Chapter 3

Surface Water Quality

3.1 Introduction

The surface water quality of the Thames River has undergone vast changes in the past century as a result of human activity in the watershed. For example, prior to the use of urban sewage treatment plants, large amounts of raw sewage went directly into the river. The Thames River also received significant inputs of non-urban industrial waste (e.g. from small dairies). While significant improvements have been made in the treatment of sewage, stormwater and industrial waste, other problems still exist and new problems have been detected.

There are concerns about the ability of the river to sustain a healthy and diverse fish population. While the Thames River supports one of the most diverse fish communities in Canada with approximately 90 species, several species are considered at risk by COSEWIC (Committee on the Status of Endangered Wildlife in Canada). Further, the Thames once supported one of the largest and most diverse populations of freshwater mussels. These populations are greatly reduced and several are also listed as 'species at risk.'

Greenside Darter

There are public health concerns related to the recreational use of the Thames River. Elevated levels of bacteria such as *Escherichia coli* in the water can cause ear, eye, nose and throat infections and increased phosphorous loadings can cause nuisance algae growth. These conditions have resulted in numerous beach closures at the three reservoir beaches (Fanshawe, Wildwood and Pittock) over the years and have prompted many studies.

Some of the pollution sources affecting local water quality were documented (Clean Up Rural Beaches (CURB) study, 1989) to include: improper sewage treatment plant discharges (e.g. stormwater bypasses), faulty private septic systems, industrial discharges, urban runoff (may contain organic pollution, petroleum products, pesticides, and fertilizers), and agricultural runoff (may contain livestock manure, pesticides, fertilizers, milkhouse wastewater).

A number of programs have promoted the use of Best Management Practices and have provided incentives to landowners to undertake remedial projects. A great deal of work has been carried out in the agricultural, municipal and industrial sectors to improve water quality. The impact of some of these efforts can be seen at Pittock Reservoir where there has been a 75% reduction in bacteria concentrations since the late 1980s.

Great strides have been made, but much work is still needed to maintain and improve the aquatic health of the Thames and its tributaries. There is a need to document local conditions in order to effectively target conservation programs. There is also a need to identify areas lacking data in order to enhance monitoring programs.

3.2 Indicators and Grades

In order to establish a water quality grading system, indicators were chosen from a long list of parameters routinely analyzed in surface water. The following four indicators provide the best overall information with regards to stream health within the Upper Thames River watershed:

- benthic invertebrate score,
- total phosphorous,
- fecal bacteria, and
- conductivity.

Descriptions and definitions for each of these indicators are given in Table 4 and in each subwatershed report card.

Each indicator was given a weight according to its overall importance in predicting stream health. Since benthic organisms are the best overall indicator and, in some cases, the only data available, the benthic parameter was given the highest weighting of 50%. Phosphorus and bacteria concentrations are about equally important in defining water quality and were weighted 20% each. Conductivity is somewhat less indicative and was weighted 10%. Variations on these weightings were tried with no significant difference in the final outcome.

Table 4. Description of Surface Water Quality Indicators

Indicator	Benthic	Phosphorus	Bacteria	Conductivity
What it measures	The benthic invertebrate organisms (bug life) living in stream sediments	The amount of phosphorus in the water	The amount of *E. coli* bacteria in the water	The ability of a solution to conduct an electrical current
How it is calculated	A system called the 'Family Biotic Index' is used to assess water quality based on the number and type of invertebrates found in a sample. Each species of invertebrate is given a score that relates to its pollution-tolerance. The larger the number, the more pollution-tolerant that organism is.	A 10 year average concentration measured in mg of phosphorus per litre of water (data from the Provincial Water Quality Monitoring Network, MOEE)	A 10 year average concentration measured in number of *E. coli* bacteria per 100 ml of water (data from the Provincial Water Quality Monitoring Network, MOEE)	A 10 year average of conductivity measured in microSiemens per cm (data from the Provincial Water Quality Monitoring Network, MOEE)
Why it is important	Benthic organisms are an excellent indicator of the quality of the water where they live. Because they are relatively immobile, the presence or absence of specific species gives good information on water conditions over time. These organisms are at the bottom of the food chain; therefore, they reflect the health of the aquatic ecosystem.	Phosphorus binds to soil particles and thus is an indicator of soil delivery to streams (as well as other contaminants that are carried to the stream on soil particles). Phosphorus is found in soaps, detergents, fertilizers, and pesticides and contributes to algae blooms in streams and lakes.	*E. coli* bacteria are found in human and animal waste and its presence in water indicates fecal contamination. *E. coli* bacteria is also a strong indicator of the potential to have other disease-causing organisms in a stream.	Conductivity is a numerical expression of water's ability to conduct an electrical current. It can be related to the amount of dissolved solids or pollutants in the water. The higher the conductivity, generally the higher the concentration of dissolved solids and pollutants in the water.

