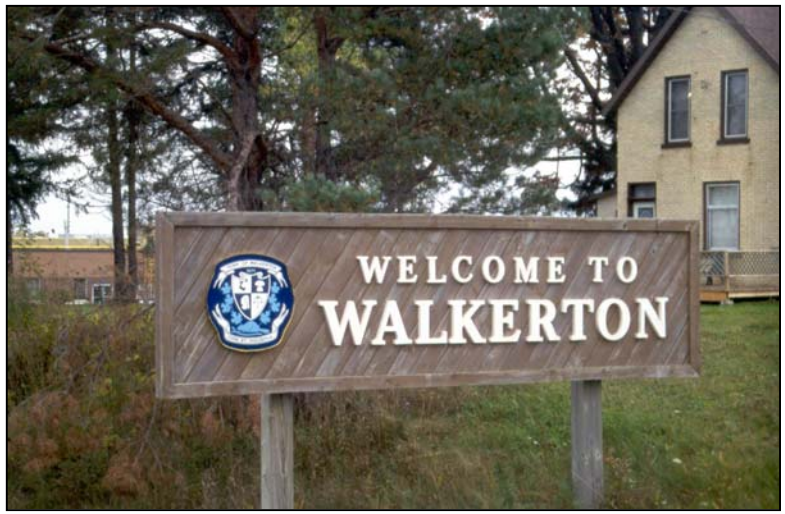
The Walkerton wake-up call - Ontario hits the snooze button!

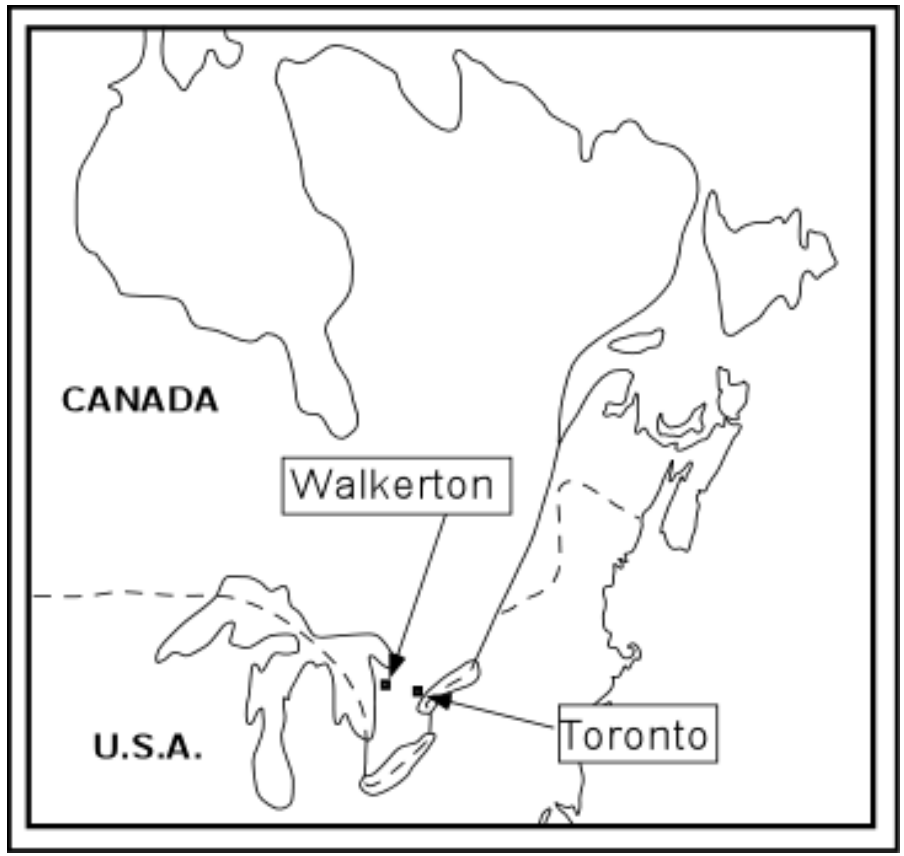


Ken Howard

University of Toronto

Walkerton, Ontario (population of <5,000) is a small rural community high above the Niagara escarpment, 200 km north west of Toronto

