



Don River Watershed Plan

Surface Water Quality – Report on Current Conditions

2009

Prepared by: Toronto and Region Conservation

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1.0 Introduction

The Toronto and Region Conservation Authority (TRCA), in consultation with the multi-stakeholder Don watershed Regeneration Council and watershed municipalities, is developing a watershed plan for the Don River. This watershed planning process has been initiated in response to a number of recent policy and planning developments, including the need to fulfill York Region's watershed planning requirements under the *Oak Ridges Moraine Conservation Plan* (ORMCP, Ontario Regulation 140/02) and to update the original management strategy outlined in *Forty Steps to a New Don* (Metropolitan Toronto and Region Conservation Authority [MTRCA], 1994).

The goal of the watershed planning study is to recommend updated management strategies that will guide land and water use decisions, such that the overall ecological health of the Don River watershed is protected and improved. The aim is to build on the *Forty Steps'* principles to protect what is healthy, regenerate what is degraded, and take responsibility for the Don. Recognizing the significant watershed planning work that has already been completed, and given that there are limited undeveloped lands remaining on the ORM within the watershed boundary, the watershed plan will focus mainly on filling information gaps, guiding land use planning and approval decisions, and providing direction to advance implementation of regeneration priorities.

This report has been prepared as part of the scoping and characterization phase of the watershed planning process, in which current watershed conditions are presented in the form of technical reports covering a range of subject areas, including groundwater quality and quantity, surface water quantity, low flows and water use, surface water quality, fluvial geomorphology, aquatic systems, terrestrial systems, nature-based experiences, cultural heritage, land and resource use and air quality.

The purpose of this document is to report on current watershed conditions of surface water quality. This report presents indicators, measures and targets for evaluating surface water quality conditions, as per sections 24 and 25 of the ORMCP. Section 2.0 provides information on factors influencing water quality, including stormwater management, and land uses and practices. Section 3.0 describes the data sources and methods used to evaluate current conditions. Sections 4.0 and 5.0 present water quality conditions and trends with respect to body contact recreation, conventional contaminants, organic compounds and metals. Section 6.0 presents conclusions and management considerations.

2.0 Understanding Surface Water Quality

Many of the natural features, such as forests and wetlands, that helped regulate flows and filter contaminants during storm events, have been lost as lands were converted first to agriculture and later to urban uses. As a consequence, flows are more 'flashy', streams are more polluted and channels are less stable than they once were. Stormwater practices help to mitigate these effects by reducing peak flows, infiltrating runoff and removing contaminants from urban runoff, but these practices are largely absent in approximately 80% of the urban part of the watershed (see Section 2.1.1 below). For more information on stormwater management in the Don, see the *Surface Water Hydrology/Hydraulics and Stormwater Management – Report on Current Conditions* (TRCA, 2009a).

During dry weather, flow in the river and its tributaries is comprised mainly of relatively clean groundwater inputs. Contaminants enter dry weather flows mostly from chemical and physical resuspension of polluted stream bed and bank sediments deposited during previous wet weather events. Dry weather storm sewer discharges, sewage treatment plant effluent and leachate from abandoned or closed landfills contribute to poor dry weather water quality in the southern portion of the watershed. As water travels downstream and is exposed to the sun, it becomes warmer, even though groundwater continues to seep into the river along its entire length.

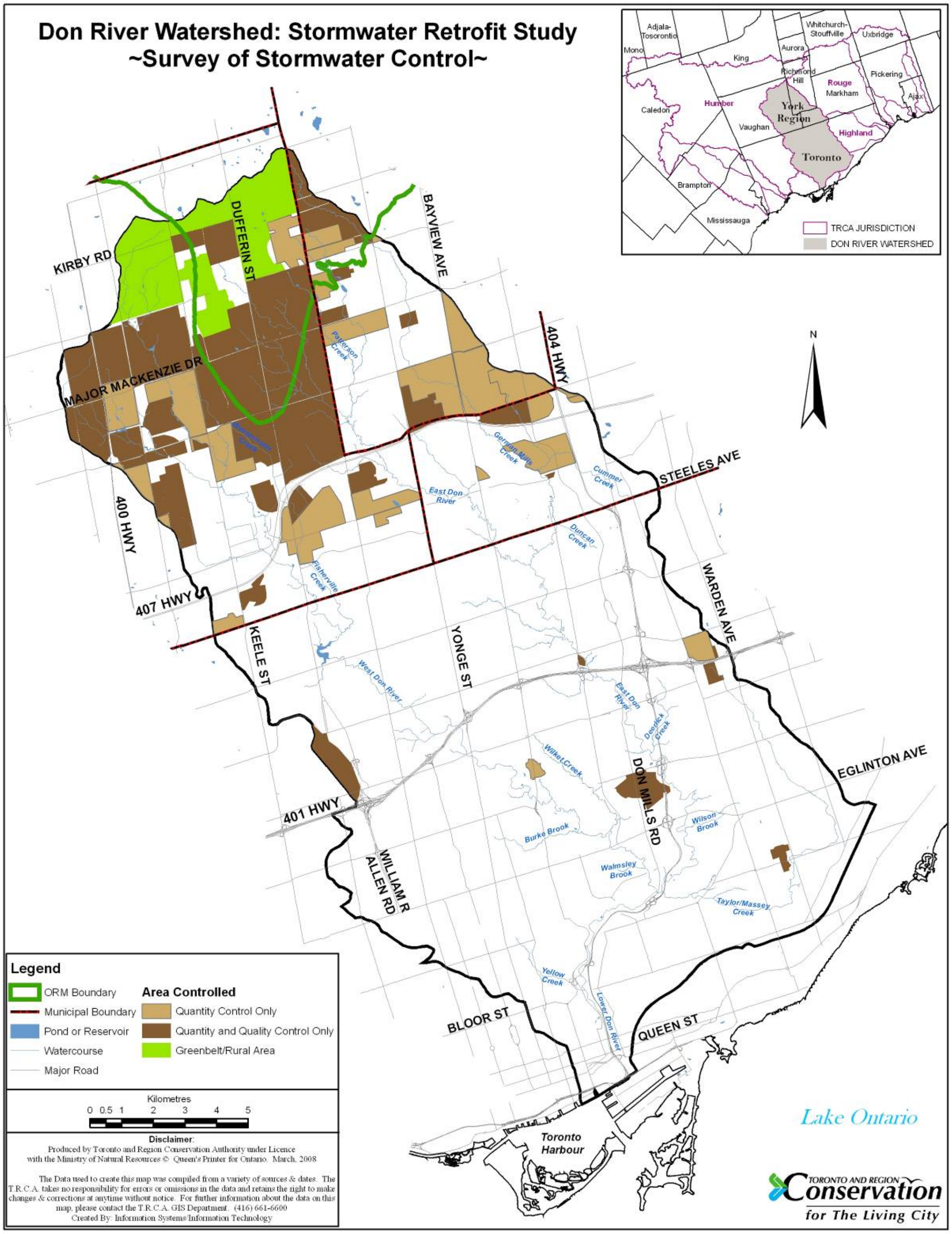
The major groundwater discharge areas in the Don River watershed occur on the south slope of the Oak Ridges Moraine (north of Rutherford Road) where discharge is primarily from the Oak Ridges Moraine Aquifer Complex, and along and south of the glacial Lake Iroquois shoreline where three aquifer complexes discharge to rivers and their associated valleys (springs) (approximately at Eglinton Avenue). Rates of groundwater discharge have probably decreased over time as rainwater that, prior to urbanization, would have infiltrated is now discharged through sewers into the river. Unfortunately, long term flow records (i.e., 75 to 100 years) are not available to quantify the magnitude of changes in baseflow associated with urbanization. More information on geology, groundwater and baseflow is available in separate technical background reports (TRCA, 2009b; 2009c).

In older developed areas, groundwater seeps into sewers through cracks and joints, and eventually finds its way into the river. These dry weather sewer flows are usually relatively clean unless the groundwater mixes with other discharges from, for example, illegal sanitary connections to the storm sewer. The City of Toronto (2005) estimates that approximately 15% of outfalls in older parts of the City have contaminated flows during dry weather.

2.1 Stormwater Management

Since most of the watershed is urbanized, management of wet weather flows through application of stormwater management practices is the single most important means of preventing flooding, improving water quality and minimizing degradation of aquatic habitat. Unfortunately, only 13% of the urbanized portion of the watershed has stormwater quantity and quality controls, almost all of which are in the northern part of the watershed (Figure 1). These controls typically consist of stormwater management ponds or wetlands. Not all of these provide for erosion control to current TRCA criteria.

Figure 1: Stormwater management areas in the Don River watershed.



The City of Toronto developed a Wet Weather Flow Management Master Plan in 2003 to help improve control of stormwater in its jurisdiction and avoid associated problems, such as basement flooding. The ambitious plan, which is now being implemented, proposes several new stormwater controls and extensive retrofits of older facilities in the City over the next 100 years. It is the first comprehensive wet weather flow plan in Ontario to adopt a treatment train approach that emphasizes source control measures first, followed by conveyance and end-of-pipe controls (City of Toronto, 2003a). In the Don watershed, the 25 year plan includes 108,000 downspout disconnections, 27,000 rain barrels, 120 km of exfiltration systems under public roads, 43 stormwater management facilities and 18 km of streams to be restored (City of Toronto, 2003b). The City of Toronto is developing an environmental assessment study which proposes to twin the Coxwell sanitary trunk sewer and further define the system of underground storage facilities needed to contain stormwater outflow until it can be properly treated. Toronto also is monitoring combined sewer outfall water quality in Taylor/Massey Creek. Richmond Hill, Vaughan and Markham also have detailed plans for retrofitting older facilities in their jurisdictions. Some of these retrofits have already taken place.

2.2 Sanitary Servicing

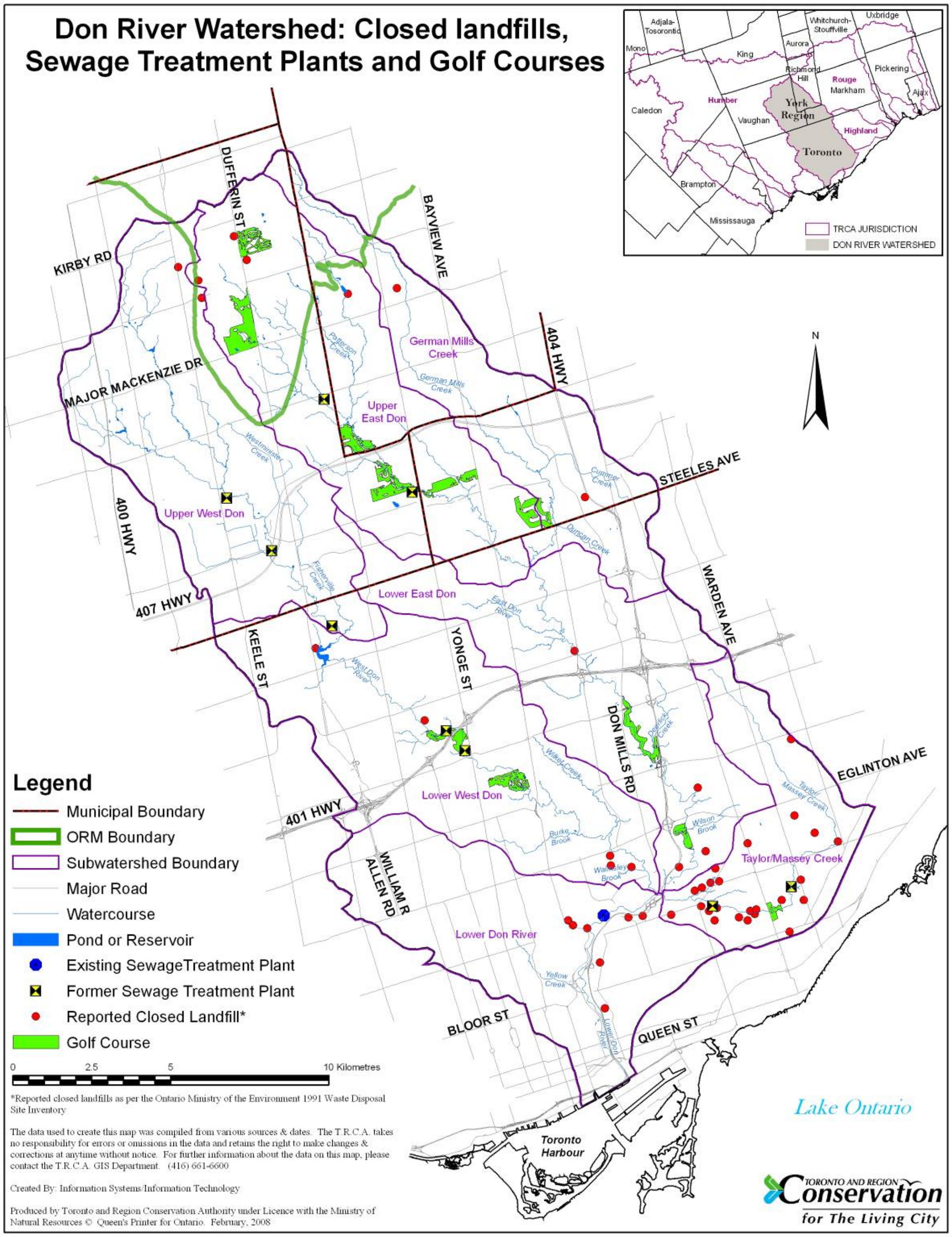
Currently, there is one sewage treatment plant (the North Toronto plant) in the Don watershed, which discharges to the Lower Don River upstream of Pottery Road. This plant is the last of 10 plants that existed historically in the watershed (Figure 2). The other plants, distributed across all of the major subwatersheds of the Don, were decommissioned by the province and municipalities in an effort to improve water quality in the river.

Only a relatively small number of residents in the northern portions of the Don watershed rely on septic systems to meet their wastewater disposal needs. Due to the relatively small area serviced, effluent from these systems is not considered to have any detectable influence on water quality in the river.

2.3 Spills

The effect of spills on aquatic life or water quality has not been well documented. Impacts will vary depending on the spill duration, the type of spill, the amount, rate and time of release, the sensitivity of the receptor and other spill characteristics. Many of the substances spilled into the environment accumulate in stream sediments, which reduce the quality of habitat for benthic invertebrates and other bottom feeding organisms. Oil clings to vegetation and grasses on the banks of rivers, posing a threat to animals that feed on these plants. In freshwater systems, petroleum contamination adversely affects all trophic levels of the food web, causing severe disruption to the complex and dynamic equilibrium of the aquatic ecosystem (Li and McAteer, 2000).

Figure 2: Location of reported closed landfills, former and existing sewage treatment plants, and golf courses in the Don River watershed.



