

# Flood Impact and Risk Assessment

**6-8 Julius Avenue North Ryde**

Prepared for **ISPT** / 20 June 2025

241920

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## Glossary and Abbreviations

|                               |     |                                                                                                                                                                                                                                                                                                                      |
|-------------------------------|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Annual Exceedance Probability | AEP | The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage                                                                                                                                                                                                         |
| Australian Height Datum       | AHD | A common national surface level datum often used as a referenced level for ground, flood and flood levels, approximately corresponding to mean sea level.                                                                                                                                                            |
| Average Recurrence Interval   | ARI | The long-term average number of years between the occurrence of a flood equal to or larger in size than the selected event. ARI is the historical way of describing a flood event. AEP is generally the preferred terminology.                                                                                       |
| Bureau of Meteorology         | BoM | An executive agency of the Australian Government responsible for providing weather services to Australia and surrounding areas.                                                                                                                                                                                      |
| Critical Duration             |     | The critical duration is the storm duration for a given event magnitude that provides for the peak flood conditions at the location of interest.                                                                                                                                                                     |
| Development Control Plan      | DCP | A Development Control Plan is a document prepared by the Council which provides detailed guidelines which assist a person proposing to undertake a development. A DCP must be consistent with the provisions and objectives of a Local Environmental Plan (LEP).                                                     |
| Finished Floor Level          | FFL | The level, or height, at which the floor of a building or structure (including alterations and additions) is proposed to be built.                                                                                                                                                                                   |
| Flood hazard                  |     | A source of potential harm or a situation with a potential to cause loss of life, injury and economic loss due to flooding. Flood hazard is defined as a function of the relationship between flood depth and velocity.                                                                                              |
| Flood Planning Level          | FPL | The combination of the flood level from the defined flood event and freeboard selected for flood risk management purposes.                                                                                                                                                                                           |
| Freeboard                     |     | A factor of safety typically used in relation to the setting of floor levels or levee crest levels. Freeboard provides a factor of safety to compensate for uncertainties in the estimation of flood levels across the floodplain, such as wave action, localised hydraulic behaviour etc.                           |
| Local Environmental Plan      | LEP | LEPs provide a framework that guides planning decisions for local government areas through zoning and development controls. Zoning determines how land can be used (for example, for housing, industry, or recreation).                                                                                              |
| Probable Maximum Flood        | PMF | The largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation. Generally, it is not physically or economically possible to provide complete protection against this event. The PMF defines the extent of flood prone land, that is, the floodplain. |

|                                 |     |                                                                                                                                                                                                                                          |
|---------------------------------|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Representative<br>Concentration | RCP | RCPs make predictions of how concentrations of greenhouse gases in the atmosphere will change in future as a result of human activities. The four RCPs range from very high (RCP8.5) through to very low (RCP2.6) future concentrations. |
| Pathways                        |     |                                                                                                                                                                                                                                          |

## Executive Summary

This Flood Impact and Risk Assessment (FIRA) has been prepared in support of a State Significant Development Application (SSD-80018208) for the proposed Julius Avenue Data Centre, located at 6–8 Julius Avenue, North Ryde. The proposed development comprises basement car parking, two data halls, an electricity generation gantry accommodating 12 generator units, a separate Ausgrid Sub-Transmission Switching Station (STSS), and a main switchboard room, along with associated site works and landscaping.

The assessment has been undertaken in accordance with the NSW Department of Planning and Environment's Flood Impact and Risk Assessment Guideline (LU01), Ryde Council's Development Control Plan (DCP), and the requirements set out in the Secretary's Environmental Assessment Requirements (SEARs). The study area is identified as a low flood risk zone, with the predominant flood hazard classified as H1 — indicating conditions that are generally safe for people, vehicles, and buildings.

Flood modelling has been completed using the updated TUFLOW hydraulic model (2025.0.0-iSP-w64) to improve reliability and address previous anomalies. The model incorporated existing and post-development site conditions, as well as climate change scenarios, blockage sensitivity tests, and Probable Maximum Flood (PMF) events. The results indicate that the majority of the site experiences shallow flooding (generally <50 mm) with low velocities (<0.5 m/s), and that no significant afflux is generated by the development. Localised afflux within the site boundary is attributed to increases in surface elevation in the post-development digital terrain model and does not reflect true hydraulic impact.

### Key flood mitigation measures include:

- Installation of two new drainage lines on the eastern and western sides of the site.
- Four additional stormwater pits along Julius Avenue.
- Upgrading three drainage pipes to 525 mm diameter.
- Construction of a 0.5 m high wall adjacent to the cul-de-sac to the south to reduce local afflux.

The finished floor level of the main building entrance is 48.0 m AHD. The 1% AEP and PMF flood level at this location is 47.60 m AHD. The higher of the two flood planning levels—either 1% AEP + 300 mm or PMF—is 47.90 m AHD, which remains below the adopted finished floor level.

Based on the modelling outcomes and proposed mitigation measures, the development is demonstrated to have no adverse flood impacts on adjacent or downstream properties and satisfies both Council and SEARs flood risk requirements. The site can be developed and operated safely, with appropriate design measures to manage residual flood risk.

## 1.0 Introduction

### 1.1 Project Introduction

This Flood Impact and Risk Assessment (FIRA) has been prepared to support the detailed State Significant Development Application (SSDA) for the proposed Julius Avenue Data Centre at 6–8 Julius Avenue, Ryde (SSD-80018208). The application seeks approval for the construction and operation of a data centre, including site preparation works, bulk earthworks, infrastructure, building construction, ancillary facilities, and associated site works. The application also includes the delivery of one internal road.

This FIRA has been prepared in accordance with the Flood Impact and Risk Assessment Guideline – LU01. The assessment considers the flood planning level as defined in the relevant Council Local Environmental Plan (LEP) and applicable State Environmental Planning Policies (SEPPs). It also addresses site-specific flood risks based on available flood studies, the potential impacts of climate change, and relevant provisions of the NSW Flood Risk Management Manual.

This assessment identifies the potential flood impacts associated with the proposed development and evaluates the corresponding flood risks under existing and future conditions. It considers site topography, catchment behaviour, overland flow characteristics, stormwater management needs, and infrastructure integration. The report also outlines appropriate flood risk mitigation and management measures consistent with applicable guidelines. These may include design responses, flood or property modification measures, operational procedures, and where necessary, the development of a Flood Emergency Response Plan.

The objective of this FIRA is to demonstrate that the proposed development can be safely, sustainably, and compatibly integrated into the floodplain without increasing flood risk to the site or surrounding areas.

### 1.2 SEARs Response

This report has been prepared in response to the Secretary's Environmental Assessment Requirements (SEARs) dated 20 February 2025, issued for the State Significant Development Application (SSD-80018208). Specifically, it addresses the flood-related requirements outlined in Table 1 of this report.

Table 1: SEARS Requirement

| Item            | Description of Requirement                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Section Reference (this Report)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Flooding</b> | <p>Identify the flood planning level as set out in the relevant council LEP or SEPP and identify any:</p> <ul style="list-style-type: none"> <li>• flood risks on site having regard to adopted flood studies</li> <li>• the potential effects of climate change, and</li> <li>• any relevant provisions of the NSW Flood Risk Management Manual</li> </ul> <p>Where the development is occurring on flood prone land a flood impact and risk assessment (FIRA) must be prepared having regard to the Flood Impact and Risk Assessment Guideline - LU01 (FIRA guide). When determining the scope and category of the FIRA the requirements outlined in the FIRA guide must be considered.</p> <p>Detail any flood risk management measures that are to be incorporated as part of the development having regard to relevant guidelines (including any design solutions, flood modification measures, property modification measures, operational procedures or Flood Emergency Response Plan).</p> | <p>The site is subject to shallow overland flow during the 1% AEP event, with low depths (&lt;50 mm) and velocities (&lt;0.5 m/s), resulting in a low flood hazard classification (H1). Under the 1% AEP climate change scenario, a slight increase in flood depth and extent is observed; however, the site remains within the H1 hazard classification.</p> <p><b>Section Reference (this Report): Sections 4.3 and 5.0</b></p> <p><b>Finished Floor Levels:</b></p> <p>The main entrance FPL is set at 48.0 m AHD. The 1% AEP and PMF flood level at this location is 47.60 m AHD. The higher of the two flood planning levels—either 1% AEP + 300 mm or PMF—is 47.90 m AHD, which remains below the adopted finished floor level.</p> <p><b>Section Reference (this Report): Section 3.0</b></p> <p>Flood modification measures include upgraded drainage lines and pipes, additional stormwater pits.</p> <p><b>Section Reference (this Report): Section 3.0 and Section 6.0</b></p> <p>A separate Flood Emergency Response Plan (FERP) will be prepared specifically for this project to address site-specific flood safety and operational procedures.</p> |

1.3 Flood Risk Management Measures

This section outlines the key flood risk management measures proposed for the site to mitigate flood impacts and ensure the safety and resilience of the development.

The primary objectives of the proposed flood mitigation measures are to:

- Minimise flood risk to property and people,
- Ensure compliance with relevant flood planning controls,
- Maintain or improve local flood behaviour,
- Reduce risk of property damage during flood events.

The table below summarises the key flood mitigation measures implemented as part of the development:

Table 2- Mitigation Measures

| Mitigation Measure                                 | Description                                                                                 |
|----------------------------------------------------|---------------------------------------------------------------------------------------------|
| Installation of two new drainage lines             | Located on the eastern and western sides of the site to improve conveyance of local runoff. |
| Four additional stormwater pits                    | Positioned along Julius Avenue to increase capture of surface water and reduce ponding.     |
| Upgrade of three drainage pipes to 525 mm diameter | Enhancing pipe capacity to better accommodate peak stormwater flows.                        |
| Construction of a 0.5 m high wall to the south     | A flood barrier wall near the cul-de-sac to limit localised afflux.                         |

The implementation of these measures is expected to reduce the extent and depth of surface flooding around the site, improve drainage system performance, and minimise flood-related impacts on surrounding roads and properties.

2.0 The Site

The subject site is located at 6–8 Julius Avenue, North Ryde, within the City of Ryde Local Government Area (LGA). It is legally described as Lot 89 in Deposited Plan (DP) 1082131 and occupies an area of approximately 28,630 m². The site is situated between Rivett Road and Richardson Place, within the Macquarie Park Corridor—an established employment precinct recognised for its focus on innovation and technology-based industries. An aerial image of the site is provided in Figure 1.



Figure 1- Aerial Photograph of Existing Site (Source: Urbis GIS 2023)

Macquarie Park is identified as a nationally significant research and employment centre and accommodates the headquarters of several major organisations, including Foxtel, Optus, and FUJIFILM. The site is approximately 4.5 km southeast of Macquarie University and 4.0 km southeast of Macquarie Shopping Centre.

The site is currently characterised as largely greenfield and undeveloped, with a small number of enclosed structures. The northern portion of the site consists of a relatively level benched area, which slopes steeply towards the southern boundary.

Vehicle access is currently provided via an existing easement along the western boundary of the site, connecting to Julius Avenue. This easement is shared with the adjoining Lot 10 in DP 876736. Additional vehicle access is available via the eastern cul-de-sac located within Lot 12 in DP 876736. This access road is an extension of Richardson Place and is subject to an access easement (DP 1003588), which nominates the City of Ryde Council as a beneficiary, thereby permitting access for public use.

