Flood Evacuation Report

614-632 High Street, Penrith
Issue P1

Prepared For Urban Property Group

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REVISION TABLE

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1 Introduction

1.1 Brief

S&G Consultants Pty Ltd (SGC) have been engaged by Urban Property Group to prepare a flood evacuation strategy for the proposed mixed-use development at 614-632 High Street, Penrith.

The following tasks were carried out:-

1. Supplied documents and previous studies were reviewed;
2. A conceptual flood evacuation strategy is proposed; and
3. This report has been compiled.

1.2 Limitations

This report is intended solely for Urban Property Group. No liability will be accepted for use of the information contained in this report by other parties than this client.

This report is limited to the information including the referenced documents made available at the time when this report was written.

This report does not imply that the site is not subject to flooding. The stakeholders should be aware that there are current and continuing risks of flooding. This report is proposing measures to manage these flooding incidences.

1.3 Reference Documents

The following documents have been referenced in this report:-

1. Architectural drawings prepared by DKO Architecture (NSW) Pty Ltd;
2. Survey plan prepared by SDG Land Development Solutions reference 6578 dated 19/03/2018.
3. NSW Government 'The Floodplain Development Manual' – The management of Flood Liable Land (2005);
4. NSW Government 'The Floodplain Development Manual' – The management of Flood Liable Land (2005);
5. Pre-lodgement Advice by Penrith Council PL20/0003; and
6. Penrith CBD Detailed Overland Flow Flood Study-Final Report prepared by Cardno dated 7 July 2015; and
7. Flood Impact Assessment report for 614-625 High St, Penrith prepared by Cardno – reference AWE200065.

2 Natural & Built Environment

2.1 Local and Regional Context

The site is located in the 'B4' mixed use zone of Penrith, on the western outskirts of Sydney in NSW. The site is identified as Lot 10 of DP 1162271, which falls within the Local Government Authority (LGA) of Penrith City Council. The site is located on High Street and the closest waterbody, 'Nepean River' is located to the north-west direction.

The survey plan of the site indicates that the site falls towards High Street. Refer to Appendix 5 for a copy of the survey plan.

The site location and surrounding area are shown in Figure 2.1 below.

Figure 2.1 Locality Plan

2.2 Proposed Development

The proposed development consists of a mixed-use development which includes:

- Construction of 44 storey residential flat building, and 5 retails over 2 levels of basement carparking and associated landscaping.

2.3 Objectives

The main objectives of this report are:

1. Address requirement from Penrith Council Pre-lodgement advice Ref PL20/2003;
2. Provide a Flood Evacuation plan;
3. Discuss the effects of the PMF event flooding on the proposed development;
4. Mitigate the flooding risk by preventing personal danger and reducing the damage to the property and the equipment on site;
5. Increase awareness of stakeholders to the flooding issue;
6. Prepare a conceptual flood emergency and evacuation response strategy; and
7. Outline the measures to be undertaken to ensure that damage caused by property inundation during storms in PMF event is minimised as much as possible.

2.4 Council Requirements

The site is affected by mainstream flooding from the Nepean River in Probable Maximum Flood (PMF) event. This report is to address the flood evacuation capacity requirement from the Department of Planning's Management for Residential Development in the Penrith City Centre.

3 Glossary

Annual Exceedance Probability (AEP)

The chance of a flood of a given or a larger size occurring in any one year, usually expressed as a percentage.

Australian Height Datum (AHD)

A common national surface level datum approximately corresponding to mean sea level.

Average Recurrence Interval (ARI)

The long term average number of years between the occurrence of a flood as big as or larger than the selected event.

Catchment

The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.

Flood

Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse.

Flood Liable Land or Flood Prone Land

Land susceptible to flooding by the PMF.

Flood Planning Levels (FPLs)

Are the combinations of flood levels and freeboards selected for floodplain risk management purposes.

Freeboard

Is a factor of safety typically used in relation to the setting of floor levels.

Habitable Room

In industrial or commercial situation: an area used for offices or to store valuable possessions susceptible to damage in the event of a flood.

Peak Discharge

The maximum discharge occurring during a flood event.

Probable Maximum Flood

PMF is the largest flood that could conceivably occur at a location, usually estimated from probable maximum precipitation.

Probable Maximum Precipitation

PMP is the greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location at a particular time of the year.

Runoff

The amount of rainfall which actually ends up as stream flow.

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4 Flood Analysis

4.1 Flood Levels

Council has advised that the development is affected by local overland flow flooding from the adopted Penrith CBD Catchment Overland Flow Flood Study. Information currently held by Council indicates that the 1% AEP water surface level affecting the site is estimated to be 27.10m AHD.

1% AEP Level	27.10m AHD
Flood Planning Level	27.60m AHD
PMF	32.90m AHD

4.2 Development Recommendations and Construction Methodologies

The crest of any access ramp will be 300mm above the top of kerb level or 300mm above the 1% AEP water surface level.

All habitable floor levels are set to be at least 500mm above the 100-yr flood level.

Table 1 Flood Level & Compliance Summary

Location & Description	Proposed Level (m AHD)	Proposed Use
Driveway Crest to Basement Carpark	27.65	Car Parking
Ground Level	27.60 – 27.68	Carpark, Bins room, Retails and Café
Mezzanine, Level 1 & Level 2 Carpark	32.40 – 38.60	Carpark
Level 3	41.70	Commercial, Residential units & Communal area
Level 4	45.40	Commercial, Residential units, Communal area & Swimming pool
Level 5	49.10	Commercial and Residential units
Level 6 – Level 44	52.80 Minimum	Residential units

4.3 Flood Characteristics

Flood information obtained from Council's Catchment Branch categorized the flood as 'Overland Flow'.

The Overland Flow Flood Study Report prepared by Cardno states that the subject site is at risk from PMF, in addition to overland flooding from the local catchment.

4.4 Persons at Risk (PAR)

The direct Persons at Risk (PAR) during the PMF was estimated for the retail/commercial outlet on the ground floor and Mezzanine Carpark and the indirect PAR was estimated for residents living in upper levels apartments.

In the case of the retail outlets, the PAR was based on the approach adopted previously for 2-8 River Road West by Cardno, 2013. The PAR was based on figures from Warringah Mall as follows:

- An estimated average 6,667 visitors to Warringah Mall each trading hour;
- 60% of all visitors are visiting ground floor retailers (estimate provided by Centre Management) giving 4,000 ground floor visitors per hour;
- The area of retail premises that experience above floor level flooding greater than 0.2m in a 1% AEP flood as a proportion of the total ground floor retail area;
- On average 9.2 hours of trading each weekday; and
- On average 15 hours of trading each weekend.

In the case of the development at 614 - 632 High Street Penrith, the average number of visitors per hour to the commercial space was scaled based on the ratio of the floor level of the retail outlets to the area of ground floor retailers at Warringah Mall. This gave an estimate of approximately **54** (24 in retail, 30 in café**)** visitors in direct risk while visiting the retail outlets and Café at 614 - 632 High Street, Penrith (based on 0.04 person/m^2 and a total retail area of 590 m^2 on Ground Level). The estimated number of people in basement and mezzanine level is **30**. Therefore, total number of people in direct risk is **84**.

