BACTERIAL ASSESSMENT AT WESTBORO BEACH

Prepared for:

ENVIRONMENTAL PROGRAMS AND TECHNICAL SUPPORT. TRANSPORTATION, UTILITIES AND PUBLIC WORKS DEPARTMENT CITY OF OTTAWA

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Oceans, Lakes & Rivers

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Executive Summary

Westboro Beach is one of four municipal recreational swimming beaches within the City of Ottawa (City). The beach is situated on the south side of the Ottawa River (River) approximately six kilometres upstream from the downtown core. Current conditions near shore are generally low and primarily driven by wind as the bulk of the river flows further offshore. It is a non-navigable section of the River for powered craft, due to the presence of several sets of rapids and the Chaudière Falls. Large cribs made of stone and timber, which are remnants from the logging industry, can be found throughout this reach of the river and make navigation hazardous even for small boats and personal watercraft.

The official beach season, that is, when lifeguards supervise the beach, generally runs from mid-June to late August, or approximately seventy-one days. Since 1998, Westboro Beach has been closed (or posted) on average for 30% of the swimming season, or twenty-one days. The City of Ottawa Health Department is responsible for monitoring the City's beaches. Water samples are collected daily at each of the beaches and tested for *Escherichia Coli* (*E.coli)*, which is used as an indicator organism for the presence of pathogenic organisms that may pose a serious health risk to the public. At Westboro Beach, the *E.coli* concentration is determined by calculating the geometric mean from five different samples taken from locations along the length of the beach. If any of the following conditions are met, a 24-hour no swimming advisory is subsequently posted:

- If the geometric mean on any single day exceeds 200counts/100ml;
- If the geometric mean exceeds 100counts/100ml on two consecutive days; and
- Rain Rule – A 24 hour no swimming advisory will be issued for Westboro Beach following a rainfall of 5 mm or more.

Since 2002, the City of Ottawa Water Environment Protection Program (WEPP) has carried out seasonal water quality sampling programs at Westboro beach and the surrounding area to gain insight into bacteriological issues associated with the beach. Although the field program has gone through refinements and modifications over the years, the focus of the sampling remains to be the beach area as well as the creeks and outfalls upstream of the beach.

There have been two separate issues observed at Westboro Beach based on *E.coli* data collected by WEPP and the Health Department since 2000:

1. Elevated counts of *E.coli* measured the day of or the day after a rainfall event. These days are referred to in this report as wet weather days.

2. Sporadic occurrences where elevated counts of *E.coli* were measured during extended periods of dry weather (i.e. little to no rain for days even weeks). These days are referred to as dry weather days in this report.

The source(s) of the water quality problem, particularly during dry weather have been more difficult to isolate as compared to the wet weather issues where point sources such as storm outfalls and Pinecrest Creek have been identified as key contributors of bacterial contamination.

In 2006, Baird & Associates was retained by the City of Ottawa to assist with an assessment of the bacterial conditions at Westboro Beach. The objectives of the study included:

- Assessment of bacterial and environmental data collected during the 2006 WEPP sampling program at Westboro Beach;

- Application of the calibrated three-dimensional numerical model to conduct a preliminary assessment on the bacterial loading in the river at the Deschenes Rapids, and the residence time of bacterial plumes discharged during wet weather events.

- Development of concepts to mitigate the high bacterial concentrations experienced at Westboro Beach. These solutions addressed both wet and dry weather conditions.

Summary of Key Findings and Observations

The following is a summary of key observations that were noted based on the findings of the investigation:

1. In 2006, the beach was posted 40% of the time (i.e. 29 days) and there were 23 days that exceeded the Provincial Water Quality Objectives (PWQO) for *E.coli*. Of the 29 days when the beach was posted, 23 days were due to the rain rule and the remaining six days were due to bacterial counts. *Note that PWQO are numerical ambient surface water quality criteria established by the Ministry of Environment (MOE). For E.coli, it is based on a geometric mean determined from a minimum of five samples per site and collected within a one month period. Concentration levels should not exceed 100 counts per 100ml sample; otherwise the site should be considered unsuitable for swimming and bathing.*

2. Since 2000, the average number of days that exceeded the PWQO for *E.coli* was determined to be 18 days or 29% of the swimming season. The number of wet and dry weather days that exceeded PWQO (based on the criteria stated above) was determined to be 8.4 and 9.6 days, respectively.