At the southern end of the cul-de-sac, a further easement extends through the 6–8 Julius Avenue site, providing vehicular access to the adjacent national park. This easement also accommodates drainage infrastructure and overhead electrical services.

The site is well serviced by public transport, including the recently completed North Ryde Metro Station and the 514-bus route along Delhi Road. It is also located in close proximity to major road infrastructure, including Epping Road and the M2 Motorway.

### 3.0 Flood Planning Requirements

The Ryde Council Development Control Plan (DCP) has been referenced for this study. The DCP categorises flood risk into three levels—high, medium, and low—based on flood velocity and depth, as well as whether the area is within an overland flow precinct. As the site is only subject to sheet flow and the associated flood hazard is classified as H1, it is considered a low flood risk area.

The DCP also classifies buildings into three categories: (1) residential; (2) commercial or industrial; and (3) recreational, non-urban, or sensitive uses and facilities. The proposed building is classified as commercial or industrial, and the corresponding flood-related controls from the DCP are applied to this development are shown in the Table 3.

*Table 3- DCP requirement*

|   | Control                                        | Requirement                                                                                                                                                                                                                                                                                                                                                         |
|---|------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Commercial development on high flood risk land | Not permitted unless it can be clearly demonstrated that the development: <ul style="list-style-type: none"><li>- Does not jeopardize public safety and access</li><li>- Does not cause property damage</li><li>- Does not worsen pre-developed flood regime</li></ul> This must be shown via a Flood Impact Statement.                                             |
| 2 | Floor levels                                   | All habitable and non-habitable rooms must meet the flood freeboard requirements in Table 2-1 of the Stormwater Technical Manual. A lesser level may be considered under specific conditions (e.g. public space, accessibility).                                                                                                                                    |
| 3 | New structures subject to floodwaters          | Must be designed to withstand hydrodynamic and hydrostatic forces. This includes: <ul style="list-style-type: none"><li>- Compliance with the Stormwater Technical Manual</li><li>- Structural engineer certification for design against 100yr ARI flood forces</li></ul>                                                                                           |
| 4 | No adverse flood impact                        | Development must not worsen existing flood regimes by redirecting flows or reducing flood storage. The Flood Impact Statement must show that the development will: <ul style="list-style-type: none"><li>- Reduce flood storage at pre-development levels</li><li>- Not increase flood levels or velocities that could adversely affect nearby properties</li></ul> |



|   |                                  |                                                                                                                                                                                          |
|---|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5 | Material storage                 | All materials must be stored above the minimum habitable floor level. Exceptions may apply in Overland Flow Precincts (minimum 500 mm above ground) if flood resilience is demonstrated. |
| 6 | Subdivision in flood-prone areas | Must show that new lots are suitable for development and won't increase flood risk.                                                                                                      |
| 7 | Land use restriction             | Conditions may be imposed to ensure safe future use of flood-prone land and prevent significant modifications without reassessment.                                                      |

Additionally, in accordance with Table 2-1 of the Stormwater Technical Manual, a minimum freeboard of 300 mm is required and has been applied to this project This is presented in Table 3.

Table 4- Freeboard required based on the Council DCP

| Drainage System/ Overland Flow                                    | Residential               |                                                                                      |                                    | Industrial/ Commercial    |             |
|-------------------------------------------------------------------|---------------------------|--------------------------------------------------------------------------------------|------------------------------------|---------------------------|-------------|
|                                                                   | Land Level <sup>(b)</sup> | Habitable Floor Level                                                                | Non-Habitable Level <sup>(c)</sup> | Land Level <sup>(b)</sup> | Floor Level |
| Surface Drainage/ adjoining ground level <sup>(a)</sup>           | -                         | .15m                                                                                 | -                                  | -                         | .15m        |
| Public drainage infrastructure, creeks and open channels          | 0.5m                      | 0.5m                                                                                 | 0.1m                               | 0.3m                      | 0.3m        |
| Flooding and Overland Flow (Overland Flow Precincts and Low Risk) | N/A                       | 0.3m                                                                                 | 0.15m                              | N/A                       | 0.3m        |
| Flooding and Overland Flow (Medium Risk and greater)              | N/A                       | 0.5m                                                                                 | 0.3m                               | N/A                       | -           |
| Onsite Detention <sup>(d)</sup>                                   | N/A                       | 0.2m                                                                                 | 0.1m                               | N/A                       | 0.2m        |
| Road Drainage<br>Minor Systems (Gutter and pipe flow)             |                           | 0.15m below top of grate                                                             |                                    |                           |             |
| Road Drainage                                                     |                           | Refer to Figure 2-1.                                                                 |                                    |                           |             |
| Detention Basins <sup>(4)</sup>                                   |                           | The top water level shall be designed to be 0.5m below top of embankment (100yr ARI) |                                    |                           |             |

Table 2.1 Freeboard requirements.



Also based on the information which is provided by the council these requirements are required:

*Table 5 Council requirements*

| Requirement No. | Description                                                                                                                                                                                                                                                 |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1               | A HEC-RAS / TUFLOW 2D computer model analysing pre- and post-development scenarios must be provided to confirm that the proposal does not adversely impact adjacent properties.                                                                             |
| 2               | Electronic copies of the hydraulic model (HEC-RAS/TUFLOW) shall be submitted to Council.                                                                                                                                                                    |
| 3               | Full executable TUFLOW modelling files (compatible with QGIS), including batch files and flood difference files identifying each scenario, must be submitted.                                                                                               |
| 4               | Electronic modelling results for pre- and post-development (velocity, depth, flood level, VxD, VxD afflux, flood level afflux for 1% AEP in .asc format) must be submitted.                                                                                 |
| 5               | If HECRAS 2D is used, full executable model files compatible with QGIS, clearly identifying each scenario, must be submitted.                                                                                                                               |
| 6               | Attach the Council flood level certificate used to calibrate the model to the report.                                                                                                                                                                       |
| 7               | Clearly show pre- and post-development flood levels inside the property and on adjacent properties.                                                                                                                                                         |
| 8               | Flood levels must be shown at 0.2 m contour intervals. Afflux maps for 1% AEP must show 10–20 mm intervals. VxD maps at 0.2 m <sup>2</sup> /s intervals. VxD afflux maps at 0.04–0.05 m <sup>2</sup> /s intervals. Impacts must be described in the report. |
| 9               | All cut and fill must be represented in the flood model.                                                                                                                                                                                                    |
| 10              | VD (velocity x depth) product of overland flow must be provided. Any increase inside the site must remain below 0.4 m <sup>2</sup> /s. No increase is permitted on neighbouring properties.                                                                 |
| 11              | The development must not worsen flooding conditions on adjacent properties or downstream catchment for both 1% AEP and PMF events.                                                                                                                          |
| 12              | If basements are proposed, the ramp crest must be raised to the PMF level before descending.                                                                                                                                                                |
| 13              | All basement openings (e.g. vents, emergency exits) must be above the PMF level.                                                                                                                                                                            |
| 14              | A cross-section of the basement ramp must show the crest level reaching the PMF level.                                                                                                                                                                      |
| 15              | A certificate from a flood engineer is required stating that basement openings are not inundated during the PMF event.                                                                                                                                      |

For this site, the Flood Planning Level has been set based on either the maximum PMF flood level or the 1% AEP flood level plus 300 mm, whichever is higher, in line with industry-accepted practice.

The basement entry is located on the southern side of the proposed development and is not affected by flooding.

The proposed development will include basement car parking and tank rooms, two data halls, an electricity generation gantry designed to accommodate 12 generator units, a loading dock, associated landscaping, an access road connecting the existing road to the west with the Richardson Place cul-de-sac to the east, and a separate Ausgrid Sub-Transmission Switching Station (STSS) along with a main switchboard room.

Figure 2- 3d View of the Proposed Development (Provided Green Box Architecture)

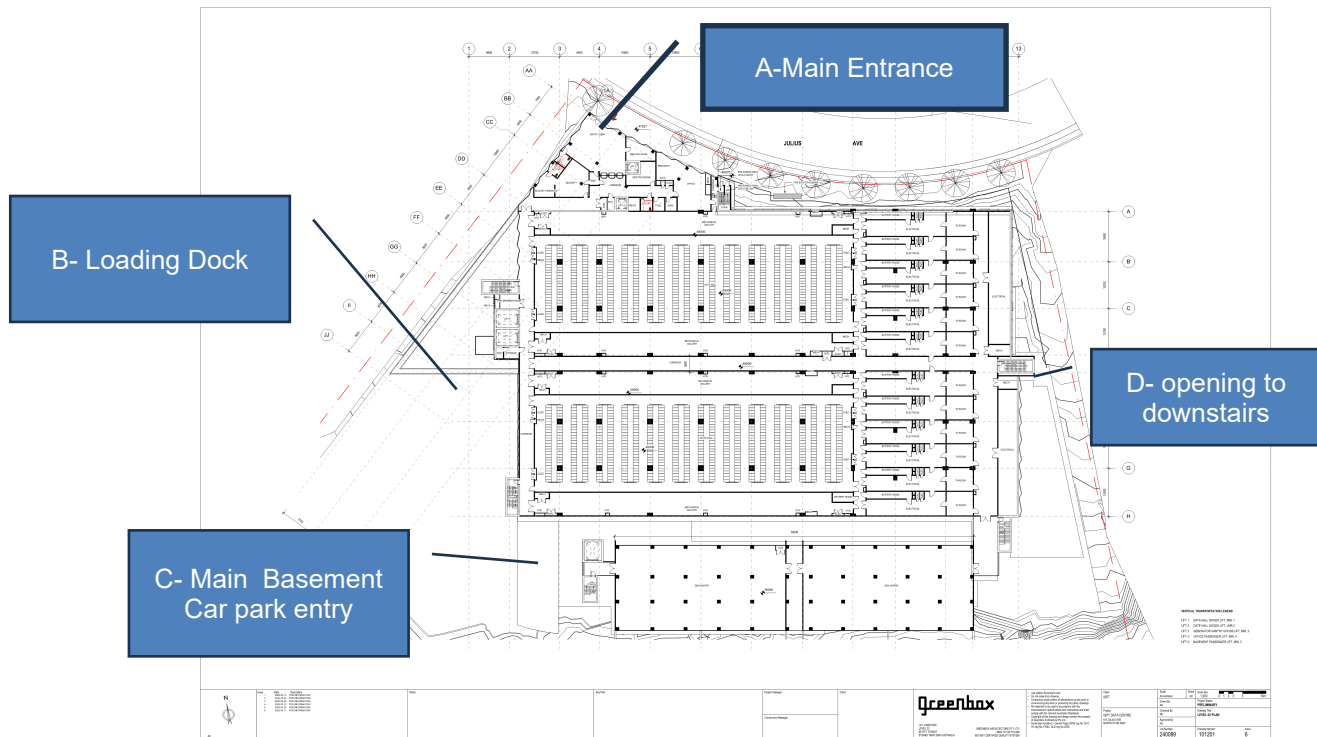


Figure 3- Level 2 Floor Plan (Provided Green Box Architecture)

Table 6- Flood Impact and Mitigation Recommendations for Key Site Access Points

| ID | Location               | Flood Conditions                              | Recommendation                                                                                                                                                                                                                              |
|----|------------------------|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A  | Main Entrance          | Julius avenue impacted by 1% and PMF Flooding | Both the PMF and 1% AEP flood levels are 47.60 m AHD. For this study, the higher of the two flood planning levels—either the 1% AEP + 300 mm freeboard or the PMF—has been adopted as the Flood Planning Level (FPL), which is 47.90 m AHD. |
| B  | Loading Dock           | Not Impacted                                  | -                                                                                                                                                                                                                                           |
| C  | Basement Carpark Entry | Not Impacted                                  | -                                                                                                                                                                                                                                           |
| D  | Opening to downstairs  | Not Impacted                                  | -                                                                                                                                                                                                                                           |

The floor plan is set at Level 2 with a finished floor level of 48.00 mAHD, which is where the main entrance is located. The 1% AEP flood level and PMF level at this location are both 47.60 mAHD. As a result, the proposed floor level meets the 300 mm freeboard requirement above the 1% AEP flood level, which would require a minimum level of 47.90 mAHD.

