Civil – Traffic – Stormwater – Waste - Flood

REPORT: FLOOD STUDY REPORT

Project: 31 – 32 Park Avenue, Kingswood
(Proposed Child Care Centre Development)

Report
Version V5– August 2021
Prepared For: MIM Property Pty Ltd (DA Submission)

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Contents

1. Executive Summary

This Flood Report has been provided for the development at 31-32 Park Avenue, Kingswood to address any flood risk matters, enable the developer to set the floor levels above the proposed 100 ARI (1%) storm event and, also to provide flood protection measures if required.

Penrith City Council 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 site is affected by local overland flow flooding from Council's adopted College, Orth and Werrington Creeks flood study. An extract of the local overland flood flows through the site is provided in the Appendix.

Information provided by Council indicate that the 1% AEP water surface level affecting the site is estimated to be RL 37.3 m AHD at the front south-western corner and RL 37.2m AHD at the front south-eastern corner.

This report demonstrates that the development proposal is consistent with Council's Local Environment Plan and Development Control Plan for Flood Liable Land. This development provides flood safe access to the site in accordance with the current version of Australian Rainfall and Runoff.

All habitable floor levels are set at minimum RL 37.8 m AHD (1% AEP water surface level + 0.5m freeboard).

The basement driveway entry is located further to the east to minimise any possible conflict with flood safe access and local overland flow flooding and the crest of the access ramp to the underground basement is greater than 300mm above the top of kerb level or 300mm above the 1% AEP top water level of the 1% AEP flood event.

2. Introduction

2.1 Background

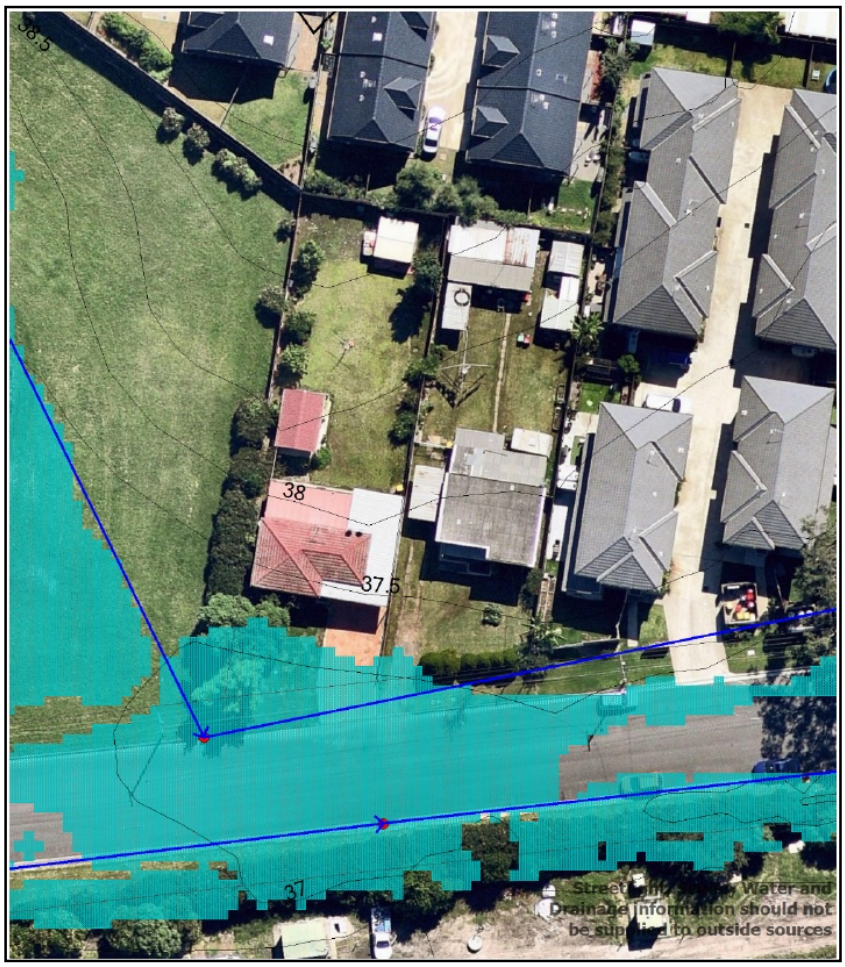
The owners of 31-32 Park Avenue, Kingswood has proposed to redevelop their property to include a Childcare Centre development and the removal on the existing dwellings. The current site is approximately 1476m^2.

