


2012 Surface Water Quality Summary

Regional Watershed Monitoring Program

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Watershed Monitoring and Reporting Section
Ecology Division

Toronto and Region Conservation for The Living City®

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1. Introduction

Since 2002, the Toronto and Region Conservation Authority (TRCA) has monitored stream water quality at selected locations within the watersheds of the greater Toronto region on a monthly basis. These activities have been undertaken as part of TRCA's Regional Watershed Monitoring Program (RWMP) in partnership with the Ontario Ministry of the Environment (OMOE). The data collected are shared with partner municipalities and other agencies, and are used for planning, implementation and reporting activities including the development of watershed plans and report cards as well as watershed characterization reports in support of source water protection planning.

This report presents selected results of the 2012 surface water quality sampling conducted in support of the Provincial Water Quality Monitoring Network (PWQMN), RWMP and special projects. It provides a general overview and description of the range of water quality conditions across the TRCA jurisdiction during the 2012 sample year. This report and associated data can assist in identifying areas of concern, elevated levels of contaminants, and can be used to affirm both poor and good water quality in different land use areas. However, results should be interpreted with caution, since sampling events were not targeted to capture specific stream flow conditions (e.g. wet weather events) and this report presents only one year of data which may not represent normal conditions.

2. Methods

In 2012, surface water quality samples were collected at 44 stations (Figure 1) throughout the TRCA's jurisdiction (the City of Toronto's wet weather stations are displayed for informative purposes in Figure 1). Sample collection and laboratory analysis were carried out through several partnerships which are outlined below:

- 13 stations were sampled by TRCA under the OMOE's PWQMN;
- 25 stations were sampled by TRCA for the RWMP;
- 3 RWMP stations (104028, 104026 and 104023) were sampled in support of the Seaton/Duffins Heights Development Monitoring Project;
- 3 stations (Glen Haffy 1, Heart Lake 1 and Bruce's Mill 1), were sampled during the first half of 2012 in support of TRCA's Parks and Culture Department's initiative to assess the water quality within TRCA parks.

Monthly samples were collected using in-stream "grab" techniques following the OMOE PWQMN protocol (OMOE 2003) and also included in-situ measurements (e.g. water temperature, pH, and specific conductivity) collected using a hand-held YSI meter (Model 600QS). Water quality samples were collected throughout the year, typically in the third week of each month, irrespective of precipitation. Samples that were part of the PWQMN partnership (13 stations) were submitted to the OMOE Rexdale Laboratory. The remaining samples from stations or months (e.g. January to March, and December) not included in the PWQMN were submitted to the York-Durham Regional Environmental Laboratory in order to augment water quality data from these stations and to maintain a year-round dataset (Table 1).

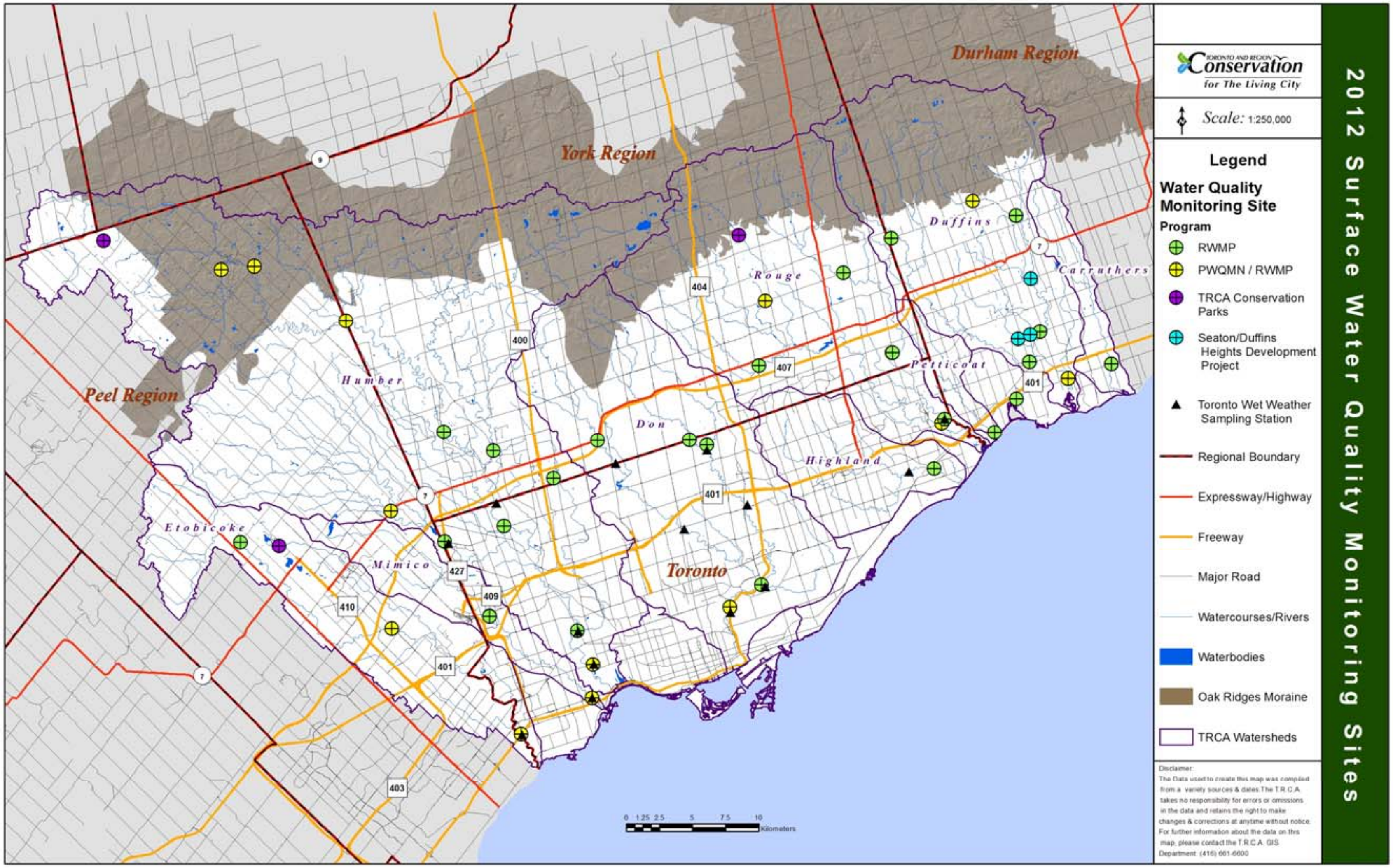

Figure 1. **2012 TRCA surface water quality monitoring stations**

Table 1. 2012 TRCA surface water quality stations and associated laboratories

Station	Watershed	UTM Coordinates		Laboratory		
		Northing	Easting	Jan-Mar	Apr-Nov	Dec
Mayfield	Etobicoke	4843488	595028	YD	YD	YD
80007	Etobicoke	4836746	606933	YD	OMOE	YD
80006	Etobicoke	4829016	616234	OMOE	OMOE	OMOE
MM003WM	Mimico	4837916	613849	YD	YD	YD
82003	Mimico	4831713	621585	OMOE	OMOE	OMOE
83104	Humber	4864112	593560	YD	OMOE	YD
83018	Humber	4864329	595961	YD	OMOE	YD
83009	Humber	4860243	602980	YD	OMOE	YD
83020	Humber	4851861	610386	YD	YD	YD
83004	Humber	4850423	614148	YD	YD	YD
HU010WM	Humber	4844744	615027	YD	YD	YD
83103	Humber	4845870	606385	YD	OMOE	YD
83002	Humber	4843562	610459	YD	YD	YD
HU1RWMP	Humber	4848311	618678	YD	YD	YD
83012	Humber	4836845	620488	YD	YD	YD
83019	Humber	4834265	621663	OMOE	OMOE	OMOE
85004	Don	4851207	622014	YD	YD	YD
85003	Don	4851256	628954	YD	YD	YD
DN008WM	Don	4850889	630236	YD	YD	YD
DM 6.0	Don	4840251	634378	YD	YD	YD
85014	Don	4838576	632000	OMOE	OMOE	OMOE
94002	Highland	4849056	647429	YD	YD	YD
97018	Rouge	4861770	634680	YD	OMOE	YD
97999	Rouge	4863887	640589	YD	YD	YD
97777	Rouge	4856823	634214	YD	YD	YD
97003	Rouge	4857669	641985	YD	YD	YD
97007	Rouge	4857816	644300	YD	YD	YD
97013	Rouge	4852830	648243	YD	YD	YD
97011	Rouge	4852511	648007	OMOE	OMOE	OMOE
FB003WM	Pine Creek	4854151	653659	YD	YD	YD
PT001WM	Petticoat	4851804	652005	YD	YD	YD
104008	Duffins	4869299	650372	YD	OMOE	YD
104037	Duffins	4866462	644191	YD	YD	YD
104029	Duffins	4868158	653641	YD	YD	YD
104028	Duffins	4863433	654742	YD	YD	YD

Station	Watershed	UTM Coordinates		Laboratory		
		Northing	Easting	Jan-Mar	Apr-Nov	Dec
104023	Duffins	4858867	653796	YD	YD	YD
104026	Duffins	4859199	654730	YD	YD	YD
104027	Duffins	4859419	655458	YD	YD	YD
104025	Duffins	4857115	654656	YD	YD	YD
104001	Duffins	4855880	657579	OMOE	OMOE	OMOE
107002	Carruthers	4856972	660850	YD	YD	YD
Heart Lake 1[a]	Etobicoke	4843199	597954	YD	-	-
Glen Haffy 1[b]	Humber	4866262	584678	YD	YD	-
Bruce's Mill 1[b]	Rouge	4866672	632670	YD	YD	-

OMOE: OMOE Rexdale Laboratory; YD: York-Durham Regional Environmental Laboratory

[a] Sampled in January, too dry to sample in February, March, and April

[b] Sampled from January to June 2012

The two laboratories analyzed a standard suite of nutrients, metals, microbiological and conventional water quality parameters which are listed in Table 2. The 16 parameters in boldface are those that were selected for discussion in this report and include all the PWQMN recommended indicator parameters as well as additional forms of nitrogen (ammonia and total Kjeldahl nitrogen), *Escherichia coli*, and several metals. These parameters provide a quick but comprehensive indication of the water quality at each station. Elevated concentrations of these parameters may point to natural and/or anthropogenic sources within the watershed.

The results of each parameter were compared to the Provincial Water Quality Objectives (PWQO) guidelines where applicable. The PWQOs are a set of numerical and narrative ambient surface water quality criteria that represent a desirable level of water quality that will protect all forms of aquatic life and all aspects of their aquatic life cycles during indefinite exposure to the water as well as protecting recreational water usage based on public health considerations and aesthetics (OMOEE 1994). When PWQO guidelines were not available, other objectives such as Canadian Water Quality Guidelines (CWQG) (CCME 2007) and Recommended Water Quality Guidelines for the Protection of Aquatic Life under the Canadian Environmental Sustainability Indicators (CESI) Initiative (EC 2012) were used. All laboratory results that were reported as less than the minimum detection limit (MDL) were set to the MDL value for the purposes of interpretation. Surface water quality data are stored in "Water", a relational SQL database that is part of the TRCA's corporate database "EnviroBase."

Table 2. Standard suite of water quality parameters analyzed[1] by York-Durham and OMOE laboratories. The results of the 16 parameters in boldface are discussed in this report

General Chemistry	Nutrients	Metals	Microbiological
Alkalinity	**Ammonia**	**Aluminium**	***Escherichia coli***
Biochemical Oxygen Demand	***Nitrate/Nitrite**	**Arsenic**	
Calcium	**Nitrogen, Total Kjeldahl**	Barium	
***Chloride**	Phosphate	Beryllium	
Conductivity	***Total Phosphorus**	Cadmium	
Dissolved Oxygen		Chromium	
Hardness		Cobalt	
Magnesium		***Copper**	
pH		**Iron**	
Potassium		***Lead**	
Sodium		Manganese	
Total Dissolved Solids		Molybdenum	
***Total Suspended Solids**		**Nickel**	
Turbidity		Strontium	
Water Temperature		Vanadium	
		***Zinc**	

Note: [1]Additional parameters may be analyzed on a site/project specific basis
*PWQMN recommended indicator parameters

Stream conditions were recorded at the time of sampling to help characterize the sample with respect to flow response to recent or occurring precipitation. These field notes (Appendix A) as well as 2012 precipitation records from Pearson International Airport were included in this report to provide context to assist with interpretation of results.