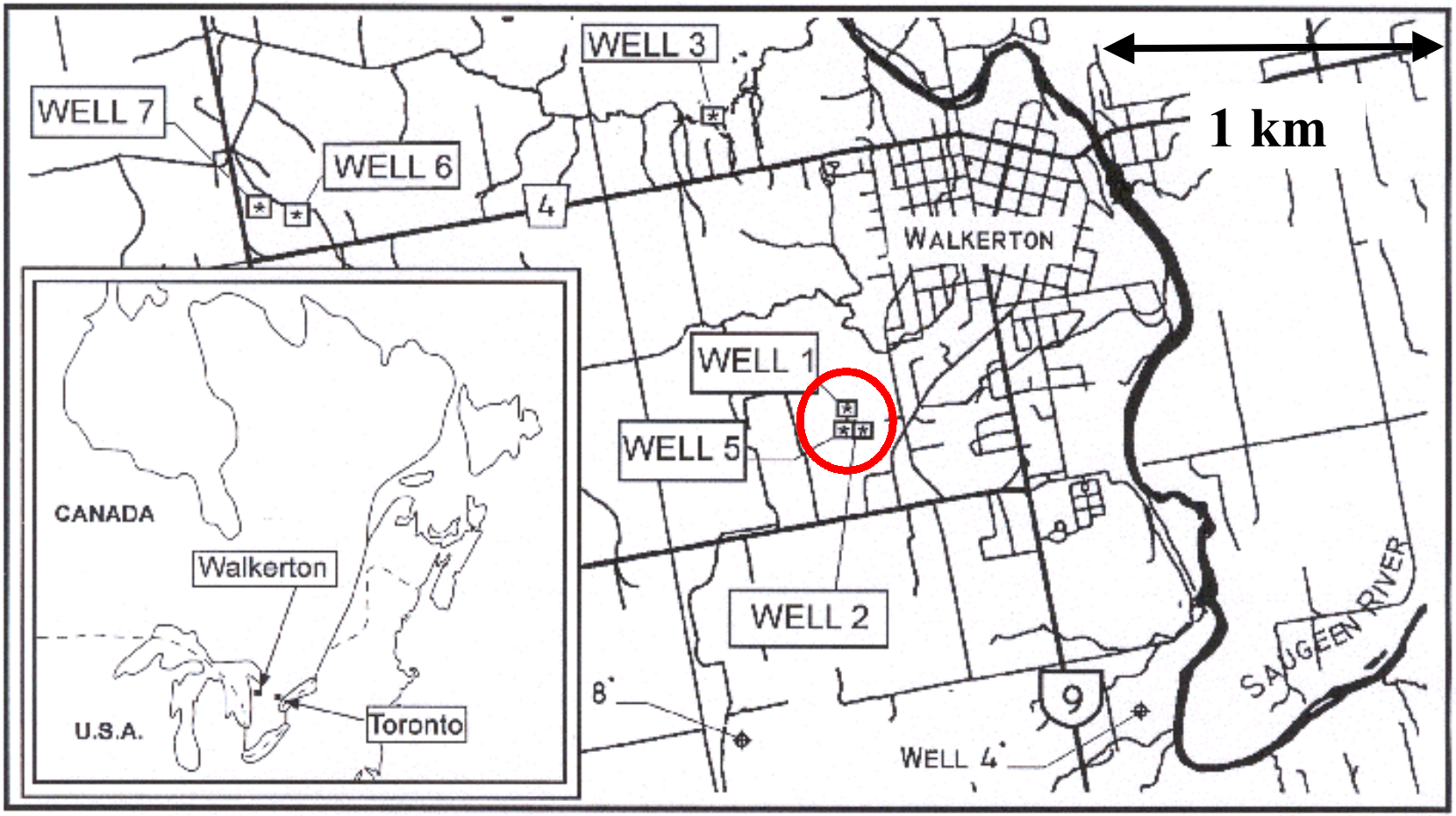
The town is almost entirely dependent on groundwater for domestic water supply



The landscape is glaciated and is best described as gently rolling hills etched into Paleozoic carbonates. These carbonates form the major aquifer.

They are draped by a thin veneer of till (a "stony, sandy silt to silt till" known as the Elma Till).