The proposed number of kids at the Childcare Centre is as follows:

- 16 x 0-2 year
- 20 x 2-3 years
- 80 x 3-5 year olds and
- 16 Staff

The site flood affected by local overland flow flooding from Council's adopted College, Orth and Werrington Creeks flood study. An extract of the local overland flood flows through the site is provided below.

Figure 2.1 – Extract of Council's Flood mapping showing extend of local overland flow flooding



Information currently held by Council indicate that the 1% AEP water surface level affecting the site is estimated to be RL 37.3 m AHD at the front south-western corner and RL 37.2m AHD at the front south-eastern corner.

This report will address Council's Pre-DA notes and demonstrate that the development proposal is consistent with Council's Local Environment Plan and Development Control Plan for Flood Liable Land.

Figure 2.2 – Site Plan

Figure 2.3 – Site Frontage

2.2 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.

2.3 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 Penrith Development Control Plan 2014 C3 Water Management C3-21 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.

The proposed Childcare Centre incorporates all the above design and flood prone land policy framework to mitigate any flood risk to the development.

2.4 Study Objectives

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
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
g) effective planning and development controls; 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.

2.5 Overland Flow Flooding

Council has undertaken a Penrith Overland Flow Flood 'Overview' Study. Consideration was given to the impact on any overland flow path. Generally, Council do not support development obstructing overland flow paths.

The proposed development do not impede on the overland flow path. A driveway is proposed which has 300mm hump to ensure the overland flow do not enter the basement carpark.

The development demonstrates that any overland flow is maintained for the 1% AEP (100 year ARI) overland flow is uninterrupted.

A merit based design approach was implied on this proposed development in regards to overland flow affectation.

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 occurrences 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.

2.6 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'.

The flood impact on this property was reduced not only by appropriate location of development but also by design, layout and structure. This proposed design 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.

This development on land is not 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.

This development sets minimum floor levels at least 0.5m above the 1% AEP (100 year ARI) flood.

