

Assessment of detection limits of fiber-optic distributed temperature sensing for detection of illicit connections



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Introduction

Separate sewer systems
=> Main issue: illicit connections



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⇒ Main issue: illicit connections

DTS powerful tool for detection

How powerful?

Detection limits: site specific parameters

- Spill conditions – temperature and volume

Source	indicative average volume per usage (L)	average discharge temperature (°C)
Bath	100	30
Shower	50	35
Toilet flush	5	18
Washing machine	40	30
Food preparation	1,5	50

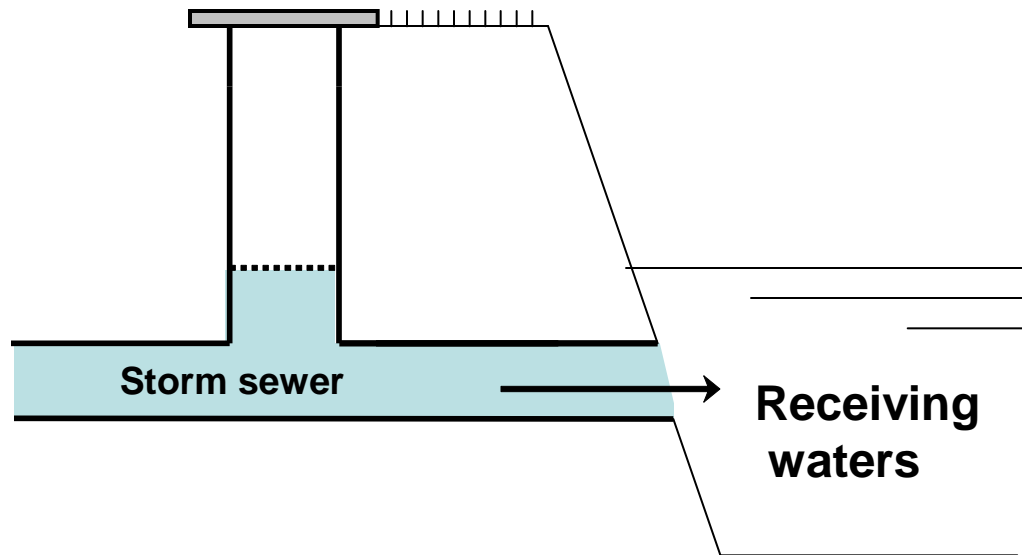
Detection limits: site specific parameters

- Spill conditions – temperature and volume
- House connection – length, geometry, soil temperature



Detection limits: site specific parameters

- Spill conditions – temperature and volume
- House connection – length, geometry, soil temperature
- Sewer conditions – water level, flow, temperature

