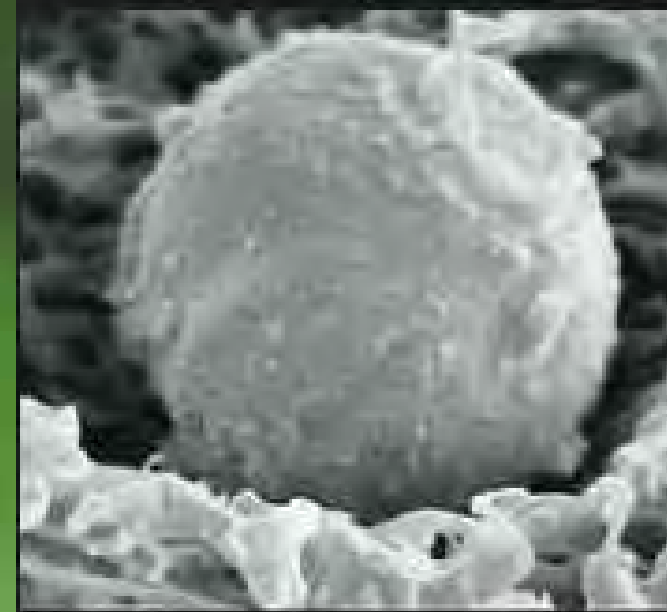




Cryptosporidium Oocyst



**A powerful cause-and-effect link:
Drowned rabbit caused a waterborne disease
outbreak.**

Bob Clement, Environmental Engineer M.S./Microbiologist, EPA Region 8, April 17, 2019

**The views expressed in this presentation are those of the author and do not necessarily
represent the views or policies of the U.S. Environmental Protection Agency**



How is it possible to catch a waterborne disease outbreak (WBDO) when it only affects $< 1/100$ of one percent of your population?

To find this example you need to travel across the “pond”



Highly awarded, Anglian Water operates 143 systems serving ~4.3 million in eastern UK.

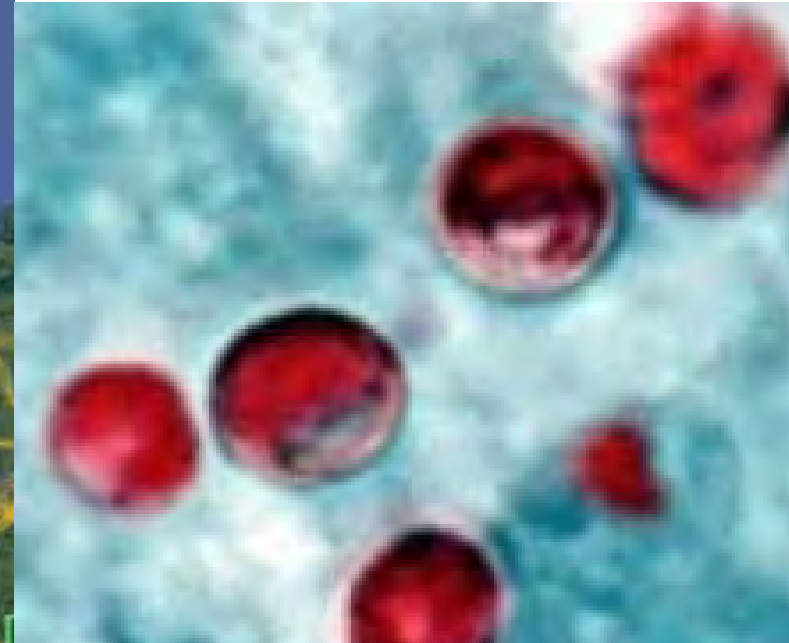
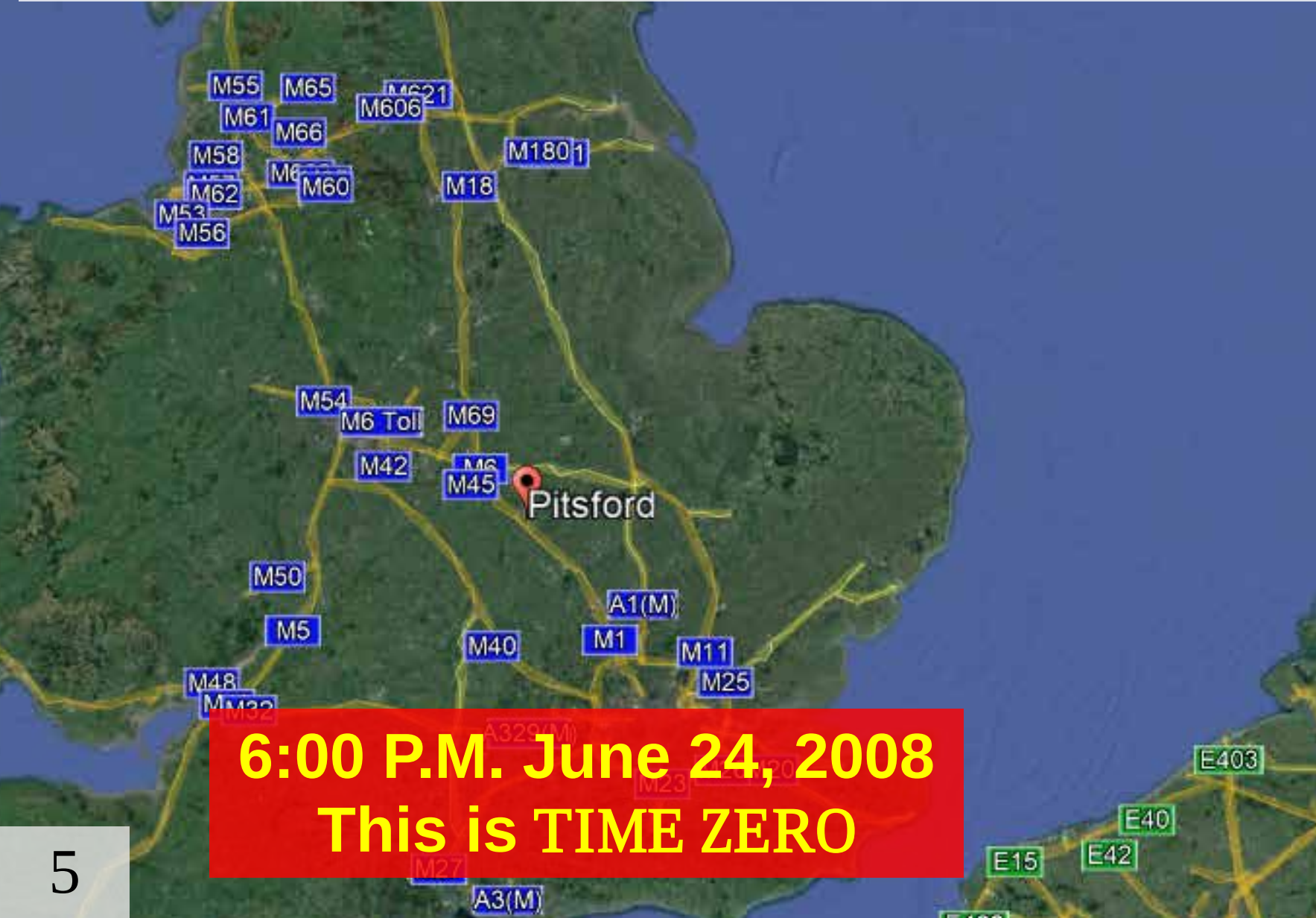
The event occurred in Northhamptonshire, at Pitsford WTP.