## 4.0 Hydraulic and Hydrologic Modelling

### 4.1 Council Hydraulic Model

The Macquarie Park Floodplain Risk Management Study and Plan, along with the associated hydraulic model, has been adopted for this assessment. The model was originally developed using the TUFLOW 2008-08-DB-iSP build. During afflux mapping for the post-development versus existing scenario without any mitigation measures, afflux values exceeding 10 mm were observed near the model extent in areas where no actual impacts are expected. This modelling anomaly is illustrated in Figure 4.

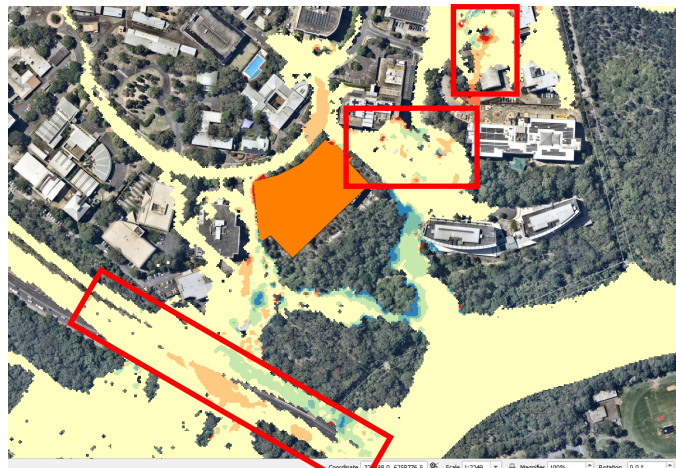


Figure 4- Afflux anomaly around the model ( 2008 TUFLOW Build)

Consequently, the model was upgraded to the latest TUFLOW build (2025.0.0-iSP-w64) to resolve existing errors and recalibrate the results by adjusting Manning's values. Although the outputs were found to be relatively insensitive to these parameter changes, the afflux issue was successfully resolved in the updated version. This is shown in Figure 5.

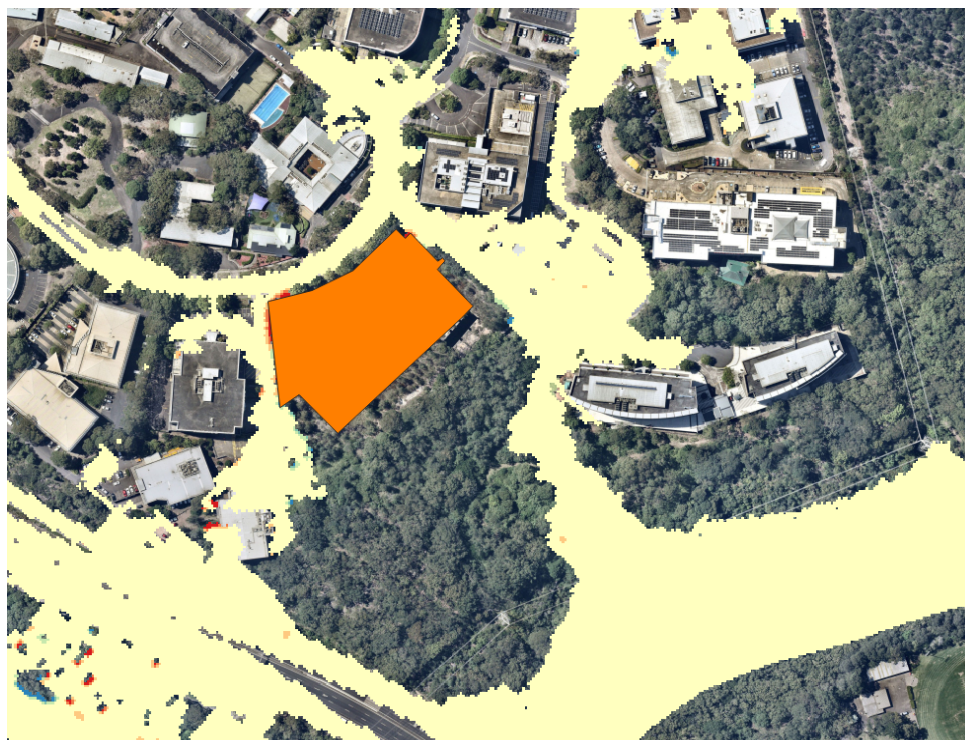


Figure 5- Afflux map around the model (2025 TUFLOW Build)



A PO line was placed within the site, as shown in Figure 6 and Figure 7. Flow comparisons for the 1% AEP event indicate that the results from the 2008 TUFLOW model build are higher than those from the 2025 version as it shown in Figure 8.

The model shows a sudden rise in flow, followed by a similar falling limb in both versions, tapering off at approximately 0.5 m<sup>3</sup>/s.

A comparison of the 1% AEP flood level and depth maps generated using the two TUFLOW builds is presented in Figure 6 and Figure 7.