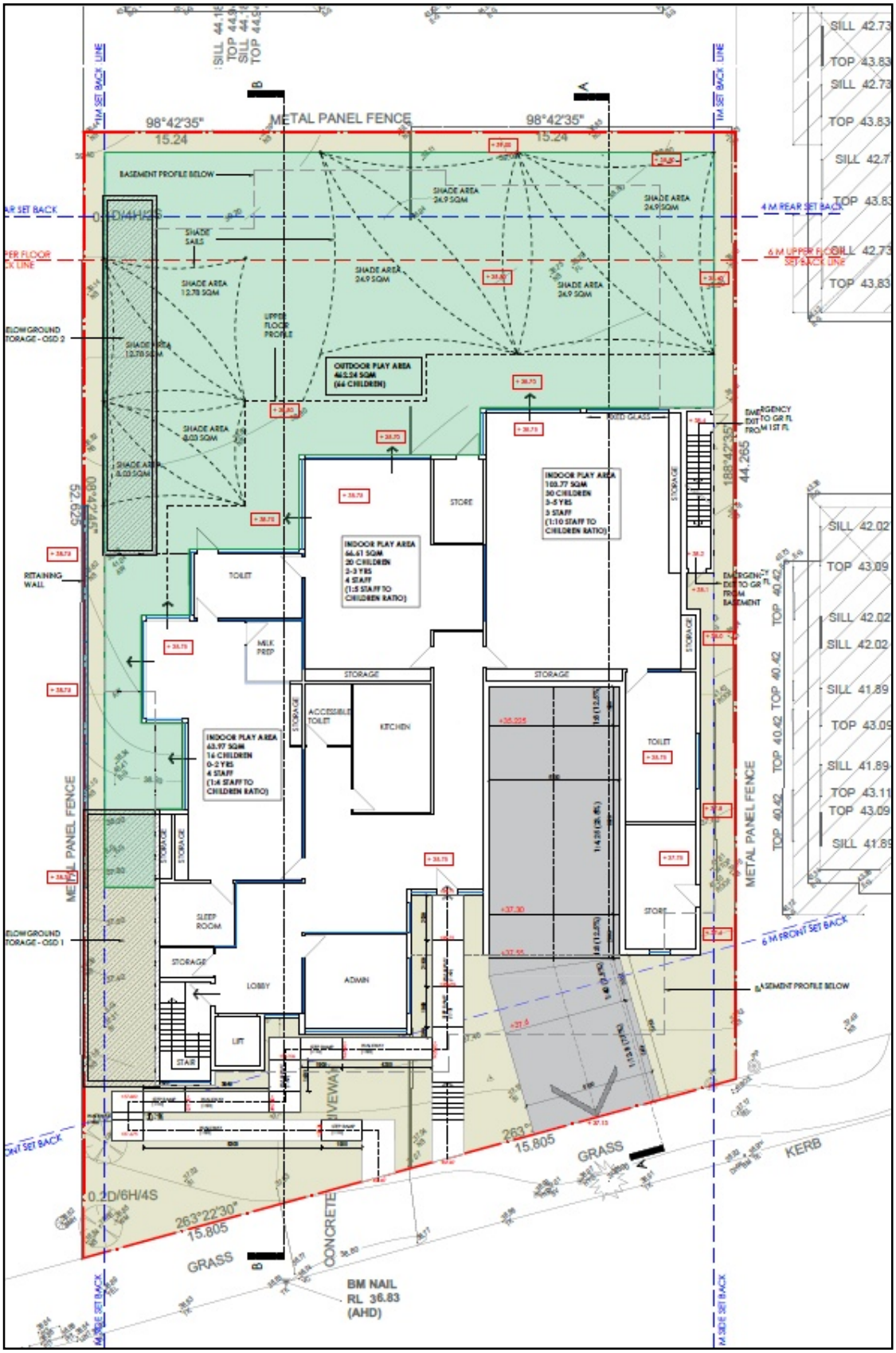
2.7 Penrith City Council Requirements

The flood information provided by Council is as follows:

- **Lot 15 DP 29528 - No. 31 Park Avenue Kingswood -** The 1% AEP local overland flow flood level affecting the above property is estimated to be RL37.2m AHD.
- **Lot 16 DP 29528 - No. 32 Park Avenue Kingswood -** The 1% AEP local overland flow flood level affecting the above property is estimated to be RL37.3m AHD.

Council requested that the applicant demonstrate that the development proposal is consistent with Council's Local Environment Plan and Development Control Plan for Flood Liable Land.

The proposed development is layout as follows:



The 1% AEP water surface level affecting the site is estimated to be RL 37.3 m AHD at the front south-western corner and RL 37.2m AHD at the front south-eastern corner. The driveway is set at minimum 300mm above the 1% AEP water surface level. All habitable floor levels are set at a minimum RL 37.8 m AHD (1% AEP water surface level + 0.5m freeboard).

The proposed design has demonstrated that the development proposal is consistent with Council's Local Environment Plan and Development Control.

The basement driveway entry is located further to the east to minimise any possible conflict with flood safe access and local overland flow flooding. The crest of the access ramp to the underground basement is greater than 300mm above the top of kerb level or 300mm above the 1% AEP top water level of the 1% AEP flood event.

All openings to the basement, including ventilation grills and the crest to any stairway, are at a minimum of 300mm above the top water level of the 1% AEP flood event.

All fencing of the area impacted by overland flows will have an open style fence to permit the passage of floodwaters.