As an area is urbanized the kilometres of roads in that area increases. Road density is the number of kilometres of roads per square kilometer in a watershed or catchment and is comparable between watersheds of different sizes. Road density data for the water quality stations are presented in Table 3. The actual road densities (roads (km) per km^2 in catchment) range from 1 to 10. The road density scores group the road densities into 4 categories: 1 to 3, 3 to 5, 5 to 8, and 8 to 10. These data were obtained by determining in which subwatershed or catchment a station was located and applying the road density of that catchment to the station. Road density is considered a surrogate for urbanization, and higher road densities indicate more impervious surfaces, more storm runoff, and higher concentrations of water quality parameters associated with urban areas.

Table 3. Road density (roads (km) per km^2) and road density scores of the station catchment

Station	Watershed	Road Density of Station Catchment	
		Roads (km) per km^2	Road Density Score (1-4)
Mayfield	Etobicoke	1.27	1
80007	Etobicoke	4.13	2
80006	Etobicoke	5.72	3
MM003WM	Mimico	7.75	3
82003	Mimico	9.15	4
83104	Humber	1.66	1
83018	Humber	1.31	1
83009	Humber	1.43	1
83020	Humber	2.04	1
83004	Humber	2.04	1
HU010WM	Humber	2.35	1
83103	Humber	2.49	1
83002	Humber	3.29	2
HU1RWMP	Humber	8.28	4
83012	Humber	3.47	2
83019	Humber	3.47	2
85004	Don	6.79	3
85003	Don	8.58	4
DN008WM	Don	9.63	4
DM 6.0	Don	8.92	4
85014	Don	8.92	4
94002	Highland	9.38	4
97018	Rouge	2.17	1
97999	Rouge	1.6	1
97777	Rouge	6.02	3
97003	Rouge	1.92	1
97007	Rouge	1.92	1
97013	Rouge	2.07	1
97011	Rouge	5.55	3
FB003WM	Pine Creek	NA	NA
PT001WM	Petticoat	3.74	2
104008	Duffins	1.57	1
104037	Duffins	2.37	1
104029	Duffins	1.18	1
104028	Duffins	1.72	1

Station	Watershed	Road Density of Station Catchment	
		Roads (km) per km²	Road Density Score (1-4)
104023	Duffins	1.03	1
104026	Duffins	1.67	1
104027	Duffins	2.07	1
104025	Duffins	1.61	1
104001	Duffins	2.07	1
107002	Carruthers	2.51	1
Heart Lake 1	Etobicoke	4.91	2
Glen Haffy 1	Humber	2.27	1
Bruce's Mill 1	Rouge	2.01	1

3. Results & Discussion

Sampling results are presented in box plots (e.g. Figure 2) which summarize the distribution of results for each parameter over the course of the year. The use of box plots allows the reader to view the range of results where the majority (50%) of results are located within the box section. The ends of the boxes represent the 25th and 75th quartiles and the difference between the quartiles is the interquartile range. The line across the middle of the box identifies the median sample value. The "whiskers" above and below the box represent the range of data plus or minus 1.5 times the interquartile range, excluding extreme values.

Water quality stations are arranged along the x-axis of each graph from upstream to downstream (left to right) and grouped into watersheds which are arranged from west to east.

This report is intended to provide a general characterization of the surface water quality conditions. For more informative interpretation of results the OMOE recommends a minimum sample size of 30 samples per station (or 5 years of data) to reduce the influence of unusual conditions such as spills, extreme runoff events and drought. Due to the low annual sample size (n=12) for each station, only one or two high results (perhaps due to storm events) are required to skew the results upwards. Stations Glen Haffy 1, Heart Lake 1 and Bruce's Mill 1 were omitted from this report because they were sampled 6 times or less and their results are not representative of the entire year.

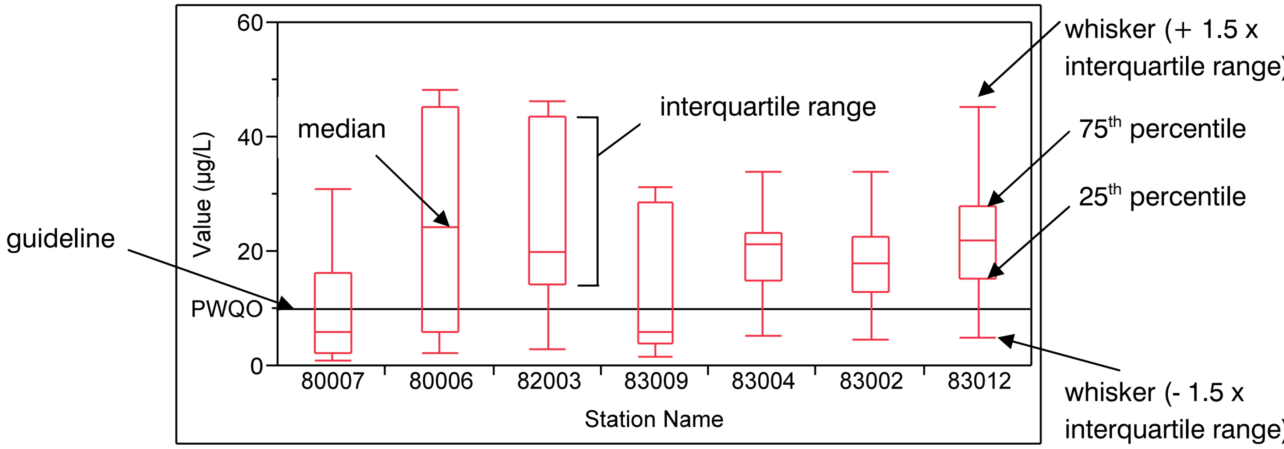

Figure 2. Box plot graphic example

3.1 Precipitation

Monthly precipitation data for the Environment Canada meteorological station at Pearson International Airport were downloaded from the National Climate Data and Information Archive website (http://www.climate.weatheroffice.gc.ca/climateData). The total amount of precipitation recorded in 2012 at Pearson measured 731 mm, which was 69 mm below the 12-year average of 801 mm (Figure 3). Monthly precipitation values for 2012 are displayed in Figure 4. Precipitation was highest in September and October and may have contributed to the elevated concentrations of pollutants found at some stations. Samples were considered collected during precipitation events if field notes indicated precipitation at the time of sampling, and/or the Pearson meteorological station indicated precipitation the day before or the day of sampling. Approximately 50% of samples were collected during, the day of, or the day after precipitation events (Appendix B). From January to April 2012, 33 cm of snow fell as precipitation compared to 75 cm in the same period in 2011 (Table 4). Presumably, the amount of road salt applied within the TRCA jurisdiction is dependent upon snowfall, and the mild winter of 2012 may have contributed to lower chloride concentrations at some water quality stations.

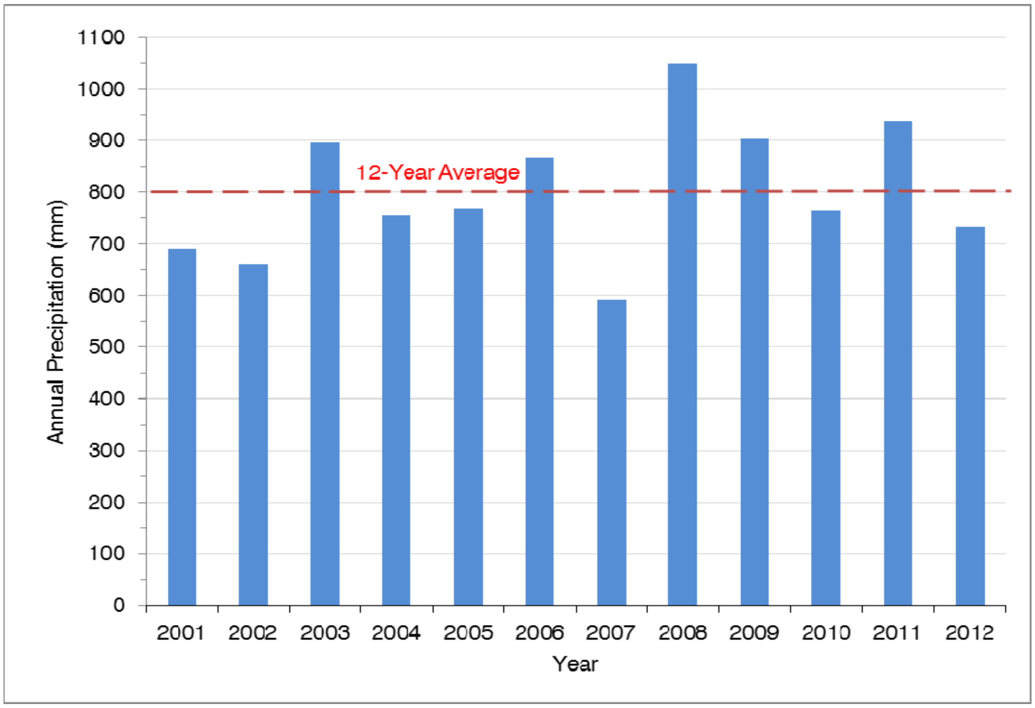

Figure 3. Annual precipitation at Pearson International Airport from 2001 to 2012

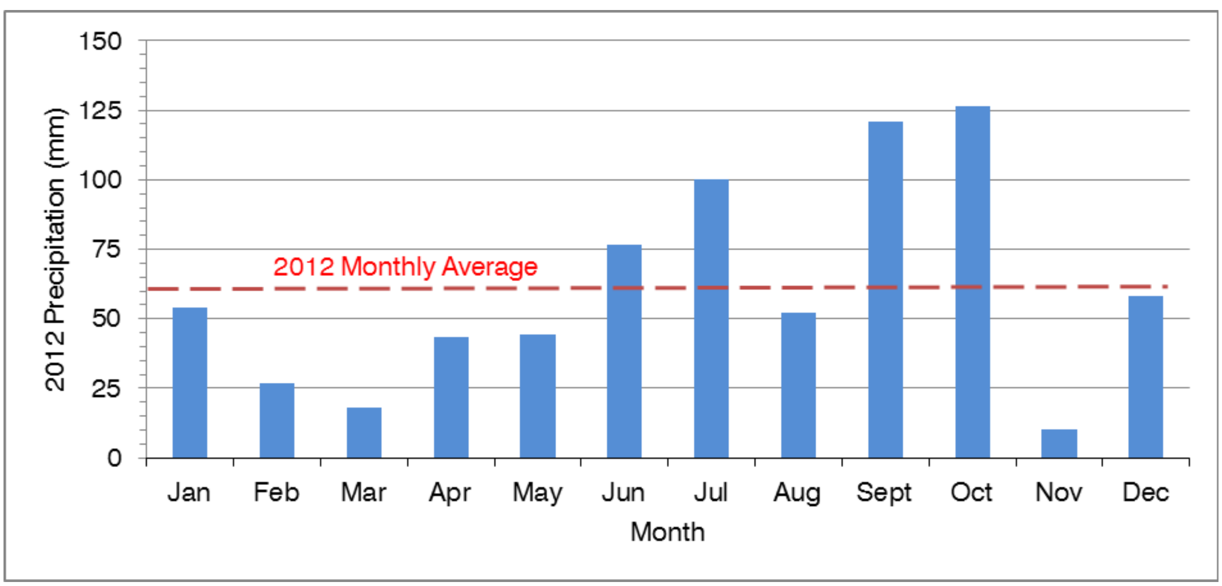

Figure 4. Monthly precipitation at Pearson International Airport for 2012

Table 4. Snow (cm) for 2011 and 2012 at Pearson International Airport from January to April

	Snow (cm)	
	2011	2012
January	46.0	16.2
February	24.4	12.6
March	0.6	2.4
April	3.8	1.8
Total:	74.8	33.0

3.2 General Chemistry Parameters

The general chemistry parameters analyzed in this report are chloride, total suspended solids (TSS) and pH.

3.2.1 Chloride

Urbanization and road density are correlated with chloride concentrations as a major source of chloride is road salting in winter months. Chloride does not readily absorb onto mineral surfaces, and thus concentrations can be high in surface water and shallow aquifers, the latter releasing chloride throughout the year (CCME, 2011). It can be toxic to aquatic organisms with acute toxic effects at high concentrations and chronic effects (on growth and reproduction) at lower concentrations (OMOE, 2003).

Chloride displayed higher levels at stations situated in highly urbanized areas (Figure 5). In 2012, there were no stations that displayed a median value exceeding the short-term CWQG of 640 mg/L. The 75th percentile chloride values of 5 stations (MM003WM, 82003, HU1RWMP, 83012, and 85004) exceeded the short-term CWQG, whereas 9 and 10 stations exceeded it in 2011 and 2010 respectively. The lower number of stations in 2012 with excessive chloride levels may be due to decreased snow precipitation which may have reduced the amount of salt applied to roads.