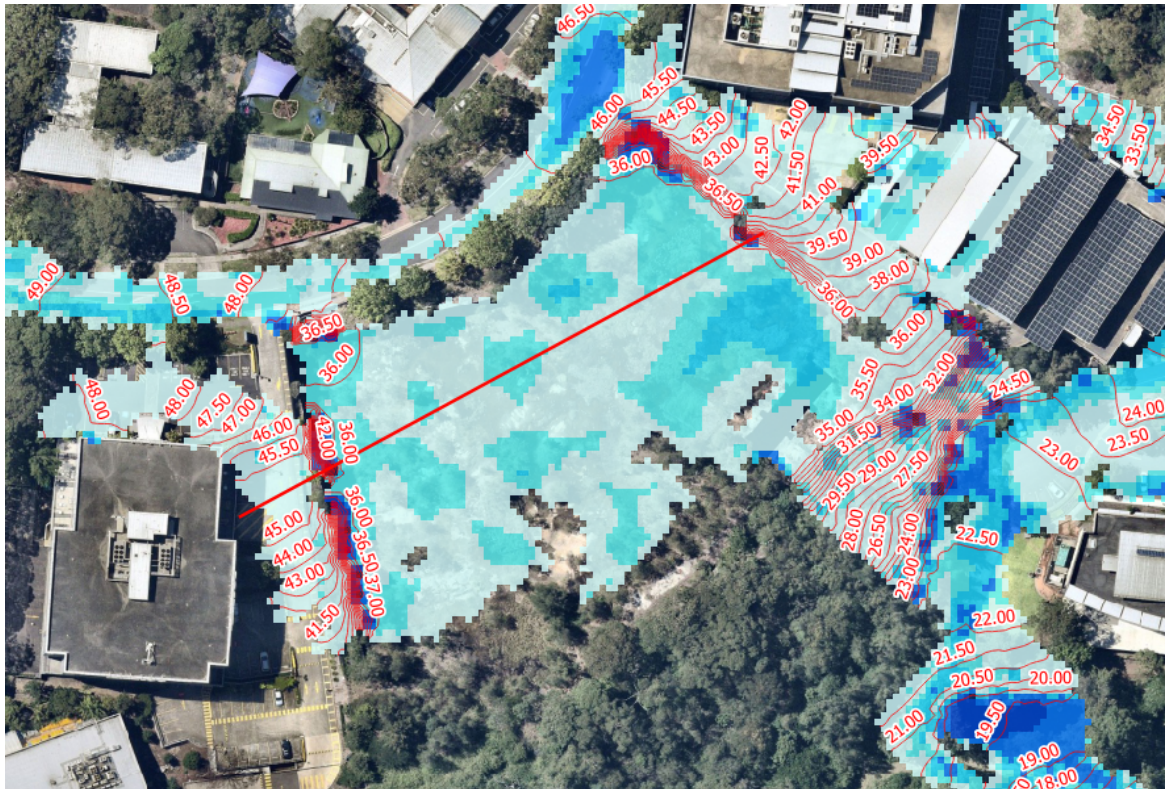


Figure 6- 1% AEP flood depth and level - 2025.0.0-iSP-w64

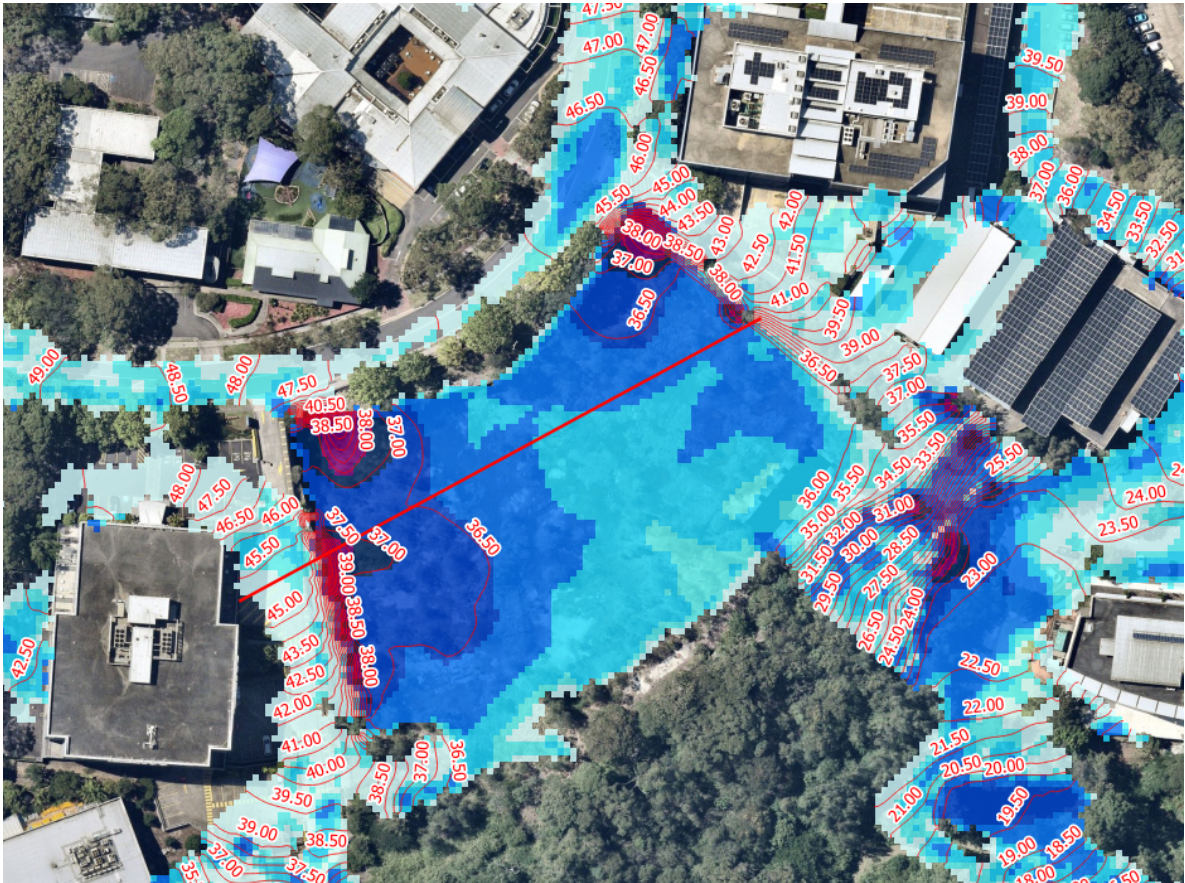


Figure 7-1% AEP flood depth and level - TUFLOW 2008-08-DB-iSP build

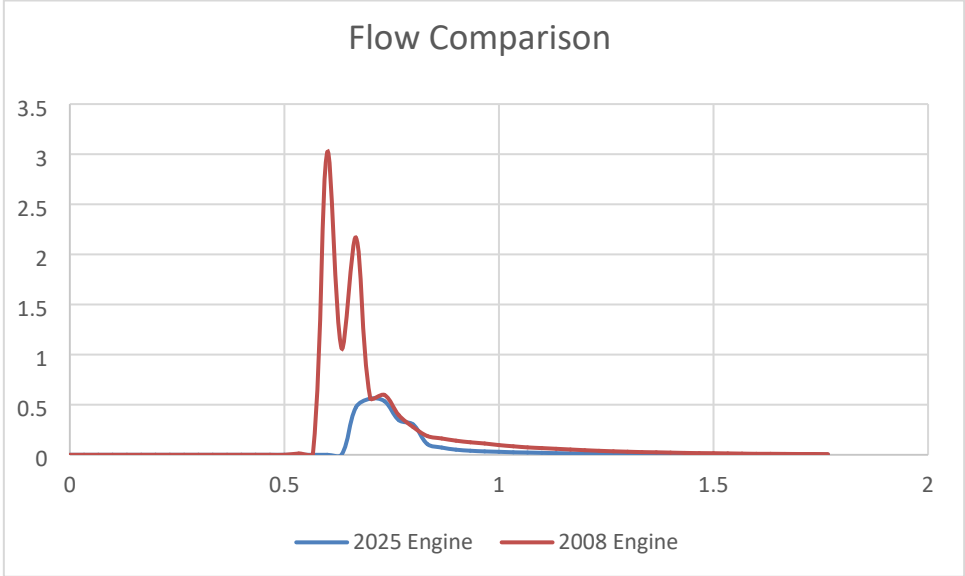


Figure 8- Flow comparison between the two different TUFLOW model

This discrepancy may be due to instability in the older model.

More PO lines were placed at various locations across the site to check flow conditions at different points and through various pipes. The locations of these pipes and PO lines are shown in Figure 9.





Figure 9- The location of PO lines and pipes from which the flow was extracted

The hydrographs at the various locations are shown in Figure 10 to Figure 18.

