

Big Creek Watershed Plan- Water Quality Update

Submitted to: Steering Committee, the Big Creek Watershed Management Study

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October 28, 2009

1. General Information on Nitrates in Water

What are Nitrates?

Nitrates are naturally occurring chemicals and they are part of the nitrogen cycle. They are also widely used in inorganic fertilizers, in explosives and as a raw chemical in various industrial processes. Nitrate is more stable form of nitrogen but can be transformed into nitrite which is the more toxic form of nitrogen.

What are the Primary Sources of Nitrates in Water?

Potential sources of nitrate in surface water and groundwater include decaying plant or animal material, agricultural fertilizers, manure, domestic sewage, industrial wastewaters, precipitation or geochemical formations containing soluble nitrogen compounds. In general, nitrate levels are higher in groundwater than in surface waters.

What are the Human Health and Aquatic Ecosystem Impacts of Nitrates?

Excessive levels of nitrates can cause serious illness and sometimes death, especially in young infants. Nitrate converts into nitrite which could interfere with oxygen carrying capacity of the blood resulting in a condition called “methaemoglobinaemia” also known as “blue baby syndrome”.

Recent studies indicate that nitrate can have harmful impacts on the development of early life stages in aquatic organisms. Increased levels of nitrogen in the water, combined with phosphorus, can cause excessive plant and algal growth that depletes oxygen levels, possibly to lethal levels. Some algal blooms also produce toxins that can affect aquatic life or humans that consume them.

What are the Nitrate Guidelines?

Currently, there are no national guidelines for the protection of aquatic life for nitrate, although they are being developed. Canadian Water Quality (CWQ) Guidelines for the protection of aquatic life for nitrite are set at 2.93 mg NO₃⁻-N per L. The EPA (1996) maximum contaminant level (MCL) for nitrate is 10 mg NO₃⁻-N per L.

2. Historic Nitrate and Nitrite Levels in Big Creek Watershed:

ERCA monitored water quality at the 2 sites in the Big Creek watershed during 1983 to 1996 through the Provincial Water Quality Monitoring Network (PWQMN) in partnership with the Ontario Ministry of the Environment (MOE). The monitoring was then discontinued due to funding cuts. Figure 1 shows the variation of nitrate concentration in the Big Creek watershed during 1983 to 1996. It is evident that nitrate levels are frequently exceeding the CWQ Guideline of 2.93 mg NO₃⁻-N per L throughout the monitoring period. Around 32% of the 147 samples collected during 1983 to 1996 exceeded the CWQ Guideline.