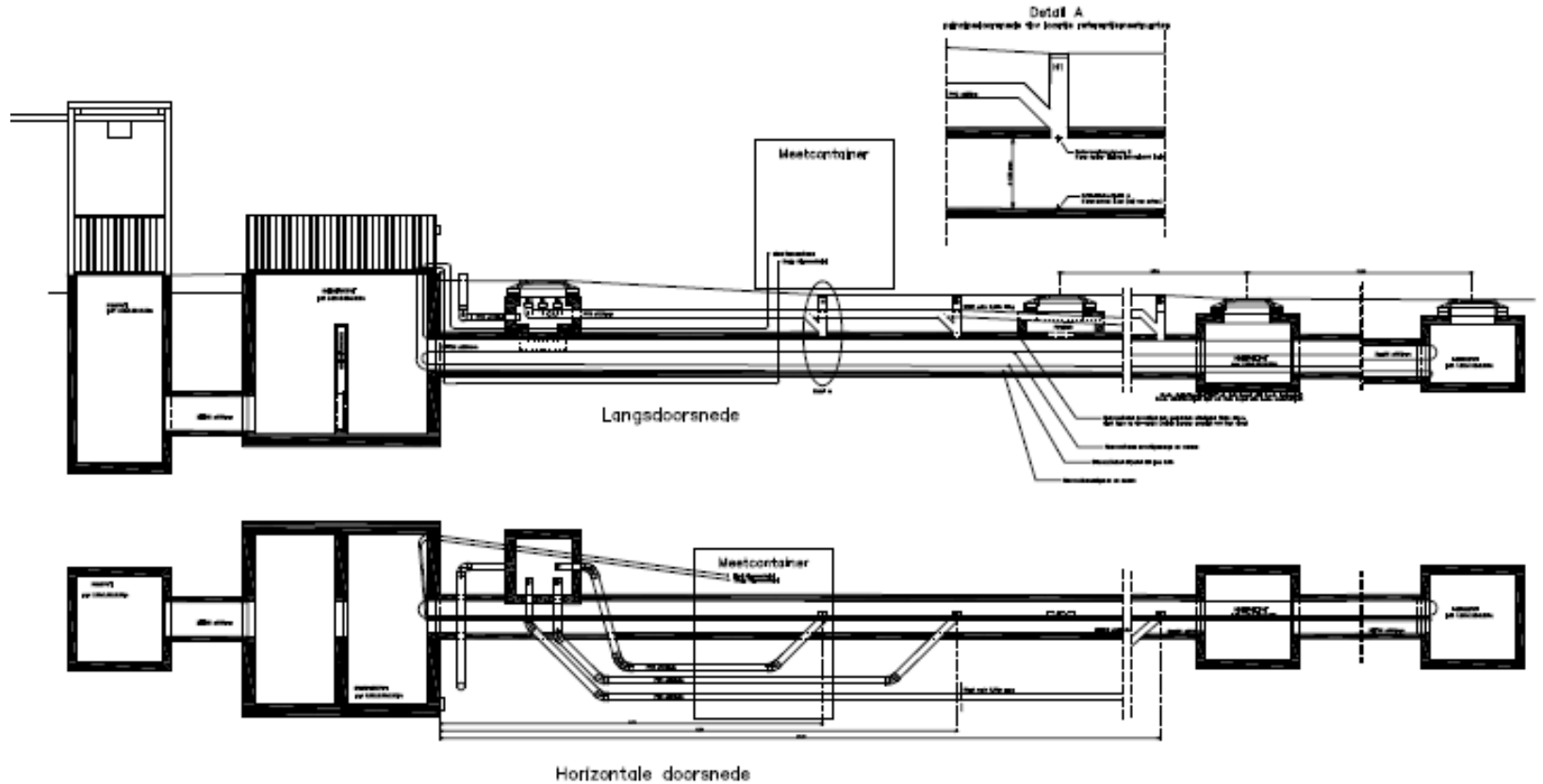


Detection limits: monitoring equipment

- Cable properties – position, length
- Instrument properties – quality of 'computer'



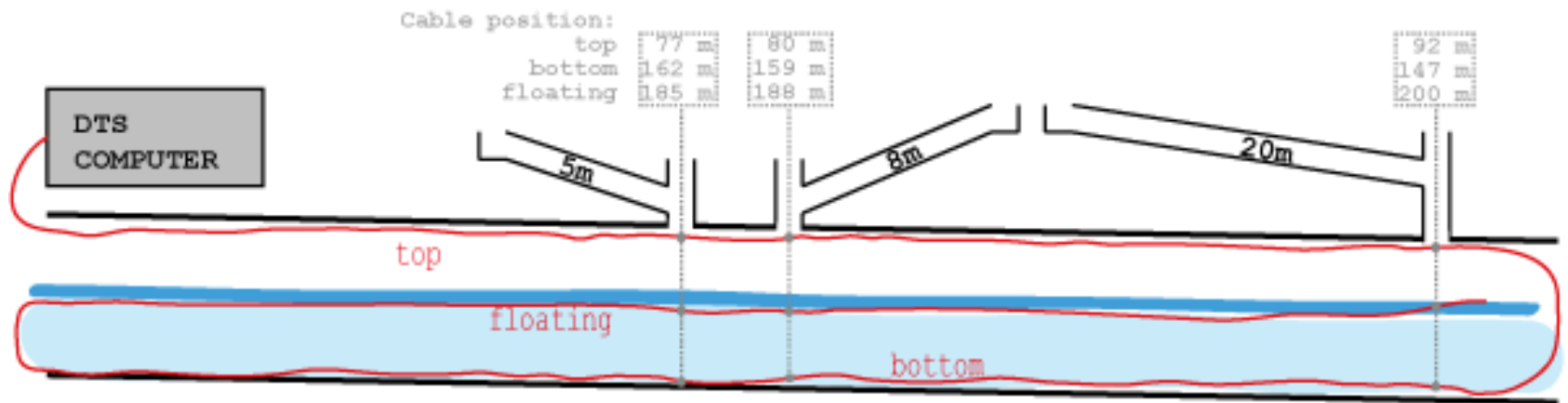
Test rig Breda: 50 m, 600 mm sewer, flow+ water level control