Exemplary action #1: Anglian Water voluntarily added continuous *Cryptosporidium* monitoring for the raw and finished water at Pitsford WTP in 2000.

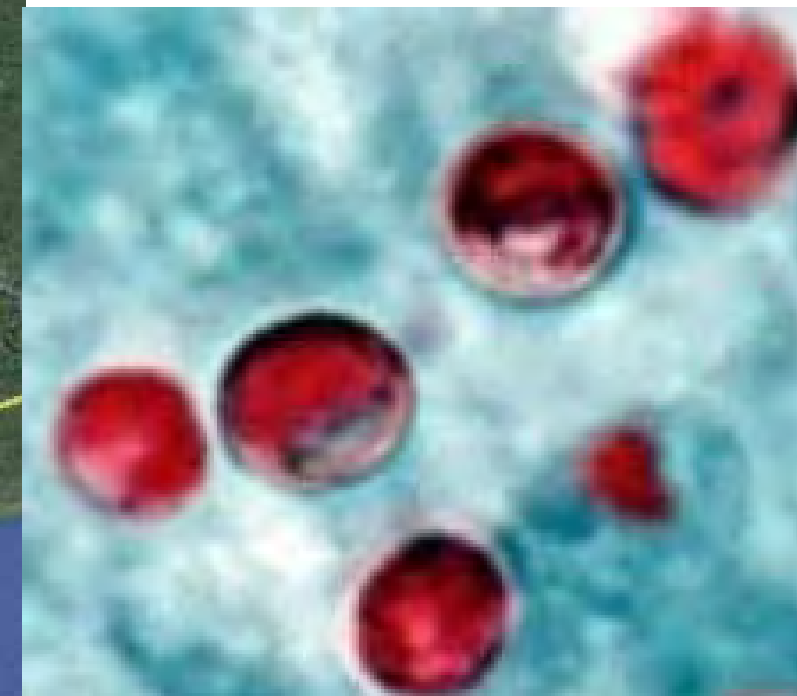


At 6:00 P.M. on June 24, 2008, the 875th cartridge filter from the finished water contained 6 oocysts -- first ever.



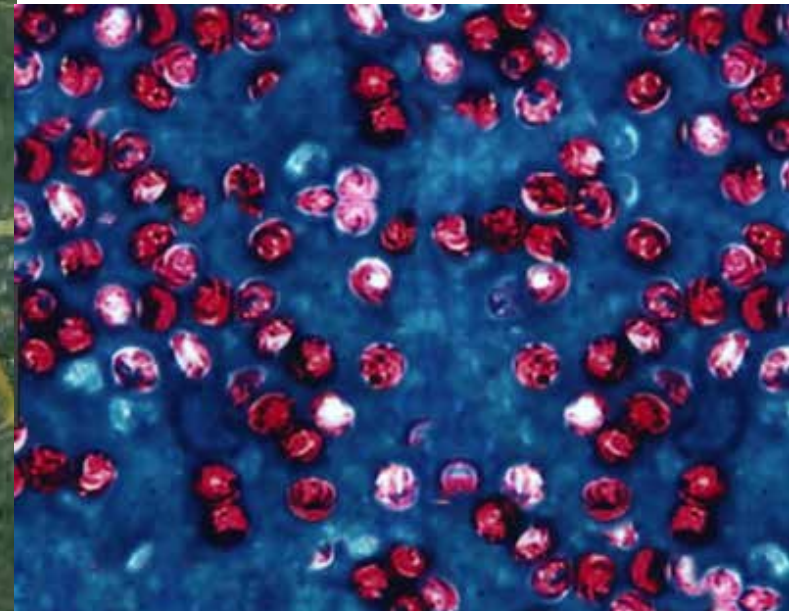
2 hours after TIME ZERO

Exemplary action #2: At 8:00 P.M. June 24, 2008, the filter currently in use was immediately pulled for analysis.



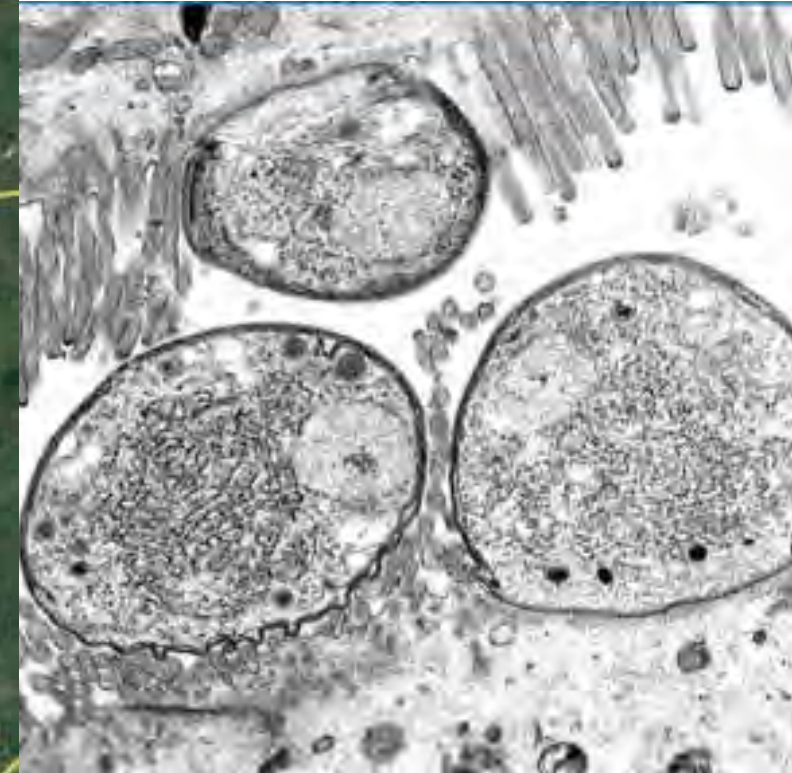
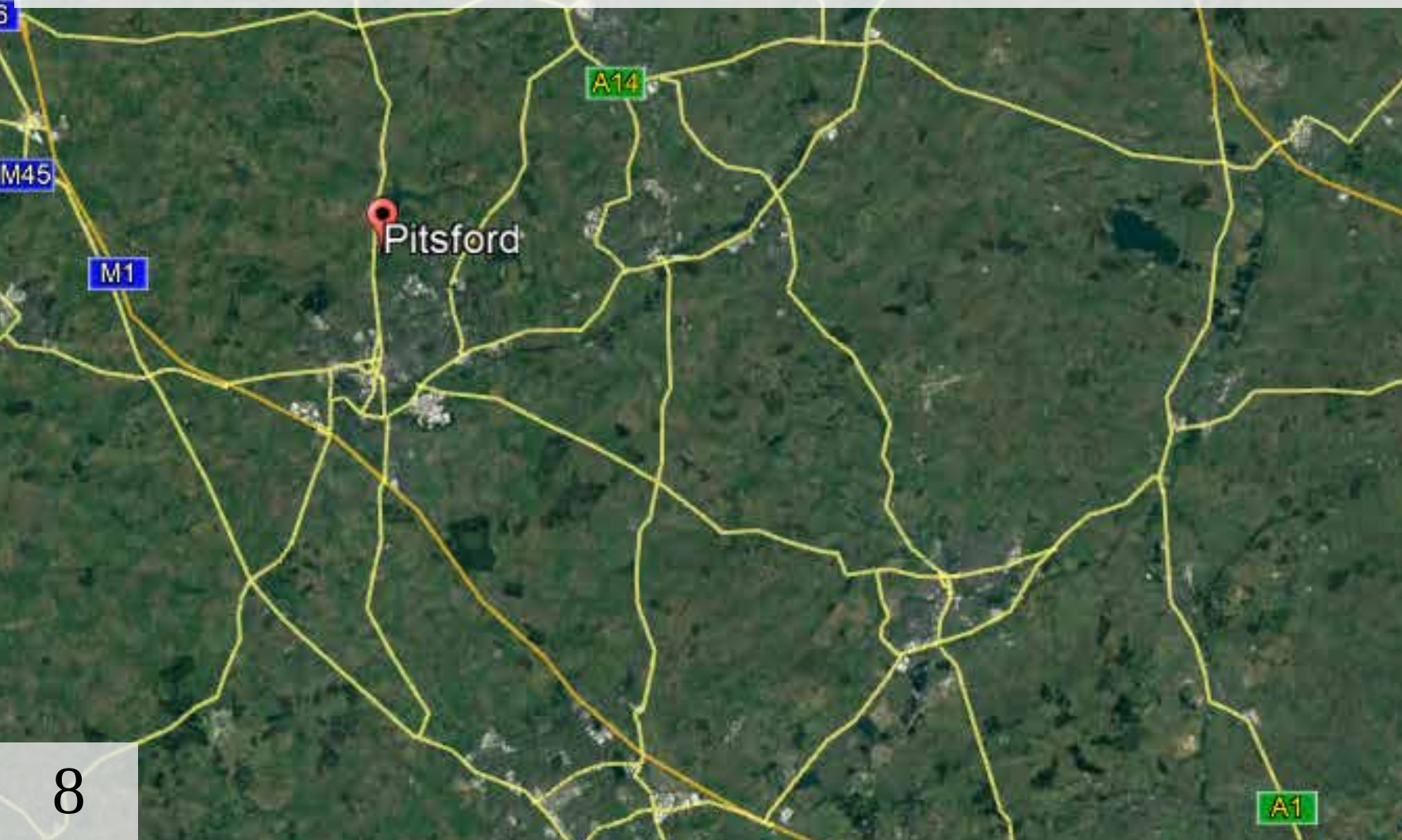
7 hours after TIME ZERO