3.3 Data Source

Two separate water quality information programs have been operating in the Upper Thames watershed over the years. The Benthic Monitoring Program and Provincial Water Quality Monitoring Network have both provided valuable information on the quality of the Thames and its tributaries.

Benthic Monitoring Program

Benthic invertebrate data have been collected at various sites throughout the Upper Thames since 1994. The Benthic Monitoring Program is a cooperative venture between the UTRCA and the University of Western Ontario (UWO) Zoology Department. Every year, UTRCA staff collect samples from approximately 100 sites across the watershed (fewer sites were sampled in the early years). Each site is sampled once in the spring and some are re-sampled in the fall.

The samples of benthic invertebrates are taken to the UWO lab and identified. The information is entered into a database. The data used in this *Upper Thames River Report Card* were taken from the benthic monitoring sites at or near the outlet of each subwatershed.

Provincial Water Quality Monitoring Network

Surface water chemistry is presently monitored at 15 sites within the Upper Thames watershed as part of the Provincial Water Quality Monitoring Network (PWQMN), a cooperative effort between the UTRCA and the Ministry of the Environment. These sites are part of the original provincial water quality monitoring program that was initiated in the 1960s. Up until 1996, data were collected from 23 sites. The number of sites was reduced due to provincial funding cutbacks.

Water samples are collected on a monthly basis and analyzed for the presence of metals, nutrients and bacteria. Only data for the last 10 years (1990-2000) were used in this report card. Ten year geometric means were used to eliminate any bias that may result from a particularly wet or dry year.

Since there are only 15 PWQMN stations in this network, not all of the 28 subwatersheds were covered. Sixteen of the subwatersheds used the PWQMN data, with the Middle Thames and Mud Creek subwatersheds using data from the same station. The specific location of the PWQMN sites is noted on a map in Figure 8.

Other Water Quality Data Sources

Additional data sources were used to cover four of the subwatersheds not included in the PWQMN. The City of London has 13 long term monitoring sites around the city and these data were used to represent Pottersburg, Medway and the Forks subwatersheds.

Short term data exists for some tributaries in the London area that were part of the London Subwatershed Study (1995). Stoney Creek subwatershed report card used data from this study.

No water chemistry data exist for the other nine subwatersheds. In order to grade all of the subwatersheds, scores for these nine were based on benthic data alone, while others are based on all four indicators. The data sources are noted on each subwatershed report card (see Appendix B).

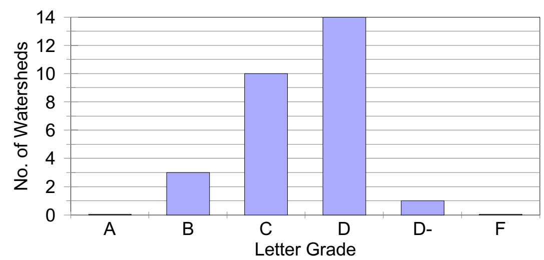
Benthic Sampling

3.4 Results

Table 5 lists the final grades and point scores for each of the 28 subwatersheds. Figure 5 maps the distribution of the subwatershed grades within the Upper Thames basin. Table 6 summarizes the information in table form.

As Figure 6 illustrates, most of the subwatersheds fall into the average grades of C and D with only a few grading B or D-. The overall average grade for surface water quality in the Upper Thames River watershed is D.

Figure 6. Distribution of Grades Surface Water Quality



Overall, the poorest water quality conditions exist in the Dingman Creek watershed which is subject to both heavy urban and agricultural inputs. The best conditions were found in Komoka Creek, Gregory Creek and the Plover Mills corridor where riparian cover is high and more natural stream conditions and flow characteristics (e.g. lots of pools and riffles) prevail.

Since the PWQMN program began documenting chemistry and bacteria parameters in the 1960s, there has been some improvement and some deterioration. Seventeen subwatersheds have shown an improvement in total phosphorus levels but four show worsening conditions, and seven have stayed relatively the same. Conductivity levels have worsened slightly throughout the watersheds since the 1970s, while bacteria levels have varied widely.