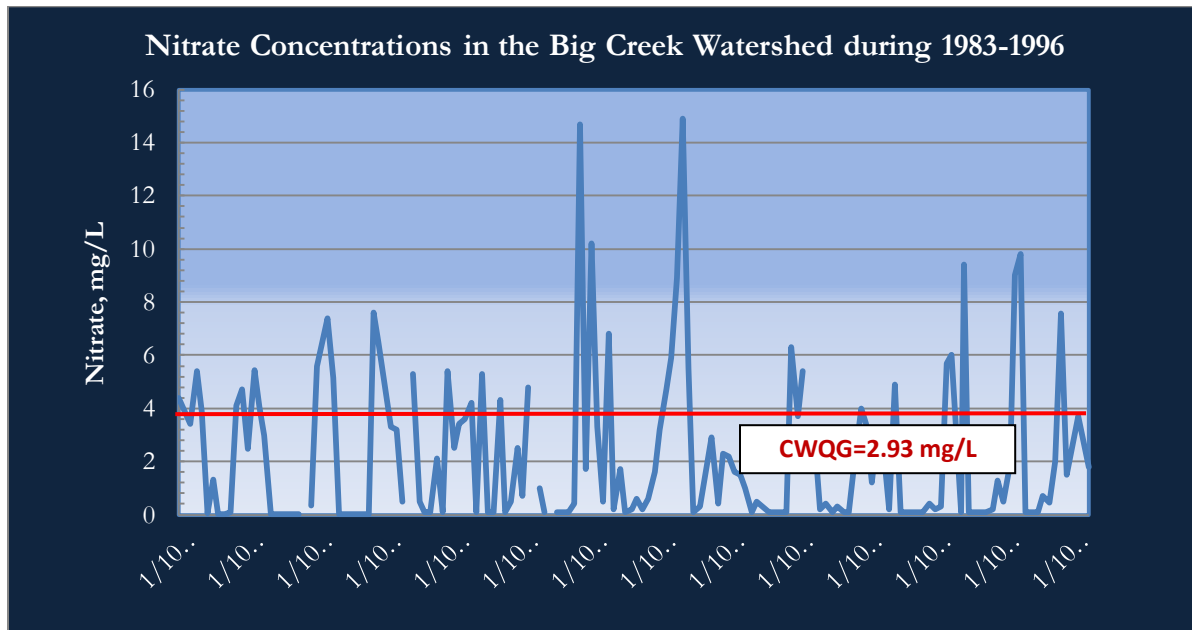


Figure 1: Long term nitrate concentrations in the Big Creek Watershed observed during 1983-1996 (Data Source: Provincial Water Quality Monitoring Network)

Nitrite concentrations were not monitored for the Big Creek water quality sites through the PWQMN program, hence could not make any comments on historical levels on nitrites in the Big Creek watershed.

3. Current Nitrate Levels in Big Creek Watershed:

As a part of the Big Creek Watershed Study, surface water quality monitoring has been undertaken at 8 sites in the Big Creek watershed, including 2 in the nearshore waters of Lake Erie (upstream and downstream of the mouth of Big Creek) (Figure 2). Table 1 and 2 summarizes the basic preliminary statistics of nitrate and nitrite concentrations observed during 2008-2009, respectively, at the 8 water quality monitoring sites in the Big Creek watershed. The data is summarized in this table is not complete as some of the lab results are not available while preparing this report, also, monitoring will be continued until end of the November 2009. A complete data set will be analyzed and results will be presented in the final report in early 2010.

Table 1: Summary Statistics of Nitrate Concentrations observed during 2008-2009

Item	New Site	Site 1	Site 2	Site 3	Site 4	Site 5	Nearshore 1	Nearshore 2
No of Samples	9	27	23	25	31	24	14	14
Exceedances, %	0	18.5	17.4	24.0	9.7	8.3	0	7.1
Minimum, mg/L	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2
Maximum, Mg/L	2.4	5	14	6.7	5	20	1	5
Average, mg/L	0.54	1.39	2.21	1.81	0.84	1.23	0.59	0.90
Median, Mg/L	0.3	0.8	1.3	1.2	0.1	0.1	0.55	0.6

It is evident from the above table that in general nitrate levels are below the CWQ Guideline limit of 2.93 mg/L, the mean concentrations ranging from 0.54 mg/L (at New Site) to 2.21 mg/L (at Site 2). However, maximum concentrations of 14 and 20 mg/L nitrates were observed at Site 2 and Site 5 respectively in 2009 during wet weather sampling events. In general, nearshore samples showed lower nitrate levels than that of in-stream sites.