Over 50% of stations (23/41) had a median value which surpassed the long-term CWQG chloride guideline of 120 mg/L for chronic exposure compared to 20 stations in 2011. Elevated chloride values at these stations have been documented consistently since 2009 and are likely a result of the surrounding land-uses (i.e. urban, industrial, commercial, residential, etc.) which increase road density. Road salting is directly linked to urbanization and increased chloride levels. Stations in Etobicoke Creek, Humber River and the Rouge River displayed a distinct increase in median chloride values from upper (less urbanized) to lower (highly urbanized) watershed. Mimico Creek, Don River, Highland Creek, Frenchman's Bay, Petticoat Creek and Carruthers Creek all display elevated median values which surpass the long-term CWQG of 120 mg/L.

Station 83009 located in the upper Humber River watershed recorded the lowest median concentration of chloride in 2011, which is likely a result of low road density. Duffins Creek, which is the least urbanized watershed, exhibited the lowest chloride concentrations and the median values did not exceed the long-term CWQG.

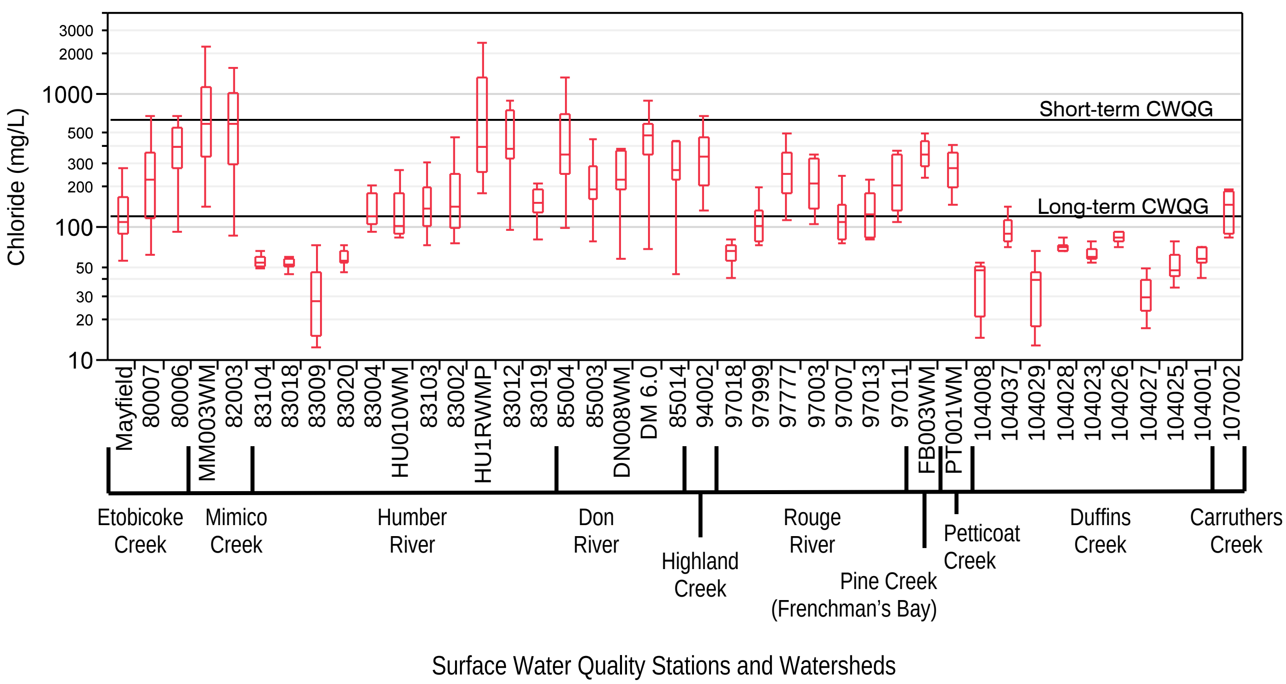

Figure 5. **Chloride concentrations (mg/L) at 41 stations within TRCA jurisdiction (CWQG: long-term 120 mg/L (chronic) and short-term 640 mg/L (acute); CCME 2011)**

3.2.2 Total Suspended Solids

Total suspended solids (TSS) are a measure of suspended sediment, which can affect fish and benthos health and stream aesthetics. Suspended particles may cause abrasion on fish gills, and reduce as well as impair spawning habitat. Toxic organics and metals often adhere to suspended solids and may become available to benthic fauna when the solids settle (CCME, 2007). Precipitation can increase TSS, and samples collected during or after precipitation events may have higher TSS values.

Median TSS values for all 41 stations remained below the CWQG of 30 mg/L (Figure 6). The 75th percentile TSS values at 4 stations (82003, 83020, 83103, and HU1RWMP) exceeded the CWQG. In 2011 and 2010, 18 and 6 stations respectively displayed 75th percentile values that exceeded the CWQG. Decreased precipitation levels in 2012 may have contributed to a reduction in TSS values.

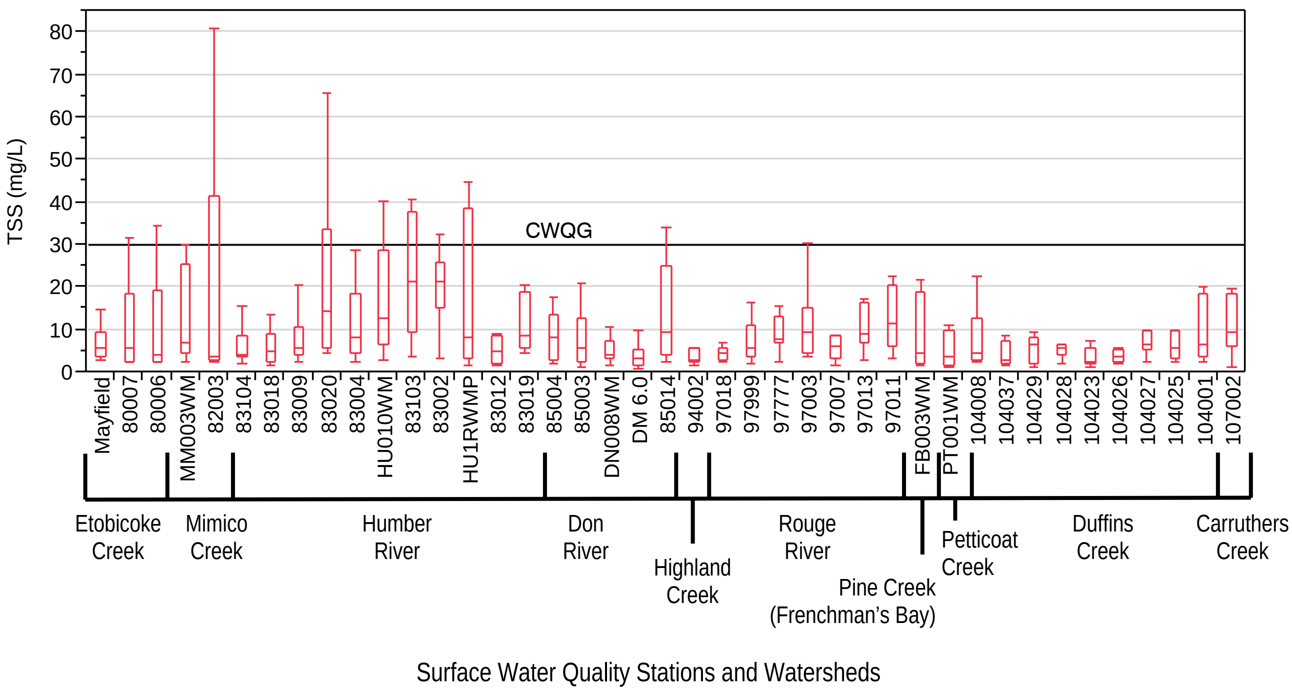

Figure 6. Total suspended solids (TSS) concentrations (mg/L) at 41 stations within TRCA jurisdiction (CWQG: 30 mg/L)

3.2.3 pH

pH measures the acidity, neutrality, or alkalinity of water. pH fluctuations can affect fish communities directly and indirectly by facilitating the release of organic and metal contaminants bonded to sediments. Nutrient cycling, the discharge of industrial effluent, and spills can result in pH fluctuations. The pH of water also affects the toxicity of ammonia. Median pH values were within PWQO range of 6.5 to 8.5 for all stations (Figure 7), although 2 stations (83019 and 97011) displayed 75th percentile values above 8.5.

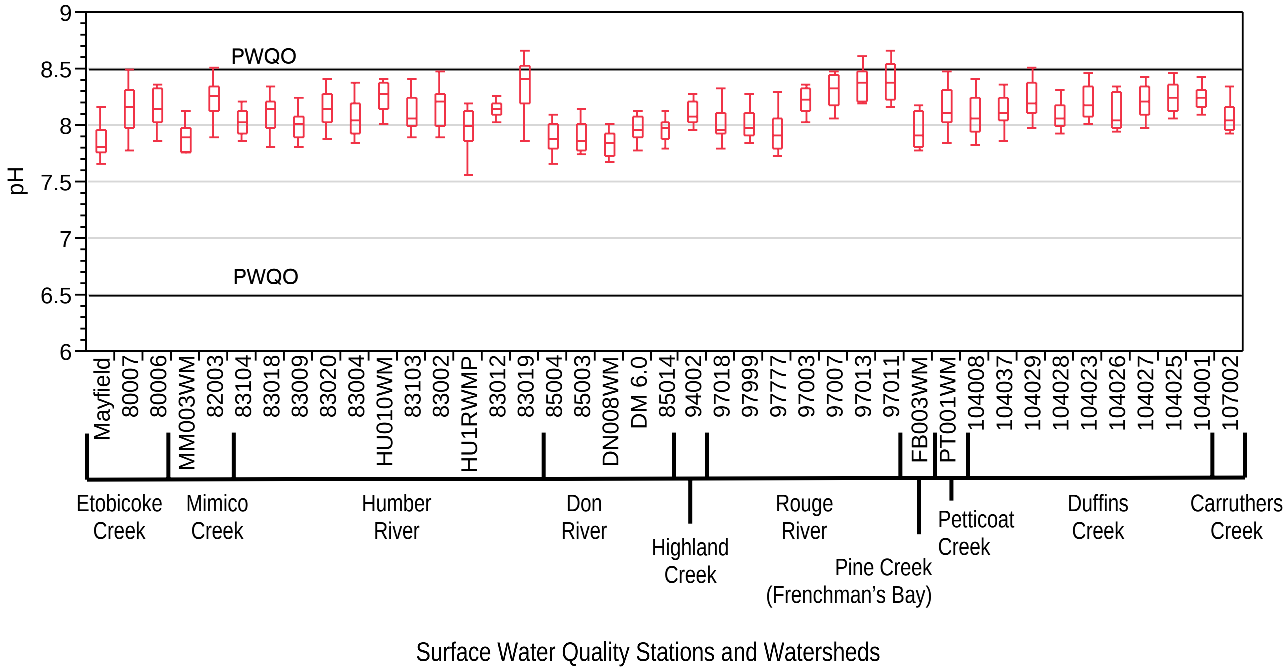

Figure 7. pH values at 41 stations within TRCA jurisdiction (PWQO: 6.5 - 8.5 pH)

3.3 Metals

Metals occur naturally in the environment, but industrial processes and increased runoff in urban areas can dramatically alter their distributions and increase their concentrations. When metals are released into the environment in higher than natural concentrations, they can be toxic, cause disruptions to aquatic ecosystems, and decrease the suitability of a waterbody to support aquatic life and to supply water for domestic uses.

3.3.1 Aluminium

Currently, there are no PWQO, CWQG or CESI guidelines which define the amount of allowable total aluminum for the protection of aquatic life. Over 8% of the earth's crust is comprised of aluminium, so the amount of aluminium in the environment from natural sources exceeds that from anthropogenic sources such as agriculture and industry. Acidic precipitation, poorly buffered soils, and rapid spring snowmelts can increase concentrations of aluminium in streams (Wetzel, 2001). Stations in urbanized areas within all watersheds demonstrated relatively higher levels of aluminium (Figure 8). Station 83103 displayed the highest median aluminium value, and stations 80006, MM003WM, 82003, 83103, and HU1RWMP had the greatest interquartile ranges. These 5 stations are situated in the low Etobicoke Creek, Mimico Creek, and mid Humber River and have elevated aluminium concentrations for some months which make their boxplots stand out from other stations. For example, all of these 5 stations had high aluminium concentrations in January 2012 and the precipitation before and/or during the January sampling may have contributed to the elevated concentrations. In 2011, 4 stations displayed 75th percentiles above 500 μg/L, however in 2012 there were no stations with 75th percentiles above 500 μg/L.