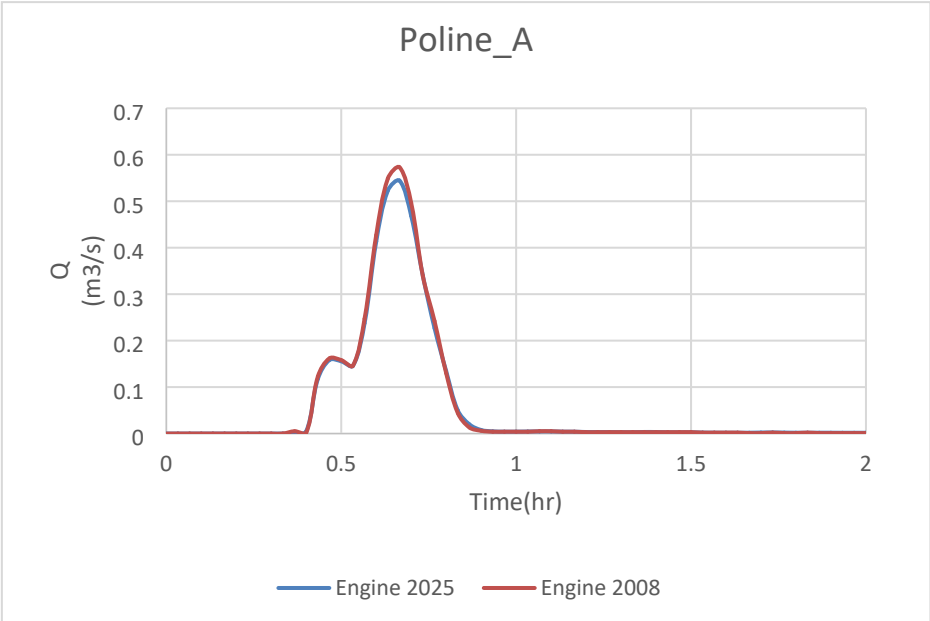


Figure 10 -Flow Hydrograph for Poline\_A

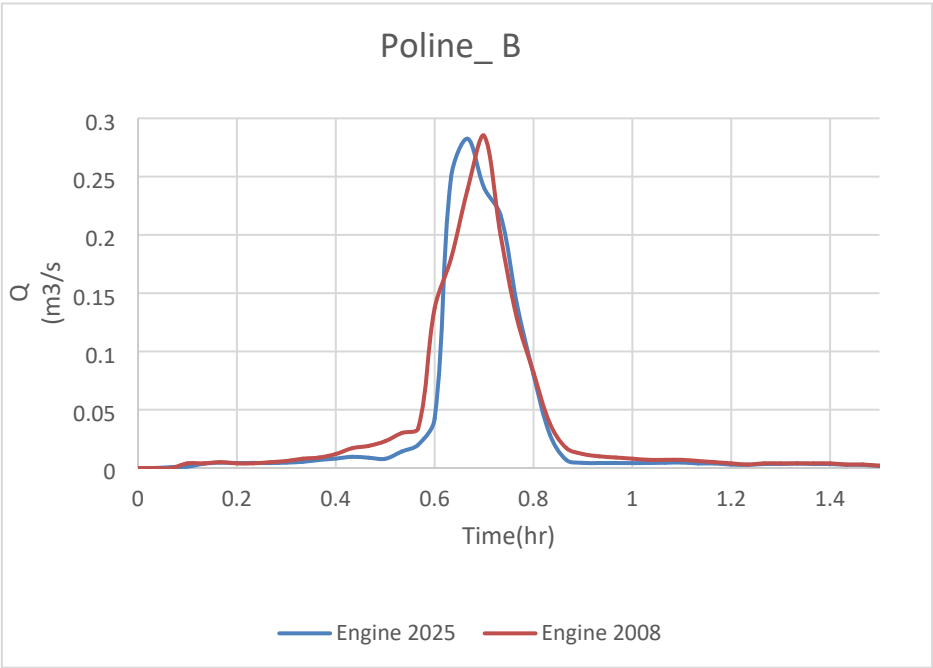


Figure 11-Flow Hydrograph for Poline\_B

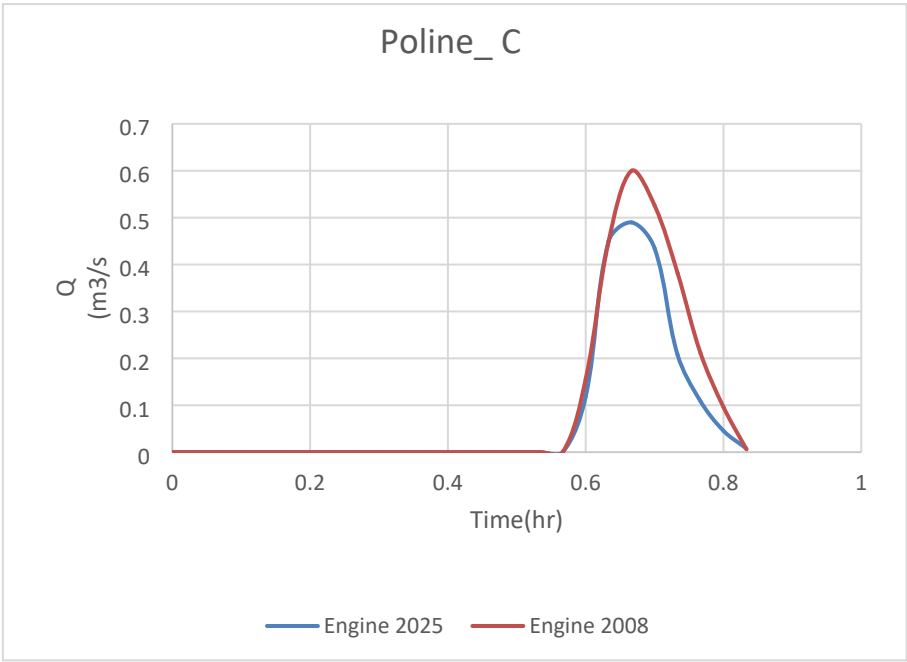


Figure 12-Flow Hydrograph for Poline\_C



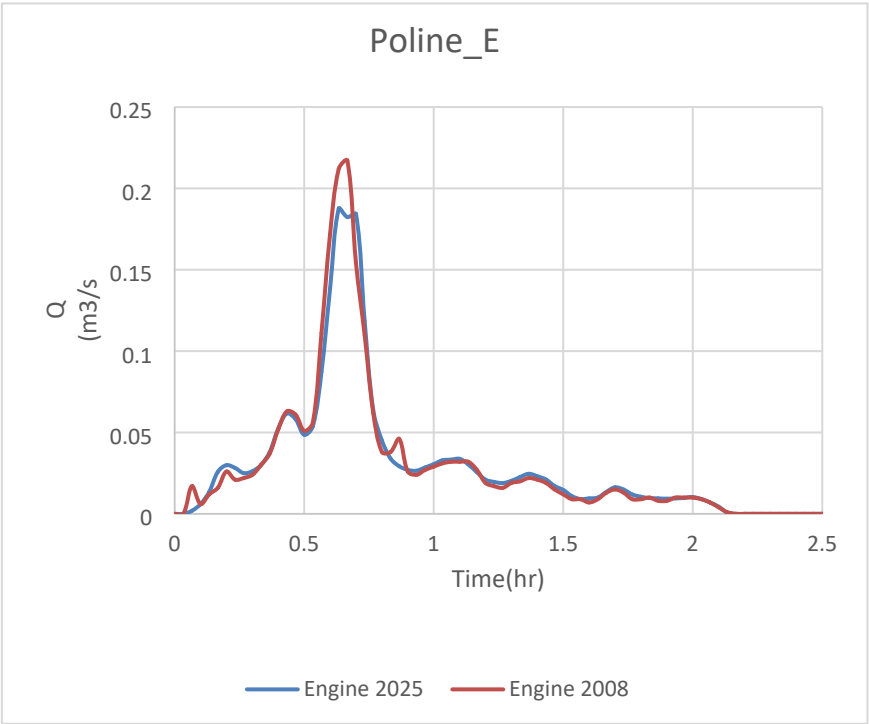


Figure 13- Flow Hydrographs for Poline\_E

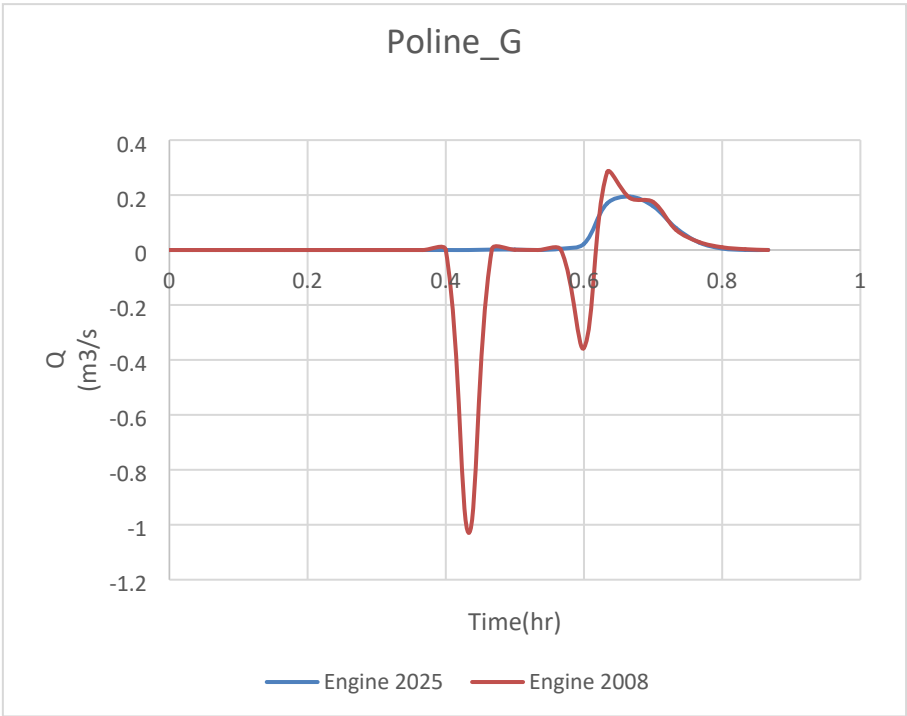


Figure 14- Flow Hydrograph for Poline\_G

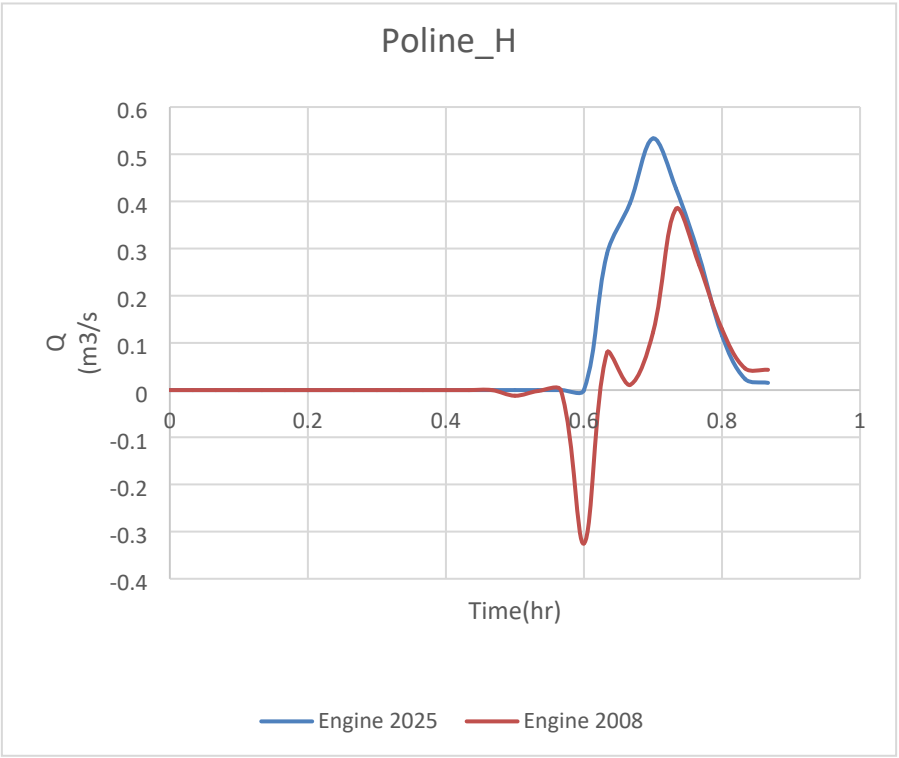


Figure 15- Flow Hydrograph for Poline\_H

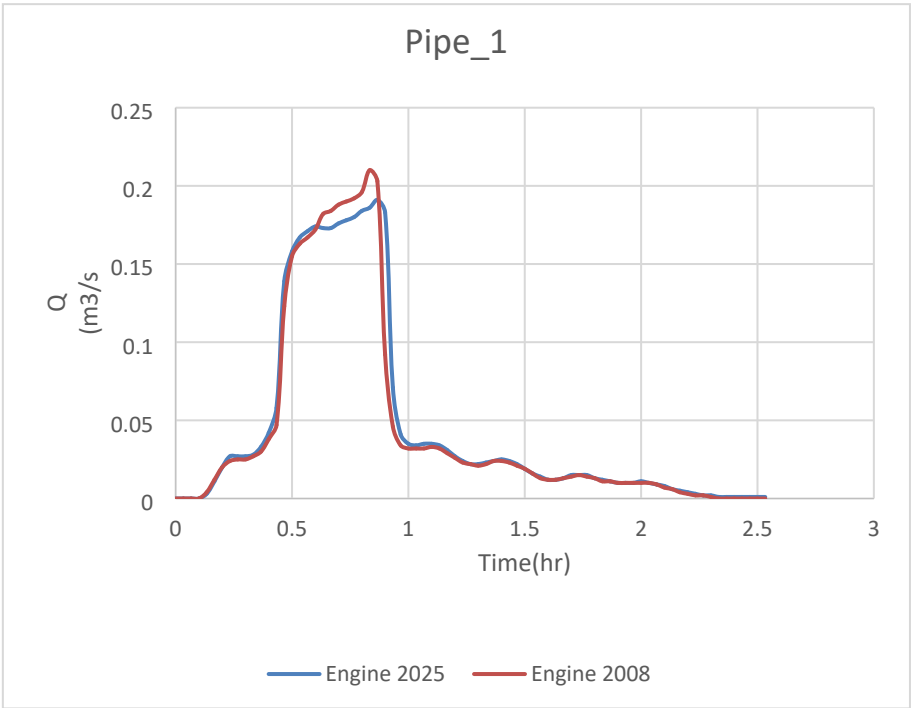


Figure 16- Flow Hydrograph for Pipe\_1

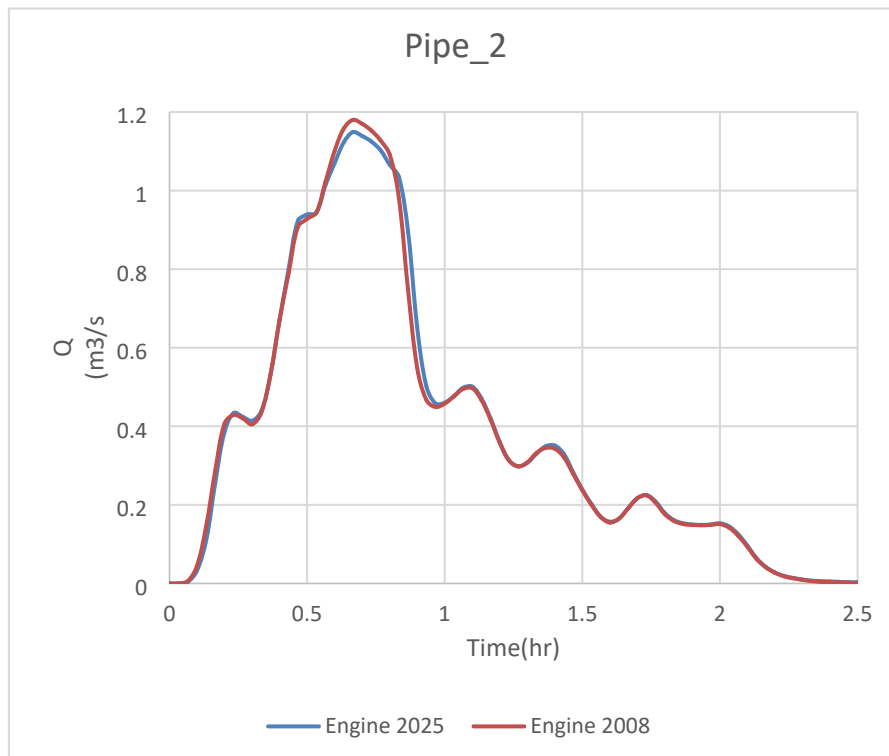


Figure 17-Flow Hydrograph for Pipe\_2

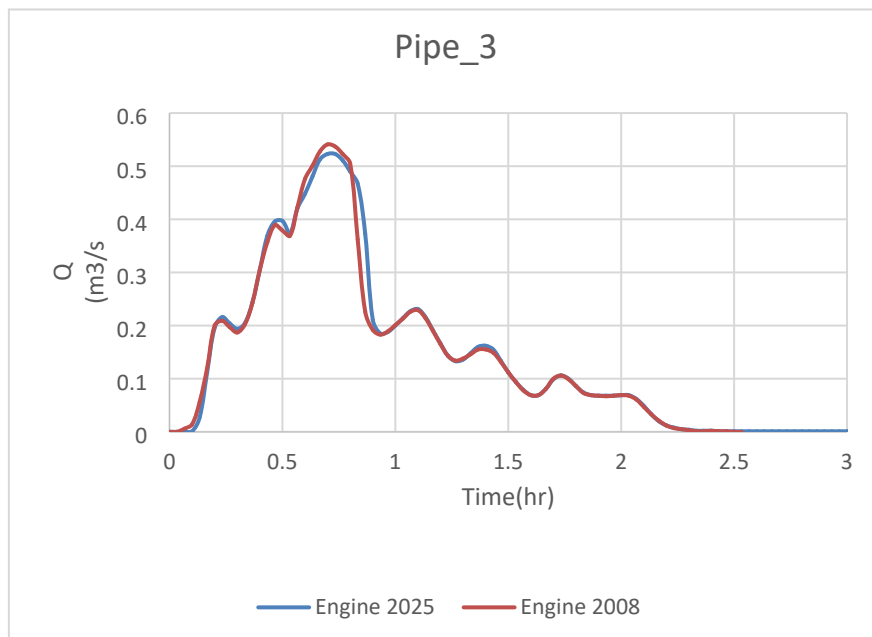


Figure 18- Flow Hydrograph for Pipe\_3

The flow hydrographs upstream of the sudden drop in elevation (as shown in Figure 19) are generally consistent across both models. However, downstream of the drop, the hydrographs differ (Hydrographs G and H, likely due to instability issues in the older TUFLOW build as the result of the sudden change in the Tin elevation.

