Rapid Flood Hazard Assessment for the Auckland CBD - An Overview

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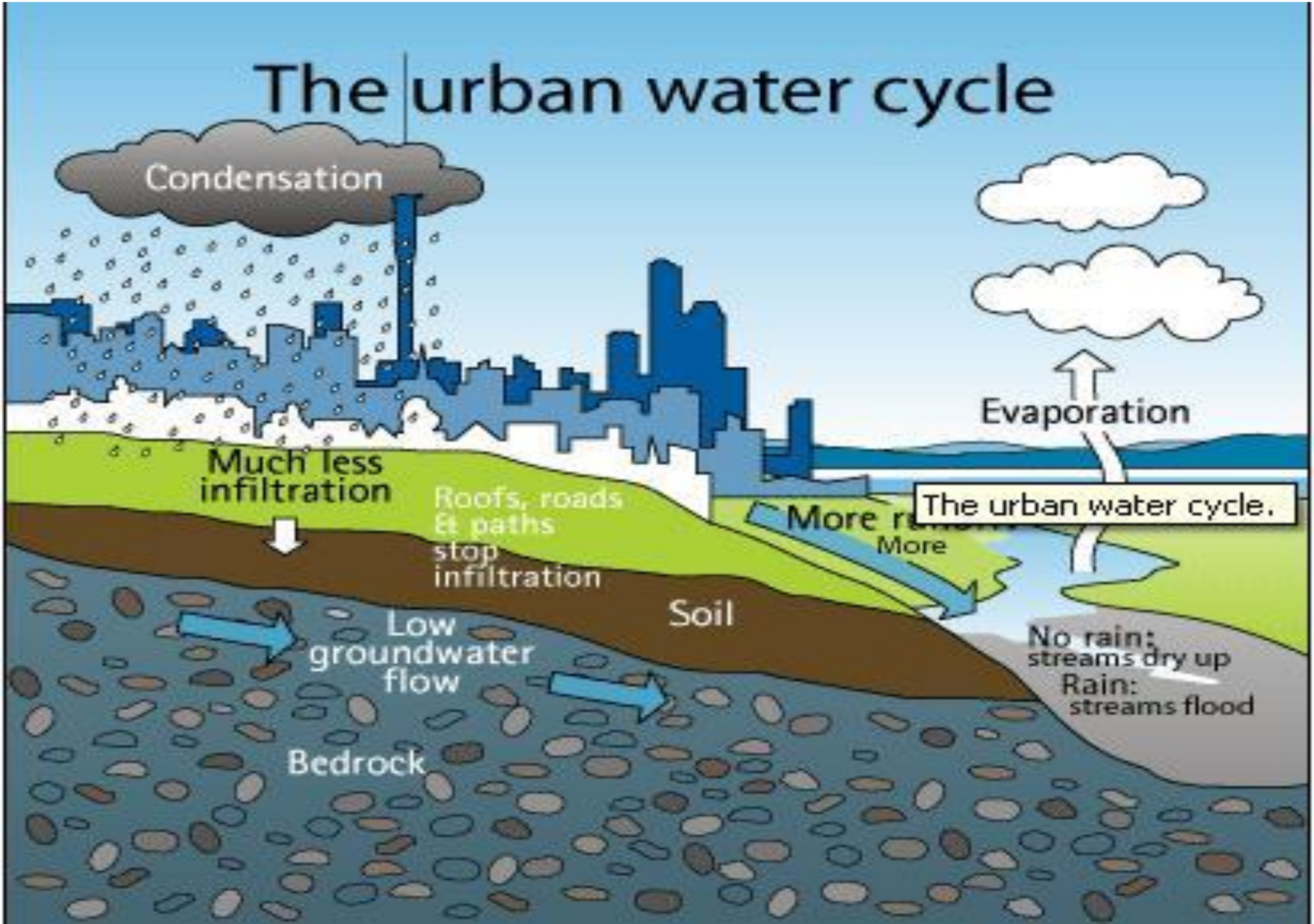
Auckland City Council's vision



Towards a more sustainable urban water cycle

Presentation Overview

- Shared Space Overview
- Model Setup
  - Terrain
  - Hydrology
  - Adjusted Hyetographs
  - Simulation Setup
  - Sensitivity
- Results
- Model Limitations
- Conclusions
- Future Work

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Introduction

- Client: Metrowater & Auckland City Council
- As part of Auckland City Council's (ACC) “CBD into the Future” strategy shared spaces are proposed
- Time constraints on this process called for a Rapid Flood Hazard (RFH) assessment was undertaken by AECOM
- RFH model consisted of only ‘Rain on Grid’
- Drainage capacity was accounted for by adjusting hydrology

Shared Spaces

- ACC's "CBD into the Future" aims to transform the CBD into a business and cultural centre
- Shared Spaces is a concept where pedestrians and vehicles share the same space
  - Improves environment without banning traffic
  - Paved surfaces across the full width of the street
  - Central channel – no kerb and channel
- Proposed changes may affect overland flow paths

