SJB Urban

Horizontal Evacuation Pilot Study
Parramatta CBD

We create spaces people love.
SJB is passionate about the possibilities of architecture, interiors, urban design and planning.
Let's collaborate.

Level 2, 490 Crown Street
Surry Hills NSW 2010
Australia
T. 61 2 9380 9911
architects@sjb.com.au
sjb.com.au

Prepared for
The City of Parramatta

Issued
29 August 2017

We create amazing places

At SJB we believe that the future of the city is in generating a rich urban experience through the delivery of density and activity, facilitated by land uses, at various scales, designed for everyone.

Version: 04
Prepared by: FL, JH, SS, AG, JF
Checked by: JK

Contact Details:

SJB Urban
Level 2, 490 Crown Street
Surry Hills NSW 2010
Australia

T. 61 2 9380 9911
architects@sjb.com.au
sjb.com.au

SJB Architecture (NSW) Pty Ltd
ABN 20 310 373 425
ACN 081 094 724
Adam Haddow 7188 John Pradel 7004

Contents

Introduction

1

1.1 Purpose of the Study and Scope of Works

The City of Parramatta (CoP) has prepared a Planning Proposal that relates to the Parramatta CBD. The area is subject to flooding, and to support the Planning Proposal, CoP is investigating a number of methods to mitigate flood impacts, as well as managing emergency response and evacuation methods throughout the CBD.

An Update to the Parramatta Floodplain Risk Management Plans was prepared by Molino Stewart dated February 2016 to ensure the Planning Proposal is consistent with Section 117(2) Direction 4.3 of the Environmental Planning and Assessment Act 1979.

The report concluded that intensification of development in the Parramatta CBD is tolerable, providing amendments are made to the Parramatta LEP and DCP to ensure the CBD Planning Proposal meets the s117 direction and represents a tolerable risk to life and property. The key LEP amendment included a requirement for either shelter in place or high level horizontal access.

A best practice urban design study was prepared by Architectus to investigate methods for mitigating and manipulating flooding effects within the public domain and ground plane.

CoP has engaged SJB to investigate methods for the safe evacuation of occupants from within buildings during a major flood event. The report investigates three methods of evacuation, with a particular focus on high level horizontal access.

Project Objectives

The project seeks to provide the following objectives:

1. *Investigate how best to evacuate people from the CBD during flood events using interconnected horizontal connections*
2. *Understand the implications of horizontal evacuation techniques on form, function and appearance of City including built form, movement patterns and public space*
3. *Investigate potential implementation through planning policy, building design and delivery, and staging*

Project Methodology

The project adopts the following methodology to test the viability of various methods of evacuation in Parramatta CBD.

1. Urban Conditions - Challenges and Opportunities

The first step is to identify the range of urban and building conditions within Parramatta CBD including streetscapes and building typologies.

Parramatta CBD comprises a range of streets and buildings, which will ultimately influence the type of evacuations strategies and if they can be achieved.

2. Strategies

After defining the urban conditions of Parramatta CBD, three methods of evacuation are identified. These include:

- **Top of Podium** - Utilising setbacks above the street wall, roofs of existing small scale buildings, and podiums of new larger developments as an evacuation route to safety.
- **Indoor Street** - relying on the creation of a two tier city, connecting the upper levels of the city with public walkways providing a secondary address to buildings.
- **Above Awning** - relying on the construction of trafficable awnings to prove access to refuge in the event of a flood within the CBD.

3. Testing on Civic Link

The final step identifies potential issues, conflicts, and safety concerns with the three methods of evacuation using the Civic Link project as a case study.

1.2 Background Information

The NSW Government and City of Parramatta Council (CoP) have identified Parramatta CBD as a key growth centre within Sydney, and that Parramatta will grow to become the second CBD within Greater Metropolitan Sydney.

A significant constraint for Parramatta is that the Parramatta River passes through the centre of the CBD, and that a large proportion of the CBD is located within the floodplain of the river or its tributaries. The small size of the catchment upstream of the CBD also results in flash flooding whereby floods arrive quickly without warning and then recede again, which can cause significant evacuation problems, particularly as population increases (Morrison & Molino, 2016).

In a paper given at the 2016 Floodplain Management Australia Conference, T Morrison and S Molino discuss some of the issues behind planning for high density in the Parramatta CBD. A summary of this discussion is provided here.
The NSW SES has developed a topographic classification system called the “Flood Emergency Response Classification of Communities” (2007) to determine which areas should be given priority for evacuation. The main classifications affecting this study include:

- “Low flood island” – a location where the evacuation route is cut before it is inundated. These are high risk zones.
- “High flood island” – a location isolated by flooding, however the occupants can still escape to an area above flood waters

It is noted that buildings in areas classified as “low flood islands” are effectively high flood islands if they have internal access to areas above the reach of the PMF. Levels above the ground floor in areas that have limited road access or overland escape routes also effectively become “flood islands” if occupants do not evacuate the building in time. A large proportion of the CBD is considered a Low or High Flood Island.

Whilst it is preferable for occupants to evacuate well ahead of a flood event, the available data for the Parramatta CBD indicates that there may be less than one hour of warning before an event, and that many of the CBD streets will be blocked by flooding in a 1 in 20 chance per year flood. Despite a number of locations permitting level ground access to areas above the PMF for safe evacuation, a large proportion of development in the CBD is high rise, and will not permit the occupants from evacuating safely on time, resulting in additional flood islands within the CBD.

The CBD road capacity is also shown to be insufficient to evacuate all vehicles from the CBD before being overwhelmed by floodwaters. As a result of these issues, CoP with advice from Molino Stewart in the Update to the Parramatta Floodplain Risk Management Plans decided that sheltering in place was the most practical and safe solution for any proposed high rise development in a flood event.

It is preferable however to encourage development that minimises the chance that people will be isolated in buildings as they may try to leave or enter the building through hazardous floodwaters; require medical assistance; or need to evacuate from a fire or other hazardous situation. Isolation within buildings hence is ideally kept to a short duration.

The provision of high rise development within the CBD itself is a flood risk reduction measure. This is because the population exposed to risk will increase, however the building will convert the site from a “low flood island” to a “high flood island”, effectively minimising the individual risk to each occupant.

SJB has been tasked with investigating methods for providing safe evacuation routes from buildings to areas above the PMF should sheltering in place not be an appropriate solution for occupants of a building.

To test a range of approaches and scenarios, the Civic Link project has been used as a case study to apply three different methods to evacuation.

Morrison, T. and Molino, S., (2016) Floodplain Management Innovation to Facilitate City Growth, Floodplain Management Australia Conference.

Figure 1.1.1 Parramatta CBD Context Aerial with Civic Link

Baseline Review

2

2.1 Review of Existing Policies

Update to Parramatta Floodplain Risk Management Plans (Molino Stewart)

Molino Stewart were engaged by CoP to review PoC two Floodplain Risk Management Plans that cover the Parramatta CBD area and prepare an updated Floodplain Risk Management Plan.

The report concluded that intensification of development in the Parramatta CBD represents a tolerable risk to life and property, providing that amendments are made to the Parramatta LEP and DCP 2011 to better manage some of the flood risks to life.

The review also identified opportunities for DCP amendments to be made, which could result in less development restrictions in parts of the floodplain and improved building design outcomes. The following key draft proposals are taken from the report:

- A separate application to the Minister for the Environment for exceptional circumstances to impose controls over the FPL for development within the Parramatta CBD affected by the PMF
- A total of 14 amendments to Parramatta DCP 2011
- A review of policy in relation to fencing and screening within floodways
- Better communication of the detailed flood information available through Section 149 Certificates
- The preparation of a Flood Emergency Response Plan including plans for evacuation for the CBD

Best Practice Urban Design in Flood Prone Areas Urban Design Strategy (Architectus)

The *Best Practice Urban Design In Flood Prone Areas Urban Design Strategy Report* was prepared by Architectus for Parramatta City Council and completed in December 2016.

The report considers the particular opportunities and challenges for Parramatta, as a flood prone area that is currently undergoing intensive urban development.

These concerns have generally been addressed according to the particular characteristics of key areas of interest within the Parramatta region. These are identified as the Parramatta CBD, River Foreshore and Clay Cliff Creek, Urban Renewal Areas - Rosehill and Camellia, North Parramatta and Granville.

A series of integrated built form and public domain design strategies have been developed to address the particular flood conditions, in alignment with the requirements of the NSW State Government Flood Prone Land Policy and other relevant legislation, policy and guidelines.

The study addresses the specific issues identified for Parramatta within the following categories:

- Activation
- Density
- Awareness
- High hydraulic hazard
- Car parking

The report recommends an integrated approach to managing Parramatta's urban form and public realm that responds to these five categories, while still ensuring an attractive and accessible urban environment.

Final design recommendations for best practice approaches are supported by relevant case studies and design testing, in addition to consideration of policy context and site conditions,

The following pages provide a summary of key aspects of the report (text extracted from the body of the report).

Objectives

The following objectives are outlines in the introduction section of the report:

- To create active and vibrant streets and public spaces within flood prone areas of Parramatta.
- To minimise flood damage and risks, to increase resilience and to ensure safety within both the public domain and adjacent building spaces.
- To identify lessons learned, their relevance to Parramatta and implication for the existing NSW policy context
- To address a range of flood conditions and scales relevant to Parramatta from the scale of the city to the riverfront to buildings and their public domain interface.
- To test case study findings against sample building designs (ground level and basement) to demonstrate compliance with standards, building systems design requirements, viability and good urban design outcomes.
- To complement the CBD Planning Framework flood study work being undertaken by Council.
- To provide recommendations for policy that could inform an alternative approach to current practice in NSW and that can be reviewed by Office of Environment and Heritage (OEH) and the State Emergency Services (SES).
- To use diagrams, precedents and technical references to clearly explain analysis and recommendations

Considerations for Flood Management Design

The Human Scale:
A series of height thresholds are proposed to define urban design solutions that vary according to flooding impact, in relation to the human scale. These heights are defined as:

- Seating Height - 450mm and under
- Railing Height - 900mm and under
- Eye Level - 1500mm and under
- Ceiling Height - 1500mm and above

Built Form:
Four main aspects of the management of flood risk in development have been identified as causes of undesirable built form outcomes:

Minimum floor level requirements and the Flood Planning Level (FPL):
By constructing minimum floor levels to the current FPL there is often significant grade changes between ground floors and adjacent street levels requiring careful design to ensure activation and aesthetics.

Basement entry level requirements:
The current basement entry minimum level requirement for FPL cannot feasibly be achieved in developments where the FPL is up to 3 metres higher than adjacent street levels.

Flood emergency response requirements:
The rapid rate of rise for Parramatta River and its tributaries limits the feasibility of flood emergency response provisions for developments, in particular evacuation.

Maintaining flood conveyance and storage:
One currently adopted approach to maintaining flood conveyance through sites is to utilise screened undercroft areas below ground floors. This presents difficulties for the streetscape and building design.

Assessment Criteria

An assessment criteria has been established to measure the effectiveness of proposed design strategies and solutions from both an urban design and flood risk management perspective. This criteria is categorised as the following:

Urban Design Criteria:

- Context
- Activation
- Connectivity
- Aesthetics

Flood Management, Feasibility and Risk Criteria Flood Management:

- Flood Risk to Life and Evacuation
- Feasibility

Flood Context - Parramatta

An investigation of the existing flood conditions for Parramatta has been included in the preliminary stages of the report. The flood characteristics particular to the Parramatta region are described on page 12:

‘The spectrum of flooding in Parramatta ranges from shallow, fast moving water occurring as a result of frequently occurring heavy storms through to large, slow-subsiding inundations of depths over 3m that occur much more rarely. Flood events affect streets, shops, homes, offices and public space; each has its own specific design requirements and patterns of use.’

The constraints for flood emergency reponse as a result of these conditions are elaborated on further in Section 3.0 ‘Flood Context’ (p.28):

‘...Parramatta River and its tributaries is classed as a flash flooding environment as the time to flooding is less than 6 hours, at some locations on tributaries this can reduce to less than 30 minutes. This means that flood emergency response is difficult for the area as there will be very limited time available for emergency services such as the SES to evacuate occupants of the floodplain in the event of flooding.’

The specific flood characteristics for the Parramatta CBD area are identified as the following (p. 21):

A number of Parramatta River foreshore sites are affected by 100yr ARI high hazard from river flooding. Other parts of the CBD are affected in the 100yr ARI by low hazard overland flow flooding which mostly align with the road reserve.

The majority of the CBD is affected by high hazard flooding (up to 4 metres depth, assumed low velocities) from Parramatta River in the PMF event. There is significant overland flow and consequent flooding across much of the CBD reaching higher levels than river flooding.

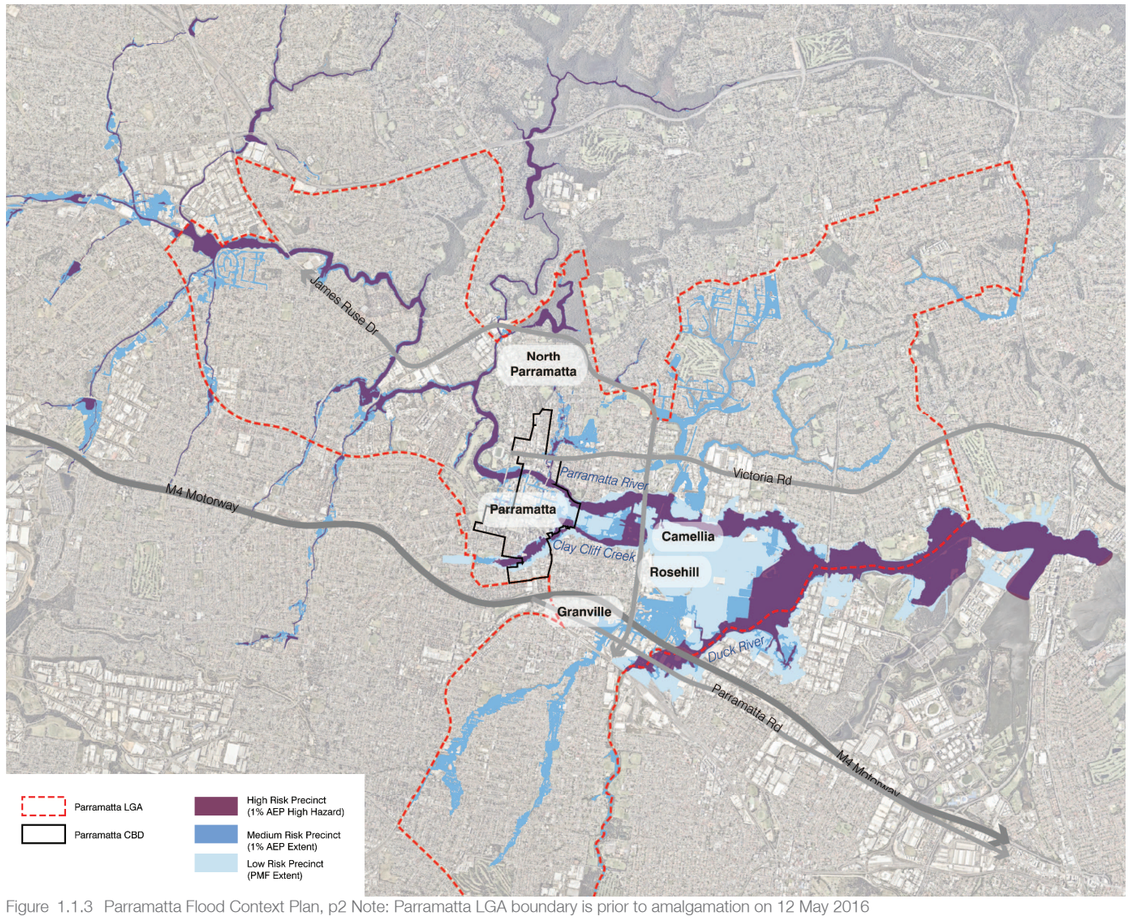


Figure 1.1.3 Parramatta Flood Context Plan, p2 Note: Parramatta LGA boundary is prior to amalgamation on 12 May 2016

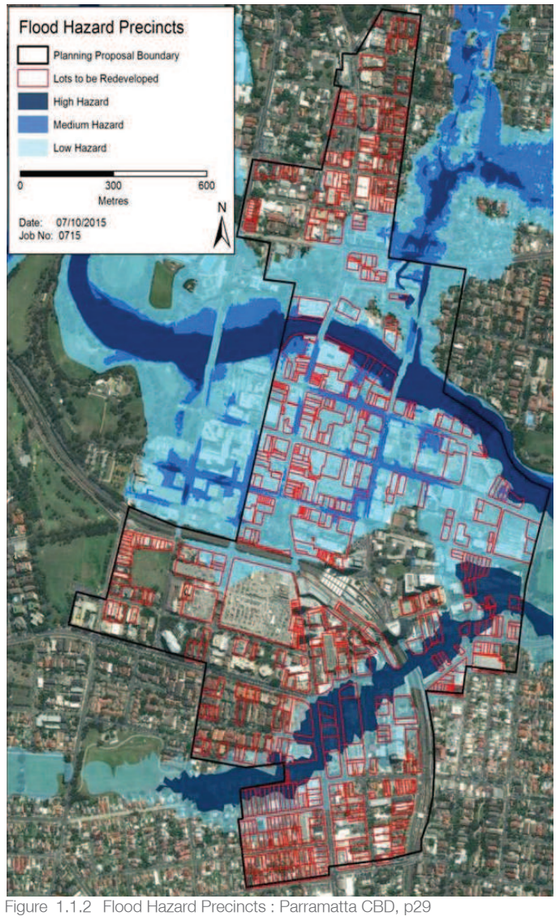


Figure 1.1.2 Flood Hazard Precincts : Parramatta CBD, p29

Flood Response - Case Studies

A series of case studies are presented in the Architectus report to investigate potential design approaches and solutions for the flood prone area of Parramatta. The overarching strategy and key design elements are identified for each case study through an analysis of local and international examples of where it has been implemented.

