Sewer Infiltration Monitoring

Background

Widespread seasonal problem for many water companies

‘Unaccounted for Water’ typically caused by groundwater entering the sewer through aged / defective pipework

Can result in internal & external flooding and pollution

Increased energy costs and wear at Sewage Pumping Stations

Increased vehicle / tanker movements
(24/7 in some catchments)

Unhappy customers & stakeholders MP’s, LA’s, EA etc.
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Background

Thames Water experienced wide scale infiltration events during the winter of 2012/13 and 2013/14

Ongoing commitment to undertake investigations and investment in catchments at greatest risk

Investigations include flow monitoring, catchment & groundwater modelling, PS analysis etc.

Existing site investigation techniques – lift & look surveys, CCTV surveys, impermeable area surveys, stoppering etc.

Innovation considered alternative investigation techniques, both linked to temperature monitoring
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DTS
Distributed Temperature Sensing (DTS)

Fibre-optic cable installed in a sewer with laser light pulsed along the length.

Temperature measurement recorded at 2m intervals every minute.

Temperature differences identify inflows to sewer.

Service provided Royal HaskoningDHV with site contractor.

![Diagram of sewer system with fiber-optic cable and manholes]
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DTS Investigations

**Hambleden**
1674m cable
Monitoring Started  8th October 2014
Monitoring Ended    11th November 2014

**Cuxham**
1151m cable
Monitoring Started  16th December 2014
Monitoring Ended    16th February 2015
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DTS – Hambleden Cable Installation
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DTS – Hambleden Cable Installation
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DTS Example of Results

Little dry weather flow during nights

Far more dry weather flow during daytime
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DTS Example of Results

[Graph showing data with dates from 08-Nov-2014 to 08-Nov-2014, with temperature ranging from 14.5°C to 18°C, and cable distance ranging from 100 m to 800 m.]
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DTS Example of Results
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DTS Example of Results

Locations with regular cold water inflow
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DTS – Pump run times

![Graph showing daily pump running times for Pump 1, Pump 2, and Total from 01/01/2014 to 05/02/2015. The graph indicates variations in pump usage over time.]
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DTS Results

Trial demonstrated the potential of the system and provided lots of data

Timing of deployment critical to capture infiltration event

Deployment required just prior to an event
But, this is the unknown..

Technique also required jetting & CCTV

Some operational problems – ragging

Costly
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Temperature Loggers

Temperature measurement is used to optimise sewage treatment processes

Considered option to identify infiltration into sewerage networks?

Reduced temperature could indicate infiltration

Low cost equipment – around £100 per logger
Sealed units – wireless data reader

Trial undertaken within a catchment with previous history of infiltration: Fencott & Murcott

Trial started September 2013
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Temperature Loggers

Temperature Logger Comparison Test

Comparable recordings from each logger
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Temperature Loggers
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Temperature Loggers

Very good diurnal pattern recorded
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Temperature Loggers

Merton
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Temperature Loggers

All sites - seasonal pattern over nearly 2 years
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Temperature Loggers

Infiltration Event Captured 2013 – 2014
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Temperature Loggers

Event with rainfall
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Temperature Loggers
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Temperature Loggers

Pump run times
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Temperature Loggers

Pump run times
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Temperature Loggers

Other catchments – Ramsdell
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Summary

Temperature loggers have provided good results to date

Durable hardware – survived in the sewers

Potential to use in the network to target sources of infiltration or unaccounted for water

Cost effective tool for long term measurement of catchment performance

No confined space access needed

Trial ongoing and rolled out to further catchments