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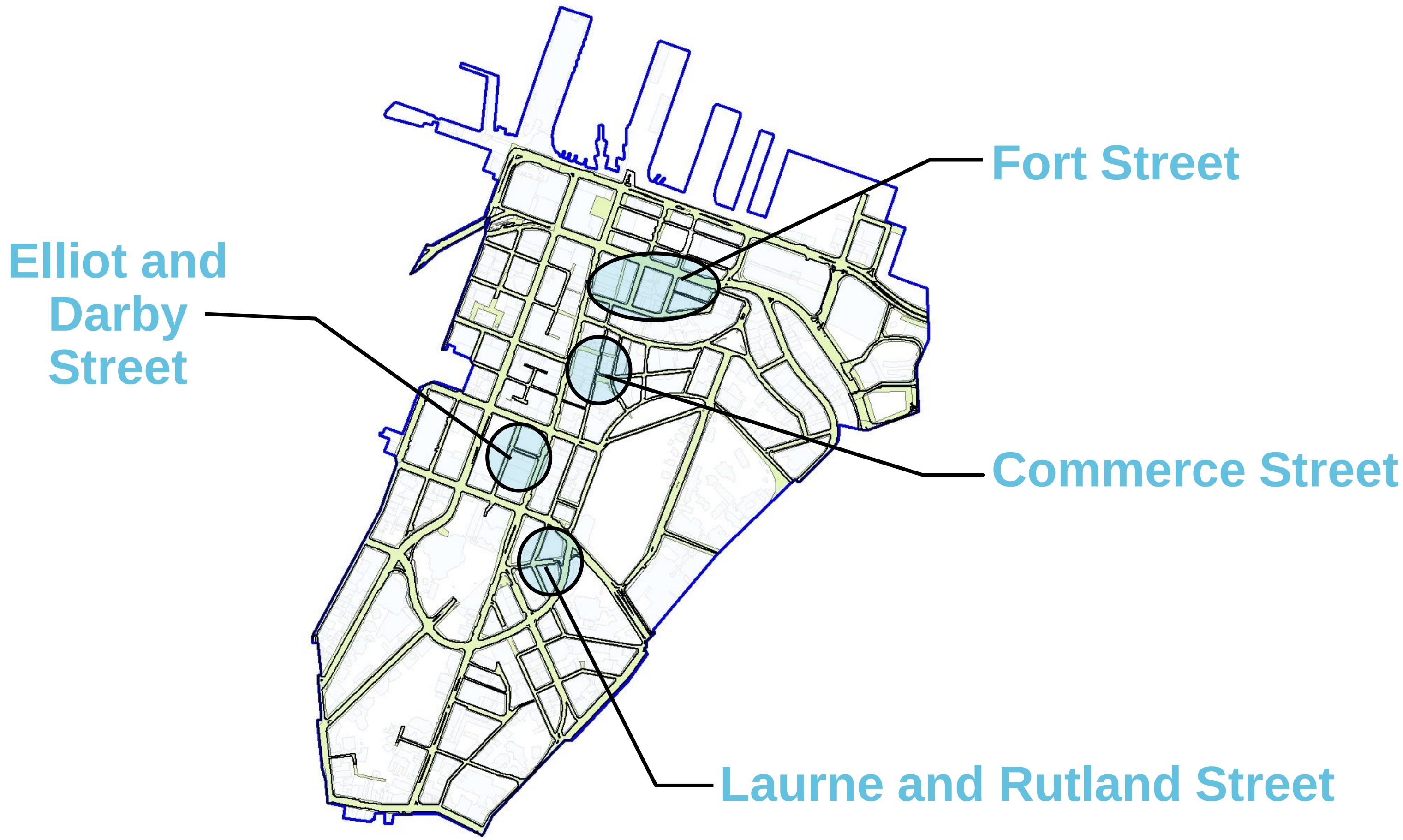
METROPOLITAN HOTEL

Shared Spaces – Location Plan



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Shared Spaces

Darby Street Existing

Shared Space Design

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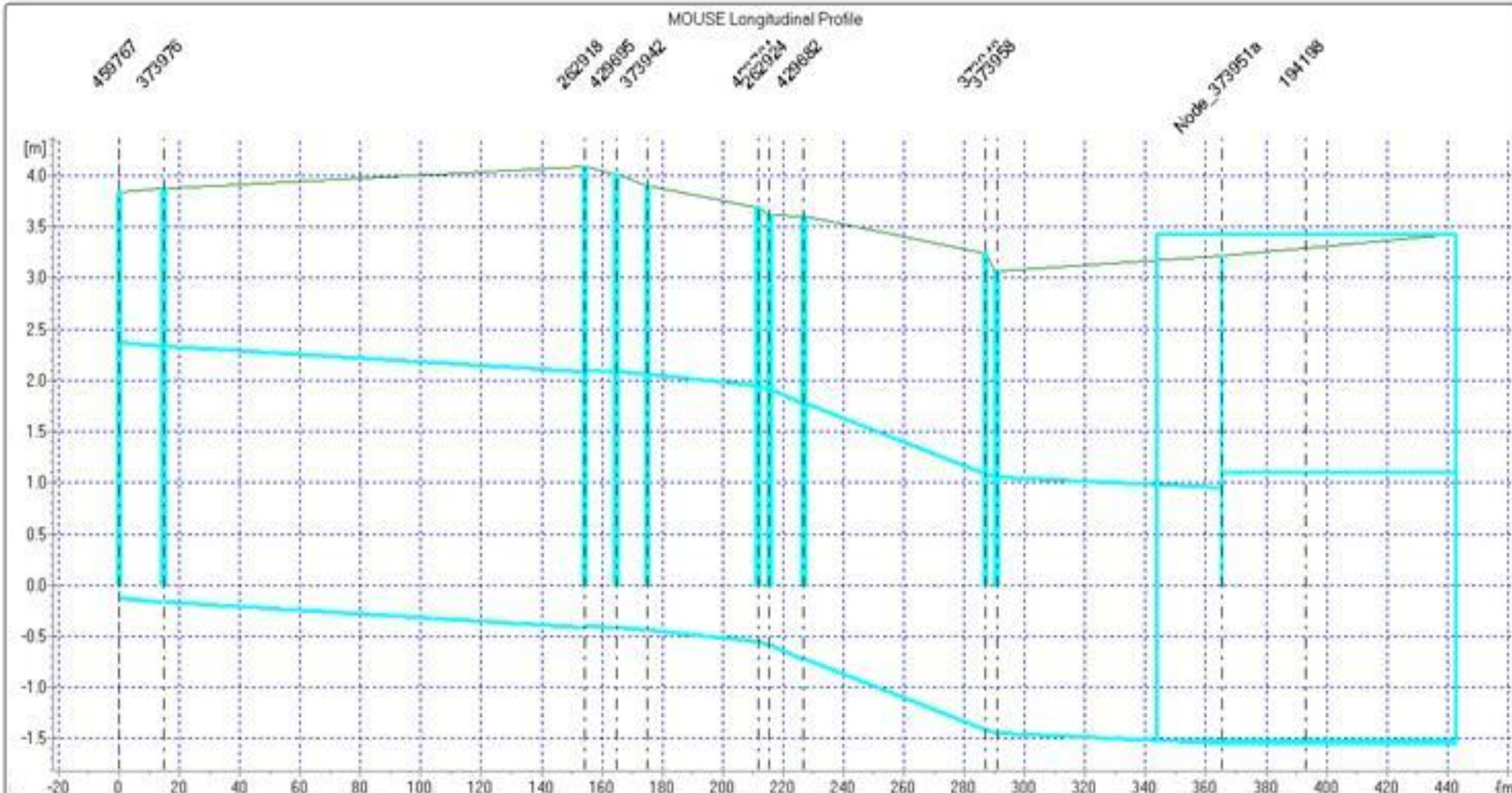
Methodology Selection
1D/2D Coupled Model vs 2D Rapid model