The number of residents that would be indirectly at risk during a PMF was estimated based on equivalent population (EP) sourced from Sydney Water data (all upper levels not affected by flooding up to PMF event):

Table 4.2 Indirect PAR on Upper Levels

Type of Unit	EP	No. of Units	Total No. of Occupants
1B	1.5	103	155
2B	2.5	142	355
3B	3.5	35	123
TOTAL			633

The estimated number of residents indirectly at potential risk during a PMF is **494** (because it accounts for periods when apartments are not occupied or only partly occupied assuming a ratio of 0.78 or 22% of the units will not be occupied).

4.5 Sizing Temporary Flood Refuge

Two primary sources of information were located when considering the size of a temporary flood refuge:-

- Building Code of Australia (2008); and
- US Flood Emergency Management Authority (FEMA) (2000).

As outlined above, the Building Code of Australia (2008) stipulates that an area of public assembly such as halls or theatres should have a maximum density of 1 m^2 per person (BCA, 2008). FEMA (2000) recommends a minimum of 0.45 m^2 per person for tornado shelters.

In the case of 614-632 High Street Penrith development, a maximum density of 1 m^2 per person has been adopted in view of the length of time visitors and/or residents may be required to shelter in place. Based on the estimated peak number of persons that could be at risk in the car park and on the retail level during trading hours (84 persons), approximately 84 m^2 of space to be publicly accessible for flood refuge areas above PMF level (RL 32.90m AHD).

4.6 Evacuation

The proposed evacuation from the site is staged as follows:

The available short warning times mean that in the case of extreme floods, there will not be sufficient time to evacuate any residents and/or visitors from the site and that instead residents and/or visitors would need to shelter in place, as in PMF event the surrounding streets are flooded with high hazard.

Under these circumstances, the expected time that visitors and/or residents would need to shelter in place would be between 20 minutes up to 4-5 hours. The shelter area will be on Level 3 in the Communal area (90 m^2) which can accommodate up to 90 people. Two dedicated staircases are provided to move people from the basement carpark level to Level 3.

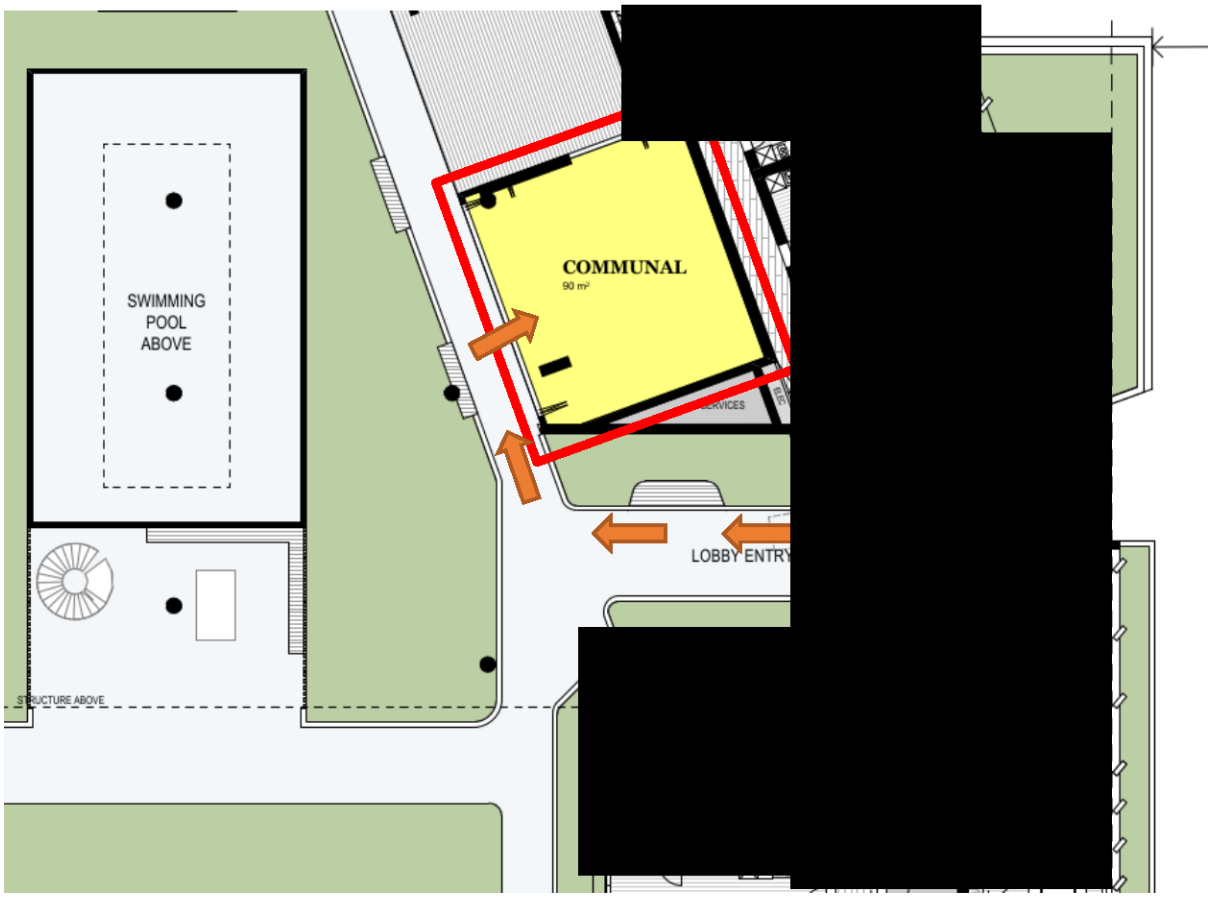

Figure 2 Communal Shelter and staircase accesses on Level 3

This report demonstrates that adequate flood warning is available to allow safe and orderly evacuation without increased reliance upon SES or other authorised emergency services personnel.

The detailed Flood Emergency Response Plan for the building will be done in consultation with SES and Penrith Council.

5 Assessment of Council Requirements

5.1 Floor Level

As per Penrith Council Pre-lodgement advice Ref PL20/2003; habitable floor FFL 27.60m AHD (minimum) to be adopted as floor level, which is 500mm above the 100 year ARI maximum flood level.

5.2 Building Components

As per item 1 of this control, the proposed development to have components that are to be compatible with flooding. The details will be shown and specified on the architectural plans at C.C. stage.

5.3 Structural Soundness

The structural Engineer to provide certification in relation to item 2 of this control.

5.4 Flood Effects

The flood impact Study prepared by Cardno (Australia) Pty Ltd demonstrates that the development will not increase flood effect elsewhere. (Refer to Appendix 3)

5.5 Car Parking and Driveway Access

The driveway access crest level of RL 27.65m AHD has been adopted for the proposed development which is 550mm above the 1% AEP flood level (as per Council's provided Pre-lodgement Advice). Therefore, all planning and development controls in relation to Car parking/ Driveway access are complying.

5.6 Evacuation

Access to the stairwells are located external to the building on the western and eastern sides to Level 3 Communal area. Elevators are not recommended to be used in a flood event as the power supply may be interrupted.

It is recommended that persons already in the commercial and residential units would remain (shelter-in-place) for the duration of the flood event. Therefore, complied with Council's Flood Management Plan.

5.7 Management & Design

This control is not applicable.