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Experiment set up

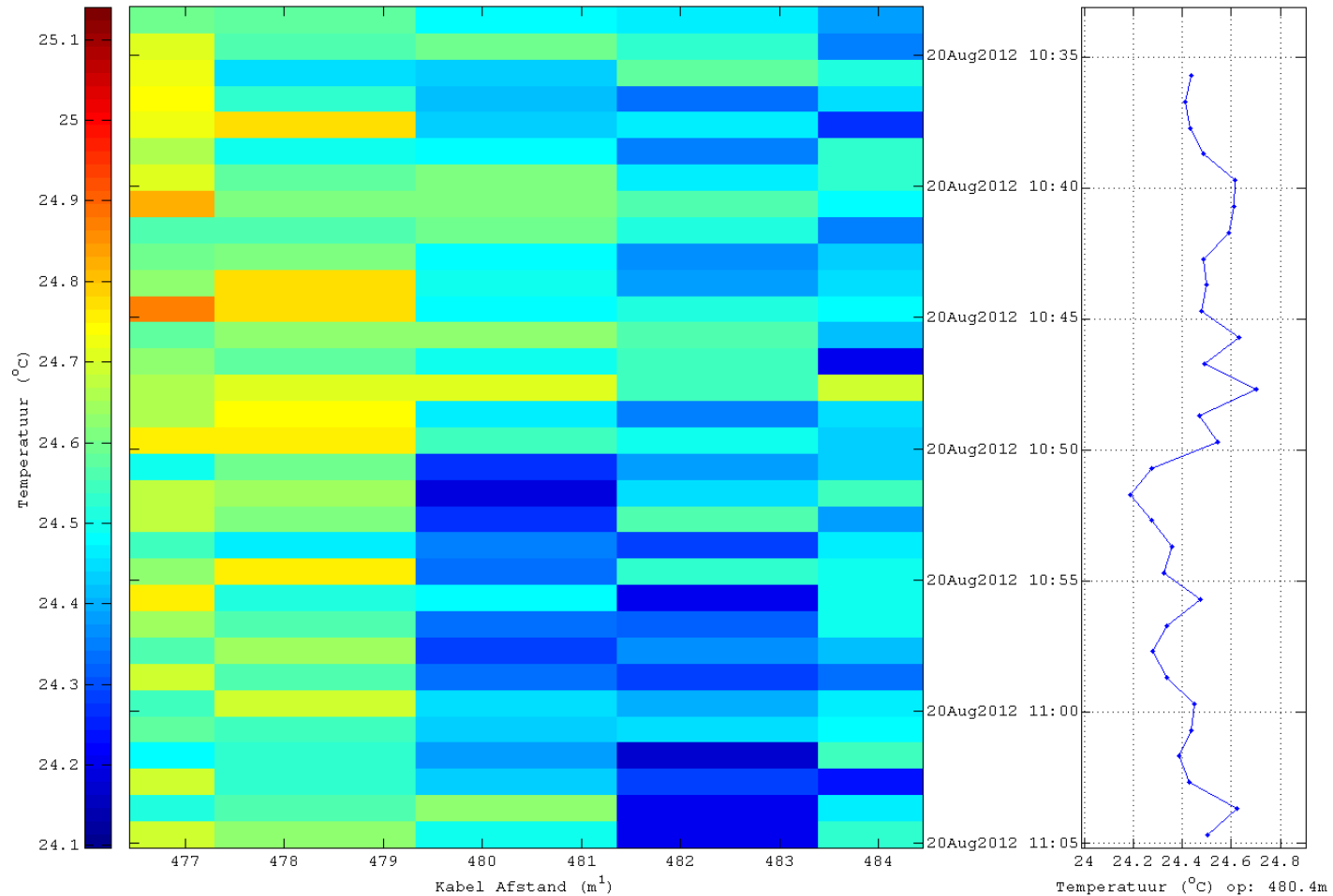


Experiment set up

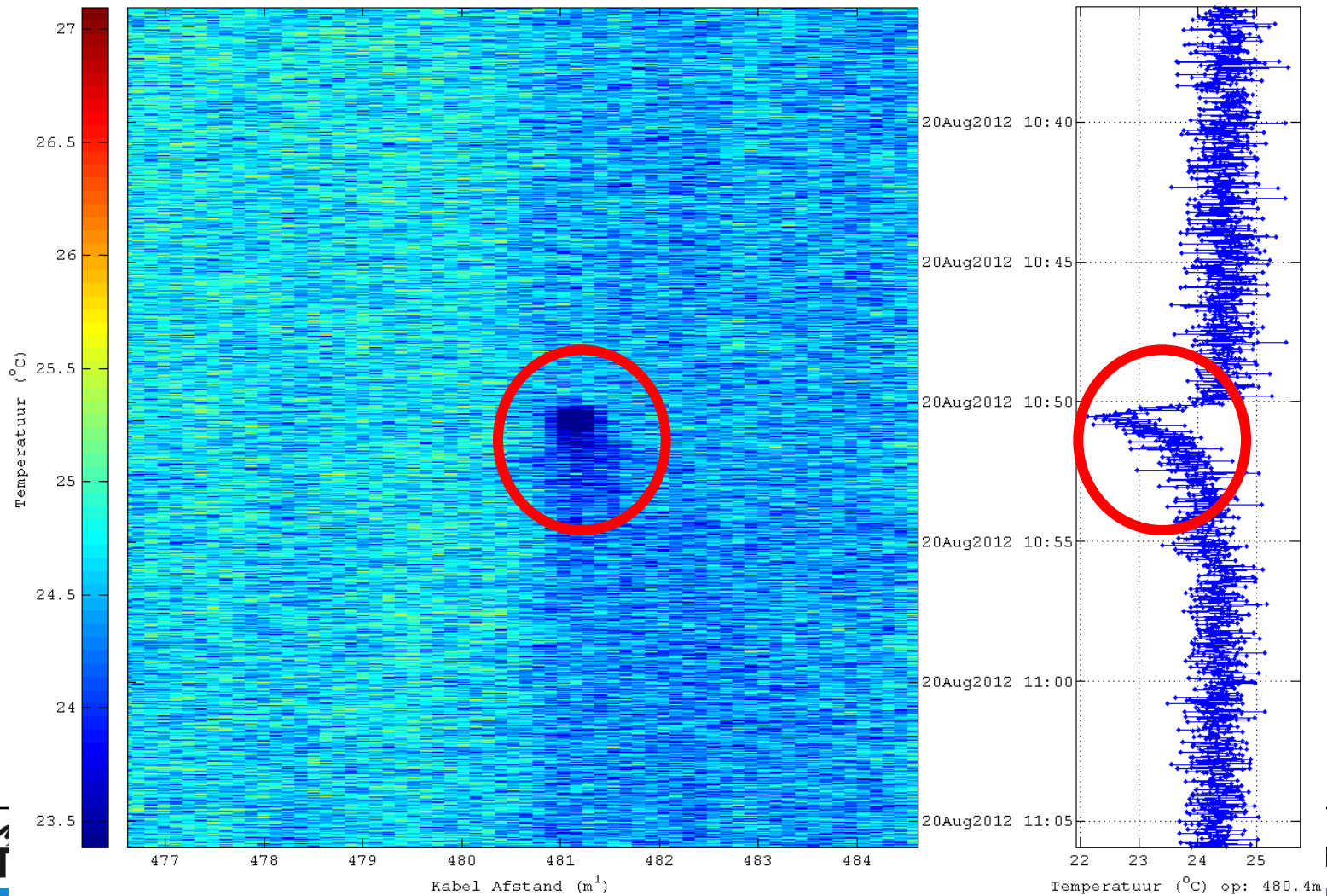
- 2 computers (HALO and ULTIMA) with 3 cable positions
- Empty, 50% and 100% filled sewer conduit
- WC discharges (5 litres at various temperatures)