- Definition:
  - 1D – links and nodes conveying flow in one direction
  - 2D – 3 dimensional surface terrain where water can travel in multiple directions
  - Rapid Flood Modelling – Utilising 2D modelling only to determine flood hazards
- Reasons for utilising 2D Rapid Model
  - Main flood area is low lying
  - Time constraints
  - Pipe network is very complex and would likely cause delays to the programme


CUSTOMS STREET WEST
NL3031
NC7379
NC7385
459652
NL3050
427582
427565
459617
CUSTOMS STREET EAST
NL3047
OA4097
NC7435
IMPERIAL ARCADE
NC7648
NC7433
NK2786
427559
ND3754
NK2785
NL3043
QUEEN STREET
NK2784
FORT LANE
NL3165
ND3424
NL6773
EXCHANGE LANE



Link ID		NW2561_1			NW2565			NW2568_3		NW2570
TypeNo					3					
Link Diameter					2.5000					
UpLevel	-0.13	-0.16			-0.44		-0.59	-0.72		-1.45
DwLevel	-0.16	-0.41			-0.55		-0.72	-1.40		-1.54
Length_C		139.453			36.614			60.182		74.651
Link Slope	0.20	0.18	0.13	0.20	0.30			4.70		0.13
Height					2.5000					
Width		3.5000						3.0000		4.5000

Shaft ID		373976	262918		373942	459784		429682	373948	373958	Node_373951a
Shaft Diameter					1.0500						
Ground Level		3.88	4.09	4.01	3.90	3.69		3.61	3.24	3.07	3.22
Invert Level											

Model Setup
Terrain

- Existing terrain setup used
  - LIDAR data
  - Design levels through Queen Street
  - Survey data through shared space areas
- Future terrain was upgraded in shared spaces using design levels
- Cells located within building footprints are set to ‘land’ to ensure correct overland flow around buildings

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Model Setup
Hydrology

- TP108 design storms were used for 20, 50 and 100 year simulations
- Rain on grid method utilised to ensure correct allocation of overland flow
  - Assumption is rainfall = runoff (i.e. No infiltration losses)
  - Considered appropriate due to the majority of the area being impervious

- Assumptions for inletting were applied to the entire catchment
  - **Catchpits** drain 20l/s each except Queen Street and Shared Spaces where design capacity is 20yr storm
  - **Building Roofs** assumed to drain a 10yr storm (current regulation is for 20yr storm therefore assumption is conservative)
  - **Other Private Drainage** assume zero other private drainage and that all other private drainage contributes to road drainage

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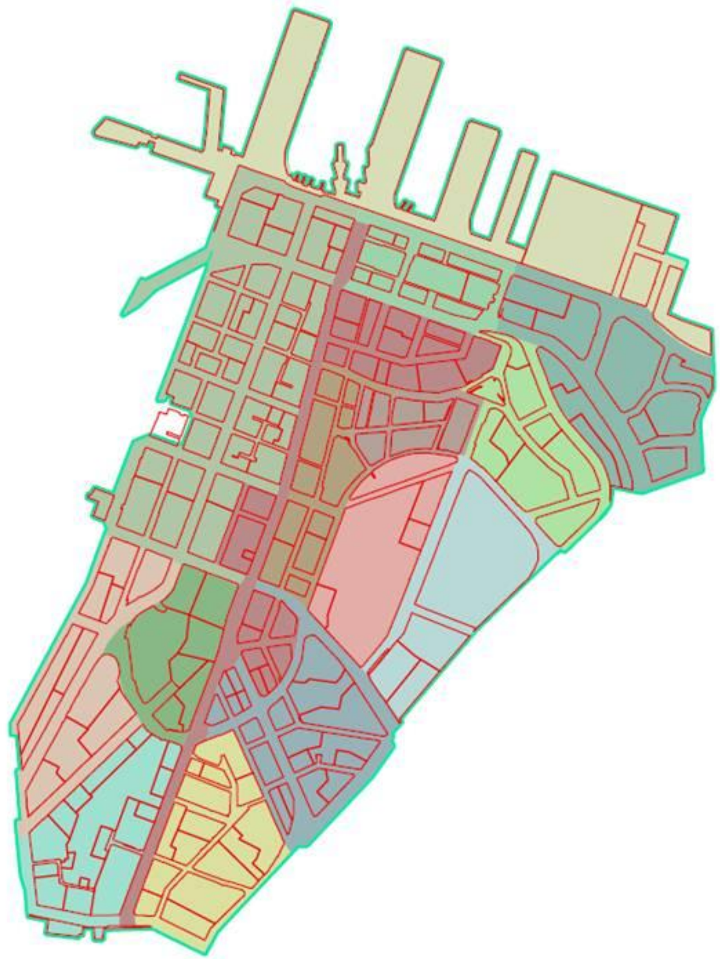
Model Setup
Adjusted Hyetographs