Exemplary action #3: At 1:00 A.M. on June 25, 2008, analysis of the second filter was complete -- 418 oocysts.



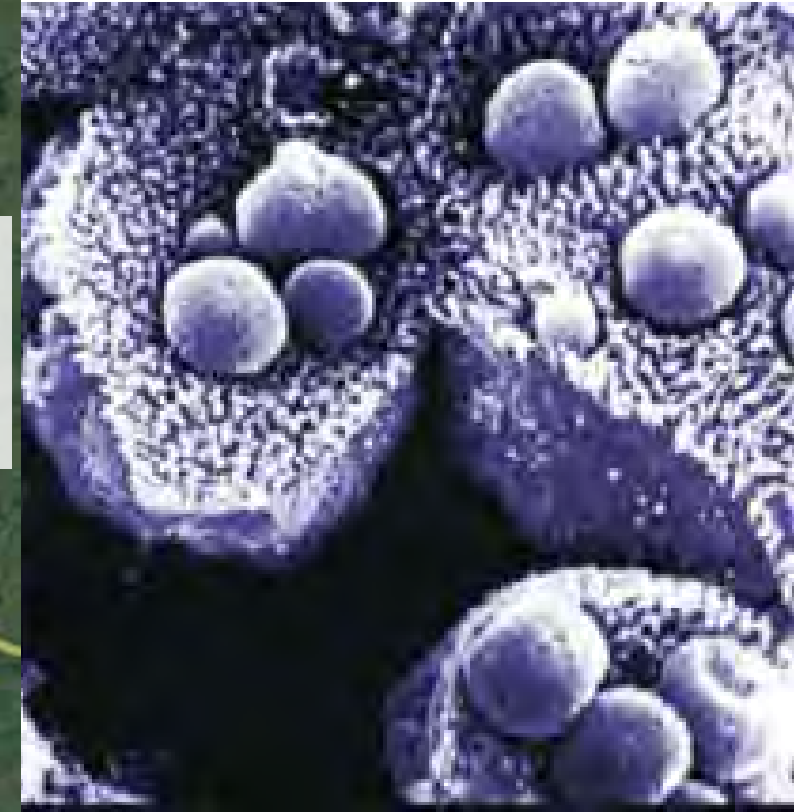
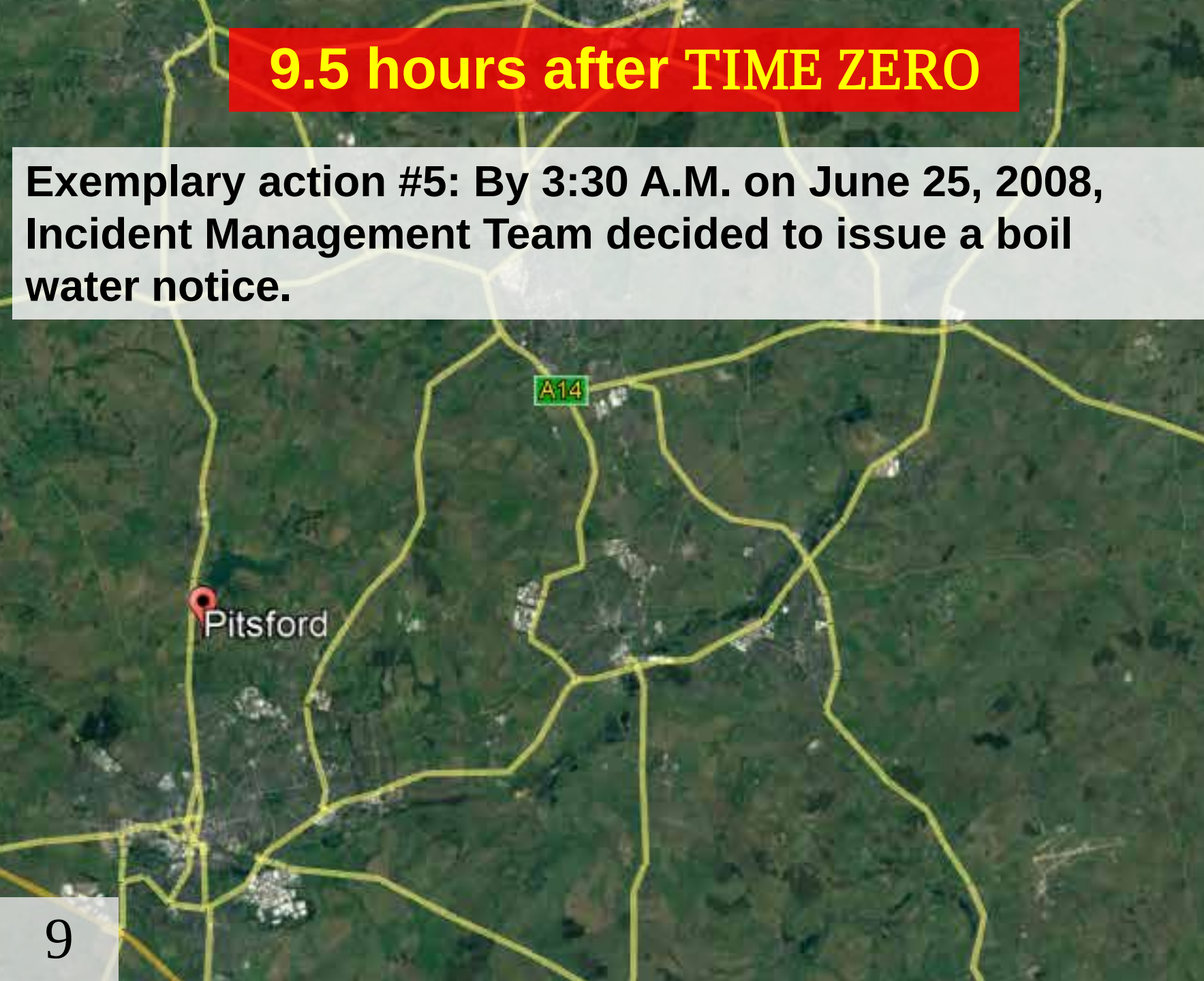
8 hours after TIME ZERO