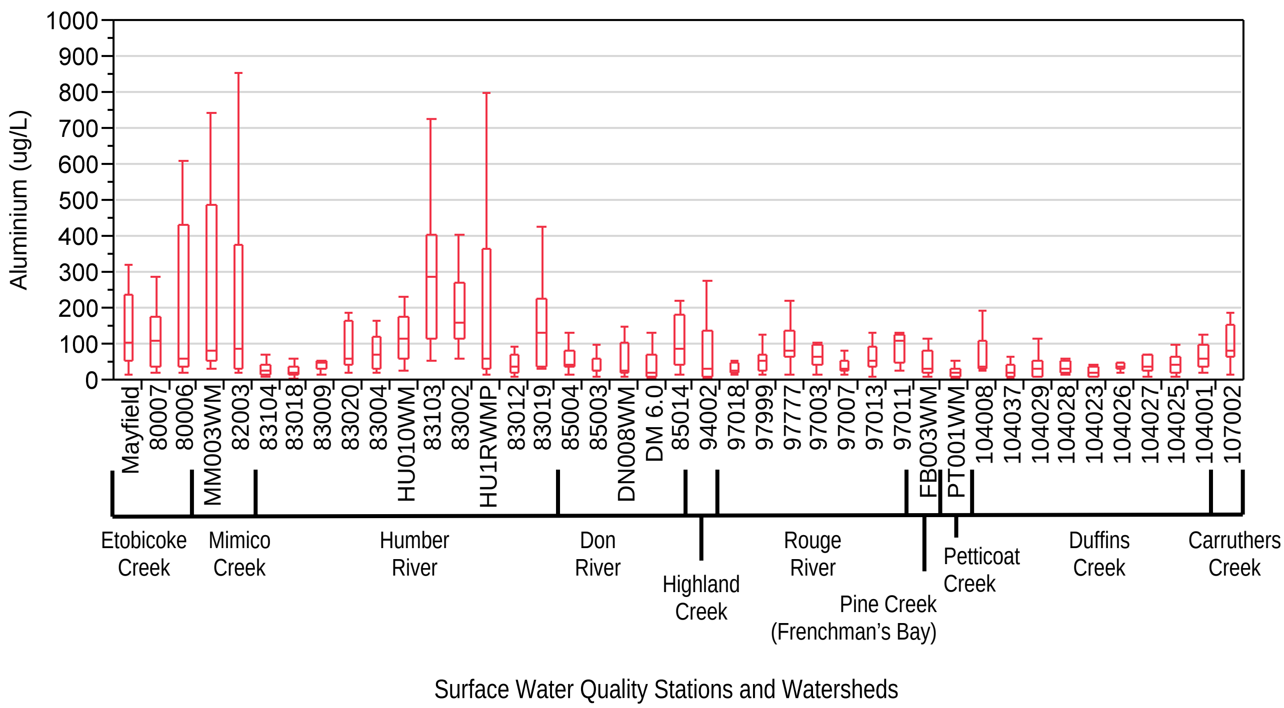

Figure 8. Aluminum concentrations (μg/L) at 41 stations within TRCA jurisdiction

3.3.2 Arsenic

Arsenic is an odourless, tasteless, and toxic metal. The weathering of rocks and soils, and smelting and refining industries are sources of arsenic. Arsenic data presented in this report was based on a 28 station subset of 2012 data since not all stations were analyzed regularly for this parameter by OMOE. Arsenic levels at these stations in 2012 (Figure 9) were well below the PWQO of 5 μg/L. Stations Mayfield, MM003WM, and 83002 displayed the highest median and interquartile range of arsenic values.

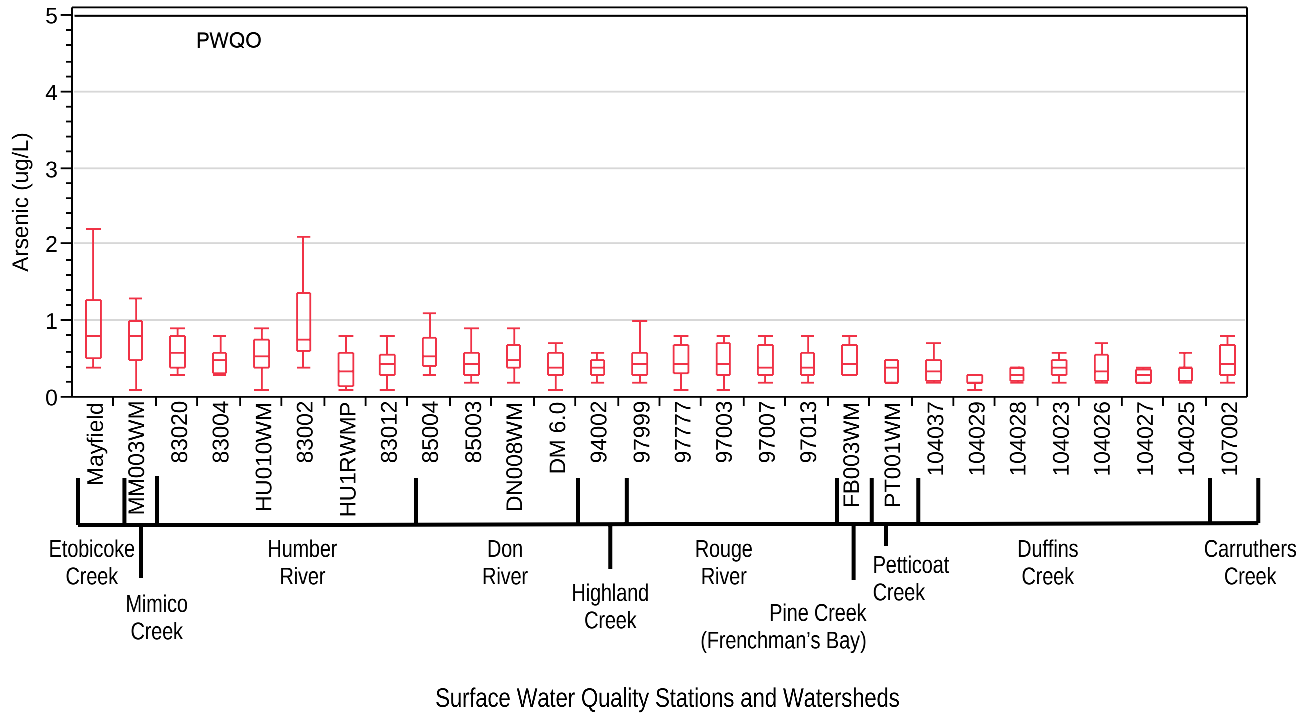

Figure 9. Arsenic concentrations (µg/L) at 28 stations within TRCA jurisdiction (PWQO: 5 µg/L)

3.3.3 Copper

Copper is a trace metal associated with urbanization. Typically, copper binds readily to soil particles (particularly organic matter) and is therefore relatively immobile. Anthropogenic sources of copper include textile manufacturing, paints, electrical conductors, plumbing fixtures and pipes, wood preservatives, pesticides, fungicides and sewage treatment plant effluent (OMOE, 2003).

Copper levels appear to increase towards the urbanized lower watershed areas while stations in relatively less urbanized watersheds (Duffins Creek) or at upstream locations display lower copper values (Figure 10). Stations 80006, 82003, and 85014 displayed the highest median copper values (similar to 2011) and stations 82003 and HU1RWMP displayed the greatest interquartile range. In 2012 only one station, 82003, had a median value above the PWQO of 5 µg/L whereas a total of 5 stations had median values in excess of the PWQO in 2011. In 2012, 5 stations (80006, MM003WM, 82003, HU1RWMP, and 85014) had 75th percentiles above the PWQO whereas in 2011 there were 8 stations.

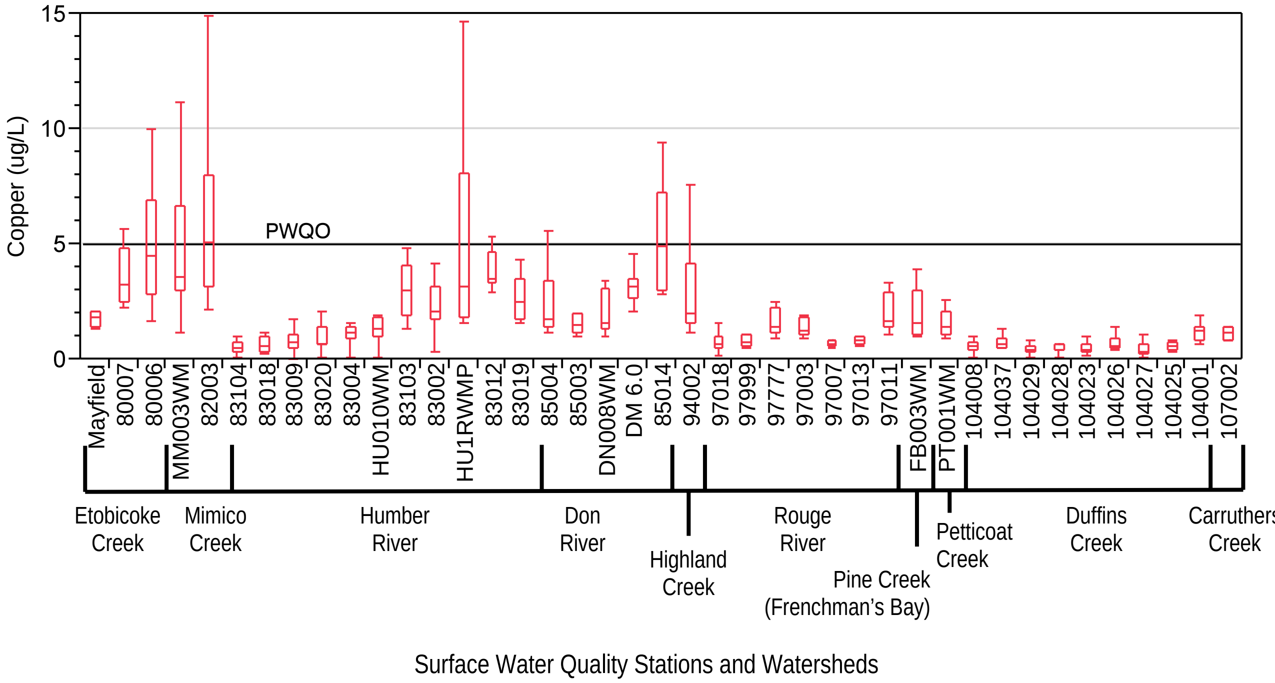

Figure 10. Copper concentrations (µg/L) at 41 stations within TRCA jurisdiction (PWQO: 5 µg/L)

3.3.4 Iron

In 2012, the median iron values of 10 stations exceeded the PWQO of 300 µg/L (Figure 11), compared to 13 stations in 2011. These stations are predominantly located in urbanized areas in the mid-lower Humber River and the Don River, with single stations in Mimico Creek, Rouge River, and Carruthers Creek watersheds. Stations 82003, MM003WM, 83103, and 80006 had the greatest interquartile ranges of iron. Station 80006 is located within two kilometres of an industrial warehouse complex that may be a source of iron contamination in Etobicoke Creek. Stations 80006 and 82003 are situated downstream of the Pearson International Airport in a highly developed area. Urban surface runoff is likely the cause of elevated iron concentrations in the surface water of Etobicoke and Mimico Creek watersheds. Stations 83103, 83002, and HU1RWMP, all in the mid Humber River, also demonstrated wide interquartile ranges in iron values.

Decreased median iron concentrations in 2012 compared to 2011 may have been a result of decreased precipitation in 2012. Precipitation tends to increase runoff which may increase iron concentrations given the fact that iron has an affinity to bind to sediment particles.

