CANADIAN WATER NETWORK
RÉSEAU CANADIEN DE L'EAU

International Experience from Water Contamination Events in Affluent Nations

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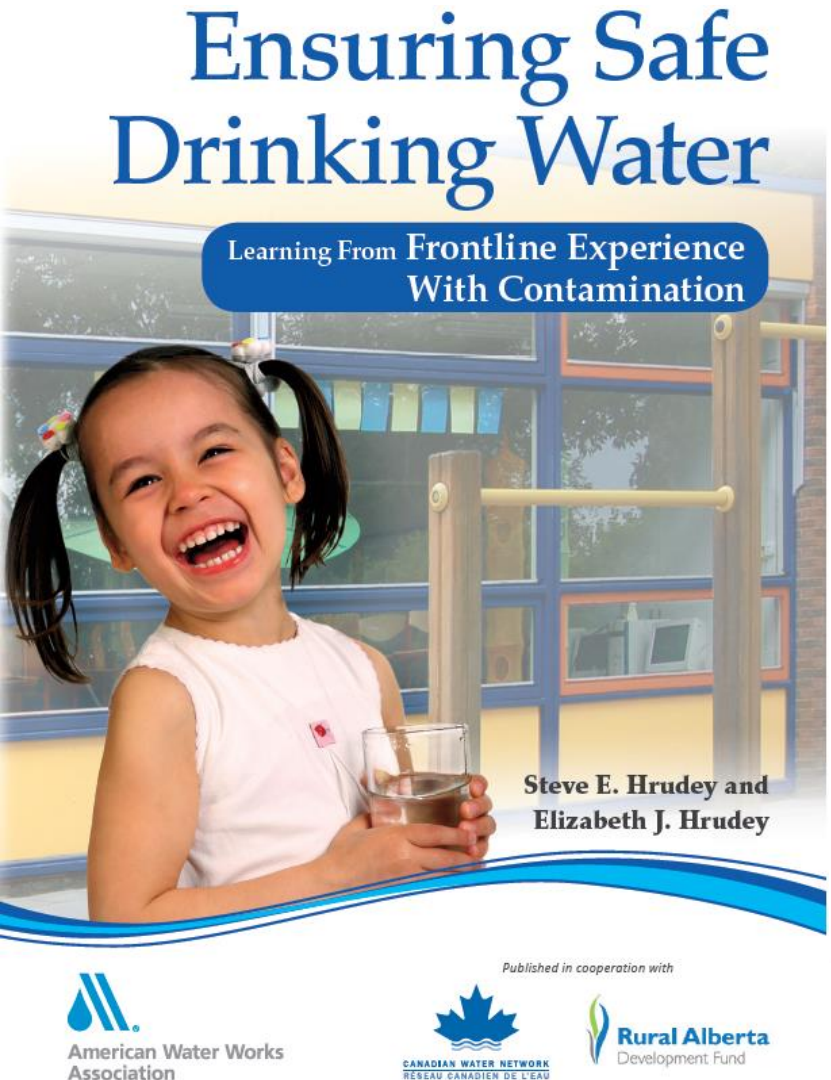
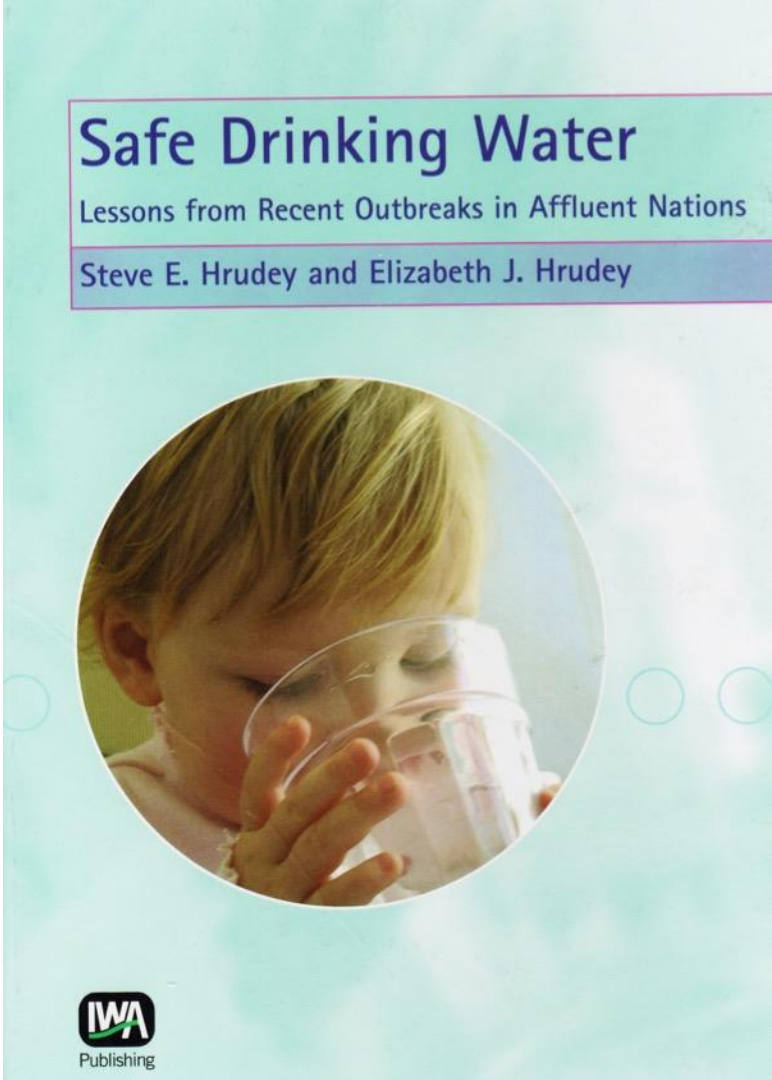
Relevant International Experience

- Our evidence for the Inquiry summarized 38 outbreaks of serious drinking waterborne disease in 13 affluent countries (9 in USA, 7 in Canada, 6 in England, 3 in Finland, 2 each in Denmark, Norway, Sweden, Switzerland and 1 each in Australia, Ireland, Japan, New Zealand and Scotland)
- Caused a total of 77 fatalities in **9 fatal outbreaks** and a total of ~460,000 cases of illness
- These outbreaks clearly illustrate the need for "***effective***" **Water Safety Plans**



We wrote a 2004 book inspired by the fatal Walkerton outbreak in May 2000 -

We wrote a sequel for frontline personnel in 2014



Do Not Learn the Hard Way?

