

Ken Howard

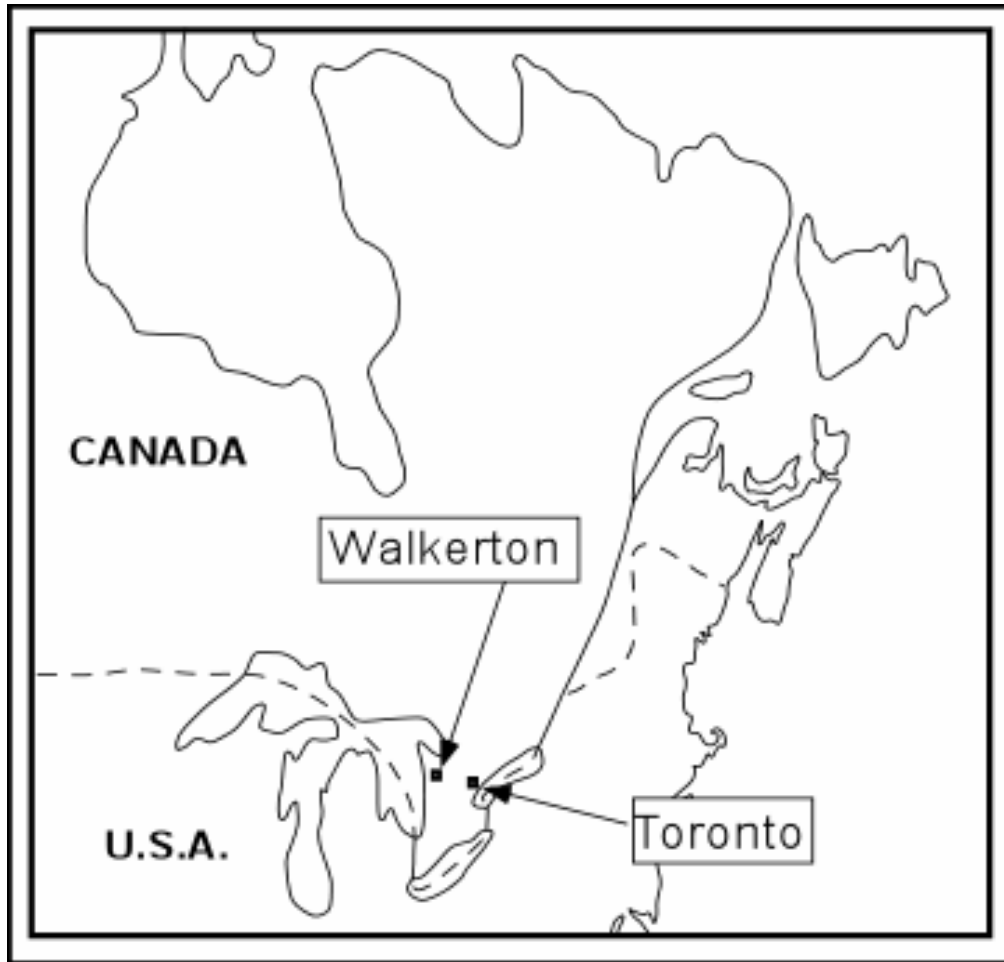
University of Toronto



**WELCOME TO
WALKERTON**

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

Walkerton, Ontario (population of **<5,000**) is a rural community located 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 carbonates are covered by a thin (2.5m - 4m) veneer of till a “stony, sandy silt to silt till” known as the Elma Till).

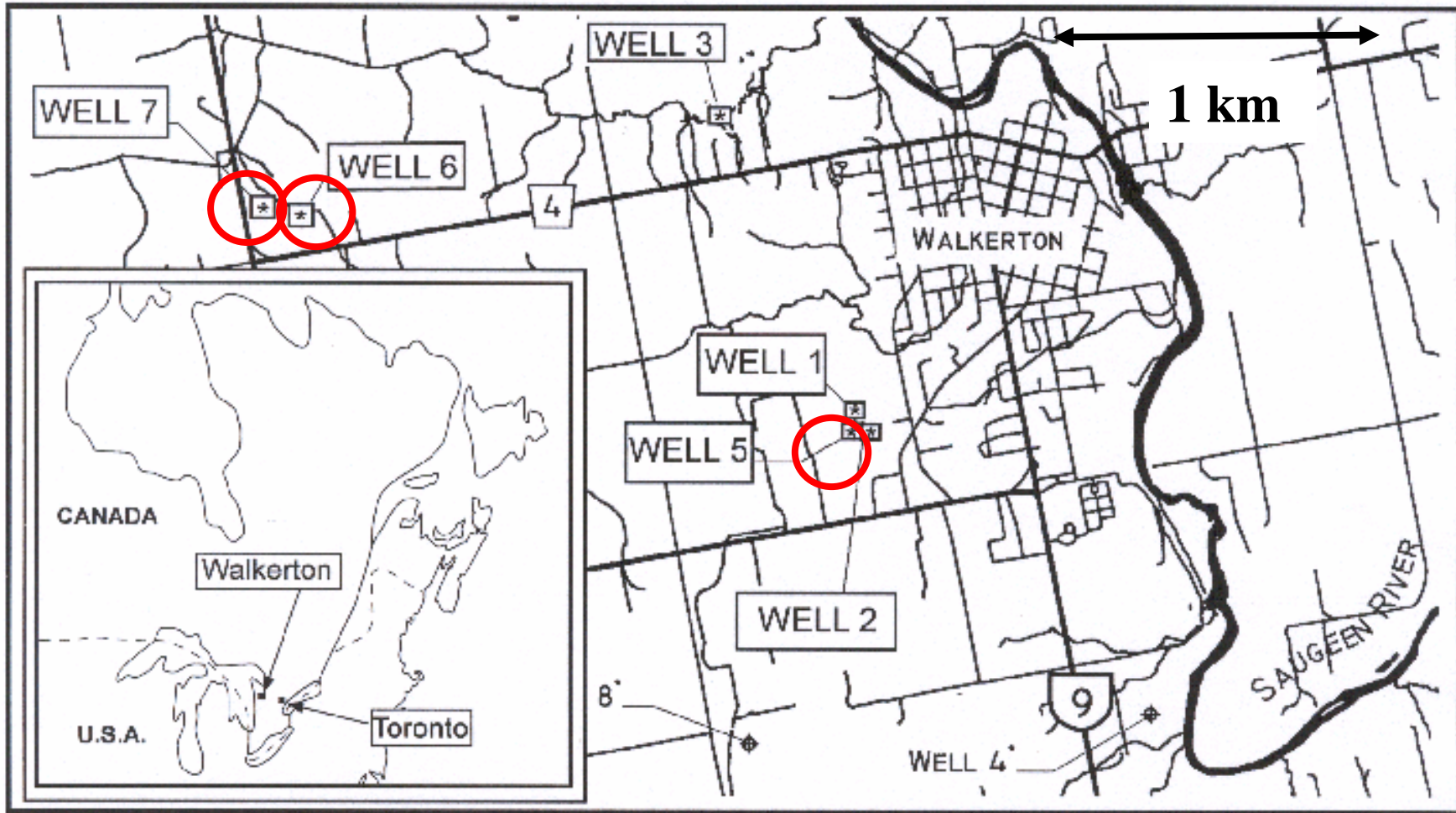


The original supply for Walkerton was obtained from deep wells (#s 1 and 2) drilled in 1949 and 1952 to depths of over 70 m.