The following case study categories are included in the report:

1. Placing over the water
Involves the integration of elevated built form elements with the urban environment.

2. Impermanence, Movement and Managed Inundation
Involves the use of public domain elements that can be easily transported or safely submerged during a flood event.

3. Temporary Resistance
Involves the temporary activation of barriers and built form elements during a flood event.

4. Integrated Resistance
Provides permanent flood protection and resilience through the use of flood-resistant built form elements, construction materials and design approaches.

5. Step within the Site
Addresses the management of level changes within a building and across the site.

6. Step within Streets
Addresses strategies for the design and retrofitting of the streetscape to manage floodwaters.

Design Testing

A series of design testing options were developed to provide alternative built form solutions that address the specific flood conditions and urban environments within the Parramatta Context. This included the testing of design strategies for residential, retail and commercial built form typologies as well as elements within the public realm.

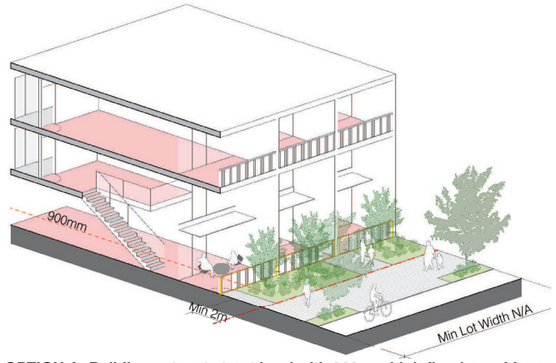
The design testing was informed by the case study research and guided by the following key principles:

1. Human Scale Steps
Aims to minimise the height transition from the public domain to the ground floor of a building. This includes the testing of tiered building setbacks, inclusion of human scaled design elements and defining of a desirable maximum height change within a step.

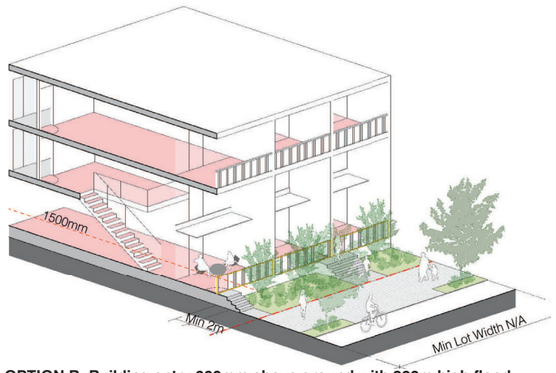
2. Active Spaces - Not Just Transition
Focuses on the activation of transitional spaces through good design integration and connectivity. This includes the integration of amenity within a transition zone, definition of the optimal width that permits an active transition space and the use of upper level promenades to connect buildings.

3. A Two Tier City
Addresses approaches to design for creating safe refuge facilities in the event of the PMF worst case scenario. This involves the provision of active, connected spaces at ground and first floor level.

Figure 1.1.4 Diagrams illustrating Design Guiding Principles, p80



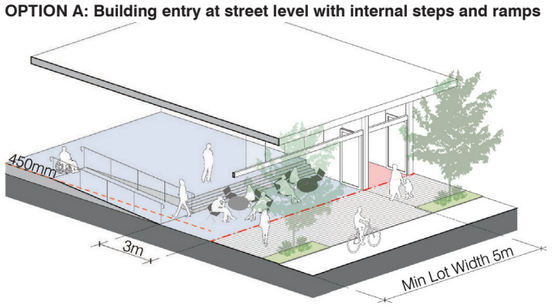
OPTION A: Building entry at street level with 900mm high flood proof fence & gate.



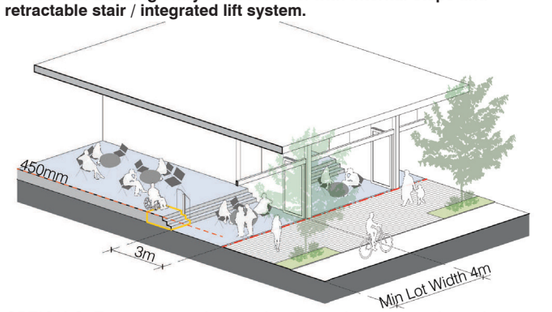
OPTION B: Building entry 600mm above ground with 900m high flood proof fence & gate.

Figure 1.1.5 Residential Built Form Testing, p82

OPTION A: Building entry at street level with internal steps and ramps



OPTION B: Building entry at street level with internal steps and retractable stair / integrated lift system.



OPTION C: Temporary resistance barrier at the property boundary

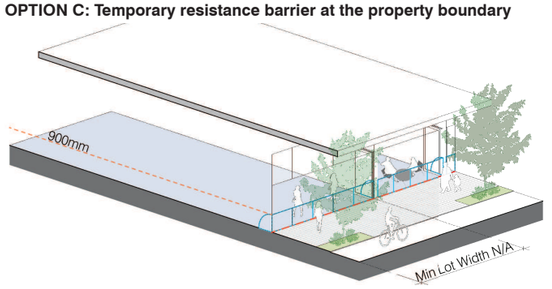


Figure 1.1.6 Retail & Commercial Testing, p83

Recommendations - Parramatta CBD

The following design recommendations are provided for the Parramatta CBD precinct, in line with the three Design Guiding Principles:

- Step within the Site and connected promenades that allow pedestrian circulation during flood events. Supporting the installation of new and retrofitted green roofs should be considered.
- Streets and adjacent parklets could be upgraded to include new WSUD plantings at footpaths and medians
- More extensive on-street contouring and conversion of parking spaces to landscaped pedestrian zones should be considered where appropriate.
- Implementation of new bicycle path infrastructure should consider additional accommodation of flood water channelling.
- In areas of fine grain retail such as Church Street, utilise temporary resistance strategies to retain the integration between shop fronts, the footpath and outdoor dining areas.
- Managed inundation for a portion of the tenancy adjacent the footpath could also be consider to reduce the impact of steps and ramps on the public domain and building frontage.

Recommendations - Overall

The Best Practice Study provides a set of recommendations that are informed by flood management and response policy, context analysis, case study research and design testing undertaken within the report.

These recommendations are presented under the following categories:

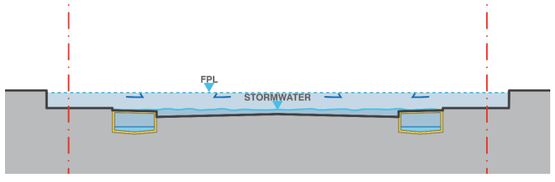
1. Design Approach:
Specific design objectives and principles are provided to address the different characteristics and requirements of the following elements within the urban fabric:

- Interconnected Public Realm
- Precincts and Renewal Areas
- Infill Sites
- Building Typologies (Commercial CBD; Mixed Use; Fine Grain Retail; Adaptive Re-use; Residential Apartments)
- The Details (Emergency Egress; Basement Design; Vehicle Entries and Pedestrian Access; Building Services; High Hydraulic Hazard; Flood Conveyancing; Stairs, Walkways and Ramps; Walls and Materials).

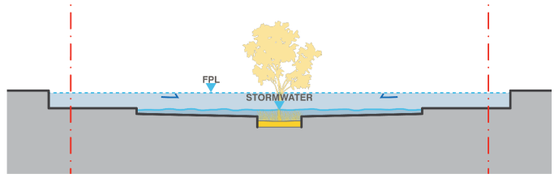
2. Guiding Principles
Recommendations that enable the optimum implementation of the three guiding principles (See ‘Design Testing’) have been derived from the testing of design options.

3. Site Planning and Design Process
A series of steps are outlined to be undertaken as part of the planning and design process for future development of flood affected sites.

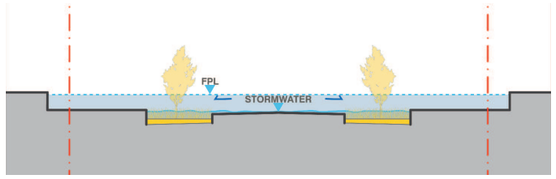
Bicycle Paths



Rain Garden Median



Rain Garden Bays



Park Median

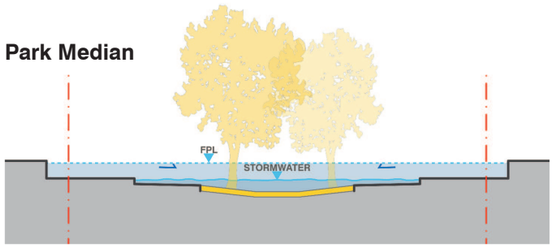
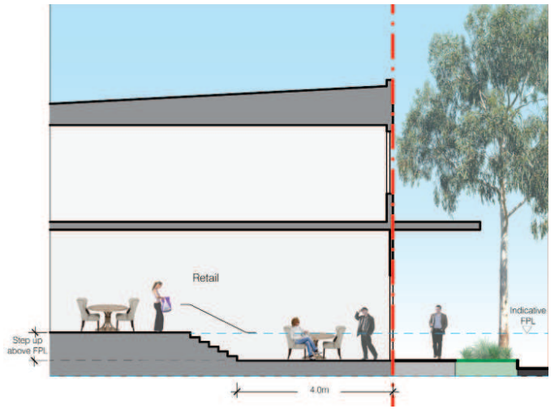


Figure 1.1.7 Public Domain : Streetscape Options, p95



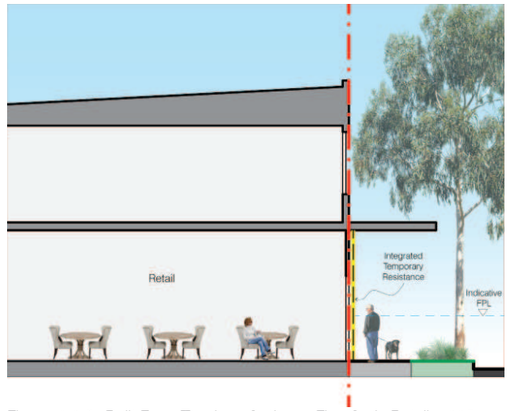


Figure 1.1.8 Built Form Typology Options : Fine Grain Retail, p110

Approach

3

3.1 Approach

CoP has identified preliminary potential marshalling areas and evacuation routes for a flood event, however this is largely for pedestrians within the public domain.

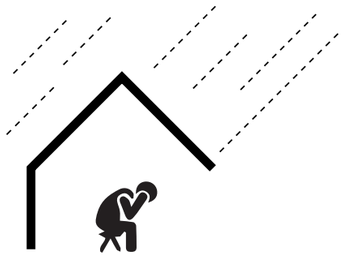
In line with the recommendations of the Molino Stewart report, the following two options is encouraged:

1. Shelter in place
2. Evacuate to marshalling area via interconnected horizontal connections

Figure 1.1.8 illustrates the flood levels within the Parramatta CBD. The areas identified as dark blue are the 1 in 100 year flood levels, and are considered inaccessible by SES during a flood event. The area shown in light blue indicates the PMF which varies throughout the CBD as being below and above the height of an awning.

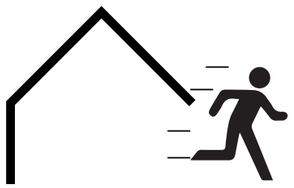
01. Shelter in Place

Occupants are encouraged to stay within the building for as long as possible, unless there is a hazard present such as a fire, or if an occupant requires medical assistance.



02. Evacuate to Marshalling area

If all adjacent buildings are considered unsafe to Shelter in Place, only then are occupants encouraged to evacuate via the proposed method to a public marshalling area that is located above the PMF.



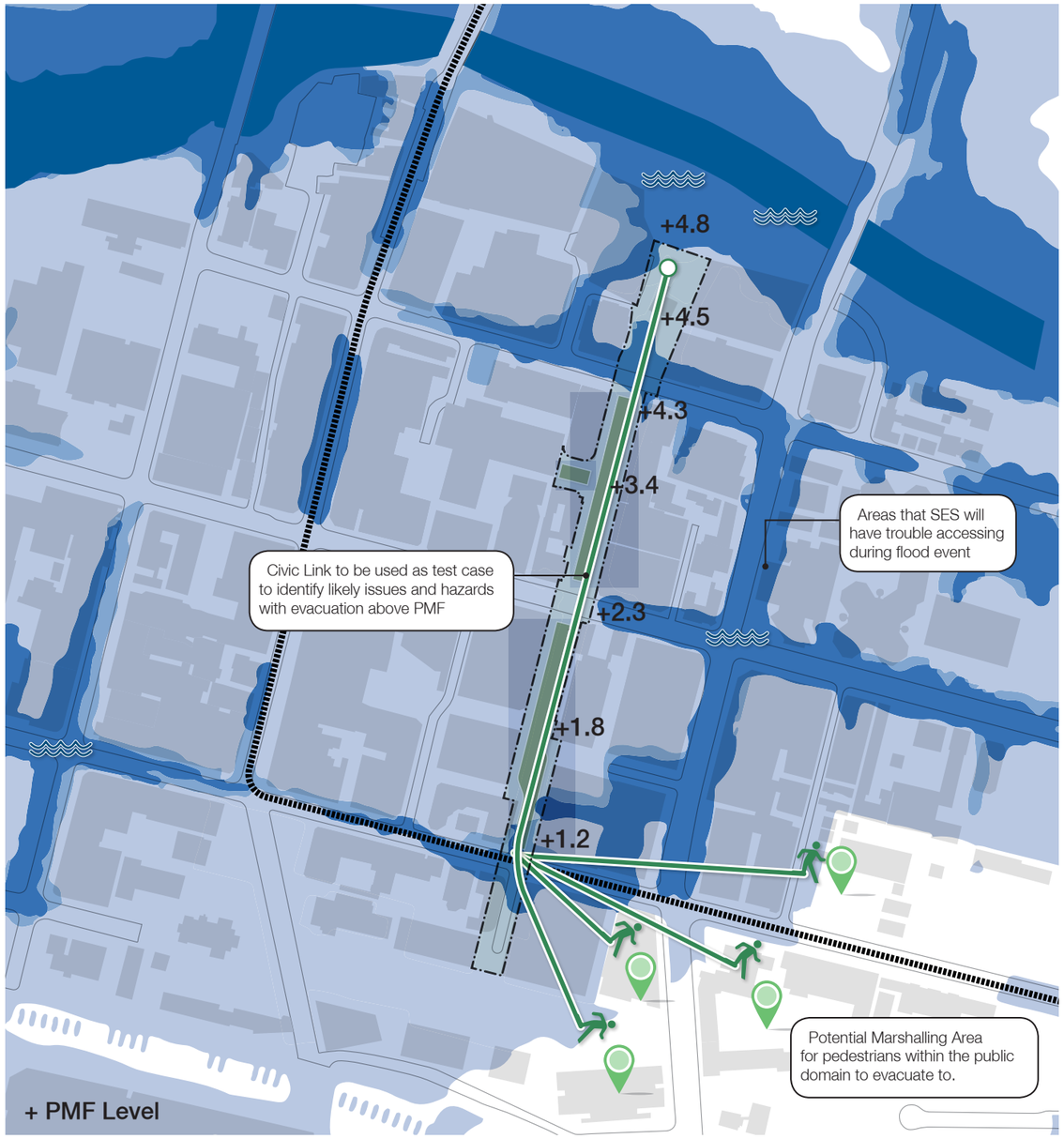


Figure 1.1.9 Flood Levels in Parramatta

3.2 Methodology

The following methodology has been established to apply three different methods to evacuation.

1. Urban Conditions - Challenges and Opportunities
The first step is to identify the range of urban and building conditions within Parramatta CBD including streetscapes and building typologies.