- Most frontline personnel (operators, managers, regulators and public health personnel) will likely **not** experience a major drinking water disaster first hand
- Makes sense to make disaster experience available and “live” for the majority so they can avoid becoming involved in a disaster
- Drinking Water Safety Plans (DWSP), must be a truly “***know your own system***” approach

A Case Study Approach

Despite the rare occurrence of drinking water outbreaks in affluent countries, they continue to happen

We must teach prevention:

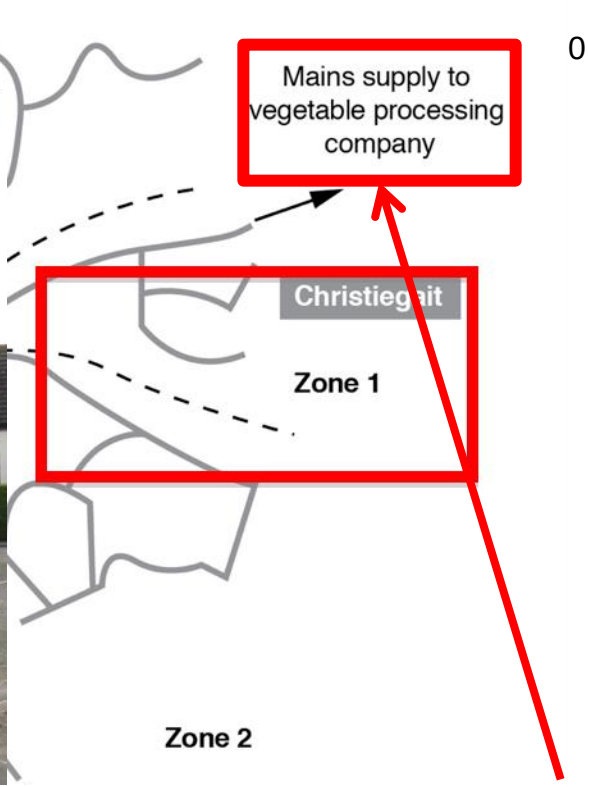
- Case studies can make learning more effective by adding reality to the learning experience
- Case studies can be adapted to local realities
- Operators do not want to harm their neighbours
- Personnel should avoid errors, if they fully understand the consequences (e.g. Walkerton)

A Case Study Approach

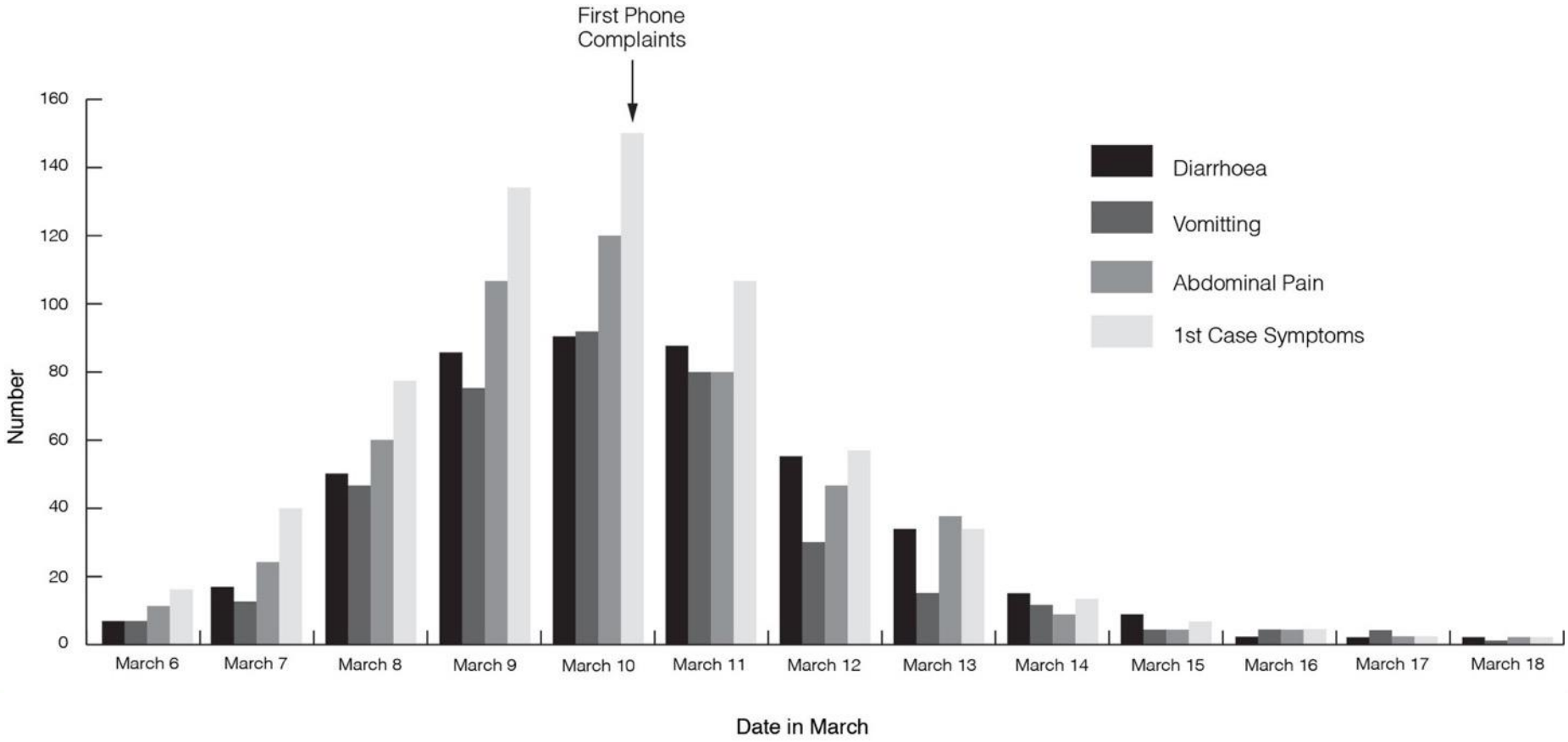
We encourage the readers of our case studies to ask themselves:

- Could this have happened to your system?
- Would all of the failures which occurred have been detected by your system management?
- Would your system have responded appropriately to all of the signals if they were detected?
- These answers should be evident with an "***effective***" **WSP** approach in place
- Look at a few example cases in brief

Freuchie, Fife, Scotland
March 1995



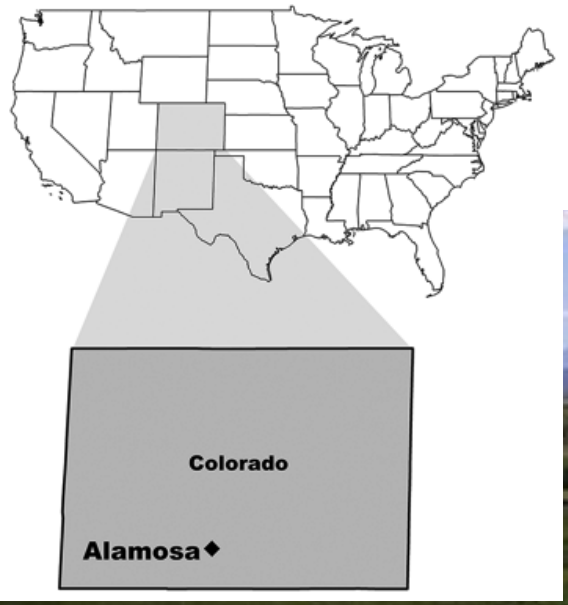
Over the course of the day, the problem was traced to a cross connection at a local vegetable processing plant leading to dire consequences

