CITYWIDE CREEK & OVERLAND FLOW MODEL PROJECT

Brisbane City Council

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Environmental Planning & Flood Resilience

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Why More Maps?
Flood Commission of Inquiry

8.1 OLF Maps for Development Assessment
   – Based on hydraulic modelling
   – Easily updatable

8.2 OLF Maps & models available to applicants & consultants
The Overland Flow Story – to date.

Local Stormwater Management Plans
The Overland Flow Story – to date.

FloodFlag Maps / City Plan 2014
The Overland Flow Story – to date.

Flood Awareness Maps
Council’s Flood Action Plan

1. Review of high risk area
2. Determine areas in need of update
3. Update existing OLF mapping

Using traditional modelling methods $$$
An innovative approach required
The Brief

1. Citywide 2D Hydrodynamic Model
2. Overland Flow & Creek
3. Account for underground drainage
4. Updateable and expandable
5. Sufficient for Development Assessment
The Challenge

• A need to map and understand overland flow & stormwater flooding in major cities

• Very large areas, with very complicated overland flow paths and stormwater networks

• Modelling the entire system using traditional methods would require a lot of time, money and data
The “Virtual Pipes” Method

• A new methodology developed by GHD in conjunction with BCC and the software vendor

• Allows simulation of stormwater systems in TUFLOW GPU using a simplified approach

• Aims to provide a reasonable approximation of the underground stormwater flows

• Greatly reduced data & time requirements, and greatly increased modelling speed compared to traditional full 1D/2D coupled models.
“Virtual Pipes Method”

• Stormwater inlets and outlets represented as points in TUFLOW GIS layer (no pipes)

• Inlets are represented by depth vs discharge capture curves

• Outlets are represented by point sources with a specified maximum discharge capacity

• Within a pipe “group”, flows capture at inlets are dynamically transferred to the outlets.
Traditional 1D Model Setup

- Solves full 1D hydraulic equations at all pits and pipes
- Dynamic linking between 1D / 2D

All pits and pipes modelled.
Invert levels
Lengths
Manning’s $n$ values
Pipe shapes
Linking between pipes
“Virtual Pipes” Representation

Pre-calculated maximum outlet capacity (i.e. 2 m³/s)
Study Area & Sub-Model Extents

- 1,200 km² study area
- 2m x 2m grid resolution
- ~300 million active grid cells
- ~200,000 stormwater inlets and outlets
- 30 individual sub-models
Pre-Processing of Stormwater Data

• Multiple steps:
  – Fix connectivity issues
  – Identify pipe groups
  – Identify inlets and outlets
  – Assign inlet curves
  – Estimate outlet discharge capacities (i.e. Manning’s equation)
Calibration to Gauged Levels
“Virtual Pipes” Validation – Area 1
“Virtual Pipes” Validation – Area 2
2014 DEM
Inlets & Outlets
“Virtual Pipes” – Example Depth Results
“Virtual Pipes” – Example Velocity Results
Strengths

1. Very quick model set up times.

2. Relatively low data requirements:
   • Can work with messy or incomplete GIS data
   • Does not require invert level data
   • Only needs pipe diameter information for the outlets

3. Leverages the advantages of TUFLOW GPU (large, fast and detailed models).

Weaknesses & Limitations

• Simplified approach – treats stormwater systems as a black box of inlets and outlets, and doesn’t solve full hydraulic equations.

• Does not account for tail-water effects or backflow.

• Does not account for pipe flow lag times.

• If weaknesses are known and understood, they can be accounted for and their effects can be minimised.
Potential Applications

• Broad scale urban overland flow path mapping.

• Identification of urban flooding hot spots & problem areas.

• Better development that addresses urban flood risks.

• Rapid testing of stormwater infrastructure upgrades.

• Informing the public of potential urban flood risks.
Where to from here

- FAM
- City Plan
- FWPR
- Planning LGIP

- “Like for Like” or “New look & Feel”
- Filter Options – fine, coarse...
- Policy Change – 1%, hazard categories, freeboard?
- Data – extent, depth, velocity, hazard?
Avoiding a flood of flood info…….

- “My property has never been flooded and I’ve been living since the beginning of the time…..” – so your maps are wrong........

- Are likelihoods the most palatable means of communication.....?
Flood behaviour…yet Keeping it Simple

• Use of Handbook 7 guidelines - 6 Flood Hazard categories

Severity of ‘impact’ communicated: people → buildings → vehicle → general safety
From likelihood to impact....
Trunk Infrastructure Planning
Conclusion

• Rapid, cost-effective alternative approach to full scale 1D / 2D modelling in certain situations.

• Can simultaneously achieve large scales, high detail and low costs.

• Produces high-quality results if limitations are understood and accounted for.

• Easy to understand coms approach to convey a complex flood behaviour
Questions?

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