Parramatta CBD comprises a range of streets and buildings, which will ultimately influence the type of evacuations strategies and if they can ultimately be achieved.

2. Strategies
After defining the urban conditions of Parramatta CBD, three methods of evacuation are identified. These include:

- Top of Podium - Utilising setbacks above the street wall, roofs of existing small scale buildings, and podiums of new larger developments as an evacuation route to safety.
- Indoor Street - relying on the creation of a two tier city, connecting the upper levels of the city with public walkways providing a secondary address to buildings.
- Above Awning - relying on the construction of trafficable awnings to prove access to refuge in the event of a flood within the CBD.

3. Assumptions
Outline of various assumptions made in relation to the testing of the three methods.

4. Testing on Civic Link
The final step identifies potential issues, conflicts, and safety concerns with the three strategies of evacuation using the Civic Link project to test the issues associated with evacuation above the PMF.

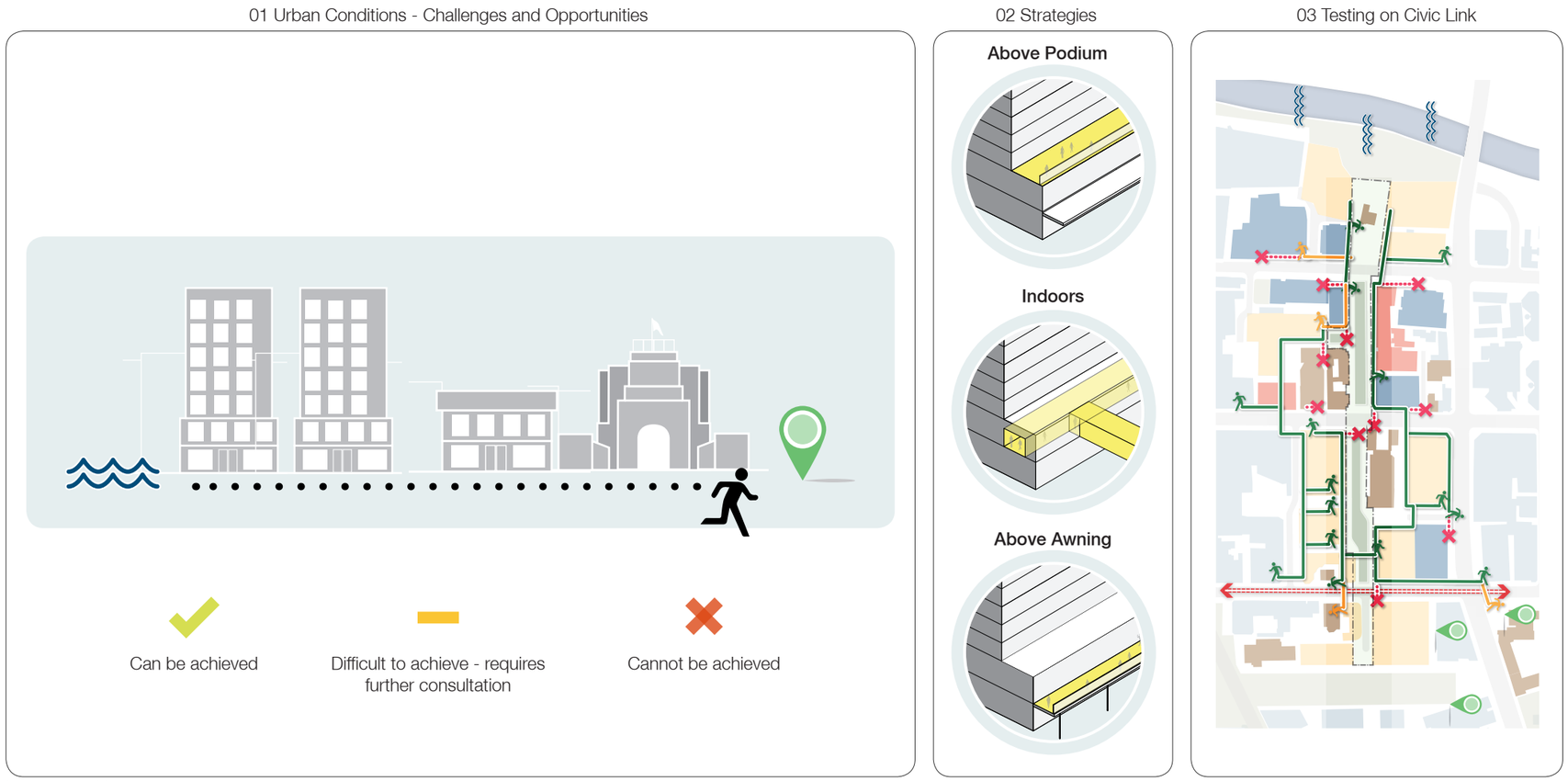


Figure 1.1.10 Methodology

3.3 Key Considerations

This section identifies the various considerations required in order to assess the practicality and likelyhood of the various strategies being delivered successfully.

1 Dimensions of Structure

- Height & width appropriate for evacuation requirements

2 Open Vs. Enclosed Structure

- Provide compliant balustrade if exposed
- Ensure weatherproof and durability of exposed structure

3 Accessibility

- Consider accessibility for evacuees with limited mobility
- 24 hour access
- How it relates with buildings and the public domain
- Provide emergency entry and exit access points to ensure safe and efficient evacuation both to/from within a building and the public domain

4 Materiality

- Appropriate selection of materials in case of exposure to conditions such as flooding, fire or electrical

5 BCA Compliance

- Fire separation
- Equitable access (DDA)
- Ramping requirements

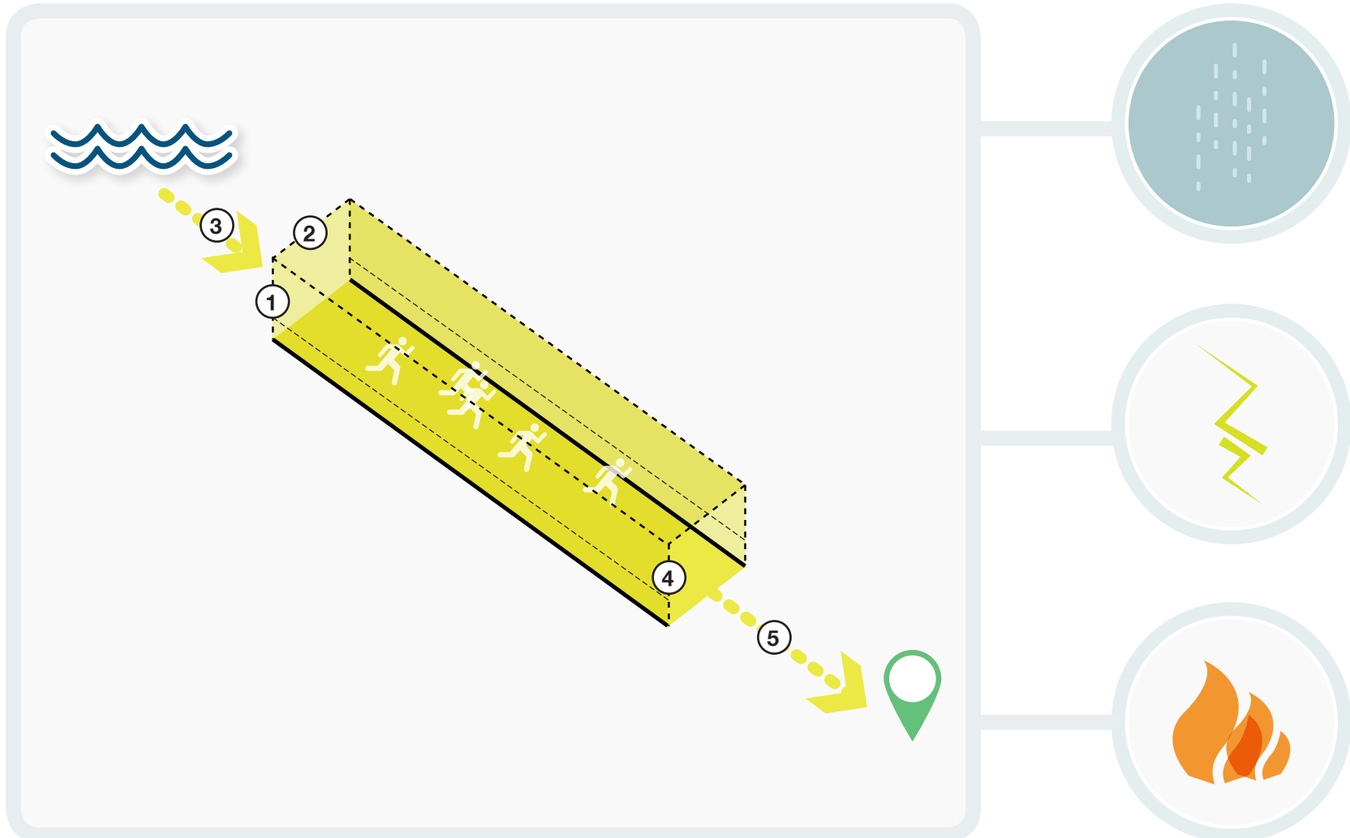


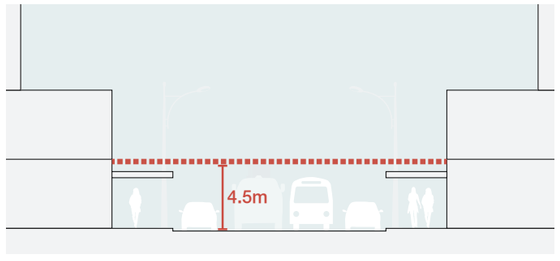
Figure 1.1.11 Key Considerations

3.4 Evacuation Strategies - Urban Conditions

As identified previously, the first step for investigating methods for safe evacuation is to identify the various urban and streetscape conditions within Parramatta CBD.

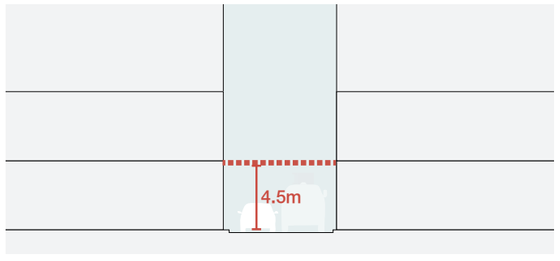
Based on a review of the area and its surroundings, Parramatta CBD has a varied urban streetscape morphology. These include streetscapes over wide public spaces, four lane bi-directional roads and streets large enough to accommodate light rail infrastructure.

The streetscape context establishes an immediate challenge to facilitate structures between buildings, factoring in the public domain, infrastructure and streetscape.



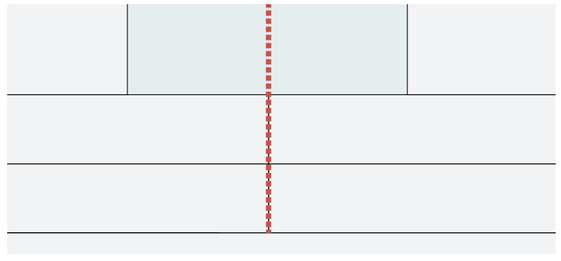
Over the Road

- Maintaining clearance height for service vehicles
- Spans of walkways will be longer and will need structural support within the public domain
- BCA/AS compliance issues
- Feasibility and cost issues



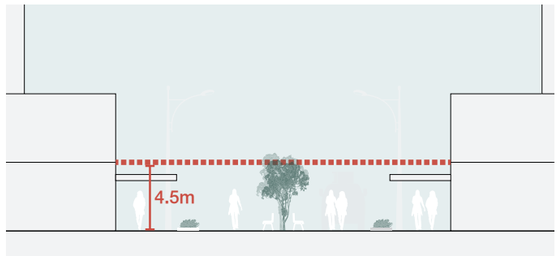
Over Lane

- Spans of walkways will be shorter and may not require structure within the public domain
- Maintaining clearance height for service vehicles
- BCA/AS compliance issues
- Feasibility and cost issues



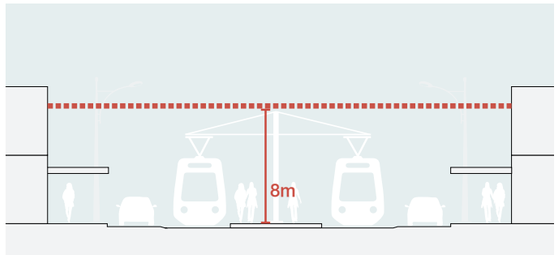
Over Boundary

- Dependant on adjacent buildings have podiums and internal floor levels at similar heights
- BCA/AS compliance issues
- Feasibility and cost issues



Over Public Space

- Visual structure in the space would detract from amenity and character of the public space
- Overhead structure may impede on solar access for open space.
- Requires clearance height for emergency and services vehicles.
- Structure to achieve span of walkways



Over Parramatta Light Rail

- 8m clearance height for light rail vehicles and infrastructure.
- Safety issues regarding interference with power lines and infrastructure.
- Spans of walkways

3.5 Evacuation Strategies - Building Conditions

Parramatta CBD is an area defined by a range of building typologies, forms and features.

The CBD is developed with a number of new mixed use, residential and commercial buildings as well as ageing building stock.

There are a number of heritage buildings that are of local heritage significance within area including Woolpack Hotel (I702), Civic Arcade (I1704) and a number of small buildings and cottages.

The challenges associated with evacuation strategies for building conditions within Parramatta CBD include inconsistent street frontages, structural integrity, loading capacity and integration of new elements into building structures.

New Building - New Building

- Access paths can be integrated in new building design
- Opportunity to create continuous street wall heights

New Building - ‘Unlikely to Change’

- Spans of walkways will be shorter and may not require structure within the public domain
- Maintaining clearance height for service vehicles
- BCA/AS compliance issues
- Feasibility and cost issues

‘Unlikely to Change’ - ‘Unlikely to Change’

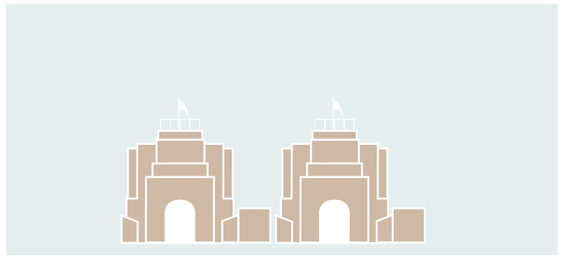
- Dependant on adjacent buildings have podiums and internal floor levels at similar heights
- BCA/AS compliance issues
- Feasibility and cost issues

Heritage - New Building

- Misaligned street walls
- Compromised character of heritage building
- Integration of walkways into heritage fabric and structure
- Structural integrity
- Will be cheaper and easier to retrofit over the top of buildings (for all of Top of Podium)

Heritage - ‘Unlikely to Change’

- Misaligned street walls
- Compromised character of heritage building
- Integration of walkways into heritage fabric and structure
- Structural integrity
- Will be cheaper and easier to retrofit over the top of buildings (for all of Top of Podium)



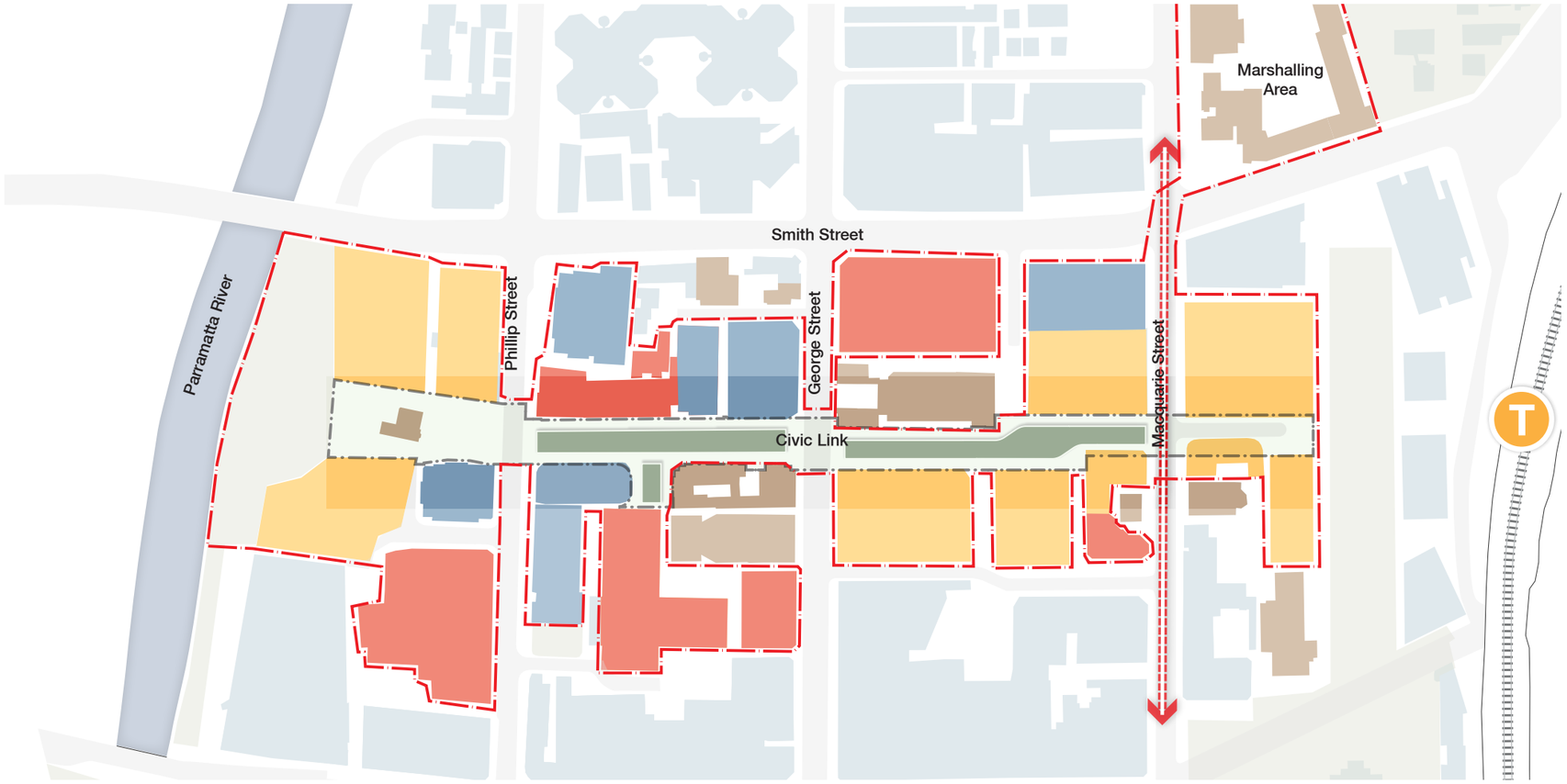
Heritage - Heritage

- Misaligned street walls
- Compromised character of heritage building
- Integration of walkways into heritage fabric and structure
- Structural integrity
- Will be cheaper and easier to retrofit over the top of buildings (for all of Top of Podium)

3.6 Test Case - The Civic Link

The following diagram depicts the extent of the test area, with a specific focus on the recently announced Parramatta Civic Link.