Ministry of the Environment data on reported spills were recently summarized for the City of Vaughan, the City of Toronto, the Town of Markham and the Town of Richmond Hill (Li, 2002a, 2002b, 2002c), as well as for the 905 area more generally (Li, 2002d). These studies reported that between 1988 and 2000, there were approximately 2475 oil spills and 1584 chemical spills in the 905 region, of which roughly half drained into nearby rivers including the Don River or one of its tributaries. The majority of oil spills occurred on major roads and parking lots, whereas chemical spills were mostly associated with commercial plants, storage facilities, pipelines, hydro facilities and tanker trucks. In terms of volume, the chemical, transportation and general manufacturing sectors contributed the most to chemical spills, often as a result of container or fuel tank leaks.

2.4 Former Landfill Properties

Currently, there are no active landfills in the Don River watershed. However, there are roughly 47 reported former landfill sites (closed or abandoned), 35 of which are located in valleys adjacent to the river (Figure 2) (OMOE, 1991). Among the reported closed landfills, there are approximately 9 located in the East Don (excluding Taylor/Massey Creek), 7 in the West Don, 24 in Taylor/Massey Creek and 7 in the Lower Don. Table 3 identifies the numbers of reported closed landfills within the stream corridor in these subwatersheds. Except for the more recent Keele Valley landfill, all of these landfills were active prior to the establishment of Ministry of the Environment regulations on the design of landfills to protect surface and groundwater resources. Hence, liners or leachate collection systems were not installed. Although data on leachate quality were not available, it can be assumed that if water is seeping into the stream from this source, it would likely have high levels of chloride, metals and an array of synthetic chemicals and organic compounds, some of which may have been subject to later bans (e.g., PCBs, DDT).

2.5 Golf Courses

Twelve golf courses cover approximately 502 hectares of land in the Don River watershed (Figure 2). This land use activity can be a source of pesticides and nutrients if appropriate best management practices are not applied. Aware of the growing public concern over water and chemical use, many golf course managers have taken proactive measures to retrofit courses to meet industry environmental standards (Webb, 2002). One study of a golf course in the Humber river watershed reported that the frequency of pesticide detection was lower at golf course sampling locations than observed at other locations in the watershed (Struger, 2007).

Water use can be a serious concern if the golf course is relying on the river as its source of irrigation water. Golf course turf requires significant water inputs that are often drawn out of the adjacent watercourse. On small tributaries in particular, these water takings can pose significant threats to stream health. Loss of vegetation and other alterations to the natural landscape may also be significant depending on golf course design and the pre-existing land use.

2.6 Construction Activity

Construction activities have been identified as a significant source of sediment to urban streams (GLAB, 2000; Caltrans, 2002). Loss of topsoil from exposed areas in construction sites is often several times greater than from forest or agricultural areas (*e.g.* Wark and Keller, 1963). Since 2000, the Upper East and Upper West Don subwatersheds have been undergoing intensive development. Many of these areas have since been developed and erosion is declining as exposed soils are revegetated. In 2005, the construction activity shifted to the Upper East Don and several large tracts of land have been stripped. Figure 3 shows the areas that were designated for development in 2002.

3.0 Data Sources and Methods

Surface water quality contaminants are typically grouped according to their management implications into bacteria, nutrients (nitrogen and phosphorus compounds), metals, conventional pollutants (*e.g.*, suspended solids, chloride) and organic compounds. Elevated levels of bacteria can impact human health through body contact recreation, particularly in swimming areas. Conventional pollutants and nutrients are assessed with regard to the protection of aquatic life and other issues such as aesthetics. The environmental effects and sources of key conventional water quality and bacterial pollutants are presented in Table 1.

Heavy metals and organic pollutants are detrimental to aquatic life, but also affect human health through consumption of sport fish and bio-accumulation in the food chain. Synthetic organic chemicals, such as are found in pesticides and pharmaceutical products, can also find their way into the environment through, for example, septic and sewage treatment plant effluent. They can even enter our drinking water, if they are not among the suite of chemicals tested and targeted for removal in drinking water treatment plants. Some studies suggest that these contaminants may have effects on endocrine disruption and hormone levels in animals and humans. Metals and organic pollutants are discussed as a separate category in this report because they can have adverse effects even at very low concentrations in surface waters.

The locations of current and historical monitoring stations for water quality and toxins in fish tissue are shown in Figure 4. Table 2 lists the sources of data used in this assessment. The majority of water quality data characterizing current conditions in the Don River watershed were collected under TRCA's Regional Watershed Monitoring Network ambient water sampling program (2002 to 2005) and the Ontario Ministry of the Environment's (OMOE) tributary toxics dry/wet weather sampling program (1991/92, 1997/8, 2003 to 2004). The OMOE program focuses primarily on organic compounds identified as priority pollutants under the Canada-Ontario Agreement. Samples are collected during wet and dry weather.

Additional wet weather data were collected in 2005 by the TRCA on the East and West Don, north of Steeles. Historical trends in water quality are based on sampling data collected since the early 1980s by the OMOE at the Pottery Road station on the Lower Don.

Figure 3: Location of urban (built-up), urbanizing (designated greenfield) and rural (agricultural and greenbelt) areas.

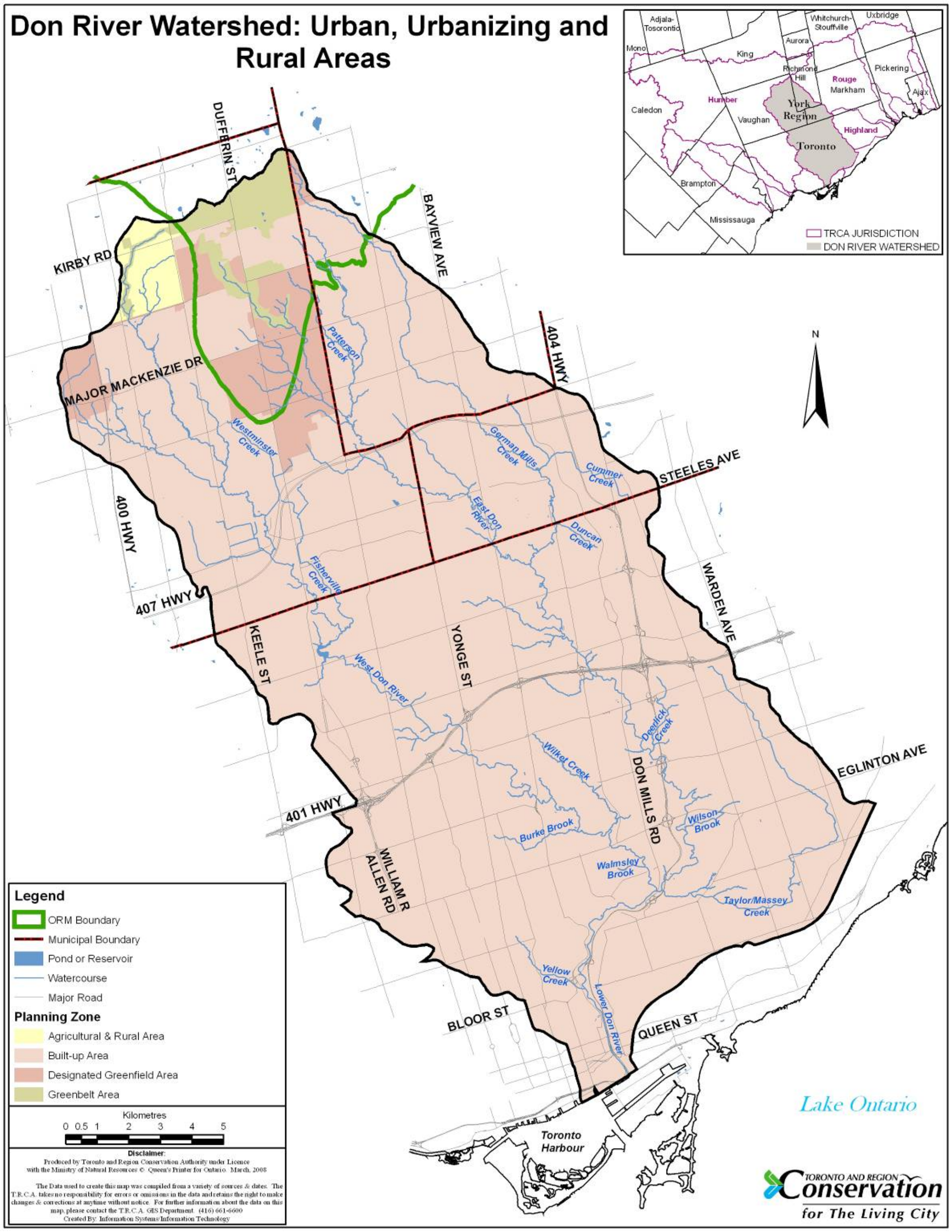


Table 1: The environmental effects and sources for key water quality variables.

Variable	Effect	Source
Total Suspended Solids (TSS)	Elevated concentrations reduce water clarity, which can inhibit the ability of aquatic organisms to find food. Suspended particles may also cause abrasion on fish gills. As solids settle, coarse rock and gravel spawning and nursing areas become coated with fine particles, limiting the ecological function of these important areas. Many pollutants are readily adsorbed by suspended solids, and may become available to benthic fauna when deposited. Buildup of sediments influences the frequency of method of dredging activities in harbours and reservoirs.	TSS originates from areas of soil disturbance, including construction sites and farm fields, lawns, gardens, eroding stream channels, and grit accumulated on roads.
Phosphorus	Phosphorus is essential to the growth and survival of organisms. However, oversupply of this nutrient promotes eutrophication of surface waters by stimulating nuisance algal and aquatic plant growth, which deplete oxygen levels as they decompose resulting in adverse impacts to aquatic fauna and restrictions on recreational use of waterways.	Sources include lawn and garden fertilizers, eroded soil particles, sanitary sewage, animal wastes and decaying plant material.
Nitrate	Excessive nitrate (NO3-N) can encourage nuisance algae growth and lead to eutrophication in aquatic environments (and the degradation of aesthetics). Nitrate has also been shown to have chronic toxic effects in amphibian species at relatively low concentrations.	Nitrate originates from agricultural and residential application of fertilizer, animal wastes, sewage and decaying plant material.
Un-ionized Ammonia	Un-ionized ammonia is a form of nitrogen that is toxic to aquatic life at low concentrations. It is influenced by temperature and pH.	Ammonia is a natural constituent of human and animal sewage, and also forms from the microbial decomposition of organic tissue.
Chloride	Chloride levels influence the quality of irrigation water, and the aesthetics and taste of drinking water. Elevated levels may also harm aquatic life. Background concentrations in natural surface waters are typically below 10 mg/L.	The largest source of chloride is from road salt applications during the winter months.
E. coli	The presence of *Escherichia coli* in surface water is indicative of loadings of faecal matter of either animal or human origin. Elevated levels can result in restrictions on the recreational use of water bodies.	Bacterial sources include illegal sewer connections and inputs from wildlife and domestic animals.

Figure 4: Water quality and fish tissue monitoring stations in the Don River watershed.

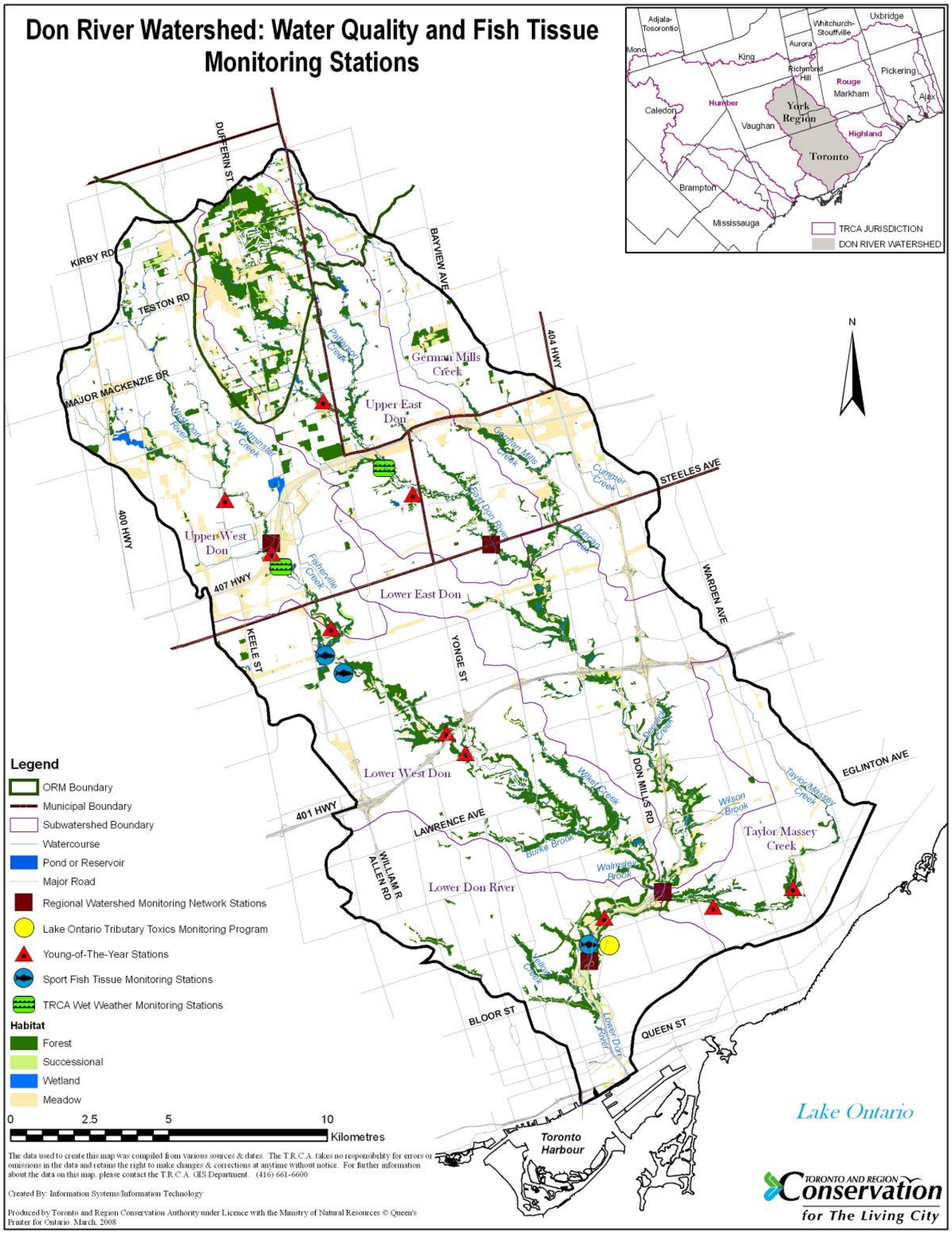


Table 2: Data sources, locations and period of record.

