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TO:	**CHAIR AND MEMBERS** **BUILT AND NATURAL ENVIRONMENT COMMITTEE** **MEETING ON SEPTEMBER 26, 2011**
FROM:	**RON STANDISH, P.ENG.** **DIRECTOR, WASTEWATER AND TREATMENT** **PLANNING, ENVIRONMENTAL AND ENGINEERING SERVICES**
SUBJECT:	**THAMES RIVER WATER QUALITY**

RECOMMENDATION

That, on the recommendation of the Director, Wastewater and Treatment, Planning, Environmental and Engineering Services, this report **BE RECEIVED** and reported to Municipal Council for their information.

PREVIOUS REPORTS PERTINENT TO THIS MATTER

Environment & Transportation Committee Agendas 2010-06-07 item 6 (2010- E07-00): "Thames River Water Quality."

BACKGROUND

Purpose:

To present information on the water quality of the Thames River for 2010.

Executive Summary:

Thames River surface water quality criteria were met or bettered in 13 of 16 Ministry of Environment's surface water quality objectives. Of the three that did not meet the objectives, E. Coli concentrations were exceeded upstream of the City and downstream at Komoka during the disinfection period. The Total Coliform levels leaving the city are higher than those entering during the disinfection period of April 1 to September 30 but are not attributable to the PCP effluents. Overflows from sanitary sewers to storm sewers (to prevent basement flooding) and bypasses of raw sewage at Pollution Control Plants would contribute to the increased coliform counts. Phosphorous increased in the Thames River as it passed through the City due to sources such as fertilizers, residual phosphorus in the effluent from the City's treatment plants and storm water runoff. Individual practices do impact the Thames River and public education on the impacts and what can be done by residents to help are beneficial. The Sewer and Wastewater section and pesticide section of the city web site and the CLEAR network has useful information to assist residents to lower the impact on the Thames River quality.

Context:

The City of London is responsible for the treatment of sewage and conveyance of storm water to the Thames River. This report provides information of the effects on the Thames River by the City.

Discussion:

The Thames River is sampled on a regular monitoring programme at ten locations. The parameters analysed include biochemical oxygen demand (BOD), pH, temperature, dissolved oxygen, total phosphorous, ammonia, bacteriological quality, suspended solids, chlorides, nitrates, nitrites, and conductivity. Heavy metals are sampled at Clarke/Highbury, Whites, Byron, and/or Komoka bridges. The sampling locations are shown on the attached map.

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Water quality in the Thames River has improved significantly since river monitoring was initiated in 1963. The dissolved oxygen levels have increased. Wastewater treatment has improved from 90% efficiency in the 1960's to the present where 99% of the BOD is removed. London's plants perform better than typical wastewater secondary treatment processes that have a removal efficiency of between 85% and 95% for BOD. Furthermore, in 2010, the City of London Pollution Control Plants removed 98% of the suspended solids and 94% of the phosphorous.

Public information about sewage treatment and what residents can do to help is on the City of London website. There is a video on sewage treatment and a Historical perspective of sewage treatment dating back to the 1800's in London. There are pamphlets on Grease management for your home (in eight languages) and a two minute video. There is a pamphlet on Grease management for Restaurants and Best Management Practices for Automotive Service facilities.

Benthic sampling of river bottom species in the Thames River in 2010 indicated that the river quality was fair to excellent using the Ohio Department of Natural Resources Pollution Tolerance Index (PTI). This index has been used by the City for many years because it provides comparisons of water courses within urbanized areas where the water courses are not pristine. The Upper Thames River Conservation Authority (UTRCA) uses the Family Biotic Index which compares to pristine conditions. The calculations at the same sites, based on the Family Biotic Index, lead to results that were very poor at Maitland to very good at the Springbank bridge. Benthic monitoring reports are on the City website.

Benthic sampling using the PTI was also done on Dingman in 2010. Dingman was sampled at eight sites and ranged from excellent at Highbury, Green Valley, Green Lane, White Oak Road, Wonderland, Colonel Talbot and Lambeth to good at Old Victoria. The Family Biotic Index evaluations for the same sites were fairly poor to fair.