In accordance with ARR (Australian Rainfall & Runoff) "A Guide to Flood Estimation" the safety of people in floods is of major concern in floodplain management for both rural and urban areas.

Sound floodplain management and emergency planning requires identification of the location, timing and duration of potentially hazardous floodplain areas for design flood conditions and the careful assessment of the most suitable mitigation options taking into consideration the specifics of each floodplain location.

It is also important to consider the flood flow characteristic impact on the size and height of a human being and vehicle. See Figures 6.7.4 and 6.7.9, and Tables 6.7.1, 6.7.3 and 6.7.4 below (source: ARR "A Guide to Flood Estimation")

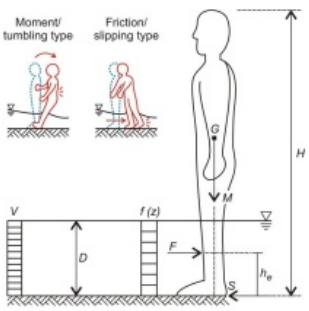


Figure 6.7.3. Typical Modes of Human Instability in Floods (Cox et al., 2010)

Table 6.7.1. Flow Hazard Regimes for People (Cox et al., 2010)

DV (m^2s^{-1})	Children (H.M = 25 to 50)[1]	Adults (H.M > 50)
0	Safe	Safe
0 - 0.4	Low Hazard if depth < 0.5m and velocity < 3m/s otherwise Extreme Hazard	Low Hazard if depth < 1.2m and velocity < 3m/s otherwise Extreme Hazard
0.4 - 0.6	Significant Hazard; Dangerous to most if depth < 0.5m and velocity < 3m/s otherwise Extreme Hazard	
0.6 - 0.8	Extreme Hazard; Dangerous to all	Moderate Hazard; Dangerous to some[2] if depth < 1.2m and velocity < 3m/s otherwise Extreme Hazard
0.8 - 1.2		Significant Hazard; Dangerous to most[3] if depth < 1.2m and velocity < 3m/s otherwise Extreme Hazard
> 1.2		Extreme Hazard; Dangerous to all

Maximum depth stability limit of 0.5 m for children and 1.2 m for adults under good condition. **Maximum velocity stability limit of 3.0 ms^{-1}** for both adults and children.

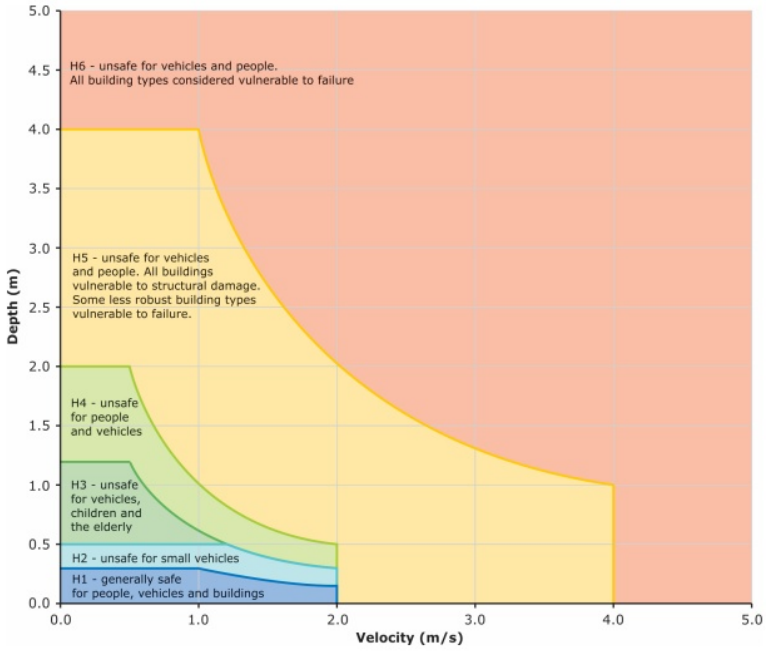


Figure 6.7.9. Combined Flood Hazard Curves (Smith et al., 2014)

Table 6.7.3. Combined Hazard Curves - Vulnerability Thresholds (Smith et al., 2014)

Hazard Vulnerability Classification	Description
H1	Generally safe for vehicles, people and buildings.
H2	Unsafe for small vehicles.
H3	Unsafe for vehicles. children and the elderly.
H4	Unsafe for vehicles and people.
H5	Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
H6	Unsafe for vehicles and people. All building types considered vulnerable to failure.

