

# Flood Evacuation Options for a Major Australian CBD

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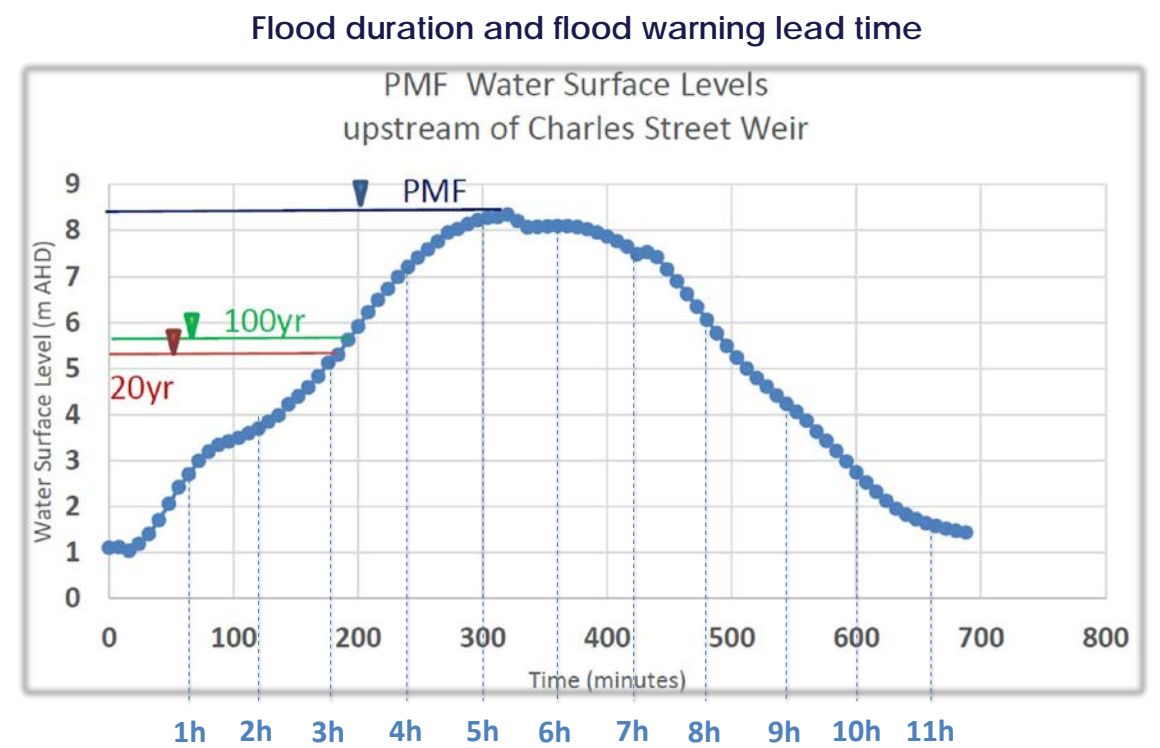
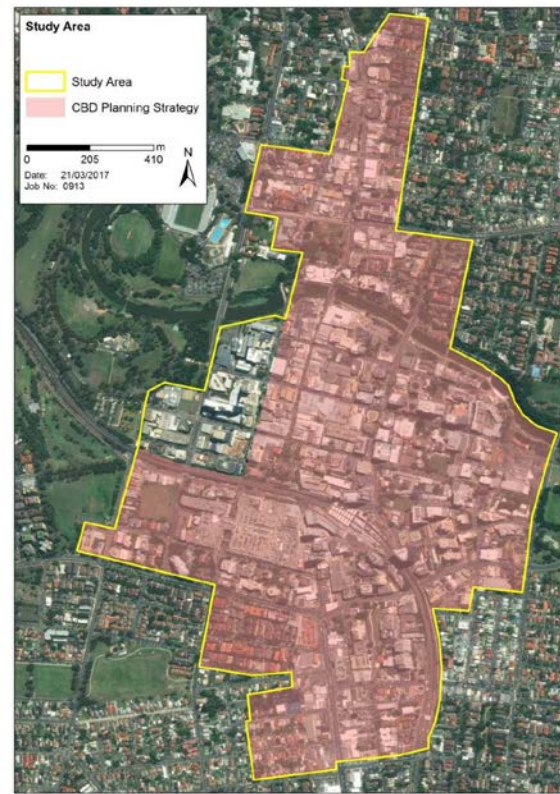
## BACKGROUND AND AIM

The NSW State Government and the City of Parramatta Council have identified Parramatta CBD as a key growth centre for large-scale commercial and residential development.