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





Well #s 1 and 2 were later “retired”,
and **well #3** was put on standby.

In recent times, supply has been obtained
exclusively from **well #s 5, 6 and 7**. There is no well #4.



← **Well #5 -1978 - 15 m**


Well #6 - 1982
72.2m →



← **Well #7, 1986 the deepest (76.2m) and “main well” producing 3400 litres per minute of normally good quality water.**

In May, 2000, the world changed for Walkerton Ontario – many residents started to fall sick.





Initially, beginning **May 18th**, food poisoning was the suspected cause and sufferers were being advised by doctors to avoid dehydration by

“drinking plenty of water”!!

It was not until **May 21st** that contaminated well water was confirmed as the cause and a boil-water alert was issued.

By May 23rd when lab results confirmed the presence of ***E.Coli* bacteria** in the town’s water supply, 500 people had been affected and 160 people had sought hospital treatment.

One, a senior citizen, had died.





The problem became worse....

Within days, **four** more deaths were recorded.

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**.

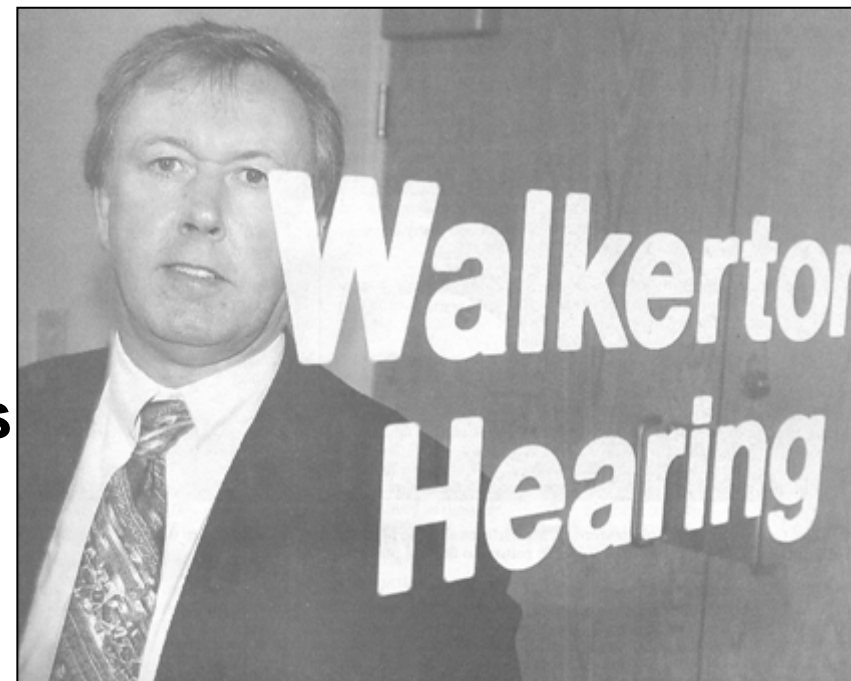





Once the cause of the outbreak was confirmed, authorities responded quickly. On **May 31st, 2000**, the Premier of Ontario set up an independent **“Commission of Inquiry”** under **Justice Dennis O’Connor**, and detailed hydrogeological studies began.

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

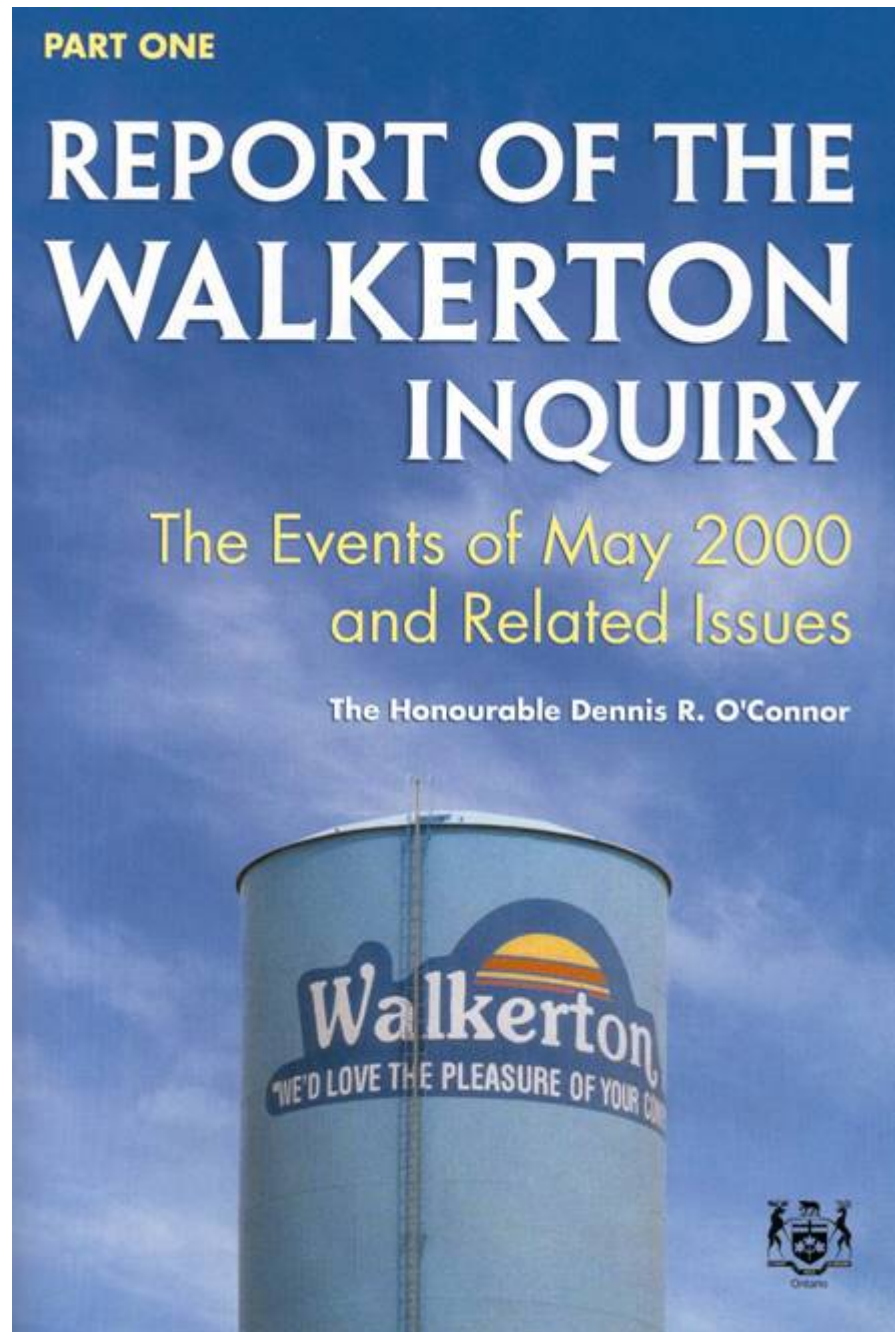
And me.....!