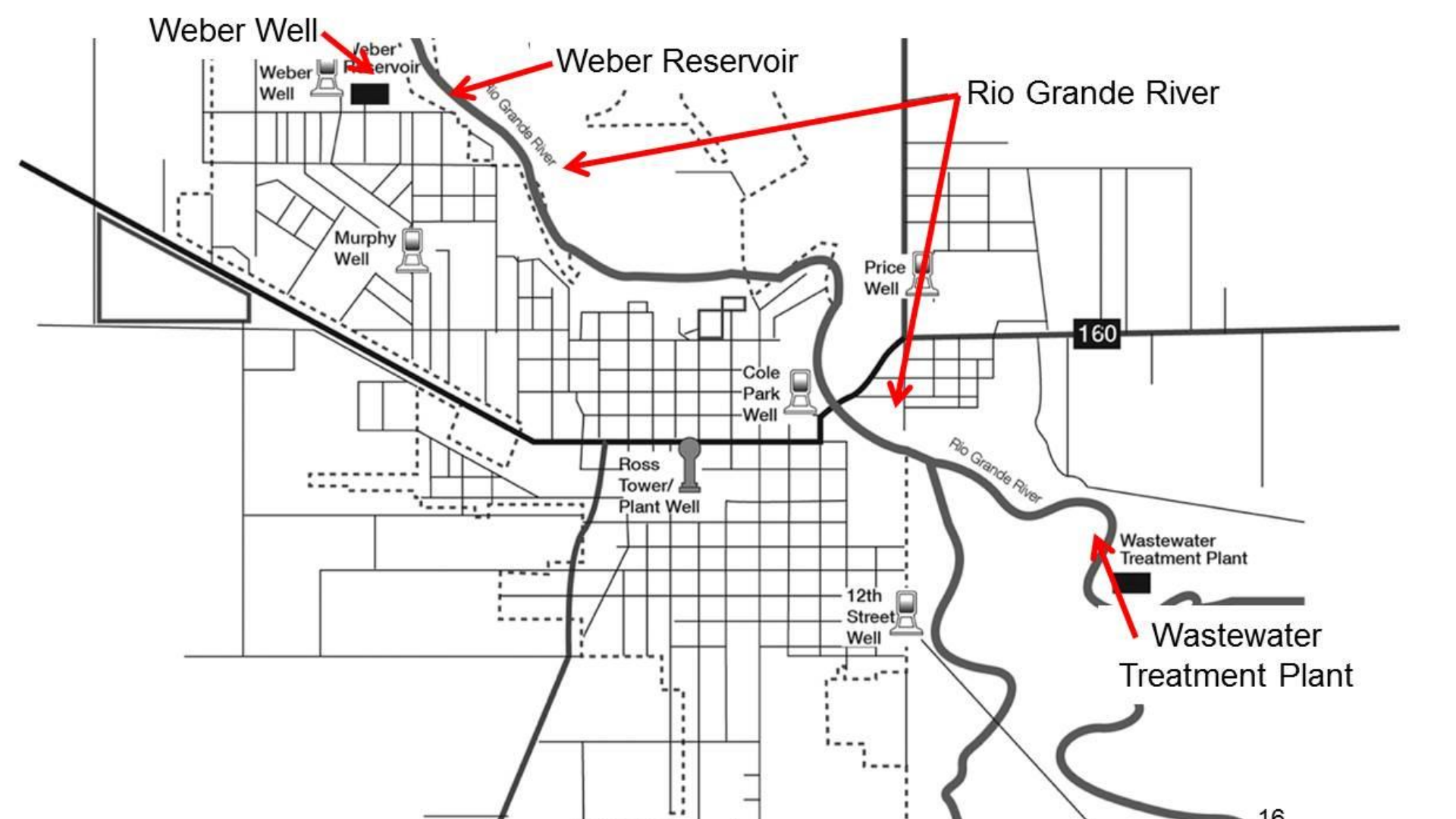

First Phone Complaints
160
140
120
100
80
60
40
20
0
Number
Diarrhoea
Vomitting
Abdominal Pain
1st Case Symptoms
March 6
March 7
March 8
March 9
March 10
March 11
March 12
March 13
March 14
March 15
March 16
March 17
March 18
Date in March

Freuchie: Consequences

- The community of about 1,100 had 765 residents who reported illness, 711 had gastrointestinal illness.
- Peak of 149 cases occurred on March 10, the day when phone complaints to the water utility had begun.
- Fortunately, despite infection by *E. coli* O157:H7, there were no deaths or severe kidney diseases – **supply was chlorinated**.
- 2/3 of the exposed population were ill by the time that the contamination was discovered, and over 90% likely had been infected, before remedial measures (flushing, increased chlorination and boil water advisory) could have shown any protective effect.

Alamosa, Colorado, USA
March - April 2008




Weber Well
Weber Reservoir
Rio Grande River
Weber Well
Weber Reservoir
Rio Grande River
Murphy Well
Price Well
160
Cole Park Well
Ross Tower/ Plant Well
Rio Grande River
Wastewater Treatment Plant
12th Street Well
Wastewater Treatment Plant

Alamosa: What Actually Happened

- Source water was **NOT** likely a cause
- Focus on storage and distribution for possible cause
- Weber reservoir was most plausible site of contamination
- Constructed in 1979, inspected in 1997 showing that the roof, exterior wall surface, and foundation were satisfactory, but the exterior corners *"were in poor condition*" and the exterior walls and foundation had "*some cracking, spalling and exposed aggregate*"
- Not drained and cleaned since 1984
- Poor or inadequate maintenance of drinking water storage caused an outbreak with a high quality groundwater source

