Executive Summary

Introduction

The Big Creek watershed is situated in the western basin of Lake Erie and drains over 7,000 hectares including parts of the urban core of Amherstburg as well and rural and agricultural lands. This watershed has experienced a number of land use changes and alteration to drainage structures that resulted in changes in watershed hydrology, reductions in water quality, and diminished ecological function.

The quality and health of the Big Creek is a fundamental aspect of a healthy watershed and the health of communities in the watershed. A watershed-based approach to manage natural resources is vital to the protection and sustenance of a healthy watershed. The Town of Amherstburg in partnership with the Ontario Ministry of the Environment (MOE), the Essex Region Conservation Authority (ERCA), and a group of private hunt clubs from the watershed, initiated the Big Creek Watershed Plan. This Plan aims to affirm and/or identify and assess natural resources in the Big Creek watershed, and to recommend appropriate strategies for the protection or management of the varied natural resource values and community priorities that exist in the area. Three key watershed-based studies inform the Plan. These are the Natural Heritage Study, the Water Quantity Report and the Water Quality Study. The Water Quality Study methodology and results are summarized below.

Methodology

The surface water quality monitoring study included two main components. Firstly, historical and long term water quality data in the Big Creek watershed was analyzed to determine if any long term significant trends exist in the watershed. Data from 1964 to 1970 and 1982 to 1996 (at 1 site) through a provincial surface water monitoring program, as well as a data from 1989 to 1990 (47 sites) through a provincial rural beaches strategy program, was analyzed.

Secondly, the assessment of current (2008-2009) water quality conditions was undertaken by conducting a comprehensive surface water monitoring program during 2008 and 2009. This involved water quality sampling in the Big Creek watershed at 2 sites that existed in 2008-2009 as part of the Essex Region Conservation Authority monitoring program, as well as 8 additional sites. Samples were taken along streams, at the marsh and nearshore during regular and wet weather. Data for various parameters, as described below, were analyzed in both components of the study to evaluate long term and current water quality. The study also included a quantitative estimation of loadings of particular pollutants from different catchments within the watershed.

Evaluation Criteria

The water quality parameter data was evaluated mainly using benchmarks for the protection of aquatic life and ecosystem health. These benchmarks are the Provincial Water Quality Objectives (PWQO) published by the Ministry of Environment (MOE), the Canadian Environmental Quality Guidelines (CEQG) published by the Canadian Council of Ministries of the Environment (CCME), and a recreational water use standard for bacteria. The parameters

reviewed include nutrients (nitrates and phosphorus), *E. coli*, chloride, pH, metals, and others. Benthic invertebrate data was analyzed using the Benthic Index of Biotic Integrity (B-IBI. A simple *fecal coliform/fecal streptococcus* ratio method was employed to understand the potential sources of microbial contamination at various sites in the Big Creek watershed.

Results

Long Term Water Quality

The surface water quality data collected at the Provincial water quality monitoring site in the Big Creek watershed showed high levels of total phosphorus and chloride. Almost all of the samples collected during 1964 to 1996 exceeded the PWQO for total phosphorus, while annual mean chloride concentrations during 1985 to 1995 exceeded the benchmark of 250 mg/L in all years, except 1986 and 1987.

Nitrate and total suspended solids (TSS) levels were found to be significantly high and increased between 1980 and 1994. *E. coli* was not monitored at this site during this period however other pathogens, fecal coliform and total coliform, were very high indicating contamination of surface water by human origin waste.

The Essex Conservation Rural Beach Program (1989-1990) study found widespread pollution of bacteria and phosphorus throughout the watershed. Nearly all the samples collected during this period exceeded the MOE guidelines for *E. coli* and total phosphorus. Very high counts of *Pseudomonas* at all the sites indicated widespread human fecal contamination. The study suggested that soil erosion might be the major source of phosphorus contamination.

Current Water Quality

Although there has been a reduction by approximately 30% in average **total phosphorus** concentrations since the 1960s, current levels remain significantly above the benchmark PWQO limit of 0.03 mg/L. Also a slight increase in current total phosphorus data was observed from upstream stations to the downstream stations. The total phosphorus concentrations observed in the marsh and at the nearshore (Lake Erie) sites were also above the benchmark but significantly lower than those found at the tributary sites. In general, the total phosphorus concentrations in the Big Creek watershed are typical of highly agricultural landscape of the Southwestern Ontario. Potential sources may include run-off from fertilized agricultural lands within the watershed and urban inputs from the Town of Amherstburg.