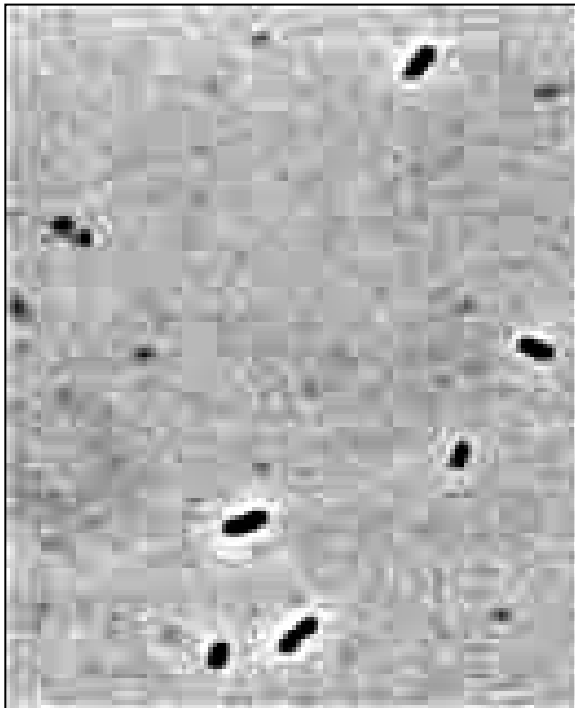
The hearing was divided into two parts and two reports were issued.

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





The hearing revealed that the outbreak was caused by *Escherichia coli (E. coli)*, and *campylobacter* in the well water and that *E. coli O157:H7* was the primary cause of the deaths.



E. coli O157:H7

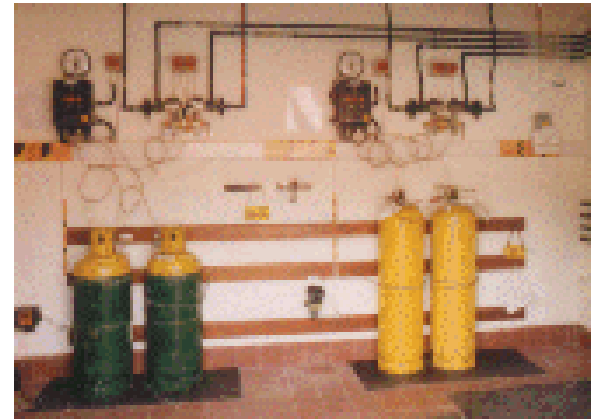
Campylobacter jejuni, was determined to have contributed to two of the deaths

Most strains of *E. coli* found in groundwater are harmless.

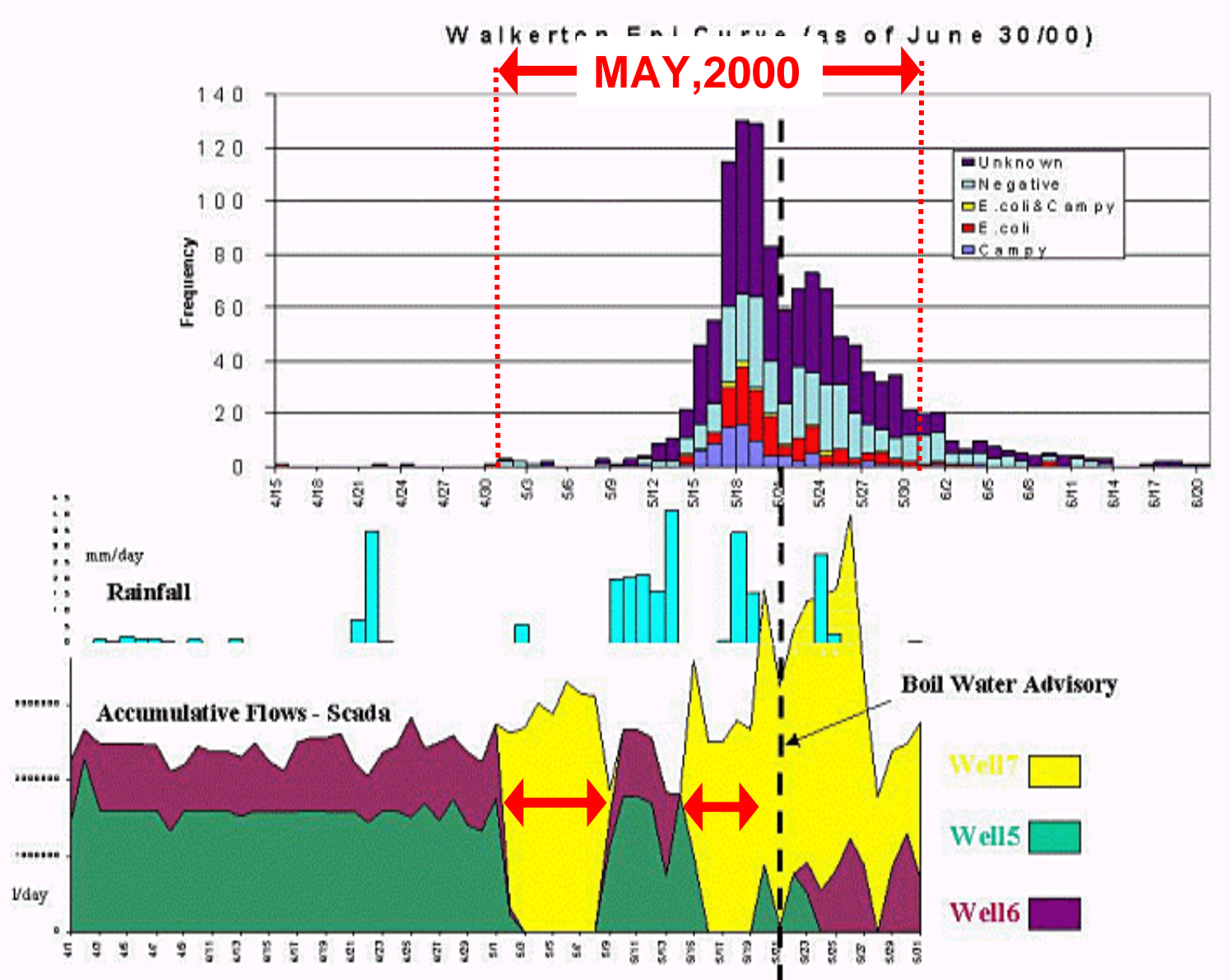
E. coli O157:H7, however, produces a powerful toxin that can cause severe illness including liver failure.