- To account for the assumed drainage capacity the hyetograph for rain on grid was adjusted

Step 1:

group areas with similar characteristics (i.e. Catchpit distribution, roof coverage etc)



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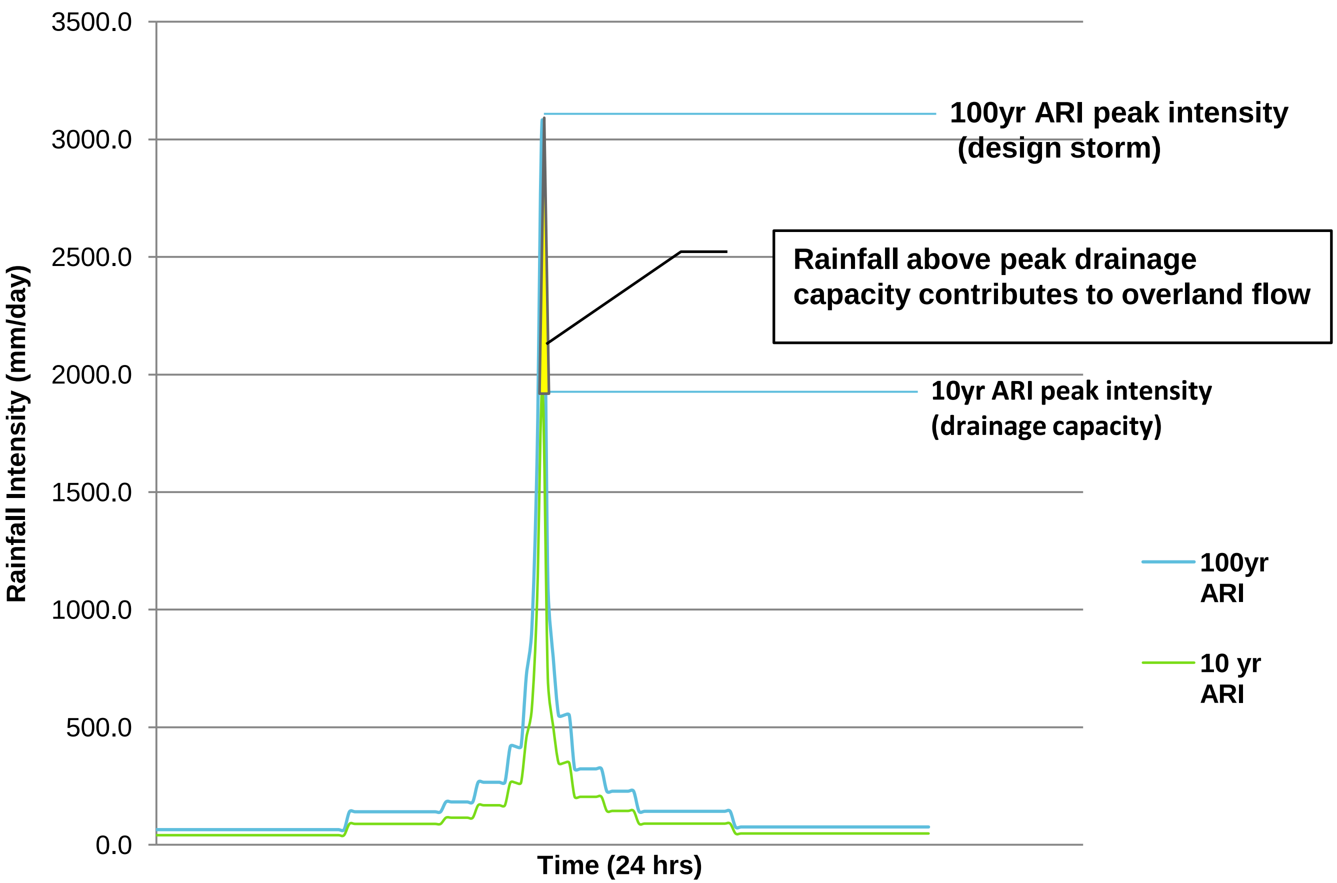
Model Setup
Adjusted Hyetographs

Step 2:
Each drainage component has a peak intensity

Below is an example of 10yr peak intensity (building capacity)



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Model Setup
Adjusted Hyetographs