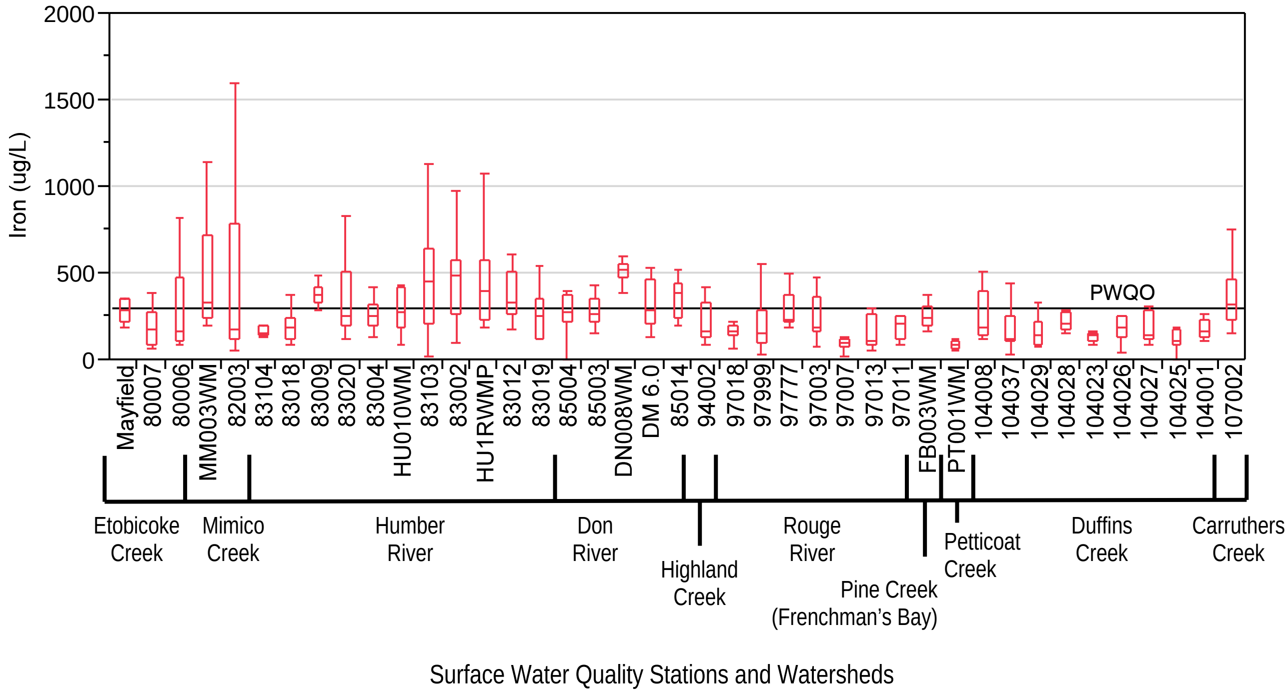

Figure 11. **Iron concentrations (µg/L) at 41 stations within TRCA jurisdiction (PWQO: 300 µg/L)**

3.3.5 Lead

The lead results were based on a subset of 28 stations whose samples were analyzed by the York-Durham Regional Environmental laboratory. OMOE lead results were excluded as the OMOE reporting detection limit (RDL) of 11 µg/L is much higher than the RDL of York-Durham (5 µg/L) and the PWQO of 5 µg/L.

Median lead values for all 28 stations were below the PWQO (Figure 12). Stations MM003WM and 83002 displayed the highest median values and MM003WM and HU1RWMP displayed the greatest interquartile range.

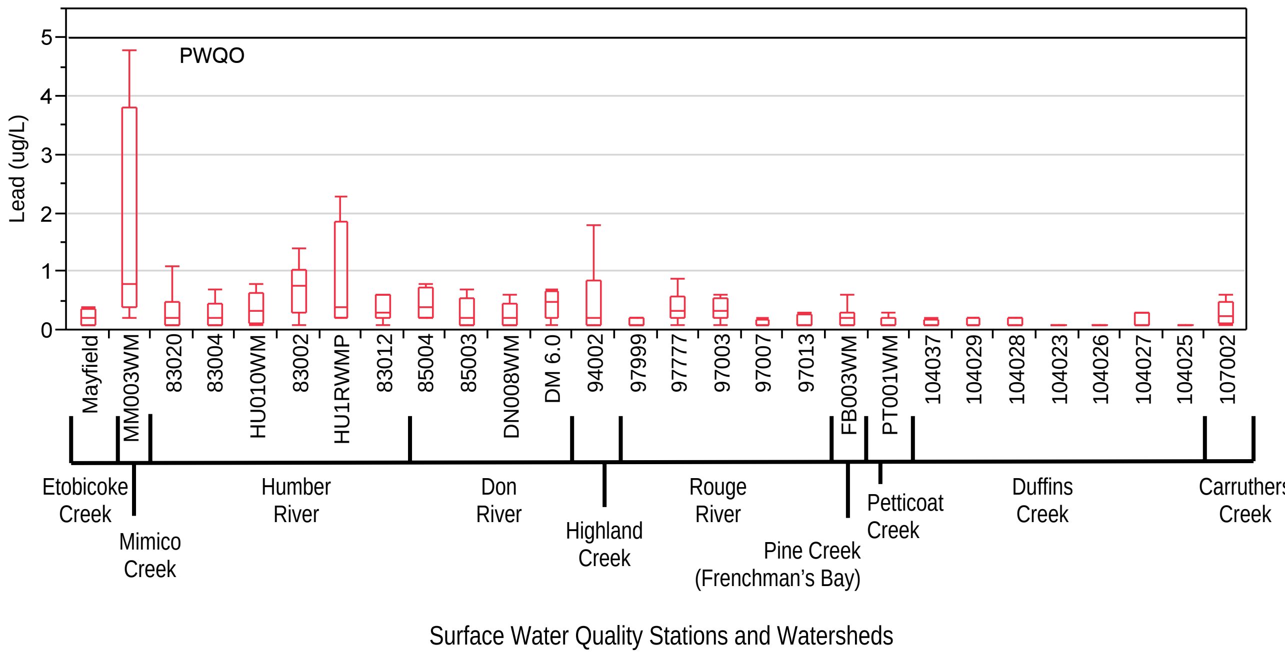

Figure 12. **Lead concentrations (μg/L) at 28 stations within TRCA jurisdiction (PWQO: 5 μg/L)**

3.3.6 Nickel

Nickel results from all stations were well below the PWQO of 25 μg/L (Figure 13). Station 82003 had the greatest range and the highest median nickel value. Stations in lower Etobicoke Creek, Mimico Creek, the mid to low Humber River, and lower Don River displayed slightly higher levels of nickel relative to other stations.

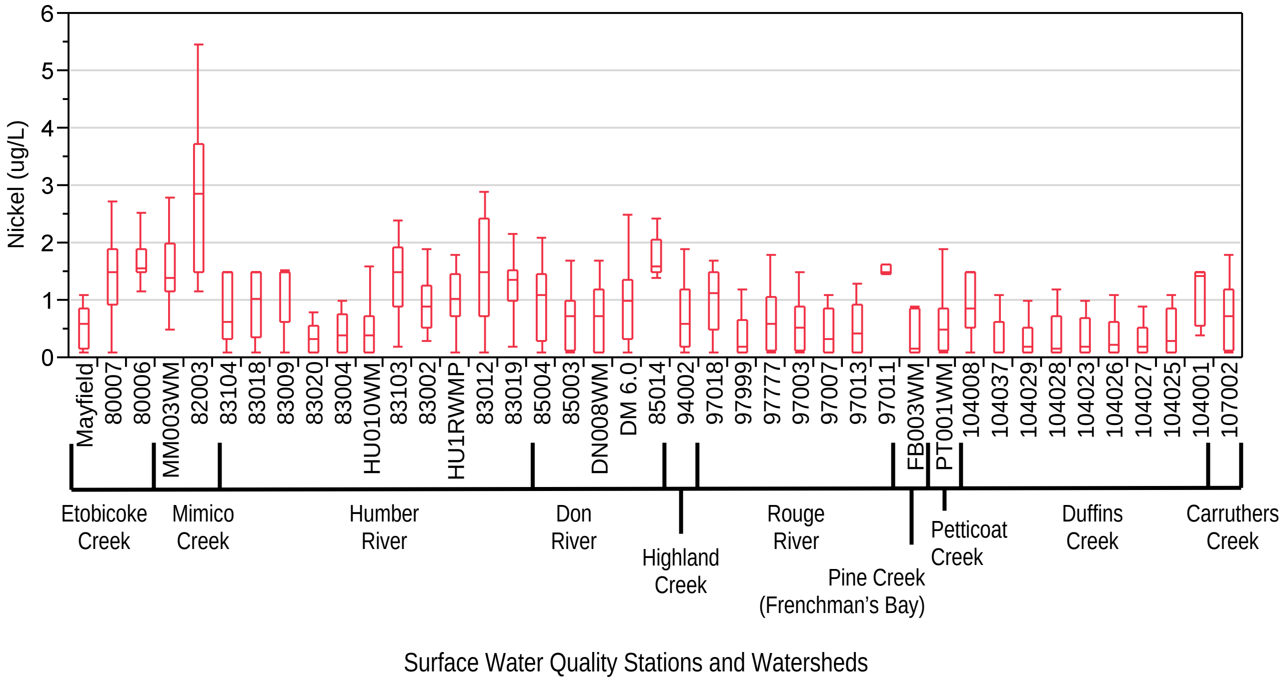

Figure 13. Nickel concentrations (µg/L) at 41 stations within TRCA jurisdiction. The PWQO of 25 µg/L is not displayed

3.3.7 Zinc

The natural process of weathering makes zinc available in ecosystems, and anthropogenic sources include municipal wastewater, wood combustion, iron and steel production and waste incineration (OMOEE, 2003).

In 2012, there were no stations with median zinc values in excess of the PWQO although four stations displayed 75th percentiles above the guideline (Figure 14). In 2011, the median zinc values of two watershed outlet stations (80006 and 82003) in Etobicoke Creek and Mimico Creek exceeded the PWQO, and eight stations had 75th percentiles above the PWQO. Stations MM003WM, 82003, and HU1RWMP displayed the greatest interquartile range of zinc values in 2012. The range of zinc concentrations at stations situated in the mid and low Etobicoke and Mimico watersheds stand out from the other stations, and urban surface runoff is the likely cause. Stations 80006 and 82003 are situated downstream of the Pearson International Airport in a highly urbanized area.

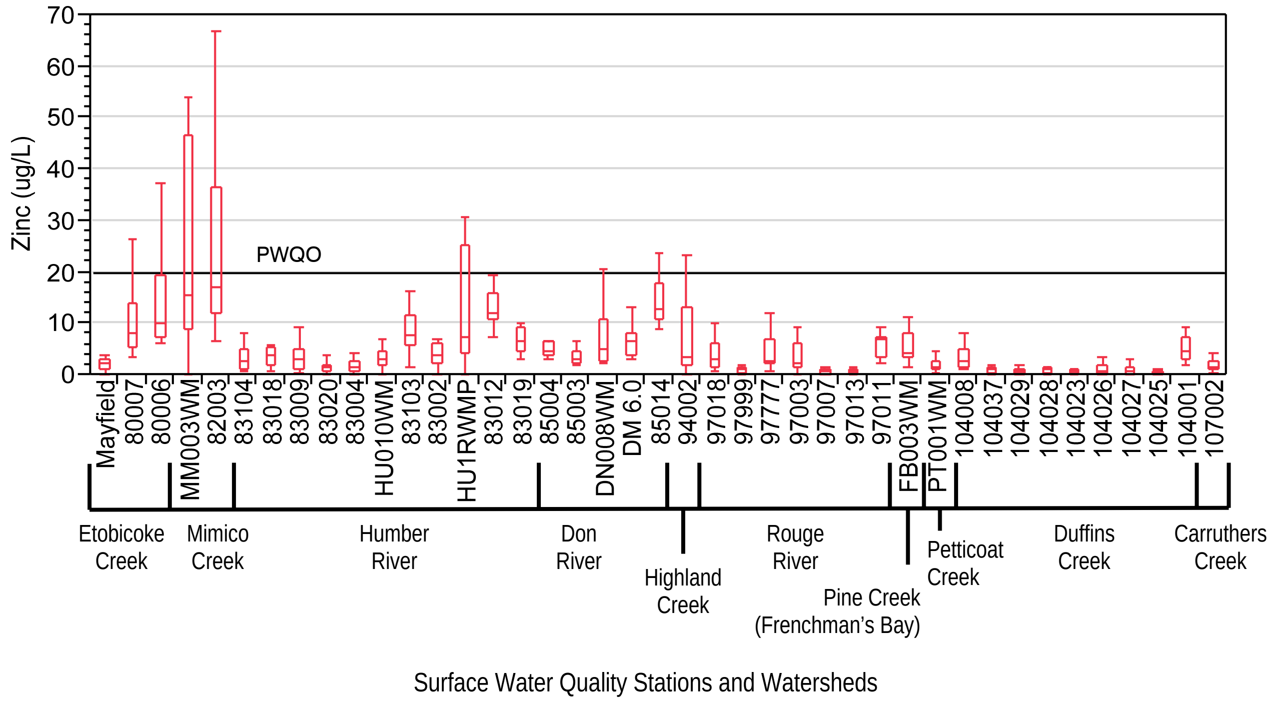

Figure 14. Zinc concentrations (µg/L) at 41 stations within TRCA jurisdiction (PWQO: 20 µg/L)

3.4 Bacteria

Microorganisms such as bacteria are found throughout our environment but elevated levels can impact human health and limit the recreational uses of a waterbody. High *Escherichia coli* (*E. coli*) levels are indications of raw sewage (human and/or animal) loading. *E. coli* levels may increase in urbanized areas due to inadequately designed combined sewer systems, illegal connections between storm and sanitary sewers, and precipitation events that overflow those sewer systems (CCME, 2003).