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

As a simple precaution, all surface water supplies and most municipal groundwater supplies are *normally* treated with chlorine



Superchlorination facilities at Soberton Water Treatment Works

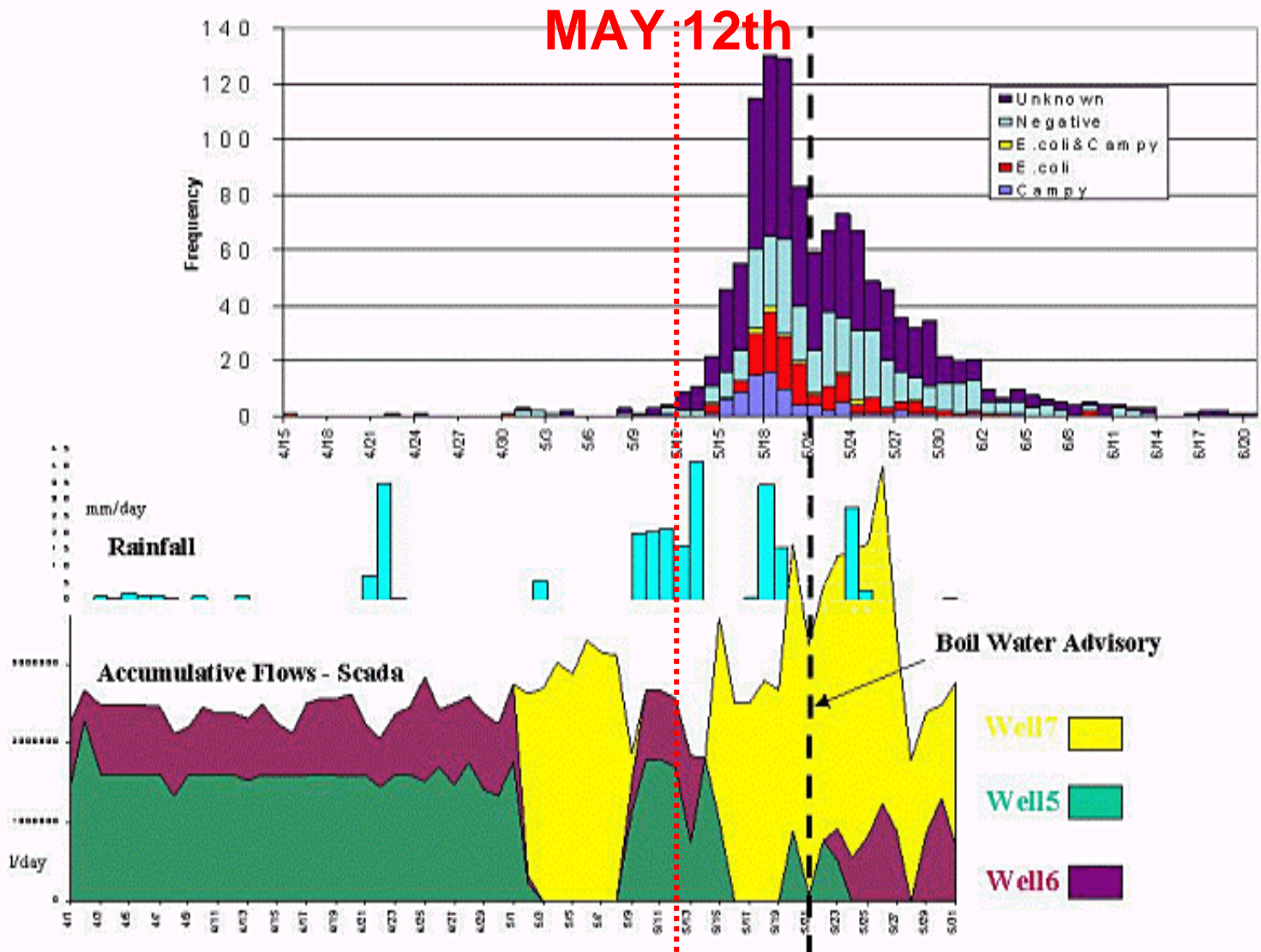


During the first week of May, 2000, and between May 15th and May 19th, well #7 was operated without a chlorinator.

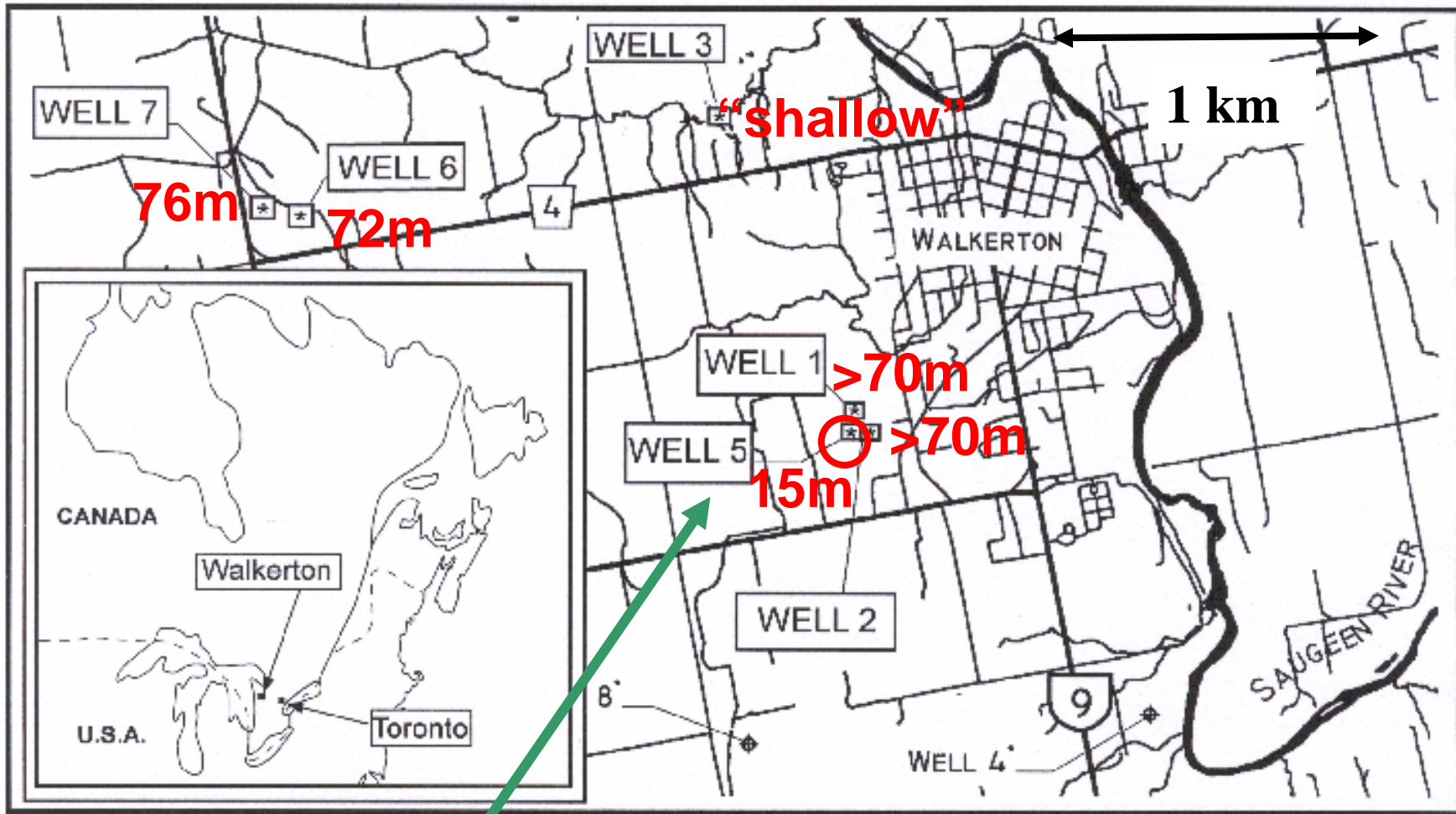
This was not reported!