The project has identified buildings within the study boundary that fall within four key categories, which will determine if various methods can successful be applied.



Legend

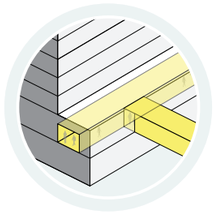
- Heritage Item
- Unlikely to Change
- Under Consideration for Redevelopment
- High Likelihood of Change
- Green Spine
- Light Rail Alignment
- Civic Link Boundary
- Broader Study Boundary

Figure 1.1.12 Civic Link Boundary

Case Study - Indoor Streets

4

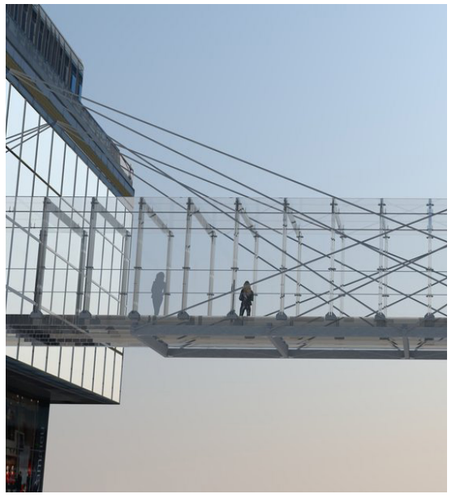
4.1 Evacuation Strategy



Indoor evacuation relies on the creation of a two tier city, connecting the upper levels of the city with public walkways providing a secondary address to buildings.

This strategy assumes that the proposed connection will be internal publicly accessible privately owned space that is accessible 24 hours a day. These spaces can be both passive and active, fronted by levels of double height retail spaces, commercial offices suites or planting.

This strategy also assumes connection points to the public domain, through existing buildings.



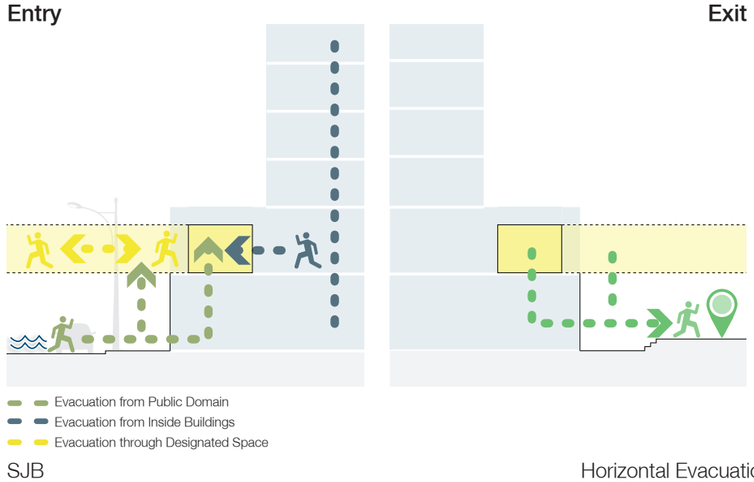
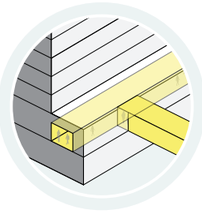


Figure 1.1.13 Examples of Indoor Streets

Case Study - Indoor Streets



4.2 Precedents Study

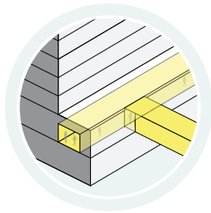
The example to the right is an elevated path located within the Wan Chai DIstrict of Hong Kong.

The island of HonG Kong's physical constraints has meant there is limited space for pedestrians to move at street level with traffic, so a series of elevated paths have been integrated with the lower levels of buildings.

Internal lobby spaces connect with the surrounding pedestrian network, which is activated by retail, creating a second street level above the traffic at street level.

This solution is primarily in response to the sheer population density of Hong Kong and limited physical space. New developments take into consideration the above ground network during concept extending the network through the city.

Figure 1.1.14 Examples of Indoor Streets



4.3 Urban Condition Test

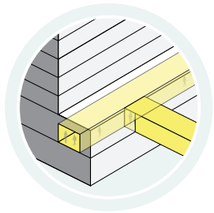
The matrix below investigates the opportunity to achieve a horizontal path based on the urban condition identified in 3.4 at specific building interfaces.

✓ Can be achieved

– Difficult to achieve - requires further consultation

✗ Cannot be achieved

Conditions / Interface	1. New Building - New Building	2. New Building - Existing Building 'Unlikely to Change'	3. Existing Building - Existing Building	4. Heritage - New Building	5. Heritage - Existing Building 'Unlikely to Change'	6. Heritage - Heritage
A. Over Road	✓ · New sky bridge/ internal walkways can be integrated as part of design	– · Will require retrofitted structure of existing building to allow for continued walkway. Dependant on exiting use	– · Will require retrofitted structure of existing building to allow for continued walkway. Dependant on exiting use	✗ · May have significant impact on the structural integrity of heritage items	✗ · May have significant impact on the structural integrity of heritage items	✗ · May have significant impact on the structural integrity of heritage items
B. Over Lane	✓ · New sky bridge/ internal walkways can be integrated as part of design	– · Will require retrofitted structure of existing building to allow for continued walkway. Dependant on exiting use	– · Will require retrofitted structure of existing building to allow for continued walkway. Dependant on exiting use	✗ · May have significant impact on the structural integrity of heritage items	✗ · May have significant impact on the structural integrity of heritage items	✗ · May have significant impact on the structural integrity of heritage items
C. Over Boundary	✓ · New sky bridge/ internal walkways can be integrated as part of design	– · Will require retrofitted structure of existing building to allow for continued walkway. Dependant on exiting use	– · Will require retrofitted structure of existing building to allow for continued walkway. Dependant on exiting use	✗ · May have significant impact on the structural integrity of heritage items	✗ · May have significant impact on the structural integrity of heritage items	✗ · May have significant impact the structural of heritage items
D. Over Public Space	✓ · New sky bridge/ internal walkways can be integrated as part of design	– · Will require retrofitted structure of existing building to allow for continued walkway. Dependant on exiting use	– · Will require retrofitted structure of existing building to allow for continued walkway. Dependant on exiting use	✗ · May have significant impact on the structural integrity of heritage items	✗ · May have significant impact on the structural integrity of heritage items	✗ · May have significant impact on the structural integrity of heritage items
E. Over Light Rail LIne	– · New sky bridge/ internal walkways can be integrated as part of design.	– · Will require retrofitted structure of existing building to allow for continued walkway. Dependant on exiting use	– · May require retrofitted structure on existing building may be visible/ unsightly in the public domain.	✗ · May have significant impact on the structural integrity of heritage items	✗ · May have significant impact on the structural integrity of heritage items	✗ · May have significant impact on the structural integrity of heritage items

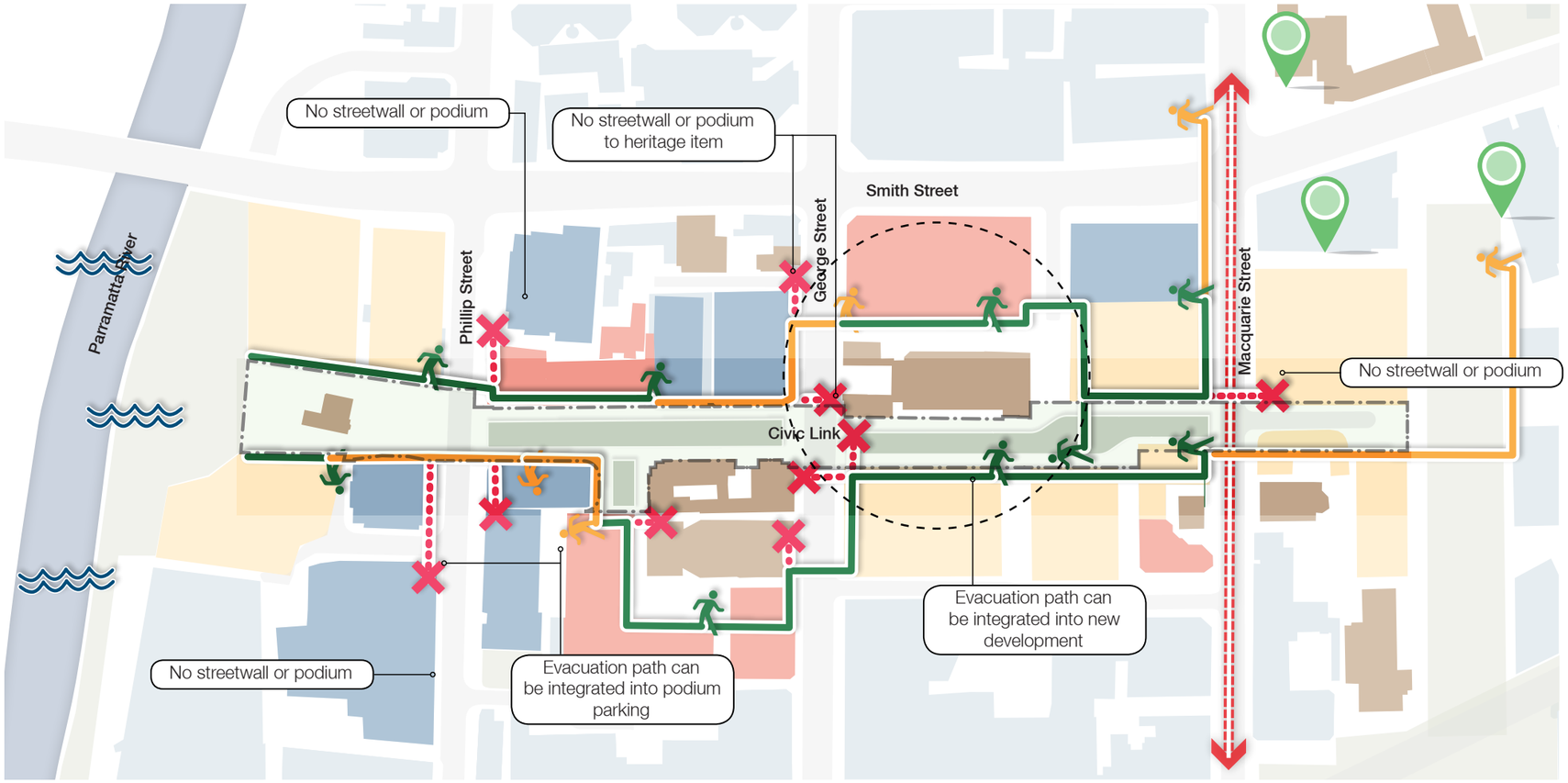


4.4 Civic Link Testing

The diagram to the right depicts the Indoor Streets Test on Civic Link.

Main challenges associated with evacuating people with this strategy include limited buildings that provide a street wall or podium. Buildings would be unable to connect to heritage items along the Civic Link and would need to divert to buildings in surrounding streets.

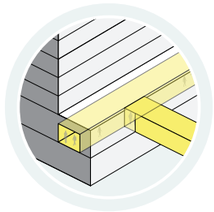
Evacuation paths could be integrated into existing infrastructure including podium car parking and new developments.



Legend

- Heritage Item
- Unlikely to Change
- Under Consideration for Redevelopment
- High Likelihood of Change
- Green Spine
- Light Rail Alignment
- Civic Link Boundary
- Cannot Be Achieved
- Difficult to Achieve - Requires further Consideration
- Can be Achieved

Figure 1.1.15 Indoor Streets - Civic Link Test



4.5 Discussion

- Possible to create a route above the PMF, however this will take many years to implement.
- Most adjacent buildings can be internally connected.
- This strategy is costly and will require extensive coordination between land owners. It is unclear who would cover what costs.
- It is also unclear who would be liable for the maintenance and access of these routes at various building points.
- If this route requires 24/7 access, then who is responsible for ensuring the buildings have 24/7 access.
- Will require coordination between city blocks as to crossing point over a road or lane, should that be required.
- This option provides a safe path of travel.
- Potential to connect the city and create new two-tiered city.

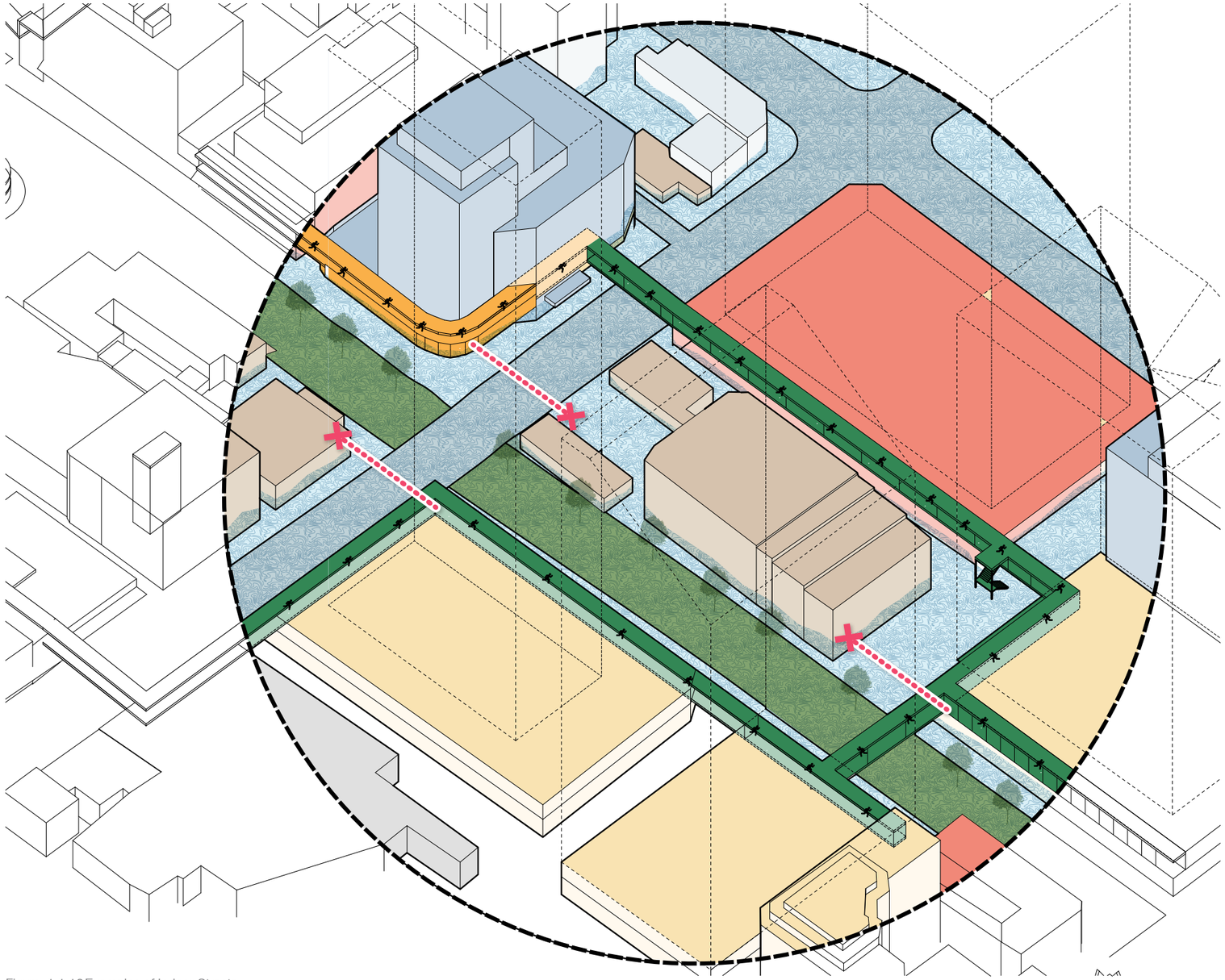
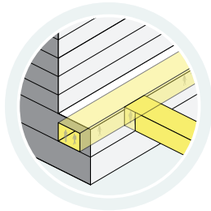


Figure 1.1.16 Examples of Indoor Streets



4.6 Key Challenges

Challenges

Feasibility

This evacuation option is likely to be more expensive due to the cost of integration into the existing fabric of the building. Walkways spanning between buildings also need to be structurally sound, and create a complete seal to the building where they enter.