Table 5. Surface Water Quality: Indicator Data, Points and Grades

Subwatershed	Benthic			Phosphorus			Bacteria			Conductivity			Final	
	Result	Points	Grade	Result mg/l	Points	Grade	Result per 100 ml	Points	Grade	Result µs/cm	Points	Grade	Score	Grade
Avon	5.23	3	C	0.121	2	D-	711	2	D	900	1	D-	2.4	D
Black	6.08	2	D	-	-		-	-		-	-	-	2.0	D
Cedar	5.75	2	D	0.077	2	D-	638	2	D	656	2	D	2.0	D
Dingman	6.70	1	D-	0.108	1	D-	591	2	D	762	1	D	1.2	D -
Dorchester	5.82	2	D	0.076	2	D	184	4	B	717	2	D	2.4	D
Fish	6.12	2	D	-	-		-	-		-	-	-	2.0	D
Flat	5.73	3	C	-	-		-	-		-	-	-	3.0	C
Forks	6.17	2	D	0.184	0	F	690	2	D	586	3	C	1.7	D
Glengowan	4.83	4	B	0.057	3	C	306	3	C	697	2	D	3.4	C
Gregory	4.96	4	B	-	-		-	-		-	-	-	4.0	B
Komoka	5.00	4	B	-	-		-	-		-	-	-	4.0	B
Medway	5.46	3	C	0.091	2	D	303	3	C	486	3	C	2.8	C
Middle Thames	5.55	3	C	0.050	3	B	203	3	C	655	2	D	2.9	C
Mud	5.47	3	C	0.050	3	B	203	3	C	655	2	D	2.9	C
North Mitchell	6.57	1	D-	0.076	2	D	407	3	C	604	2	D	1.7	D
North Woodstock	5.15	3	C	0.090	2	D	108	4	B	639	2	D	2.9	C
Otter	5.19	3	C	-	-		-	-		-	-	-	3.0	C
Oxbow	5.58	3	C	-	-		-	-		-	-	-	3.0	C
Plover Mills	4.97	4	B	0.074	3	C	58	4	B	546	3	C	3.7	B
Pottersburg	6.10	2	D	0.050	4	B	343	3	C	613	2	D	2.6	C
Reynolds	5.75	3	C	0.107	1	D-	762	1	D-	654	2	D	2.1	D
River Bend	4.98	2	B	0.151	0	F	321	3	C	664	2	D	1.8	D
South Thames	5.66	3	C	0.115	1	D-	533	2	D	771	2	D	2.3	D
Stoney	6.01	2	D	0.055	3	C	440	3	C	492	3	C	2.5	D
Trout	6.81	1	D-	0.058	3	C	256	3	C	592	3	C	2.0	D
Waubuno	5.22	3	C	-	-		-	-		-	-	-	3.0	C
Whirl	5.76	2	D	0.076	2	D	407	3	C	604	2	D	2.2	D
Wye	5.99	2	D	-	-		-	-		-	-	-	2.0	D
Mean	**5.66**			**0.08**			**305**			**642**			**2.5**	D

Range of Percentage Values separated into Points and Grades

Benthic	Phosphorus	Bacteria	Conductivity	Points	Grades
< 4.25	<0.025	< 50	< 200	5	A
4.25 - 5.00	0.025 - 0.050	51 - 200	200 - 400	4	B
5.10 - 5.75	0.051 - 0.075	210- 500	201 - 600	3	C
5.76 - 6.50	0.076 - 0.100	501 - 750	601 - 800	2	D
6.60 - 7.25	0.110 - 0.125	751 - 1000	801 - 1000	1	D-
> 7.25	>0.125	> 1000	> 1000	0	F

Final Grades	
>4.5	A
3.6-4.5	B
2.6- 3.5	C
1.6 - 2.5	D
0.5 - 1.5	D-
< 0.5	F

Sources:

Benthic data taken from the UTRCA Benthic Monitoring Program, 1998-2000.

Phosphorus, bacteria and conductivity data taken from OMOE, Provincial Water Quality Monitoring Network, 1990-2000.

Table 6. Final Surface Water Quality Grades

A (>4.5)	B (3.6 - 4.5)	C (2.6 - 3.5)	D (1.6 - 2.5)	D- (0.6 - 1.5)	F (<0.5)
-------	Plover Mills (3.7) Gregory Cr. (4.0)* Komoka Cr. (4.0)*	Pottersburg Cr. (2.6) Medway Cr. (2.8) Middle Thames (2.9) Mud Cr. (2.9) N. Woodstock (2.9) Waubuno Cr. (3.0)* Flat Cr. (3.0)* Otter Cr. (3.0) Oxbow Cr. (3.0)* Glengowan (3.4)	N. Mitchell (1.7) The Forks (1.7) River Bend (1.8) Black Cr. (2.0)* Cedar Cr. (2.0) Fish Cr. (2.0)* Trout Cr. (2.0) Wye Cr. (2.0)* Reynolds Cr. (2.1) Whirl Cr. (2.2) South Thames (2.3) Dorchester (2.4) Avon River (2.4) Stoney Cr. (2.5)	Dingman Cr. (1.2)	-------

* Grade based on benthic information only

3.5 Watershed Features

In addition to the data used to calculate the grades, a great deal of additional information was compiled for each subwatershed. This includes:

- land use,
- soil type,
- soil erosion/delivery,
- physiography,
- stream flow,
- groundwater,
- fishery resources,
- dams,
- sewage treatment, and
- riparian forests.