Data Sources	Monitoring Station(s)	Period of Record	Water Quality Groups	Comments
Regional Water Quality Monitoring Network	4 stations	2002 - 2005	conventionals, nutrients, metals bacteria, nutrients	Routine monthly grab samples - biased towards dry weather
Provincial Water Quality Monitoring Network	3 stations at Pottery Road, Upper East and Upper West Don.	Historical data	conventionals, nutrients, metals bacteria, nutrients	Routine bi-monthly grab samples - biased towards dry weather
Beach Sampling Programs (Peel, York, Toronto)	Clark & Ward Beaches	swimming season 1997 - 2004	Beach postings	Postings based on geometric mean of E. coli in 5 samples
Lake Ontario Tributary Toxics Monitoring Program	1 station Don @ Pottery Road	2003 - 2004; 2000 - 2001; 1991 - 1992	Conventionals, metals, organic compounds	Sampling methods were different in each survey
2005 Wet Weather Monitoring	2 stations: Upper Don East & West	summer 2005	Conventionals, nutrients, metals, bacteria	Separate samples collected for the rise, peak and run of the hydrograph
OMOE Guide to Eating Ontario Sport Fish	3 stations: in and below the G. Ross Lord Dam and at Pottery Road	2005	Mercury, PCBs, mirex and pesticides	Adult fish tissue analysis
OMOE Young-of-the-Year Fish Monitoring	8 stations on the River and all major tributaries.	2005	Mercury, PCBs, DDT	Juvenile fish tissue analysis

4.0 Current Conditions in the Don River Watershed

Flowing through the heart of Toronto, the Don River is one of the Greater Toronto Area's most degraded rivers. Approximately 80 percent of the watershed is urbanized or in the process of being urbanized. During rainstorms, rain and melt water moves rapidly over paved surfaces, entering storm sewers, which in 80% of the urbanized area go directly to the river without any form of treatment, causing rapid fluctuations in stream water levels, erosion of river banks, and stress to aquatic organisms inhabiting the river. In the older urban areas, south of Eglinton, combined sewers that carry stormwater and sanitary sewage regularly overflow during heavy rain events, spilling dilute raw sewage directly into watercourses.

Several steps have been taken in recent years to improve the health of the Don River, but signs of degradation are still apparent as development continues to expand northward. This report evaluates current water quality conditions in the watersheds, examines the factors that influence these conditions, documents changes in water quality over time, and suggests priority issues for management of water quality.

4.1 Characterization of Drainage Areas

Table 3 presents land use, stormwater management and unit area baseflows for areas upstream of the Regional Water Quality Monitoring Network Stations. As shown in the Table, the majority of rural land use, natural cover and stormwater management is concentrated in the areas upstream of the East and West Don water quality monitoring stations. In 2002, the West Don had slightly more urban land uses than the East Don, but better overall levels of stormwater control, and less areas designated for urban land uses. The fully urbanized Taylor/Massey Creek had the highest concentration of abandoned landfills and almost no stormwater control facilities (only 2% of the urban lands in Taylor/Massy have stormwater control for water quantity and quality). Several of the lower reaches of the watershed have also been channelized or piped underground, which can accelerate erosion and exacerbate flooding downstream of these areas.

Table 3: Characterization of Drainage Areas at each the Regional Water Quality Monitoring Network Stations.

		West Don (Station ID: 85004)	East Don (Station ID: 85003)	Lower Don (Station ID: 85014)	Taylor/Massey (Station ID: DM6.0)
Total Drainage Area (ha)		3,429	5,840	31,971	3,376
Land Use (% of total upstream drainage area)	Urban	73	69	90	100
	Urbanizing	10	21	6	0
	Rural	17	10	4	0
Stormwater Management (% of total upstream drainage area)	None	22	50	73	96
	Quantity	16	10	7	2
	Quantity and Quality	45	31	16	2
Unit Area Baseflow (L/s/ha)		0.019	0.041	0.046	0.022
Closed Landfills (approx. number **adjacent to the stream** upstream of the station)		1	2	27	16

Discharge of relatively clean and cool groundwater into streams can significantly improve the quality of dry weather flows. Based on low flow measurements in June 2005, the Upper East Don and Lower Don water quality monitoring stations had the highest rates of base flow on a unit area basis. The low baseflows upstream of the West Don station may be explained in part by the predominance of clay and silty clay soils in this area. Baseflows at the Lower Don station are augmented with warmer and dirtier flows from the North Toronto Sewage Treatment Plant.

4.2 Swimming and Body Contact Recreation

The *Escherichia coli* (*E. coli*) and faecal coliform groups of bacteria indicate the presence of fecal matter of human or animal origin, and can indicate the potential presence of other harmful pathogens or viruses that could infect humans, pets, and other warm blooded animals. Faecal matter can originate from human sewage, via cross contamination between storm and sanitary sewers, or wet weather overflows of combined sewers, as well as from pet, livestock, and wildlife faeces washed off fields, lawns and paved surfaces during rain events.

Levels of *E. coli* bacteria in excess of the provincial guideline of 100 colony forming units (CFU) per 100 mL can result in beach postings and create health risks associated with other forms of body contact recreation such as wading. The indicator bacteria group selected for the provincial guideline changed from faecal coliforms to *E. coli* in 1994 because studies reported that, among the coliform group of bacteria, *E. coli* is the most suitable and specific indicator of faecal contamination.

E.coli concentrations in monthly grab samples collected between 2003 to 2005often exceeded the provincial guideline of 100 CFU/100 mL at water quality monitoring stations throughout the Don River watershed (Table 4, see also Appendix A). The Taylor/Massey Creek and East Don stations had the highest number of samples with *E. coli* concentrations above the 100 CFU/100mL limit. Twenty-eight sewer outfalls discharging to Taylor/Massey Creek were identified by the City of Toronto in 2005 and 2006 as having elevated levels of bacteria and other contaminants during dry weather. Subsequent investigations by City staff have led to the remediation of five of these discharges; others are still under investigation (City of Toronto, 2006).

The source of dry weather bacteria in the Upper East Don is less clear, as this subwatershed receives significant clean groundwater discharges from the Oak Ridges Moraine aquifer complex and stormwater runoff is partially controlled by ponds and other end-of-pipe facilities. Dry weather discharges from sewer outfalls in Richmond Hill are currently not being sampled.

The closest beaches to the mouth of the Don River are Clark Beach at the foot of Cherry Street, and Ward's beach, on one of the Toronto islands. These beaches were typically open more than 80% of the swimming season between 2000 and 2004, which would suggest that flows from the Don River have little influence on water quality in these areas.

Table 4: Don River *E.coli* levels and beach postings.

	2003		**2004**		**2005**		**2003 - 2005**	
Monitoring Station (Station ID)	**Geo-mean *E. coli*$^{+}$**	**% meet PWQO^{+}**	**Geo-mean *E. coli*$^{+}$**	**% meet PWQO^{+}**	**Geo-mean *E. coli*$^{+}$**	**% meet PWQO^{+}**	**Geo-mean *E. coli*$^{+}$**	**% meet PWQO^{+}**
West Don (85004)	479	11	142	20	562	11	391	13
East Don (85003)	862	0	1661	0	1651	0	1332	0
Pottery Road (85014)	420	26	450	31	n/a	n/a	434	18
Taylor/Massey Creek (DM 6.0)	2005	0	1042	0	2304	0	1756	0
Percent of season safe for swimming*								
	2000	**2001**	**2002**	**2003**	**2004**	**AVERAGE**		
Clark Beach	87	98	97	98	93	94		
Ward Beach	73	89	91	90	91	87		

Sources: Regional Watershed Monitoring Program, City of Toronto Beach Sampling Program
$^{+}$Samples were collected year round. N=7-11/year
*Year-to-year variations in beach postings are influenced by variations in the intensity and frequency of rainfall events.

4.3 Conventional Contaminants

Conventional pollutants discussed in this section were selected based on their relevance to common water use concerns. Their effects and sources are summarized in Table 1 earlier in the report. More detailed summary statistics for each station are provided in Appendix A.

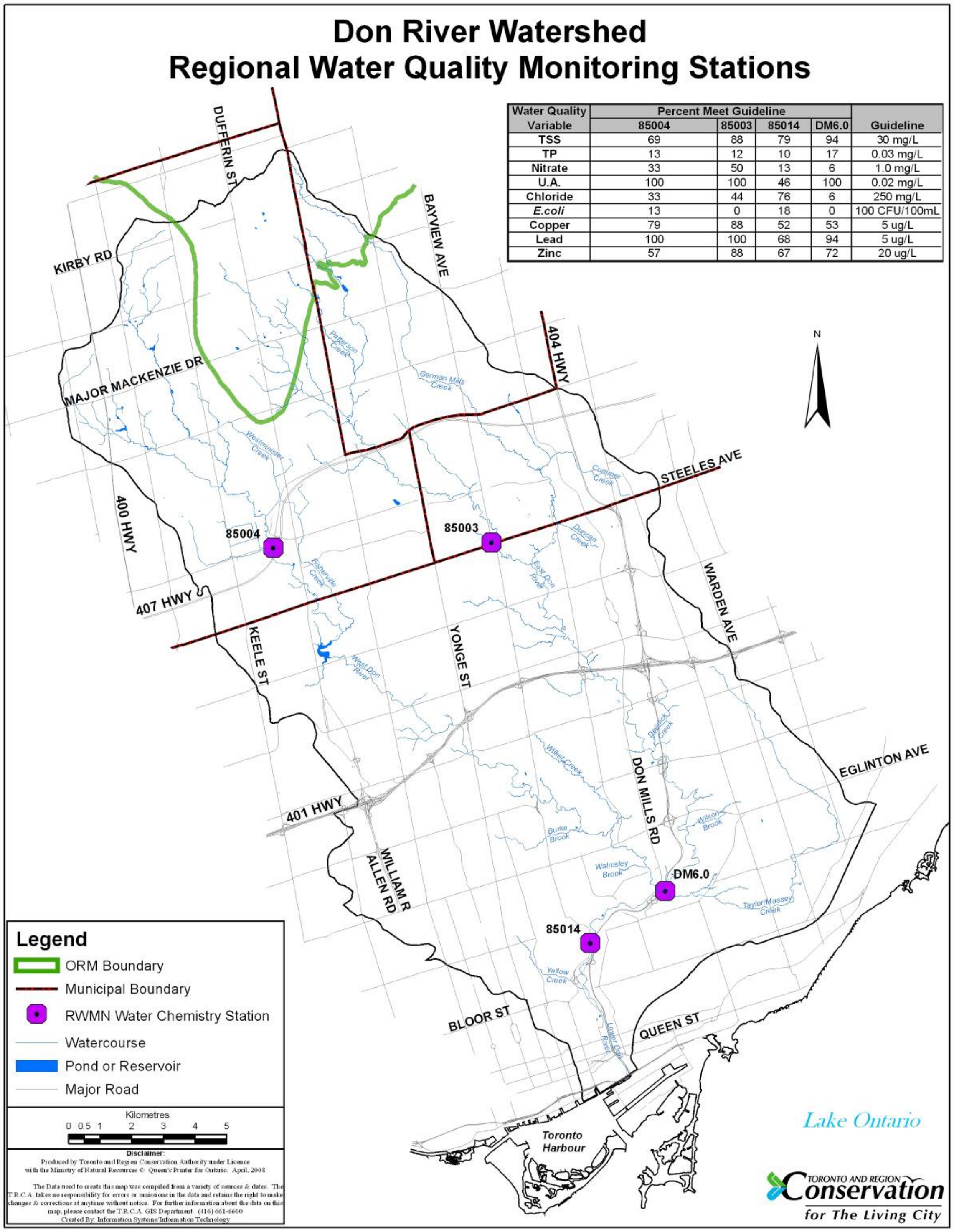
Water quality samples were collected on a pre-determined day each month under the Regional Watershed Monitoring Network at four stations from January 2002 to December 2005. Table 5 presents the median concentrations and frequency that samples meet existing guidelines for selected conventional pollutants. Figure 5 shows these same frequencies on a map of the Don River watershed for ease of reference. Values represent predominantly dry weather or low flow conditions in the Don River because samples are collect monthly on set dates, and low flow conditions prevail roughly 75% of the time. The impact of water temperature on aquatic life is assessed in relation to historical fish communities and thermal river reach designations in a separate background technical report addressing fisheries and aquatic habitat.

Table 5: Median concentrations and the percent of samples that meet guidelines (GL) at Don River monitoring stations (2002-2005).

Monitoring Station (Station ID)	TSS		Chloride		Total Phos.		Nitrate		Un-ionized Ammonia	
	% meet GL	median	% meet GL	median	% meet GL	median	% meet GL	median	% meet GL	median
West Don (85004)	69	20	33	580	13	0.08	33 / 100	1.2	100	0.00
East Don (85003)	88	5	44	422	12	0.07	50 / 94	1	100	0.00
Pottery Road (85014)	79	12	76	220	10	0.15	13 / 89	1.5	46	0.02
Taylor/Massey Creek (DM 6.0)	94	6	6	422	17	0.07	6 / 65	2.3	100	0.00
Guideline	30 mg/L[1]		250 mg/L[5]		0.03 mg/L[2]		1.0/2.5 mg/L[3]		0.02 mg/L[2]	

Data Source: Regional Watershed Monitoring Network.
Guideline Sources: 1. Canadian Water Quality Guidelines (CCME, 1999) 2. Provincial Water Quality Objectives (OMOE, 1999b); 3. 1.0 mg/L - to avoid excess growth of aquatic plants (CAST, 1992), 2.5 mg/L - for protection of amphibians (Rouse *et al.*, 1999); 5. Environment Canada and Health Canada, 2001 (see text for discussion of guideline sources).

Figure 5: Frequency that samples meet guidelines for selected water quality variables at indicated sampling stations.



Water Quality Variable	Percent Meet Guideline				Guideline
	85004	85003	85014	DM6.0	
TSS	69	88	79	94	30 mg/L
TP	13	12	10	17	0.03 mg/L
Nitrate	33	50	13	6	1.0 mg/L
U.A.	100	100	46	100	0.02 mg/L
Chloride	33	44	76	6	250 mg/L
E.coli	13	0	18	0	100 CFU/100mL
Copper	79	88	52	53	5 ug/L
Lead	100	100	68	94	5 ug/L
Zinc	57	88	67	72	20 ug/L

4.3.1 Total Suspended Solids

Total suspended solids (TSS) median concentrations in samples collected from 2002 to 2005 at all the Don monitoring stations met the guideline of 30 mg/L between 69 and 94% of the time. The West Don station at Highway 7 had the highest overall concentrations of suspended solids, probably due to higher levels of construction activity upstream of this station.

