Fine-scale rainfall measurement and prediction to enhance urban pluvial flood control

Investing in Opportunities

This project has received European Regional Development Funding through INTERREG IV B.

INTERREG IVB

Pilot location: Cranbrook Catchment, London Borough of Redbridge (UK)

Monitoring

Rainfall

Rain gauges:

- 3 tipping bucket rain gauges with 0.2 mm resolution and 1 min data sampling operated by Imperial College London and equipped with wireless real-time communication devices.

Radars:

- The area is within the coverage of two C-band radars operated by the UK Met Office:

Specifications	Chenies Radar	Thurnham Radar
Radar type	C-band	C-band
Polarisation	Horizontal*	Dual-polarisation
Doppler	No*	Yes
Antenna	Parabolic 3.6 m diameter, 43 dB gain	
Beamwidth	1°	
Frequency range	5.4 – 5.8 GHz	
Range resolution	1 km up to 50 km range/2 km up to 75 km range	
Temporal resolution	5 min scan repeat cycle**	
Elevations (°)	0.5, 1.5, 2.5, 4.0, 5.0	0.5, 1.0, 1.5, 2.5, 4.0

*Currently being upgraded to dual-polarisation and doppler
**Within the RainGain project the potential benefits of reducing the repetition cycle to 2-3 min will be tested

Water depth sensors

- 2 pressure sensors for water depth measurement in the Roding River and 1 pressure sensor for water depth measurement in an open channel
- 2 sensors for water depth measurement in sewers

All sensors are equipped with wireless real-time transmission devices

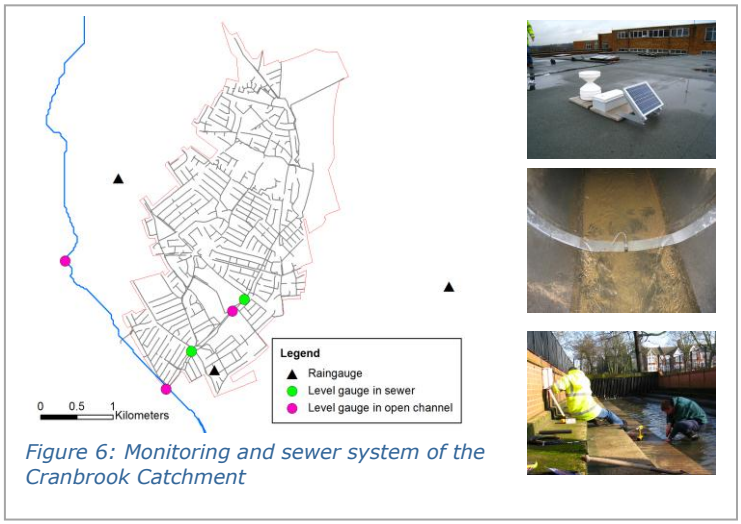

Figure 6: Monitoring and sewer system of the Cranbrook Catchment

Spatial datasets

- **Digital Terrain Model (DTM):** 1 m horizontal resolution LiDAR-generated DTM with stated vertical accuracy of ±0.15 m and horizontal accuracy smaller than the pixel size (provided by the EA) (see *Figure 7*).
- **Location of buildings and critical infrastructure:** Master maps and polygon shapefiles of buildings, roads, schools, hospitals, amongst other critical infrastructures, were provided by London Borough of Redbridge (see *Figure 8*).
- **Topology of sewer system:** information of the sewer system was provided by Thames Water. It comprises a total of 1776 nodes and 1816 pipes covering a total length of 98 km (see *Figure 6*)

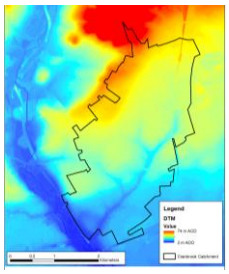

Figure 7: Digital Terrain Model (DTM) of the Cranbrook Catchment

Figure 8: Location of buildings in the Cranbrook Catchment

Urban pluvial flood models

Two types of dual-drainage urban pluvial flood models have been setup for the Cranbrook catchment using the InfoWorks CS 10.5 software package:

- **A 1D-2D model** in which the sewer system is modelled in 1-dimension (1D) and the urban surface is modelled in 2-dimensions (2D) using a triangular mesh generated from the DTM. This model can represent surface flooding in detail and provides good visualisation of results. However, the associated runtimes are long, thus hindering its use for real-time applications.
- **A 1D-1D model** in which both, the sewer system and the surface are modelled in 1D. In this case the surface is modelled as a 1D system made up of ponds (modelled as storage nodes) and pathways (modelled as conduits with specific geometry computed from the DTM). This model is less detailed than the 1D-2D, but it is significantly faster.

Both models are **semi-distributed** and rainfall is applied to them using subcatchments associated to manholes. Within each subcatchment the NewUK rainfall-runoff model is used. The flow in the sewers and on the surface is simulated based on the full shallow-water equations (i.e. it is a **fully hydrodynamic model**). The interactions between the sewer system and the surface takes place at manholes and gullies.

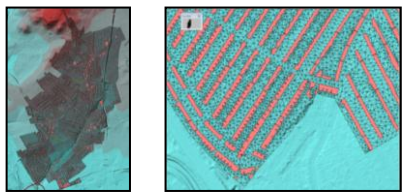

Figure 9: 2D model of the surface

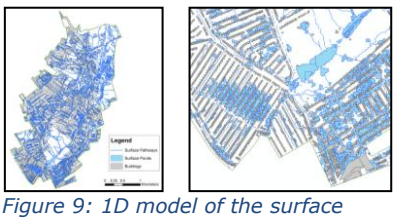

Figure 9: 1D model of the surface