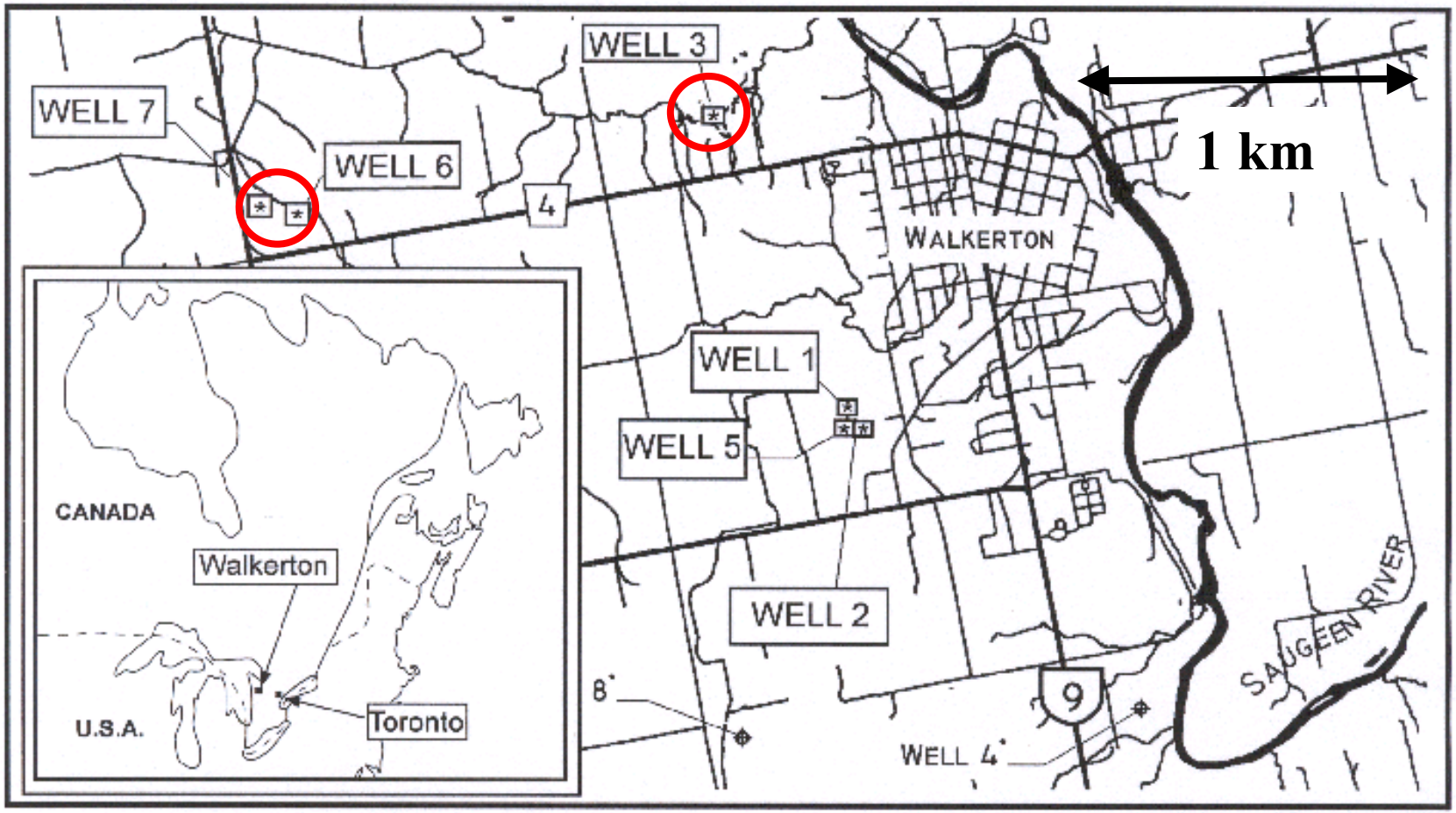
The original supply for Walkerton was obtained from deep wells (#s 1 and 2) drilled in 1949 and 1952 to depths of over 70 m.



The quality of the groundwater obtained from these wells was always relatively poor

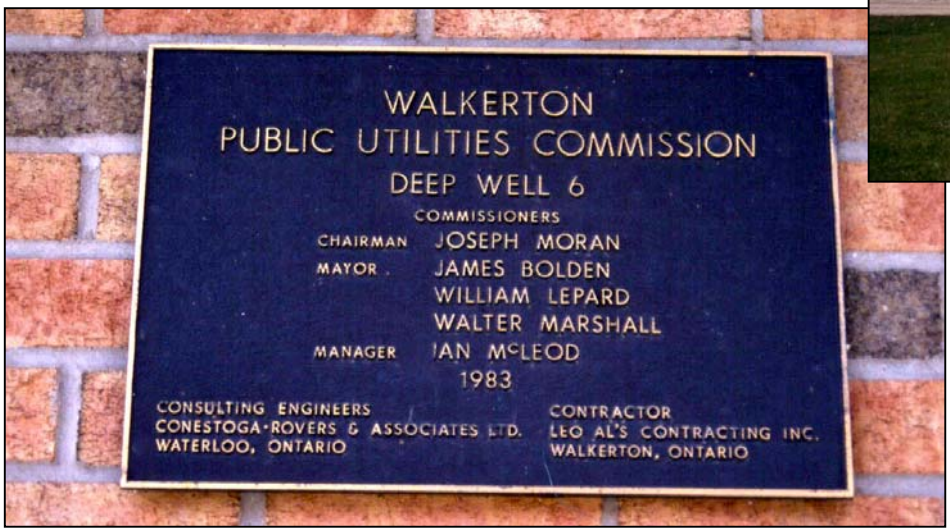
(due to natural mineralisation)

In 1962, additional, better quality water was obtained from a new shallower well (#3).



Wells #s 1 and 2 were later "retired", and well #3 was put on standby. In recent years, supply has been obtained exclusively from well #s 5, 6 and 7. These wells were drilled in 1978, 1982 and 1986 to depths of 15 m, 72.2m and 76.2m respectively.


WALKERTON
Public Utilities
PUMPING STATION


WALKERTON
PUBLIC UTILITIES COMMISSION
DEEP WELL 6
COMMISSIONERS
CHAIRMAN JOSEPH MORAN
MAYOR JAMES BOLDEN
WILLIAM LEPARD
WALTER MARSHALL
MANAGER IAN McLEOD
1983
CONSULTING ENGINEERS
CONESTOGA-ROVERS & ASSOCIATES LTD.
WATERLOO, ONTARIO
CONTRACTOR
LEO AL'S CONTRACTING INC.
WALKERTON, ONTARIO

Well #7, a deep well, is regarded as the "main well" producing 3400 litres per minute of normally good quality water.