Exemplary action #4: At ~2 A.M. June 25, 2008, an Incident Management Team was assembled.



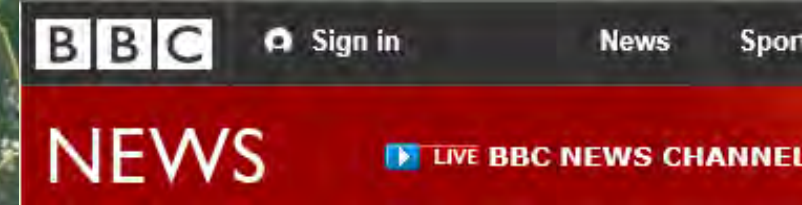
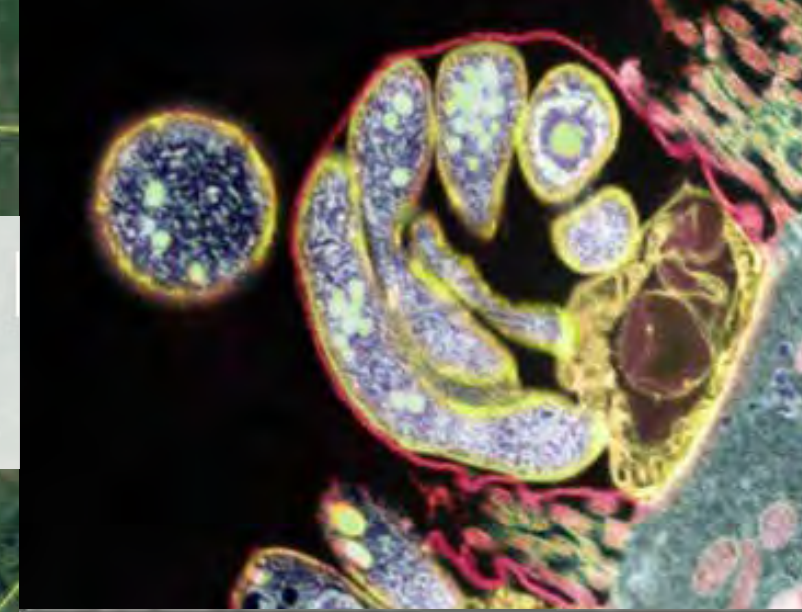
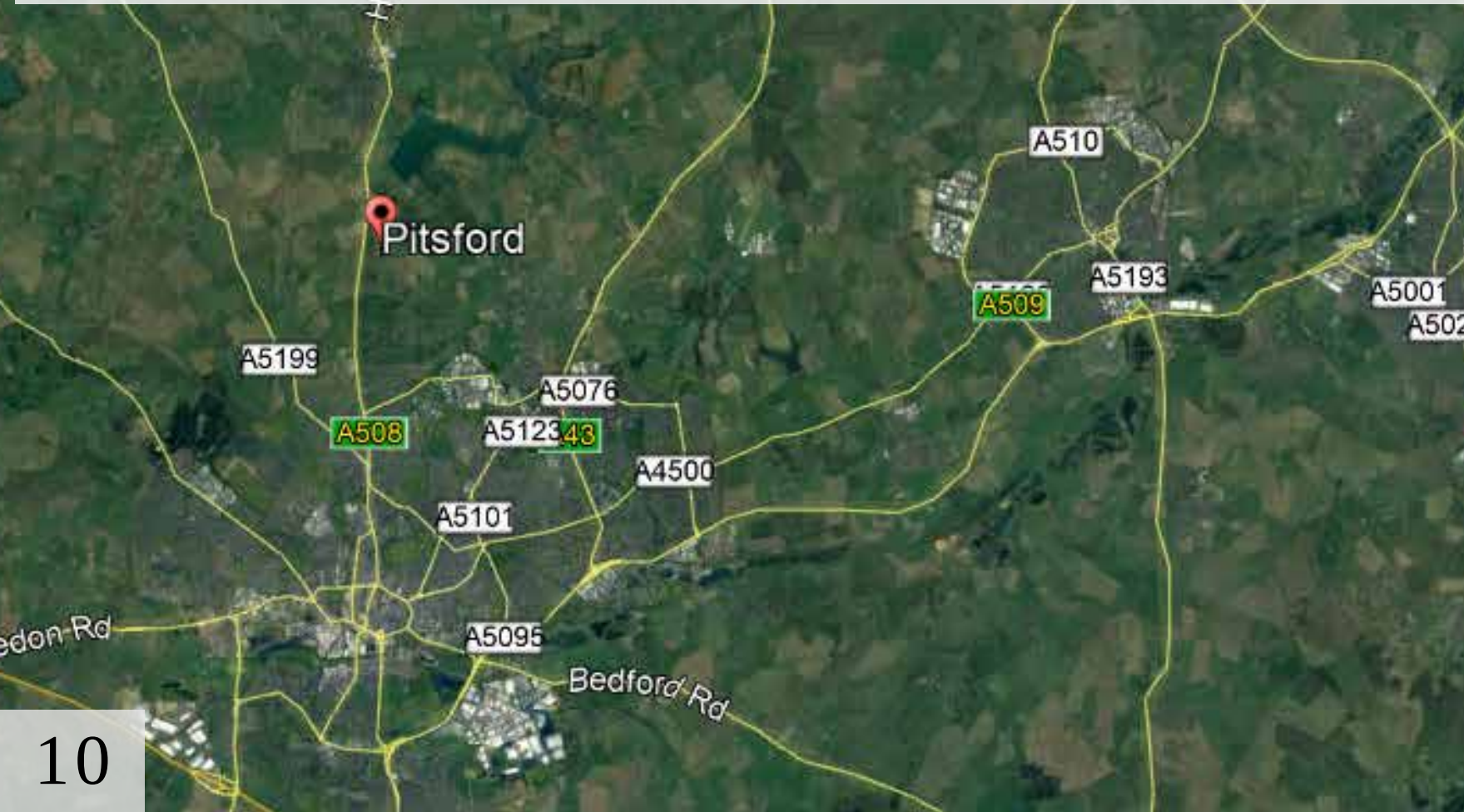
9.5 hours after TIME ZERO

Exemplary action #5: By 3:30 A.M. on June 25, 2008, Incident Management Team decided to issue a boil water notice.



