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Activities to Understand the Microbial Water Quality of Lake Huron Beaches in the Past Twenty Years

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Questions Most Frequently Asked by Cottage Owners, Local Politicians and the Public in both Canada and the USA.

1. Why are beaches posted indicating that the water is unfit for swimming and related activities?

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2. Why is one specific beach posted when the beach adjacent is not posted?

(e.g.. Public beach is posted but the Provincial Park beach is not)

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3. Why do bacterial levels, such as fecal coliforms and *E. coli*, vary so much between 3 to 5 sampling sites across one beach?

4. Why are fecal coliforms used as a fecal pollution indicator by some, while others use *E. coli* for the same purposes?

Everyone, including citizens, local, provincial and federal politicians wanted answers to why the beaches were posted in the summer of 1983.



Political Point of View

- Somehow fecal material had hit the fan and it had landed in beaches of the Great Lakes including some inland waters.
- The Ministry of Health had the mandate to monitor public beaches while the Ministry of the Environment was to determine the sources of the fecal pollution and how it may have effected beach water quality.

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In 1984, the Ministry of the Environment spent over $100,000 in a large multi-faceted study to find answers to the preceding questions.



Study Components:

- Monitor 3 popular beaches on a daily basis at five sampling sites at approximately for fecal coliforms, *E. coli* and fecal streptococci for the entire season of 1984 (May to September)
- Monitor bottom sediment at 2 - 5 centimeters at the sediment water interface and water column levels of *E.coli* bi-weekly at 3 beaches.
- Monitor daily wave height and rainfall in vicinity of beaches through summer season

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- Investigate the levels of *E.coli* at the waist and chest depth across a shallow beach (slope less than 1) and a steeper beach (slope greater than 1) at different days.
- Investigate the impact of major rivers (Ausable, Bayfield, Maitland) and drains discharging to Lake Huron near specific beaches by measuring *E.coli*, fecal streptococci and Pseudomonas aeruginosa during multiple wet and dry weather periods.

- Assess hourly changes in *E.coli* concentrations over a twelve hour period on a typical summer day.
- Assess impact of storm water of communities located on the shores of Lake Huron near public beaches (e.g.. Grand Bend, Goderich and Bayfield)

- Asses the impact of boats (power and sail) at marinas on nearby beaches by measuring *E.coli*, fecal *streptococci* and *Pseudomonas aeruginosa* levels in or near boat docks.

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Studies through 1985 - 1990 focused on the agricultural sources of *E.coli* and other fecal associated bacteria impacting rivers and drains discharging to the beaches of Lake Huron.



Potential Sources of Fecal Wastes Identified

Urban:

- Sewage treatment discharges
- Storm water
- Septic tanks
- Marinas
- Bathers
- Pets and waterfowl

Potential Sources of Fecal Wastes Identified

Agricultural:

- Manure spreading in wet weather
- Liquid swine manure spreading on tiled fields
- Cattle watering in streams
- Septic tanks
- Manure piles located on stream banks
- Wildlife: waterfowl such as ducks, geese, seagulls, muskrats and beavers.

Sediment Sampling Provides a History

- Sediment sampling of beaches, rivers and drains were conducted to determine levels of *E.coli* and fecal *streptococci*..
- Levels in nutrient-rich sediments ranged between 10^5 and 10^6 per gram at the sediment / water interface.

Source Detection Techniques

- *Salmonella* serotyping using specific O and H antigen determination.
- *Pyocin* typing of *Pseudomonas aeruginosa* recovered from various potential sources.
- Antibiotic resistance profiling of *E.coli* and *Enterococci* was used to assist in source determination.

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Fecal Bacterial Transport Study Methods

- Comprehensive site investigations by CA staff of many authorities which include detailed documentation of potential fecal sources on any one farm.
- Assessment of abatement required to reduce or eliminate these sources.
- Assess the number of major sources contaminating agricultural drainage and determine the distance fecal waste may travel by using a labeled *E.coli* spike into manure and run off.

- Survival rates of *E.coli* (labeled) in Lake Huron water column and sediments using M^{c}Feter diffusion chambers were determined.
- The Desjardin drain, a typical agricultural drain of 16 kilometers, when contaminated at the head waters could impact Grand Bend beach in 24 to 96 hours as determined by tracer studies performed at various times of the years.
- *E.coli* were found to survive in nutrient sediments of the agricultural drains, including over winter.

Continued Source Detection in 1990-1998

Field Tile Contamination by spreading liquid swine manure.

- Studies conducted by Ausable / Bayfield and CA are demonstrated on various farms that liquid swine manure spread according to OMAF guidelines showed manure discharging to header tile and then to the receiving drain in 20 minutes.



Summary

- Fecal contamination of recreational waters was originating from both agricultural and urban sources.
- Cattle watering in streams, septic tanks, liquid swine manure applications, municipal wastewater discharges (by-pass events) and storm water were major urban sources.
- Significant revenue from Provincial and Federal sources were required to assist facilitating abatement activities.



- New methods of manure management were required.
- New methods of application had to be developed as existing procedures were causing a significant impact on surface water quality.
- Reduce cross-connections of sanitary sewers with storm sewers in all communities along shores of Lake Huron.