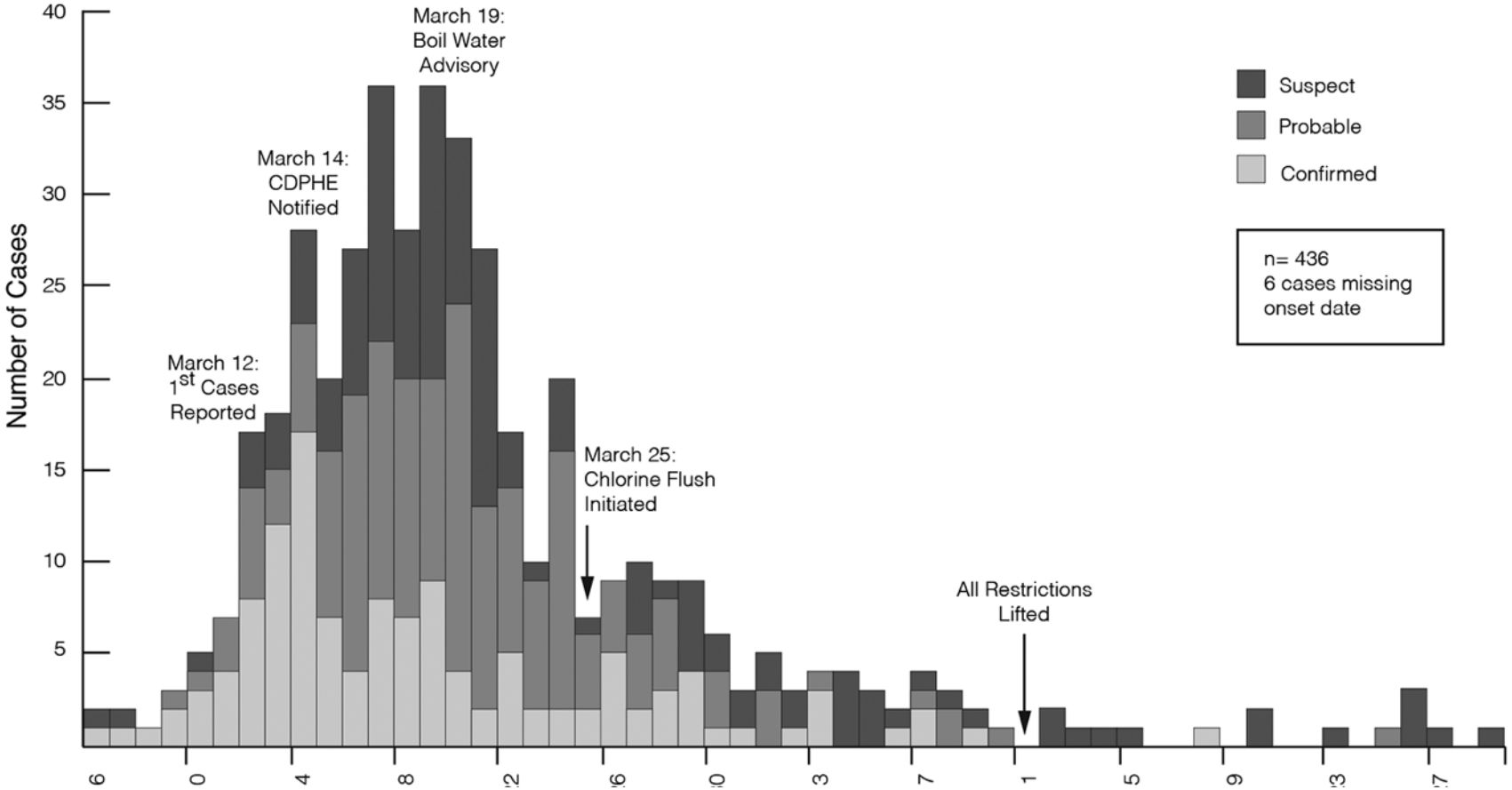

Weber Reservoir

Alamosa: What Actually Happened

- Identified potential cross-connection hazards: 3 locations considered to be potentially extreme hazards - 2 mortuaries and a combined meat packing and restaurant facility.
- None of these was judged to have been responsible for the *Salmonella* contamination because no sources of *Salmonella* were identified.
- Most plausible explanation for *Salmonella* contamination was the entry of fecal contamination carried by rain or snowmelt through cracks in the roof and sides of the tank – no critter bodies found.
- Sediment samples for *Salmonella* nalysis were handled improperly preventing confirmation of this contamination mechanism

Alamosa: Consequences

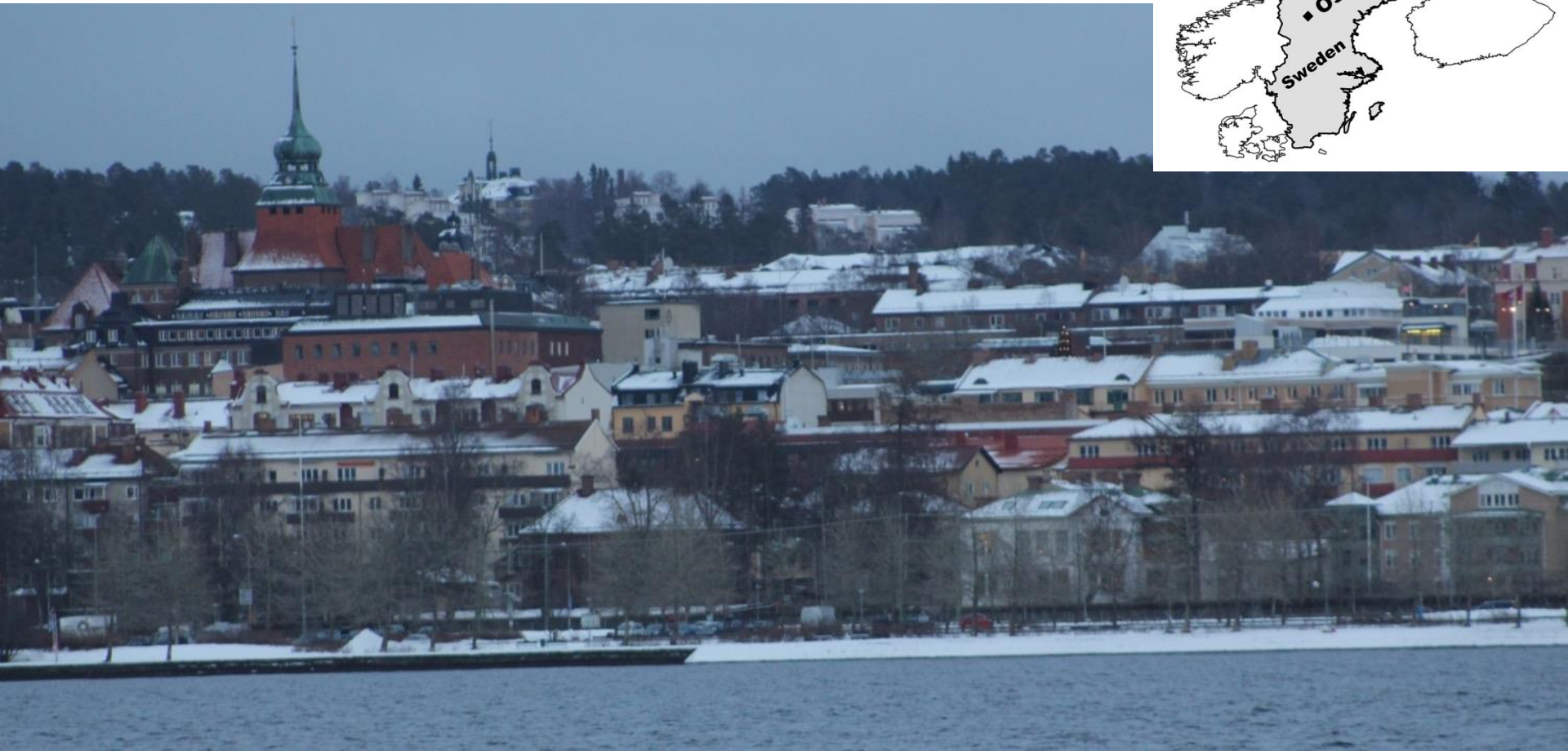
- This outbreak resulted in 434 reported cases of gastroenteritis, including 124 laboratory-confirmed cases of salmonellosis, with 20 hospitalizations and **1 death**.
- A telephone survey estimated that a total of 1,300 were ill during this waterborne outbreak.
- Of those who reported diarrheal disease (21 percent of those surveyed), 29 percent reported illness with potential long-term health consequences.
- Symptoms may involve acute inflammation, headache, abdominal pain, diarrhea (bloody in up to 30 percent of cases), nausea, and possible vomiting