Step 3:
Each drainage area has a percentage of each drainage component

Each area has a percentage of roof/paved and roads

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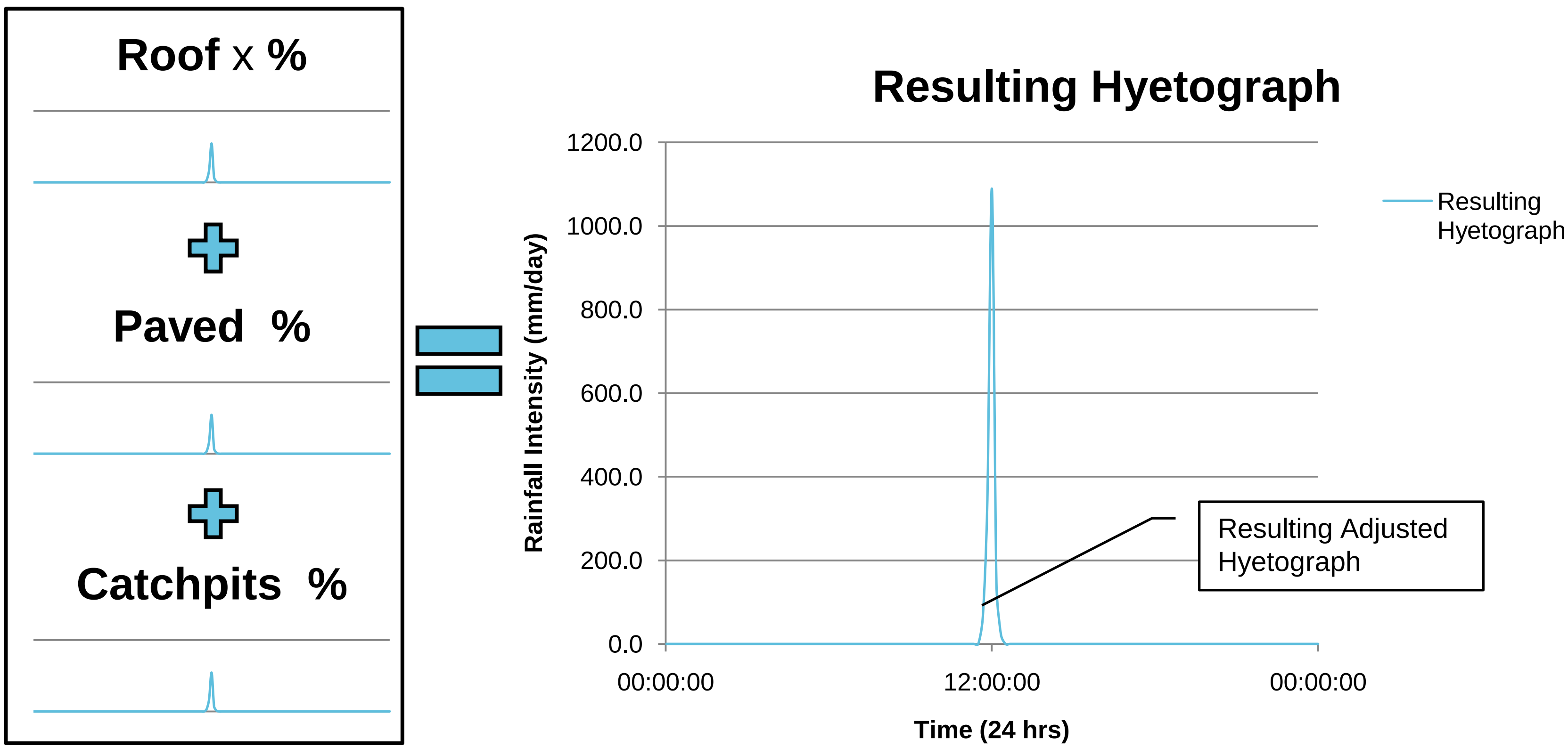
Model Setup
Adjusted Hyetographs

Using a %age area weighted method the hyetographs were summed. The result is a hyetograph for each area



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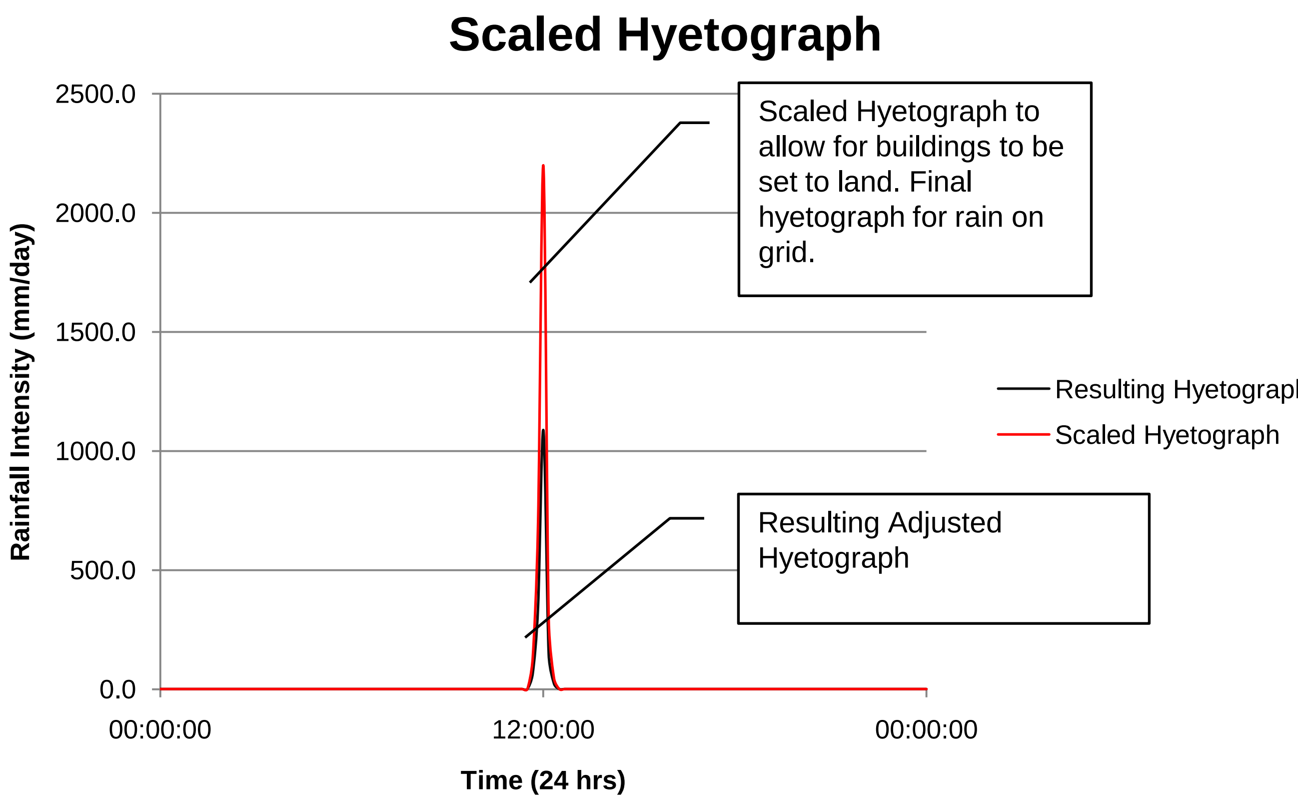
Model Setup
Adjusted Hyetographs