Under rest conditions this well flows naturally at the surface.

Until the spring of 2000, Walkerton, was a sleepy rural community on the banks of the Saugeen River.

Popular for fishing, it was little than a lunch stop for Toronto residents traveling to the Bruce Peninsula

In May, 2000, everything changed dramatically – many residents started to fall sick.

Initially, beginning May 14th, food poisoning was the suspected culprit and sufferers were being advised by doctors to avoid dehydration by

"*drinking plenty of water*"!!

It was not until May 21st that the likely root cause of the problem – contaminated well water - was recognized and a boil-water alert was issued.

By Tuesday May 23rd when the results of tests confirmed the presence of *E.Coli* in the town's water supply, 160 people had sought hospital treatment and another 500 had called area hospitals complaining of symptoms.

One, a senior citizen, had died.

Even at that stage the magnitude of the problem had not been recognised.

Within days, four more deaths were recorded and reports of sickness became widespread.

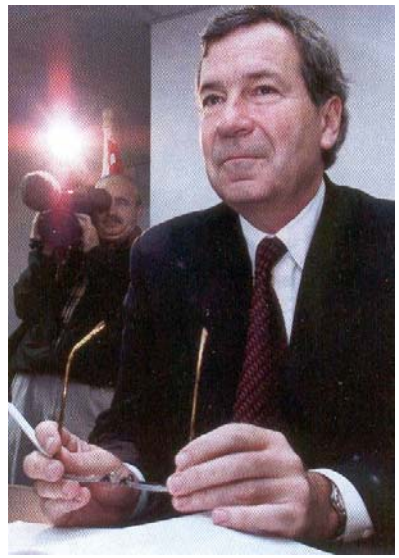
By July 26, Walkerton's water had been directly linked to 2300 cases of illness and six deaths.

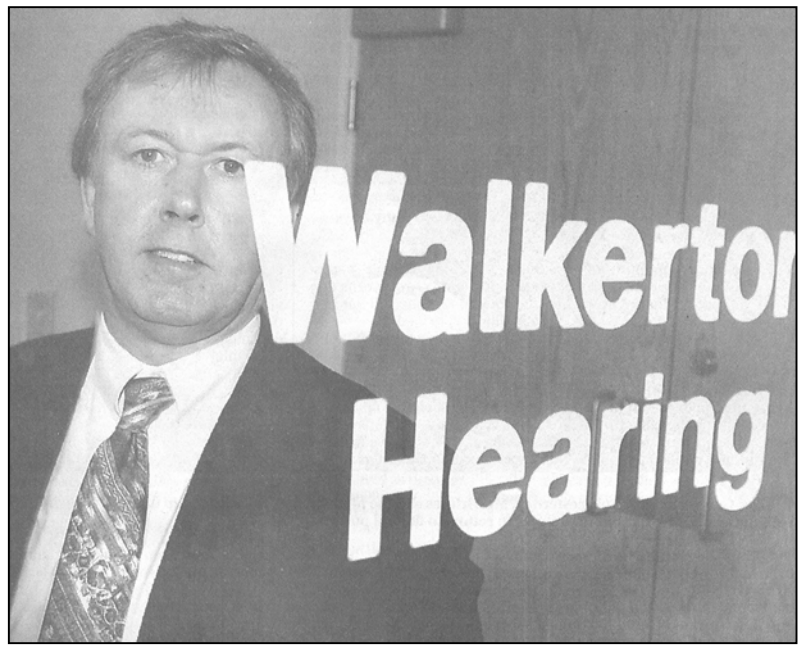
Later studies set the death toll at seven.

Some children who narrowly survived the tragedy face life-long kidney problems.

Once the cause of the outbreak was confirmed, authorities responded quickly.
On May 31st, 2000, the Premier of Ontario set up an independent "Commission of Inquiry" under Justice Dennis O"Connor, and detailed hydrogeological studies began.