3. A review of the bacterial samples taken upstream of the Deschenes Rapids showed that *E. coli* concentrations remained low as the monthly geometric mean for June, July and August 2006 never exceeded 12 counts/100ml. Higher *E. coli* concentrations were evident downstream of the rapids and throughout the river down to Westboro Beach, suggesting that bacterial contamination during the summer months originates downstream of Lac Deschenes. Potential sources of contamination include:

    a. Storm outfalls: there are approximately thirteen outfalls between Westboro Beach and the Deschenes Rapids on the Ontario side of the river.

    b. Pinecrest Creek

    c. Gull populations in the Deschenes Rapids and at Westboro Beach

    d. Inputs from the Quebec side of the river

4. The findings from the data analysis and numerical simulations have confirmed that Pinecrest Creek and the adjacent outfalls upstream of Westboro Beach are key contributors of bacterial contamination at the beach during wet weather conditions.

5. Results from numerical model simulations and desktop analyses determined that wet weather discharges from upstream point sources, such as Pinecrest Creek and storm outfalls, could impact the beach up to four days following a storm event, when the weather conditions are more conducive for bathers. The degree of bacterial contamination at the beach will be dependent on factors such as river flow, water levels, bacterial loading, and wind conditions.

6. Dry weather sources were more difficult to identify as the data does not isolate one particular source as a key contributor. Previous studies have determined that waterfowl represent a potential localized source of bacterial contamination at the beach and in the shallow regions upstream of the beach. Creeks and outfalls are another potential source; however, dry weather discharges to the river are generally very low. Studies have shown a 60% correlation between bacterial levels at the beach and upstream of the beach during dry weather. Numerical model results have shown that these sources do contribute to the general bacteriological conditions at the beach as *E.coli* concentrations increased by 25 counts/ 100ml. These results are based on numerical simulations for dry weather discharge conditions where a concentration value of 10,000 counts/100ml was defined at each creek/outfall location.

a. *Note that the maximum bacterial concentrations measured at the outfalls during wet or dry weather never exceeded 10,000 counts/100ml; suggesting the samples were diluted in the laboratory. It is quite possible that concentration levels could be in excess of this value; this would subsequently increase bacteriological conditions at the beach. Future sampling programs should consider the actual counts where possible as this information would be important in order to complete a more detailed assessment of the performance of potential preferred solutions.*

7. Large gull populations were evident in the Deschenes Rapids in 2006 and do contribute to the general bacteriological conditions in the river. The fecal bacteria in gull droppings is composed of almost 100% *E.coli* and is approximately 1,000 times more potent than goose droppings. It is estimated that the bacteria concentration is 184 million counts per gull dropping (Schultze 2002). The results from the river samples, taken above and below the rapids, showed an increase in the monthly geometric mean (GM) of approximately two to three times the upstream counts. Note that the maximum monthly GM immediately downstream of the rapids was determined to be 32 counts/100ml.

8. Numerical modelling results have determined that the extent of the impact at Westboro Beach varies depending on the loading; one gull in the rapids will have no impact at the beach, however, one hundred gull droppings could increase counts at the beach possibly 3 to 23 counts/100ml depending on the wind conditions. The randomness associated with bacterial loadings from gulls makes it difficult to accurately predict or quantify the resultant concentration levels at the beach. The numerical results tend to suggest that gulls can elevate bacterial levels in the river and at the beach under the right conditions (i.e. simultaneous loading from a large population of gulls); however, there is no evidence to suggest that they are a primary contributor of dry weather contamination at the beach.

9. Elevated background concentrations have been observed in the main river channel in 2006; concentration levels tend to increase with distance downstream, and higher counts were evident in August as compared to June. A review of the influent water quality at the Britannia Water Purification Plant also confirms an increasing trend in *E.coli* concentrations starting in July and peaking in October. Storm outfalls and creeks from both sides of the river, and gull populations within the Deschenes Rapids, contribute to the bacteriological conditions, which vary spatially in this reach of the river.

10. There is evidence from other studies that high bacteria levels during dry weather may be linked to turbidity, and that beach sand is a potential source of bacterial contamination. Furthermore, the general assumption that traditional faecal indicators such as *E.coli* and *enterococci* do not occur in natural environments is being challenged as scientists have observed *E.coli* and *enterococci* populations

multiplying on macroalgae such as *Cladophora*. What these studies suggest is that it is becoming more apparent that many beach closures challenge the traditional paradigm, as they are not all linked to rainfall events or a spill event. As a result, it is becoming increasingly difficult to isolate key source(s) of dry weather bacteriological contamination.

To summarize, the elevated bacterial counts experienced at Westboro Beach during dry weather conditions are not specific to one particular source, based on the available data. It is conceivable that a combination of poor water quality conditions in the shallow nearshore regions upstream of the beach combined with elevated background river concentrations, and bacterial contributions from local waterfowl create an extremely complex bacterial environment that responds to both wind driven currents and river hydraulics.

Conceptual Alternatives

This study has identified a range of general concepts to mitigate the persistent bacteriological issues at Westboro Beach. The table below provides a summary of each concept including the estimated capital cost and the primary advantages and disadvantages. The concepts are in ascending order with the most effective conceptual alternative presented at the top.