This information is outlined in each report card and is presented in more detail in Appendix A.

These parameters help describe why the watersheds experience good or poor health and identify resources in need of protection or remediation. For example, spills, dams and sewage treatment effluent may combine to contribute to poorer water quality.

On average, there have been 10 or fewer spills per subwatershed reported to the MOE since 1988. However, the Forks subwatershed had over 100 spills and Pottersburg Creek and the Avon River watershed each had about 50 spills. Dingman Creek, North Woodstock, South Thames and North Mitchell all had over 15 reported spills (see Figure 7). The source of the spills may be either municipal, industrial or agricultural.

There are about 78 dams and/or weirs on watercourses within the Upper Thames, with an average of two to three per subwatershed (see Appendix A). The majority of dams are privately owned. The Trout Creek, Mud Creek, South Thames, and Medway Creek subwatersheds all have high numbers of dams (e.g. over eight per watershed). Dams and weirs can impair water quality and impede fish migration.

3.6 Actions for Improvement

Using the above information, a list of actions needed for improvement is given in each report card. The action items present specific and common Best Management Practices that would help to improve water quality.

Some actions are specific to a watershed, while others are applicable to all. For example, if coldwater streams are found in a watershed, then targeting the rehabilitation of these streams is important. If a high number of spills have occurred in an area, the issue should be addressed through education, regulation and improved response. Planting buffers (treed or grassed) along all open drains, creeks and rivers to filter runoff and provide shade to streams is an activity that would benefit all watercourses.

These actions are presented merely as a list of options to help improve watershed health. It is recognized that thereare many issues (e.g. economic, cultural) that factor into the existing land uses and local environmental decision-making. These issues clearly influence the extent to which actions can be taken. The list of actions should be viewed as a starting point for community groups, landowners and agencies who wish to contribute to improving water quality.

Bioengineering work on a steep river bank in Lambeth

3.7 Information Gaps

Long term monitoring stations for water chemistry and bacteria data are lacking for nine of the 28 subwatersheds. Other subwatersheds lack data on stream flow, stream status (cold vs. warm water), or fish habitat and populations. Table 7 identifies the subwatersheds that lack any of these available data.

In some watersheds, provincial water quality monitoring data do exist but the monitoring site may not necessarily be located at the downstream end of the subwatershed. Figure 8 maps the existing long term water chemistry and bacteria monitoring stations. It would be beneficial to have a long term monitoring station at the downstream end of each subwatershed.

Groundwater

Groundwater data are severely lacking, making it difficult to assess and track changes in quality and quantity. The MOE is establishing a network of wells to begin a long term monitoring program, that should fill part of this information gap. As a partner in this project, the UTRCA will monitor approximately 12 of these wells within its jurisdiction. This information will be used to assist with watershed drought management strategy and groundwater recharge mapping.

The Counties of Oxford and Perth have recently completed groundwater studies that provide varying degrees of information such as identifying infiltration zones. Middlesex County is also initiating a groundwater study.

The North Thames River near Thorndale

Table 7. Information Gaps in Water Quality Data

Watershed	Long Term Water Chemistry and Bacteria Data	Flow Data	Stream Status (cold vs. warm water)	Fish Habitat and Populations
Avon				
Black	✘	✘	✘	✘
Cedar				
Dingman				
Dorchester				
Fish	✘		✘	
Flat	✘	✘		✘
Forks				
Glengowan			✘	
Gregory	✘	✘		
Komoka	✘	✘		
Medway				
Middle Thames				
Mud	✘	✘		
North Mitchell			✘	✘
North Woodstock				
Otter	✘	✘	✘	✘
Oxbow	✘	✘		
Plover Mills				
Pottersburg		✘		
Reynolds		✘		
River Bend				
South Thames				
Stoney	✘	✘		
Trout			✘*	✘*
Waubuno	✘			
Whirl		✘	✘	✘
Wye	✘			

✘ data lacking for the subwatershed

✘* data lacking for north part of the subwatershed