When flows were elevated, TSS concentrations generally ranged between 30 and 300 mg/L. The maximum TSS concentration was 313 mg/L, observed at the Pottery Road station on the Lower Don. Even higher TSS concentration ranges would be expected during the early portion of rain events as soil from pervious areas and accumulated grit and dirt from hard surfaces are washed into streams. Short term exposures of elevated suspended solids concentrations during rain storms or the spring freshet have been reported to exert severe effects on aquatic biota (Waters, 1995).

4.3.2 Nutrients

Phosphorus is the limiting nutrient for plant growth in most inland waters and, as such, is often regarded as the principle cause of eutrophication in receiving waters. Median concentrations of total phosphorus in samples collected from 2002 to 2004 were between 0.07 and 0.08 mg/L at all stations except Pottery Road, where the median concentration was 0.15 mg/L. At the four stations, the provincial guideline of 0.03 mg/L for phosphorus was only met between 10 and 17% of the time. Discharges from the North Toronto sewage treatment plant a short distance upstream of the Pottery Road station are probably an important source of elevated phosphorus concentrations at this station.

Although not generally a limiting nutrient for plant growth, nitrate (NO_3 - N) is thought to contribute to excessive plant and algae growth in rivers and lakes at concentrations above approximately 1.0 mg/L (CAST, 1992). Nitrate has also been shown to have chronic toxic effects in amphibian species at concentrations as low as 2.5 mg/L (Rouse *et al.*, 1999). Median nitrate concentrations ranged from 1.0 mg/L on the Upper East Don to 2.3 mg/L at the mouth of Taylor/Massey Creek. The 2.5 mg/L limit was met most of the time at all but the Taylor/Massey Creek station, where only 65% of samples met the guideline. Contaminated dry weather flows from priority sewer outfalls identified by the City of Toronto (2005) may be an important source of the elevated nitrate concentrations in Taylor/Massey Creek.

Un-ionized ammonia is a form of nitrogen that can be toxic to aquatic organisms at concentrations above 0.02 mg/L. In urban areas, sanitary sewer discharges, combined sewer overflows, and sewage treatment plant effluent can result in elevated ammonia concentrations in streams. Water samples at all but the Pottery Road station met provincial standards for un-ionized ammonia (0.02 mg/L) 100% of the time. At Pottery Road 55% of samples collected exceeded the guideline, possibly due to discharges from the North Toronto sewage treatment plant a short distance upstream. Decommissioning of sewage treatment plants in other parts of the GTA have been shown to result in significantly lower downstream concentrations of un-ionized ammonia, phosphorus and Biological Oxygen Demand (BOD) (see Section 5).

4.3.3 Chloride

Road salts have come under increased scrutiny since they were deemed to be a toxic substance as defined in Section 64 of the Canadian Environmental Protection Act (Environment Canada and Health Canada, 2001). The five year risk assessment leading to the designation of road salts as 'toxic' suggested a limit for chloride (a major constituent of road salt) of approximately 250 mg/L for the protection of sensitive aquatic organisms. By comparison, the suggested irrigation water limit for agricultural crops ranges from 100 mg/L for sensitive plants to 700 mg/L for more tolerant ones (CCME, 1999). Chloride is highly soluble and does not readily adsorb to mineral surfaces. Hence, it is not effectively treated by stormwater technologies such as ponds that rely on settling for pollutant removal (SWAMP, 2005).

Chloride concentrations in the Don River varied considerably among stations. The highest median value was recorded at the West Don station (520 mg/L), but Taylor/Massey Creek had the fewest number of samples (only 6%) below the 250 mg/L limit. Road salt discharges from the densely urbanized drainage area upstream of the Taylor Creek station likely explains much of this result. Median concentrations during the winter were 2 to 5 times greater than during the summer (see section 5). In Taylor/Massey Creek, chloride may also be leaching into the stream from closed landfills, of which approximately 16 exist within the valley upstream of the monitoring station.

4.4 Organic and Metal Contaminants

4.4.1 Organic Compounds

Organic contaminants such as pesticides, poly-chlorinated biphenols (PCBs) and polycyclic aromatic hydrocarbons (PAHs) have been linked to chronic health effects in aquatic organisms, terrestrial wildlife species and humans. Aquatic impacts of organic pollutants can include physical deformities, tumours and lesions, some leading to population declines through increased embryo mortality and damage to reproductive systems. Many of these compounds have been demonstrated, or are believed, to be carcinogenic to humans.

Forty-one harmful pollutants were identified under the Canada-Ontario Agreement (COA) for priority management in the Great Lakes Basin ecosystem. The first group of these, called 'Tier 1' contaminants, consist of 14 contaminants known to persist and biomagnify in the environment, and have been targeted for virtual elimination. Significant progress has been made over the past 15 years in reducing production and release of these chemicals, and some, such as dichloro-diphenyl-trichlorethane (DDT), Chlordane, Mirex, Alkyl-lead and Toxaphene are no longer being produced in Ontario.

The second group, called Tier II contaminants, are believed to be persistent and have the potential for biomagnification and toxicity. In some cases, these chemicals have already caused local adverse impacts within the Great Lakes basin, but there is not sufficient agreement among scientists in both the U.S. and Canada to warrant setting joint targets and goals with regard to these substances. The pollutants in the Tier II category include 17 PAHs and various other organic compounds.

Sampling for organic compounds on the Don River at the Pottery Road station was conducted in 1991/92, 2000/01 and most recently in 2003/04 as part of the Ontario Ministry of the Environment's Lake Ontario Priority Pollutants Monitoring Program. The results of the 2003/04 data are not provided because of frequent non-detects and concerns over the reliability of laboratory analyses for some variables. The earlier sampling programs are, unfortunately, not directly comparable because of differences in sampling and laboratory analytical protocols. The 1991/92 program samples were collected over a 24 hour period and targeted high flow events during the spring freshet. The 2000/01 concentrations represent a single 28 day composite of samples collected at 6 hour time intervals, thereby representing a mix of dry and wet weather.

Table 6 presents Tier 1 organic contaminant sampling results for the 1991/92 and 2000/01 surveys. Several priority organic compounds, such as DDT and Aldrin/Dieldrin, were not measured in 2000/01 because they were not expected to be present in a wet/dry composite sample. In 2000/01, PCBs met the guideline in 92% of wet/dry composite samples, which appears to be an improvement over 1991/92 conditions. The PAH, benzo (a) pyrene, met guideline levels in 54% of samples. The guideline used in the 1991/92 study was much higher (210 ng/L) than used in the 2000/01 study (15 ng/L), which accounts for the different sampling program results.

Among Tier 2 contaminants, only PAHs (and selected metals) were analyzed. Unlike other organic compounds, PAHs are not manufactured directly by humans, but enter the environment indirectly as by-products of combustion processes. Residential heating, vehicular exhaust, power generation and wood burning are all sources of PAHs. Emissions from these sources are deposited on surfaces and wash off with stormwater runoff into rivers and creeks, where they accumulate in sediments and aquatic organisms (Sharma *et al.*, 1997).

PAH levels are a concern because these compounds are known carcinogens and can have detrimental effects on the health of aquatic organisms. Humans are more at risk from inhalation of air-born PAHs than through consumption of fish or other freshwater foods because our lifetime exposure to sources such as vehicular exhaust and wood smoke can be significant.

Table 6: Levels of Canada-Ontario Agreement 'Tier 1' Contaminants in the Lower Don River at the Pottery Road station.

COA Tier 1 Contaminants	PWQO	1991/1992 survey					2000/2001 survey		
		% > DL			% meet PWQO		% > DL		% meet PWQO
		MDL (ng/L)	dry (n=24)	wet (n=19)	dry (n=24)	wet (n=19)	MDL (ng/L)	dry/wet comp. (n=13)	dry/wet comp. (n=13)
Chlordane	60 ng/L	0.02	54	90	100	100	0.2	8	100
DDT	3 ng/L	0.05	50	79	100	63	---	--	--
PCBs	1 ng/L	1	--	84	87	16	1	69	92
Aldrin/ Dieldrin	1.0 ng/L	0.01	88	84	100	58	---	--	--
HCB	6.5 ng/L	0.01	38	63	---	---	---	---	---
Mirex	1 ng/L	0.05	0	0	100	100	--	--	--
B(a)p	15 ng/L	0.2	35	94	100*	89*	2	92	46*
Mercury	0.2 mg/L	0.02	--	38	--	100	0.02	8	100

Source: Ministry of the Environment. Other Tier 1 contaminants such as toxaphene, dioxins, furans, alkyl lead, and octochlorostyrene are either not detected in Ontario fresh water or are observed at such low concentrations that they are best measured in fish flesh, rather than water.
**The guideline was 210 ng/L in the 1991/92 study and 15 ng/L in the 2000/01 study. The maximum concentration of B(a)P in the Don River watershed in 2000/01 was 76 ng/L.

At the Pottery Road station in the Don River, concentrations of several PAHs occasionally exceeded provincial guidelines (Table 7). Comparing 1991/92 and 2000/01 survey results, it would appear that PAHs may have declined. Like other organic compounds, however, this apparent trend may simply be a result of differences in sampling methods and laboratory analytical procedures. Given the increase over the 1990s in traffic and use of fuel in the watershed for residential heating and commercial activities, there is little reason to expect that PAH concentrations in water would be declining.

Table 7: Levels of polycyclic aromatic hydrocarbons (PAHs) sampled in the Lower Don River at the Pottery Road station.

PAHs	PWQO (ng/L)	1991/1992 survey					2000/2001 survey		
		% > Detection Limit			%>PWQO		% > Detection Limit		% > PWQO
		MDL** (ng/L)	dry (n=23)	wet (n=18)	dry (n=23)	wet (n=18)	MDL (ng/L)	dry/wet comp. (n=13)	dry/wet comp. (n=13)
Phenanthrene	30	0.2	61	100	13	61	1	100	38
Anthracene	0.8	---	--	67	9	67	1	23	23
Fluoranthene	0.8	0.2	30	61	78	100	1	100	100
Pyrene	25*	0.2	91	100	--	--	1	100	
Benzo (a) anthracene	0.4	0.2	--	100	13	100	2	100	100
Chrysene	0.1	0.2	61	100	61	100	2	100	100
Benzo (b) fluoranthene	---	0.2	65	100	--	--	2	100	--
Benzo (k) fluoranthene	0.2	---	---	---	---	---	2	100	100
Benzo (e) pyrene	--	---	---	---	---	---	2	100	--
Benzo (a) pyrene	15**	0.2	35	94	0	11	2	100	--
Perylene	0.07	0.2	---	67	---	61	2	46	46
Indeno (1,2,3-c,d) pyrene	---	0.5	22	94	---	---	2	100	--
Dibenzo (a,h) anthracene	2	0.5	---	50	---	44	2	31	31
Benzo (g,h,i) perylene	0.02	0.5	30	100	26	100	2	92	92

Source: Ministry of the Environment.
*Canadian Water Quality Guideline
**MDL: Method Detection Limit
*** The percent of samples that meet the PWQO is set equal to 100 less the % of samples greater than the MDL for variables with method detection limits greater than the PWQO. In these cases, the percent of samples meeting the PWQO may be less than stated.

A detailed study of "in-use" pesticide concentrations in the Don and Humber rivers was conducted between 1998 and 2002 (Struger *et al.*, 2007). In this study, 262 samples were collected, of which 123 were collected during or shortly after a rain event and 139 were collected during dry weather. One hundred and fifty two pesticides and 8 metabolites were monitored. The most frequently detected compounds at four stations in the Don River were mecoprop (MCPP), diazinon, 2-4-D, total phenoxy, bromacil (West Don) and atrazine. Among the pesticides detected, most were below available water quality guidelines, except diazinon, which exceeded guidelines in 28% of samples. Other compounds occasionally observed above guidelines (i.e. less than 1% of samples) included carbofuran, chlorpyrifos, and atrazine.

Diazinon and chlorpyrifos are currently being phased out for urban lawn insect control. The Pest Management Regulatory Agency of Health Canada has also recommended that bromacil (detected in the West Don) not be used in residential areas, and that large buffer zones be provided between application areas and sensitive aquatic habitat. The City of Toronto has passed a pesticide bylaw to be fully phased in by 2007, which should lead to reductions in pesticide occurrence in the Don River south of Steeles.

4.4.2 Trace Metals

Metals are found naturally in the environment, but many are toxic to aquatic life at elevated levels. Copper, lead and zinc originate from urban and industrial land use activities and, as such, are the most common heavy metals in stormwater runoff (Marselek and Shroeter, 1988). Mercury and cadmium are designated under COA as Tier1 and Tier 2 contaminants, respectively. Mercury comes from natural sources, such as decaying vegetation and degassing of soils, as well as anthropogenic sources, such as base metal recovery, coal combustion, paint application, and the chlor-alkali industry. The major anthropogenic sources of cadmium include corrosion of galvanized pipes, discharge from metal refineries and runoff from waste batteries and paints. Natural sources from weathering of rocks can also contribute significant quantities of this element to streams.

Table 8 shows the percentage of samples that meet guidelines for selected metals at the four RWMN stations in the Don River watershed. Other metals, such as mercury, were not selected because sample concentrations consistently met PWQOs (as discussed earlier).

Table 8: Percent of samples that met guidelines for selected trace metals at Don River Monitoring Stations (2002 to 2005).

Station	Aluminum	Cadmium	Chromium	Cobalt	Copper	Iron+	Lead	Nickel	Zinc
West Don (85004)	79*	93	93	n/a	79	7	100	100	57
East Don (85003)	94*	100	100	n/a	88	53	100	100	88
Pottery Road (85014)	38*	94	100	87	52	34	68**	100	57
Taylor/Massey Creek (DM 6.0)	100*	100	83	n/a	53	35	94	94	72
Guideline (OMOE, 1999)	75 ug/L*	0.5 ug/L	8.9 ug/L	0.9 ug/L	5 ug/L	300 ug/L	5 ug/L	25 ug/L	20 ug/L

Data Source: Regional Watershed Monitoring Network
*The guideline applies to clay free samples only. Filtering the samples prior to analysis would likely have increased the percent of samples that met the aluminum guideline.
**The OMOE laboratory detection limit for lead (10 ug/L) is considerably higher than that of the laboratory used to analyze samples at the other stations (0.06 ug/L). Since values below the detection limit were assumed to meet the guideline (5 ug/L), the actual number of samples that met the guideline may be significantly less than stated.
+ Unfiltered reactive at stations 85004, 85003 and DM 6.0 and unfiltered total at 85014.

Levels of metals were lowest at the East Don station and highest at the Pottery Road station. The West Don station had elevated levels of iron and zinc. Copper levels were highest at the Pottery Road and Taylor/Massey stations, with just over 50% of samples meeting the guideline. Lead concentrations at the Pottery Road station are higher than observed elsewhere in the GTA. The cause of elevated lead levels at this station requires further investigation.