6 Qualifications of Author

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A1 Appendix 1

Council's Requirements in DCP 2013 – Chapter 11

3.5 Flood Planning

A. Background

Impact of Flooding

The Hawkesbury/Nepean River system has one of the most dramatic flood behaviours in the world. The geography and topography of the area mean that flood waters are contained in the Nepean Gorge until they reach the floodplains at Penrith, resulting in unusually rapid rises in water levels. These floods continue to modify the physical environment of the valley as well as causing social and economic challenges to the valley's inhabitants.

Relevant Policies

Local government is the primary authority responsible for both flood risk management and land use planning in NSW. However, the State Government has introduced the *Flood Prone*

Land Policy and the associated *Floodplain Development Manual* (2005) (FDM) to reduce the impacts of flooding and flood liability on individual owners and occupiers of flood prone property, and to reduce private and public losses resulting from floods, utilising ecologically positive methods wherever possible. To achieve this objective, the supporting FDM acknowledges a broad risk management hierarchy of:

- avoidance of flood risk;
- minimisation of flood risk using appropriate planning controls; and
- flood risk mitigation.

Generally, the Flood Prone Land Policy adopts the following approach:

- The impact of flooding and flood liability on existing developed areas shall be reduced by flood mitigation works and measures, appropriate development and building controls and the voluntary acquisition of property in hazardous areas;
- The potential for flood losses in all new developed areas shall be contained by the application of effective planning and development controls;
- A merit approach to all development and building decisions which takes account of social, economic factors, as well as flooding considerations, should be followed.

Local Environmental Plan

The LEP contains provisions for development on land at or below the flood planning level, defined in the LEP as the level of a 1:100 Average Recurrence Interval (ARI) (1% AEP (100 year ARI)) flood event plus 0.5m freeboard.

The 1% AEP (100 year ARI) flood event is a tool for broadly assessing the suitability of land for development. It is not an assessment of flood risk, nor does reference to the 1% AEP (100 year ARI) flood event mean that properties and development above this level are not subject to flood risk.

Average Recurrence Interval (ARI) is the long term average number of years between the occurrence of a flood as big as or larger than the selected event. For example, floods with a discharge as great as or greater than the 100 year ARI flood event will occur on average once every 100 years.

Consideration of Floods Larger than the 1% AEP (100 year ARI) Flood Event

The 1% AEP (100 year ARI) flood is not, in most cases, the largest flood that can occur. There have been documented floods which exceeded this level for the Nepean River on a number of occasions over the last 200 years. The highest flood event at Penrith occurred in June 1867 and is estimated at greater than the 1:200 ARI event. Floodwaters reached a peak height of 27.5m above Australian Height Datum and covered most of the present day Emu Plains and large parts of Penrith. The 1967 flood for Ropes Creek and the 1956 and 1988 floods for South Creek were also major flood events.

For this reason, developments that may have a significant impact on the extent of flooding experienced by nearby or downstream properties may be asked to consider floods larger that the 1% AEP (100 year ARI) flood event. Significant areas of Penrith are affected by the Probable Maximum Flood (PMF) and in some cases this will need to be considered in determining flood hazard.

Probable Maximum Flood (PMF) is the largest flood that could conceivably occur at a particular location.

Flood Hazard Classifications

In order to determine what development may occur in areas subject to partial or full flooding, it is necessary to classify land according to flood hazard.

The greatest flood hazard occurs in land that is a 'floodway'. They are often aligned with obvious naturally defined channels.

Floodway is defined as those areas of the floodplain where a significant discharge of water occurs during floods.

In addition, there are significant risks in 'flood storage areas'.

Flood storage areas are defined as those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood.

Floodplain is defined as the area of land which is subject to inundation by floods up to and including the PMF event.

The remaining area of land affected by flooding after floodway and flood storage areas have been defined is the 'flood fringe area'.

Alterations to Land at or below the Flood Planning Level/Watercourses

One key issue with the development of land at or below the flood planning level is that some developments have the potential to adversely affect flood behaviour (including flow distributions and velocities). This can result in detrimental increases in the potential flood impacts on other development or properties and/or impacts on the floodplain environment that could cause erosion, siltation, destruction of riparian vegetation or a reduction in the stability of the river bank/watercourse.

Developments that would partially or fully block floodways or flood storage areas may result in redistribution of flood flows or impacts. The greatest impact comes from filling land at or below the flood planning level in order to raise development above the flood planning level. Therefore, these impacts must be minimised in the location and design of any structures on the land.

Minimising Flood Impacts on Property

Flood impacts on property can be reduced not only by appropriate location of development but also by design, layout and structure. This Plan provides controls for appropriate levels for 'habitable rooms' or 'flood proofing' of buildings.

Habitable rooms are defined as a living area such as a lounge room, dining room, rumpus room, kitchen and bedroom and excluding garages.

Flood proofing refers to the combination of measures incorporated in the design, construction and alteration of individual buildings or structures subject to flooding to reduce or eliminate flood damages.

B. Objectives

a) To ensure floodplain risk management minimises the potential impact of development and other activity upon the aesthetic, recreational and ecological value of the waterway corridors;

b) To maintain the existing flood regime and flow conveyance capacity and avoid significant adverse impacts on flood behaviour;

c) To avoid significant adverse effects on the floodplain environment that would cause erosion, siltation, destruction of riparian vegetation or a reduction in the stability of the river bank/watercourse;

d) To reduce the impact of flooding and flood liability on individual owners and occupiers;

e) To limit the potential risk to life and property resulting from flood events;

f) To contain the potential for flood losses in all new developed areas by the application of effective planning and development controls;

g) To apply a "merit approach" to all development and building decisions, which takes account of social, economic and ecological factors as well as flooding considerations;

h) To prevent the introduction of unsuitable land uses on land subject to the flood planning provisions of the LEP; and

i) To deal equitably and consistently (where possible) with applications for development on land affected by potential floods, in accordance with the principles contained in the Floodplain Development Manual, issued by the NSW Government.

C. Controls

The following controls only apply to land subject to the flood planning provisions of the LEP.

1) Submission Requirements

a) Where relevant, a comprehensive flood study, incorporating:

i) a survey of the main watercourse;

ii) a survey of the site; and

iii) a detailed flood and drainage investigation which establishes the estimated 1% AEP (100 year ARI) flood level;

is to be submitted with any development application on land identified as fully or partially flood affected. The levels on the survey are required to be verified during construction by a survey certificate.

b) The applicant shall be required to demonstrate to the satisfaction of Council (on the basis of a qualified consultant report) that:

i) The development will not increase the flood hazard or risk to other properties;

ii) The structure of the proposed building works shall be adequate to deal with flooding situations;

iii) The proposed building materials are suitable;

iv) The buildings are sited in the optimum position to avoid flood waters and allow safe flood access for evacuation;

v) The proposed redevelopment will not expose any resident to unacceptable levels of risk or any property to unreasonable damage; and

vi) Compliance of any existing buildings with the *Standard - Construction of Buildings in Flood Hazard Area* and the accompanying handbook developed by the Australian Building Codes Board (2012).

2) Flood Hazard Classifications

a) Council will consider development on land subject to the flood planning provisions of the LEP but will not grant consent to new development in floodways or in high hazard areas.