Heritage Value

Creating a walkway that connects into a heritage building would significantly damage or compromise the integrity of the item.

Adjacent Levels

Due to the rapid development underway in the CBD, it is likely that there will be existing and new buildings constantly changing.

New buildings now have to address flood levels through elevated floor levels, whilst many existing buildings will have floor levels that do not align. Hence the connection of various floors between buildings will pose a challenge to creating a path of access, and an appropriate architectural solution.

Integrity

This is a more complicated approach as the walkways connecting between buildings have not been accounted for in the original design of a building (in the case of retrofitting). This requires additional cost to ensure the structural integrity of the walkway, as well as the cost to the architectural integrity of the building.

No further investigation required. Option unlikely to be realised.

Safety

The risk to evacuees moving between buildings is greatly reduced in this option, as the path of travel is sheltered from the weather, and is less likely to create a slip hazard, or allow access to areas that occupants should not travel to.

In the case that occupants are evacuating because of a fire in a building, this option will not be safe, as appropriate fire measures would need to be in place to separate the buildings. As such, in the case of a fire, these internal walkways would either need to be treated in the same manner as a fire escape, or alternatively, provide separation between the buildings and create an inaccessible area.

In the later case, the walkway can no longer serve it's purpose for evacuation. In the first case, the walkway takes up valuable space within a building envelope that is only used in the case of an emergency.

Implementation

This strategy would have a lengthier time frame than the other two strategies, and would require extensive negotiations between land owners, Council, and other government organisations.

A holistic strategy could take years to deliver, and in the meantime a more appropriate strategy may need to be implemented to reduce the levels of risk within the CBD. This would suggest that a more appropriate response may be to address the immediate needs of the CBD.

Existing uses will also need to be renegotiated to allow public access to parts of the building as a permanent solution.

Continuous Path of Travel

This strategy is unlikely to be able to provide a continuous path of travel due to the private nature of many of the buildings in the CBD.

Connecting to different levels between the buildings will cause the main problem for connectivity, as well as some building operators not wishing to create an internal and permanent connection.

As this strategy assumes that there is a new 24 hour public space running above the city, there will be no issues with the need to instigate the emergency response such as connecting bridges over roads. The walkways are permanent and already in place.

Implications

Visual impact

The impact upon the city of this strategy will only be seen between buildings, and could potentially be dealt with in an attractive manner.

However, this would take years to realise and the various stages of construction could result in an incoherent built form appearance for the city.

Wayfinding

A wayfinding strategy within internal paths of travel would be easier to manage and implement, as the walkways can be clearly signed within the buildings.

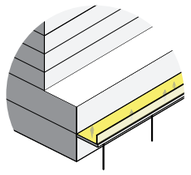
Design

A number of cities around the world have indoor pathways that connect large sections of the city, whether through raised walkways or underground arcades. These can be designed to become the 'second tier' of the city, and provide retail or public amenity to these walkways.

Case Study - Above Awning

5

5.1 Evacuation Strategy



This strategy relies on the construction of trafficable awnings to provide access to refuge in the event of a flood within the CBD. Awnings typically only extend to the front of the building and do not cross streets and lanes, and would require a bridge to cross should evacuees need to move to a public marshalling area.

A continuous awning can be delivered by individual developments or as a single public domain element delivered by the Civic Link.

It is noted that this study has not found any examples of trafficable awnings. It is therefore difficult to evaluate the validity of this as a viable evacuation strategy.

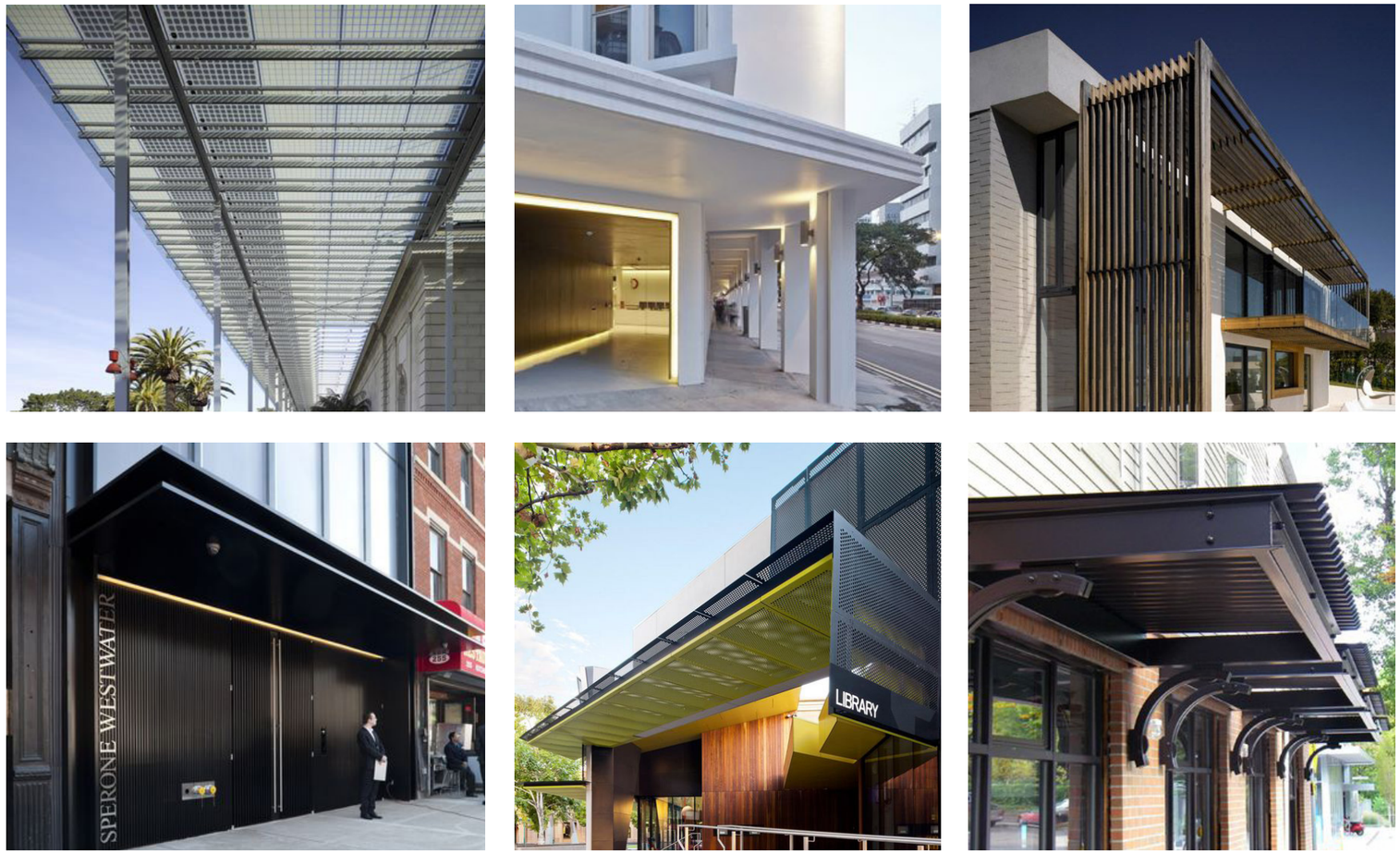
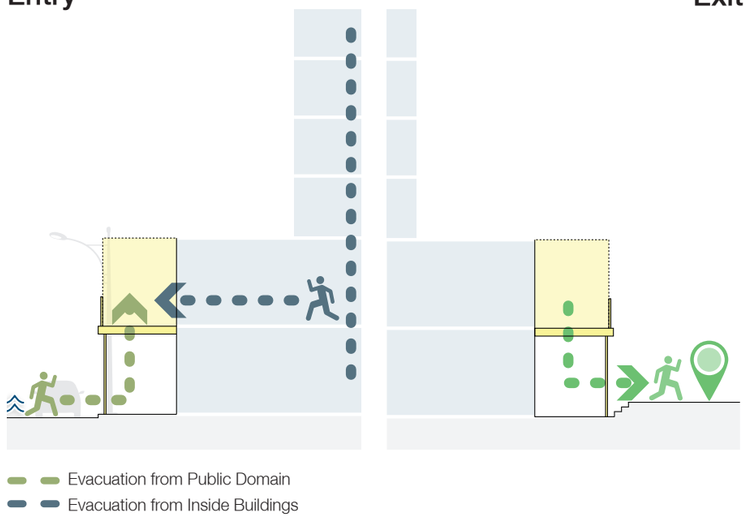
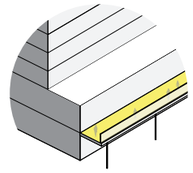


Figure 1.1.17 Examples of Above Awning



Case Study - Above Awning

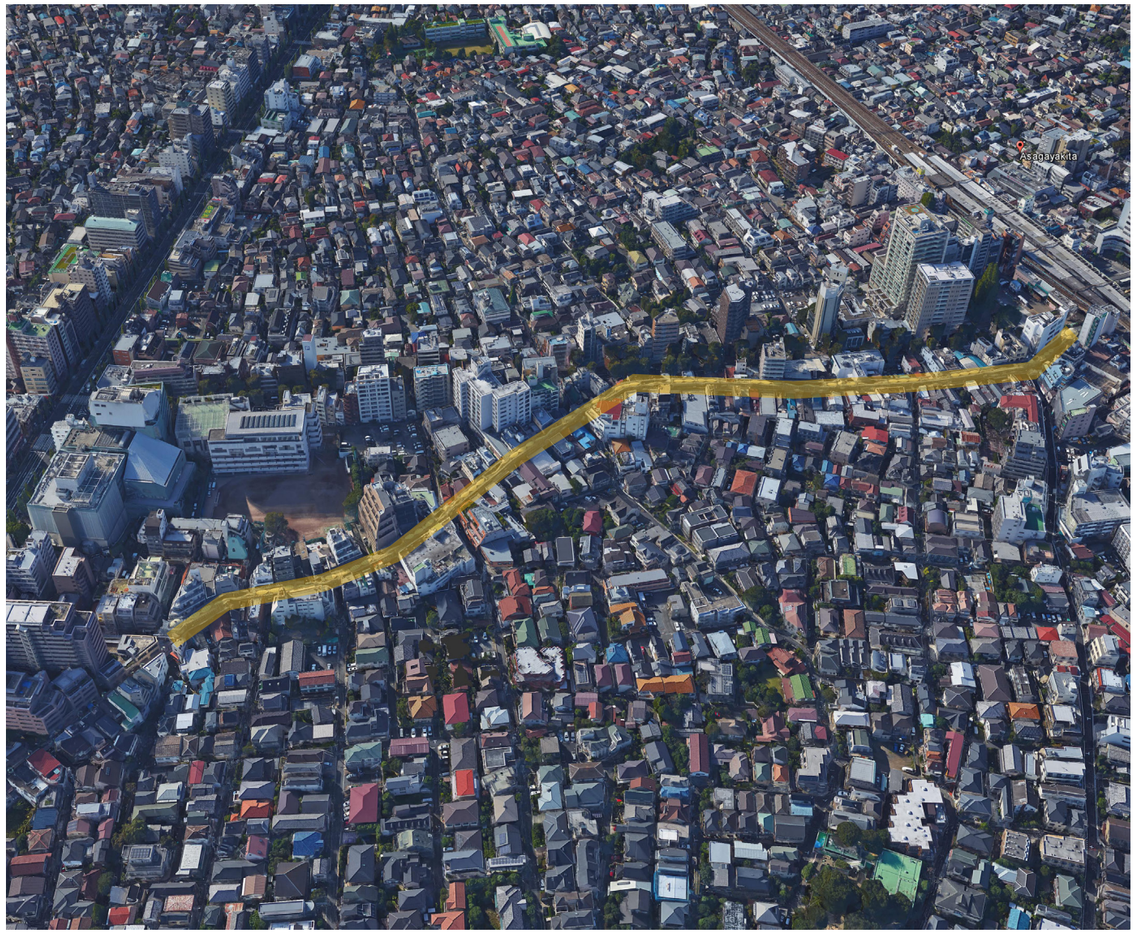


5.2 Precedents Study

As identified to the right, there are very few examples of above awnings being adopted for the purposes of pedestrian movement and evacuation.

One example of this strategy is located in Jazz Alley in Asagaya, Tokyo where bridges connect awnings to form an elevated pedestrian link.

Awnings would need to be designed to handle load and volume of pedestrians and present a contiguous frontage, which may sterilise the streetscape and have a detrimental impact on the quality of public domain.



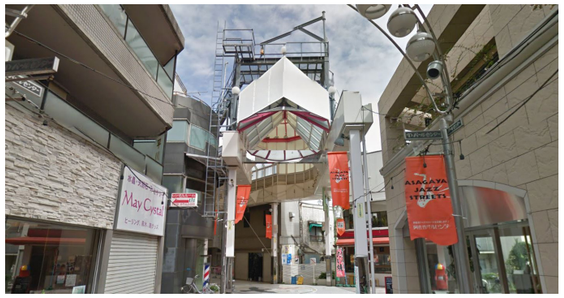
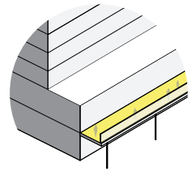


Figure 1.1.18 Examples of Above Awning

Case Study - Above Awning



5.3 Urban Condition Test

The matrix below investigates the opportunity to achieve a horizontal path based on the urban condition identified in 3.4 at specific building interfaces.

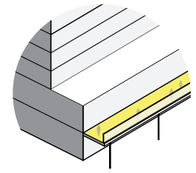
✓ Can be achieved

– Difficult to achieve - requires further consultation

✗ Cannot be achieved

Conditions \ Interface	1. New Building - New Building	2. New Building - Existing Building 'Unlikely to Change'	3. Existing Building - Existing Building	4. Heritage - New Building	5. Heritage - Existing Building 'Unlikely to Change'	6. Heritage - Heritage
A. Over Road	– · Will require independent structure to cross the road	– · Will require independent structure to cross the road	– · Will require retrofitted structure of existing building to allow for continued walkway. Dependant on exiting use	– · Will require independent structure to cross the road	– · Will require independent structure to cross the road	– · Will require independent structure to cross the road
B. Over Lane	– · Will require independent structure to cross the road	– · Will require independent structure to cross the road	– · Will require independent structure to cross the road	– · Will require independent structure to cross the road	– · Will require independent structure to cross the road	– · Will require independent structure to cross the road
C. Over Boundary	✓ · Awnings can be made to align with adjoining properties	✓ · Awnings can be made to align with adjoining properties	✓ · Awnings can be made to align with adjoining properties	– · May have significant impact of the physical integrity of heritage items	– · May have significant impact of the physical integrity of heritage items	– · May have significant impact of the physical integrity of heritage items
D. Over Public Space	– · Will require independent structure to cross over public space.	– · Will require independent structure to cross over public space.	– · Will require independent structure to cross over public space.	– · Will require independent structure to cross over public space.	– · Will require independent structure to cross over public space.	– · Will require independent structure to cross over public space.
E. Over Light Rail LIne	✗ · Required height to clear PLR will mean awning is ineffective	✗ · Required height to clear PLR will mean awning is ineffective	✗ · Required height to clear PLR will mean awning is ineffective	✗ · Required height to clear PLR will mean awning is ineffective	✗ · Required height to clear PLR will mean awning is ineffective	✗ · Required height to clear PLR will mean awning is ineffective

Case Study - Above Awning



5.4 Civic Link Testing

The diagram to the right depicts the Above Awning Test on Civic Link.