11.5 hours after TIME ZERO

Exemplary action #6: At 5:30 A.M. on June 25, 2008, the press, radio, television were invited to a briefing on the boil water notice.



Rabbit contaminated water supply

A rabbit has been named as the cause of a sickness bug which was found in water supplies in Northamptonshire.

Customers in 100,000 homes were told by Anglian Water to boil tap water for up to 10 days after the *Cryptosporidium* outbreak on 25 June.



Water supplies were declared safe on 4 July

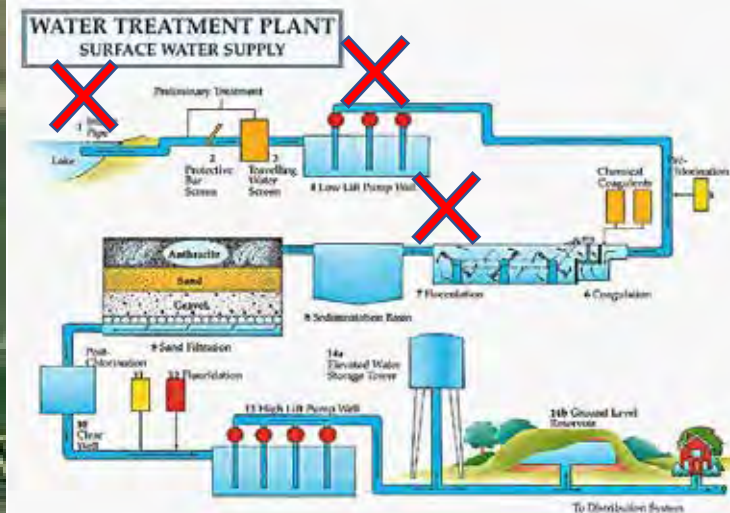
The firm said a rabbit gaining access to the treatment process led to the bug at Pitsford Treatment works.

"We have already taken steps to ensure this cannot happen again," Peter Simpson, of Anglian Water, said.

"We have concluded that this occurrence was due to a combination of unusual circumstances."

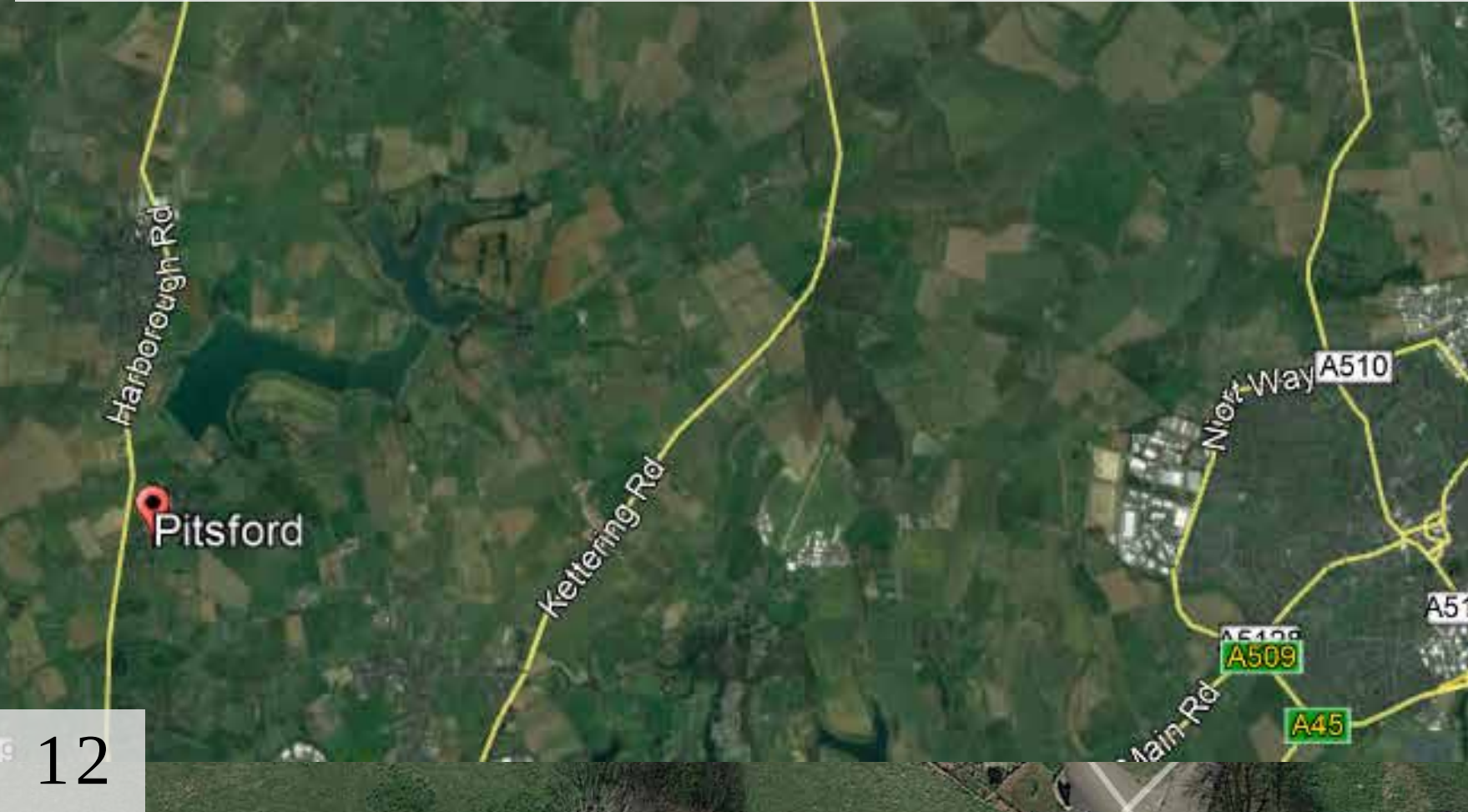
14 hours after TIME ZERO

Exemplary action #7: At 8:00 A.M. (estimated) June 25, 2008, crypto sampling begins after each major unit process.