Walkerton Epi Curve (as of June 30/00)



As it turns out, **well #7 was not the cause** of the outbreak. Bacteria entered the system on or just after **May 12th** when well #7 was out of service.



Well # 5 was the culprit!

On or soon after May 12th when bacteria entered the delivery system, well #5 was the primary source of the town's water and well #6 cycled on and off.

Well #5 was being chlorinated but chlorine residuals were not being monitored !



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,
cattle manure was applied during late April, 2000
to within 80m of well #5 .

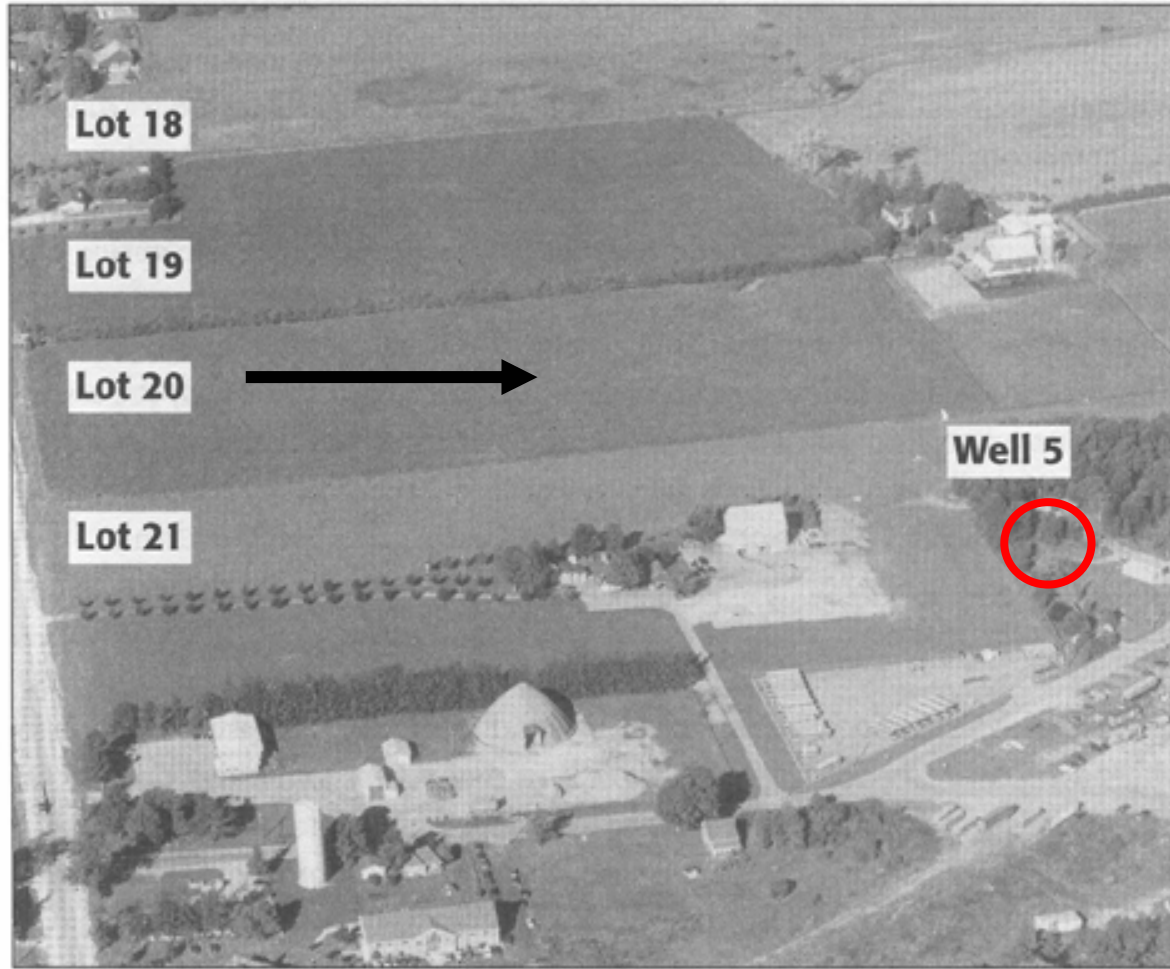
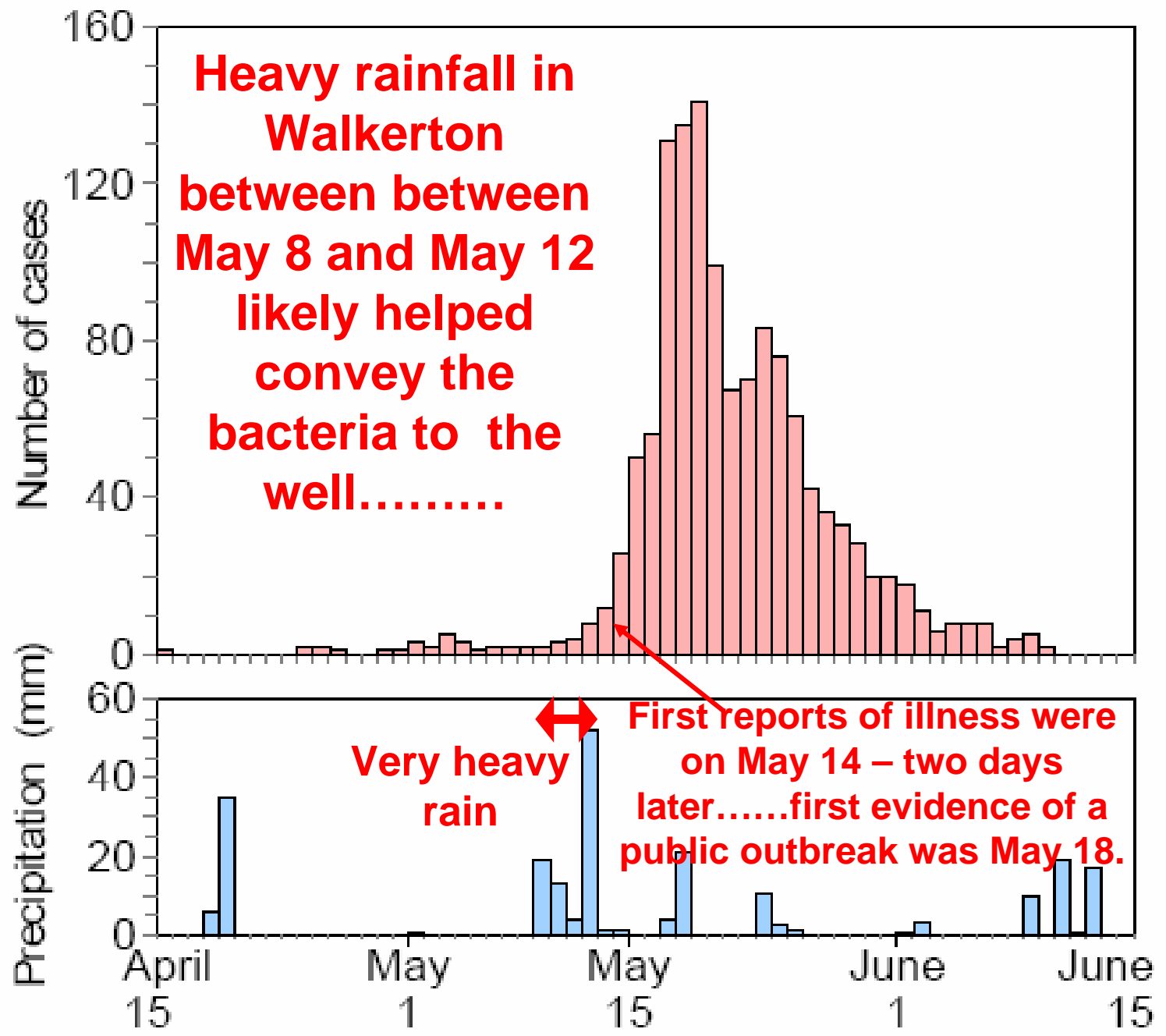