A listing of parameters (Appendix A) indicates annual average values and surface water criteria. Comments on noteworthy parameters are as follows:

SUSPENDED SOLIDS

The weighted average concentration of suspended solids discharged from the PCPs in 2010 was 5 mg/L. The average background level of suspended solids levels in the river was three times higher than the average effluent from the PCPs. Suspended solids are a concern due to potential for covering of spawning beds and bottom dwelling organisms.

PHOSPHOROUS

The MOE objective has been based on preventing algae blooms and effectively can only occur in pristine conditions. Phosphorous levels in the Thames River are unfavourable in that they exceed the surface water quality objective by a factor of 2.3 in 2010 entering London, and by a factor of 3.3 at Byron. Phosphorous promotes algae and excessive plant growth. There would be aesthetic benefits in reducing phosphorous levels in the Thames River.

The City currently treats its sewage to reduce phosphorous levels to less than current Ministry of Environment Certificate of Approval criteria which vary from 0.5 to 1.0 mg/L. The weighted average phosphorous effluent level from London's PCP's in 2010 was 0.33 mg/L.

Based on an average for the period 2006 to 2010 inclusive, 81% of phosphorous loading in the Thames River originates upstream of London. The City of London PCP's contribute about 17% and other city sources contribute 2% of the phosphorous loading on an annual basis. There are seasonal variations for phosphorous loading in the Thames River. In the summer, the Pollution Control Plant loading contribution increases to 31% of the load due to decreased river flows. Other sources within London contributed 9% of the load in the spring and 8% of the load in the fall.

The sewage treatment plants have on average removed 91% of phosphorous in sewage.

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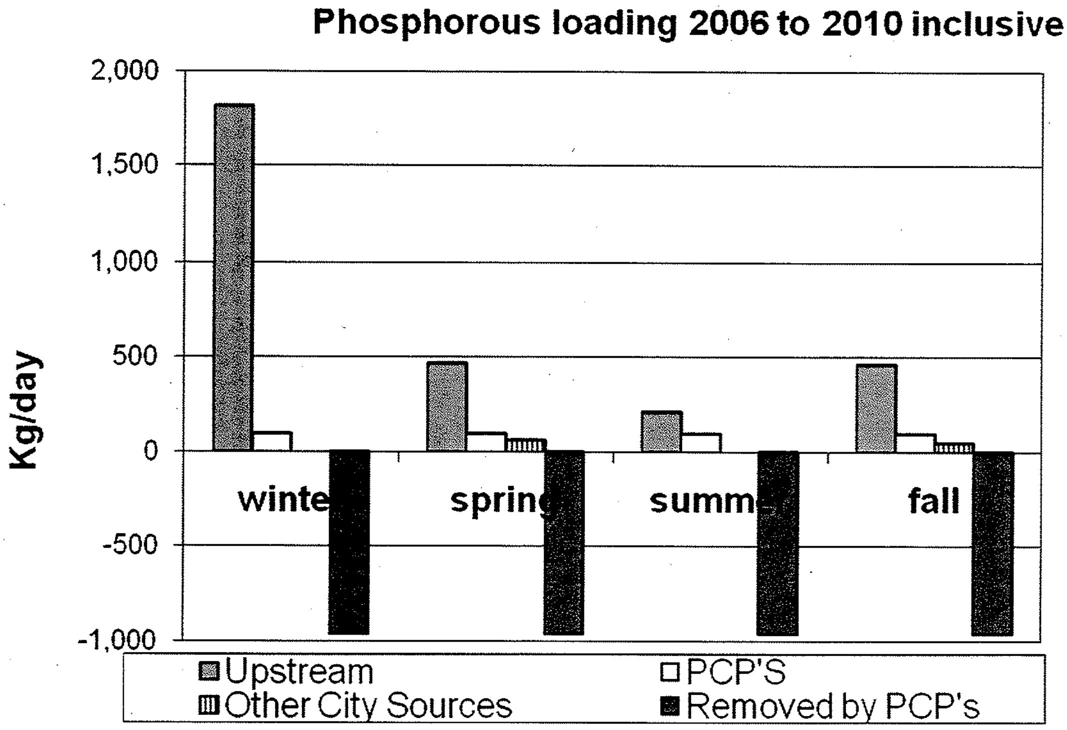