Flood hazard (high) or high flood hazard occurs when there is possible danger to life and limb; evacuation by trucks is difficult; there is potential for structural damage; and social disruption and financial losses could be high.

b) Consideration will be given to such matters as depth and nature of flood waters, whether the area forms flood storage, the nature and risk posed to the development by flood waters, the velocity of floodwaters and the speed of inundation, and whether the development lies in an area classed as a 'floodway', 'flood fringe area' or 'flood storage area'.

3) Residential - New Developments - Single Dwellings

b) Residential – upper storey additions will not be considered as 'New Development' provided; the first floor additions are above the Flood Planning level and the additions and alterations do not increase the building footprint at ground level beyond 35m^2. (Ground floor additions include all non-habitable buildings such as garages, storage areas, carports and the like).

c) Floor levels of habitable rooms shall be at least 0.5m above the 1% AEP (100 year ARI) flood; i.e. the flood planning level.

d) The lowest floor level of habitable rooms shall be not more than 3.0m above ground level.

e) Any portion of buildings subject to inundation shall be built from flood compatible materials.

f) Flood safe access and emergency egress shall be provided to all new developments and for dwelling replacements where practicable.

Flood safe access means access that is generally considered satisfactory when the depth of flooding over vehicular driveways and roads is limited to approximately 0.25m with low velocities.

g) All services associated with the development shall be adequately flood proofed.

h) A certificate, prepared by a registered surveyor to verify the lowest floor level of a habitable room of a residential building to the required Australian Height Datum (AHD) level, shall be submitted to the Council upon completion of the building to that level. The building shall not be further constructed until approval is given by Council to proceed with construction works.

4) Residential - Minor Extensions

a) This section does not apply to minor extensions for the purpose of dual occupancy development, an existing single storey home which retains essentially the outer walls of the existing dwelling and proposes an upper floor addition, a knockdown rebuild that retains exactly the same building footprint, or a building burnt down and replaced with the same building footprint. These shall be treated as new development.

b) Once only extensions with a floor area up to 30m^2 may be approved with floor levels below the 1% AEP (100 year ARI) flood, if the applicant can demonstrate that no practical alternatives exists for constructing the extension above the 1% AEP (100 year ARI) flood.

c) Once only extensions which increase the existing floor area by between 30 and 35m^2 may be approved with floor levels at or above the 1% AEP (100 year ARI) flood.

d) Extensions greater than 35m^2 will be treated as a new development.

5) Non-Habitable Extensions or Alterations, Outbuildings and Swimming Pools

a) All electrical services shall be adequately flood proofed.

b) All flood sensitive equipment (including electric motors and switches) shall be located above the 1% AEP (100 year ARI) flood.

6) Industrial/Commercial - New Development

a) Floor levels shall be at least 0.5m above the 1% AEP (100 year ARI) flood or the buildings shall be flood-proofed to a least 0.5m above the 1% AEP (100 year ARI) flood. If floor levels are below the 1% AEP (100 year ARI) flood the matters listed in section 7 i) – vii) shall be addressed.

b) Flood safe access and emergency egress shall be provided to all new developments.

7) Industrial/Commercial - Extensions and Infill Development

a) Where the application is for an extension to an existing building on land at or below the flood planning level or for new development that can be classed as infill development, Council may approve of the development with floor levels below the 1% AEP (100 year ARI) flood if it can be demonstrated by the applicant that all practical measures will be taken to prevent or minimise the impact of flooding. In considering such applications and determining the required floor level, Council shall take into account such matters as:

i) The nature of the business to be carried out;

ii) The frequency and depth of flooding;

iii) The potential for personal and property loss;

iv) The utility of the building for its proposed use;

v) Whether the filling of the site or raising of the floor levels would render the development of the property unworkable or uneconomical;

vi) Whether the raising of the floor levels would be out of character with adjacent buildings; and

vii) Any risk of pollution of water from storage or use of chemicals within the building.

b) Any portion of the proposed building extension subject to inundation shall be built from flood compatible materials.

8) Change of Use of Existing Buildings

a) Development consent for change of use of an existing building with floor levels below the 1% AEP (100 year ARI) flood will only be given where it can be demonstrated by the applicant that:

i) There is no foreseeable risk of pollution associated with the proposed use of the building in the event that the 1% AEP (100 year ARI) flood occurs;

ii) All practical measures shall be taken to minimise the risk of flood damage to the property within the building by the 1% AEP (100 year ARI) flood. These measures could include:

- Flood proofing the building to the level of the 1% AEP (100 year ARI) flood by either construction of a wall or levee bank or some other means of preventing water entry;

Figure A 1.1 Flood Planning

A2 Appendix 2

Council's Pre-lodgement Advice regarding Flood Levels

(e) Mainstream Flooding

The site is affected by mainstream flooding from the Nepean River in Probable Maximum Flood (PMF) event. The application shall address the flood evacuation capacity requirements (including non-residential) from the Department of Planning's '*Development Assessment Guideline: An Adaptive Response to Flood Risk Management for Residential Development in the Penrith City Centre*'.

A copy of the Guideline is available from the Department of Planning's website. Shelter in place is not supported as an alternative to evacuation.

The application must demonstrate that the proposal is compatible with the State Government Floodplain Development Manual and Council's Local Environmental Plan 2010 including controls related to Flood Liable Lands.

(f) Local overland flows

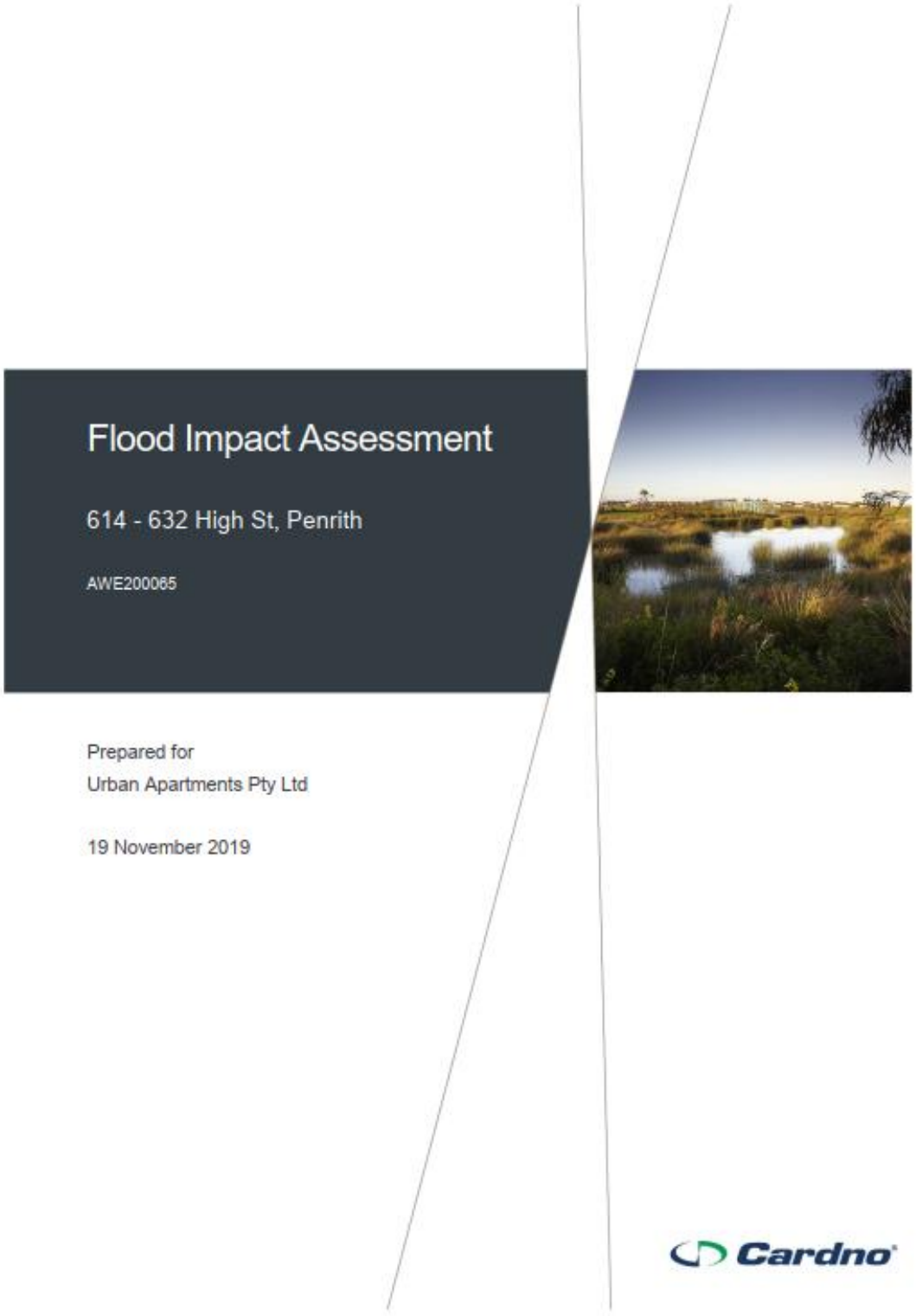
The site is affected by local overland flow flooding from the adopted Penrith CBD Catchment Overland Flow Flood Study. Information currently held by Council indicates that the 1% AEP water surface level affecting the site is estimated to be 27.1 m AHD. All plans for the site shall have levels and details to AHD and all habitable floor levels shall be a minimum RL 27.6 m AHD (1% AEP water surface level + 0.5m freeboard). The floor area of the ground floor retail tenancies and lobby areas, on the submitted pre lodgement plans is noted as being RL27.55m AHD.