Sampling results from OMOE monitoring at the Pottery Road station are provided in Table 9 for comparison. As mentioned previously, the various OMOE sampling programs are not directly comparable because of differences in sampling methods. However, the data suggest that levels of lead, copper and cadmium may have declined since 1991/92. Long term trends for conventional pollutants and metals are discussed in Section 4.5 below.

Table 9: Levels of trace metals sampled in the Don River at the Pottery Road station.

Metals	1991/1992 survey				2000/2001 survey		2003/2004 survey	
	% > DL		% meet PWQO		% > DL	% meet PWQO	% > DL	% meet PWQO
	dry (n=7)	wet (n=29)	dry (n=11)	wet (n=15)	dry/wet comp. (n=12)	dry/wet comp. (n=12)	dry/wet grabs (n=14)	dry/wet grabs (n=14)
Lead	58	100	14	10	100	92	100	71
Copper	100	100	14	0	100	54	100	50
Nickel	83	73	100	95	92	100	100	100
Chromium	83	93	100*	100*	92	100*	100	93*
Iron	100	100	0	0	100	46	100	21
Zinc	33	93	73	10	100	69	100	50
Cadmium	25	67	46	45	33	100	100	100
Mercury	---	27	--	100	0	100	0	100

Data from Lake Ontario Priority Pollutant Monitoring Program conducted in 1991/1992 (OMOE, 1999), 2000-2001 (OMOE, 2002), and 2003-2004 (unpublished data from OMOE).
*PWQO for chromium used in the 1991/92 survey was 100 ug/L, compared to the 8.9 ug/L guideline used in later surveys.

4.4.3 Contaminants in Fish Tissues

The detection of organic contaminants or metals in fish flesh indicates that these pollutants are present in river water or sediments in forms that are biologically available, and depending on the nature of the contaminant, may be bio-accumulated through the food chain. Restrictions on the consumption of sport fish are set if these contaminants exceed established levels in order to protect humans against potential adverse health effects.

Sportfish tissue contaminants were measured in the West Don in and below the G. Ross Lord Reservoir, and at the Pottery Road station (Figure 4). Consumption restrictions were noted for the first time in 2005 for brown bullhead in and below the Reservoir on the West Don, representing an increase in restrictions at this station (Table 10). Below the Dam, one of the two species that previously had restrictions was not restricted in 2005, but one species (white sucker) had a slight increase in restriction level. Only white suckers were evaluated at Pottery Road, and these had more restrictions in 2005 than in the earlier years.

Table 10: Sportfish consumption advisory limits for sites in the Don River watershed.

Location	Substances Tested	Species	Restricted Fish Length (cm)			Restriction Level[2]		
			1999	2003	2005	1999	2003	2005
West Don River (G. Ross Lord Reservoir)	Mercury, PCBs, Mirex, Pesticides	carp largemouth bass rock bass brown bullhead white sucker	nr -- nr nr --	nr nr nr nr nr	nr nr nr 20-25, 25-30 nr	nr nr nr nr --	nr nr nr nr nr	nr nr nr 4,2 nr
West Don River (Below G. Ross Lord Dam)	Mercury, PCBs, Mirex, Pesticides	carp white sucker pumpkinseed	35-45,45-55 25-30 nr	35-45, 45-55 25-30 nr	nr 15-20,20-30 nr	2,1 4 nr	2,1 4 nr	nr 4,2 nr
Don River (Pottery Road)	Mercury, PCBs, Mirex, Pesticides, chlorinated phenols and benzenes, Dioxins and Furans	white sucker	45-55	45-55	35-40, 40-50	4	4	4

Source: Ministry of the Environment, 2000, 2004, 2006
nr=no restrictions (there were no restrictions below the 8 meal maximum).
[2]Restriction level refers to the maximum number of monthly meals it is safe to consume. Further restrictions apply to women of childbearing age and children under 15 (see OMOE, 2003).

The location of young-of-the-year fish sampling stations were shown earlier in Figure 4. All stations had tissue guideline exceedances for PCBs and DDT. Mercury concentrations were above the guideline at 5 of the 8 stations monitored (Table 11). The only stations where mercury in juvenile fish tissues was not observed above guideline levels were on the lower branch at Danforth and at the two 905 stations on the East and West Don. It is worth noting that the fish tissue guideline for mercury and DDT have both decreased in recent years making it more difficult to achieve a passing score for these contaminants.

Table 11: Young-of-the-year fish sampling location where fish tissue guideline exceedances occurred.

Location	Mercury (0.033 ug/g)	PCB (100 ng/g)	DDT (14 ng/g)
E. Don @ Eglinton	yes	yes	yes
Don @ Danforth	no	yes	yes
Taylor/Massey Creek	yes	yes	yes
Don/little Don @ confluence	yes	yes	yes
W. Don @ Eglinton	yes	yes	yes
E. Don u/s of Taylor Cr.	yes	yes	yes
W. Don below G. Ross	no	yes	yes
E. Don @ Finch below dam	no	yes	yes

Source of data: Petro, 2006

4.5 Wet Weather

The most recent wet weather sampling data available are from a sampling program conducted by TRCA on the East and West Don River north of Steeles (see Figure 4) in the summer and fall of 2005. Samples were collected by automatic samplers programmed to initiate sampling when water levels rose above a set level, representing wet weather flow conditions. Event samples were subsequently flow proportioned based on separate samples collected and analyzed for the rise, peak and run of the hydrograph. Results from this sampling program for selected pollutants are presented in Table 12. Unfortunately, TSS and turbidity sample results could not be included because of concerns over reliability of sample analysis.

As expected, concentrations of various water quality variables were elevated during wet weather, particularly phosphorus, copper, and feacal coliforms (Table 12). Other trace metals that exhibited elevated levels during wet weather at one or more stations include aluminum, chromium, zinc, and nickel. There were relatively few chloride exceedances because the wet weather sampling program was conducted during the warm summer and fall months when road salt is no longer being applied to roads. As during dry weather, wet weather concentrations of most variables were higher on the West Don, except phosphorus, TKN, and a few metals.

Table 12: Wet weather mean concentrations of selected variables collected by TRCA from May to November, 2005.

Variable	Guide-line	Don West Station (n=21)				Don East Station (n=16)			
		Min	Max	Median	% Meet GL	Min	Max	Median	% Meet GL
Chloride (mg/L)	*250*	60	363	234	67	41	116	60	100
Ammonia+Ammonium-N (mg/L)	--	0.004	0.12	0.02	--	0.004	0.96	0.02	--
Nitrate-N (mg/L)	*1.0 / 2.5*	0.35	1.13	0.67	100 / 100	0.21	0.82	0.55	100 / 100
Nitrite-N (mg/L)	--	0.01	0.08	0.04	--	0.003	0.07	0.03	--
TKN (mg/L)	--	0.95	2.53	1.22	--	0.42	3.00	1.26	--
Total Phosphorus (mg/L)	*0.03*	0.033	0.67	0.23	0	0.06	1.57	0.34	0
O-Phosphate (as P) (mg/L)	--	0.001	0.25	0.03	--	0.001	0.61	0.06	--
Faecal coliforms (CFU/100mL)	*100*	189	49,083	10,952	0	1347	28,695	6,185	0
Aluminum (ug/L)	*75*	0.5	696	107	45	0.5	1734	118	33
Cadmium (ug/L)	*0.5*	0.02	0.22	0.05	100	0.05	0.13	0.05	100
Chromium (ug/L)	*8.9*	0.2	80.3	2.0	80	0.2	6.7	2.1	100
Cobalt (ug/L)	*0.9*	0.10	1.25	0.15	90	0.10	1.3	0.17	93
Copper (ug/L)	*5.0*	4.6	20.3	7.2	5	2.4	16.4	5.7	33
Iron (ug/L)	*300*	2.5	859	278	50	228	3162	644	27
Lead (ug/L)	*5.0*	0.30	*106	0.53	95	0.30	2.99	0.30	100
Nickel (ug/L)	*25.0*	0.6	37.6	1.7	95	0.05	4.6	1.0	100
Zinc (ug./L)	*20.0*	0.1	71.6	12.5	75	0.1	28.7	8.7	87

* All lead samples were below the guideline except one, which had a very high concentration

The risk posed by poor water quality to the health of aquatic communities is a function of, among other factors, the type and concentration of chemicals, the duration of exposure, and the type and diversity of aquatic organisms present in the receiving waters. Unfortunately, provincial and federal water quality guidelines are represented by a single threshold value, not multiple or scaled values associated with varying exposure durations and habitat types. Thus, while the results provided here indicate that water quality guideline exceedances are greatest during wet weather, it should be recognized that, all other factors remaining equal, the consequence of guideline exceedances on the health of aquatic communities during short duration wet weather events may not be as severe as during longer duration dry weather periods.

4.6 Ratings for the Water Quality Indicators

In evaluating current conditions in the Don River watershed, a rating system was adopted based on standard letter grades. Each of these categories corresponds with “poor”, “fair”, “good” and “excellent” levels of condition as shown in the table below. Where the measures and targets were quantitative and data permitted, ratings were assigned, in part, to reflect the percent satisfaction of the target. Comparisons to conditions in other watersheds under TRCA jurisdiction were made and informed evaluations where data were available, to reflect relative conditions. Where measures and targets were qualitative, or data were lacking, evaluations were based on professional judgment.

Grade	Rank	Percent of Target Achieved
A	Excellent	Better than 80
B	Good	Between 70 and 79
C	Fair	Between 60 and 69
D	Poor	Between 50 and 59
F	Fail	Below 50
TBD	To be determined	Further study required; baseline data not available

The management objectives, indicators, measures, targets, and current conditions ratings for the water quality indicators are presented below. Current conditions have been compared to previous assessments of condition undertaken as part of report cards prepared after *Forty Steps*, where detailed assessments were available (Don Watershed Regeneration Council (DWRC) and MTRCA, 1997; TRCA, 2000, 2003c).

4.6.1 Swimming and Body Contact Recreation

The target selected for meeting the surface water quality objective of managing the Don River watershed for body contact recreation is provided below, along with a rating for existing conditions in the watershed. Beaches are not included in the measures and targets because the waterfront beaches closest to the watershed mouth do not appear to be strongly influenced by flows from the Don River.

Objective: Protect and restore surface water quality with respect to toxic contaminants and other pollutants, such as sediment, nutrients, bacteria and road salt			Overall Rating
			F
Indicator	Measure	Target	
Swimming and body contact recreation	*Escherichia coli* densities in water samples	Bacterial levels in surface water are lower than observed over the 1991 to 1995 monitoring period (*i.e.* when the last detailed assessment was conducted).	

The swimming and body contact recreation indicator was assigned a failing grade because observed bacteria levels between 2003 and 2005 were not statistically different than levels observed between 1991 and 1996 at three of the four monitoring stations. Data at the Taylor/Massey Creek station were not available in the early 1990s for comparison.

4.6.2 Conventional Pollutants

The measures and targets selected for meeting the surface water quality objective of managing the Don River watershed with respect to conventional contaminants are provided below, along with a rating for existing conditions in the watershed.

Objective: Protect and restore surface water quality with respect to toxic contaminants and other pollutants, such as sediment, nutrients, bacteria and road salt			Overall Rating
			F
Indicator	Measure	Target	
Conventional pollutants	Concentrations of suspended solids, phosphorus, nitrate, un-ionized ammonia, dissolved oxygen and chloride.	Levels of suspended solids, phosphorus, nitrate, un-ionized ammonia, dissolved oxygen and chloride meet guidelines in at least 75% of samples.	

As shown previously in Table 5, nitrate and phosphorus guidelines were not met guidelines in 75% of samples at any of the four of the Don River monitoring stations. Chloride also failed to meet the 75% frequency target at all but the Pottery Road station. Other variables below target levels include TSS at the West Don station and un-ionized ammonia at Pottery Road. Although the continuous data needed to accurately assess the status of dissolved oxygen in the Don River were not available, in situ measurements of dissolved oxygen at the time of sampling showed generally acceptable levels throughout the watershed. A failing grade was assigned to the conventional pollutant indicator because at most stations, sample concentrations of the six variables rated did not meet the guidelines more than 75% of the time.

4.6.3 Heavy Metals and Organic Contaminants

The indicator, measures and targets selected for meeting the surface water quality objective of managing the Don River watershed with respect to metals and organic contaminants are provided below, along with a rating for existing conditions in the watershed. These targets are generally consistent with the Toronto Remedial Action Plan and Toronto Wet Weather Flow Management Master Plan objectives for toxic contaminants.

Objective: Protect and restore surface water quality with respect to toxic contaminants and other pollutants, such as sediment, nutrients, bacteria and road salt		Overall Rating
		D
Indicator	Measure	Target
Heavy metals and organic contaminants	Concentrations of persistent organic contaminants, pesticides and heavy metals in surface waters, and in fish (young-of-the year and adult sport fish)	Concentrations of metals and organic compounds meet surface water guidelines. Organic contaminant levels in young-of-the year fish meet IJC and CCME guidelines. Restrictions on sport fish consumption have not increased since 1999

The chronic effects indicator rating reflects a grade of ‘good’ (or B) for metal concentrations in water (based on copper, lead and zinc), a grade of ‘good’ (or B) for organic compounds (based on an average of Tier 1 and 2 contaminants meeting guidelines 72% of the time), a failing grade for tissue contaminants in young of the year fish and a failing grade for sport fish because restrictions increased since 1999 (albeit only slightly). Averaging the four ratings yields an overall ‘poor’ (or D) rating for the heavy metals and organic contaminant indicator.

5.0 Water Quality Trends in the Don River Watershed

Trends in water quality were assessed for TSS, turbidity, chloride, phosphorus, nitrogen compounds, dissolved oxygen, biological oxygen demand, *E.coli*, copper, lead and zinc at three of the four RWMN stations where long term data were available. Annual median values over the period of record are presented in Figures 6 to 11.

Total suspended solids (TSS) levels have decreased in the upper portions of the watershed, north of Steeles, as active agricultural lands have been converted, but at Pottery Road there is no clear trend. As expected, trends in turbidity show a similar decline over time in the East and West Don. A noticeable increase in turbidity occurred at both sites during the housing construction boom between 1986 and 1988, when large tracks of land would have been stripped to bare soil. Since then, TSS and turbidity levels have generally been lower than during most of the historical period. The recent construction boom since 2000 appears to have had little effect on the East Don so far, but TSS data suggest that the Upper West Don may have experienced an increase in suspended solids concentrations. Improvements in sediment controls on construction sites since the 70s and 80s may explain part of the downward trend in TSS levels. However, a different picture may have emerged had the sampling programs been targeted towards wet weather, as this is when most of the sediment from construction sites is transported into the streams and rivers.