Photo: Marc Bolduc, RCMP

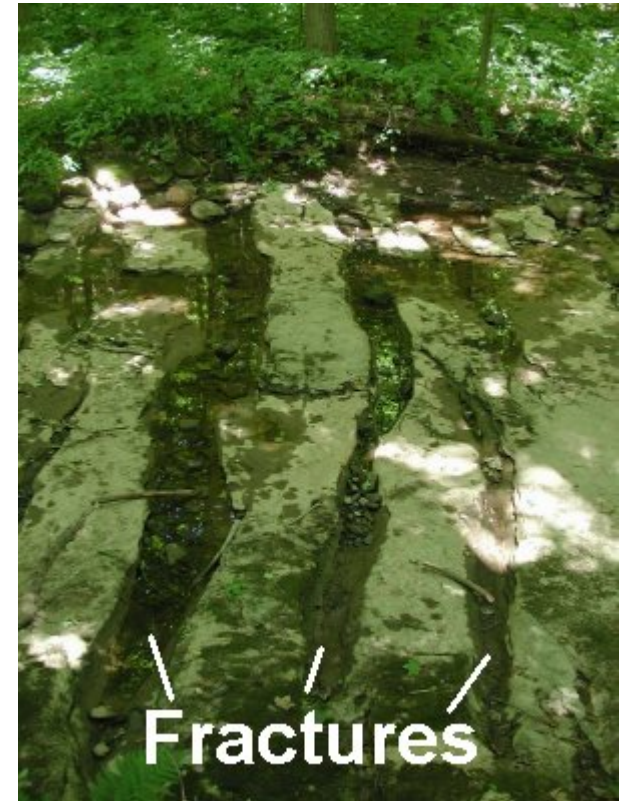
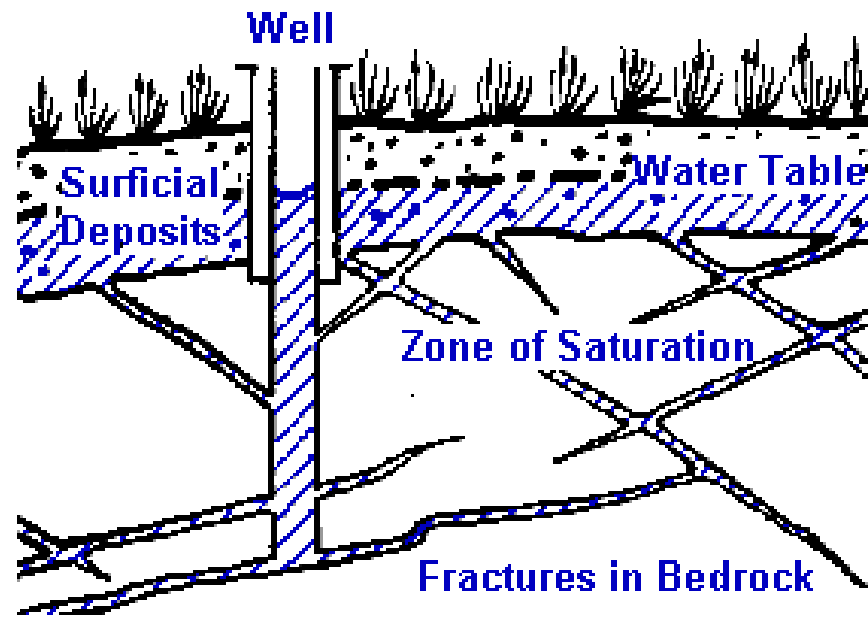







However, the precise transport route was never reliably determined.

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





...but flow paths via the glacial till draping remain less clear.



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

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

It is also perhaps significant that the original wells (#s 1 and 2) were retired but never properly sealed



These may have allowed contaminants to move directly down into the aquifer.



**Stan
Koebel**



Justice O'Connor concluded that the outbreak could have been averted if monitoring procedures had been strictly followed.

- Evidence presented at the hearing showed that PUC operators engaged in numerous improper practices including
- failing to use appropriate doses of chlorine,
 - failing to monitor chlorine residuals daily,
 - making false entries about residuals in daily operating records, and
 - misstating the locations at which microbiological samples were taken.

If PUC operators had manually monitored the chlorine residuals at well #5 during the critical period, the extent of the outbreak would have been significantly reduced