The **nitrate** levels in most of the samples were below the CEQG limit of 2.93 mg/L. The majority of the nitrate in the Big Creek watershed originates in the northeast region of the watershed. The current levels of nitrate in the watershed appear to be similar to historical levels. Nitrate levels were found to be well below the benchmark at all four sites in the marsh and nearshore area.

In general, **chloride** concentrations in the Big Creek watershed tend to be high compared to typical chloride concentrations observed in small streams in Essex Region. Chloride is typically indicative of road salt in urban runoff. The current levels of chloride appear to be lower than historical levels. The majority of the chloride in the Big Creek watershed originates from the 3

headwater sites, all of which have relatively high urban land drainage area. The lower concentrations in the downstream sites could be attributed to dilution. An unusually high chloride spike was observed in 2009 at a site on Big Creek at Alma Street, just downstream of the soda ash basin. More investigation on this issue is warranted. Chloride levels in the marsh and at the nearshore sampling were normal and well below the benchmark value of 250 mg/L.

The ***E. coli*** levels tend to be higher than the recreational guideline limit of 100 CFU/100mL at the tributary sites in the Big Creek watershed. No significant difference was found between wet weather and regular weather *E. coli* counts. The *E. coli* counts in the samples collected in the marsh and nearshore area are well below the benchmark. *E. coli* is considered to be an indicator of fecal contamination.

Heavy metals analyzed include arsenic, cadmium, chromium, iron, lead and zinc. There are high levels of iron in all of the Big Creek watershed samples, exceeding the PWQO of 0.3 mg/L. Copper and zinc levels exceeded the PWQO criteria at the site BC-3 which is just downstream of the urban land in the Big Creek watershed. The majority of water samples in Lake Erie and the marsh showed metals below the detectable limits, with just a few exceptions for the marsh inlet samples.

Measured **pesticides** included atrazine, 2,4-D, metolachlor, and glyphosate. Pesticide results revealed all the pesticides below detectable limits, except that atrazine and glyphosate were found in low concentrations at all the tributary sites. The site BC-3 showed an exceedance of glyphosate. The majority of water samples in Lake Erie and the marsh showed pesticides below the detectable limits, with just a few exceptions for the marsh inlet samples.

The **benthic community** is graded as very poor to good, based on the Benthic Index of Biotic Integrity (B-IBI) scores obtained for all seven monitoring sites in the Big Creek watershed. The site BC-N, which is immediately downstream of a highly urbanized area of the watershed, showed very poor benthic community, while the benthic community observed in the marsh was of good quality.

Fecal coliform/Fecal streptococcus (**FC/FS**) ratios for all the monitoring sites in the Big Creek watershed were reviewed. The results indicated bacterial contamination due to only human fecal sources at site BC-3, the site just downstream of the urban land in the Big Creek watershed. These results do not confirm absence of human fecal contamination at other sites in the watershed. More advanced *E. coli* source tracking methods need to be employed in future focusing mainly in the drainage area of site BC-3.

The Water Quantity Study Report, which is one of three Technical Studies that form the background for the Big Creek Watershed Management Plan, presents the results of sediment and nutrient loading estimations using the Annualized Agricultural Non Point Source Pollution (AnnAGNPS) model. The modelled average daily mass flow of total sediment from the Big Creek Watershed is 8.3 mg/day. The months of April through June have the highest average monthly sediment yield rates, which is likely caused by spring runoff events. The average daily mass flow of nitrogen and phosphorus from the Big Creek Watershed are 207 kg/day and 112 kg/day, respectively. The areas with the lowest average annual phosphorus and nitrogen yields in

the watershed had land use types of forest and open water. Refer to the Water Quantity Study Report for more details on the sediment and nutrient loading estimations.

Based on the results of the water quality monitoring study, measures such as efficient private septic systems, proper road salt management and implementation of focused agricultural best management practices such as buffer strips, conservation tillage and soil erosion control structures (e.g. rock chutes, header tile retrofits) are suggested in order to improve and protect the water quality conditions in the Big Creek watershed.