Significant decreases in phosphorus, un-ionized ammonia, biological oxygen demand, as well as increases in dissolved oxygen, occurred in the 1970s and 1980s when wastewater treatment plants in the watershed were decommissioned and sewage was diverted through trunk sewers to newly constructed or expanded plants on the waterfront. The North Toronto Plant is the last sewage treatment plant in Toronto, and although it continues to have an impact on the Lower Don, these impacts are no where near as severe as were observed in the 1970s in other parts of the watershed. Since the mid 1980s, concentrations of phosphorus and dissolved oxygen have remained relatively constant at the three monitoring stations. Un-ionized ammonia concentrations appear to have increased in the late 1990s, for unknown reasons. Total kjeldahl nitrogen (TKN) also increased as TKN represents the sum of ammonia and organic nitrogen. Phosphorus levels at all stations are still consistently above guidelines.

Nitrite concentrations increased in the East Don until the early ‘80s, at the same time that concentrations were falling slightly in the West Don. None of the stations for which nitrite data were available showed a significant trend since the early ‘80s. There were not enough historical data to assess trends in nitrate, although it would appear the nitrate concentrations may be declining at the Pottery Road station. As noted earlier, TKN experienced a significant decline in the 1970s, remained relatively constant through the early 1990s, and, for unknown reasons, appears to have increased with un-ionized ammonia at Pottery Road since the late 1990s.

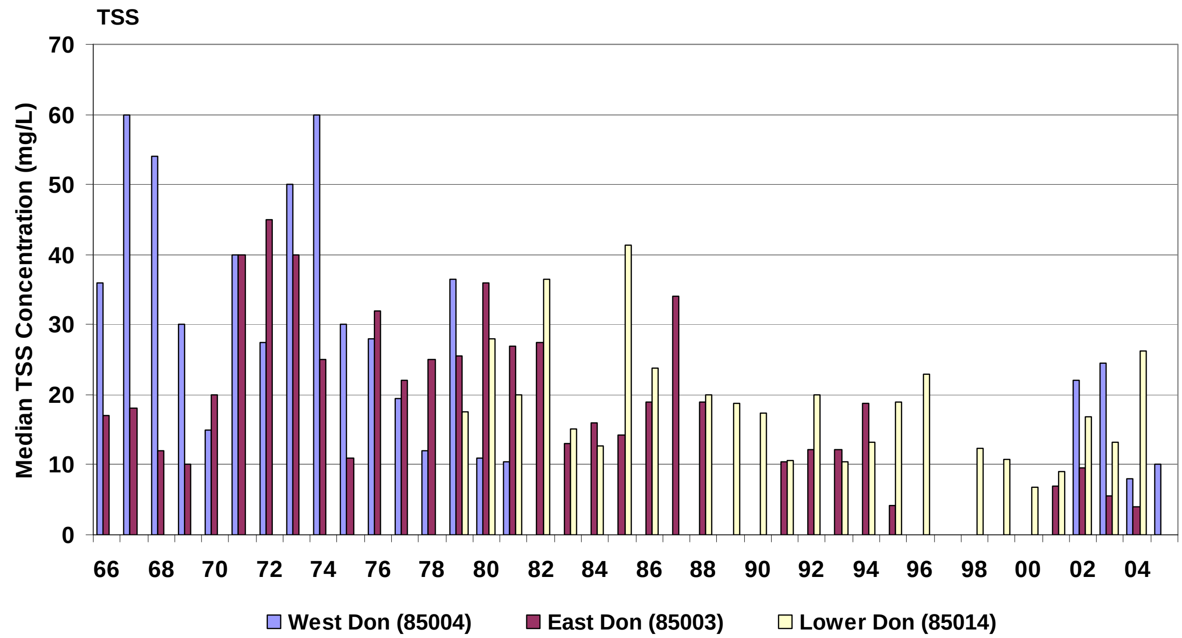
Chloride and sodium concentrations would generally be expected to increase in proportion to the rising number and density of roads to which road de-icing salts are applied. This is apparent to a smaller extent in the Don compared to other watersheds because much of the watershed was developed prior to the beginning of monitoring in the 60s and 70s. Nevertheless, there is an apparent increase in the East and West Don from the low point during the mid 1980s. A levelling off of chloride levels in the Don may be expected as municipal salt management plans, developed in 2004, begin to take effect. Alternatives to road salts will need to be considered on local roads if significant reductions in chloride levels are to occur.

E. coli data were not available over the entire historical monitoring record. Thus, faecal coliforms have been used instead. Generally, faecal coliform densities are about 10 to 20% greater than *E. coli* densities, hence a slight decrease would be expected after 1995, when the Provincial Water Quality Objective for bathing areas switched from faecal coliforms to *E. coli* (OMOE, 1999b). The historical record shows extreme year-to-year variability in both bacterial indicators and no discernable trend.

Copper, zinc and lead were identified earlier as three of the most important metals of concern in the watershed. All are common road runoff contaminants. Median concentrations of copper declined at all stations in the 80s and early 90s, but appear to be increasing since 1999 (Figure 9). Since this constituent binds readily to solid particles, year to year variations in concentrations may be in part explained by year to year variations in TSS. Median concentrations of copper were weakly correlated with TSS at the East Don and Pottery Road stations (R2 between 0.30 to 0.36) and with turbidity at the West Don Station (R2 = 0.42). There was no trend in zinc and lead. Lead showed a decline mostly during the 1980s, reflecting the phase out of lead in fuels initiated in the 1970s. Declines in lead through the 1990s may have been evident had the laboratory detection limit for lead been lower. Caution should be exercised in interpreting the trace metals data as trends may have been influenced by periodic changes in laboratory methods over the historical record.

A *State of the Ecosystem Report* (Paragon Engineering Ltd and Ecologistics Ltd, 1992) was prepared in 1992 in support of *Forty Steps to A New Don,* and included a summary of surface water quality conditions based on Beak and Theil (1991). Since that time, some water quality conditions have improved, such as metal concentrations (copper, lead), while others have declined, such as phosphorus and unionized ammonia concentrations. While rural agricultural activities are no longer a major source of contaminants, construction associated with urbanization, lack of stormwater control, combined sewer outfalls, and spills remain major sources of contamination.

Figure 6: Median concentrations of TSS and turbidity at the Upper West Don, Upper East Don and Lower Don monitoring stations.



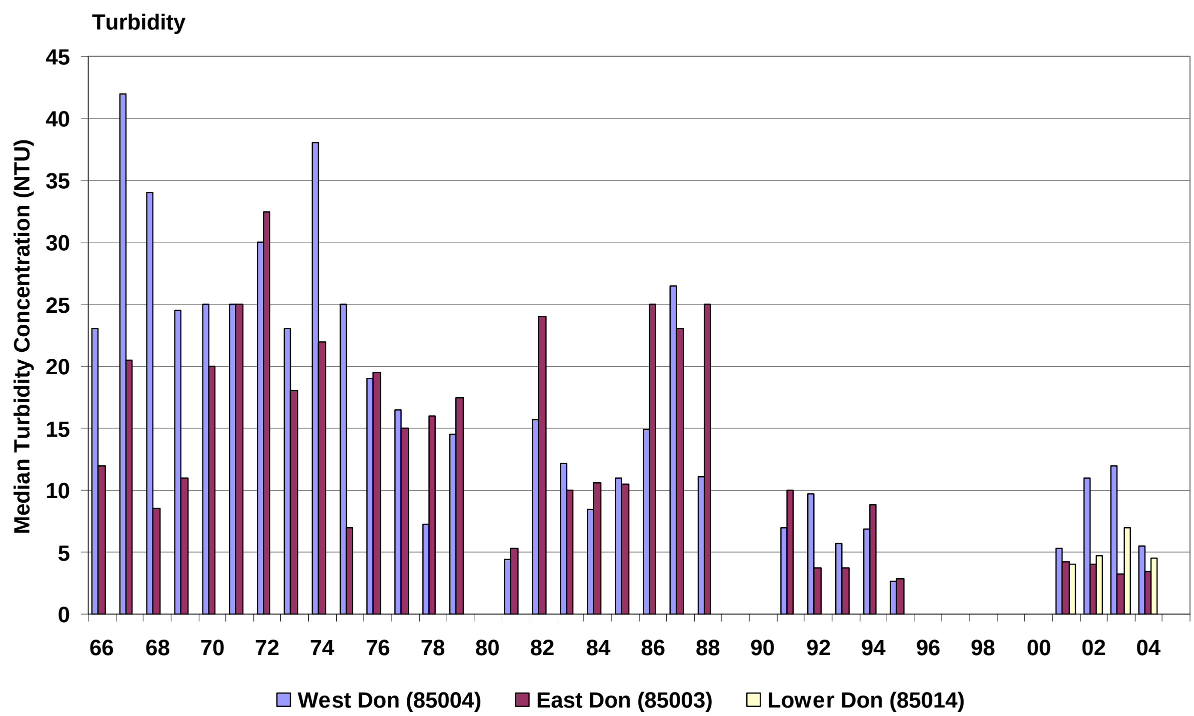


Figure 7: Median total phosphorus, dissolved oxygen, biological oxygen demand and un-ionized ammonia concentrations at the Upper West Don, Upper East Don and Lower Don stations. Historical BOD data were not available at the Lower Don station.

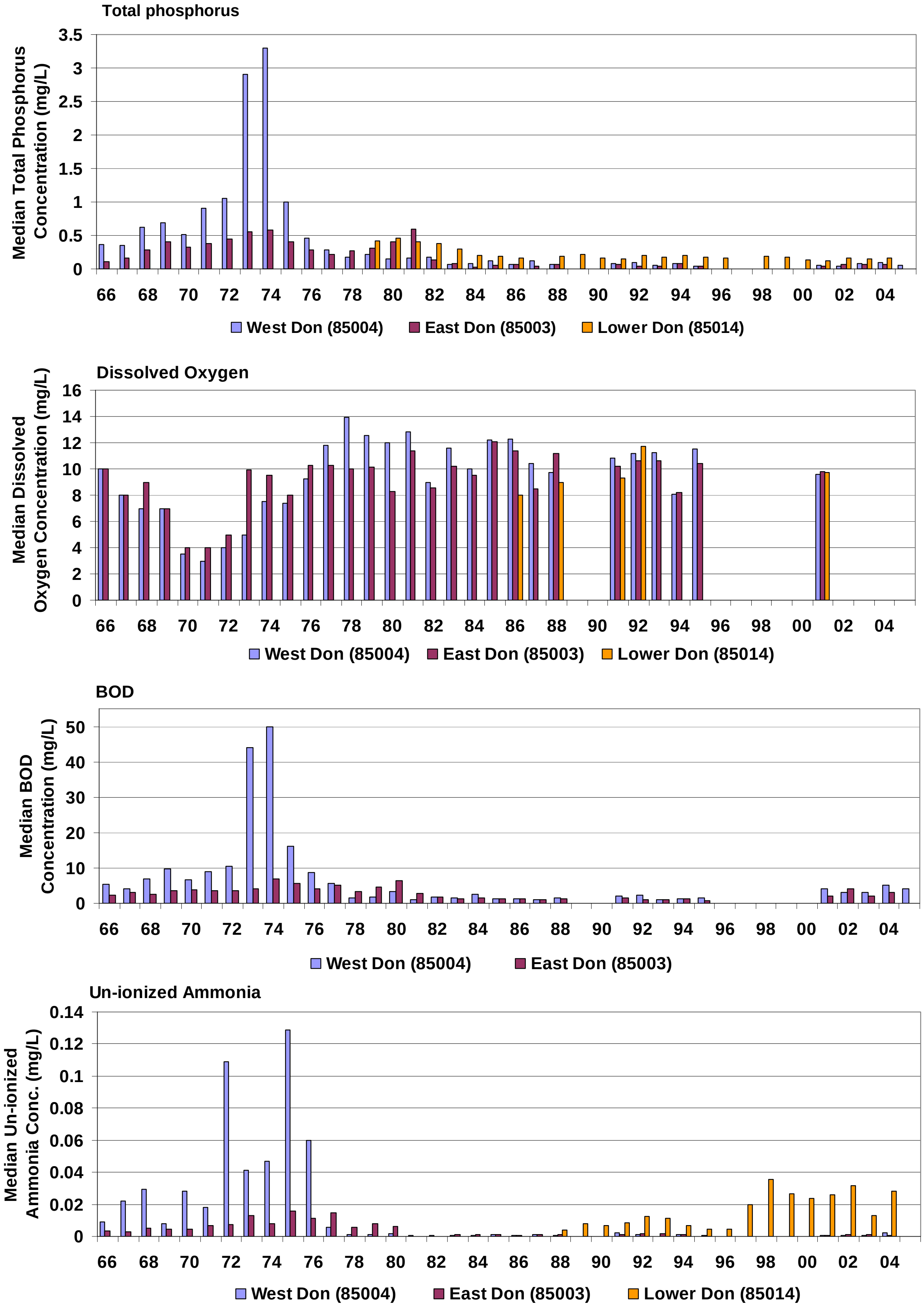
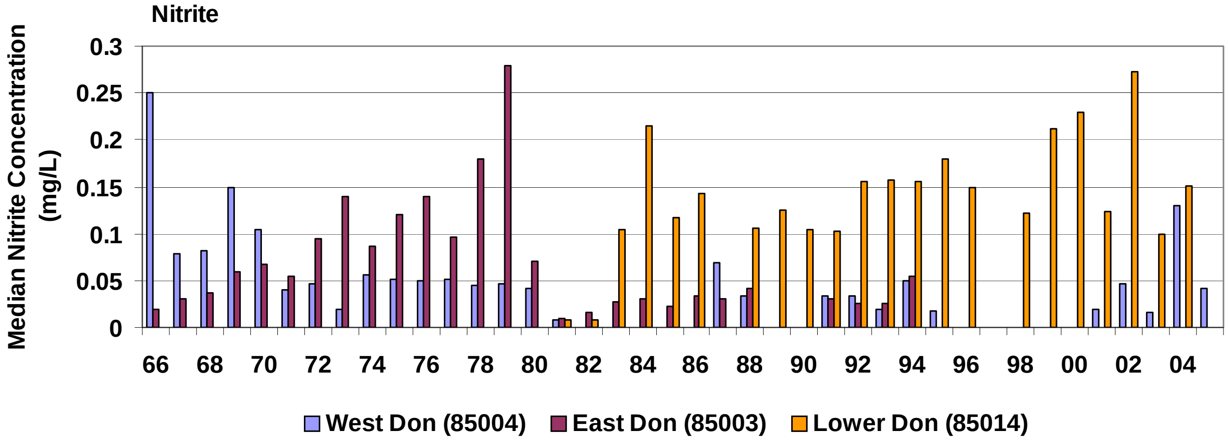
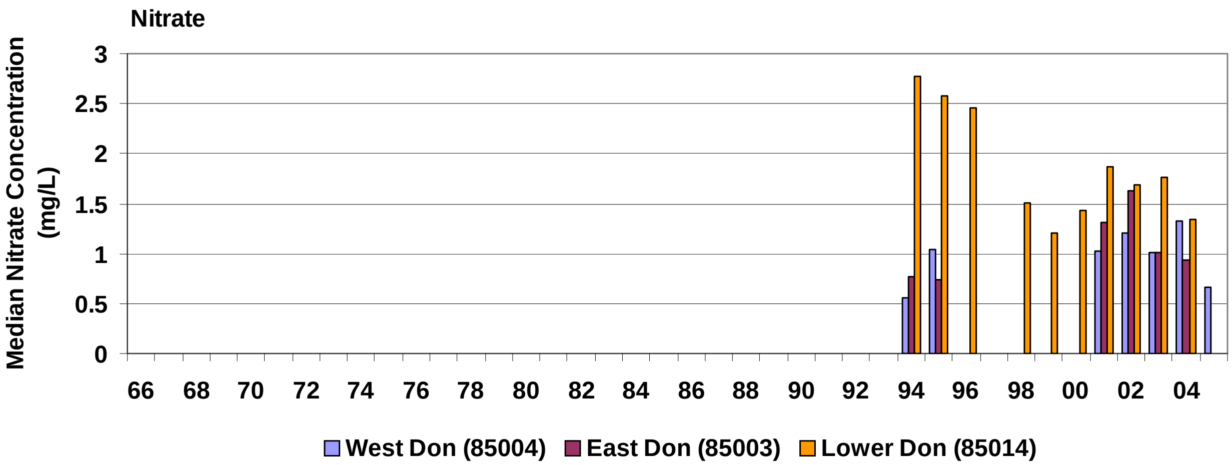


Figure 8: Median nitrite, nitrate, and total kjedhal nitrogen (TKN) concentrations at the Upper West Don, Upper East Don and Lower Don monitoring stations.