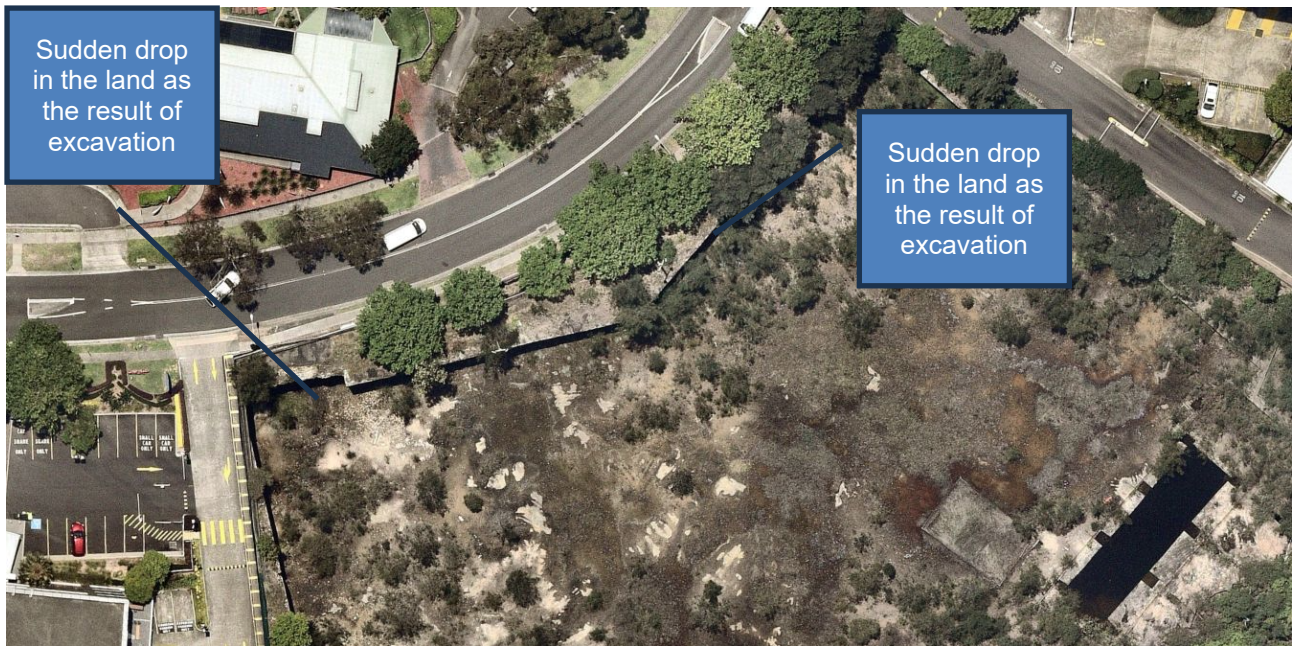


Figure 19- Orthophoto of the site showing the sudden drop

As a result, greater weight has been given to the 2025 model results, as they reflect the most recent and reliable version. The results from the **2025.0.0-iSP-w64** build have been adopted for this assessment due to their improved accuracy and successful resolution of the previously observed afflux anomaly. It is important to note that no other changes were made to the model apart from updating the TUFLOW build.

It should also be noted that a new flood study was completed by Ryde Council in 2023. The updated flood maps from this study are currently in draft format and have not yet been gazetted yet. Based on the information available on the Council's website, the updated study indicates that the site is less impacted during the 1% AEP storm event compared to the previous study.

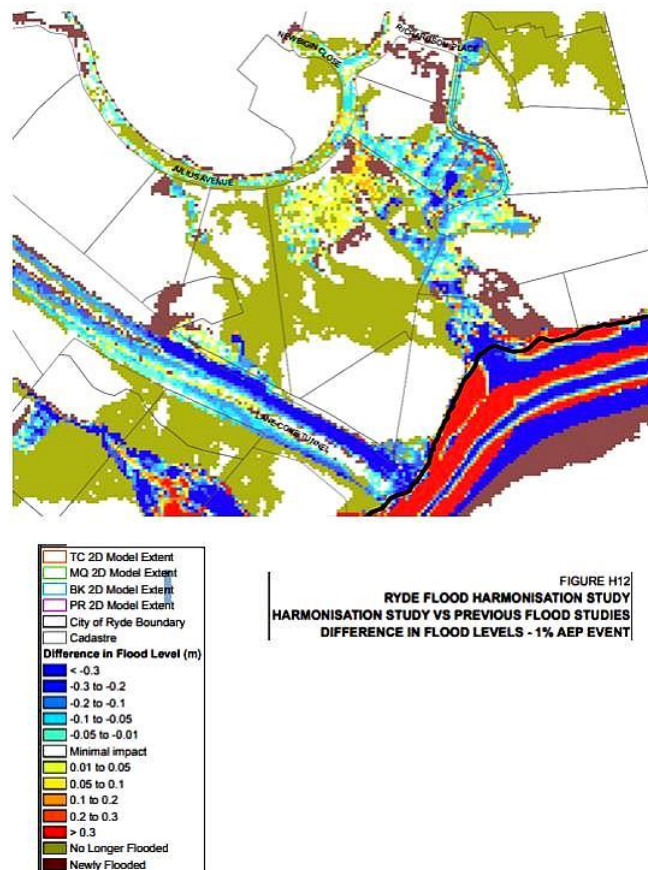


Figure 20- Difference in 1% AEP Flood Levels – Previous vs 2023 Ryde Council Flood Study

## 4.2 Site Survey

The site survey provided by Beveridge Williams has been completed and used for this study. The survey data has been incorporated into both the existing and post-development TUFLOW models to improve the accuracy of the modelling outcomes. This is shown in Figure 21.

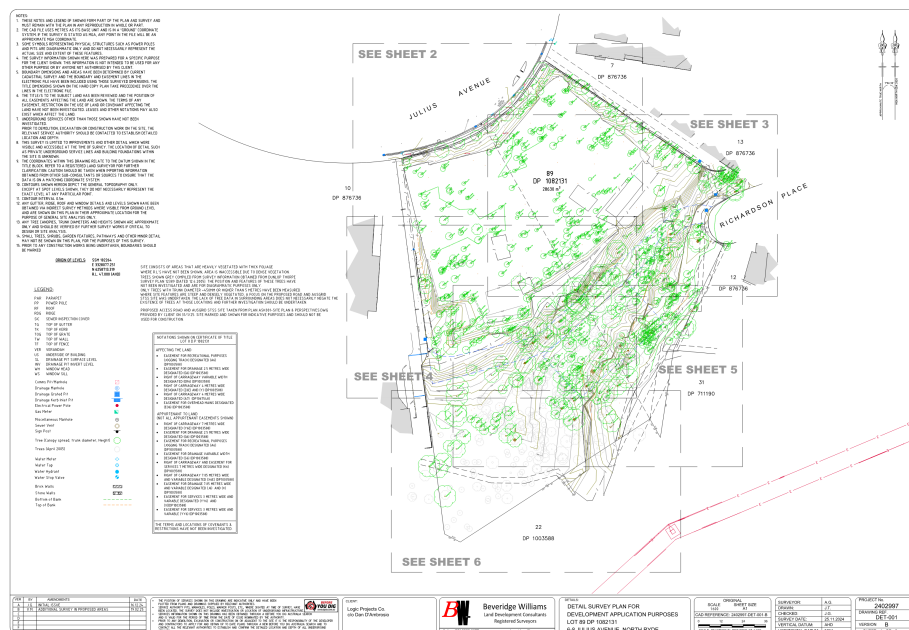


Figure 21- Survey which is used for this study



### 4.3 Flooding Impact Due to Climate Change

The Council flood climate change scenario has been used for this assessment.

### 4.4 Flood Hazard Assessment

The relative vulnerability of the community to flood hazard has been assessed by using the flood hazard vulnerability curves set out in '*Handbook 7 – Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia*' of the Australian Disaster Resilience Handbook Collection (2017).

These curves assess the vulnerability of people, *vehicles and* buildings to flooding based on the velocity and depth of flood flows. The flood hazard categories are outlined in Figure 22, ranging from a level of H1 (generally safe for people, vehicles and buildings) to H6 (unsafe for vehicles and people, with all buildings considered vulnerable to failure). Table 7 outlines the threshold limits for each hazard category.

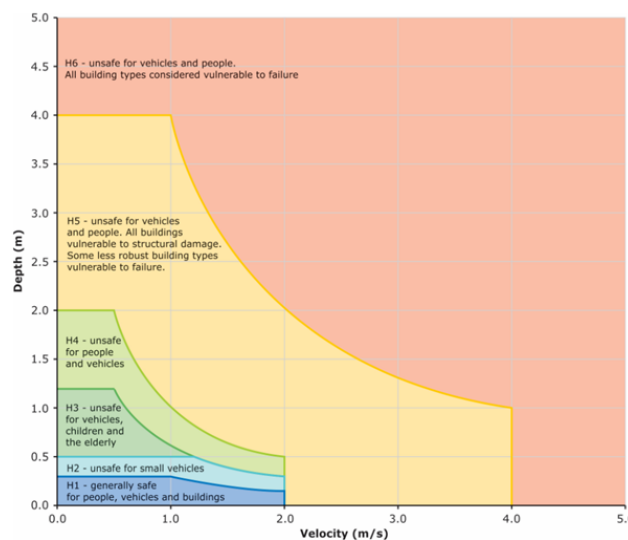


Figure 22- Flood hazard vulnerability curve (Source: Flood Risk Management Guide FB03 - Flood Hazard, NSW Department of Planning and Environment, 2022)

Table 7- Hazard vulnerability threshold limits

| Hazard Classification | Description                                                                          | Classification Limit (m <sup>2</sup> /s) | Limiting still water depth (D) (m) | Limiting velocity (V) (m/s) |
|-----------------------|--------------------------------------------------------------------------------------|------------------------------------------|------------------------------------|-----------------------------|
| <b>H1</b>             | Generally safe for people, vehicles and buildings                                    | $D \times V \leq 0.3$                    | 0.3                                | 2.0                         |
| <b>H2</b>             | Unsafe for small vehicles                                                            | $D \times V \leq 0.6$                    | 0.5                                | 2.0                         |
| <b>H3</b>             | Unsafe for vehicles, children and the elderly                                        | $D \times V \leq 0.6$                    | 1.2                                | 2.0                         |
| <b>H4</b>             | Unsafe for people and vehicles                                                       | $D \times V \leq 1.0$                    | 2.0                                | 2.0                         |
| <b>H5</b>             | Unsafe for people and vehicles. All buildings vulnerable to structural damage.       | $D \times V \leq 4.0$                    | 4.0                                | 4.0                         |
| <b>H6</b>             | Unsafe for people and vehicles. All building types considered vulnerable to failure. | $D \times V > 4.0$                       | –                                  | –                           |

## 5.0 Existing Flood Model Results

A flood study has been undertaken using the updated Council flood model. The modelling was completed for the 1% AEP event, the 1% AEP event incorporating climate change, the 1% AEP event with blockage conditions, and the PMF event.