Number of Cases
40
35
30
25
20
15
10
5
March 19:
Boil Water
Advisory
March 14:
CDPHE
Notified
March 12:
1st Cases
Reported
March 25:
Chlorine Flush
Initiated
All Restrictions
Lifted
Suspect
Probable
Confirmed
n= 436
6 cases missing
onset date

Alamosa: Consequences

- Insurer for the City paid $360,000 to 29 Alamosa residents, including the widow of the deceased 54-year-old male.
- Alamosa issued a press release stating that it continues to "*dispute that there was any negligence on the part of the City for the outbreak*."
- Costs experienced by residents and local businesses was a median estimate of $1.5 million (range: $197,000 to $6 million).
- Total costs including governments and public agencies was a median estimate of $2.6 million (range: $1.1 million to $7.8 million).

Östersund, Sweden 2010



Östersund, Sweden 2010

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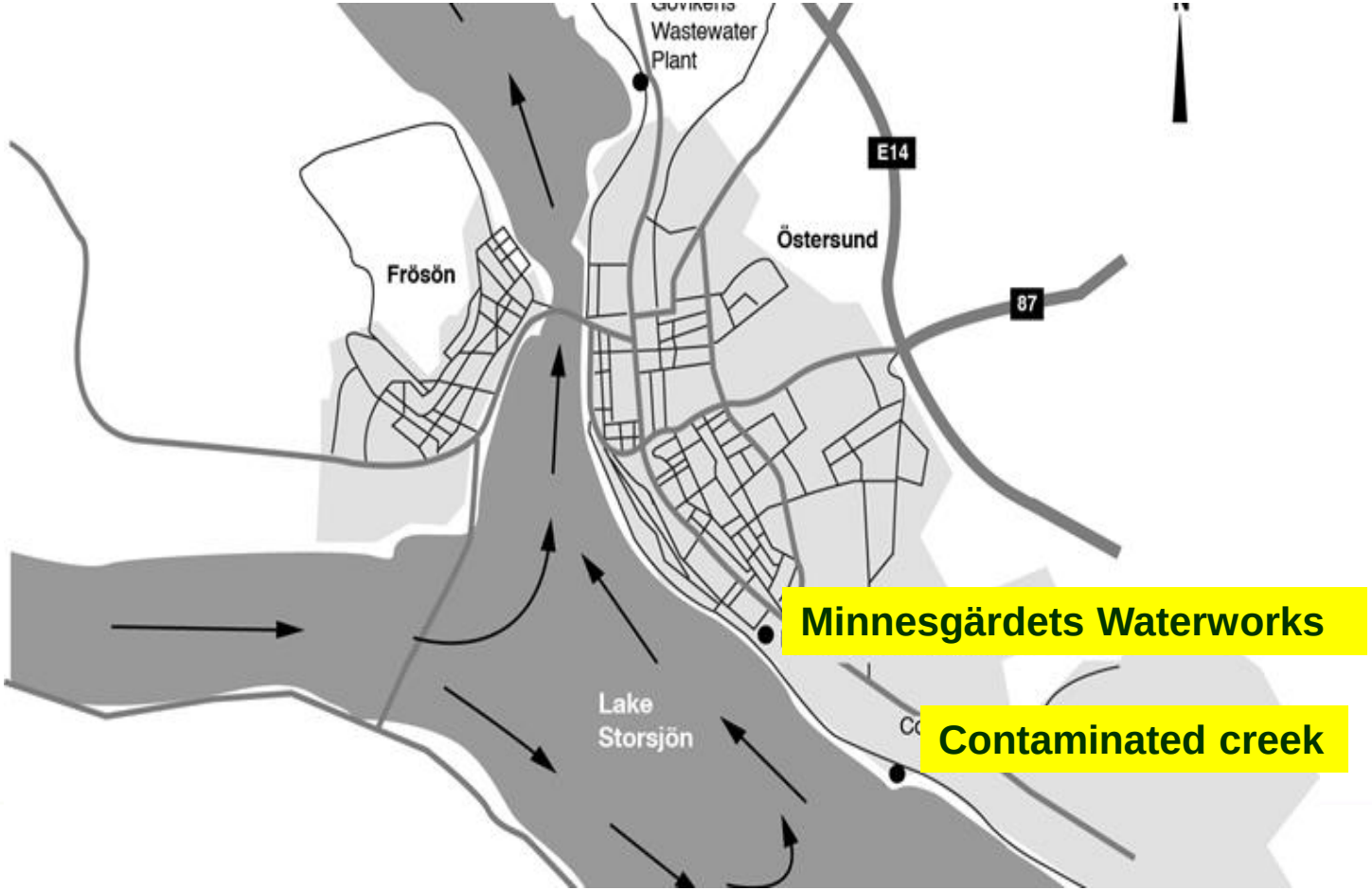