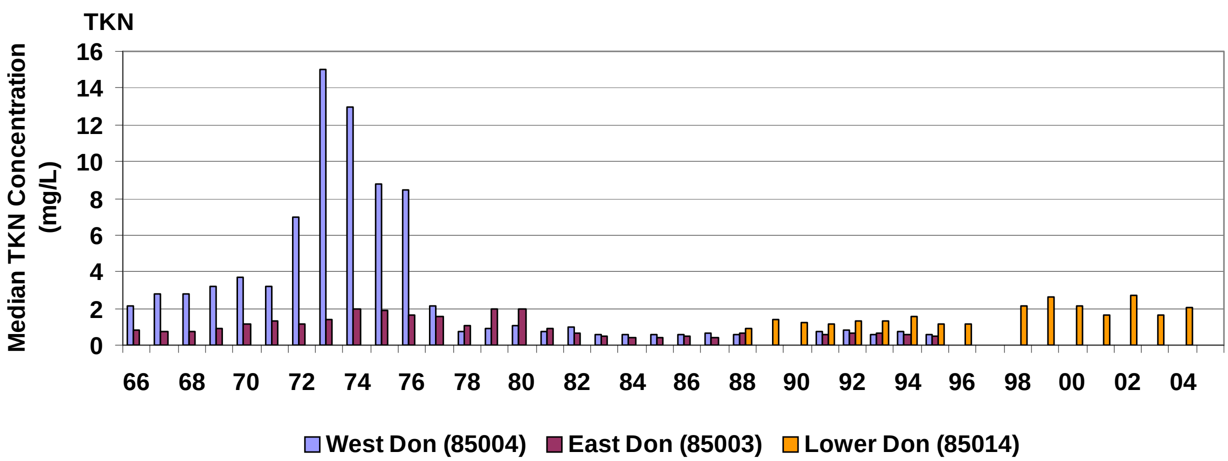


Figure 9: Summer (May to October) and Winter (Nov. to April) chloride levels in the Upper East, Upper West and Lower Don. The chloride acute toxicity threshold for the protection of sensitive aquatic organisms is approximately 250 mg/L (EC and HC, 2001).

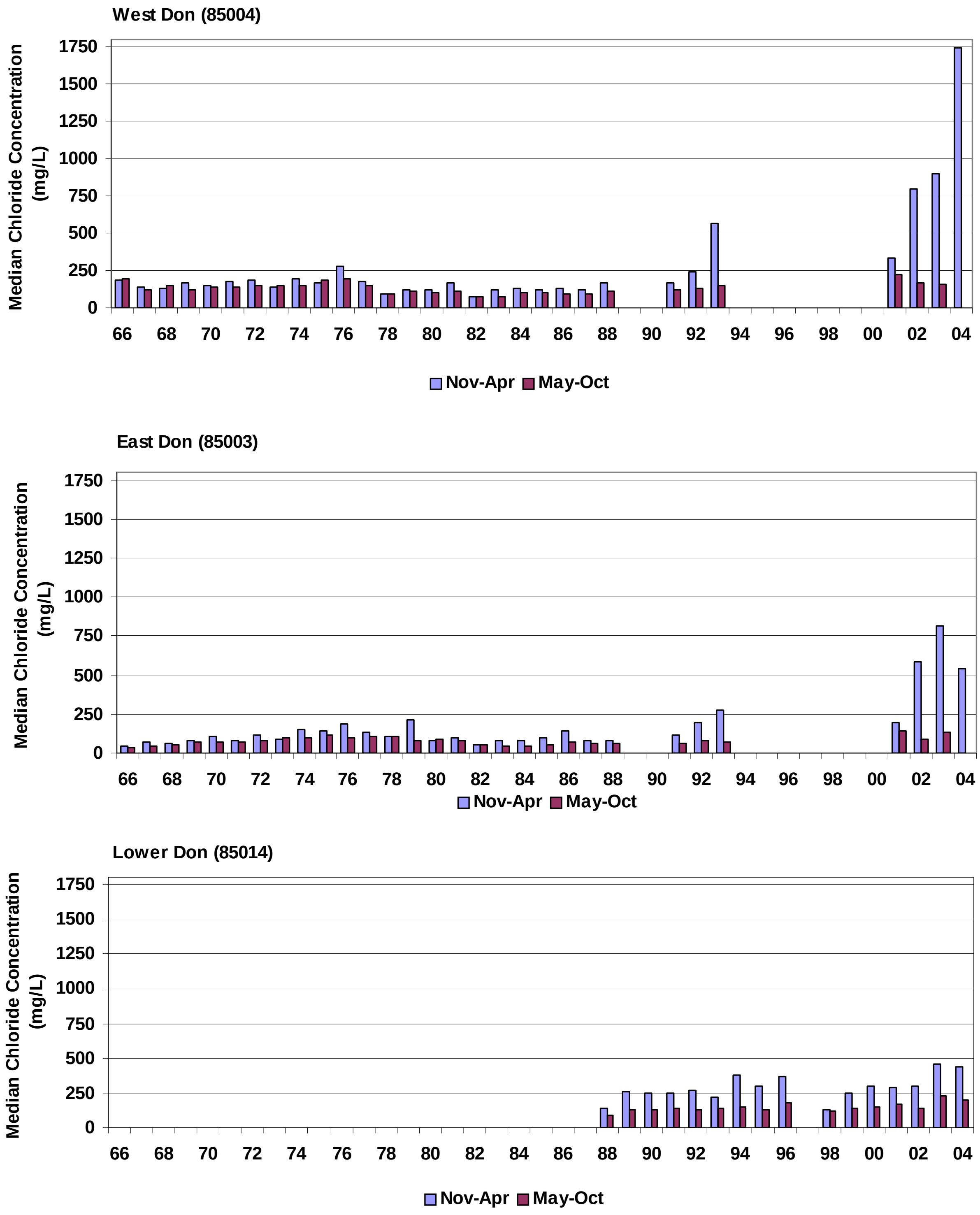


Figure 10: Median concentrations of faecal coliforms (until 1994) and *E.coli* (1995 and after) at the Upper West Don, Upper East Don and Lower Don monitoring stations.

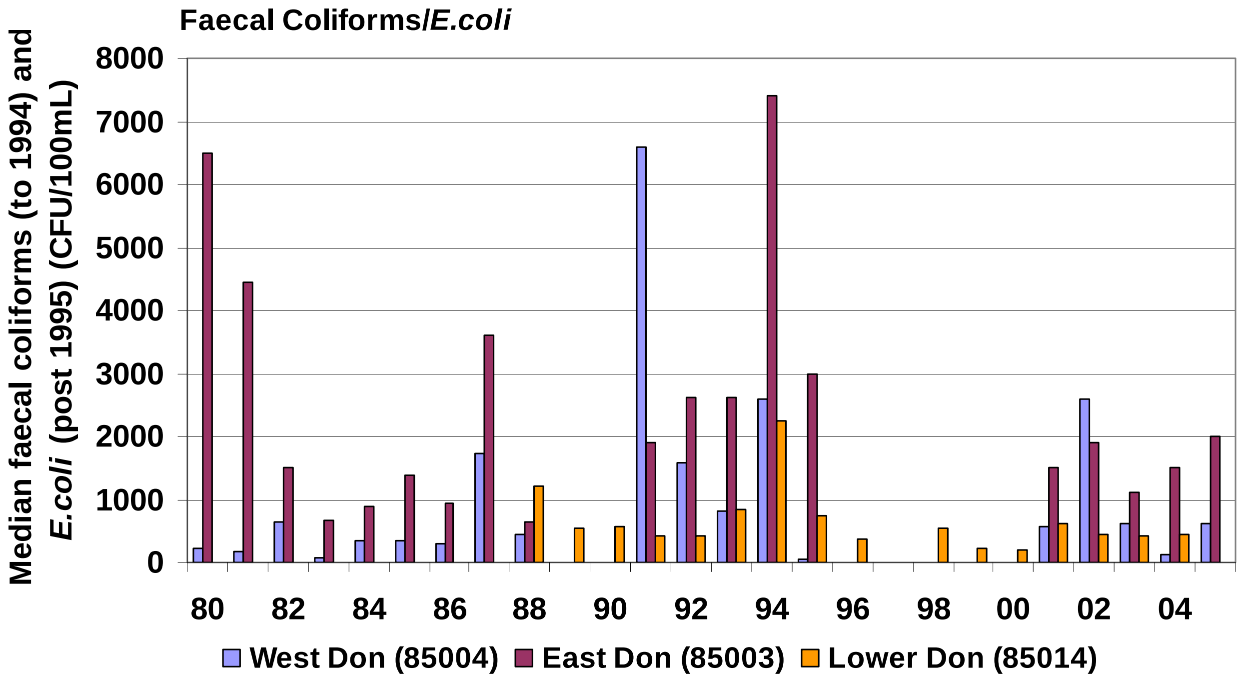
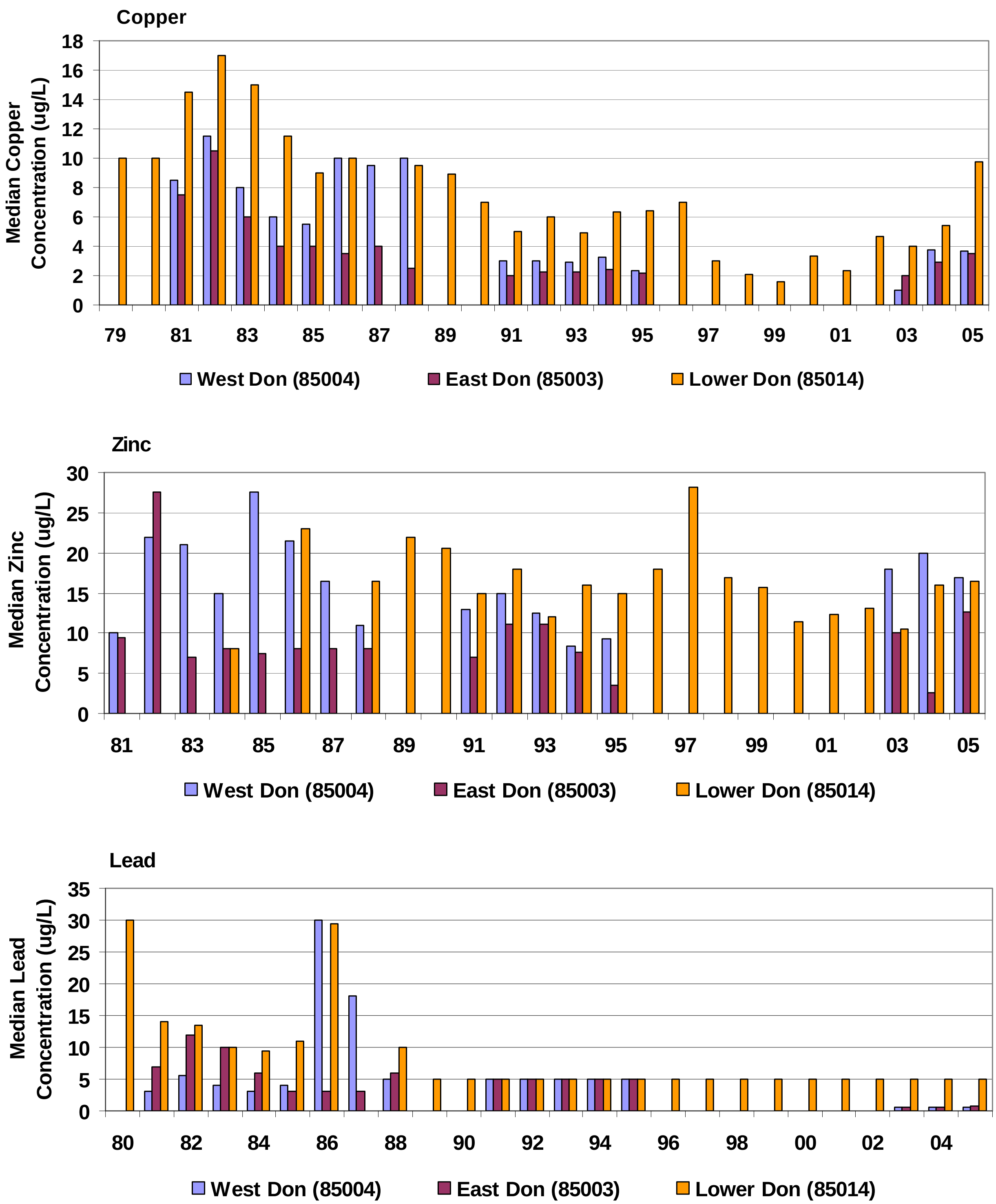


Figure 11: Median concentrations of copper, zinc and lead at the Upper West Don, Upper East Don and Lower Don monitoring station.