Median *E. coli* counts equalled or exceeded the PWQO of 100 colony forming units (CFU)/100 mL at 23 of 41 stations in 2012 (Figure 15), compared to 31 stations in 2011. In 2012, 31 stations had 75th percentiles that exceeded the PWQO whereas in 2011 there were 43 stations. There were two stations in 2012 with median values over 1000 CFU/100 mL compared to nine stations in 2011. In 2012 there were no stations with median values over 2000 CFU/100 mL unlike 2011 when there were four stations.

Despite the reduced frequency of extreme *E. coli* values in 2012 compared to 2011, areas of concern still include Etobicoke Creek, Mimico Creek, mid to lower Humber River, the Don River, Highland Creek, station 97777 in the mid Rouge River, and station FB003WM in Pine Creek (Frenchman's Bay). The highest median concentrations were recorded at station 80006 in the low Etobicoke Creek, station 82003 in the low Mimico watershed, stations DM 6.0 and 85014 in the Don River watershed, station 83012 on a tributary of the lower Humber River, and station 94002 in Highland Creek. Those stations also displayed high median values in 2011. Station DM 6.0 is located on a heavily urbanized tributary (Taylor Massey Creek) of the Don River that is serviced by combined sewers. Also, illegal sewage cross connections to stormwater sewers may have contributed elevated levels. Station 85014 is located downstream of DM 6.0 as well as approximately 1.5 km downstream of the North Toronto Wastewater Treatment Plant which may contribute to elevated *E. coli* concentrations in the lower Don River. Station 83012 is located on a highly urbanized tributary in the Humber River watershed that is serviced by combined sewers with large portions of the channel hardened with concrete banks. These conditions appear to result in an influx of contaminants from upstream urban areas, which have little opportunity to be filtered or absorbed due to the lack of riparian zone vegetation as they travel downstream. The elevated *E. coli* median value documented at station 94002 is likely a result of the watershed being completely urbanized.

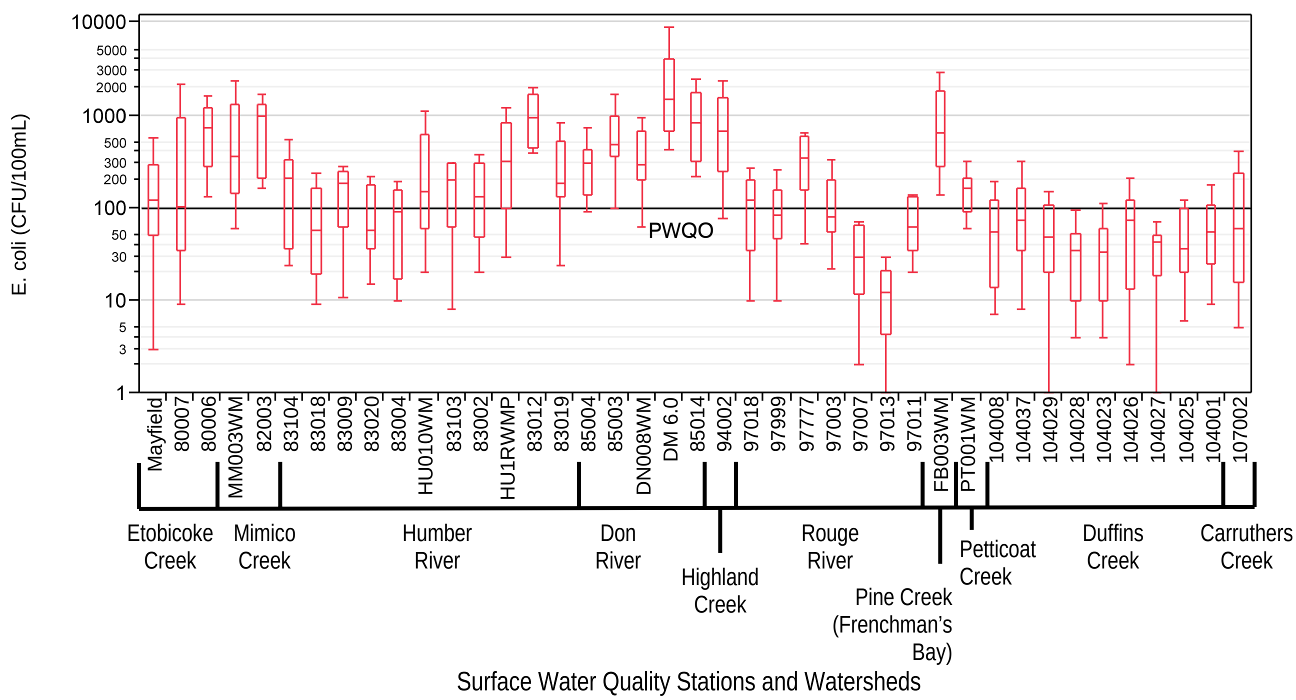

Figure 15. ***Escherichia coli*** **concentrations (CFU/100mL) at 41 stations within TRCA jurisdiction (PWQO: 100 CFU/100 mL)**

3.5 Nutrients

Nitrogen and phosphorus are critical to plant and animal life and their concentrations determine the productivity of aquatic systems. If there is substantial phosphorus loading into aquatic systems, nitrogen becomes the growth limiting nutrient.

Nitrogen occurs in various forms such as nitrate, nitrite, and ammonia. Nitrate is the most common form of nitrogen entering freshwater systems and is assimilated by plants. Upon the decomposition of plant matter, nitrate is converted to ammonia, an energy-efficient source of nitrogen for plants. Bacteria convert ammonia into nitrate, nitrite, and nitrogen. Nitrite is easily converted and rarely accumulates unless organic pollution is high (Wetzel, 2001). Total Kjeldahl nitrogen (TKN) is a quantitative determination of nitrogen and ammonia that is required in the analysis of sewage treatment plant effluent.

Anthropogenic sources of nitrogen and phosphorous such as agricultural fertilizer, animal wastes and municipal sewage that leach into aquatic systems provide unusually high concentrations of these nutrients. This over-nutrition, or eutrophication, of aquatic environments can promote excessive plant and algae growth. Eutrophic lakes can be characterized by algal blooms which reduce recreational use and deplete oxygen levels to the detriment of other biota, especially fish. Excessive growth of aquatic plants in streams can cause dissolved oxygen concentrations to decrease during the night to levels that may not sustain certain aquatic species, as well as reduce the aesthetic appeal of the stream.

3.5.1 Ammonia

Currently, there are no PWQO, CWQG or CESI guidelines which define the amount of allowable total ammonia for the protection of aquatic life. The highest median ammonia value (1030 μg/L) was recorded at station 85014 in the Don River (Figure 16). Ammonia levels at this station can be attributed to combined sewer systems and the proximity of the North Toronto Wastewater Treatment Plant upstream which discharges effluent into the lower Don River. In addition, this portion of the Don River is subjected to illegal cross connections that discharge effluent directly into stormwater sewers and into the Don River.

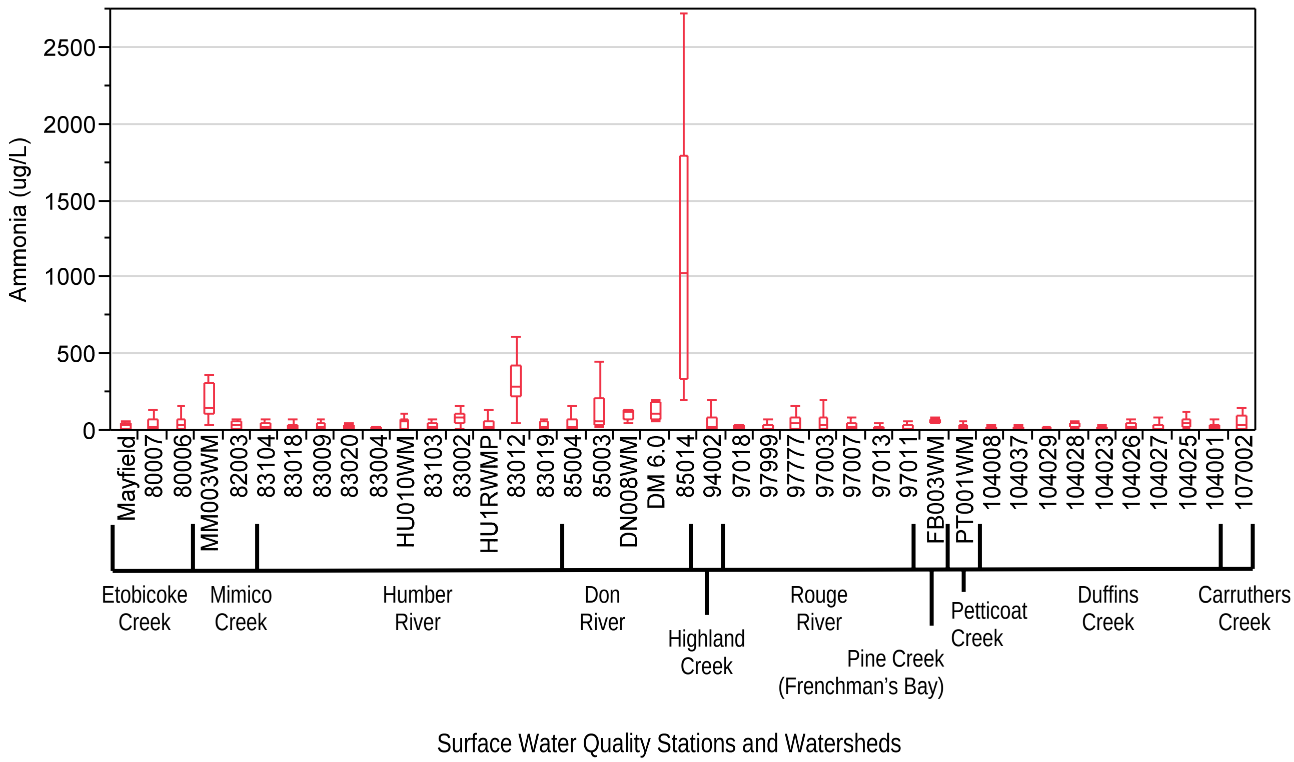

Figure 16. Ammonia concentrations (µg /L) at 41 stations within TRCA jurisdiction

3.5.2 Nitrate, Nitrite, and Total Kjeldahl Nitrogen

There were no stations with median nitrate values above the CESI of 2.93 mg/L (Figure 17). Station DM 6.0 had the highest median value and is situated in a highly urbanized watershed and receives input from combined sewers and illegal cross connections. Stations Mayfield and 80007 displayed the greatest interquartile range: both these stations have substantial agricultural lands in their catchments.

In 2012, stations 83012 and 85014 displayed median nitrite values higher than the CWQG (Figure 18). Stations MM003WM, 83012, DM 6.0, and 85014 displayed the greatest interquartile ranges of nitrite, which was similar to 2011. Generally, nitrite concentrations appeared to increase with urbanization.

TKN median value and interquartile range were highest at station 85014 (Figure 19). Generally, TKN levels increased at stations situated lower in the watershed and in urbanized areas.