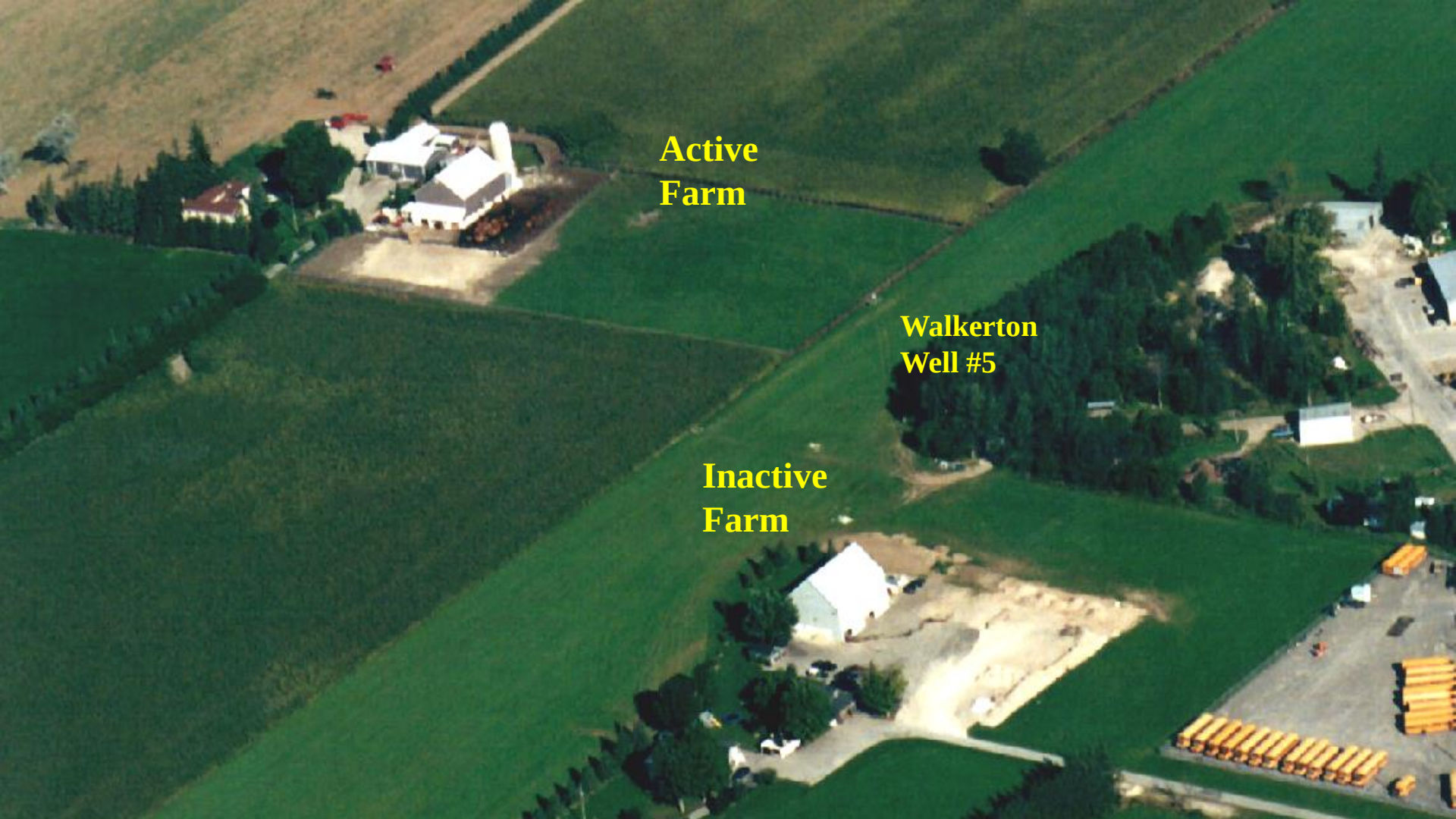
Östersund, Sweden 2010

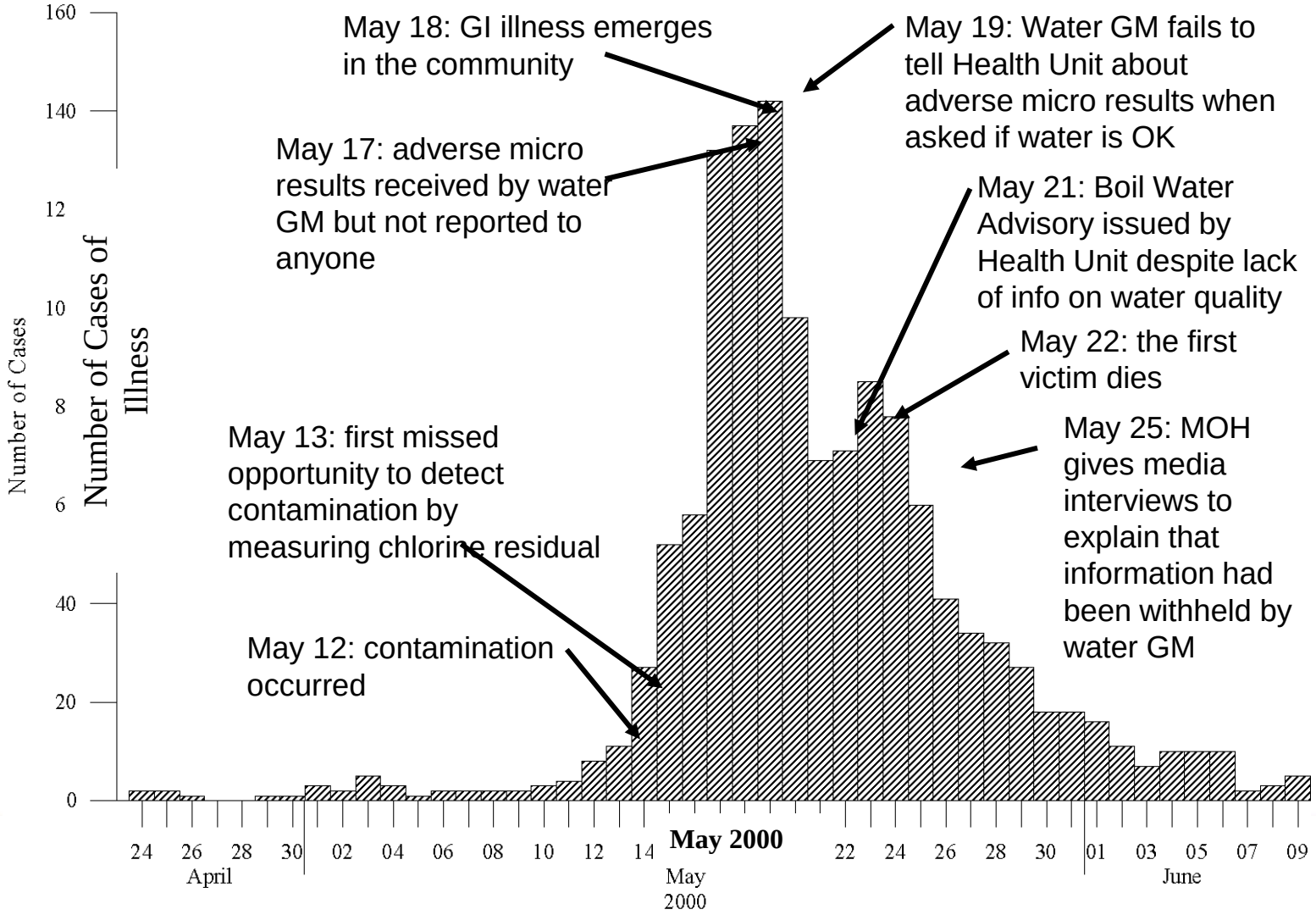
- This community of 60,000 experienced an estimated 27,000 cases of cryptosporidiosis, **the largest outbreak in European history**.
- Östersund was fortunate to locate a suitably-sized UV treatment unit to be installed at Katrineholm, 650 km to the south.
- Katrineholm agreed to let its UV unit ($690,000) be installed in Östersund to deal with its crisis.
- Östersund flushed 320 km of pipe ($260,000) a total of 10 times to avoid leaving any oocysts in biofilms.
- The boil water advisory was removed after 84 days.