Note: The laboratory that analyzed metals in samples collected in the East and West Don starting in 2003 had a lower reporting method detection limit for lead (0.6 ug/L) than did the lab that analyzed samples collected at the lower Don station, and at all stations prior to 1996 (10 ug/L). Values below the detection limit since 1989 were set at half the detection limit.

6.0 Conclusions and Management Considerations

Surface water quality in the Don River reflects a watershed that is heavily urbanized and has relatively few measures in place for the control of stormwater. Although progress has been made in recent years on implementing stormwater controls, they are not yet extensive enough to change water quality conditions. In addition, untreated human sewage still occasionally overflows into the lower reaches of the Don from combined sewers. Chloride levels regularly exceed the threshold for the protection of aquatic life and the situation is becoming worse as development expands northward. Bacteria and phosphorus levels remain high in the watershed, particularly during wet weather periods.

While the lower watershed exhibits the poorest overall water quality, areas north of Toronto are not significantly better. The West Don station at Highway 7, for instance, had the highest median concentrations of TSS, chloride, iron and zinc. Elevated TSS and turbidity levels in the West Don are attributed to intense construction activity upstream of this station, especially during 2002 and 2003. Since 2005, the construction activity has shifted to the East Don, which was the cleanest of all sites monitored until the end of 2004. Avoiding a repeat of the West Don experience will require tight enforcement of erosion and sediment control plans on all construction sites in the East Don.

Elevated levels of phosphorus, and un-ionized ammonia at the Pottery Road site suggest that effluent discharges from the North Treatment Sewage Plant a short distance upstream may be adversely impacting water quality in the lower reaches of the watershed. While phosphorus has declined at Pottery Road during the 1980s, and has remained relatively constant through the 1990s and early 2000 period, a sustained increase in un-ionized ammonia above levels considered safe for aquatic life appear to have occurred since the late 1990s. The cause of this increase and potential solutions to the problem require further investigation.

The Taylor/Massey Creek station had the fewest number of samples that met the chloride and nitrate guidelines and the highest mean concentrations of *E.coli*. This fully urbanized tributary to the lower Don River is renowned for having the largest number of closed landfills (a source of chloride among other contaminants) and an unusual number of ‘priority’ outfalls. Sampling of dry weather flows from these outfalls by the City of Toronto (2005) has shown them to contain exceptionally high concentrations of bacteria and nutrients. Some of this contamination may be attributed to illegal connections of toilets and sinks to storm sewers during do-it-yourself home renovations, and a portion may represent cross flow of sanitary sewage to storm sewers through cracks and fissures in the pipes. The City is currently tracking these flows through its priority outfall monitoring program and has already begun to implement remedial measures on some outfalls.

While mean bacteria concentrations were highest on Taylor/Massey Creek, they were not significantly higher than on the Upper East Don. Even during dry weather flows, *E.coli* concentrations at both stations never met the provincial guideline for body contact recreation. This was an unexpected finding as the Upper East Don receives significant clean water discharges from the Oak Ridges Moraine aquifer and stormwater in the drainage area upstream of the monitoring station is partly controlled. Synoptic dry weather outfall monitoring should be conducted in Richmond Hill, Vaughan and Markham to help identify the potential source of bacterial contamination.

Winter levels of chloride, primarily from road salts, rose in the upper and lower portions of the watershed since the early 1990s. Winter levels were consistently above the threshold established to protect aquatic life. The West Don has been particularly hard hit as upstream areas have been developed. A similar impact may be expected in the upper East Don as development activity shifts to this branch of the watershed. A leveling off of chloride levels in Don streams may occur in the future as municipal salt management plans, developed in 2004, begin to take effect. Alternatives to road salts will need to be considered on local roads if significant reductions in chloride levels are to occur.

The provincial objective for phosphorus in receiving waters was not met more than 50% of the time anywhere in the Don. Elevated levels in the upper portions of the watershed in part reflect the limited ability of current stormwater ponds and other end-of-pipe stormwater management facilities to reduce this constituent to levels at or below the receiving water objective. Even during dry weather, effluent concentrations from stormwater ponds and wetlands are typically at least double the provincial objective for phosphorus. Stormwater infiltration practices such as permeable pavement and underground perforated pipe systems are much more effective in reducing phosphorus loads but currently these practices are still relatively rare in the Don River watershed. In the lower parts of the watershed, and in other areas lacking stormwater controls, fertilizer use on lawns and golf courses, as well as combined sewer overflows are likely the most important sources of phosphorus.

The sources of organic compounds are almost as diverse as the compounds themselves. Many enter the watershed through atmospheric deposition, others are sprayed on vegetation to control weeds or insects, some enter through storm or sanitary sewers, as discharge from industry or as accidental spills, and some of these same chemicals are so persistent that they continue to be detected in stream sediments and fish even decades after being phased out. Federal governments on both sides of the border work together to reduce the use of organic compounds that have been shown to persist and bio-accumulate in the food chain. These activities may take the form of outright bans on chemicals or involve targets for reduced chemical use through, for instance, industrial pollution prevention programs. The gradual decline in levels of some banned chemicals (*e.g.* PCBs) in the Great Lakes has demonstrated the effectiveness of these measures.

Organic and inorganic chemicals entering watercourses through spills or accidental discharges are controlled by federal, provincial and municipal governments through a complex array of regulations and programs. The large number of spills that continue to occur in the GTA suggest that still more could be done in this area. Actions that would help to address this problem include better spill prevention programs, improved structural controls on spill prone areas, stronger penalties for violations and stepped-up enforcement of existing laws.

Pollutants deposited into waterways via the atmosphere are not so easily managed on an individual watershed basis since they often originate many kilometers from where they are deposited, even from entirely different continents. Some, such as polycyclic aromatic hydrocarbons (PAHs), are classified as probable human carcinogens. Reductions in fossil fuel consumption and use of cleaner energy sources such as wind power and solar energy would help to cleanse the air of these contaminants. Renewable sources of energy have become significantly cheaper over the last 10 years, and further price reductions will likely occur in the future as the cost of conventional sources rise and more and more of our energy needs are supplied by renewables. Pesticide by-laws, such as was enacted in Toronto in 2004, will also help to reduce atmospheric emissions of some volatile compounds.

Overall, water quality in many parts of the Don River have improved significantly since the 1970s and early 1980s, when there were several sewage treatment plants discharging to the river. The large spikes in phosphorus, biological oxygen demand, TKN and un-ionized ammonia associated with these plants have been permanently eradicated from the watershed. Suspended solids and turbidity have also witnessed a modest decline in the river north of Steeles since the 1980s, probably due to improved stormwater management and better erosion and sediment controls on construction sites. The West Don monitoring shows that more still needs to be done in controlling construction sediment discharges. Lead levels in water have fallen consistent with trends all across North America with the phase out of lead from gasoline in the 1970s and 80s. The new and rising threat to the watershed is chloride as some of the last remaining rural lands are developed and improved municipal road salt management programs are still in the early stages of implementation. Most stormwater management practices are not effective at controlling chloride, leaving prevention and more efficient and judicious application of road salts as the primary tools available in the fight against this pollutant.

The following management recommendations should be considered in the *Don River Watershed Plan*, to address improvement in surface water quality conditions:

- Progress in stormwater and combined sewer overflow management is needed to improve water quality conditions throughout much of the watershed.
- Stormwater ponds should be retrofitted to incorporate water quality and erosion controls.
- Outreach education and stewardship regarding pollution prevention best management practices (BMPs) should target watershed residents and businesses – particularly those adjacent to watercourses.
- Winter maintenance (i.e., salt management) should be optimized to minimize salt use and its impacts on water quality. Considerations should include:
    - Additional research on effectiveness of salt management BMPs at key locations (e.g., highways, snow dump sites), including salt application techniques and temporary storage tanks.
    - Additional research on the potential impacts of climate change on winter maintenance needs and options
    - Design, operations and maintenance of stormwater ponds to minimize release of concentrated plumes
    - Review and implement municipal salt management plans with special consideration for protecting sensitive headwaters and groundwater resources on the Oak Ridges Moraine
- Monitoring is needed to identify the source of high dry weather *E. coli* levels in the Upper East Don River subwatershed.

- Monitoring is needed to determine the impact of closed landfills on surface and groundwater quality in the watershed.

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Appendix A: Don River Water Quality Data Collected by the Regional Watershed Monitoring Program from 2002 to 2005

Station #: 85003 (Bayview and Steeles N of Steeles Bridge)
(data collected from 1/31/02 to 7/19/05)

	#Obs	Min	Max	Mean	Median	PWQO or other guideline	% Meet Objective
Phosphorus (mg/L)	17	0.015	0.118	0.07	0.07	0.03	12
Suspended Solids (mg/L)	17	2	100	14	5	30.0	88
Chloride (mg/L)	16	86	3300	644	422	250	44
Un-ionized Ammonia (mg/L)	17	0.0001	0.0034	0.0013	0.0010	0.02	100
Nitrate (mg/L)	16	0.54	3.1	1.25	1.0	1.0 / 2.5	50 / 94
***E. Coli* (CFU/100 mL)**	*37*	*10*	*10000*	*2096*	*1500*	*100*	*3*
Aluminum	*17*	*0.5*	*389*	*30*	*0.5*	*75*	*94*
Cadmium	*17*	*0.05*	*0.3*	*0.12*	*0.05*	*0.5*	*100*
Chromium	*17*	*0.1*	*6*	*1.78*	*1.04*	*8.9*	*100*
Copper	*17*	*0.1*	*6.2*	*2.94*	*3.10*	*5*	*88*
Iron	*17*	*103*	*719*	*355*	*291*	*300*	*53*
Lead	*18*	*0.3*	*1.9*	*0.67*	*0.6*	*5*	*100*
Nickel	*17*	*0.05*	*11*	*1.5*	*0.74*	*25*	*100*
Zinc	*17*	*0.1*	*22*	*9.40*	*11.18*	*20*	*94*

Station #: 85014 (Pottery Rd. and Bayview Ave. just S of Pottery Rd. Bridge) (data collected from 1/31/02 to 7/19/05)							
	#Obs	***Min***	***Max***	***Mean***	***Median***	***PWQO or other guideline***	***% Meet Objective***
Phosphorus (mg/L)	*72*	*0.01*	*0.50*	*0.18*	*0.15*	*0.03*	*7*
Suspended Solids (mg/L)	*17*	*4*	*39*	*12*	*8*	*30.0*	*88*
Chloride (mg/L)	*71*	*27*	*3920*	*437*	*220*	*250*	*59*
Un-ionized Ammonia (mg/L)	*71*	*0.0002*	*0.18*	*0.042*	*0.023*	*0.02*	*45*
Nitrate (mg/L)	*70*	*0.85*	*4.4*	*1.7*	*1.5*	*1.0 / 2.5*	*13 / 89*
***E. Coli* (CFU/100 mL)**	*54*	*10*	*44000*	*2839*	*615*	*100*	*31*
Aluminum	*68*	*5.5*	*1060*	*220*	*117*	*75*	*38*
Cadmium	*68*	*0.14*	*1.26*	*0.33*	*0.30*	*0.5*	*94*
Chromium	*68*	*0.4*	*6*	*1.55*	*0.7*	*8.9*	*100*
Copper	*68*	*0.8*	*70*	*7.45*	*4.84*	*5*	*53*
Iron	*53*	*146*	*1890*	*495*	*357*	*300*	*34*
Lead	*68*	*5*	*14.6*	*5.4*	*5.0*	*5*	*94*
Nickel	*68*	*0.35*	*12.90*	*1.72*	*1.46*	*25*	*100*
Zinc	*68*	*5*	*61*	*19*	*13*	*20*	*66*

Station #: 85004 (Hwy 7 and N Rivermede north of Hwy 7 bridge) (data collected from 1/31/02 to 7/19/05)							
	#Obs	***Min***	***Max***	***Mean***	***Median***	***PWQO or other guideline***	***% Meet Objective***
Phosphorus (mg/L)	16	0.02	12	0.82	0.08	0.03	13
Suspended Solids (mg/L)	16	3	1810	137	20	30.0	69
Chloride (mg/L)	15	118	2850	989	580	250	33
Un-ionized Ammonia (mg/L)	16	0.0001	0.0072	0.002	0.001	0.02	100
Nitrate (mg/L)	15	0.55	2.3	1.2	1.2	1.0 / 2.5	33 / 100
***E. Coli* (CFU/100 mL)**	32	10	4000	800	565	100	16
Aluminum	14	0.5	4710	379	7.31	75	79
Cadmium	15	0.05	4.74	0.45	0.12	0.5	93
Chromium	14	0.1	47	5.52	2.81	8.9	93
Copper	14	0.1	18.6	4.3	3.13	5	79
Iron	14	246	5970	807	402	300	7
Lead	14	0.3	3.1	0.61	0.3	5	100
Nickel	14	0.05	16.4	3.07	1.05	25	100
Zinc	14	0.2	120	24	19	20	64

Station #: DM6.0 (Don Mills Rd. and Overlea Blvd. Taken in Taylor Creek Park under) DVP Bridge (data collected from 1/31/02 to 7/19/05)							
	#Obs	***Min***	***Max***	***Mean***	***Median***	***PWQO or other guideline***	***% Meet Objective***
Phosphorus (mg/L)	*18*	*0.01*	*0.3*	*0.08*	*0.07*	*0.03*	*17*
Suspended Solids (mg/L)	*17*	*2*	*32*	*8.6*	*6*	*30.0*	*94*
Chloride (mg/L)	*17*	*187*	*5070*	*1233*	*422*	*250*	*6*
Un-ionized Ammonia (mg/L)	*18*	*0.00009*	*0.016*	*0.004*	*0.0032*	*0.02*	*100*
Nitrate (mg/L)	*17*	*1.0*	*3.7*	*2.4*	*2.3*	*1.0 / 2.5*	*6 / 65*
***E. Coli* (CFU/100 mL)**	*35*	*10*	*8600*	*2302*	*1800*	*100*	*3*
Aluminum	*19*	*0.5*	*0.5*	*0.5*	*0.5*	*75*	*100*
Cadmium	*18*	*0.05*	*0.3*	*0.14*	*0.12*	*0.5*	*100*
Chromium	*18*	*0.1*	*142*	*11.8*	*1.5*	*8.9*	*83*
Copper	*17*	*0.1*	*13.8*	*5.0*	*4.8*	*5*	*59*
Iron	*18*	*213*	*681*	*365*	*362*	*300*	*35*
Lead	*18*	*0.3*	*1.03*	*1.2*	*0.67*	*5*	*94*
Nickel	*18*	*0.05*	*61*	*5.66*	*1.98*	*25*	*94*
Zinc	*17*	*0.8*	*53*	*21*	*12*	*20*	*71*