Results computer: HALO WC discharge

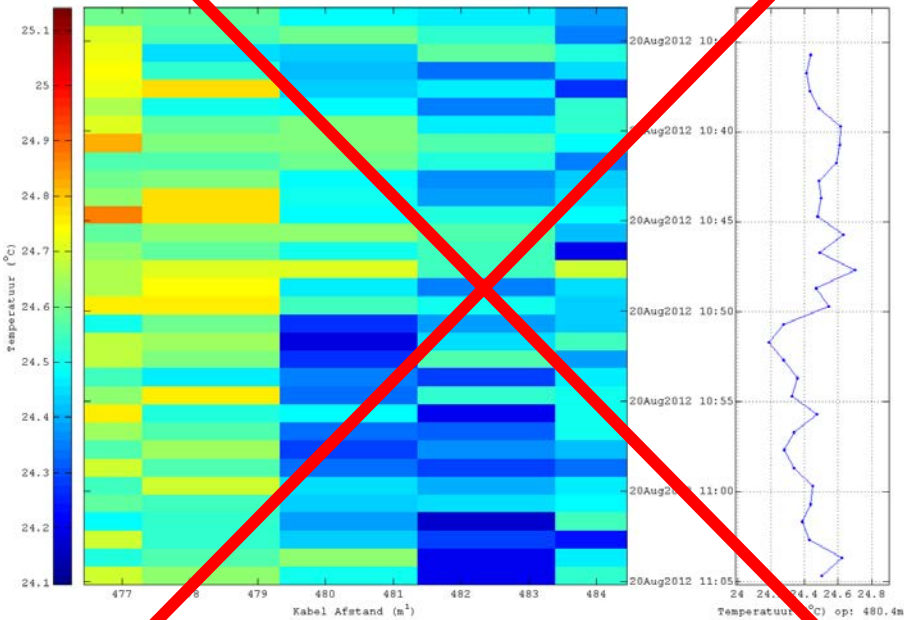


Results – ULTIMA WC discharge

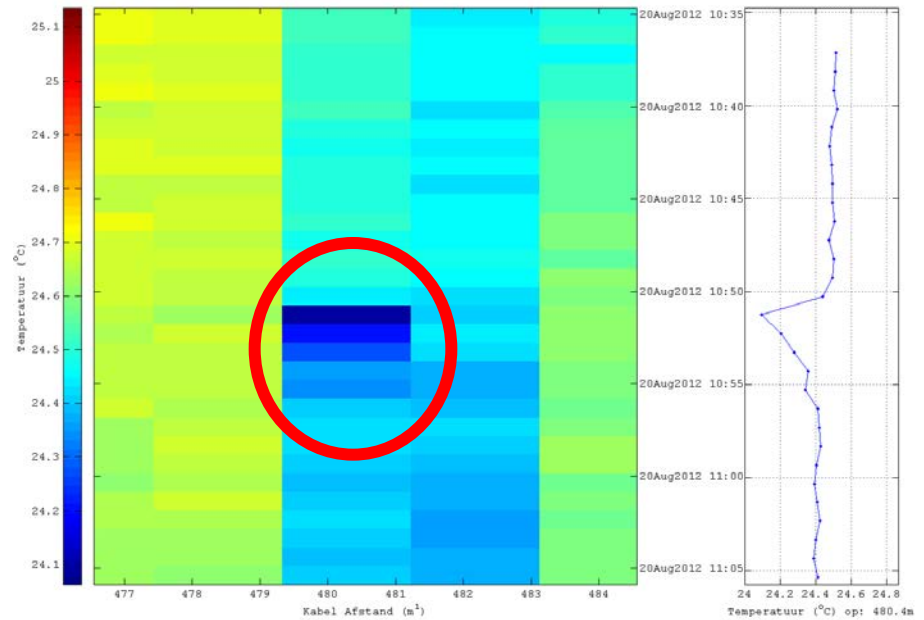


Results –HALO vs ULTIMA – WC discharge (dt = 60 s and dx = 2 m)