The crest of any access ramp to any underground basement shall be the greater of 300mm above the top of kerb level or 300mm above the 1% AEP water surface level.

Figure A 2.1 Council's Pre-lodgement Advice regarding Flood Levels

A3 Appendix 3

Flood Impact Assessment by CARDNO



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Appendices

Tables

Figures

1 Background

1.1 Subject Site

The site, 614-632 High Street, Penrith (shown in Figure 1-1), is proposed for future redevelopment with a multi-storey building on the current vacant site (comprising grassed areas and concrete hardstand/ pavement). This report is an assessment of flooding at the subject site and review of the compliance of the proposed development with Council's policies and development controls.

Figure 1-1 Locality Plan (Image source – Nearmap)

1.2 Proposed Development

A multi-storey building with retail, commercial, residential units, multiple carparking levels, and communal open space areas is proposed for the site. Design plans by DKO Architecture dated 08/11/2019 are included as Appendix A. A ground survey of the existing site by SDG dated 10/10/2019 is attached as Appendix B

2 Flood Affectation

Two recent studies estimate flood behaviour at the site for the two potential flooding mechanisms of local catchment overland flow and mainstream inundation as detailed in the:

- Penrith CBD Detailed Overland Flow Flood Study (July 2015)
- Hawkesbury-Nepean Valley Regional Flood Study for Infrastructure NSW (July 2019)

2.1 Local Overland Flow Affectation

Cardno prepared the Penrith CBD Detailed Overland Flow Flood Study in 2015 for Penrith City Council. The 2015 Study defined the behaviour of local overland flows and flooding within the catchment which includes the subject site. The 2015 overland study shows the site is not inundated by flooding in a 1% Annual Exceedance Probability (AEP) event as shown on the extract map of Figure 2-1 (which has a filter showing depths greater than 0.15m). A peak 1% AEP flood depth of 27.05 mAHD is estimated on the adjacent property (to the east). Figure 2-2 is an extract of the provisional hazard map for the 1% AEP event which shows only low provisional hazard adjacent to the site.

In a Probable Maximum Flood (PMF) event, the site is estimated as being inundated as shown in Figure 2-3 (extracted from the 2015 overland study, which has a filter showing depths greater than 0.15m). In general, overland flow is conveyed from east of the site to the western side. The model results estimate a peak PMF flood level of 27.95 mAHD on the western side and 28.10m AHD on the eastern side. Low provisional hazard conditions are estimated on the site (refer to Figure 2-4).