Table 6.7.4. Combined Hazard Curves - Vulnerability Thresholds Classification Limits (Smith et al., 2014)

Hazard Vulnerability Classification	Classification Limit (D and V in combination)	Limiting Still Water Depth (D)	Limiting Velocity (V)
H1	D*V ≤ 0.3	0.3	2.0
H2	D*V ≤ 0.6	0.5	2.0
H3	D*V ≤ 0.6	1.2	2.0
H4	D*V ≤ 1.0	2.0	2.0
H5	D*V ≤ 4.0	4.0	4.0
H6	D*V > 4.0	-	-

The flood levels on the proposed lots are as follows:

- **Lot 15 DP 29528 - No. 31 Park Avenue Kingswood -** The 1% AEP local overland flow flood level affecting the above property is estimated to be RL37.2m AHD.
- **Lot 16 DP 29528 - No. 32 Park Avenue Kingswood -** The 1% AEP local overland flow flood level affecting the above property is estimated to be RL37.3m AHD.

The existing round levels is around RL37.0m AHD in front of the property. This property has only slight flood affection in front of the property in regards to 1% AEP local overland flow flood level.

The limiting Still water Depth (D) is less than 300mm (0.3m).

In accordance with Figure 6.7.9 the site and adjacent public road access fall under H1 Hazard Vulnerability Classification, thus the proposed is deemed generally safe for people, vehicles and building.

(Council is also currently exhibiting until 26 August 2021 the Draft Floodplain Risk Management Study and Plan for the College, Orth and Werrington Creeks catchment and updated Peak Design Floodwater Levels for the site and road frontage during the 1% AEP flood indicated in Figure 20.2 see https://www.yoursaypenrith.com.au/project/COWCreeksFPRMS). Figure 4.2 of the Public Exhibition Draft Plan identifies a low flood hazard risk (H1 or H2) within the road reserve of Park Avenue during the 1% AEP Flood, which confirms that safe and effective evacuation is maintained to the site during the 100 year ARI flood in accordance with Council's DCP controls.)

2.8 Flood Evacuation Plan

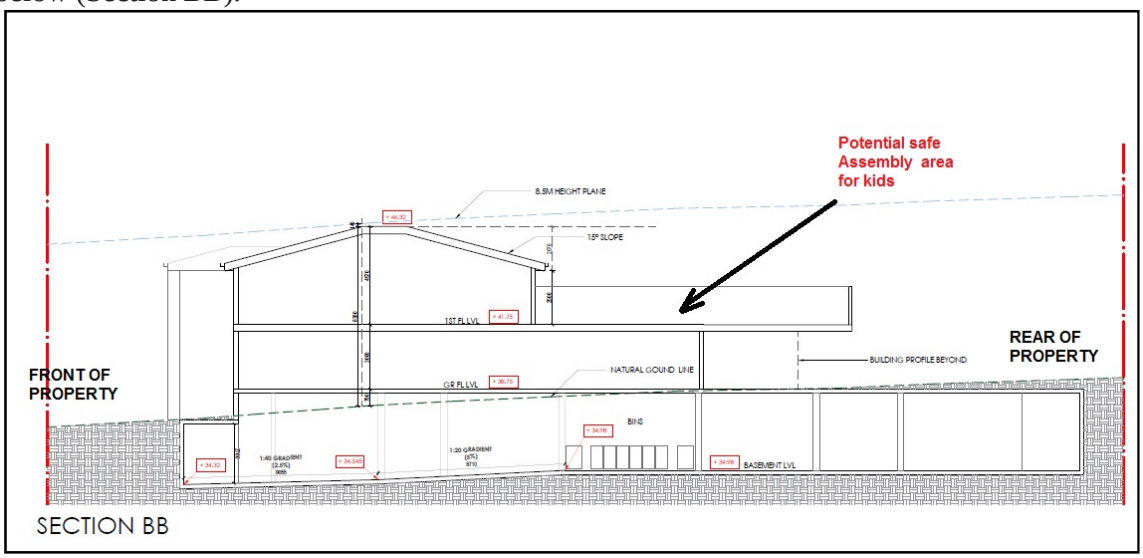
Penrith DCP 2014 Part C3.5 Water Management, Control 11(b) requires safe and effective evacuation during a 100 year ARI flood for uses such as child care that may attract large numbers of people.

