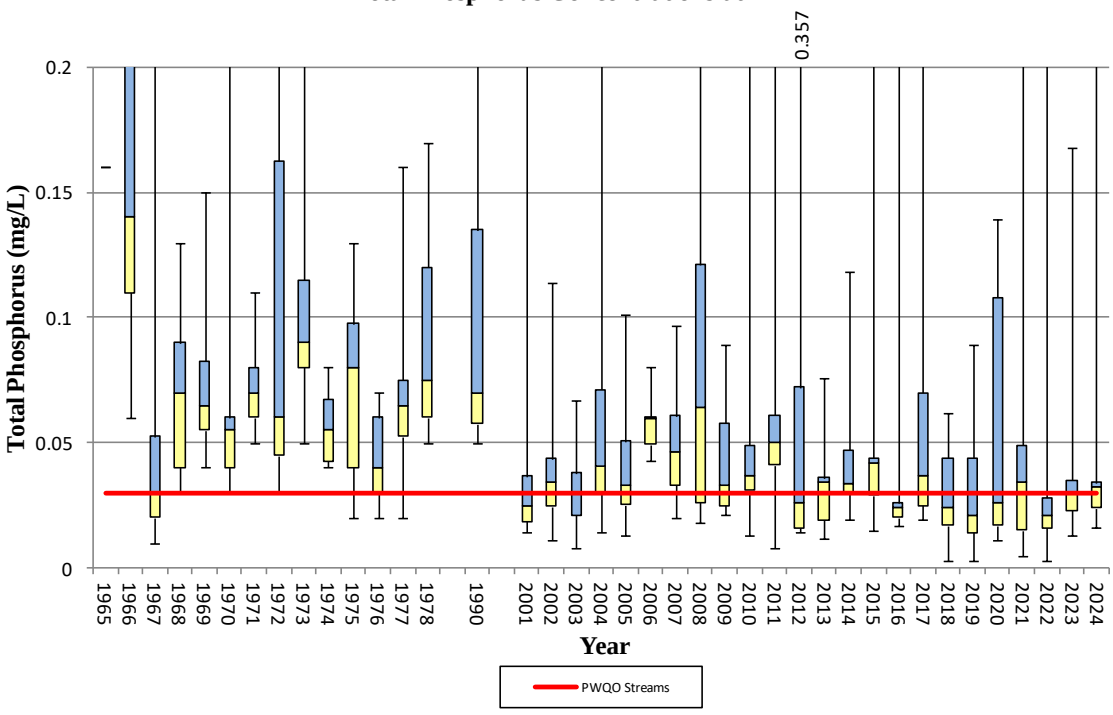
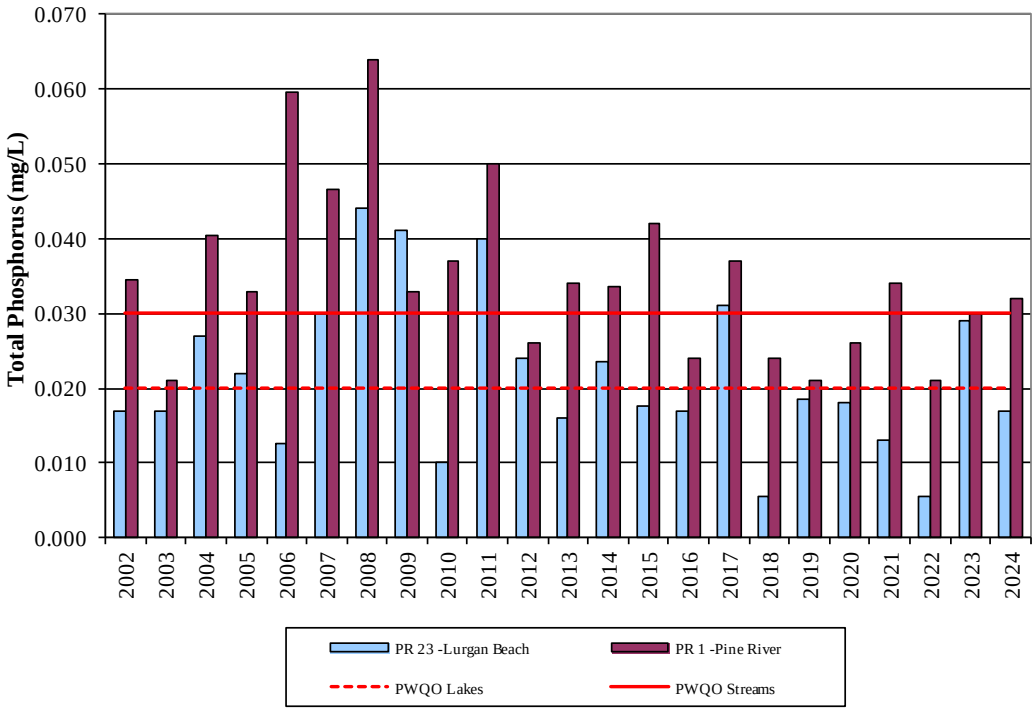


Figure 4.6
Median Total Phosphorus Concentration 2002-2024
Lake vs. Stream Site



5.0 CONCLUSIONS

The Township of Huron-Kinloss is accumulating a database of information regarding water quality in area streams and the nearshore of Lake Huron. The data collected to date shows that the streams have variable water quality with respect to *E. coli*, total phosphorus, and nitrate concentrations. No definable sources of nutrient or *E. coli* loadings have been identified beyond general agricultural and rural residential land use, runoff, and soil and sediment transport throughout the landscape.

Lake sites displayed excellent results, with a low number of *E. Coli* exceedances in 2024. In-stream *E. coli* levels were variable and generally exhibited low results with occasional event and individual site spikes, with general attenuation through downstream sites. PR11 and its downstream site PR10 were particularly elevated. The Jardine Creek group was elevated, particularly site 13. All sites are subject to spikes likely related to weather conditions and ultimately the loading factors which enable transport of *E. coli*.

Nitrate results at lake sites were consistently under the CWQO in 2024. In-stream nitrate results were variable in 2024. Few site medians were above the CQWO, though many site's seasonal averages were above the CWQO. All inland sites displayed a large drop to near background levels from August to November. Particularly elevated sites include PR11, PR17, and Point Clark site 5.

Phosphorus levels are improved compared to historical data, towards values just above the PWQO for streams and rivers. Phosphorus levels are lower at lake sites compared to in-stream sites, although results for any sites are variable and can show large spikes in concentration.
The 2024 phosphorus results at lake sites were generally excellent.

The 2024 results for inland sub-watersheds show generally elevated results, and sites tend to show some attenuation downstream. Particularly elevated sites include PR11 and its downstream site PR10, PR17 and its adjacent site PR18, and Jardine Creek's sites 8, 12, 13 and 17. Point Clark's site results may be mediated by different factors in the more urban setting than in the more rural Pine River sampling sites, and any particularly elevated sites are candidates for additional investigation. Continued monitoring of the nutrient parameters throughout Point Clark will benefit future interpretation, such as for an understanding of the area's attenuation dynamics of the phosphorus component of septic system discharge, fertilizer application, or leaf litter.

The Township should continue this monitoring program, so that the database of information continues to build, and in-depth determinations can be made.

All of which is respectfully submitted.

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APPENDIX A
WATER QUALITY RESULTS FOR THE YEARS
2002 - 2024

APPENDIX B

INVENTORY OF SAMPLING LOCATIONS