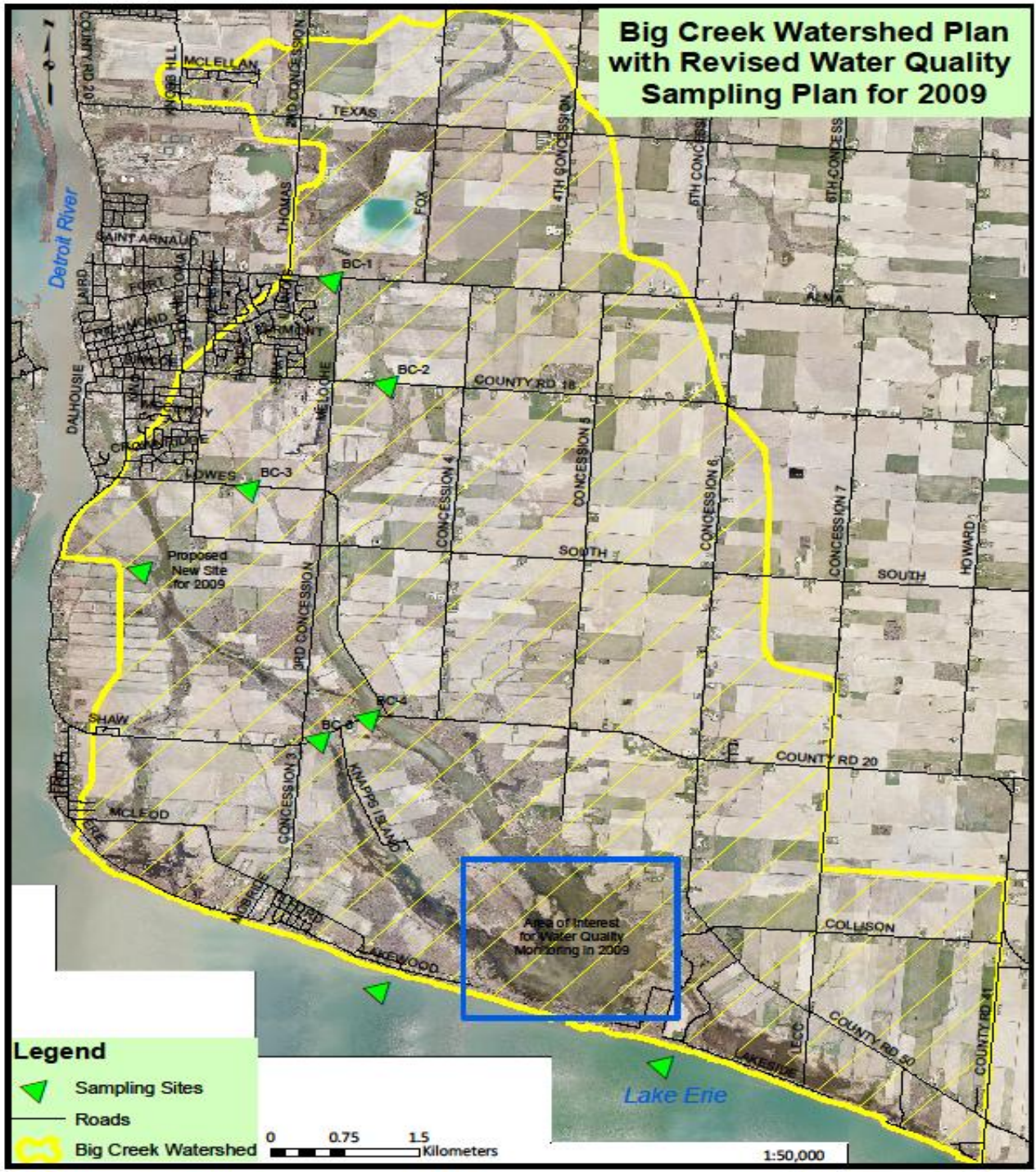


Figure 2: Surface Water Quality Monitoring Sites in the Big Creek Watershed during 2008-2009

Table 2: Summary Statistics of Nitrite Concentrations observed during 2008-2009

Item	New Site	Site 1	Site 2	Site 3	Site 4	Site 5	Nearshore 1	Nearshore 2
No of Samples	9	27	23	25	31	24	14	14
Exceedances, %	0	16.8	10.1	25.1	3.25	10.25	0	8.25
Minimum, µg/L	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Maximum, µg/L	BDL	200	500	900	2200	200	BDL	200

Similar concentration profile was observed with nitrites in the Big Creek watershed. The majority of elevated levels of nitrites correspond to the peak levels of nitrates during the monitoring period. The CWQO for nitrite levels is set at 60 µg/L for the protection of aquatic life. The highest number of exceedances was observed at Site 3 while the site on Pike Road did not show any exceedances during the same time period.

4. PCB Contamination in sediment and fish tissues of the Big Creek Watershed.

A comprehensive literature survey was conducted on PCBs and other toxic metal contaminations in the fish tissue as well as sediments in the Essex Region watershed, for the preparation of Essex Region Conservation Authority’s recently released water quality status report (2009 WQ Status Report). Literature suggest no evidence of PCB (or other toxic metals) contamination of sediment or fish tissues in the Big Creek watershed.

However, the Guide to Eating Ontario Sport Fish by the Ontario Ministry of the Environment (OMOE) showed that approximately 40% to 60% of advisories on sport fish given for the Lake St. Clair - Detroit River corridor and in Lake Erie respectively, results in some level of consumption restrictions. The majority of these advisories are based on high concentrations of dioxins, furans and dioxin-like PCBs in fish tissue while small portion of these restrictions are caused by mercury. Several areas of the Detroit River showed high levels of mercury and PCBs in sediments. The five locations in the river were recognized as the most hazardous sites or ‘hot

spots' based on mercury levels in sediments. PCBs are no longer produced in Canada and the United States, but they can enter in the environment through leakage or spillage from disposal sites and storage facilities. The majority of the PCB loadings to the Detroit River are found to be from Michigan sources, while less than 10% of came from Ontario sources such as tributaries, point sources, CSOs and stormwater from the City of Windsor.