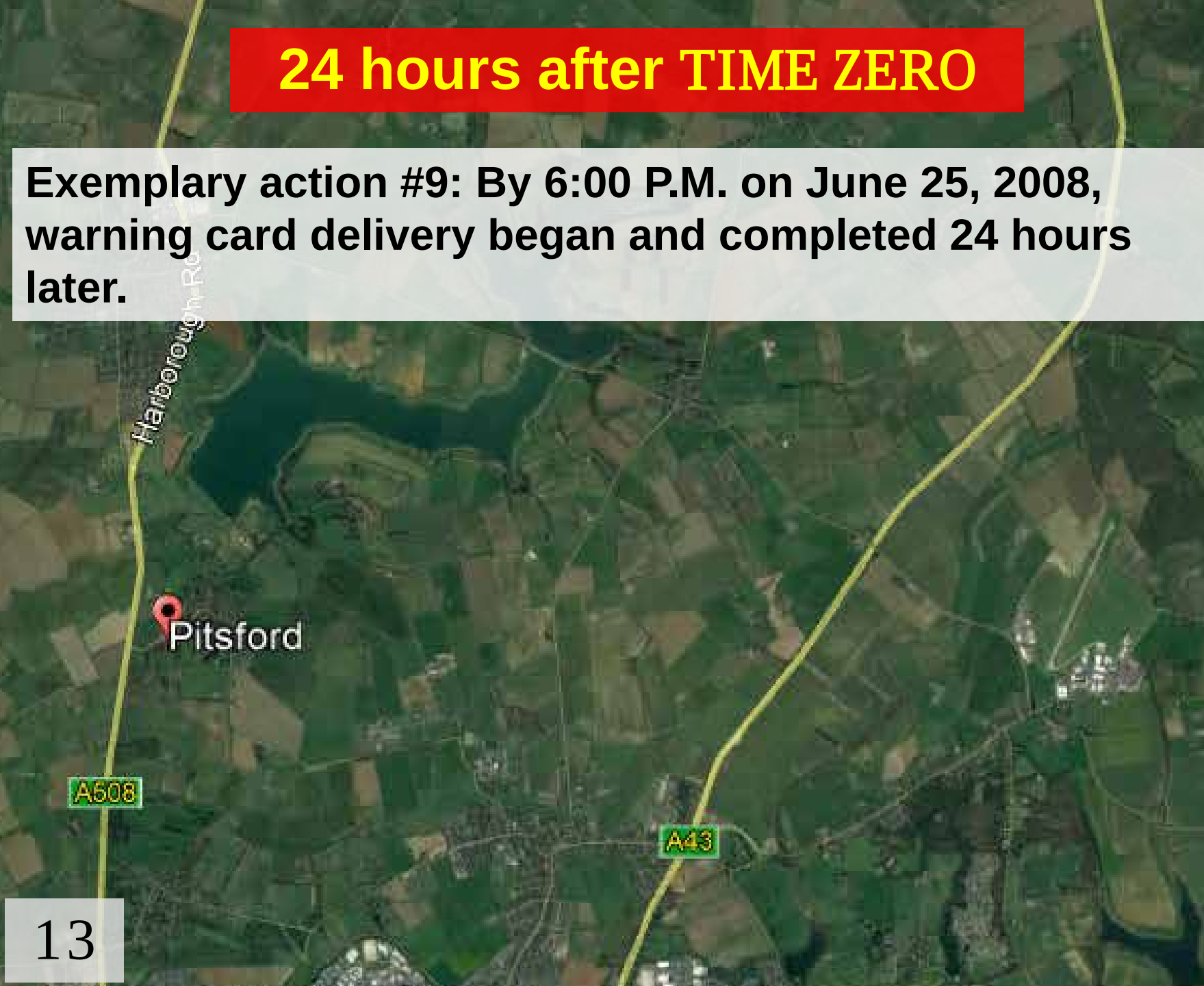
17.5 hours after TIME ZERO

Exemplary action #8: Around 11:30 A.M. on June 25, 2008, UV installation begins on each of their three mains leaving the plant.



24 hours after TIME ZERO

Exemplary action #9: By 6:00 P.M. on June 25, 2008, warning card delivery began and completed 24 hours later.



1 day 14 hours after TIME ZERO

Exemplary action #10: By 8:00 A.M. (estimated) June 26, 2008, crypto sampling begins in homes and confirms oocyst contamination.

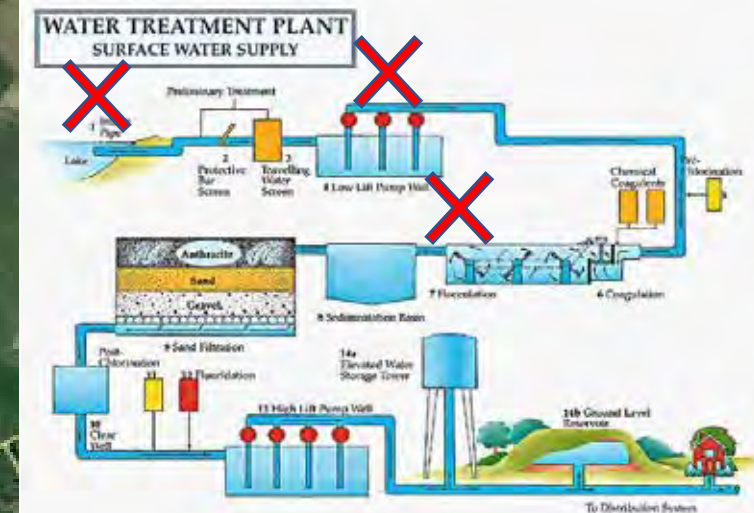


Distribution system



1 day 18 hours after TIME ZERO

Exemplary action #11: Noon (estimated) June 26, 2008, one positive crypto sample was found at both the outlet of the GAC and the chlorine contact basin.



2 days after TIME ZERO

Exemplary action #12: By 6:00 P.M. (estimated) June 26, 2008, external inspection found a missing vent screen on the GAC backwash tank. No animals were found.