The Ministry of the Environment has targeted phosphorous for further reduction and are taking actions to reduce discharges. As illustrated in the graph above, London Pollution Control Plants contribute up to 31% to the already high background levels in the summer but other sources within London contribute about 9% of the load as well during the spring and 8% of the load in the fall. The City has committed to gradually reduce its phosphorus limits from its treatment plants over the next 20 years through the Discharge Strategy. If a more aggressive approach was desired, it would require the installation of filters at an approximated cost of over $40 million for all the plants.

Contributors of "other city sources" for phosphorous is fertilizers applied to lawns, birds and pets faeces and organic sources. Reducing the practice of applying fertilizers prior to rain storms and minimizing phosphorous based fertilizers would decrease phosphorous contributions to the Thames River. Managing phosphorous in rural areas is problematic.

BACTERIOLOGICAL QUALITY

Bacteriological quality standards are set to prevent diseases and infections for activities such as swimming and bathing. The Escherichia Coli (E. Coli) is the dominant organism in human faeces but is also found in faeces of birds and mammals. E. Coli is used as an indicator organism for pathogens. Total Coliforms are also an indicator of pathogens, but Total Coliforms can also be derived from sources other than sewage and faecal matter. To improve bacteriological quality the City is required to disinfect its Pollution Control Plant effluent during the period of April 1 to September 30 each year (the disinfection season). The following observations are related to the disinfection season:

Total Coliform quality in the Thames River, both entering and leaving the City, has consistently failed to meet surface water quality objectives. The bacteriological quality of effluent from the City of London PCP's (309 organisms per 100 millilitres) was better than the quality entering the City for Total Coliforms, and a third of the surface water quality objective (1,000 MPN per 100 millilitres) for the disinfection period (April 1 to September 30) in 2010. The Ultra Violet light disinfection installed at all of the City's plants is more effective than chlorine disinfection. Despite the superior quality of PCP effluents, the Total Coliform levels leaving the City are higher than those entering. The increasing population of Canada geese represents one source of Total Coliforms.

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The geometric mean in 2010 for **E. Coli** was greater than the surface water criteria entering and leaving the City of London. The bacteriological quality of effluent from London's PCP's was less than half the surface water quality objective for E. Coli in 2010 for the disinfection period.

Overall, E. Coli levels have decreased by a factor of 10 over the past 10 years. Total Coliforms have remained in the same range over the past 10 years. This 10-year decrease in E. Coli levels implies an overall decrease in the level of pathogens in the Thames River.

UN-IONIZED AMMONIA

The surface water objective for un-ionized ammonia is set for the protection of aquatic life. Excessive levels can be toxic.

Un-ionized ammonia levels in the Thames River met the surface water quality objective at Whites, Clarke/Highbury, Byron, and Komoka bridges in 2010.

Sources of ammonia are domestic sewage and fertilizers. The City's PCPs nitrify sewage to reduce ammonia in order to meet Ministry of Environment criteria. Water entering and leaving the City is better than the surface water quality criterion (see Appendix A).