Figure 2-1 Extract of 1% AEP Flood Extent

Figure 2-2 Extract of 1% AEP Provisional Hazard

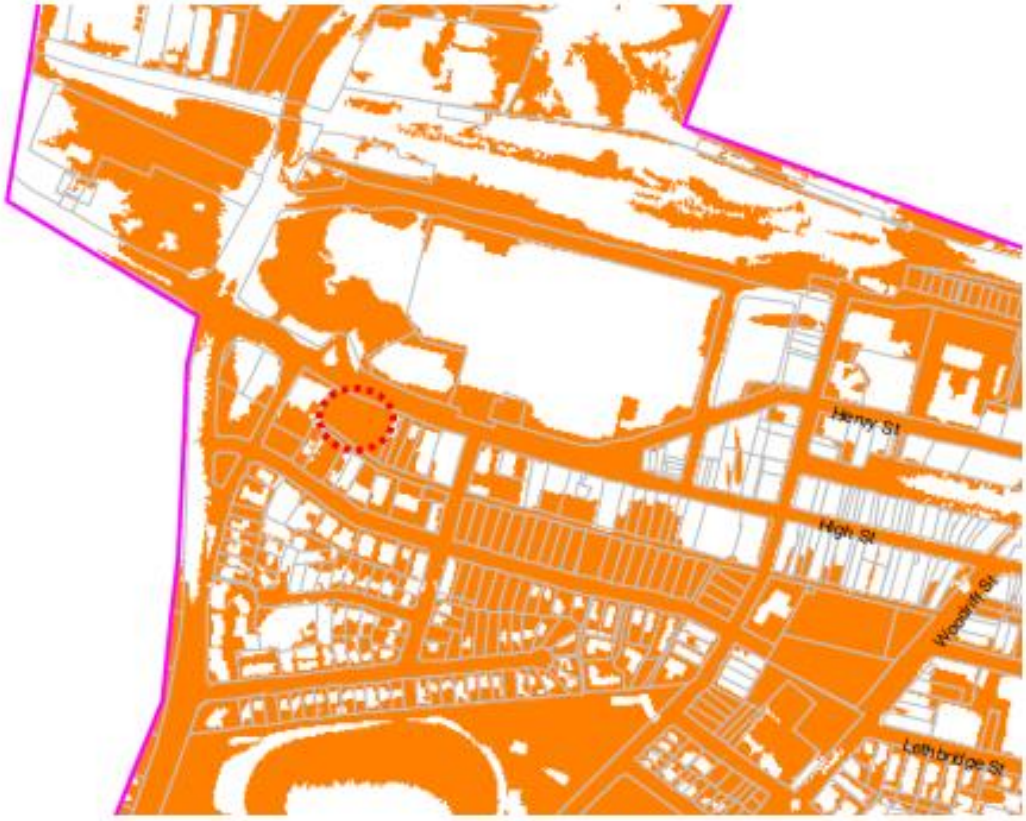


Figure 2-3 Extract of PMF Flood Extent

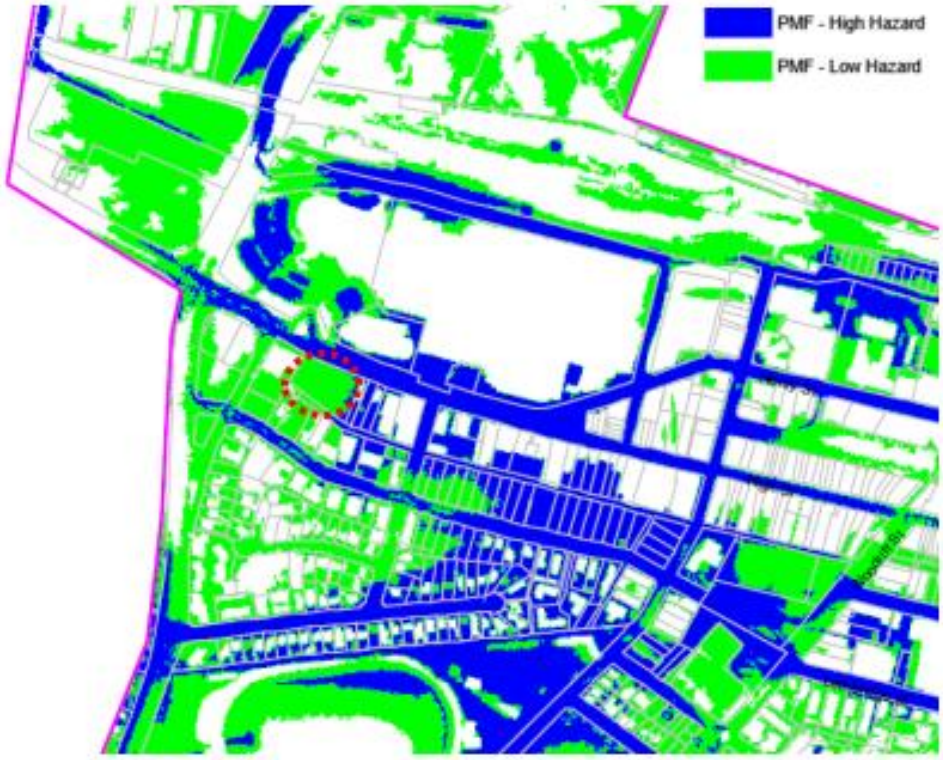


Figure 2-4 Extract of PMF Provisional Hazard

2.2 Hawkesbury-Nepean Flood Affectation

The Hawkesbury-Nepean Valley Regional Flood Study for Infrastructure NSW (dated July 2019) estimated flood extents of the river including within the Penrith CBD area. A 1% AEP river flood event does not inundate the site (noting an estimated peak flood level of about 26.0 mAHD). In a PMF event, a peak level of about 32.9 mAHD is estimated indicating a peak depth at the site of greater than 4 m.

3 DCP/LEP Requirements

Penrith City Council DCP 2014 Section C3 – Water Management provides the relevant controls for flood impact assessments. The LEP contains provisions for development on land at or below the flood planning level, defined in the LEP as the level of a 1:100 Average Recurrence Interval (ARI) (equivalent to 1% AEP) flood event plus 0.5 m freeboard.

A summary of some Penrith City Council development controls for a number of development types is presented in Table 3-1 below.

Table 3-1 Flooding Development Control Summary from Penrith DCP (2014)

Development Type	Floor Level
Residential - New Developments - Single Dwellings	Floor levels of habitable rooms shall be at least 0.5 m above the 1% AEP (100 year ARI) flood; i.e. the flood planning level. The lowest floor level of habitable rooms shall be not more than 3.0 m above ground level. A certificate, prepared by a registered surveyor to verify the lowest floor level of a habitable room of a residential building to the required Australian Height Datum (AHD) level, shall be submitted to the Council upon completion of the building to that level. The building shall not be further constructed until approval is given by Council to proceed with construction works.
Industrial/ Commercial - New Development	Floor levels shall be at least 0.5m above the 1% AEP (100 year ARI) flood or the buildings shall be flood-proofed to a least 0.5m above the 1% AEP (100 year ARI) flood. If floor levels are below the 1% AEP (100 year ARI) flood level, the text in the below cell applies.
Industrial/ Commercial - Extensions and Infill Development	Council may approve of the development with floor levels below the 1% AEP (100 year ARI) flood if it can be demonstrated by the applicant that all practical measures will be taken to prevent or minimise the impact of flooding. Council will consider matters including: • The nature of the business to be carried out; • The frequency and depth of flooding; • The potential for personal and property loss; • The utility of the building for its proposed use; • Whether the filling of the site or raising of the floor levels would render the development of the property unworkable or uneconomical; • Whether the raising of the floor levels would be out of character with adjacent buildings; and • Any risk of pollution of water from storage or use of chemicals within the building.

Regarding flood impact, the DCP (Section 3.5) requires that any development must not increase the flood hazard or risk to other properties. This includes the impact on any overland flow path. Development should not obstruct overland flow paths and must demonstrate that any overland flow is maintained for the 1% AEP event. However, Council will take a merit based approach when assessing development applications that affect the overland flow.

Filling of floodways or high hazard areas is not permitted and filling of other land at or below the flood planning level is generally not supported. However, Council will also adopt a merits based approach, including consideration of the following criteria:

- Flood levels are not increased by more than 0.1m by the proposed filling;

- Downstream velocities are not increased by more than 10% by the proposed filling;
- Proposed filling does not redistribute flows by more than 15%;
- The potential for cumulative effects of possible filling proposals in that area is minimal;
- There are alternative opportunities for flood storage;
- The development potential of surrounding properties is not adversely affected by the filling proposal;
- The flood liability of buildings on surrounding properties is not increased;
- No local drainage flow/runoff problems are created by the filling; and
- The filling does not occur within the drip line of existing trees.

The DCP has the following further requirements regarding Overland Flow Flooding (Section 2.4):

The following key principles shall also be considered in the overland flow flood study:

- All levels shown shall be to the Australian Height Datum (AHD)
- The development shall not adversely impact on surrounding properties through the diversion, concentration or ponding of overland flows (i.e. the extent, velocity and the depth of overland flow shall remain unchanged);
- The development shall not impede the passage of overland flow to cause a rise (afflux) in the water levels and / or increase velocities of flow on adjoining lands;
- The development shall accommodate the passage of overland flow over the site and, where applicable, shall be designed to withstand damage due to scour, debris and buoyancy forces;
- The development must not be sited where overland flows may result in a hazardous situation for future occupants in terms of depth and velocity of overland flows through the property (i.e. velocity-depth product greater than 0.4 is not acceptable);
- Overland flows shall be directed through common areas and not through private courtyards or on-site detention systems;
- No structures and / or filling are permitted within the overland flow path unless suitable flood mitigation measures approved by Council are to be implemented;
- Any fencing (including boundary fencing) over the extent of the overland flow path must be replaced with open style fencing or similar to allow the free passage of overland flows;
- Design elements such as concrete or paving shall be used to fix critical levels in overland flow paths to minimise interference by future occupiers; and
- Provision of adequate freeboard to finished floor levels.