Safe and effective evacuation and flood safe access to the site is achieved during a 100 year ARI flood in accordance with the current version of Australian Rainfall and Runoff as described in Section 2.7 given the site and adjacent public road access fall under low flood hazard risk and safe access to the assembly areas is as per the diagram below.

Based on the size of the catchment and the random nature of rainfall patterns, it is understood that the overland flow will rise with little to no warning. Therefore for storms above the 1% flood to the PMF, it suggests that at the very best there will be a matter of 45 minutes or less of warning for a major flood. Although this is sufficient time to escape to the buildings, the occupants and visitors would need to evacuate to higher ground within the buildings. The effective warning time is typically used to move equipment, evacuate people and transport their possessions away from flood zone. The evacuation shall be towards the rear of the property.

The safe assembly area shall also be on level 1 as shown above. This is only a precautionary area to be maintained on the site during the 100 year ARI flood as Council's available flood study data does not indicate any flooding (100 year ARI flood to PMF) behind the front building line at the rear ground level outdoor play area or ground floor of the building within the property.

Penrith DCP 2014 Part C3.5 Water Management, Control 11(b) requires safe and effective evacuation during a 100 year ARI flood for uses such as child care that may attract large numbers of people. Other safe and effective evacuation is shown in the plan below (Section BB).



The safe assembly area shall also be on level 1 as shown above. This is only a precautionary area to be maintained on the site during the 100 year ARI flood as the available Council's flood study data do not impede on the flooding (100 year ARI flood) within the property.

2.9 Construction Materials

As part of the Flood Risk Assessment, recommendations are provided on the types of materials to be used in construction to ensure that structural integrity of the building is maintained during a flood event.

Various types of loads must be considered in the design of the proposed building in relation to flood protection. These include:

Impact loading caused by debris carried by flood waters;

- Uplift or buoyancy forces;
- Hydrostatic forces; and
- Hydrodynamic forces.

The structure will be designed in accordance with AS1170 for the types of loadings listed above for all flood events up to the PMF.

The hydrostatic and hydrodynamic forces caused by the rising flood water surrounding the structure are the most critical forces in terms of damage they can cause to the structure. Because of this the structural engineer will need to ensure the building's structure retains integrity during flooding. Impact loading in this area should not be a major issue.

In addition to potential loadings due to flooding, construction materials must be durable for short term duration immersion in flood waters. This would include all structural components being constructed from reinforced concrete, bricks or reinforced masonry blocks.

3. Conclusion

- The development will not increase the flood hazard or risk to other properties
- The structure of the proposed building works shall be adequate to deal with flooding situations
- The proposed building materials are suitable
- The building is sited in the optimum position to avoid flood waters and allow safe flood access for evacuation;
- The proposed redevelopment will not expose any occupant to unacceptable levels of risk or any property to unreasonable damage. The driveway is proposed on the east end of the property with the design hump height greater than 300mm of the 100 year ARI flood levels to protect any influx of the flood overland water entering into the basement carpark.