In April 2015, Council adopted the Parramatta CBD Planning Strategy, detailing the type of development envisaged and devising an implementation plan. The plan spans until year 2056.

One of the main constraints to development in Parramatta CBD is the risk of flash flooding from the Parramatta River and its tributaries. At the time this project was completed, a flood warning system was being put in place which would provide a lead time of 2 hours before the peak of any event.

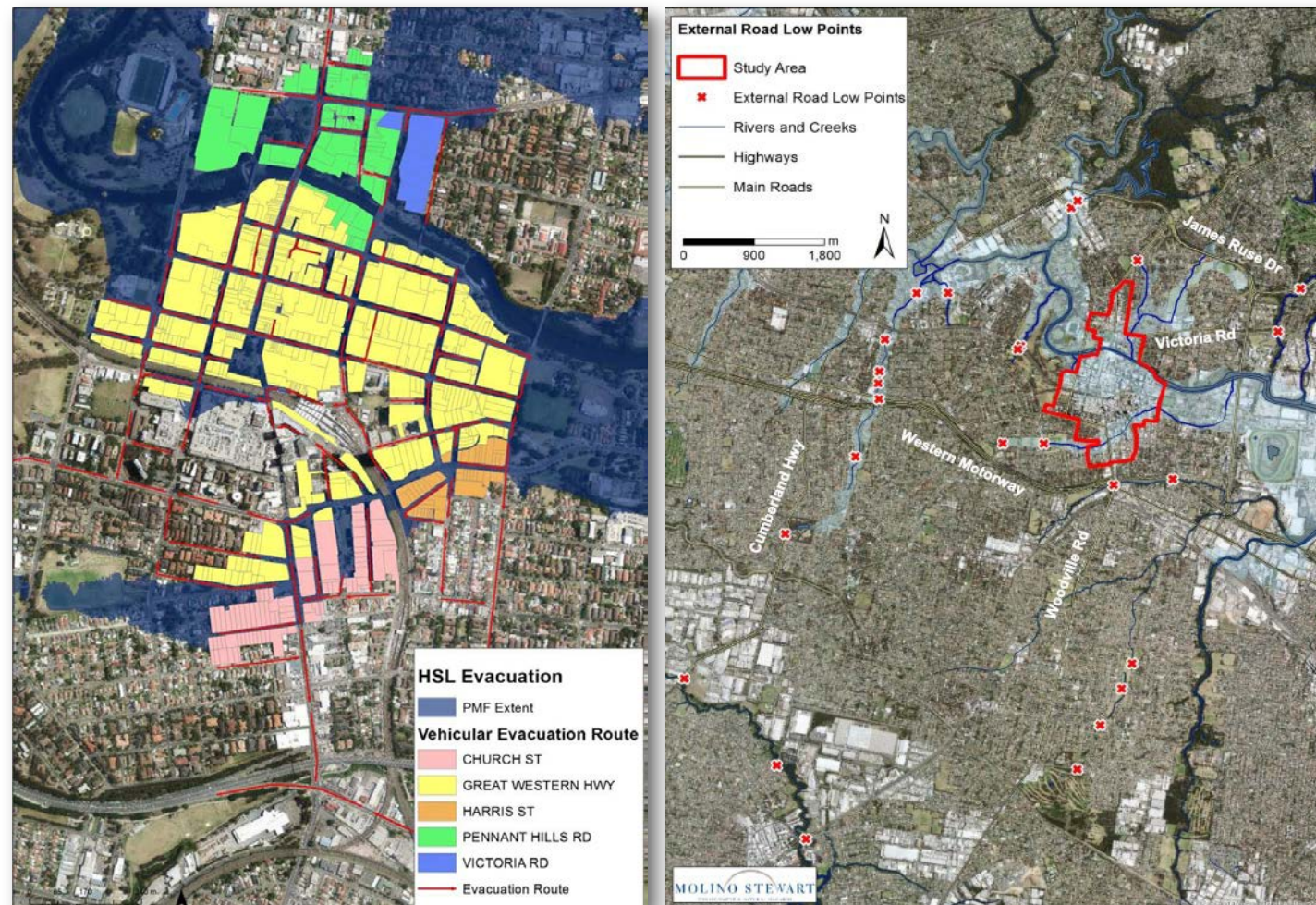
The aim of this study was to identify the most suitable flood emergency response strategy for Parramatta CBD, under existing and future conditions.