Main challenges associated with evacuating people with this strategy include providing connections across streets, creating new awnings on buildings.

Providing awnings along Macquarie Street would be challenging due to the clearance requirements for the light rail and associated servicing infrastructure.

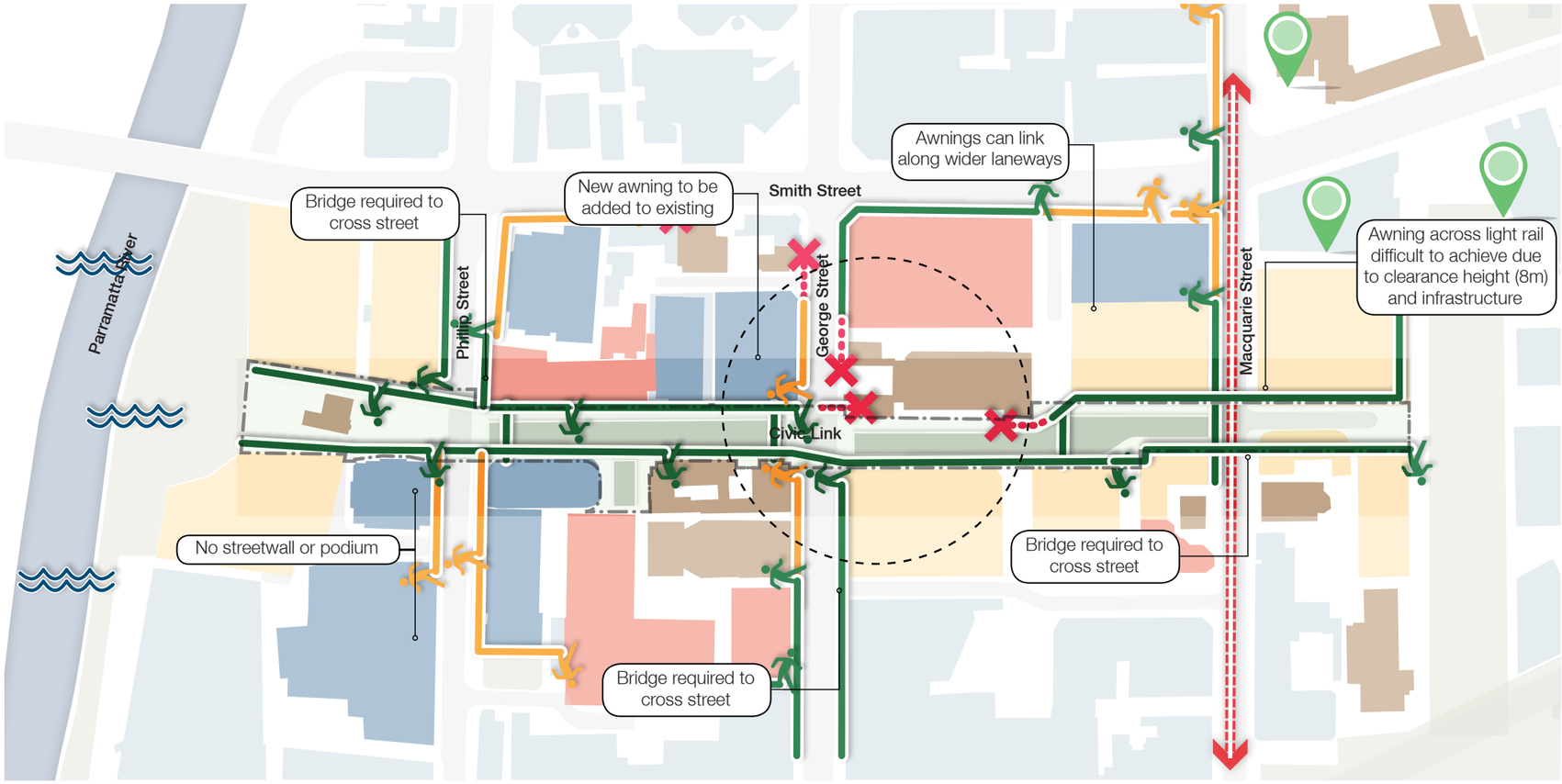
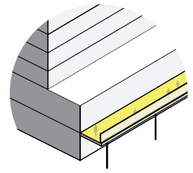


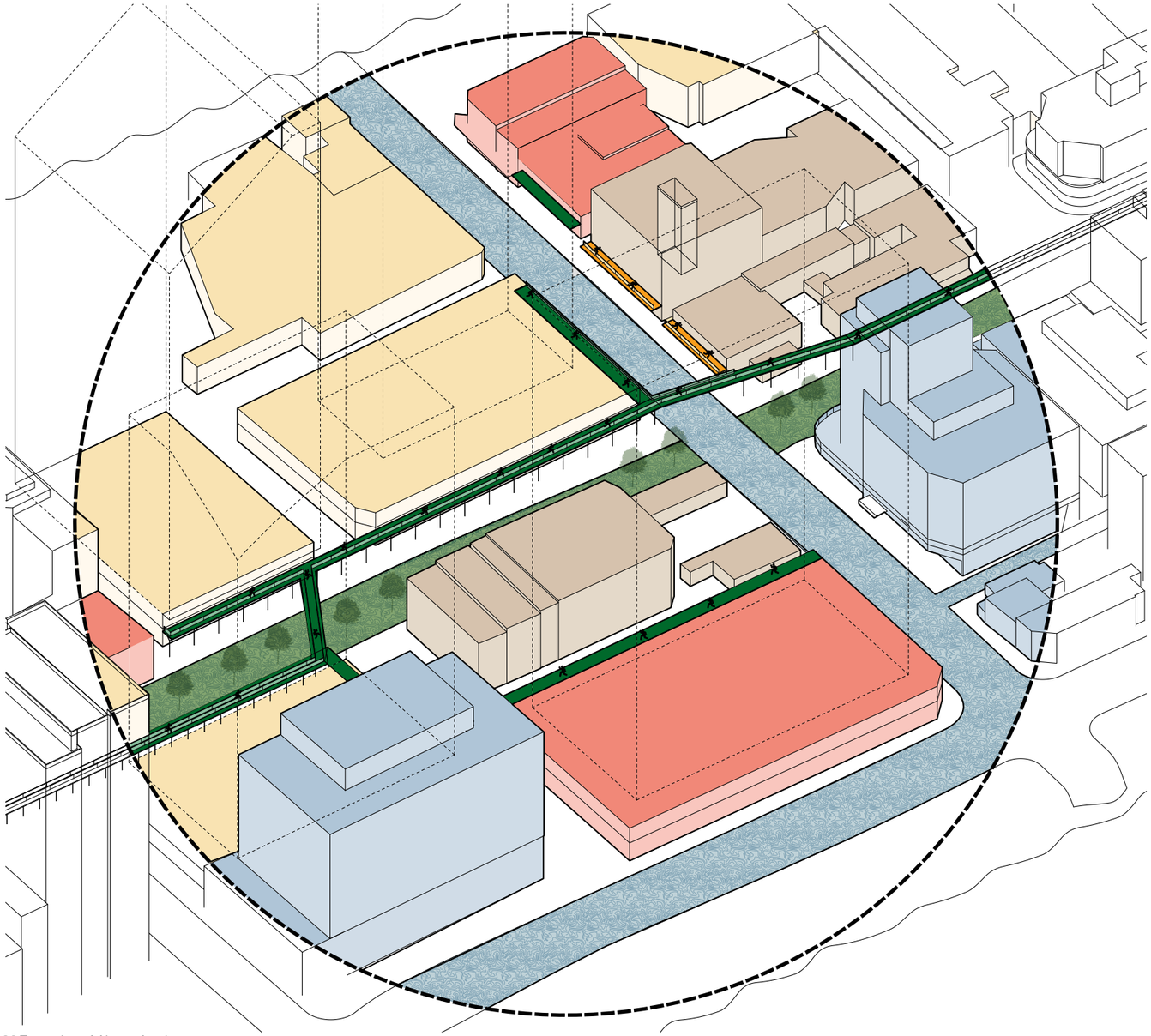
Figure 1.1.19 Above Awning - Civic Link Test

Case Study - Above Awning



5.5 Discussion

- Possible to create a route, however this is not always above the PMF and hence does not lower the risk of developments.
- Does not create a safe path of travel, with submerged objects moving underwater and crashing into awnings.
- Most adjacent buildings can be connected.
- This strategy is costly due to most awnings needing to be replaced to carry the load of people walking during an emergency.
- Will require coordination between city blocks as to crossing point over a road or lane, should that be required. This would create a permanent fixture in the public domain which is unlikely to be desirable as an urban design feature.



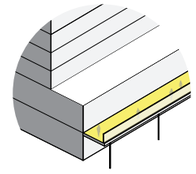
Can be achieved

Difficult to achieve - requires further consultation

Cannot be achieved

Figure 1.1.20 Examples of Above Awning

Case Study - Above Awning



5.6 Key Challenges

Challenges

Feasibility

There may be challenges in getting a unified roll out of this strategy through the city. Owners of buildings with recently completed awnings will not wish to replace the awnings with new, more structurally sound awnings. Whilst more feasible than the Indoor strategy, it will still be more expensive than the Above Podium option.

Heritage Value

Heritage items that have flat and trafficable awnings would need to replace them to ensure their structural integrity. However a number of items have bull-nose awnings which would not be trafficable. Replacing these with a different style would damage the integrity of the item. In the case where an item has no awning, the addition of an awning would again damage the integrity of the item.

Adjacent Levels

The creation of a continuous and level awning throughout the city is a fairly straightforward task, however the PMF level throughout the CBD varies significantly.

It is crucial to an effective evacuation strategy that the evacuation route is above the PMF. As such, this strategy will not be applicable through some areas of the CBD, where the PMF is above typical awning height.

Wayfinding

Wayfinding would be challenging due to the discontinuous path of travel, and having to place signage on the exterior of buildings.

No further investigation required. Option unlikely to be realised.

Integrity

To appropriately provide a safe and effective route of travel, the awnings must be structurally sound and able to carry a heavy temporary load. This will require additional cost to a typical awning, and dependant on the size of the building and the number of occupants, may even require structural posts to the street frontage.

Awnings of this style can be troublesome due to RMS requirements, and may not be appropriate within the city.

Safety

Travelling along an awning provides the greatest number of risks to an evacuee including exposure to heavy rain and potential storm conditions. A number of floating objects are also likely to threaten evacuees, such as cars that are floating at or just below awning height.

Safety railing is recommended to be provided to avoid slips and falls, which could pose an unpleasant addition to the built form.

Powerlines from the streets or Parramatta Light Rail may potentially be active and fall, creating additional hazards.

Implementation

This strategy would be reasonably straightforward to implement throughout the city in terms of providing a continuous awning and requiring additional safety measures for them, however creating a continuous path of travel around the city would be challenging, and would require a combination of strategies.

Continuous Path of Travel

It will not be possible to have a continuous path of travel through the city, as some awnings are under the PMF height. When the path of travel comes to a road, lane or public open space, a bridge would be required to connect to the other side. As such, in any application of travel on the awning, a combination of strategies will be required.

If the mechanisms are not permanently set up on awnings, the way in which these are set up in an emergency event will need to be coordinated by both the CoP and building occupants.

Allowing time for bridges to be set up throughout the city is something that is unlikely to have time in an emergency event, however simply moving from one building to the adjacent building should not require a bridge in most cases.

Implications

Visual impact

This strategy will have a moderate visual impact, provided that any additional safety measures are able to be hidden when not in use (i.e. hand rails to prevent slipping and falling).

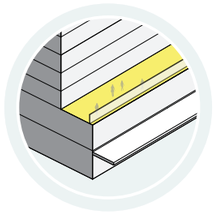
Design

A continuous awning of this nature could be designed and delivered as part of the Civic Link project.

Case Study - Top of Podium

6

6.1 Evacuation Strategy

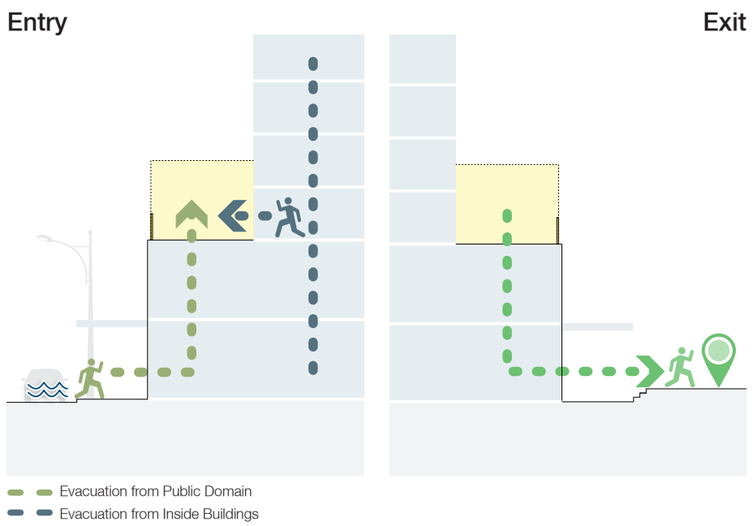


This evacuation method utilises setbacks above the street wall, roofs of existing small scale buildings, and podiums of new larger developments as an evacuation route to safety.

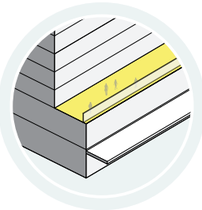
This strategy assumes that most of these spaces are typically not occupied for everyday uses, and can be made to allow for evacuation to other rooftops.

Proposed solutions as a part of this strategy are intended for the purposes of a flood event only and would not provide access at other times.

Figure 1.1.21 Examples of Top of Podium



Case Study - Top of Podium



6.2 Precedents Study

As identified in the precedent images to the left, above podium structures would largely consist of lightweight step ladders on the rooftop of buildings.

There are a number of challenges associated with such structures being used to reliably transport pedestrians across buildings and spaces in the event of a flood evacuation. Key issues include:

- Lightweight step ladders are largely used to service platforms, machinery, roof decks and other maintenance areas
- Use of such structures generally requires flat shoes to prevent trips and falls
- They are not enclosed and consequently, are exposed to hail, rain, lightning and fire, which can cause additional injury and harm
- They are not designed to carry large quantities of people, which can ultimately impact the loading of such structures
- Difficult to implement across pitched roofs and irregular building rooftops, which limits who can use them i.e. elderly or persons with a disability
- If access can be provided from within the building, who is responsible and liable for ensuring this access is provided 24 hours a day
- Would need to implement midway landing platforms across various buildings, which would result in choke points
- Would need to comply with Disability Discrimination Act i.e. size, gradient and design of the structure and access to the structures

As a result of the assumptions made earlier in this report (BCA Compliance, Accessibility, Materiality, Dimensions etc), the above podium method with a light weight stair structure is not considered viable for the safe evacuation to a marshalling area in a flood event.

Figure 1.1.22 Examples of Top of Podium with Light Weight Structures

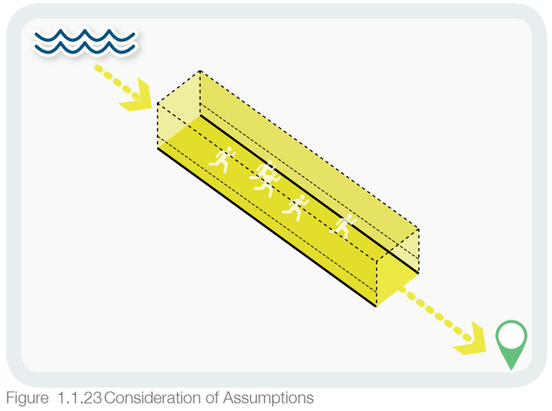
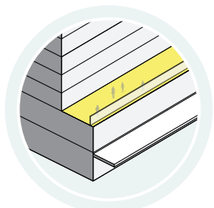


Figure 1.1.23 Consideration of Assumptions



6.3 Tube Investigation

As identified earlier, this report has considered top of podium as a method of evacuation.

Initial discussion concluded that this method would require light weight ladders and stairs on the top of buildings or podiums. However, further investigation revealed a number of legal, safety and governance related challenges associated with its implementation.

As a result, we have considered the pedestrian tubes/ overpass bridges to be connected to along the facade of buildings and across the public spaces. Examples of these are depicted to the right.