- 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).
- The proposed design has demonstrated that the development proposal is consistent with Council's Local Environment Plan and Development Control.
- The proposed design incorporates all matters raised in Council's Pre-lodgement Advice dated 11 May 2021.

It is considered that the flood affectation within the front setback area of the site is considered minor based on Council's flood advice and that the proposal has been designed to satisfactorily mitigate potential flood risk based on the proposed floor levels and that the proposal is not considered likely to result in any adverse flooding impacts.

(Council is also currently exhibiting until 26 August 2021 the Draft Floodplain Risk Management Study and Plan for the College, Orth and Werrington Creeks catchment and updated Peak Design Floodwater Levels for the site and road frontage during the 1% AEP flood indicated in Figure 20.2 see https://www.yoursaypenrith.com.au/project/COWCreeksFPRMS), Figure 4.2 of the Public Exhibition Draft Plan identifies a low flood hazard risk (H1 or H2) within the road reserve of Park Avenue during the 1% AEP Flood, which confirms that safe and effective evacuation is maintained to the site during the 100 year ARI flood in accordance with Council's DCP controls.)

Appendix A – Flood Information – 31 Park Avenue, Kingswood

PENRITH

Flood Information
Lot 15 DP 29528 - No. 31 Park Avenue Kingswood

Date of issue: 15 September 2020

The 1% AEP local overland flow flood level affecting the above property is estimated to be RL37.2m AHD.

Property less than 0.5m above the 1% AEP flood level is subject to Penrith Development Control Plan 2014 Section C3.5 Flood Planning. The Penrith Development Control Plan 2014 is available from Council's website www.penrithcity.nsw.gov.au.

Definitions

AEP – *Annual Exceedance Probability* – the chance of a flood of this size occurring in any one year.

AHD – *Australian Height Datum* – A standard level datum used throughout Australia, approximately equivalent to mean sea level.

Legend

	Extent of 1% AEP local catchment overland flow path. Generally depths less than 150mm is not shown.

Notes:

1. The contours shown above in yellow numbering are at 0.5m intervals and are based on Aerial Laser Scanning (ALS) Survey undertaken in 2002. The contour levels are approximate and for general information only. Accurate ground levels should be obtained by a Registered Surveyor.
2. The flood level is based on current information available to Council at the date of issue. The flood level may change in the future if new information becomes available. The 1% AEP flood is the flood adopted by Council for planning controls. Rarer and more extreme flood events will have a greater effect on the property.
3. Council's studies are reflected in flood mapping for the City which show properties potentially affected by overland flows in excess of 150mm.
4. This property is shown on Council's flood mapping as potentially so affected.
5. Council imposes flood related development controls where, in its opinion, such controls are justified. Such controls may or may not be imposed with respect to this property in the event of an application for development consent.
6. If a development proposal is submitted with respect to this property, Council will consider the possibility of flood or overland flow in the context of the application. Council may impose a requirement that the applicant for development consent carry out a detailed assessment of the possible overland water flows affecting the property (a flood study) and/or may impose other controls on any development designed to ameliorate flood risk.
7. You are strongly advised if you propose to carry out development upon the property, that you retain the assistance of an experienced flooding engineer and have carried out a detailed investigation.
8. Council accepts no liability for the accuracy of the flood levels (or any other data) contained in this certificate, having regard to the information disclosed in Notes "1" to "4". As such you should carry out and rely upon your own investigations.

[redacted]

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Appendix B – Flood Information – 31 Park Avenue, Kingswood

PENRITH

Flood Information
Lot 16 DP 29528 - No. 32 Park Avenue Kingswood

Date of issue: 15 September 2020

The 1% AEP local overland flow flood level affecting the above property is estimated to be RL37.3m AHD.

Property less than 0.5m above the 1% AEP flood level is subject to Penrith Development Control Plan 2014 Section C3.5 Flood Planning. The Penrith Development Control Plan 2014 is available from Council's website www.penrithcity.nsw.gov.au.

Definitions

AEP – *Annual Exceedance Probability* – the chance of a flood of this size occurring in any one year.

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