Walkerton, Ontario
May 2000


RESTAURANT
LICENSED CELLER


Well 7
Well 6
To Paisley Highway
Walkerton Town Centre
To Hanover Hwy 104
Well 5
PUC Shed
Mother Teresa School
Saugeen River
N
To Kincardine Highway 9 &104


Active
Farm
Walkerton
Well #5
Inactive
Farm


May 18: GI illness emerges in the community
May 19: Water GM fails to tell Health Unit about adverse micro results when asked if water is OK
May 17: adverse micro results received by water GM but not reported to anyone
May 21: Boil Water Advisory issued by Health Unit despite lack of info on water quality
May 22: the first victim dies
May 25: MOH gives media interviews to explain that information had been withheld by water GM
May 13: first missed opportunity to detect contamination by measuring chlorine residual
May 12: contamination occurred
Number of Cases of Illness
Number of Cases
160
140
12
10
8
6
40
20
0
24 26 28 30 02 04 06 08 10 12 14 16 18 20 22 24 26 28 30 01 03 05 07 09
April
May 2000
May
2000
June

What caused Walkerton?

- The water operators were long-term residents of Walkerton and those who died or were violently ill were their neighbours in a community of 5,000
- They continued to drink the water throughout the outbreak
- They did not understand that pathogen contaminated drinking water could kill consumers
- They only chlorinated because they were told to, but had no idea about serious health risks from failing to disinfect
- They did not understand that monitoring chlorine residual could tell them if water was contaminated
- If they were incompetent, what does that say about their management and the regulators?

FEAR OF CH

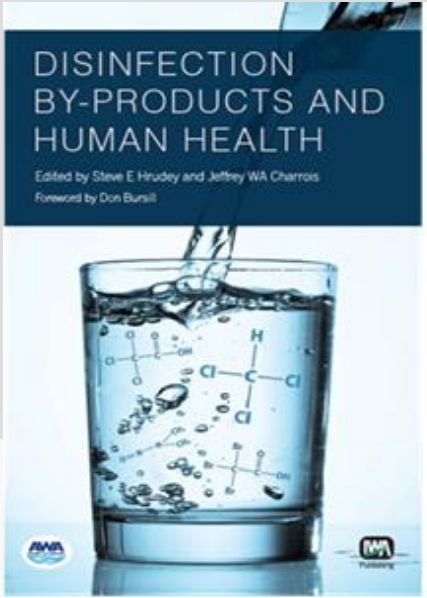
N*A*S*H

Lab

N*A*S*H

Labour

Let's start with the principle that we all want safe drinking water.



EVALUATING EVIDENCE FOR ASSOCIATION OF HUMAN BLADDER CANCER WITH DRINKING-WATER CHLORINATION DISINFECTION BY-PRODUCTS

Steve E. Hrudey[1], Lorraine C. Backer[2], Andrew R. Humpage[3], Stuart W. Krasner[4], Dominique S. Michaud[5], Lee E. Moore[6], Philip C. Singer[7], Benjamin D. Stanford[8]

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[3]SA Water, 250 Victoria Square, Adelaide, South Australia, Australia
[4]Metropolitan Water District of Southern California, Los Angeles, California, USA
[5]Tufts University, Medford, Massachusetts, USA
[6]Epidemiologist, Bethesda, Maryland, USA
[7]University of North Carolina, Chapel Hill, North Carolina, USA
[8]Hazen and Sawyer, Raleigh, North Carolina, USA

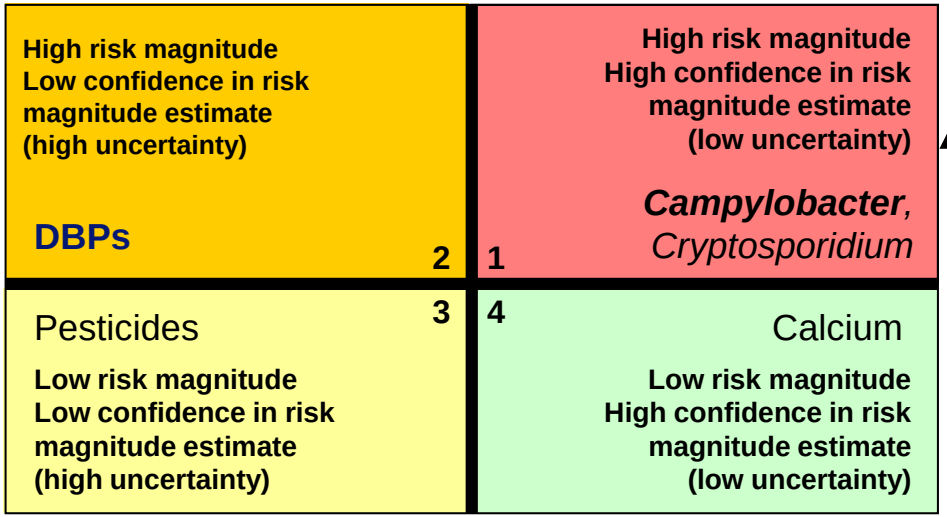
Exposure to chlorination disinfection by-products (CxDBPs) is prevalent in populations using chlorination-based methods to disinfect public water supplies. Multifaceted research has been directed for decades to identify, characterize, and understand the toxicology of these compounds, control and minimize their formation, and conduct epidemiologic studies related to exposure. Urinary bladder cancer has been the health risk most consistently associated with CxDBPs in epidemiologic studies. An international workshop was held to (1) discuss the qualitative strengths and limitations that inform the association between bladder cancer and CxDBPs in the context of possible causation, (2) identify knowledge gaps for this topic in relation to chlorine/chloramine-based disinfection practice(s) in the United States, and (3) assess the evidence for informing risk management. Epidemiological evidence linking exposures to CxDBPs in drinking water to human bladder cancer risk provides insight into causality. However, because of imprecise, inaccurate, or incomplete estimation of CxDBPs levels in epidemiologic studies, translation from hazard identification directly to risk management and regulatory policy for CxDBPs can be challenging. Quantitative risk estimates derived from toxicological risk assessment for CxDBPs currently cannot be reconciled with those from epidemiologic studies, notwithstanding the complexities involved, making regulatory interpretation difficult. Evidence presented here has both strengths and limitations that require additional studies to resolve and improve the understanding of exposure response relationships. Replication of epidemiologic findings in independent populations with further elaboration of exposure assessment is needed to strengthen the knowledge base needed to better inform effective regulatory approaches.