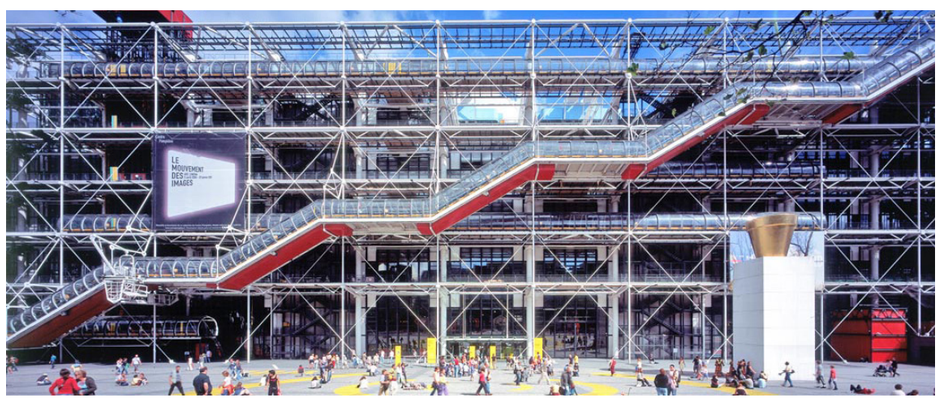
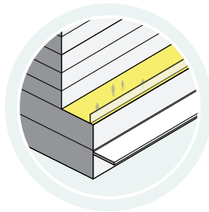


Figure 1.1.24 Examples of Top of Podium with Tube Structure

Case Study - Top of Podium



6.4 Urban Condition Test

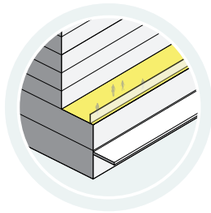
The matrix below investigates the opportunity to achieve a horizontal path based on the urban condition identified in 3.4 at specific building interfaces.

✓ Can be achieved

– Difficult to achieve - requires further consultation

✗ Cannot be achieved

Conditions \ Interface	1. New Building - New Building	2. New Building - Existing Building 'Unlikely to Change'	3. Existing Building - Existing Building	4. Heritage - New Building	5. Heritage - Existing Building 'Unlikely to Change'	6. Heritage - Heritage
A. Over Road	✓ · New sky bridge/ temporary structure can be integrated as part of design	– · May require retrofitted structure on existing building may be visible/ unsightly in the public domain.	– · May require retrofitted structure on existing building may be visible/ unsightly in the public domain.	✗ · Bridges and walkways over the road may impact the structural integrity of the heritage item	✗ · Bridges and walkways over the road may impact the structural integrity of the heritage item	✗ · Bridges and walkways over the road may impact the structural integrity of the heritage item
B. Over Lane	✓ · New sky bridge / temporary structure can be integrated as part of design	✓ · May require retrofitting of existing structure but narrow width of lane can help conceal built external walkways	✓ · May require retrofitting of existing structure but narrow width of lane can help conceal built external walkways	✗ · Bridges and walkways over lane may impact the structural integrity of the heritage item	✗ · Bridges and walkways over lane may impact the structural integrity of the heritage item	✗ · Bridges and walkways over lane may impact the structural integrity of the heritage item
C. Over Boundary	✓ · New sky bridge/ temporary structure can be integrated as part of design	✓ · May require retrofitting of existing structure but can be concealed within the building fabric	✓ · May require retrofitting of existing structure but can be concealed within the building fabric	✗ · Bridges and walkways over boundary may impact the structural integrity of the heritage item	✗ · Bridges and walkways over boundary may impact the structural integrity of the heritage item	✗ · Bridges and walkways over boundary may impact the structural integrity of the heritage item
D. Over Public Space	✓ · New sky bridge/ temporary structure can be integrated as part of design	– · May require retrofitted structure on existing building may be visible/ unsightly in the public domain.	– · May require retrofitted structure on existing building may be visible/ unsightly in the public domain.	✗ · Bridges and walkways over public space may impact the structural integrity of the heritage item	✗ · Bridges and walkways over public space may impact the structural integrity of the heritage item	✗ · Bridges and walkways over public space may impact the structural integrity of the heritage item
E. Over Light Rail LIne	✓ · New sky bridge/ temporary structure can be integrated as part of design	– · May require retrofitted structure on existing building may be visible/ unsightly in the public domain.	– · May require retrofitted structure on existing building may be visible/ unsightly in the public domain.	✗ · Required clearances for bridges and walkways over the PLR may impact the structural integrity of the heritage item	✗ · Required clearances for bridges and walkways over the PLR may impact the structural integrity of the heritage item	✗ · Required clearances for bridges and walkways over the PLR may impact the structural integrity of the heritage item



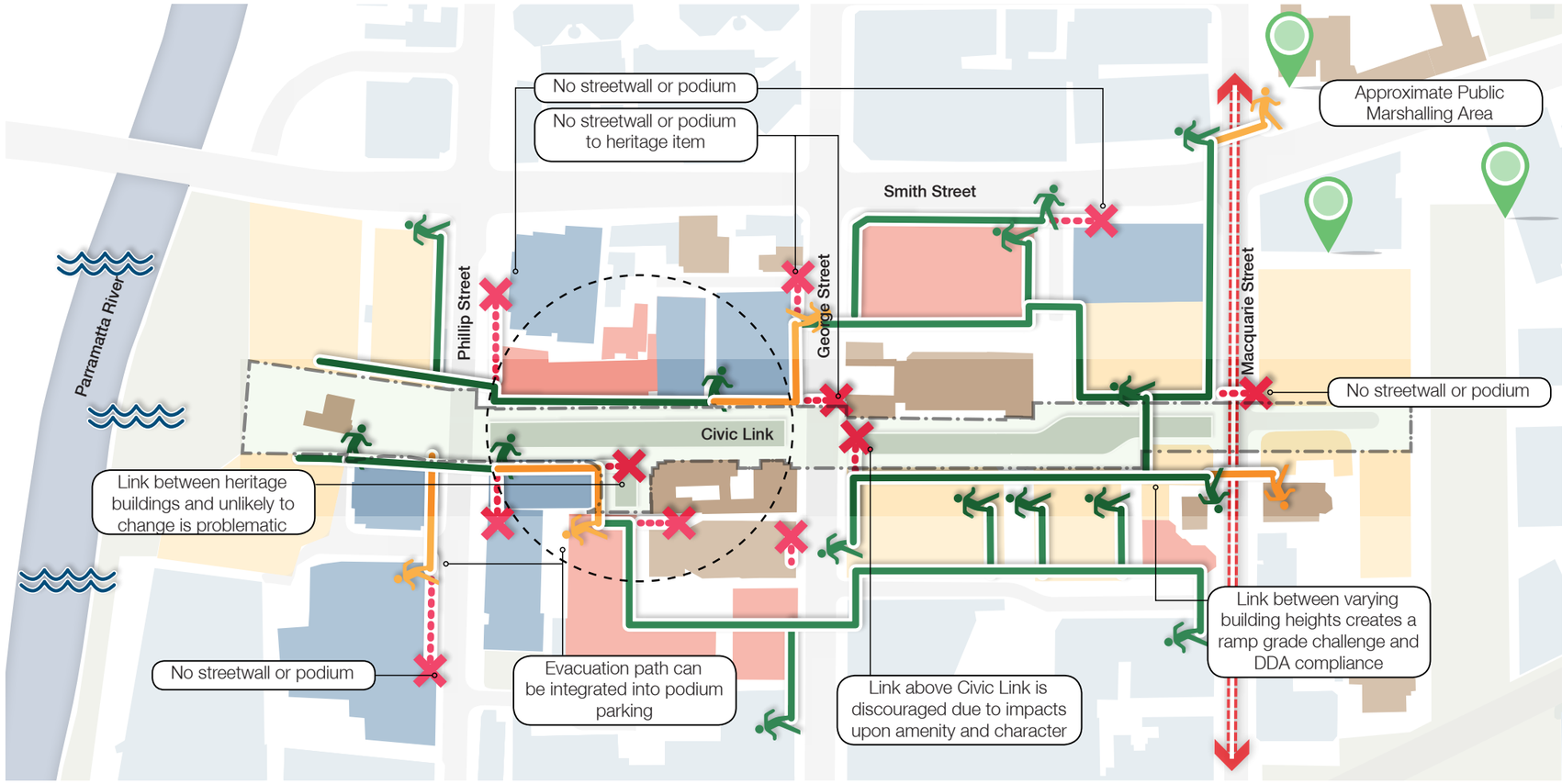
6.5 Civic Link Testing

The diagram to the right depicts the Top of Podium Test on Civic Link.

Main challenges associated with evacuating people with this strategy include connecting to buildings that are next to a heritage item or that present no street wall. This is most notable at the intersection of Civic Link and George Street.

Connections between heritage buildings and buildings that are unlikely to change present a significant obstacle in ensuring this method can be realised.

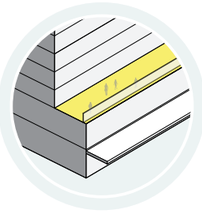
However, this strategy could be achieved by diverting paths around Civic Link towards buildings that are more conducive to retrofits and structural modifications.



Legend

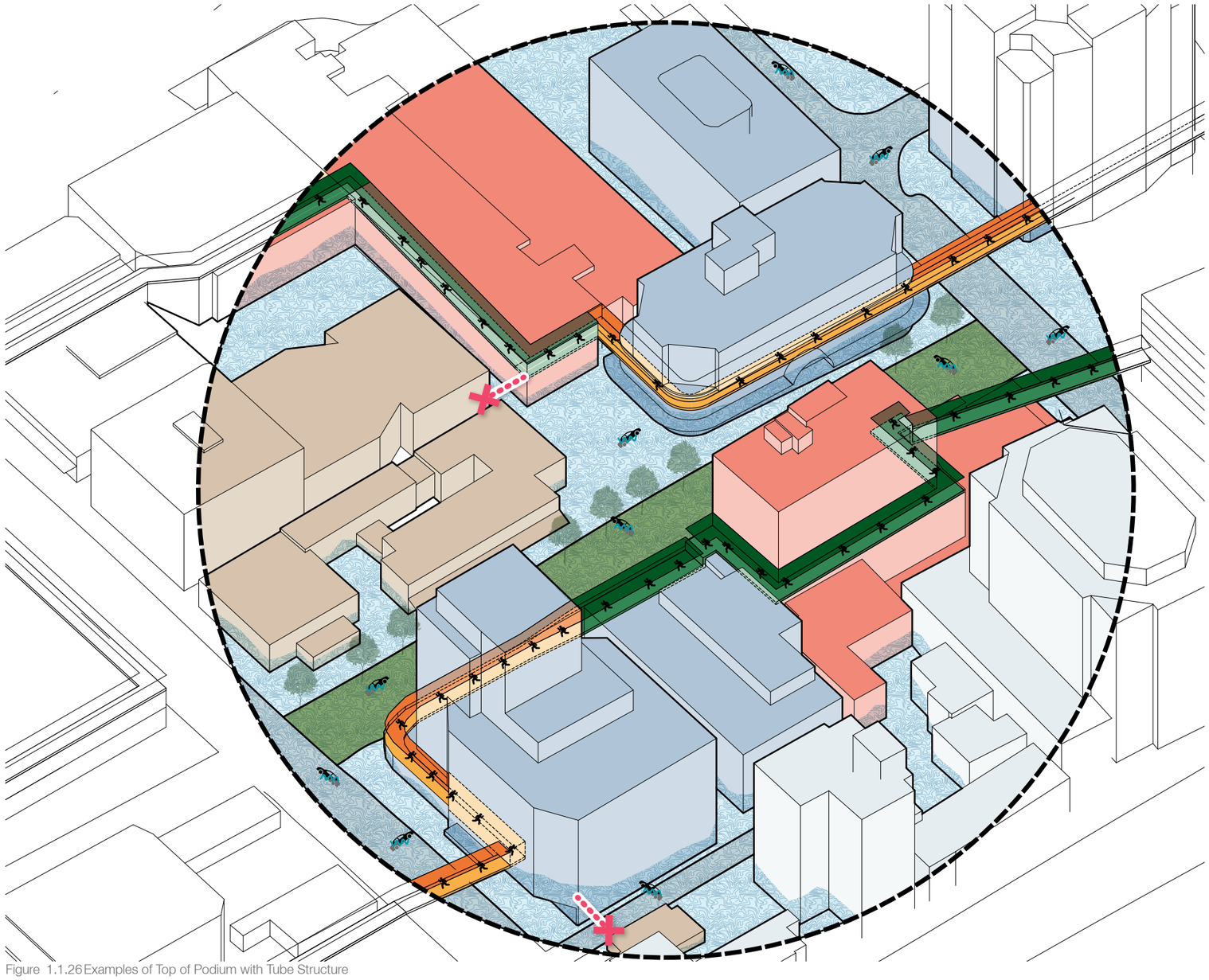
- Heritage Item
- Unlikely to Change
- Under Consideration for Redevelopment
- High Likelihood of Change
- Green Spine
- Light Rail Alignment
- Civic Link Boundary
- Cannot Be Achieved
- Difficult to Achieve - Requires further Consideration
- Can be Achieved

Figure 1.1.25 Above Podium - Civic Link Test



6.6 Discussion

- Possible to create a route well above the PMF.
- Most adjacent buildings can be connected either via the podium or podium to a rooftop via a staircase. However, heritage items would be excluded from any connection.
- Will require coordination between city blocks as to crossing point over a road or lane, should that be required.
- Lifting the path of travel will remove a number of hazards including floating or submerged and moving objects crashing into awnings.
- Hazards may include slips and falls as well as security of buildings.
- Hazard during a thunderstorm with lightning, which may impact the operation of the tubes i.e. electronic doors, alarm etc.

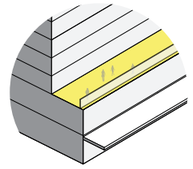


Can be achieved

Difficult to achieve - requires further consultation

Cannot be achieved

Figure 1.1.26 Examples of Top of Podium with Tube Structure



6.7 Investigation Scenario

Investigation of a tube structure along Civic Link has been explored to appreciate the physical and practical impact of this option being implemented. In this detailed test grades of 1:14 at intervals not greater than 9 metres have been applied with 1.2 metre landings. It is evident this option presents a series of impacts to the Civic Link.

We have considered the implementation of a tube structure from three interfaces:

- Public domain to top of podium
- Top of podium between buildings
- Top of podium across streets

Based on the example area below, approximately 131 metres of ramp would be required to connect people from the public domain to the top of podium. The ramp would also extend beyond the 5.5m pedestrian pathway and into the green spine of Civic Link.

Implementation of this as a strategy will have significant impact on the public domain creating physical divide between the civic link and the retail frontages on either side.

