CASE STUDY - URBAN STORMWATER MODELLING APPROACHES IN NZ AND THE UK

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PROJECT BACKGROUND

Between 2019 and 2020 Metis Consultants and Awa Environmental collaborated to deliver eleven large urban stormwater models in the United Kingdom (areas modelled ranged from 500ha to 2000ha). The purpose of the work was to update the national Risk of Flooding from Surface Water (RoFSW) mapping including flood depth, velocity and hazard information. A funding package of £2million / NZD$3.8million was provided by the Environment Agency / Defra (UK) as the RoFSW map included only 5% coverage of detailed local mapping of surface water flood risk, provided by Local Authorities to date. The aim of the funding package was to increase this proportion with priority to include higher risk areas that were in a national level 'Flood Risk Area', in a strategic growth area or had experienced significant surface water flooding.

Metis supported seven clients to secure £750k (NZD$1.4million) in funding to build eleven models. The model extents ranged from 600ha to 2,000ha and were within Greater London (9x models) or South Gloucestershire (2x models) covering a mixture of urban and rural areas. The work scope to build detailed integrated urban drainage models included:

- Data Review & Modelling Strategy
- Asset Data Capture
- Model Build & Validation
- Reporting
- Result Post-Processing

PARTNERSHIP DELIVERY

Metis in the UK lead the team by delivering project management, technical leadership, data capture and model build in XP STORM. Awa provided technical support from NZ by delivering data pre-processing and model builds in Infoworks ICM. The team worked collaboratively to achieve a tight delivery timeframe of just over 12months from award to full completion of all eleven models.

MODELLING BACKGROUND

In England and Wales, the national Risk of Flooding from Surface Water map was completed in two iterations between 2010 and 2013. This modelling was completed using a 2D only approach on a 2m rectangular grid and delivered surface water flood extent, depth, velocity and hazard information for all areas. The modelling excluded all underground drainage networks and represented major watercourse structures in 2D only.

No national updates have been completed since 2013 and none are currently planned. The national mapping can be updated on an area-by-area basis using local detailed modelling. These modelling studies are generally led by Local Authorities to better understand local flood mechanisms and develop solutions to them. The RoFSW is underpinned by a

performance based technical specification to ensure all local updates are based on the same general set of assumptions and relative confidence levels can be measured and reported.

MODELLING METHODOLOGY

The modelling needed to:

- Be compliant with the national RoFSW Technical Specification - which delivers the Flood Risk Regulations (2009) and EU Floods Directive
- Follow (where practical) local modelling technical specifications
- Follow good practice guidance provided in the WaPUG / CIWEM UDG Code of Practice for the Hydraulic Modelling of Urban Drainage Systems (2017), Rainfall Guide (2016) and Integrated Urban Drainage Modelling Guide (2009)
- Represent all key components influencing stormwater flooding – including interactions with river systems and combined drainage networks

During the model build process it became apparent that there were some fundamental differences in the overall purpose and technical approaches used in NZ and the UK for this type of model.

CASE STUDY LOCATION & DESCRIPTION

The differences in the overall purpose and technical approaches used in NZ and the UK will be demonstrated and discussed using a case study – the Yate and Chipping Sodbury model in South Gloucestershire (refer *Figure 1*). The case study will explore the following differences:

- Motivation to undertake modelling
- National / local technical standards
- Specific hydraulic approaches