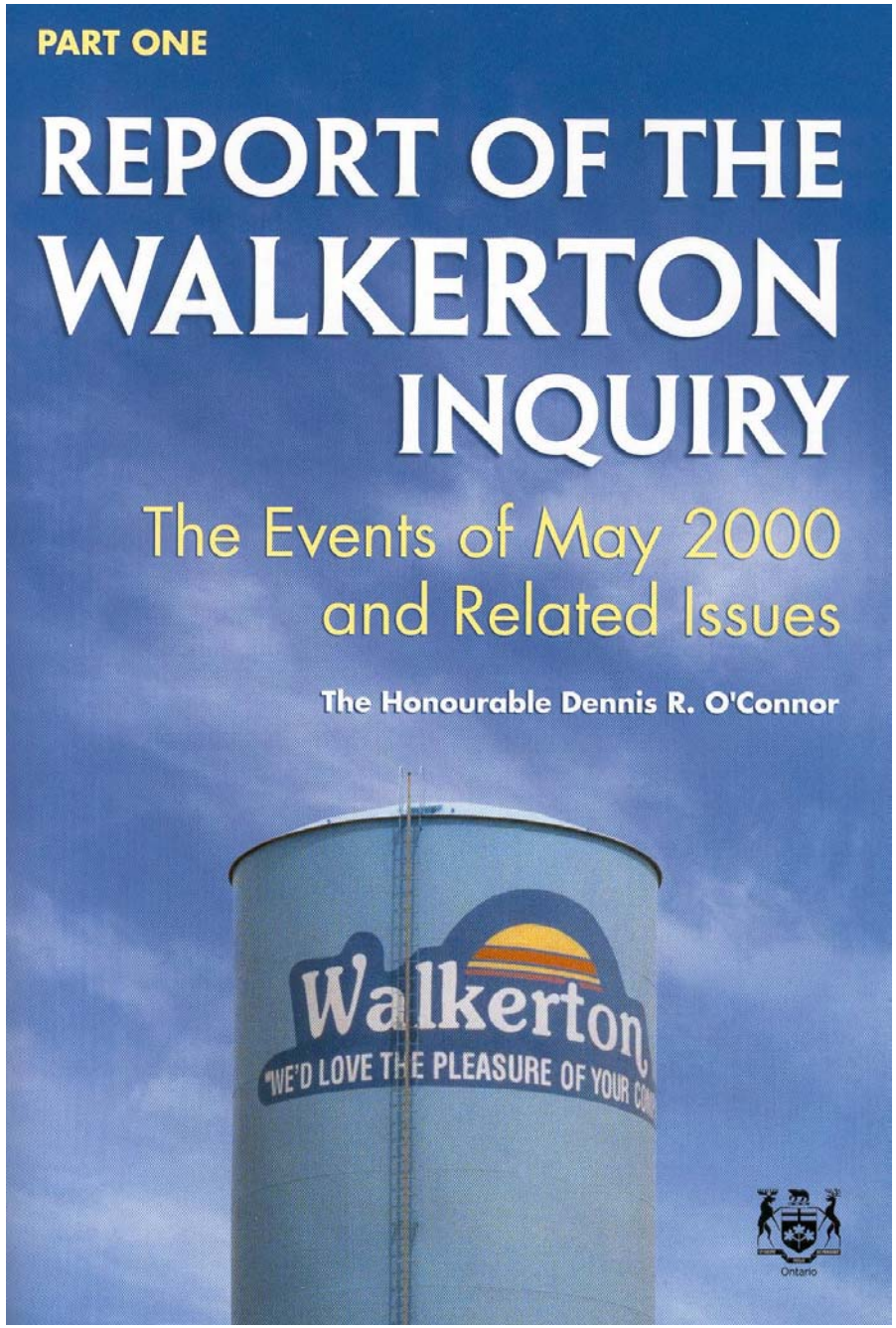
Starting in July 2000, and lasting 9 months, the hearing heard from 114 witnesses including two former ministers of the Environment, and the Premier.





The hearing was divided into two parts and two reports were issued.

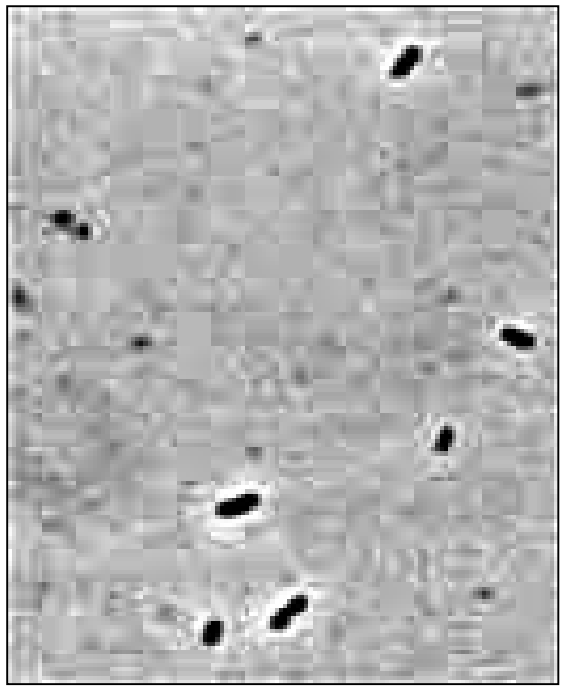
The first appeared in early 2002 and focused <u>purely</u> on the events at Walkerton at the causes of the outbreak.



Re: Part 1

It is now clear that the outbreak was caused by *Escherichia coli (E. coli*), and *campylobacter* in the well water.

In particular, *E. coli* O157:H7 was determined to be the primary cause of the deaths.