- Volume is removed from calculations when buildings are set to land
- Hyetograph scaled up proportionately based on the % of each area that was set to land



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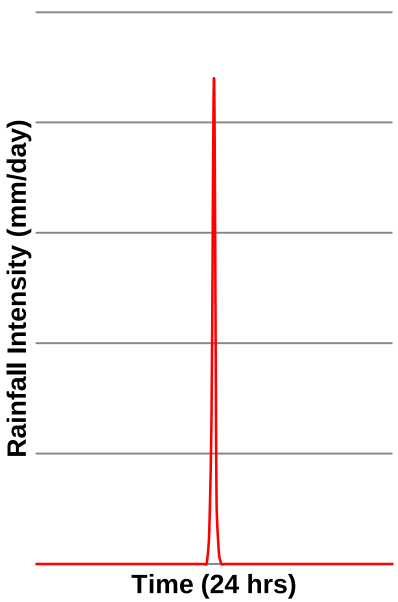
Model Setup
Adjusted Hyetographs

Step 5: Adjust for Spatially and Temporally Distributed Rainfall

Scaled Hyetograph



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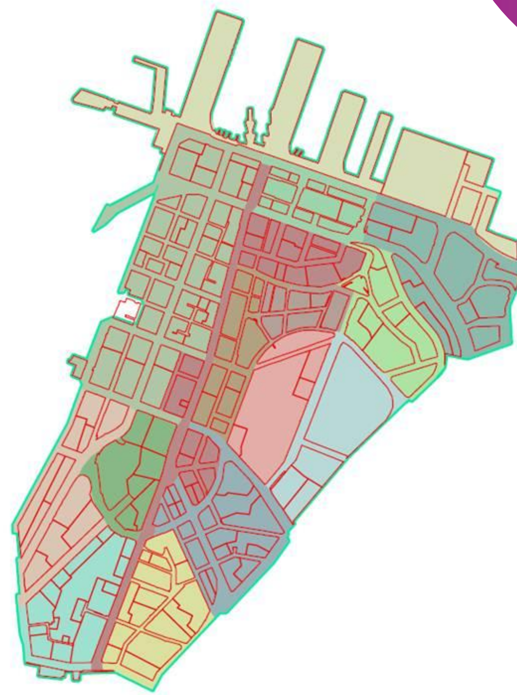

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Spatially and Temporally Distributed Rainfall as DFS2

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Model Setup
Simulation Setup

The "rain on grid" method is very computationally demanding therefore:

- Due to the 'peaky' nature of the adjusted hyetographs and;
- Flooding begins to recede less than 2 hours after the peak

Simulation could be run from 11.30am to 3pm

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Model Setup
Sensitivity

A sensitivity check was carried out to determine how critical our assumptions regarding drainage capacity are :

Step 6: Sensitivity Check

	Roof downpipe capacity	Catchpit capacity
Sensitivity Check 1	5 year ARI	10l/s
Sensitivity Check 2	No private roof drainage (assume all downpipes blocked	10l/s

Results show that fully blocked private drainage significantly effects flooding extent due to the additional volume