hoodwinked by the ***so-called experts****."*

Hrudey
Fawell
Leiss
Rose
Sinclair

Full report "*Managing Uncertainty in the Provision of Safe Drinking Water*"
http://www.cwn-rce.ca/resources/category/23-reports

Priorities for Health Risks in Drinking Water



Risk magnitude = probability x consequences
At or below levels which **have occurred** in drinking water

Higher **prevalence** will increase probability

Confidence in disease causation at or below **levels** found in drinking water

Hrudey et al. 2012. Managing uncertainty in the provision of safe drinking water.
www.cwn-rce.ca/assets/resources/pdf/managing-uncertainty-in-the-provision-of-safe-drinking-water.pdf

YOU NEED A TOTAL COMMITMENT TO WATER QUALITY & PUBLIC HEALTH –
CANNOT BE RECONCILED WITH LOUSY SANITATION AND INADEQUATE MAINTENANCE
If you would not eat there, do not claim to make safe water there

Plant floor of a licensed water treatment plant 30 min from Walkerton,

Was still operating in May 2005

Was only shut down by Ontario MOE in 2007!

ADWG "*Read Me First*" GUIDING PRINCIPLES

1. *The greatest risks to consumers of drinking water are pathogenic microorganisms. Protection of water sources and treatment are of paramount importance and must never be compromised*
2. *The drinking water system must have, and continuously maintain, robust multiple barriers appropriate to the level of potential contamination facing the raw water supply.*
3. *Any sudden or extreme change in water quality, flow or environmental conditions (e.g. extreme rainfall or flooding) should arouse suspicion that drinking water might become contaminated.*
4. *System operators must be able to respond quickly and effectively to adverse monitoring signals.*

ADWG "*Read Me First*" GUIDING PRINCIPLES

5. *System operators must maintain a personal sense of responsibility and dedication to providing consumers with safe water, and should never ignore a consumer complaint about water quality.*
6. *Ensuring drinking water safety and quality requires the application of a considered risk management approach.*

These Guiding Principles are the distilled wisdom of a group of international drinking water experts including NZ's Dr. Michael Taylor

They are certainly as valid now as when they were articulated in Adelaide in 2001.

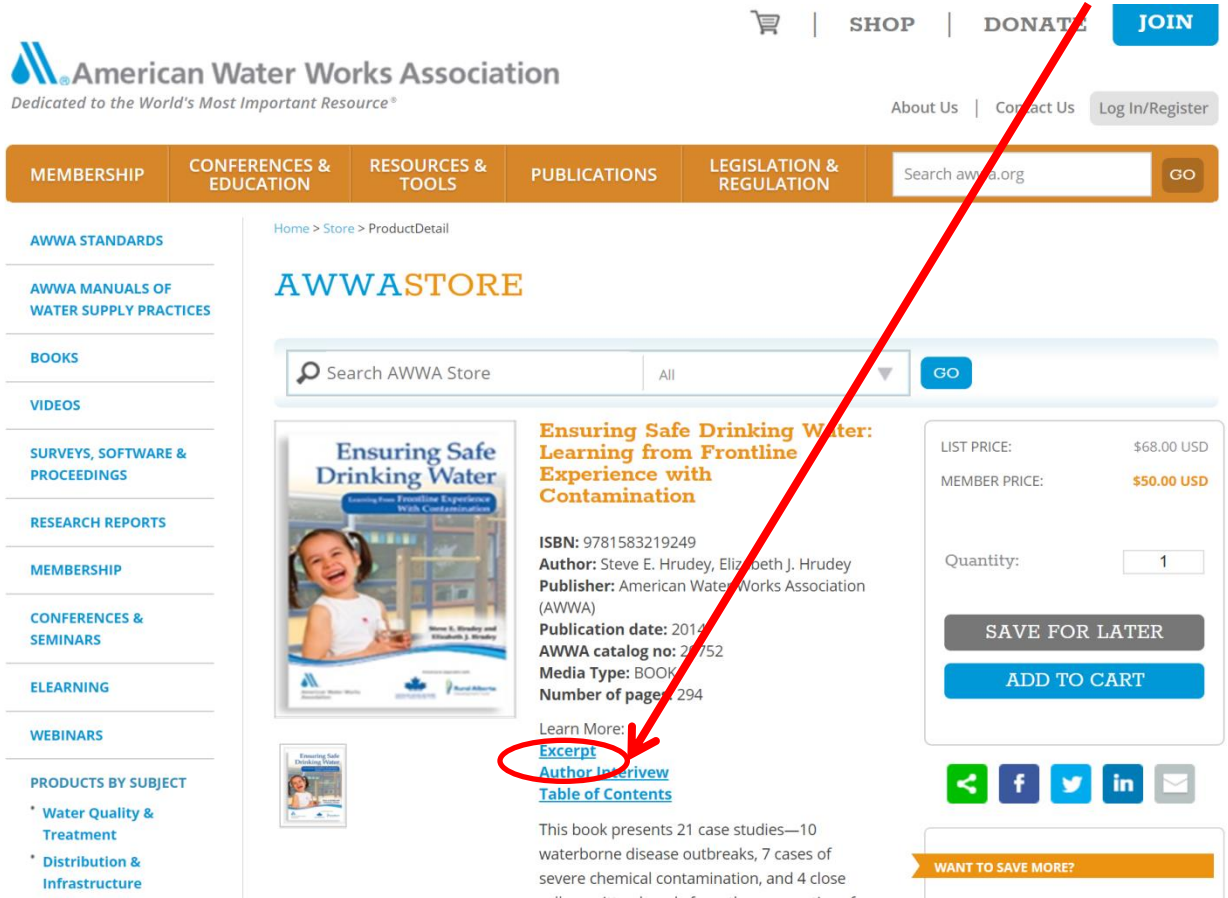
The Bottom Line

You can have cheap water

Or you can have safe water

But you cannot have cheap, SAFE water!

A free excerpt of our book is available at: www.awwa.org/esdw



Questions???

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