The results for the 1% AEP event indicate that flood depths across the site are generally less than 50 mm. two minor flow paths are observed originating from the north of the site, along Julius Avenue, and discharging into the Lane Cove River. This is shown in Figure 23.

It is also noted that a sag point exists on Julius Avenue near the access driveway to 4 Julius Avenue. The flood depth at this sag point is approximately 378 mm for the 1% AEP event and approximately 456 mm for the PMF event.

Flood velocities within the site are generally below 0.5 m/s, while velocities along Julius Avenue are typically less than 1 m/s. The assessed flood hazard is predominantly classified as H1, indicating conditions that are generally safe for people, vehicles, and buildings both within the site and the surrounding area.

The flood results for the 1% AEP climate change scenario are within the same range as the standard 1% AEP event, with only a minor increase in flood depth and extent observed across the site.

For the PMF event, flood depths across the site and surrounding roads are generally less than 0.2 m. Flood velocities remain below 0.5 m/s within the site, and below 1 m/s along Julius Avenue, with the flood hazard also predominantly classified as H1.

Flood mapping for existing conditions, including flood depths, flood levels, velocities, and hazards ZAM1 and Z0 (Vxd) and for the 1% AEP, 1% AEP incorporating climate change, 1% AEP with blockage conditions, and PMF events, is presented in Figure 23 to Figure 38.