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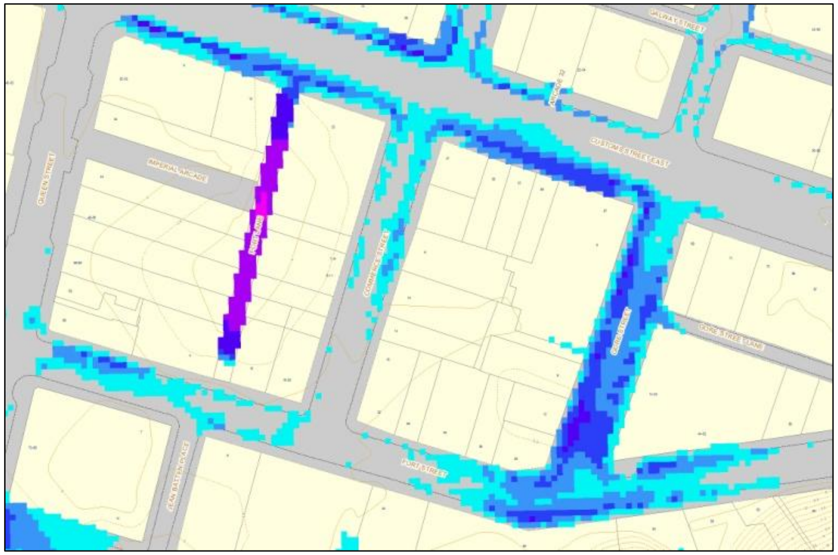
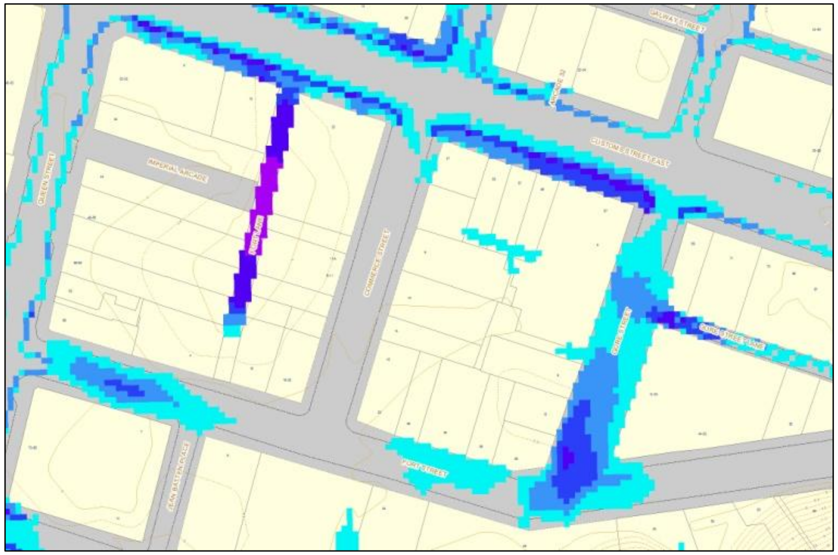
Results

Below shows typical results obtained from the model



Pre shared space



Post shared space

Flooding has been changed, however, generally flooding has been reduced

Limitations

The following limitations are applied to the Rapid Flood Hazard Model:

- Assumes the network has capacity to receive and convey the assumed drainage capacities for catchpits and private properties

- Ignores the effect of backwater due to tidal influences

- Results were to be used to gauge **relative** differences in flood extent and depth

Conclusions

- Proved to be a useful tool for assessing relative changes in flood extents.

- The rapid assessment was a significant time and therefore cost saving to the Client

- Results were comparable with detailed 1d pipe based models previously developed.

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Further Work

Detailed 1D/2D coupled models are being developed for:

- Shared Spaces development team
- FHM programme for Auckland City Council

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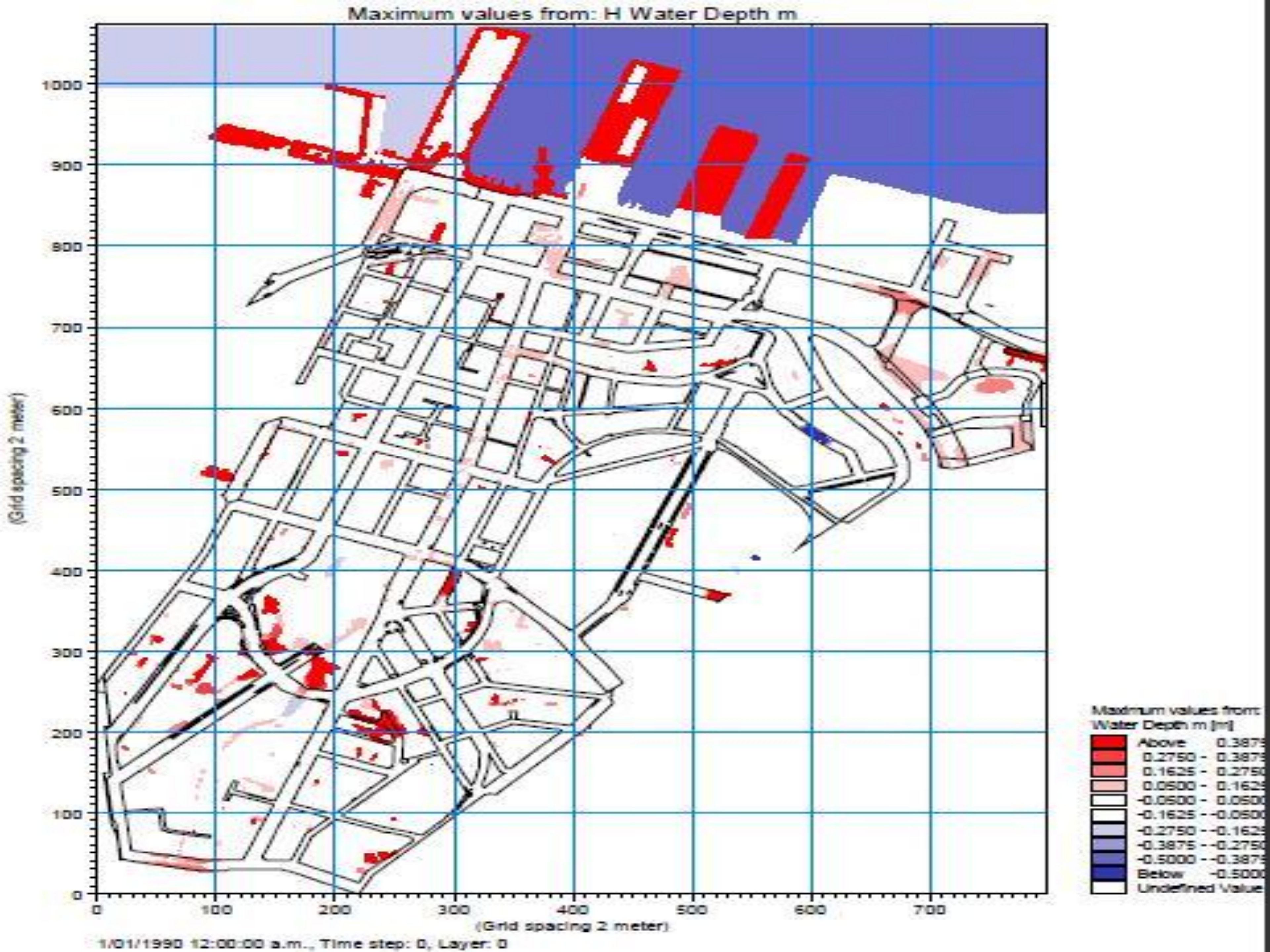
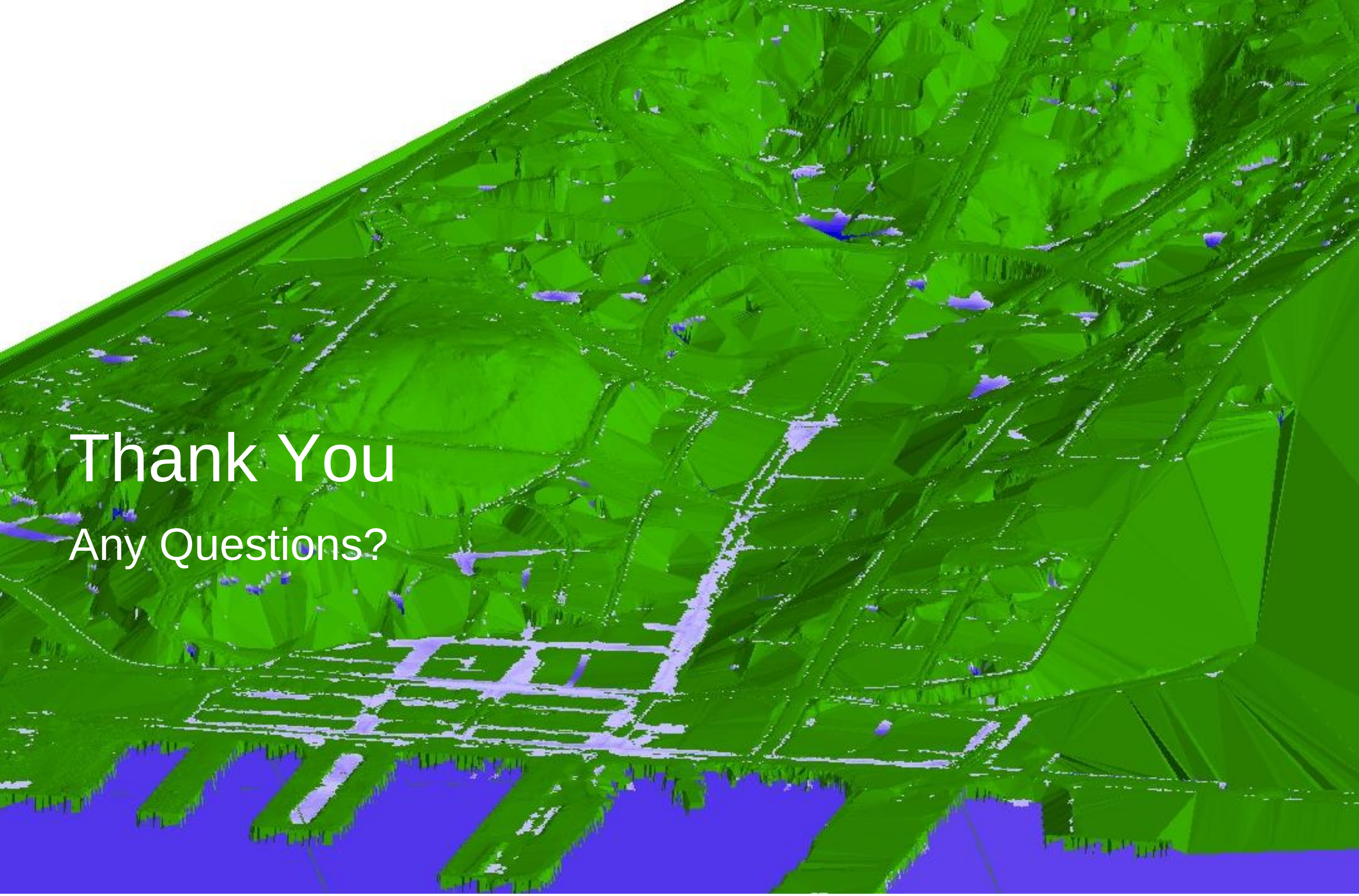


Maximum values from: H Water Depth m
(Grid spacing 2 meter)
(Grid spacing 2 meter)
Maximum values from:
Water Depth m [m]
Above 0.3875
0.2750 - 0.3875
0.1625 - 0.2750
0.0500 - 0.1625
-0.0500 - 0.0500
-0.1625 - -0.0500
-0.2750 - -0.1625
-0.3875 - -0.2750
-0.5000 - -0.3875
Below -0.5000
Undefined Value
1/01/1990 12:00:00 a.m., Time step: 0, Layer: 0



Thank You

Any Questions?