Each solution is unique; some concepts address both wet and dry weather issues while others concentrate on one or the other. The different concepts presented and their relative advantages and disadvantages should be considered preliminary in nature. Furthermore, cost estimates presented in this report are approximations that were intended to provide a general sense of the relative cost between each alternative solution. The different concepts presented and their relative advantages and disadvantages will be discussed in more detail with the City of Ottawa.

Conceptual Alternative	Description	Capital Cost (million $)	Comments (Advantages/Disadvantages)
Stomwater Detention Facility	Remove and provide a level of treatment to all point sources between Westboro Beach and the Deschenes Rapids by diverting discharge to a detention facility prior to release back into the river at a location downstream of the beach	$2 to $3 M[1]	1. Addresses wet and dry weather flows as inputs upstream of the beach are removed 2. Will improve nearshore river water quality upstream of the beach 3. Does not address contamination from waterfowl
Pier Structure (Formalization of the Sandbar)	Construction of a structure upstream of the beach to divert flow offshore and away from beach. The concept involves building over the existing sandbar located just upstream of the beach and extending the structure into the river	$1.5 to $3 M	1. Addresses wet and dry weather flows from outfalls 2. Does not improve river water quality upstream of the beach 3. Does not address contamination from waterfowl
Nearshore Exchange System (Beach Seepage System)	Discharge water from the beach face, generating an offshore current and diluting contaminated water in the nearshore.	$1 M	1. Addresses dry weather flows during low river levels (see discussion below) 2. Does not address wet weather flows 3. Does not improve nearshore river water quality upstream of the beach 4. Does not directly address contamination from waterfowl
Gull Wiring System	Overhead wire system is used to keep beaches and swimming area free of waterfowl, in particular gulls, which are a source of bacterial contamination	$0.3 M	1. Directly addresses contamination from waterfowl (dry weather issue) 2. Does not improve nearshore river water quality upstream of the beach 3. Does not address wet and dry weather flows from outfalls
Do Nothing	Continue to operate beach understanding that the beach will be closed on average approximately 21 days of the swimming season	$0	No issues addressed

[1] Note: Cost estimate does not include the Pinecrest Creek catchment or land acquisition

The stormwater detention facility (also referred to as a wet pond) would offer the greatest benefits with respect to improving river water quality at the beach and throughout the nearshore section of this river as a significant number of point sources upstream of Westboro Beach would be removed. Westboro Beach would no longer be subject to a rain rule as the implementation of this concept addresses all wet weather issues and dry weather flows as well. Note that since 2002, the rain rule has accounted for approximately 65% of the days posted. This concept does not address the potential contamination from waterfowl, which populate the beach area as well as the shallow regions upstream. However, based on the available data, there is no evidence at this point to support a relationship between gull populations and *E.coli* concentrations at the beach.

The construction of a pier upstream of Westboro Beach would address both wet and dry weather flows from the source inputs (such as creeks and outfalls) upstream of the beach area, by diverting the near shore river flow away from the beach into the main channel. The concept is similar to the structure that currently exists at Britannia Beach; the performance of the structure is dependent upon its length; and it is expected that rain rule would no longer be necessary if the pier was extend out to water depths greater than 7m.

Unlike the detention facility, this concept does not improve river water quality near shore as river inputs still exists. Similar to the detention facility, formalization of the sandbar will not address the potential contamination associated with waterfowl.

The nearshore exchange (beach seepage) system is appropriate for sheltered environments characterized by weak current conditions and dry weather conditions. Westboro Beach experiences these types of conditions for part of the swimming season; generally mid to late summer when water levels drop to expose the sandbar upstream. The nearshore exchange system is not expected to perform as well in the early part of the season during periods of high river flows and stronger currents. Note that, although the seepage system will help to reduce the impacts from wet weather flows, it will not alleviate the problem. As a result, the benefits of this particular concept are limited to part of the summer season and consider dry weather concerns only.

Gull wiring systems have improved the water quality at other area beaches such as Britannia and Mooney's Bay, where gulls were isolated as a source of bacterial contamination. This alternative directly addresses the issue with waterfowl by discouraging the populations from congregating at the beach and in the swimming area. Gull systems do not alleviate the impacts from wet and dry weather flows. Although the gull population observed at Westboro Beach during the summer months is large enough to potentially contaminate the nearshore swimming area; there is no evidence, based on the measured bacterial data and gull surveys, to support the notion that they are a primary contributor of dry weather contamination at the beach. As such, this option may no be the most appropriate at this point in time.

The final option is to do nothing and continue to operate the beach facility with the knowledge that the beach will be closed, on average, approximately 21 days of the swimming season.

Reporting History

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