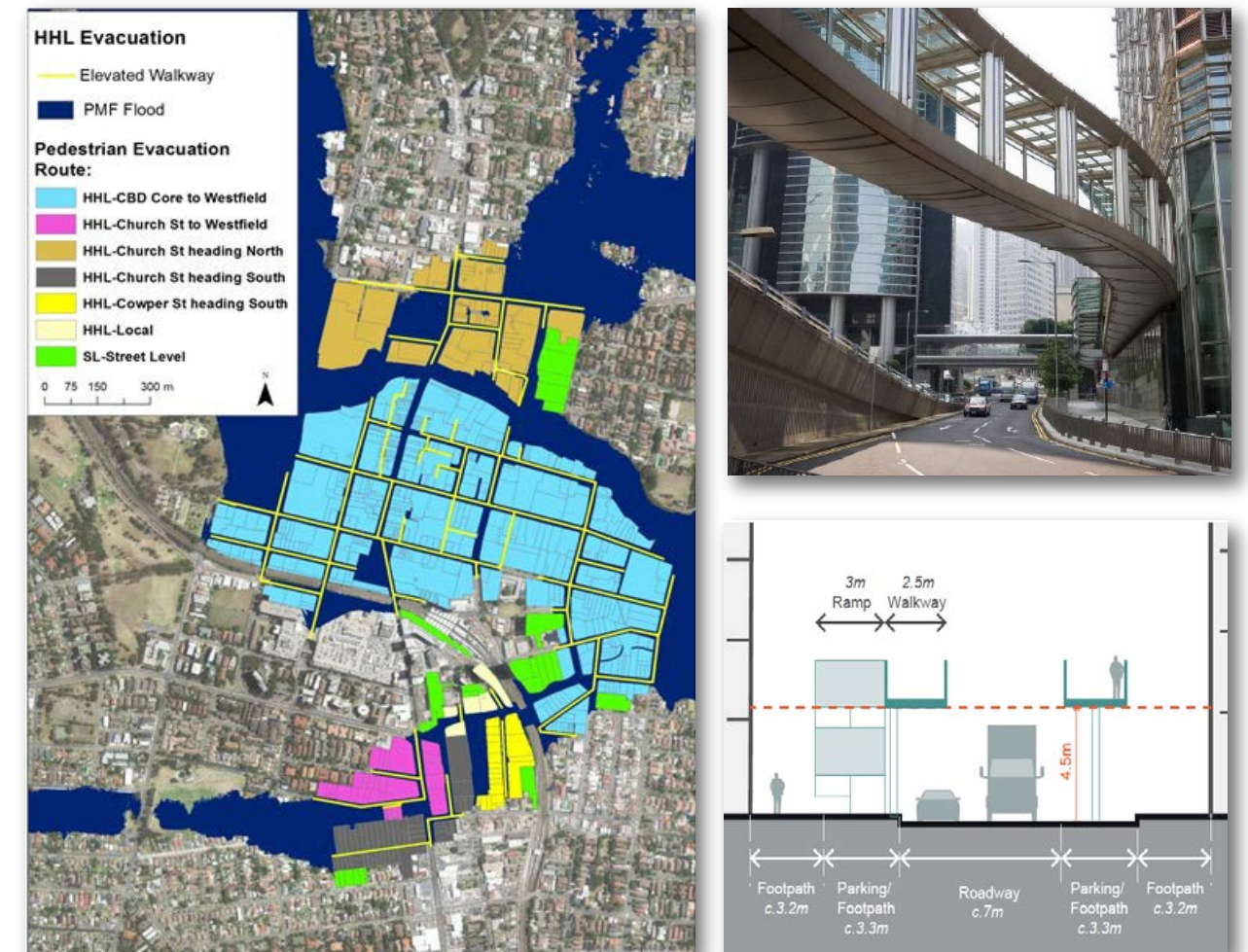
## METHODOLOGY

The project aim was achieved by assessing and comparing three possible flood evacuation strategies:

1. **Horizontal Street Level (HSL) evacuation**, achieved by vehicle before any roads are cut by floodwaters. We initially identified five main evacuation routes based on an analysis of all main road low points around Parramatta CBD:



2. **Horizontal High Level (HHL) evacuation**, achieved on foot by using a network of elevated walkways which would allow evacuation above flooded roads and pathways. A draft design and costing of the required infrastructure was provided:



3. **Vertical Evacuation through Sheltering in Place (SIP)**, in which evacuees would reach a refuge above the flood level within their building and wait for floodwaters to recede.

Each evacuation strategy was assessed using different flood events (20 year ARI, 100 year ARI, PMF), different degrees of implementation of the CBD Planning Strategy (year 2016, year 2036 and year 2056), and different times of the day at which a flood emergency response may be necessary (Midnight, Midday, PM Peak).