***E. coli* O157:H7**

Campylobacter jejuni, was determined to have contributed to two of the deaths

Table 10 Deaths Associated with the Walkerton Outbreak, 2000

Date of Onset	Date of Death	Did the Outbreak Cause Death or Contribute to Death?	Probable Outbreak Organism
May 18	May 22	Contribute	*E. coli* O157:H7
May 18	May 23	Cause	*E. coli* O157:H7
May 19	July 25	Contribute	C. jejuni
May 19	May 24	Cause	*E. coli* O157:H7
May 20	May 29	Contribute	*C. jejuni*
May 20	May 30	Cause	*E. coli* O157:H7
May 21	May 24	Cause	*E. coli* O157:H7

E. coli **is a common problem in groundwater. Although most strains are harmless and live naturally in the intestines of healthy humans and animals,** ***E. coli*** **O157:H7 produces a powerful toxin that can cause severe illness including liver failure.**

Normally, most infections come from eating undercooked ground beef contaminated during slaughter.

It is also transmitted by drinking unpasteurized milk and swimming in or consuming sewage-contaminated water.

By applying DNA typing techniques, a cattle farm located a short distance from well #5 was identified as the *E. coli* contaminant source.

Using industry-standard, best management practices, farmland on Lot 20 had been dressed with cattle manure during late April, 2000 to within 80m of well #5 .

It was applied at a rate of 12 tons per hectare (or 120 g "fresh" weight….25 g dry weight per square metre). Fresh manure can contain between 10^6 and 10^9 fecal coliforms per g. dry weight.

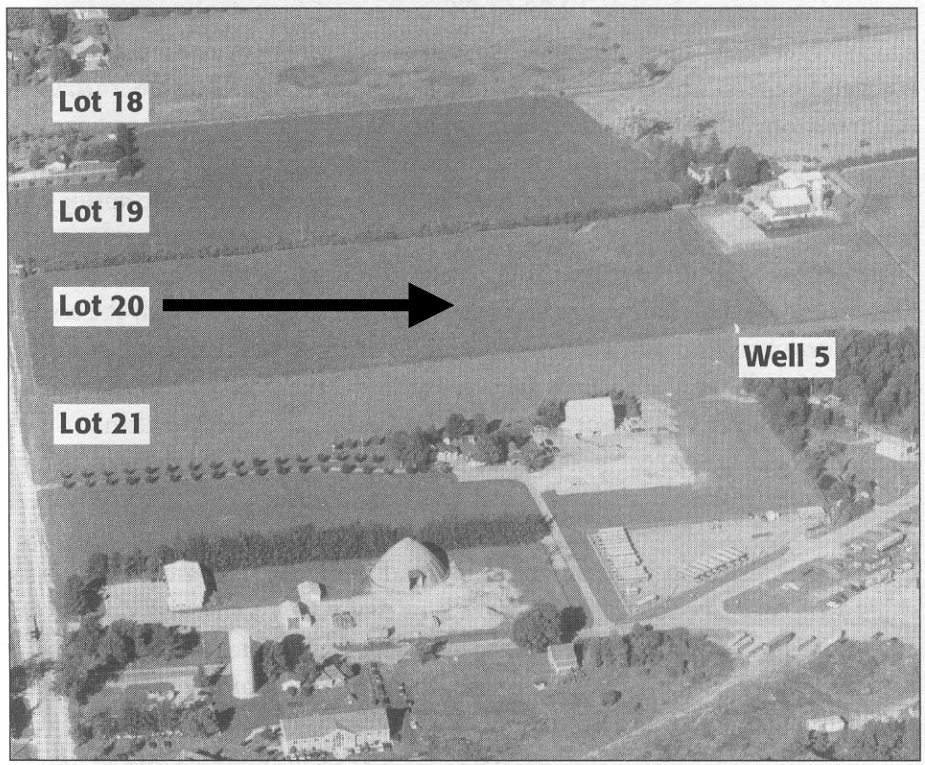


Photo: Marc Bolduc, RCMP

Heavy rainfall in Walkerton between between May 8 and May 12 likely helped convey the bacteria to the well……

Table 5 Estimated Rainfall, Walkerton, May 1–12, 2000

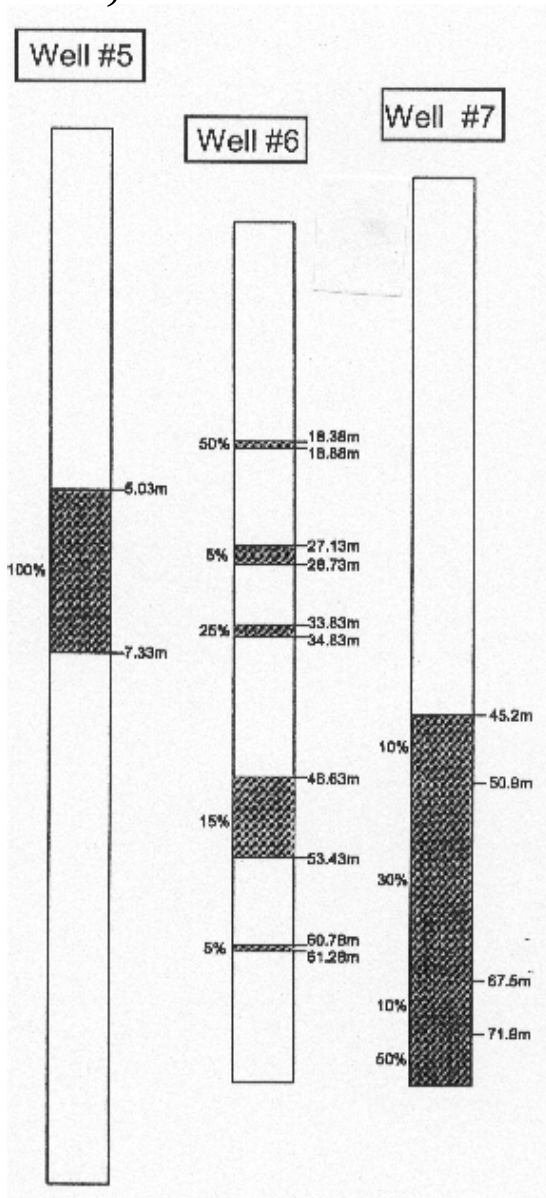
Date	Rainfall (mm)	Cumulative Monthly Total (mm)
May 1	5.5	5.5
May 8	15.0	20.5
May 9	15.0	35.5
May 10	20.0	55.5
May 11	12.5	68.0
May 12	70.0	138.0