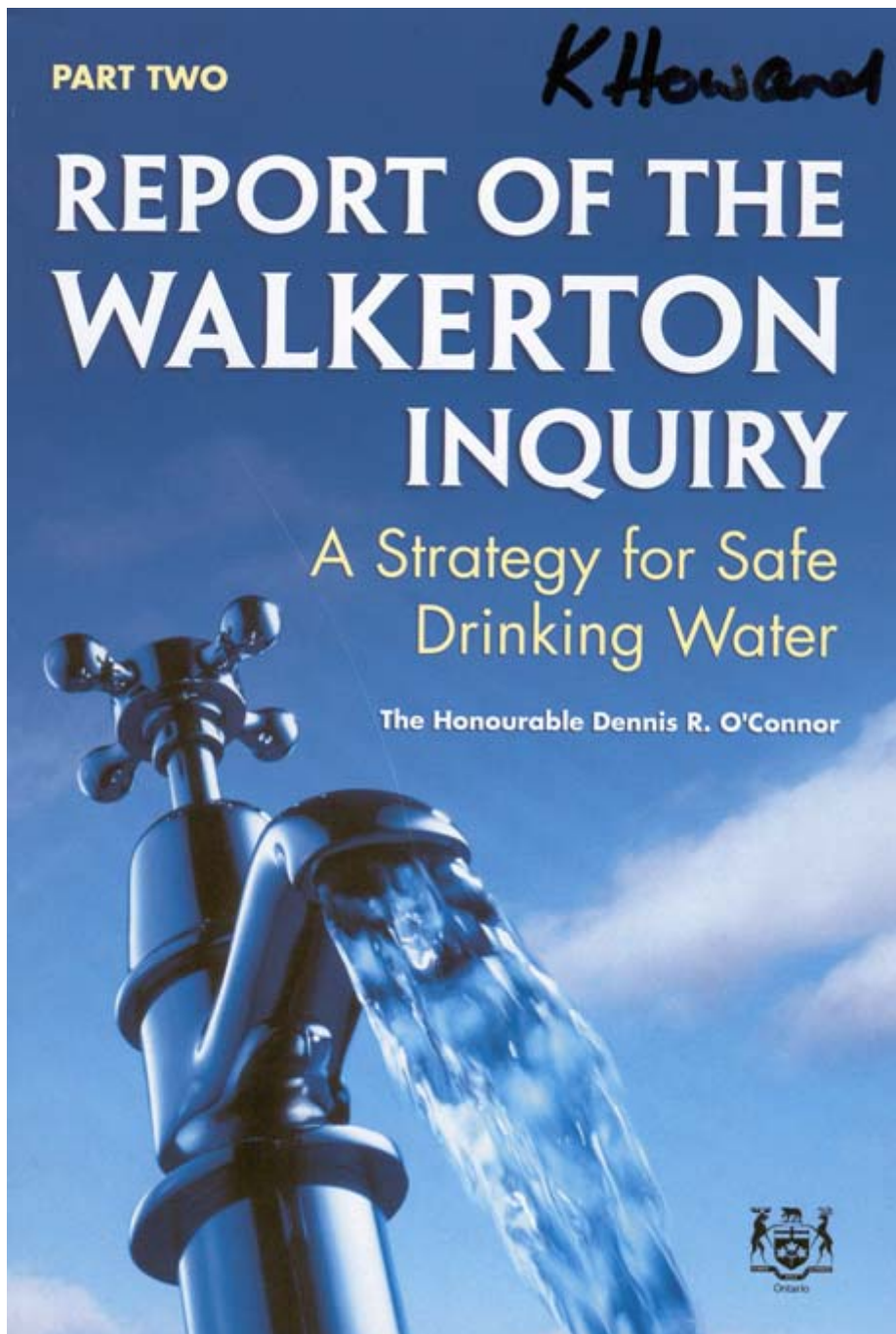
PUC operators did not saddle all the blame. The outbreak would have been prevented **entirely** if continuous chlorine residual and turbidity monitors had been installed at well #5.

MOE inspectors were aware that well #5 was vulnerable to contamination by surface water, referred to as GUDI (groundwater under the direct influence of surface water) and should have known that the Ontario Drinking Water Objectives (ODWO, 1994) require such sources to **monitored continuously** for chlorine residual and either continuously or a minimum of four times a day for turbidity. Also, the MOE inspection program should have detected the improper practices of PUC personnel.

Provincial budget reductions were directly implicated in the failings of the MOE.



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

- * aquifer management and**
- * aquifer protection.**

Namely...

Recommendation 1

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

- comprehensive water budget for the watershed
- detailed records of water withdrawals
- land use maps for the watershed
- the identification of wellhead protection areas
- maps of areas of groundwater vulnerability
- records of major point and non–point sources of contaminants in the watershed
- numerical simulation models that describe the fate of pollutants in the watershed
- a program for identifying, and properly decommissioning abandoned wells and other shortcuts that can introduce contaminants into aquifers
- the identification of areas where a significant direct threat exists (GUDI) to the safety of drinking water
- additional research

The background of the slide is a photograph of a water treatment facility. It shows a large, dark, curved structure, possibly a filter or part of a pump, in the foreground. In the background, there are several large, rectangular concrete basins or tanks, some of which are filled with water. The sky is clear and blue, and there are some trees and greenery in the distance.

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

....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 ignored 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 unveiled its proposed approach to groundwater protection in the province....

which turned out to be 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 suggested **8m of permeable gravel** provides as much protection from contamination as **1m of impermeable clay!**

Clearly absurd!



3) To make matters worse, it committed just \$ 10 million to support 34 groundwater studies protection across the province (involving over 100 municipalities) – studies that would involve:

- * aquifer mapping**
- * 3-D groundwater flow modeling**
- * auditing of chemical sources and**
- * the development of groundwater protection strategies based on its 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!



Subsequently, and in an effort to regain some credibility, the MOE 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.”



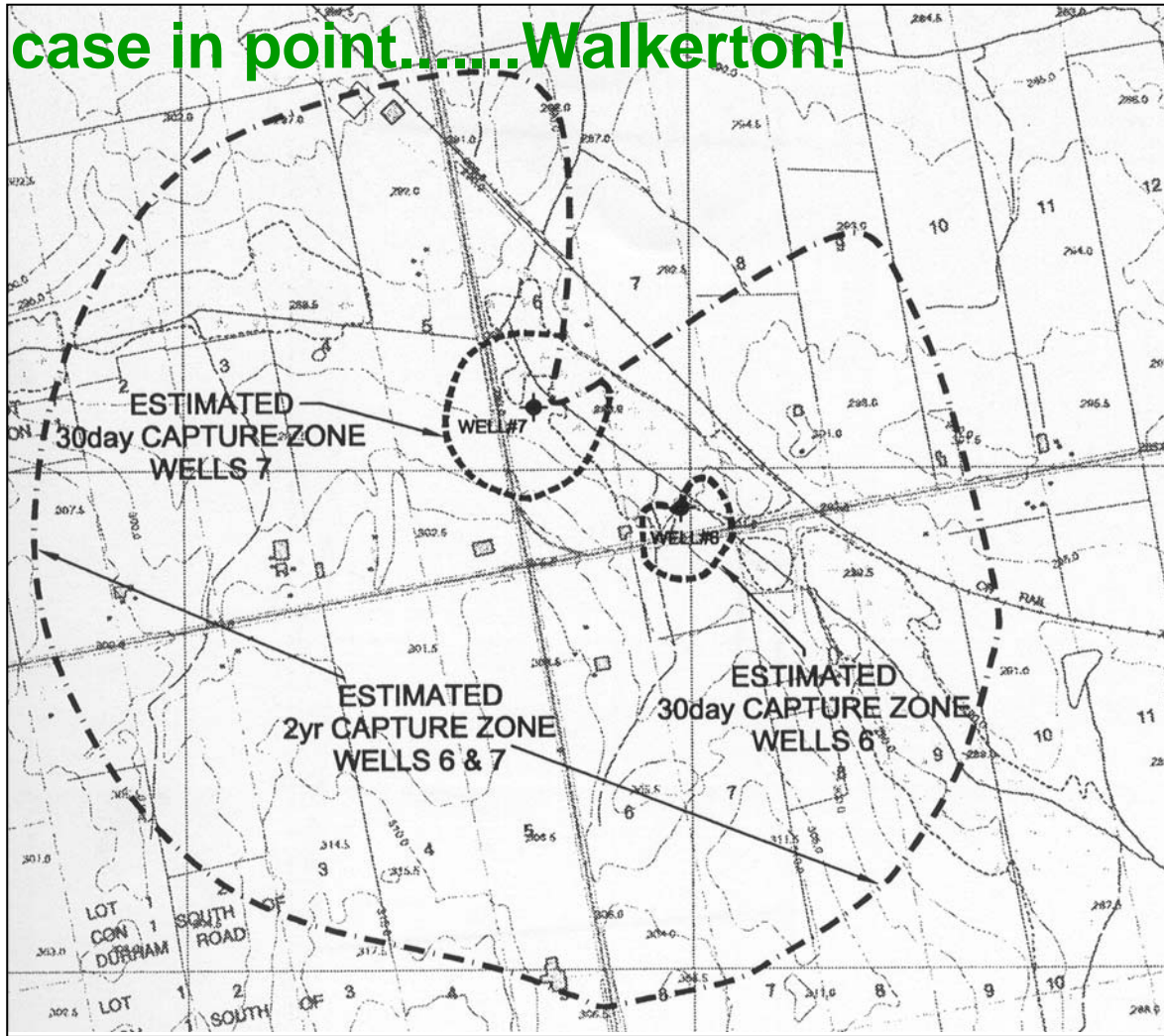
**Don't be fooled into thinking
that Ontario was waking up !**