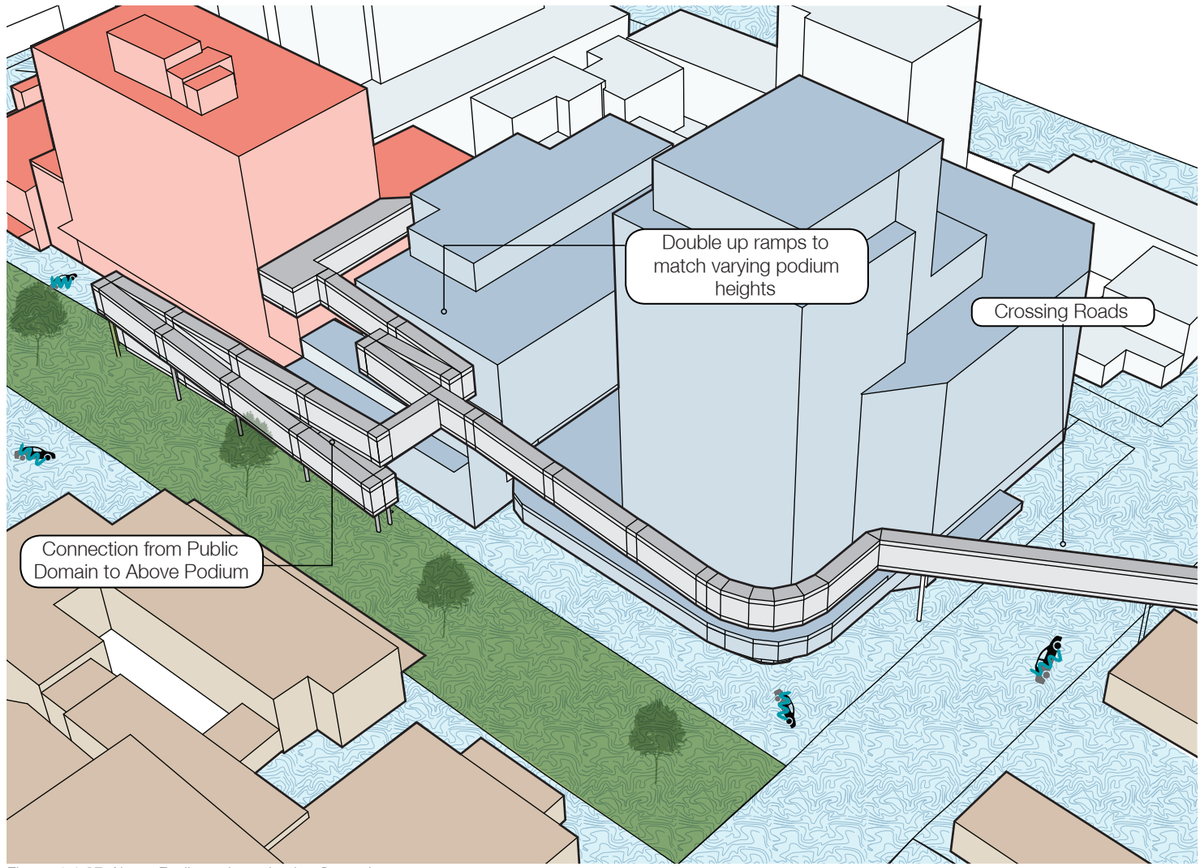


Figure 1.1.27 Above Podium - Investigation Scenario

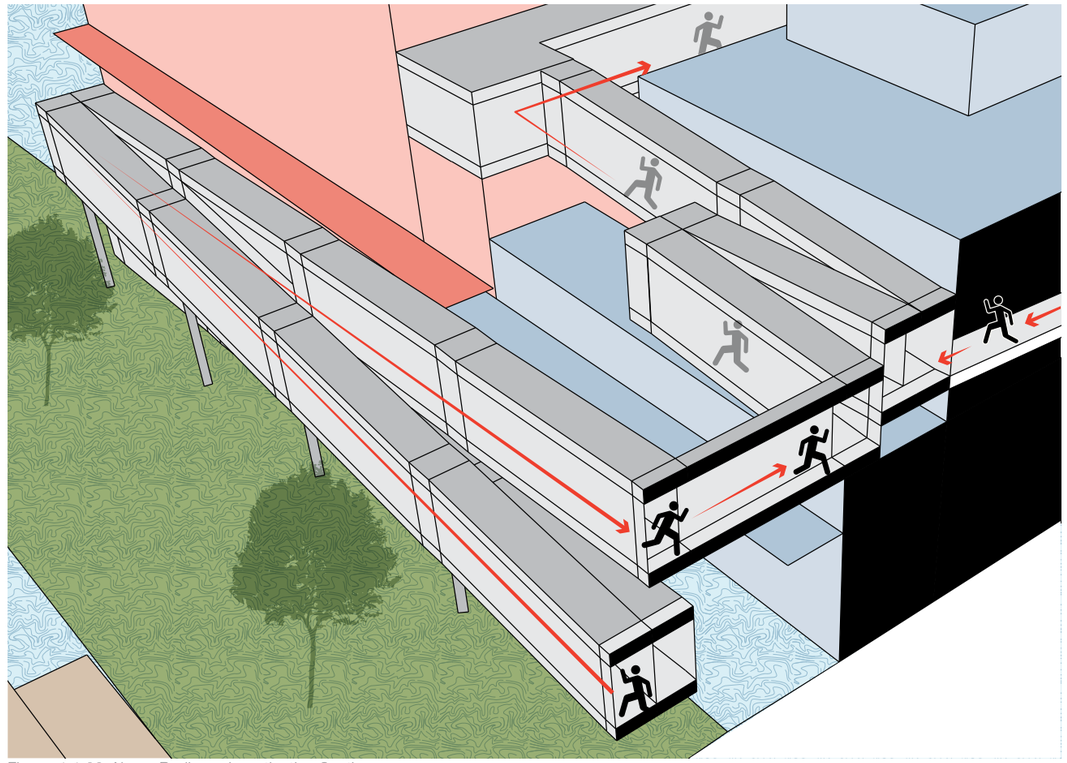


Figure 1.1.28 Above Podium - Investigation Section

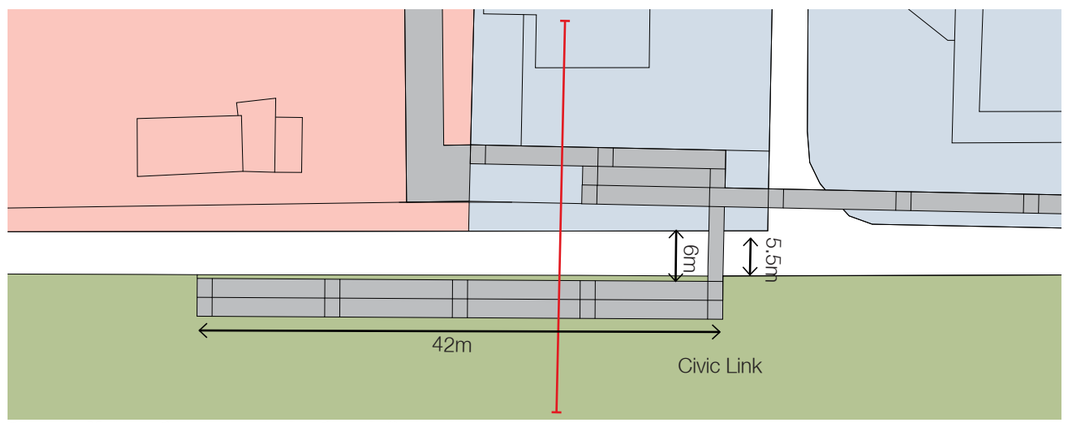
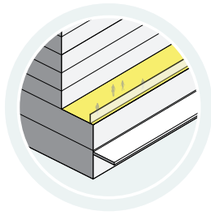


Figure 1.1.29 Above Podium - Investigation Plan with Section Line



6.8 Investigation Scenario - Perspectives

The perspective renders to the right clearly identify the significant visual impact this method of evacuation would have on the built environment.

The DDA compliant ramps within the public domain present a number of urban design issues including visual dominance, pedestrian movements, location and growth of street trees, shop front activation and shadowing.

Ramps would also need to be provided at various points within the study area to ensure that in the event of a flood, there are multiple access points from the public domain.

Integrating this method near heritage buildings and a variety of building heights along Civic Link would equally prove challenging to reconcile with the need to provide a high quality public realm and experience for visitors and pedestrians.

Tube structures across roads also present significant visual impact to the quality of the public domain.

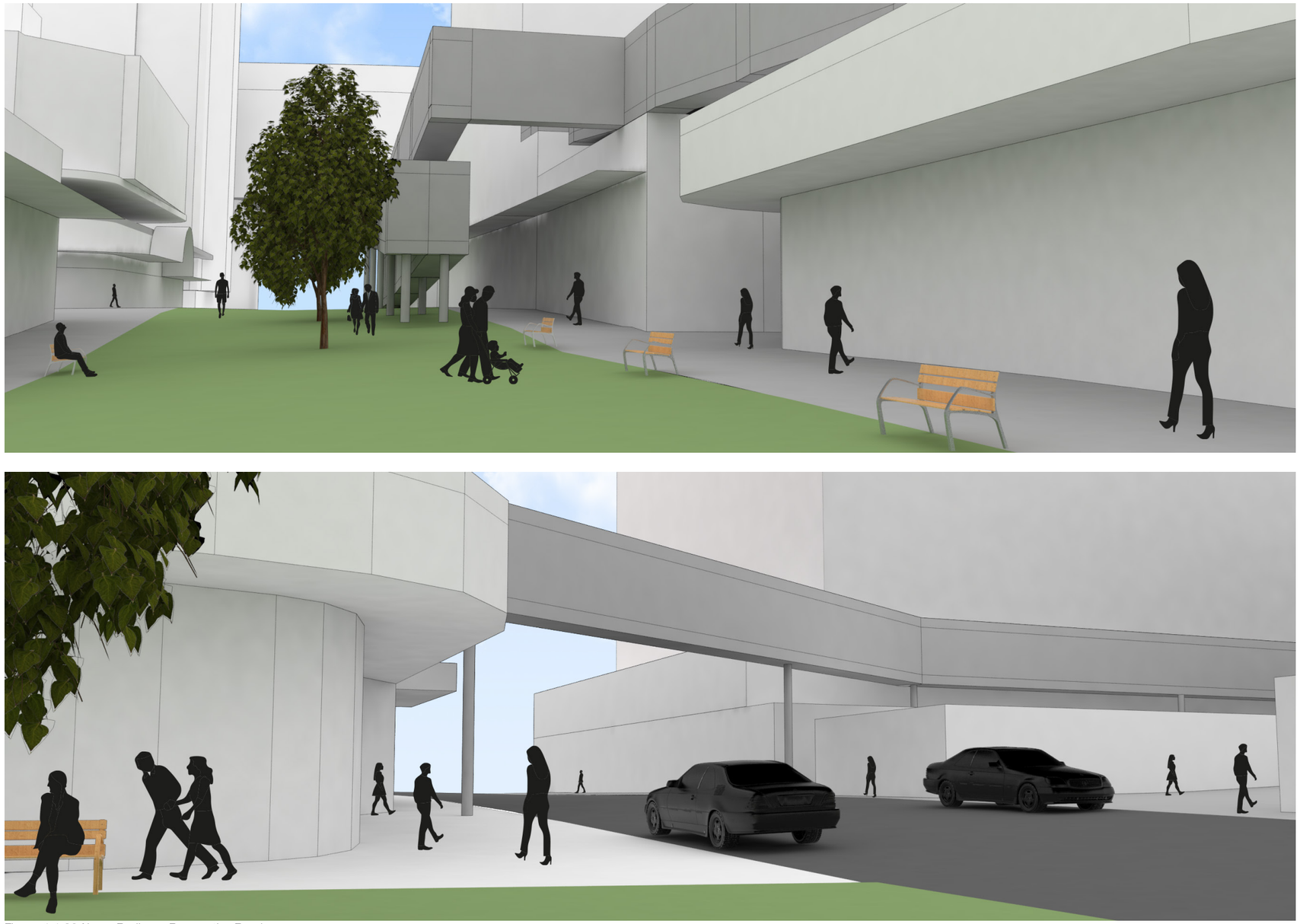
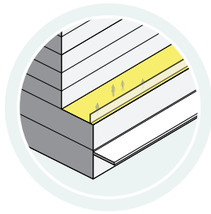


Figure 1.1.30 Above Podium - Perspective Renders



6.9 Key Challenges

Challenges

Feasibility

The cost of retrofitting walkways between the tops of podiums or buildings is relatively minor, and could be required as standard for all new buildings.

Heritage value

Due to the height of existing heritage items, this solution may require a walkway that sits above the roof of the building, which would dramatically impact the heritage item. Given the various structural loading requirements on older building materials, this may be difficult to implement.

Due to the difficulties involved with evacuating occupants to the rooftop of a heritage item such as new access ways, increased structure required and likely pitched roofs, it is unlikely that this option would an appropriate solution for heritage items, and thus the heritage items would remain a “low flood island” risk.

Visual impact

When retrofitting an existing building, lightweight materials such as aluminium and expanded steel may be utilised to connect to other buildings, or to provide one safe path of access across a rooftop or podium that may otherwise be inaccessible.

However, in the instance of a substantial structural element like a tube, this may require heavier materials and various colonnades to support links across the public domain.

Adjacent levels

The various developments occurring around the CBD will provide a range of challenges when connecting between them.

Connecting over the top of buildings that vary in height would be relatively difficult to be managed as heavier and larger structural elements for a tube/sky bridge may have a more complex integration between buildings. Also ensuring tubes on top of buildings where no podium is available would prove challenging to form an appropriate gradient and comply with DDA.

Safety

Appropriate safety measures should be able to be employed via handrails and signage. This solution will provide numerous situations for hazards including:

- slipping and falling from walkway
- moving off walkway and onto areas of buildings that are not usually accessible to the public
- hazard of being exposed to downpours of rain.

Additional safety measures to ensure that an evacuation route does not enable people to break into, or inappropriately access, areas of a building that are privately owned.

If these paths are open 24/7, then appropriate CCTV measures would need to be implemented to ensure the structures do not pose an unsafe environment and promote anti-social behaviour. CPTED measures would need to be incorporated and considered

Wayfinding

Appropriate signage within the building is to be provided to inform occupants that the most appropriate strategy is to Shelter in Place, however if this is no longer safe, to evacuate to the podium or rooftop.

Clear descriptions and wayfinding would need to be provided to ensure that evacuees are travelling towards a marshalling area or collection point.

Structural integrity

Adequate structure will need to be provided if retrofitting existing buildings, and to ensure that these areas are trafficable and safe. This may impact on the quality of the street wall and public domain.

Continuous Path of Travel

This strategy is likely to be able to create a continuous path, however not one that is level.

The continuous path will be formed of stairs, ramps and walkways, and can easily connect over the top of roads and public spaces if needed.

If the mechanisms are not permanently set up on the buildings, the way in which these are set up in an emergency event will need to be coordinated by both the CoP and building occupants.

However if evacuees are simply moving from one building to an adjacent building bridges to connect across roads and public spaces will not be required in most cases.

Governance

When implementing tube like structures onto new and existing buildings, the management, security and maintenance of these would be subject to question.

Agreements would need to be established to identify if these assets are publicly owned and privately managed or publicly owned and managed. From a governance and libability perspective, this may become complex.

In the event of a flood evacuation, it may be difficult to reinforce a process of ensuring these assets are made available and open when required.

Implications

Feasibility

The cost of providing expanded tube walkways to existing buildings would be significant. It could be incorporated throughout the city in a reasonably medium-long period of time.

Implementation

If providing tube walkways to the buildings around the city, this could be funded by Council and other public sources. This would have to be staged in line with new buildings, whilst also facilitating upgrades of existing buildings.

Design

New buildings would be able to incorporate a more permanent option within their design, as well as being better able to nagivate security concerns from the design phase.

Conclusion and Summary

7

7.1 Conclusion

The horizontal evacuation study has sought to investigate three methods of evacuation for the Civic Link in the Parramatta CBD. The study comprised the following objectives:

1. *Investigate how best to evacuate people from the CBD during flood events using interconnected horizontal connections*
2. *Understand the implications of horizontal evacuation techniques on form, function and appearance of City including built form, movement patterns and public space*
3. *Investigate potential implementation through planning policy, building design and delivery, and staging*

The study has highlighted that each method of evacuation presents a series of implications and challenges for Civic Link and the broader CBD ranging from design, staging, implementation, governance and suitability.

The study summarises the challenges for each option:

Indoor

- The indoor evacuation scheme could potentially provide a good outcome for the city, and architecturally could be made to become an asset to the city.
- However, this strategy is likely to take upwards of 10 years to deliver a city-wide scheme, and will not help the evacuation of the city in a flood event before its implementation.
- Therefore from an implementation, staging and delivery perspective the indoor strategy is not viable.

Above Awning

- The above awning strategy poses a significant cost to the city, without a truly safe evacuation route, or a route that is continuous through the city.
- Our investigation has concluded that there are no benchmark examples in any major cities and therefore the suitability of this option is subject to question.

Top of Podium

- The above podium provides the most immediate strategy that can be implemented city-wide by the CoP, and has the opportunity to develop into a more permanent and designed solution over time.
- This solution not only immediately lowers the societal risk within the city, but can also provide safe access to evacuees through the city.
- Further investigation of this option would require the implementation of a tube structure or similar for the purposes of carrying large volumes of pedestrians and ensuring compliance with the relevant standards.

Based on a high level analysis of the three options, the top of podium evacuation strategy was explored in further detail to understand the practicality of this strategy being adopted in Civic Link.

Detailed Investigation - Top of Podium

There were a number of challenges and issues associated with adopting this strategy including:

- Significiant visual and physical impacts within the public domain.
- Substantial duration to traverse ramps to reach above podium from the public domain, due to ramping requirements.
- Implementation of double up ramps to reach above podium of varying building heights.
- Significant impact on the function of Civic Link.
- VIsual impacts crossing roads.

Heritage Items

Evacuating heritage items will always be an issue. Retrofitting any of the three solutions to a heritage item is likely to severely compromise the integrity of the item.

As such, any heritage item within the 1 in 100 year flood level will remain a “low flood island” (high risk), and should have a specific evacuation strategy. Occupants of heritage items should evacuate the city in the same way as a pedestrian in the public domain.

7.2 Recommendations

In light of the findings in this study there are practical challenges and issues with implementation of the three high level evacuation strategies on the public domain and various building typologies. As such, shelter in place may be a more practical solution from an urban design perspective.

CoP should continue to carefully review the findings/ conclusions again following the report amendments outlined in this chapter, and may make further recommendations.

SJB Urban

sjb.com.au

We create spaces people love.
SJB is passionate about the
possibilities of architecture,
interiors, urban design
and planning.
Let's collaborate.

Level 2, 490 Crown Street
Surry Hills NSW 2010
Australia
T. 61 2 9380 9911
architects@sjb.com.au
sjb.com.au