NITRATES

There is no Ontario surface water criterion for nitrates; however, there is a drinking water criterion of 10 mg/L. The proposed "Canadian Council of Minister of the Environment (CCME) Water Quality Guidelines" for nitrate is 13 mg - NO_3/L. There are a number of ways to report nitrates in the literature and the City of London reports nitrates as mg NO_3 – N/L following Standard Methods. The CCME nitrate standard would have to be divided by 4.43 to compare with City of London monitoring data (a CCME proposed limit of 2.9 mg NO_3 – N/L). Nitrate levels averaged 5.2 mg/L entering and 5.4 mg NO_3-N/L leaving the City, with peaks as high as 15.9 mg NO_3-N/L entering the city on the south branch, 7.5 mg NO_3-N/L on the North Branch and 11.7 mg NO_3-N/L leaving the City occurred in 2010. Nitrate levels are higher in the winter than in the summer due to uptake by bacteria in the summer. The weighted average for nitrates discharged from London's sewage treatment plants is 11.8 mg NO_3-N/L. Levels of Nitrates entering and leaving the City of London in the Thames River are higher than the proposed CCME surface water quality guideline. The acute toxicity level for nitrates at the 5th percentile is 61 mg NO_3 – N/L indicating that acute toxicity is not an issue in the Thames River. The long term impact data is based on the Maximum Acceptable Toxicant Concentration (MATC). The MATC for lake trout is 3.1 mg NO_3-N/L due to delay of sac fry to the swim-up stage. Lake trout are found in cold deep lakes and rarely enter rivers. Levels of nitrate in Lake Huron and Lake Erie range from 0.2 to 0.8 mg NO_3-N/L based on City of London water supply data. This indicates that nitrates would not be an issue in Lake Huron or Lake Erie for lake trout. The MATC for Rainbow trout is 8.6 mg NO_3-N/Ldue to delay of sac fry to the swim-up stage. Rainbow trout are found in lakes, and move to rivers and streams in the spring and fall. Steelhead trout (type of rainbow trout) are found in London streams and on the North branch up to Fanshawe Dam and downstream of London. The average concentration of nitrates in the spring and fall between 2006 and 2010 inclusive is less than 6 mg NO_3-N/L in the Thames River entering or leaving the City of London. The next lowest MATC is 30 mg NO_3-N/L for the water flea which would not be an issue in the Thames River.

BYPASSES AND COMBINED SEWER OVERFLOWS TO THE RIVER SYSTEM

Bypasses at Pollution Control Plants

Pollution Control Plants effectively treat raw sewage, however; during rain events, flows exceed capacity of the treatment plants. The City's long term strategy is to reduce overflows; however, the challenge is the significant variability in the flows. Vauxhall wet weather capture was 94% in 2007 (a dry year), 92% in 2008, 90% in 2009 and 88% in 2010. The Ministry of the Environment's CSO Control Procedure F-5-5 requires 90% capture between April 1 to October 31.

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The City commissioned the Dingman sanitary pond in mid 2005, resulting in fewer overflows from the Dingman pumping station and the total overflow volume in 2007 declined to zero due to the dry weather. The 2009 bypasses at Dingman were 63% of the volume in 2005 and there were no by-passes in 2010. In 2011 to the end of March there was 48% of the bypass volume compared to 2005. The increase was due to snow melt and rainfall that kept the Dingman pond full due to the high flows in the sanitary sewer from weeping tile. The number of portable generators used to prevent bypasses at pumping stations during power outages has increased from 4 to 9 units since 2005. Many of the newer pumping stations have their own generators. Bypasses at the Greenway and Oxford sewage treatment plants receive primary treatment and disinfection (during the disinfection period) which is better than criterion in the Ministry of the Environment's CSO Control Procedure F-5-5.

Overflows to storm sewers

As part of the City of London's Wet Weather Overflow strategy, staff are currently investigating the various connections between sanitary and storm sewers throughout the existing sewer system. The majority of these overflows were installed between 1950 and 1970 as a solution to frequent basement flooding. In the downtown core, these overflow connections discharge to large deep relief sewers that outlet to the Thames River. Overflows also exist in older residential areas where basement flooding has been a historical problem. The installation of sanitary overflows ceased in the early 1980's.

Many of the sanitary overflows were installed on an ad hock basis; therefore, very little design information is available for the location or configuration of these sewer connections. It is estimated that there are 281 sanitary sewer connections to the storm sewer system based on information collected from sewer drawings, sewer operations personnel, and Wastewater and Drainage Engineering site inspections. In many cases, more than one overflow connection will discharge to a single sewer. A single storm outlet to the Thames River may receive sewer discharges from several sanitary connections. There are 44 known storm sewer outlets that are downstream of sanitary sewer overflow connections.