4 Development Review

4.1 Flood Impact

The model results indicate the site is not inundated by flooding in a 1% AEP event with a peak flood level adjacent to the site of 27.05 mAHD. Therefore, the proposed development is not likely to have a significant impact on the 1% AEP flood behaviour. In extreme flood events, overland flow from Union Lane can flow to High Street by the new road adjacent to the site and the pedestrian laneway.

4.2 Floor Levels

The proposed development has retail and commercial units on the ground floor at a finished level of 27.55 mAHD which is the required 1% AEP peak level plus 0.5m freeboard. Other floor levels and proposed uses are summarised in Table 4-1.

Table 4-1 Proposed Floor Levels

Proposed Floor	Proposed Finished Level (m AHD)	Proposed Use / Application of Level
Ground Floor	27.55	Carparking, bike parking, retail units, residential lobby, commercial lobby, bin room, substation
Mezzanine	32.35	Carparking
Level 1	35.45	Carparking, storage cages
Level 2	38.55	Carparking, storage cages
Level 3	41.65	Carparking, bicycle storage, pool equipment room
Level 4	44.75	Commercial units, residential units, communal open space, swimming pool
Level 5	48.45	Commercial units, residential units, communal open space
Level 6	52.15	Commercial units, residential units, communal open space
Level 7	55.85	Residential units
Level 8 to Level 44	58.95 and above	Residential units

4.3 Materials and Services

Any portion of buildings subject to inundation shall be built from flood-compatible materials. All services associated with the development shall be adequately flood-proofed.

4.4 Flood Safe Access

Flood safe access and emergency egress shall be provided to all new developments. This means access that is generally considered satisfactory when the depth of flooding over vehicular driveways and roads is limited to approximately 0.25 m with low velocities.

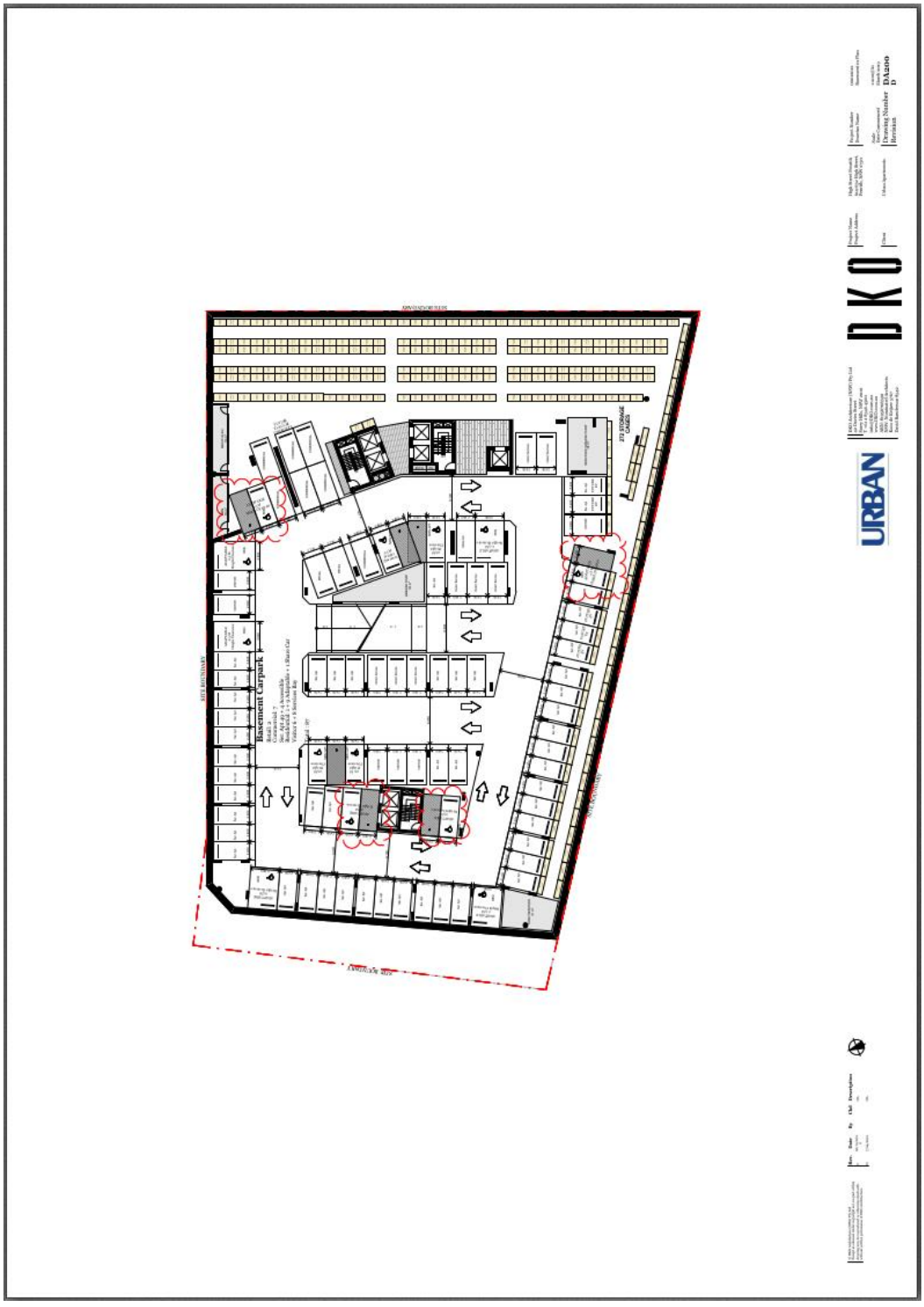
In a PMF event, the peak flood level at the site is estimated as 28.10 mAHD for a local overland flood event and 32.9 mAHD in a Hawkesbury-Nepean riverine flood event. As the proposed ground floor level is 27.55 mAHD evacuation to higher floors within the building are recommended. Moving up one level to the mezzanine level is sufficient for a local overland event and then up another level to Level 1 which is above the riverine PMF event as well.

Access to the three stairwells are located external to the building on the western, north-eastern, and south-eastern sides. The internal driveway ramp may also be used for access to higher levels (noting it has a 4:1 grade). Elevators are not recommended to be used in a flood event as the power supply may be interrupted. The communal open space on Level 4 may be a suitable refuge for longer duration flood events (such as a riverine event). It is recommended that persons already in the commercial and residential units would remain (shelter-in-place) for the duration of the flood event.

Advisory signage (of the potential risk and directional information to stairwells) is recommended as well as information for residents and owners/operators of the commercial/retail units.