Depths:

15m; 75.2m 76.2 m

However, the precise transport route was never reliably determined.

Given *E. Coli* bacteria normally survive in groundwater <30 days, fissure flow in the carbonate aquifer was clearly very important……



……but flow paths paths via the till draping are less clear.

Fence post holes in the till may have helped the runoff water penetrate the till rapidly;

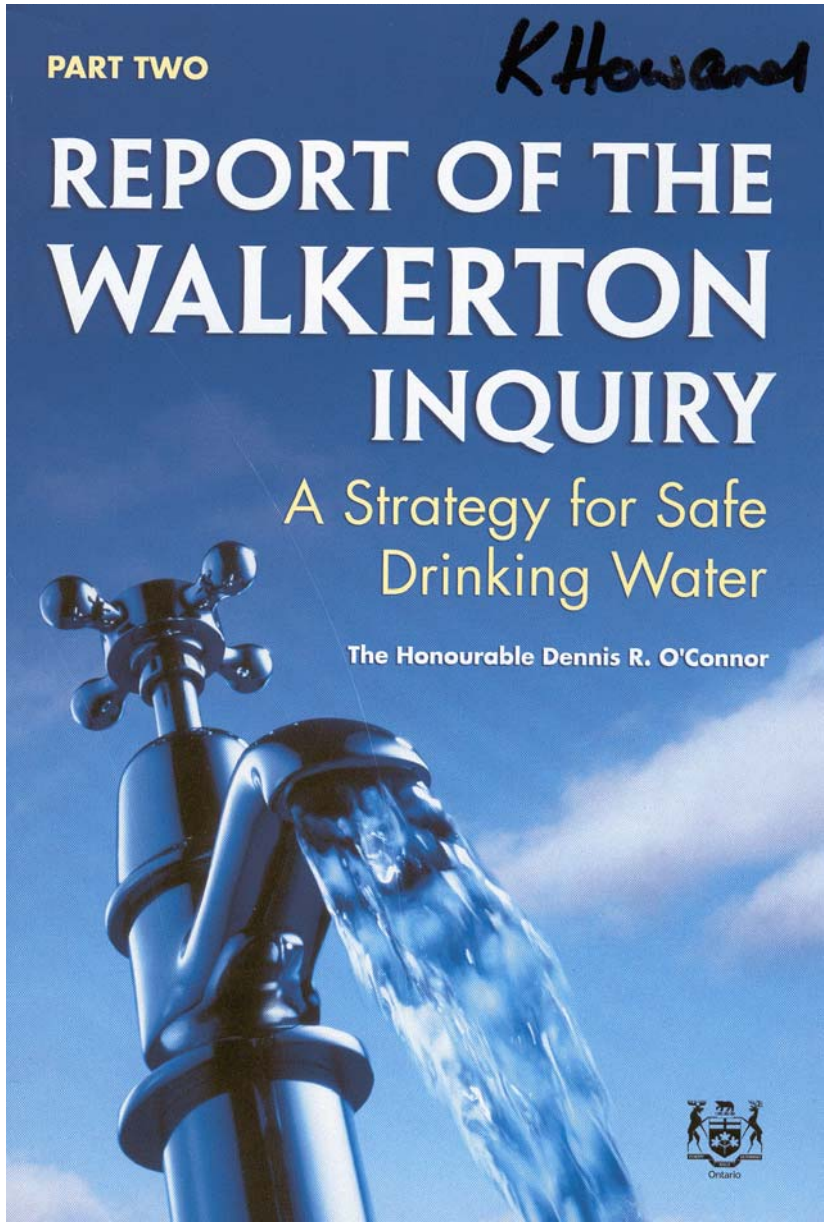
but permeable "sand and gravel zones" within the till were also potentially involved in the rapid transmission of contaminated water.

We can only hope that Walkerton will eventually dispel the persistent belief amongst many hydrogeologists that a draping of glacial till, provides significant water quality protection to underlying aquifers.