It is anticipated that municipalities will be required to quantify the volume and frequency of sanitary overflows within the next five years if proposed changes in Federal Legislation are approved in 2011. In order to meet these requirements, staff are currently undertaking a systematic inventory of existing sanitary overflow connections. Once these overflow locations have been confirmed staff will begin a flow monitoring program and sewer analysis. Based on the results of the monitoring and sewer analysis, EESD will begin to develop alternatives for managing sanitary sewer overflows. These alternatives will be developed in the context of the City's proposed Wet Weather Strategy.

Summary:

1. Public information on the impacts of daily activities on the quality of the Thames River can be seen at the web sites http://www.london.ca/d.aspx?s=/Sewer_and_Wastewater/Thames_River_quality.htm http://cleanlakes.ca/ , http://www.clear.london.ca and http://www.thamesriver.on.ca .

2. Video's on sewage treatment in the City of London and A Historical perspective of sewage treatment (going back to the mid 1800's) is on the City of London web site http://www.london.ca/d.aspx?s=/Sewer_and_Wastewater/Sewagetreatment_index.htm

3. Phosphorous and Bacteriological quality are the parameters that exceed surface water criteria in the Thames River.

4. The proposed CCME surface water criteria for nitrates is not being met in the Thames River and the City of London could be forced to denitrify at its sewage treatment plants.

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Acknowledgements:

This report was prepared by Anthony Van Rossum, Environmental Services Engineer, Pollution Control Operations, with data obtained by the City Monitoring Program, the MOE/UTRCA monitoring, river flow data from Environment Canada. Geordie Gauld, Division Manager Wastewater Treatment Operations, reviewed the report.

SUBMITTED BY:	RECOMMENDED BY:
GEORDIE GAULD DIVISION MANAGER WASTEWATER TREATMENT OPERATIONS	RON STANDISH, P. Eng. DIRECTOR, WASTEWATER AND TREATMENT, PLANNING, ENVIRONMENTAL AND ENGINEERING SERVICES

REVIEWED & CONCURRED BY:
PAT MCNALLY, P.ENG. EXECUTIVE DIRECTOR, PLANNING, ENVIRONMENTAL AND ENGINEERING SERVICES

September 16, 2011

Attach: Appendix "A" – Annual Averages

c.c. John Braam
Ministry of the Environment
Upper Thames River Conservation Authority
London and Middlesex Health Unit
Advisory Committee on the Environment (ACE)

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APPENDIX A

Annual averages of water quality in milligrams per litre (mg/L) in the Thames River for Upstream (average of Clarke & Whites) and Komoka bridges are as follow in the table below:

PARAMETER	MOE SURFACE WATER CRITERION	UPSTREAM		DOWNSTREAM (Komoka Bridge)		Average met Objective
		2010	3 Year average	2010	3 Year average	
Suspended Solids		15	15	14	18	
BOD	4.0	2.5	2.5	2.3	2.5	Y
Dissolved Oxygen	4.0	11.3	10.8	10.2	10.4	Y
Phosphorous	0.03	0.07	0.09	0.09	0.12	**N**
Un-ionized Ammonia	0.019	0.001	0.002	0.002	0.002	Y
Nitrates		5.2	4.5	5.4	4.9	
Total Coliforms * xx	1,000	5,200	5,100	9,500	8,100	**N**
E. Coli * xx	100	194	153	144	150	**N**
Iron	0.30	0.03	0.02	0.04	0.02	Y
Manganese	0.050	0.013	0.013	0.005	0.005	Y
Aluminum	0.100	0.075	0.049	0.069	0.054	Y
Cadmium	0.0002	L0.0002	L0.0002	L0.0002	L0.0002	Y
Chromium	0.100	L0.001	L0.001	L0.001	L0.001	Y
Copper	0.005	0.001	0.001	0.002	0.002	Y
Nickel	0.025	0.004	0.003	0.004	0.003	Y
Lead	0.025	L0.001	L0.001	0.001	L0.001	Y
Zinc	0.030	0.004	0.003	0.006	0.005	Y

* Results during Disinfection Season (April 1 to September 30) - units are defined as most probable number (MPN) per 100 mls.

L in the table means less than

xx The 2010 weighted geometric mean for the PCP's effluent for the disinfection period was 309 most probable number (MPN) per 100 mls. for Total Coliforms and 24 most probable number (MPN) per 100 mls. for E. Coli.