A4 Appendix 4

Architectural Plan by DKO



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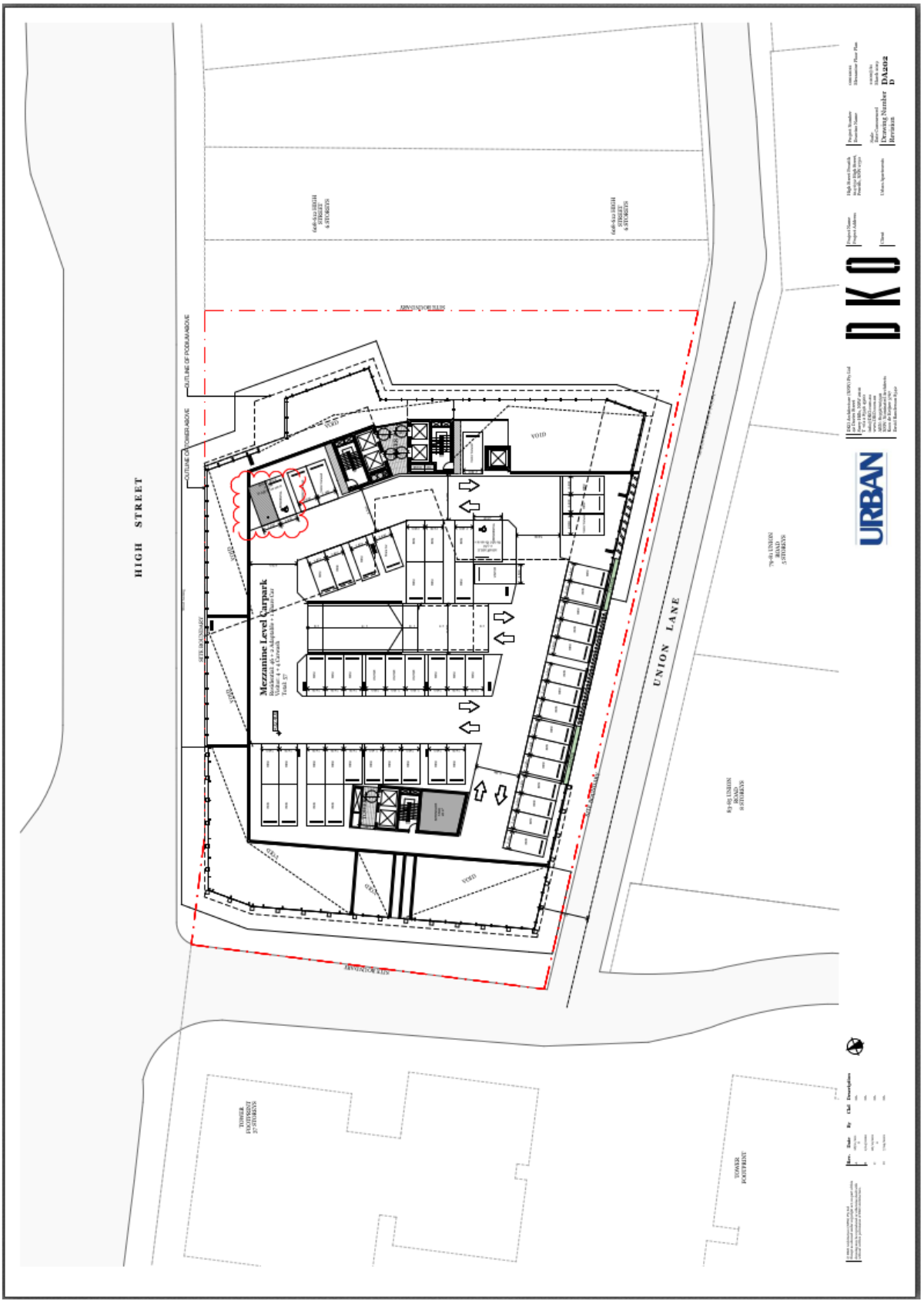

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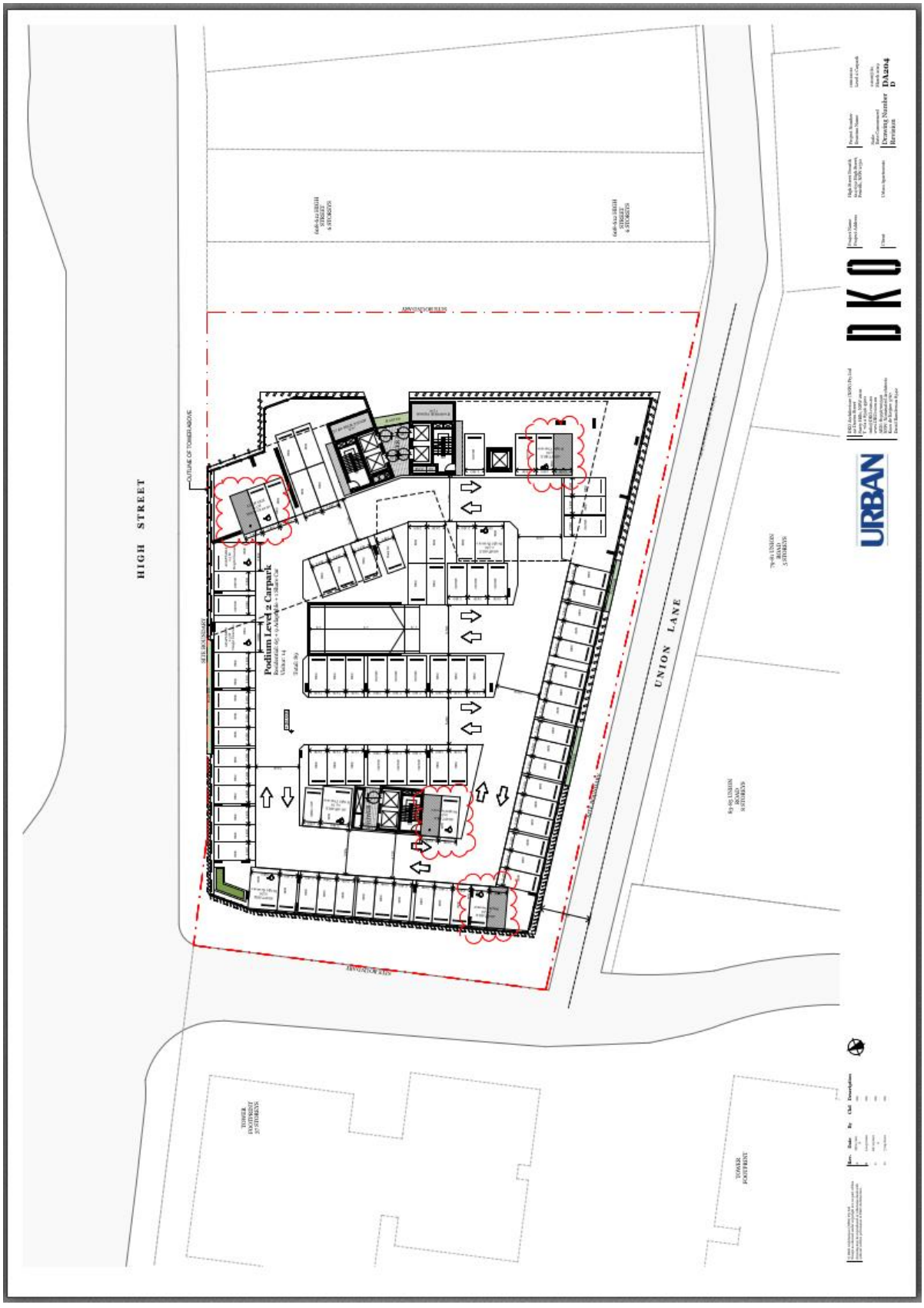

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A5 Appendix 5

Survey Plan

Figure A 5.1 Survey Plan

P: 02 8883 4239

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SGC