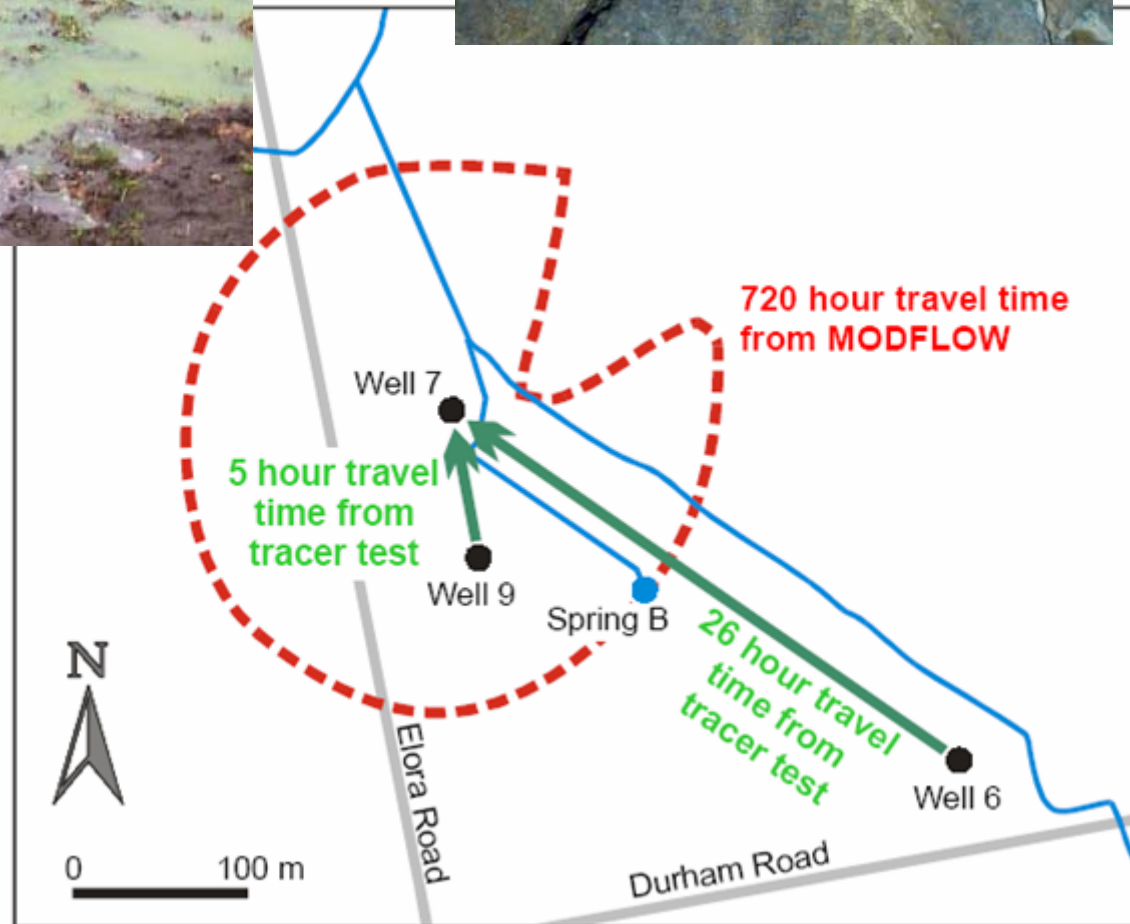
The Act simply responded to Recommendation #67 that dealt exclusively with matters related to the treatment and distribution of drinking water.

It 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”
were barely paid lip service**

As one example, the Province is busily constructing wellhead protection zones for all municipal wells. Unfortunately, the **method adopted is so simple** and the **funds provided to gather necessary data so limited**, that in many cases these zones are simply meaningless.

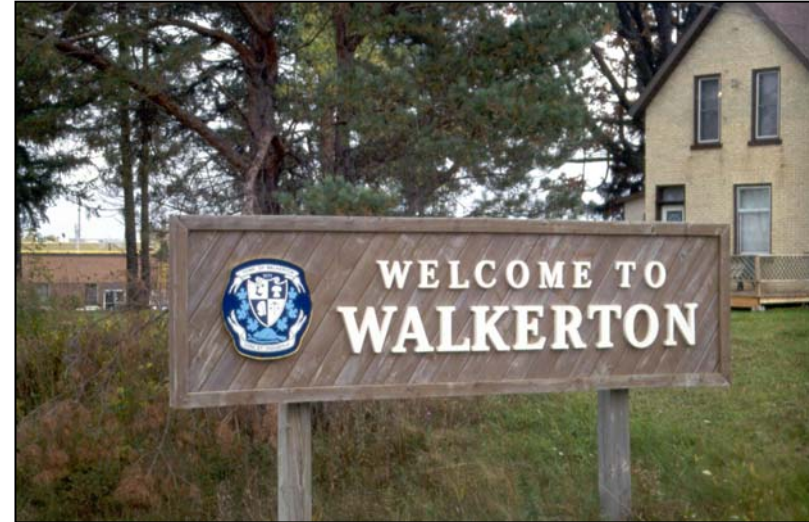




CONCLUSION

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.



“At the hearing I suggested that “Ontario, and most of Canada was 20 years behind the rest of the world when it came to groundwater management and protection”.

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