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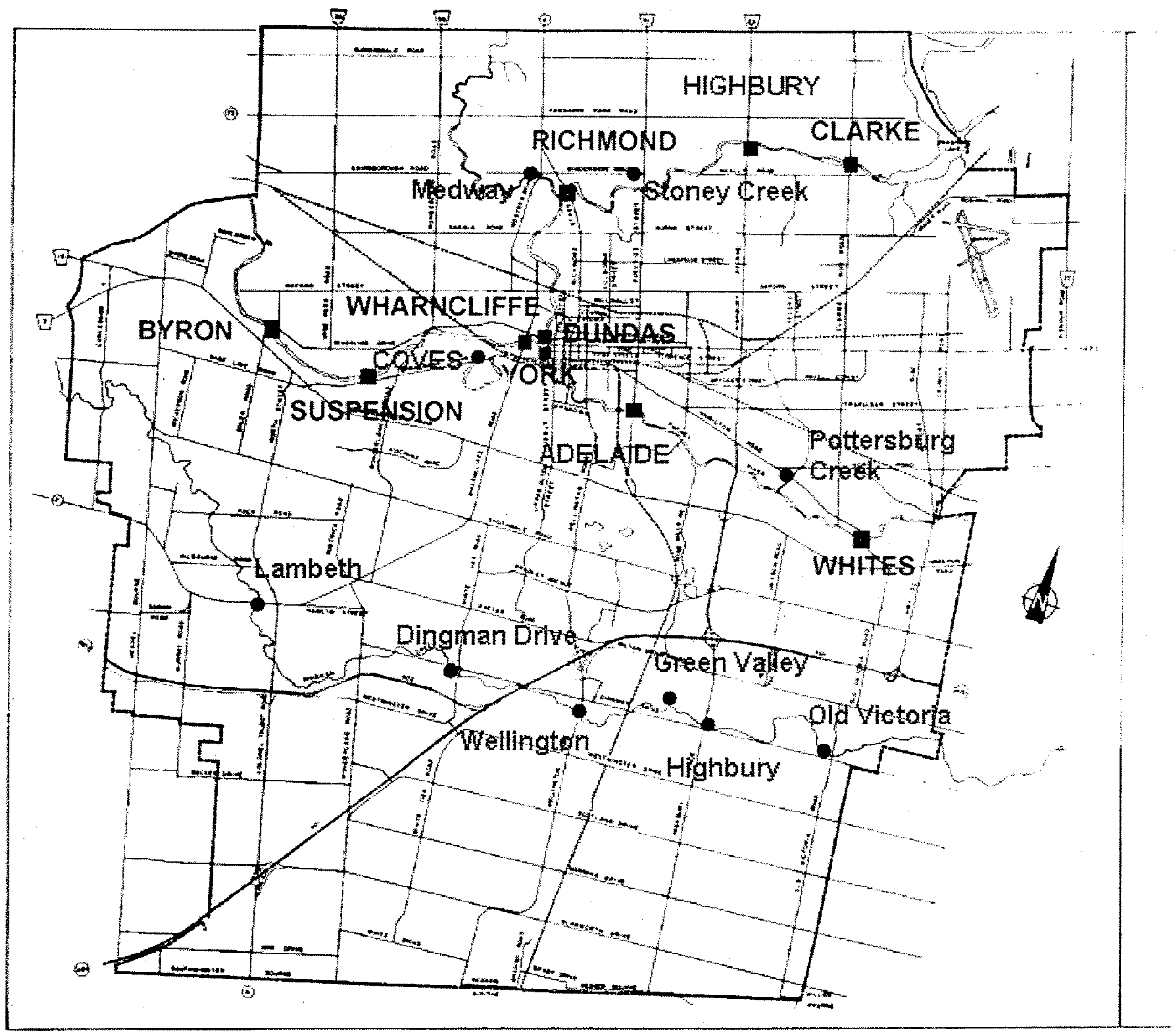

■ **Denotes monitoring site on the Thames River**

● **Denotes monitoring site on a creek**