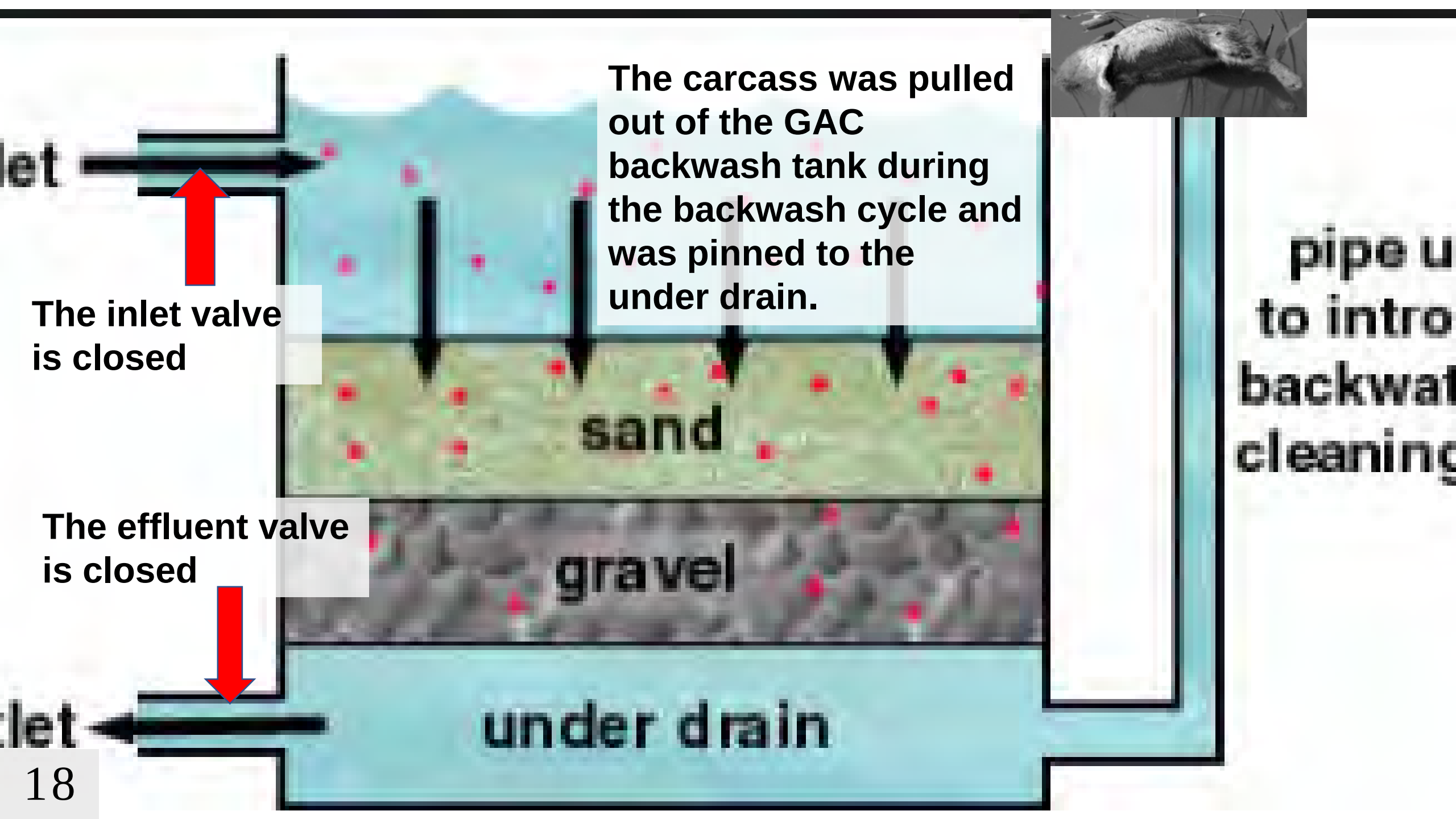


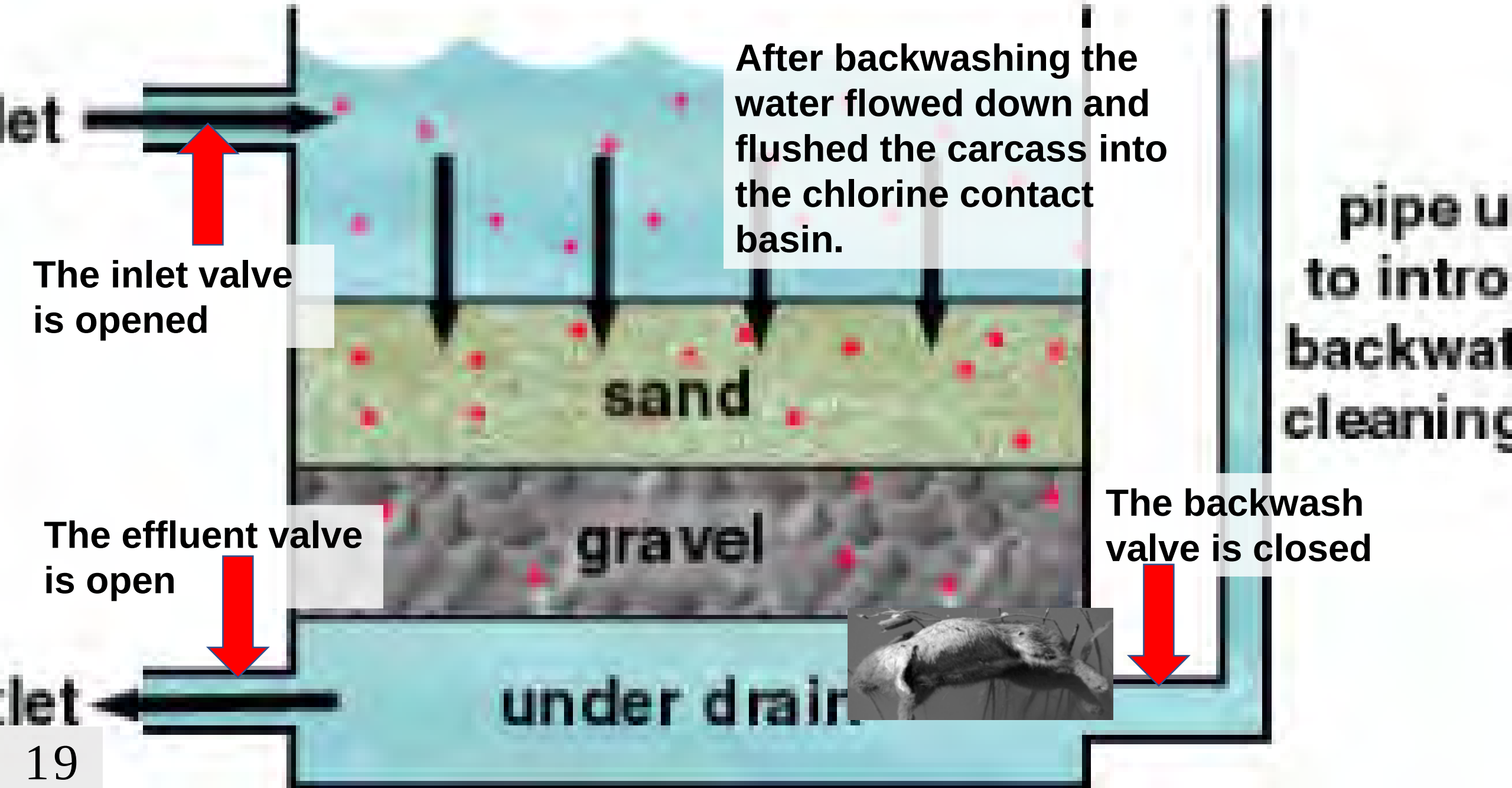
3 days after TIME ZERO

Exemplary action #13: By 6:00 P.M. (estimated) June 27, 2008, internal inspection of the chlorine contact basin revealed a small, relatively fresh rabbit carcass.



But how did the carcass get from the GAC backwash tank to the chlorine contact basin?





10 days after TIME ZERO

Exemplary action #14: Prior to the boil water notice being lifted on July 4, 2008, the following significant efforts were made to purge the oocysts:

- All treatment processes and storage tanks were drained, flushed and disinfected.
- Over 1,000 miles of distribution pipes were flushed.
- Crypto levels decreased as the tanks and pipes were unilaterally cleaned.



1 month 7 days after TIME ZERO

The final Incident Management meeting was held on July 31, 2008. In just 37 days their extraordinary efforts led to:

- 342 crypto samples being taken over a 12-day period.
- DNA analysis performed by the UK reference laboratory on the oocysts from the rabbit carcass, the oocysts from 7 water samples collected in the distribution system and the oocysts collected from 9 stool samples all showed the same genotype (DNA) from the rabbit.
- **This evidence directly linked the rabbit to the cause of cryptosporidiosis in these 22 cases of human illness.**
- This is the first time rabbit *Cryptosporidium* has been demonstrated to cause illness in humans.