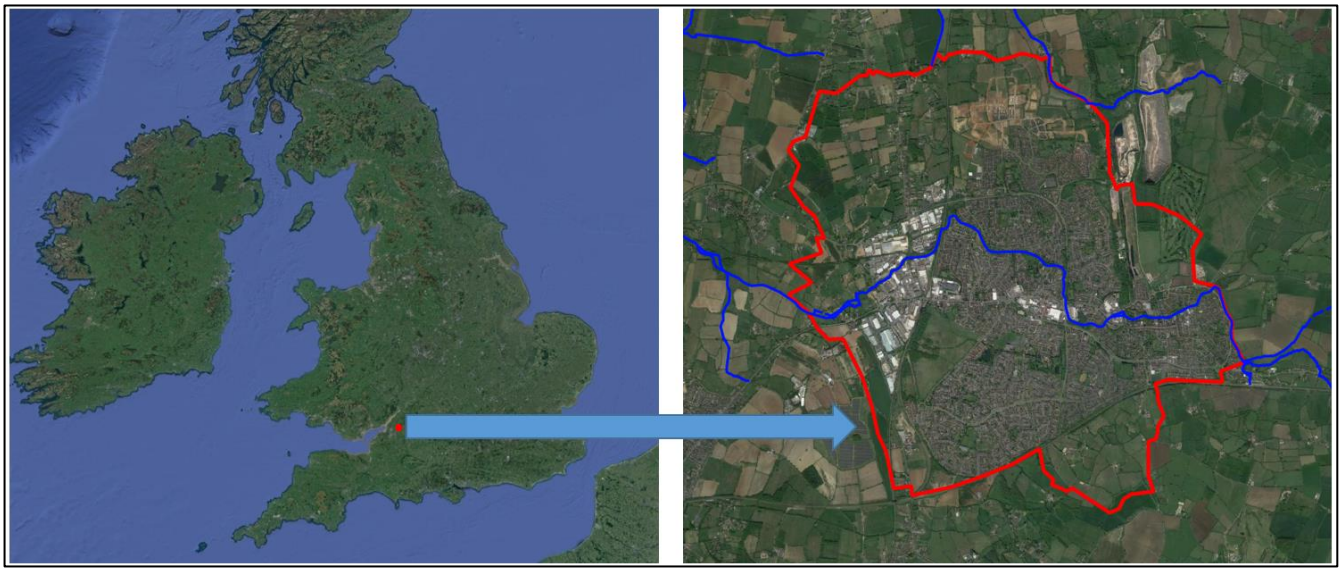

Figure 1: Case Study Location

MOTIVATION

The motivation for modelling within the Yate and Chipping Sodbury area was to update the national RoFSW mapping to provide a higher level of confidence in the flood depth, velocity, and hazard information.

The methodology used for national scale modelling provided general flood hazard locations with different degrees of severity. This modelling is used for broad-scale planning purposes. The Yate and Chipping Sodbury model would represent the stormwater system in more detail and include sub-surface drainage. While the primary purpose of this model was to update the national RoFSW mapping, this model would also be used to:

- Improve knowledge of local flood mechanisms
- Refine planning and inform capital works
- Provide a baseline model for further investigations
- Provide a tool for economic appraisal of flood mitigation schemes
- Provide a way for local partners to deliver joint schemes

Even more fine-scale models at a localised extent could later be developed as needed for specific investigations.

In NZ, there is currently no national-scale standardised flood mapping methodology or database. Instead, regional, district and city councils undertake modelling with varying levels of scale and detail. For regional councils, the main motivation to undertake modelling comes from a need to understand flood risk in the area, generally from rivers. In the case of city / district councils, models are often used for a wide range of purposes from flood hazard identification and high-level planning to property level assessments and mitigation option assessments. Therefore, these models often represent fine scale detail for entire catchments.

NATIONAL / LOCAL TECHNICAL STANDARDS

The modelling was compliant with the national RoFSW Technical Specification, as well as local modelling technical specifications where practical, and good practice guidance. The national RoFSW Technical Specification is a brief document (<5000 words) that outlines the minimum requirement for model inputs and provides general information on recommended practices. It does not provide detail on specific model configurations or parameters and instead relies on local specifications and good practice guidance documentation for this detail.

The local technical specification used in this study was Wessex Water's *Design Standard 520*. The model configuration and parameters detailed in this specification were largely used in this modelling however on occasion alternative approaches were implemented where appropriate.

In NZ, stormwater models are built to comply with regional guidelines, where available, and follow local technical specifications, where available. When guidance is available, the level of detail for regional guidelines is typically much greater than that within the UK's national RoFSW Technical Specification. City / district council modelling specifications also tend to be very detailed and allow little leeway for alternative innovative approaches.

SPECIFIC HYDRAULIC APPROACHES

The model in this case study was built with similar considerations to that of models built to NZ standards. The overall detail included in the model however was less than that of many NZ models. The key difference in the hydraulic approaches between this and similar models in NZ is as follows:

- As-built plans were not available for the model build. Instead site survey was made available. In NZ, as-built plans are generally made available where possible prior to site survey.

- Pipes with diameters > 300mm were included in this modelling. In NZ, smaller diameter public network is often included in a model.
- Gully traps were not modelled in this study whereas in NZ, modelling of gully traps is becoming more common.
- In this study, subcatchments were delineated to manholes based on the Thiessen Polygon method. In NZ, subcatchments are typically generated using terrain and watershed analysis.

While the modelling in this case study was of a similar scale to that of many stormwater models in NZ, this modelling included less detail. In NZ, models are often built to include a high level of detail as they are then used for large-scale and small-scale analysis.

LESSONS LEARNED

The following lessons were learned that could benefit NZ practices:

- National funding can be strategically, transparently and fairly allocated to local level modelling work to benefit at-risk communities. A similar process could be administered by Taumata Arowai in future to target funding allocations.
- A national technical specification for stormwater modelling ensures that all work completed is to a similar technical standard, but can be adapted to suit local conditions and / or innovative approaches. It does not need to be long or complex to achieve this.
- The motivation and purpose to undertake the modelling should be considered when schematising the model. This motivation should also be considered throughout the model build process to ensure the final model is appropriate for the intended purpose.
- Models do not always need to be built to include great amounts of detail. Models can be built at a coarser resolution and refined for localised extents as needed.
- Where refined modelling is undertaken, it is beneficial to feed the flood hazard mapping outputs back to a central database to ensure that the latest information is accessible to all.

The difference in modelling approaches between the UK and NZ presented in this case study highlights the difference in how surface water / stormwater is regulated. With the ongoing three waters reform it may be that regulations in NZ align more closely with those in the UK and that modelling in NZ will start to look similar to the UK in the future.

KEYWORDS

Stormwater management, success stories / case studies, hydraulic modelling