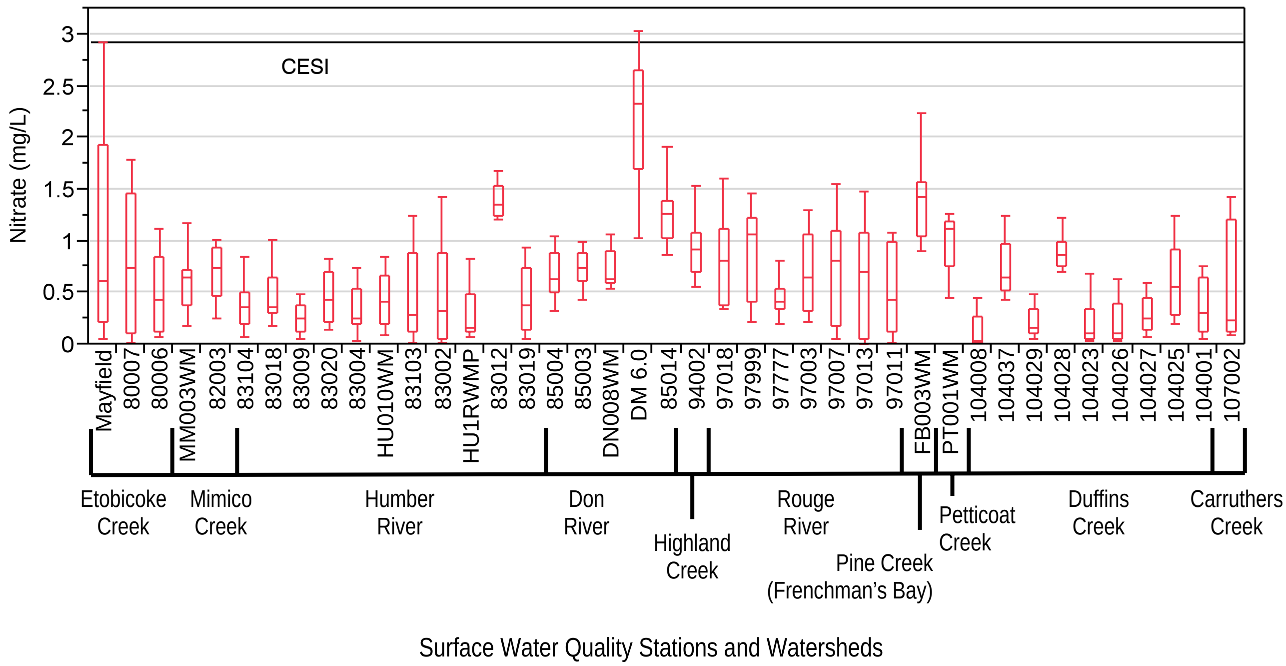

Figure 17. **Nitrate concentrations (mg/L) at 41 stations within TRCA jurisdiction (EC: 2.93 mg/L)**

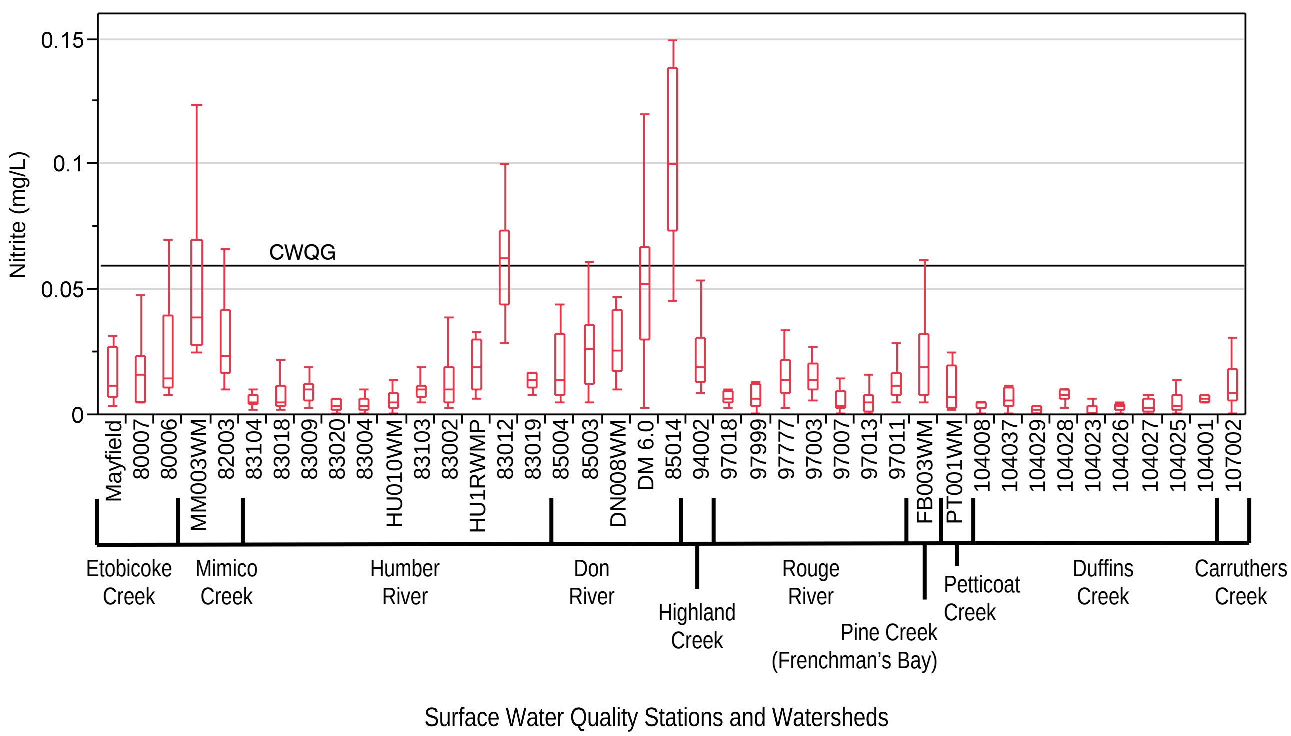

Figure 18. **Nitrite concentrations (mg/L) at 41 stations within TRCA jurisdiction (CWQG: 0.06 mg/L)**

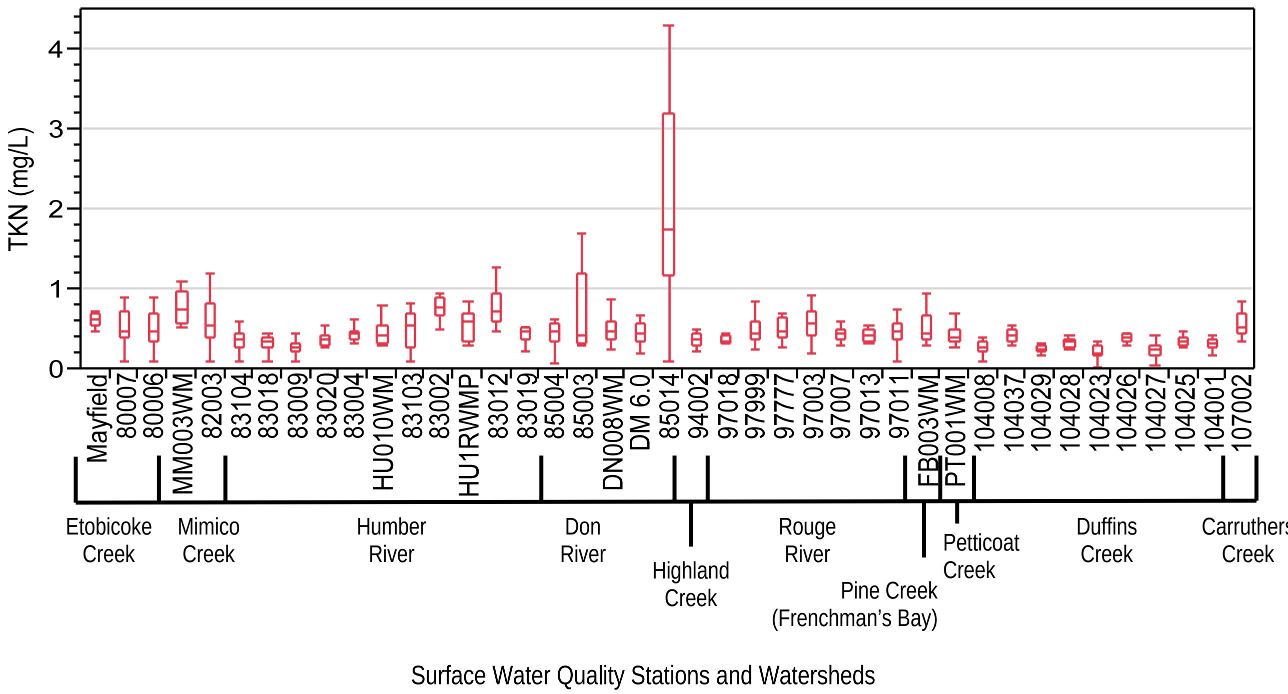

Figure 19. Total Kjeldahl nitrogen (TKN) concentrations (mg/L) at 41 stations within TRCA jurisdiction

3.5.3 Phosphorus

Phosphorus readily binds to sediment particles and increases in phosphorus concentrations are typically associated with storm events and elevated levels of turbidity. Median phosphorus levels exceeded the PWQO of 0.03 mg/L at 15 out of 41 stations in 2012 (Figure 20), compared to 28 stations in 2011. The majority of these stations were located in Mimico Creek, mid to low Humber River, Don River, mid Rouge River and Carruthers Creek. Stations 83002 and 85014 displayed the highest median levels of phosphorus and the stream water at both stations was often characterized as turbid. In 2012, 32 stations had phosphorus 75th percentiles over the PWQO compared to 42 stations in 2011. The lowest phosphorus median values and interquartile ranges were at stations 94002 in Highland Creek, 97007 in mid Rouge River, PT001WM in Petticoat Creek, and 104029, 104023, 104026, 104025 in Duffins Creek. The fewer phosphorus median and 75th percentile values above the PWQO in 2012 compared to 2011 may be a result of the reduced precipitation in 2012.

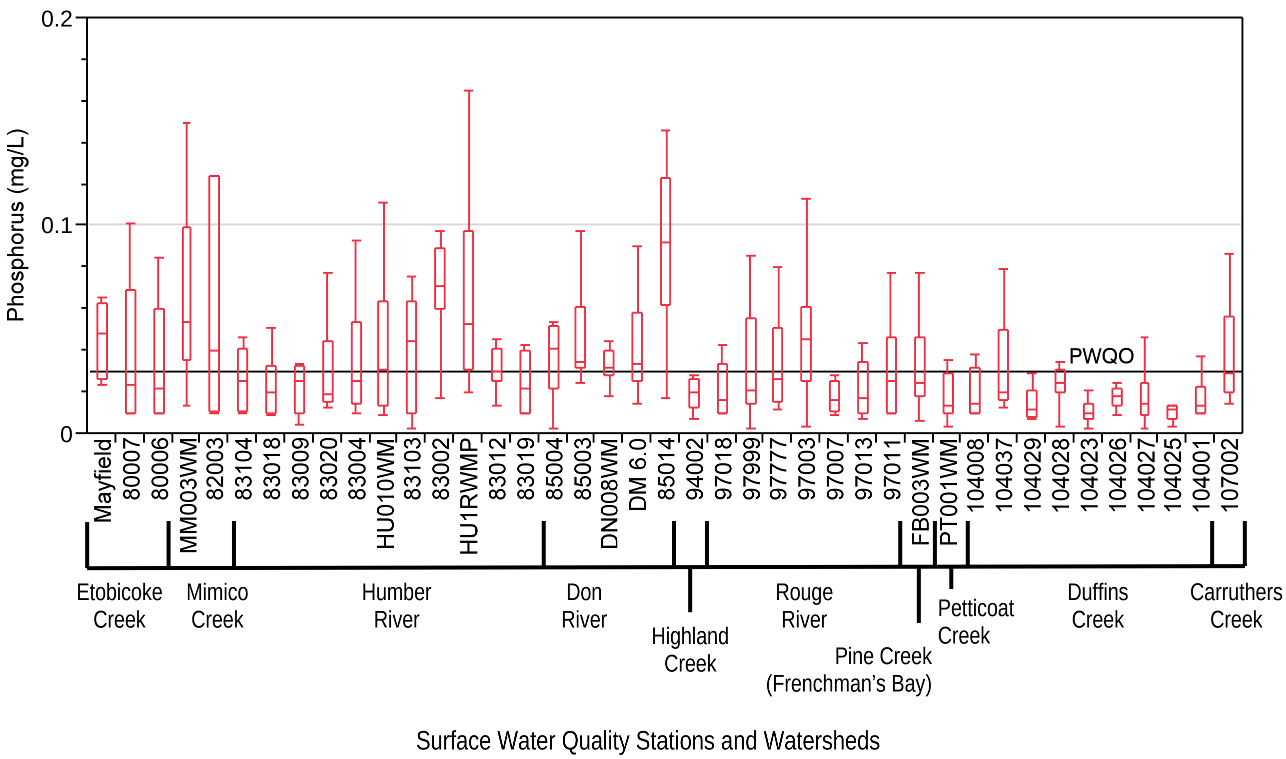

Figure 20. Total phosphorus concentrations (mg/L) at 41 stations within TRCA jurisdiction (PWQO: 0.03 mg/L)

4. Summary

The results in this report represent a limited assessment and characterization of 2012 water quality conditions. Sampling was performed irrespective of precipitation, and it is expected that levels of many of the parameters presented in this report would be higher when mobilized by storm events. The lower precipitation levels in 2012 may have contributed to fewer extreme values of water quality parameters compared to 2011.