## COMPARISON AND RESULTS

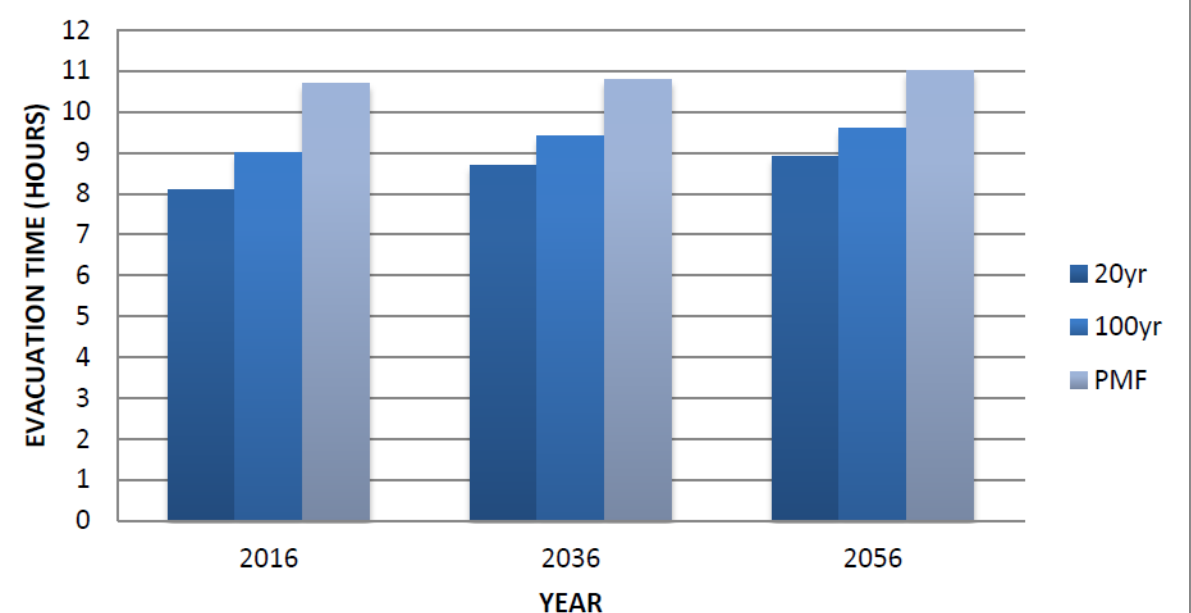
Using Multi-Criteria Analysis (MCA), the evacuation strategies were compared and the most suitable strategy was identified. The following evaluation criteria were used:

- Strategy effectiveness, in terms of capability to safely evacuate the population before routes are cut by floodwaters. The total evacuation time for each strategy was calculated using state of the art flood evacuation models, including the NSW SES Timeline Evacuation Model. The simulations addressed 24 "worst-case" scenarios, combining flood probability, degree of implementation of the CBD Planning Strategy, and time of the day. Evacuation time was then compared with the time available for each evacuation route to assess the strategy effectiveness;
- Difficulty of implementation of the strategy, arising from setting-up the necessary infrastructure (e.g. elevated walkways) and from the logistics of the response;
- Risks to life associated with each strategy and the extent to which these can be reduced;
- Impacts on the urban environment (i.e. due to the elevated walkways);
- Cost of implementation and maintenance of the strategy;
- Load on emergency services.

Results showed that:

- Under the assumptions of the NSW SES Timeline Evacuation Model, safe vehicular evacuation would not be realistically achievable under any circumstances and regional flooding would block evacuation of most traffic which leaves the CBD;
- A network of elevated walkways would allow safe HHL evacuation (including late evacuation), however evacuation time would be of the same order of magnitude as the flood duration.
- Importantly, a network of elevated walkways catering for events up to the PMF would have a high cost (\$324 million) and very significant impacts on the CBD urban landscape and heritage buildings. A smaller network of elevated walkways, catering for events up to the 20 year or the 100 year ARI flood, would have lower costs (i.e. \$94.5 million and \$111 million respectively), but would need to be paired with SIP to cater for larger flood events, and the impacts on the CBD landscape would still be significant.
- SIP is the optimal flood emergency response strategy for the Parramatta CBD, given the large residential and working population, the large number of multi-storey tall buildings available for SIP, and the relatively short duration of flooding. However, SIP could expose people to a number of secondary risks to life, including those arising from: building structural failure, medical emergencies, building fires or people deciding to leave the shelter and walk through floodwaters. Development controls would need to be imposed on development to reduce these secondary risks to a tolerable level and ensure there was not an increased demand for rescue operations by the NSW SES.

### Vehicular (HSL) Evacuation Time



### Pedestrian (HHL) Evacuation Time