In summary, the Anglian Water's proactive actions made it possible to prove the dead rabbit was the cause of this WBDO.



BBC Sign in News Sport

NEWS LIVE BBC NEWS CHANNEL

Rabbit contaminated water supply

A rabbit has been named as the cause of a sickness bug which was found in water supplies in Northamptonshire.

Customers in 100,000 homes were told by Anglian Water to boil tap water for up to 10 days after the Cryptosporidium outbreak on 25 June.

The firm said a rabbit gaining access to the treatment process led to the bug at Pitsford Treatment works.



Water supplies were declared safe on 4 July

Think of all the pieces of the puzzle that had to come together to give the drinking water industry this picture; this powerful direct cause-and-effect link between a rabbit drowning in a storage tank and a WBDO.

- The screen on a vent to a storage tank had to be missing
- The rabbit that drowned had to be infected with *Cryptosporidium*
- The storage tank had to be within the processes of the plant that was conducting continuous monitoring for *Cryptosporidium* on the finished water.
- Analysts, operators and managers had to act with lightening speed to caught the slug of pathogens
- They had to take crypto samples at the plant, tanks and in the dist. system to find if it had entered peoples homes.
- They had to take stool samples.
- They had to perform DNA analysis on the oocysts in the rabbit, water and stool samples.
- And this occurred at a system that disinfects.

What does this event tell us?

- Every animal that enters and drowns has the potential to cause illness.
- A drowned animal releases it's pathogens early.
- One small drowned rabbit caused a WBDO.
- The chlorine levels used to treat drinking water cannot protect us if the *Cryptosporidium* source occurs after treatment.



Anglian Water found a WBDO when $< 1/100$ of one percent of their population acquired cryptosporidiosis.



By comparison the largest WBDO in U.S. history in Milwaukee wasn't known until a $\frac{1}{4}$ of population became ill.

A microscopic view showing several pink, worm-like Cryptosporidium parasites against a dark background. One parasite is inside a blue, spherical structure, while others are free-floating.

BBC Sign in News Sport

NEWS

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An aerial photograph showing a winding river through a green, hilly landscape with some agricultural fields.

Water supplies were declared safe on 4 July

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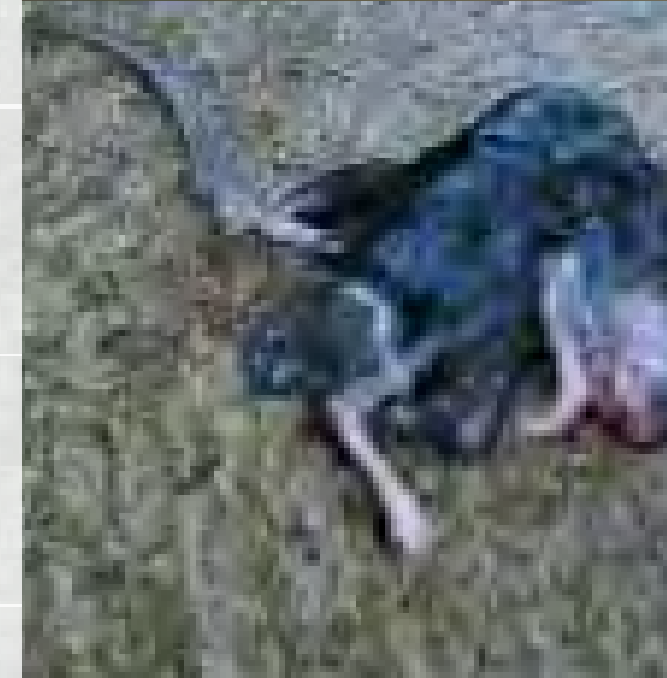
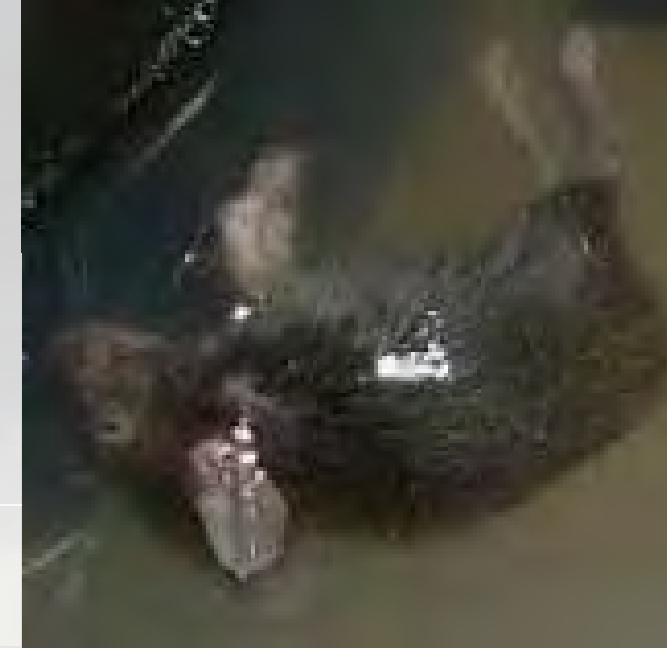
"We have concluded that this occurrence was due to a combination of unusual circumstances."

The Centers for Disease Controls' definition for a WBDO is not event based, only two or more people getting ill from the same water source and epidemiologic evidence.

One reason there is not a WBDO associated with every carcass found in a drinking water storage tank is no investigation occurred at the time pathogens were being released.

What if it's too late and a carcass has released its pathogens? Based on this example, here are some suggested actions:

- Contact your state epidemiologist and strongly recommend that a retroactive epidemiologic study be conducted at your system for the past year.**
- The carcass is evidence of a potential WBDO. Save the freshest ones. Preserve them on ice and contact CDC or EPA to find a lab that can analyze it for pathogens.**
- Isolate the tank. According to Ten State Standards tanks shall be designed so they can be isolated while maintaining pressure in the distribution system.**
- Drain the tank and use a high pressure stream of water to dislodge any microscopic particles of flesh that may be attached to the walls (divers are not sufficient).**
- Disinfect using AWWA guidance.**
- Flush the affected sections of the distribution system.**



The tremendous effort and cost of a WBDO can be avoided if the following efforts are implemented in concert with the greatest attention to details:

- 1. Perform biweekly inspections of tanks.**
- 2. Make repairs immediately after you notice them developing (e.g., caulk beginning to separate from the gap it is filling).**
- 3. Use a #24 mesh screen on vents and overflows: all tanks 2018 Ten State.**
- 4. Ensure the vent is at least 24 inches above the roof or ground.**
- 5. Ensure the overflow is not attached to the tank drain or any other drain: clarified 2018 Ten State.**
- 6. Terminate the overflow two feet above a splash plate and have it be visible.**
- 7. Ensure the hatch is fitted tight (no light).**
- 8. Fix any openings in the roof-to-side wall joints or anywhere else.**
- 9. Suggest using cameras for 24 hour surveillance (vents, overflows, hatches).**
- 10. Redundant alarms on the overflow.**
- 11. Clean and inspect tanks every three years per industry guidance.**