Areas of concern in 2012 were the lower portions of Mimico Creek, Humber River, Don River, and Etobicoke Creek. These areas of concern were similar to previous years except that in 2012 the lower Mimico Creek demonstrated the most impaired water quality whereas in 2011 the lower Don River held this dubious distinction. Water quality stations situated in urbanized areas displayed high chloride, conductivity, metals, *E. coli*, and phosphorus concentrations. Less urbanized and/or upper areas of watersheds did not display high chloride or metals concentrations, but still had high *E. coli* and phosphorus levels.

Etobicoke Creek displayed median values of chloride, conductivity, metals and phosphorus that exceeded water quality guidelines or objectives. Mimico Creek had high chloride, conductivity, metals, nitrogen, and phosphorus values, and both Etobicoke and Mimico watersheds had high *E. coli* values.

The mid and lower Humber River exhibited median values of chloride, conductivity, metals and TKN above guidelines, and high *E. coli* and phosphorus concentrations. The mid and lower Don River displayed high *E. coli* and phosphorus values, and chloride, conductivity, metals, and nitrogen median values were above guidelines. Frenchman's Bay and Petticoat Creek watersheds, which are also urbanized but drain much smaller areas, displayed median chloride and conductivity values above guidelines, and high *E. coli* values.

Less urbanized areas displayed less degraded water quality than highly urbanized areas such as the Etobicoke, Mimico, lower Humber, and lower Don watersheds. The upper Humber and Rouge did not display the high chloride or metal concentrations that their lower watershed areas did, however these upper areas had high *E. coli* and phosphorus levels. The upper Don displayed high chloride and conductivity values, presumably due to the higher degree of urbanization and road density compared to the upper Humber or Rouge. The lower Rouge and Carruthers watersheds displayed median chloride, *E. coli*, and phosphorus values above guidelines. Duffins Creek exhibited the least degraded water quality throughout the jurisdiction however at some stations the median *E. coli* and phosphorus values were above guidelines.

The water quality parameters with the most numerous occurrences of high concentrations were *E. coli*, phosphorus, chloride, iron, and TKN. Nitrate, pH, lead, zinc, and TSS had the least frequencies of high concentrations. Factors that contribute to impaired water quality are urbanized areas, road density, agricultural areas, compromised sewage systems, and stormwater runoff. The cumulative influence of these factors degrades water quality at stations situated lower in the watershed.

5. References

Canadian Council of Ministers of the Environment (CCME). 2007. *Summary of Canadian water quality guidelines for the protection of aquatic life*. In: Canadian Environmental Quality Guidelines, 2007, Canadian Council of Ministers of the Environment, Winnipeg.

Canadian Council of Ministers of the Environment (CCME). 2011. *Canadian water quality guidelines for the protection of aquatic life*: Chloride. In: Canadian Environmental Quality Guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

Environment Canada (EC). 2012. Data Sources and Methods: Freshwater Quality Indicator. Canadian Environmental Sustainability Indicators, Sustainability Directorate, Environment Canada, Gatineau, Quebec. April 2012.

Ontario Ministry Environment and Energy (OMOEE). 1994. *Policies Guidelines and Provincial Water Quality Objectives of the Ministry of Environment and Energy*. Queen's Printer for Ontario, Toronto. June 1994.

Ontario Ministry Environment and Energy (OMOEE). 2003. *Water Sampling and Data Analysis Manual for Partners in the Ontario Provincial Water Quality Monitoring Network* (DRAFT). February 2003.

Wetzel, R. 2001. Limnology: Lake and River Ecosystems. Third edition. Academic Press. San Diego

Appendix A

2012 Water Quality Stream Conditions from Field Notes

Station	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
80006	Turbid	Normal	Turbid	Normal	Normal	Normal	Turbid	Normal	Normal	Normal	Normal	Normal
80007	Turbid slightly, frozen	Clear, frozen slightly	Turbid slightly, high slightly	Turbid slightly	Excessive amount of filamentous algae growth	Normal	Turbid slightly	Normal	Normal	High slightly	Normal	Turbid, high
82003	Turbid	Turbid	Turbid	Low water level	Normal	Normal	Turbid, high extremely	Normal	Normal	Normal	Normal	Normal
83002	Turbid slightly, sampled during rain event	Normal	Turbid, high slightly	Turbid slightly	Normal	Normal	Normal	Normal	Turbid slightly	Turbid, high	Normal	Turbid, high
83004	Sampled during rain event	Normal	Turbid slightly	Turbid slightly	Normal	Normal	Turbid slightly	Normal	Normal	Turbid slightly, high slightly	Normal	Turbid slightly, high slightly
83009	Sampled during rain event	Normal	Turbid, high slightly	Turbid slightly, high slightly	Normal	New road storm sewer installed immediately upstream	Normal	Normal	Normal	Turbid slightly	Normal	Turbid slightly
83012	Turbid slightly	Normal	Normal	Normal	Excessive amount of algae growth present	Normal	Turbid, high extremely	Normal	Normal	Normal	Normal	Normal
83018	Sampled during rain event, frozen slightly	Normal	Normal	Turbid, high	Normal	Normal	Normal	Normal	Normal	High slightly	Normal	Normal
83019	Turbid	Turbid slightly	Turbid slightly	Normal	Normal	Normal	Turbid, high extremely	Normal	Normal	High slightly	Normal	Normal

Station	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
83020	Sampled during rain event	Normal	Turbid, high	Turbid slightly, high slightly	Turbid slightly	Turbid unusual	Turbid	Normal	Normal	Turbid, high	Normal	High
83103	Turbid, sampled during rain event	Clear, frozen slightly	Turbid slightly	Turbid	Turbid slightly	Normal	Turbid	Normal	Normal	Turbid, high	Normal	Turbid, high slightly
83104	Sampled during rain event, frozen slightly	Clear, frozen slightly	Normal	Turbid slightly, high slightly	Normal	Normal	Normal	Normal	Normal	High	Normal	Normal
85003	Turbid slightly	Turbid slightly	Normal	Normal	Turbid slightly	Normal	Turbid, high extremely	Normal	Normal	Normal	Normal	Normal
85004	Turbid slightly	Turbid slightly	Normal	Normal	Normal	Normal	Turbid, high extremely	Normal	Normal	Normal	Normal	Normal
85014	Turbid slightly	Water lower than normal	Water level low	Low water level	Normal	Normal	Turbid, high extremely	Normal	Low level	Normal	Low	Normal
94002	Turbid, high slightly	Turbid slightly	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
97003	Turbid, high	Turbid slightly	Turbid	Turbid	Normal	Normal	Normal	Religious offerings	Normal	Turbid slightly, high slightly	Normal	High slightly
97007	Turbid, high	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	High slightly	Normal	High slightly
97011	Turbid, high	Turbid slightly	Normal	Turbid	Normal	Normal	Normal	Normal	Normal		Normal	High slightly
97013	Turbid, high	Turbid slightly	Normal	Normal	Normal	Normal	Normal	Normal	Normal	High slightly	Normal	High slightly
97018	Turbid slightly, high slightly	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
97777	Turbid, high slightly	Normal	Turbid slightly	Turbid slightly	Turbid slightly, low water level	Normal	Normal	Normal	Normal	Normal	Normal	Normal
97999	Turbid, frozen slightly	Clear, frozen slightly	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Turbid slightly
104001	Turbid, high	Turbid slightly	Turbid slightly	Normal	Water level low	Normal	Normal	Normal	Normal	Normal	Normal	Normal
104008	Turbid, high slightly, frozen slightly	Clear, frozen slightly	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal

Station	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
104023	Turbid slightly, frozen slightly	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
104025	Turbid, high	Turbid slightly	Turbid	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
104026	Turbid, high	Turbid slightly	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
104027	Turbid, high	Turbid slightly, water lower than normal	Turbid slightly	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
104028	Turbid slightly, high slightly	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
104029	Turbid, high slightly, frozen slightly	Clear, frozen slightly	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
104037	Frozen	Clear, frozen slightly	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
107002	Turbid, high	Turbid slightly	Normal	Low water level	Normal	Normal	Low water	Normal	Turbid slightly, low	Normal	Normal	High slightly
Bruce's Mill 1	Turbid, high slightly	Normal	Normal	Normal	Normal	Normal	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled
DM 6.0	Normal	Normal	Normal	Normal	Normal	Normal	Turbid, high extremely	Normal	Normal	Normal	Normal	Normal
DN008WM	Turbid slightly	Normal	Normal	Normal	Normal	Normal	Turbid, high extremely	Normal	Normal	Normal	Normal	Normal
FB003WM	Turbid, high slightly	Turbid slightly	Normal	Normal	Normal	Normal	Normal	Normal	Turbid slightly, high: beaver dam	Very high, flooded due to beaver interference	Extremely flooded due to beaver activity	Turbid, extremely high due to beaver activity
Glen Haffy 1	Sampled during rain event, frozen	Clear, frozen slightly	Normal	Turbid, high	Clear, high, more flow than normal	Normal	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled

Station	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Heart Lake 1	Turbid, sampled during rain event	Dry	Dry	Dry Channel	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled	Not sampled
HU010WM	Turbid, high slightly, sampled during rain event	Normal	Turbid slightly, high slightly	Turbid, high	Normal	Turbid slightly	Turbid slightly	Normal	Normal	Turbid, high	Normal	Turbid slightly, high
HU1RWMP	Turbid, high, sampled during rain event	Normal	Turbid slightly	Turbid, high	Normal	Normal	Normal	Normal	Normal	High slightly	Normal	Turbid, high
Mayfield	Sampled during rain event, frozen slightly	Clear, frozen slightly	Very turbid, high slightly	Turbid, high	Normal	Normal	Normal	Normal	Normal	Turbid slightly, high	Normal	Turbid, high
MM003WM	Turbid, high, sampled during rain event	Normal	Normal	Turbid, high	Normal	Normal	Normal	Normal	Normal	High slightly	Normal	Turbid, high
PT001WM	Turbid, high	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	High slightly	Normal	High slightly

Appendix B

Stations Sampled in 2012 during Precipitation Events.

Samples were considered collected during precipitation events if field notes indicated precipitation at the time of sampling, and/or the Environment Canada meteorological station at Pearson International Airport indicated precipitation the day before or the day of sampling. "P" indicates samples collected during precipitation events and "NS" indicates stations or months not sampled.

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Precipitation Samples	No Precipitation Samples
06008000602	P	P		P			P			P		P	6	6
06008000702				P			P			P			3	9
06008200302	P	P		P			P			P		P	6	6
06008300202	P	P		P			P			P		P	6	6
06008300402	P	P		P			P			P		P	6	6
06008300902				P			P			P			3	9
06008301202	P	P		P			P			P		P	6	6
06008301802				P			P			P			3	9
06008301902	P	P		P			P			P		P	6	6
06008302002	P	P		P			P			P		P	6	6
06008310302	P	P		P			P			P		P	6	6
06008310402				P			P			P			3	9
06008500302				P			P			P			3	9
06008500402				P			P			P			3	9
06008501402	P	P		P		P	P					P	6	6
06009400202	P	P		P		P	P		P			P	7	5
06009700302	P	P		P		P	P		P			P	7	5
06009700702	P	P		P		P	P		P			P	7	5
06009701102	P	P		P		P	P		P			P	7	5
06009701302	P	P		P		P	P		P			P	7	5
06009701802	P	P		P		P	P		P			P	7	5
06010400102	P	P		P		P	P		P			P	7	5
06010400802	P	P		P		P	P		P			P	7	5
06010402302	P	P		P		P	P		P			P	7	5
06010402502	P	P		P		P	P		P			P	7	5
06010402602	P	P		P		P	P		P			P	7	5
06010402702	P	P		P		P	P		P			P	7	5
06010402802	P	P		P		P	P		P			P	7	5
06010402902	P	P		P		P	P		P			P	7	5
06010403702	P	P		P		P	P		P			P	7	5

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Precipitation Samples	No Precipitation Samples
06010700202	P	P		P		P	P		P			P	7	5
97777	P	P		P		P	P		P			P	7	5
97999	P	P		P		P	P		P			P	7	5
Bruce's Mill 1	P	P		P		P	NS	NS	NS	NS	NS	NS	4	2
DM 6.0				P			P			P			3	3
DN008WM				P			P			P			3	9
FB003WM	P	P		P		P	P		P			P	7	5
Glen Haffy 1	P	P		P			NS	NS	NS	NS	NS	NS	3	3
Heart Lake 1	P	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1	0
HU010WM	P	P		P			P			P		P	6	6
HU1RWMP	P	P		P			P			P		P	6	6
Mayfield	P	P		P			P			P		P	6	6
MM003WM	P	P		P			P			P		P	6	6
PT001WM	P	P		P		P	P		P			P	7	5
											Total:		252	249