HALO

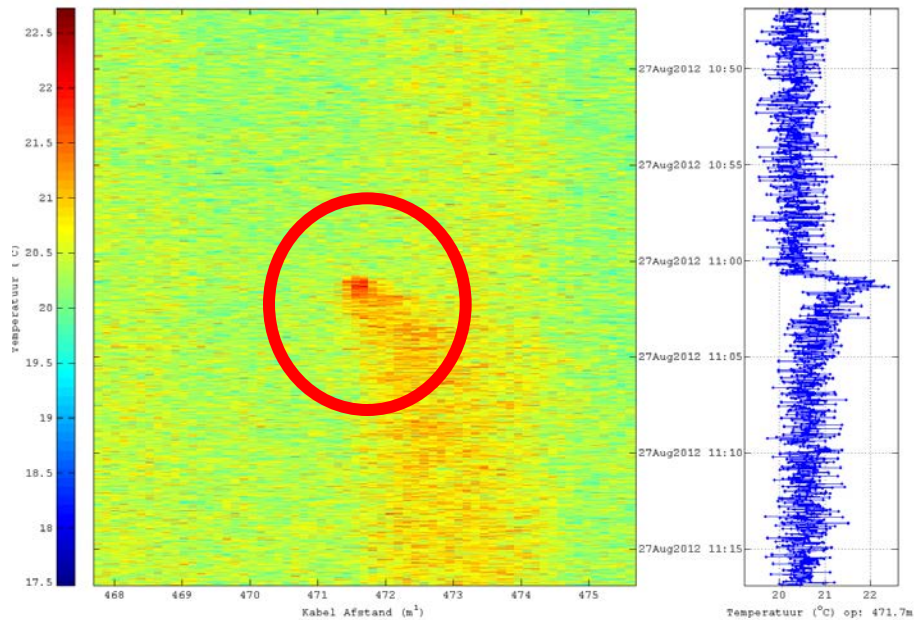


ULTIMA

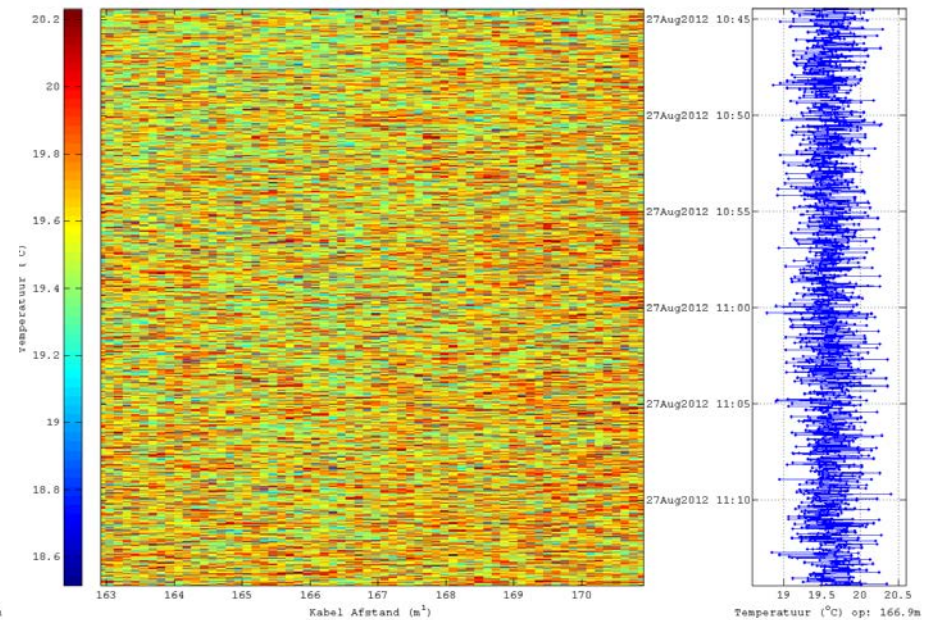


Results cable position 100% full sewer

cable top

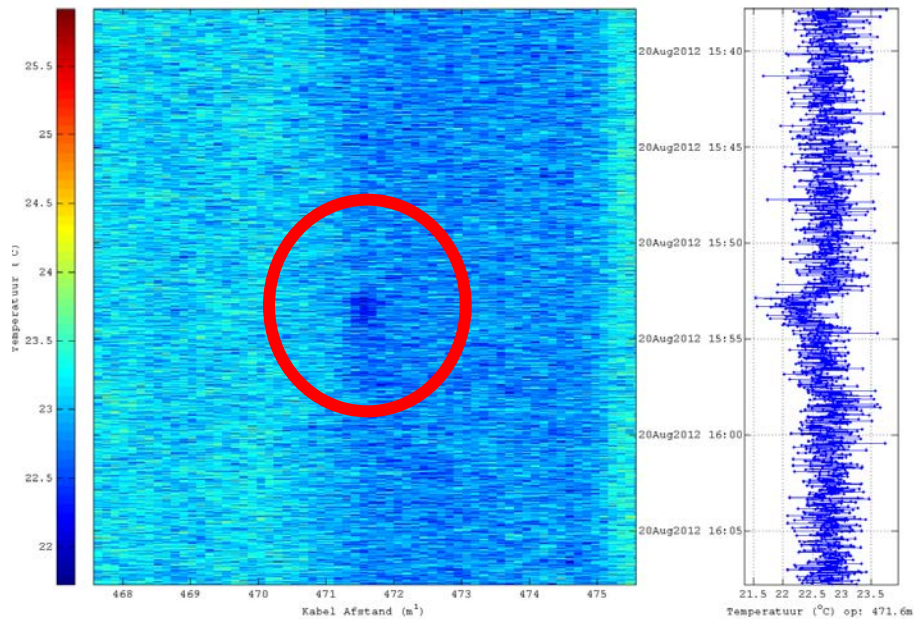


cable bottom

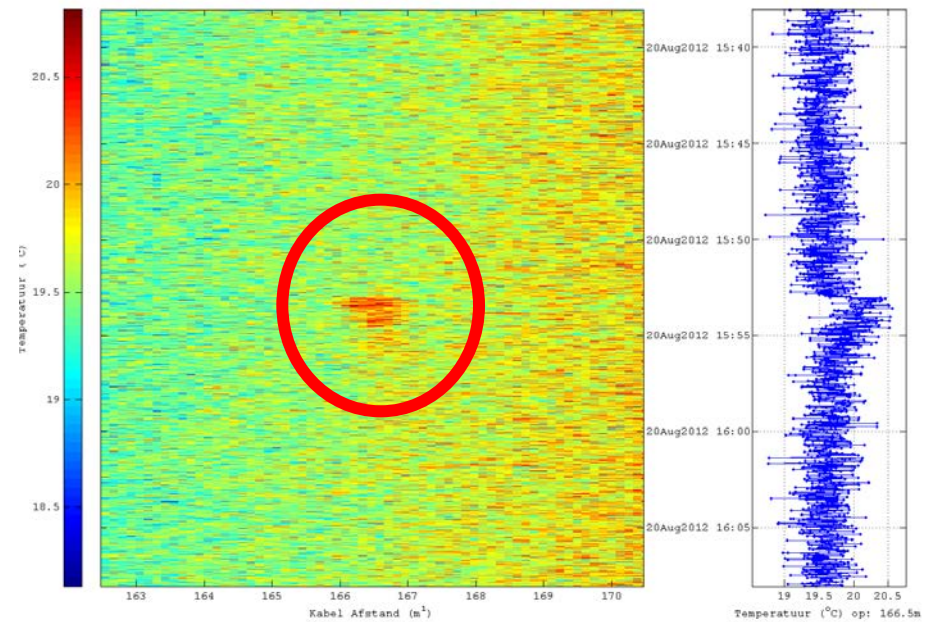


Results cable position 50% full sewer

cable top



cable bottom



Conclusion

- DTS is powerful tool for detection of illicit connections
- Well established detection limits
- Sewer conditions (water level/mixing) determine required quality of monitoring equipment, cable position and monitoring period