Certainly, one outcome of the inquiry was to highlight the potential role of inadequately abandoned wells as conduits for rapid, vertical, groundwater flow. For example, disused Well #s 1 and 2 were never properly sealed after their "retirement".

Serious questions were also raised regarding the engineering design of well heads and the protection, if any, they provide.

In fact, Part 2 of the Inquiry Report, published in May, 2002, focused on these and a large number of other potential problems that might affect the safety of drinking water across the Province.



It was entitled "A Strategy for Safe Drinking Water" and included 93 Recommendations for improvements to Ontario's water delivery system:

Source Protection (17)

Drinking Water Quality Standards (12)

Water Treatment (4)

Water Distribution (2)

Monitoring (5)

Laboratories (3)

Role of Municipal Government (7)

Quality Management (8)

Training of Individual Operators (6)

Provincial Government (16)

Small Systems (7)

First Nations (6)

Significantly, the very first recommendation dealt with

* **hydrogeology,**
* **aquifer management and**
* **aquifer protection.**

It delivered a message to the government that had been "falling on deaf ears" for over twenty years:

Namely…

Recommendation 1

Drinking water sources should be protected by developing watershed-based source protection plans.

Source protection plans should be required for all watersheds in Ontario.

More importantly, Justice O'Connor clearly defined what he meant by "watershed-based source protection plans". He said that at a minimum they should include:

- a water budget for the watershed, or a plan for developing a water budget where sufficient data are not yet available;
- the identification of all significant water withdrawals, including municipal intakes;
- land use maps for the watershed;
- the identification of wellhead areas;
- maps of areas of groundwater vulnerability that include characteristics such as depth to bedrock, depth to water table, the extent of aquifers, and recharge rates;

- **the identification of all major point and non–point sources of contaminants in the watershed;**
- **a model that describes the fate of pollutants in the watershed;**
- **a program for identifying and properly decommissioning abandoned wells, excavations, quarries, and other shortcuts that can introduce contaminants into aquifers;**
- **the identification of areas where a significant direct threat exists to the safety of drinking water**
- **the identification of significant knowledge gaps and or research needs to help target monitoring efforts.**

…. in fact, it was the perfect BLUEPRINT for the management and protection of Ontario's groundwater

….and a valuable opportunity for the Province's cash-starved hydrogeologists

….To date, the government's response has been very disappointing

It certainly "woke up" very quickly and began well, bringing on-line some initiatives even before the Inquiry reports were published. It:

- **gave $15 million to the Municipality of Brockton to restore a safe water supply for Walkerton**
- **Launched Operation Clean Water which established strict protocols for operating large water works**
- **Committed $240 million under the SuperBuild program to upgrade health and safety infrastructure including municipal waterworks**

Then it hit the snooze button !!

1) Within months it announced the Oak Ridges Moraine Conservation Plan Regulation, a plan which virtually ignores the fundamental concept espoused by Justice O'Connor that water needs to be managed and protected on a watershed basis.

(i.e. not by isolating areas deemed to have special significance and imposing special regulatory controls).

2) It also organised an "Aquifer Mapping and Wellhead Delineation Workshop" in the summer of 2001 where it unveiled its proposed approach to groundwater protection in the province.

Unfortunately, the approach proposed was seriously deficient:

It was antiquated at best, and

Scientifically unsound and dangerous at worst

Unbelievably, it included a primitive indexing approach to vulnerability analysis that perpetuated the myth that glacial tills provide significant protection to underlying aquifers!
The Walkerton aquifer would have been classified as having "LOW VULNERABILITY" to contamination!!!!!

3) To make matters worse, it committed a paltry $10 million to support 34 groundwater protection studies across the province (involving over 100 municipalities) – studies that according to the terms of reference would involve:

* **aquifer mapping**
* **3-D groundwater flow modeling**
* **auditing of chemical sources and**
* **the development of groundwater protection strategies based on a slightly improved, yet still flawed version of its vulnerability mapping approach**

The fact that this totally inadequate level of funding was announced as

"the largest single investment in groundwater source protection in the province's history"

illustrates perfectly how seriously under-funded groundwater issues have been!

In recent times, and in an effort to regain some credibility, the MOE has unveiled the *Safe Drinking Water Act*, 2002, described by Mr. Eves as:

"one of the most significant pieces of legislation that will ever be introduced to ensure that Ontarians have safe drinking water now and in the future…….the legislation will ensure that Ontarians have the cleanest and safest drinking water in the world."

Don't be fooled into thinking that Ontario is waking up !

The Act simply responds to Recommendation #67 that deals exclusively with with matters related to the treatment and distribution of drinking water. All it does is set tighter regulations for such things as water quality monitoring, inspections and training of operators.

Fundamental needs such as those presented as Recommendation #1 "management and protection of groundwater" are barely paid lip service

CONCLUSION

Post-Walkerton, the signs are not encouraging...

Justice O'Connor did an outstanding job, but the government response on many key issues has been slow and largely cosmetic.

"Ontario, in fact most of Canada is 20 years behind the rest of the world when it comes to groundwater management and protection"

Without continued pressure on the government, don't expect this to change.