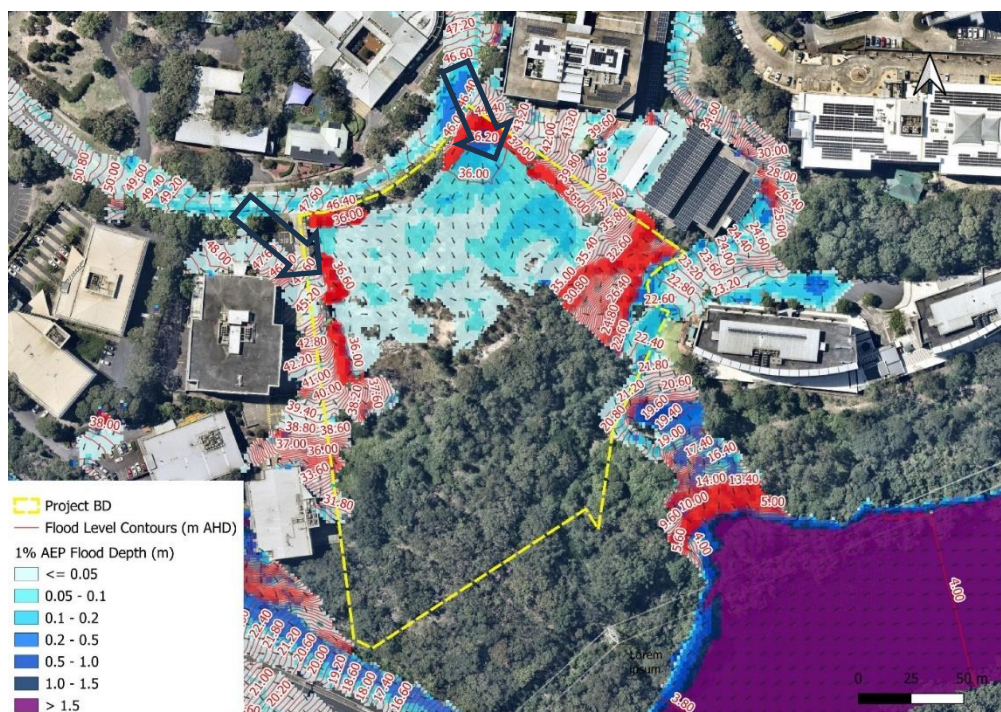


Figure 23-1% AEP Flood Depths and Levels-Existing Scenario



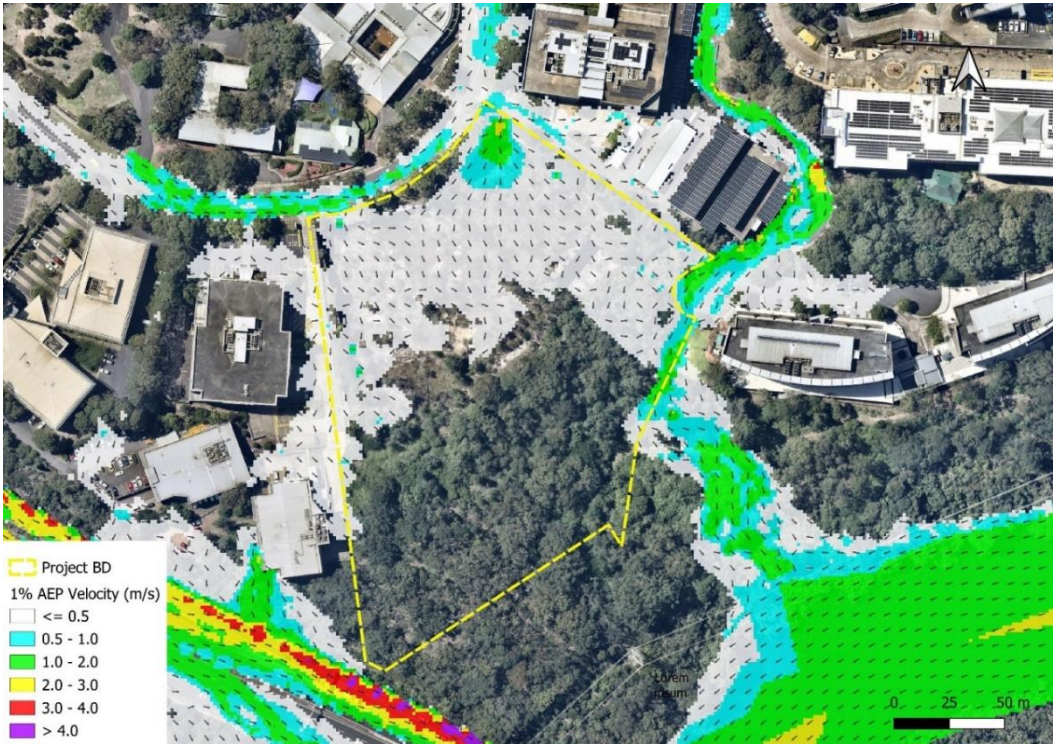


Figure 24-1% AEP Flood Velocities-Existing Scenario

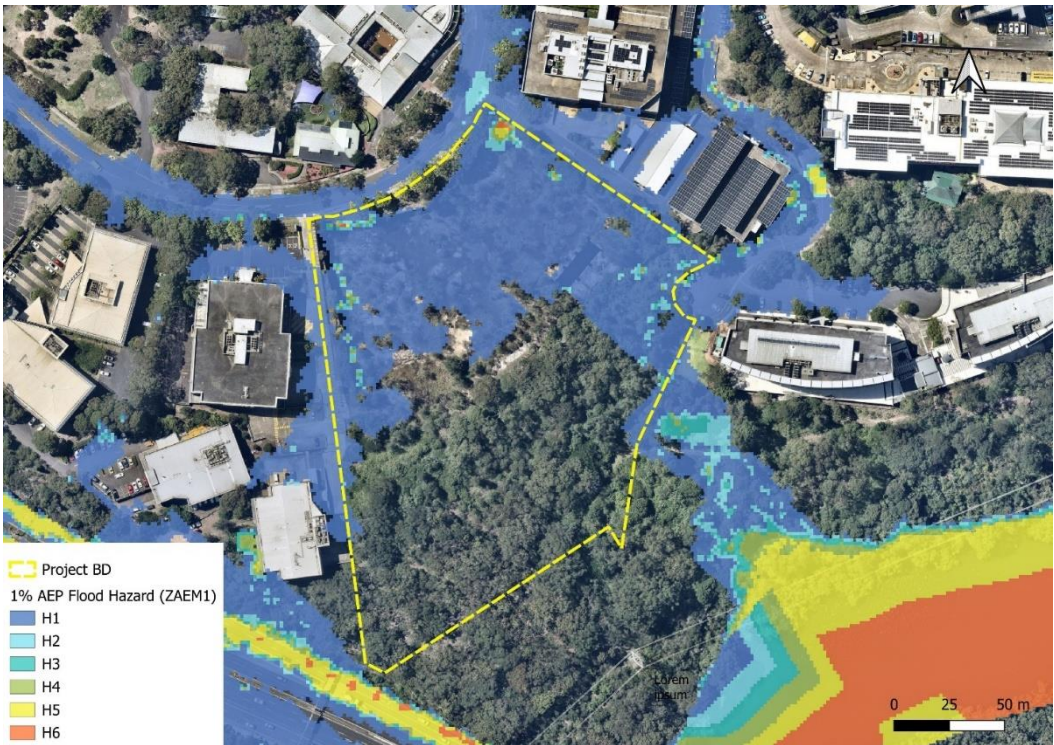


Figure 25-1% AEP Flood Hazard (ZAEM1)- Existing Scenario



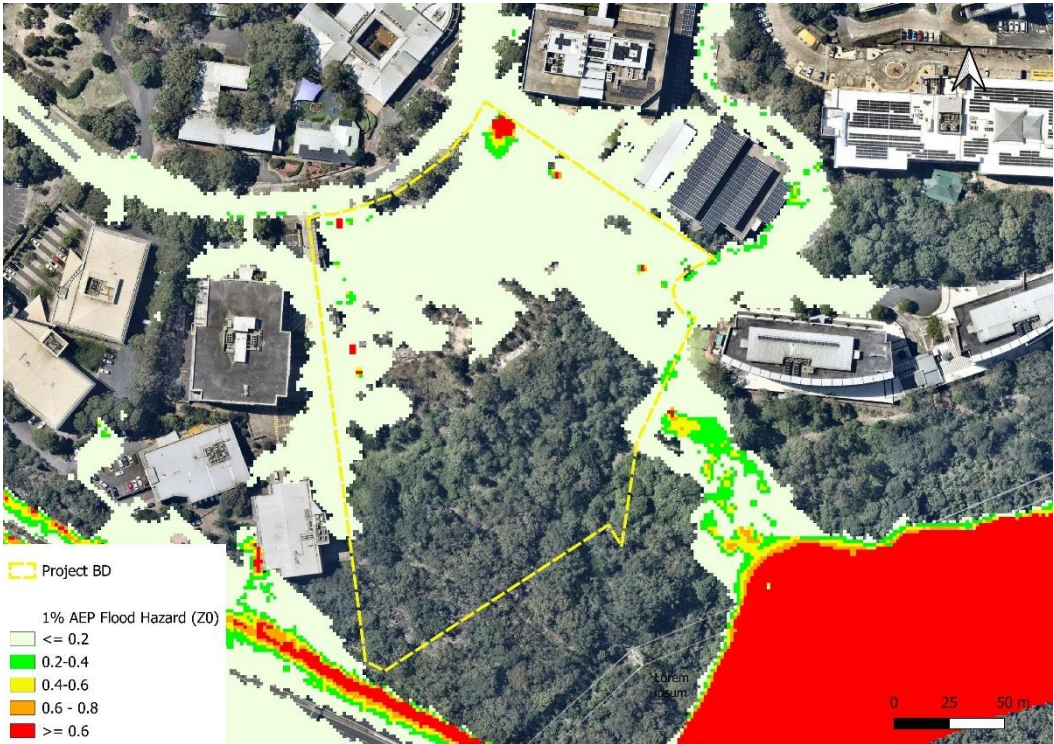


Figure 26-1% AEP Flood Hazard (Z0)- Existing Scenario

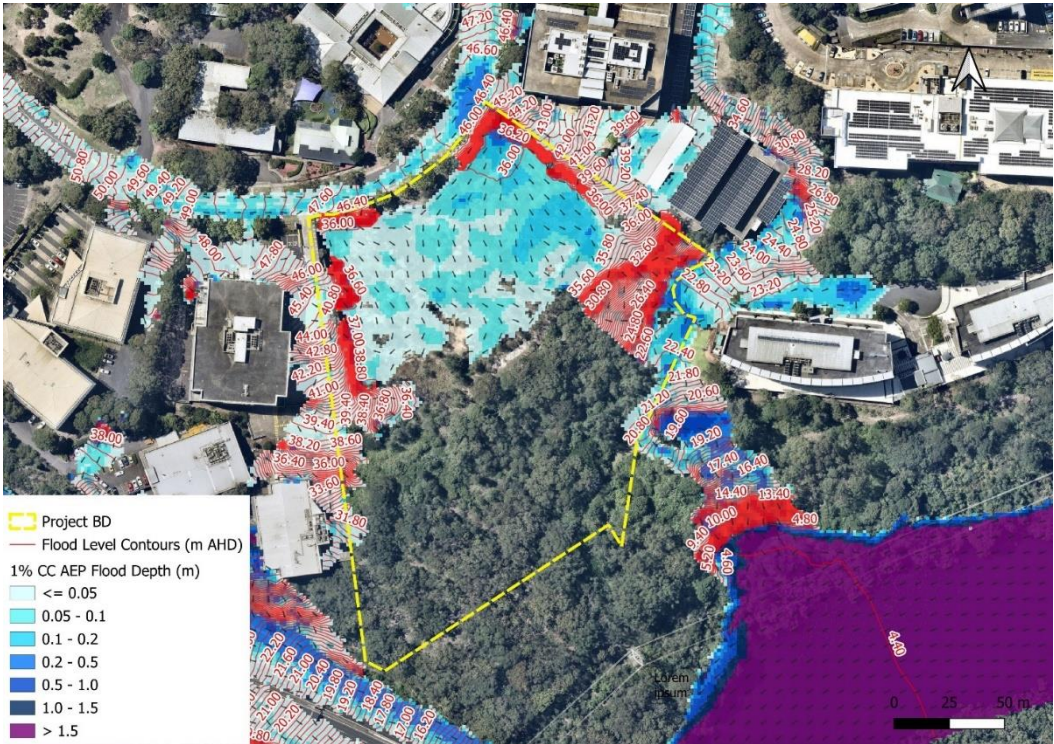


Figure 27-1% AEP CC Flood Depths and Levels-Existing Scenario



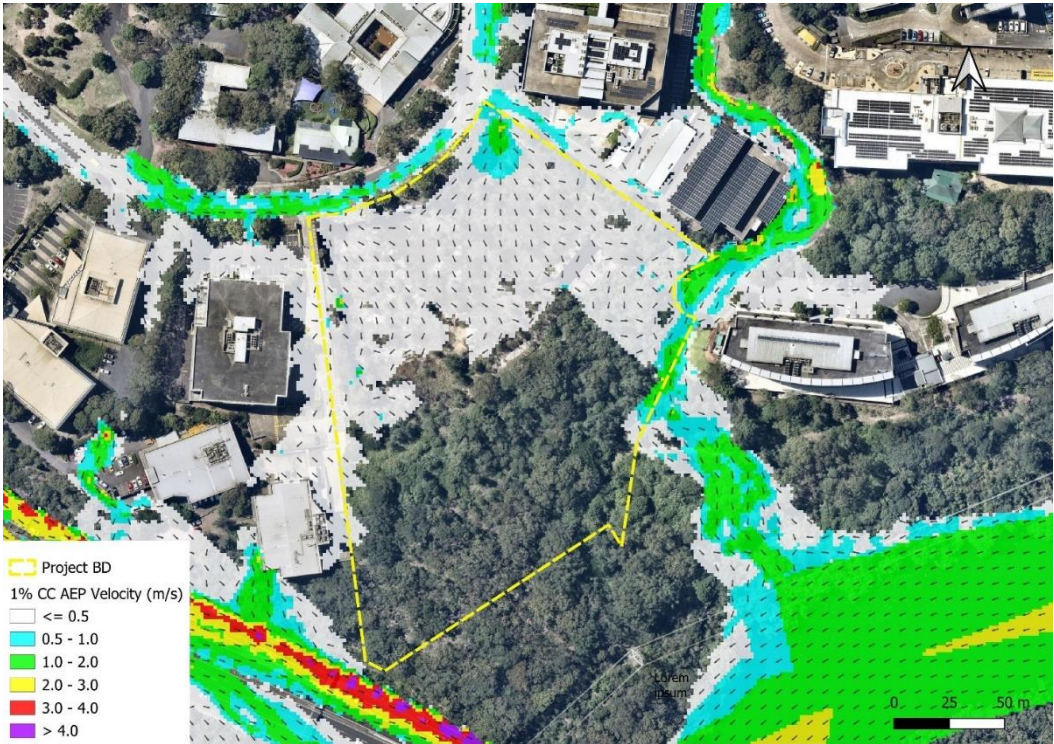


Figure 28-1% AEP CC Flood Velocities-Existing Scenario

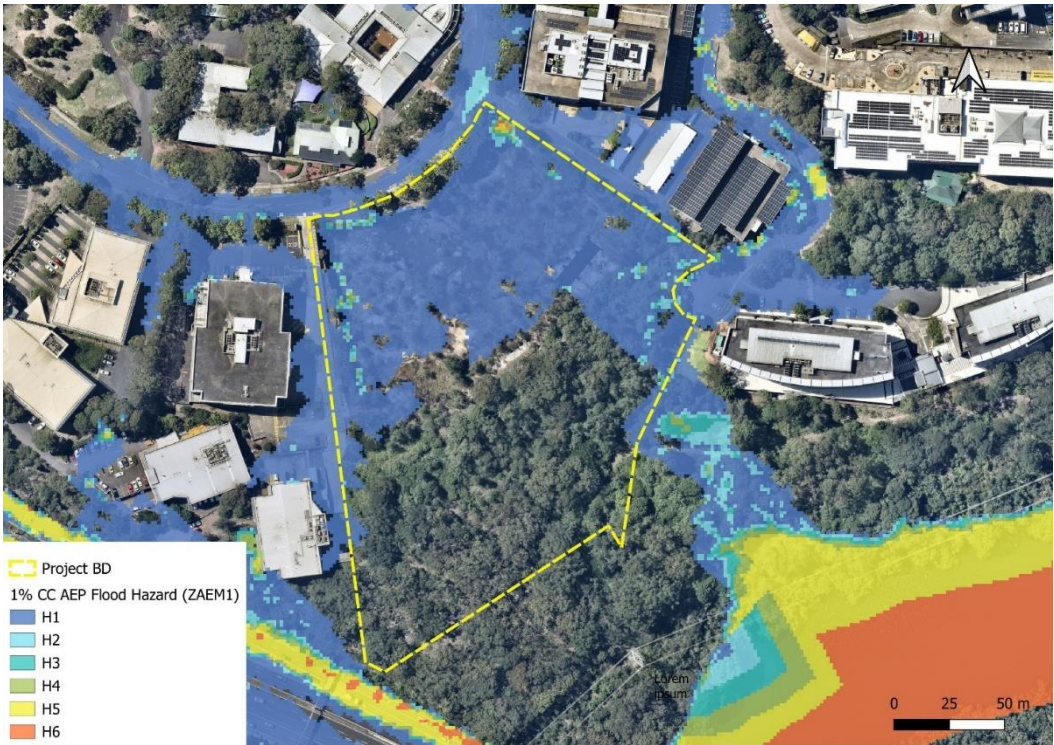


Figure 29-1% AEP CC Flood Hazard (ZAEM1) -Existing Scenario





Figure 30-1% AEP CC Flood Hazard (Z0) - Existing Scenario

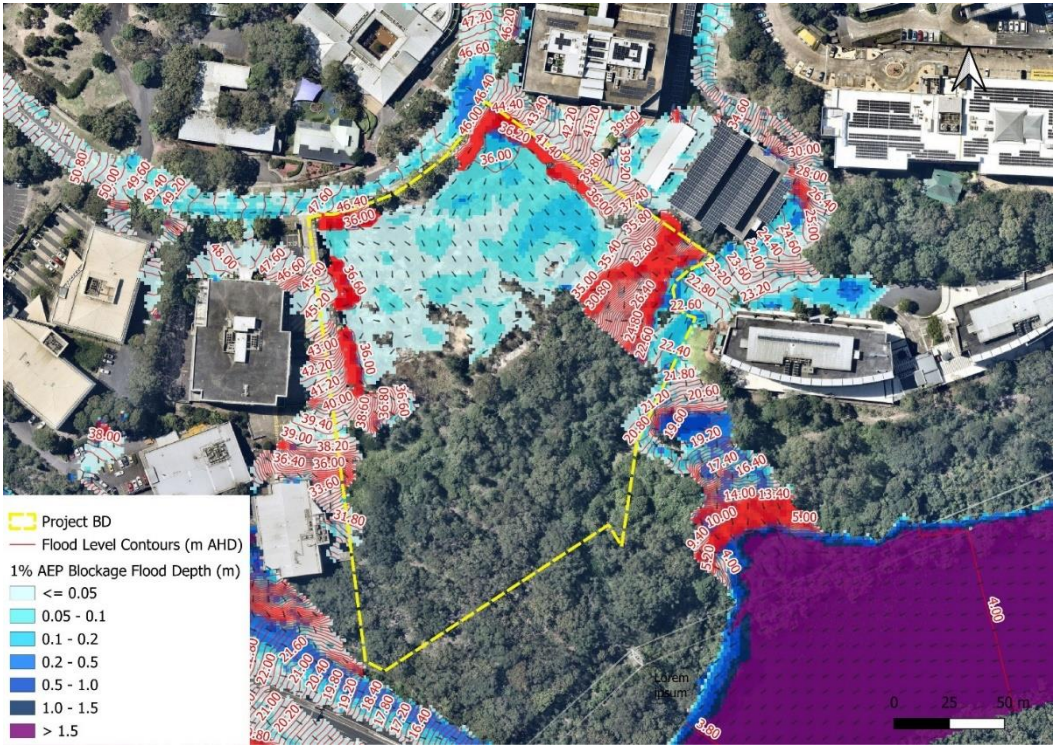


Figure 31- 1% AEP+Blockage Flood Depths and Levels-Existing Scenario



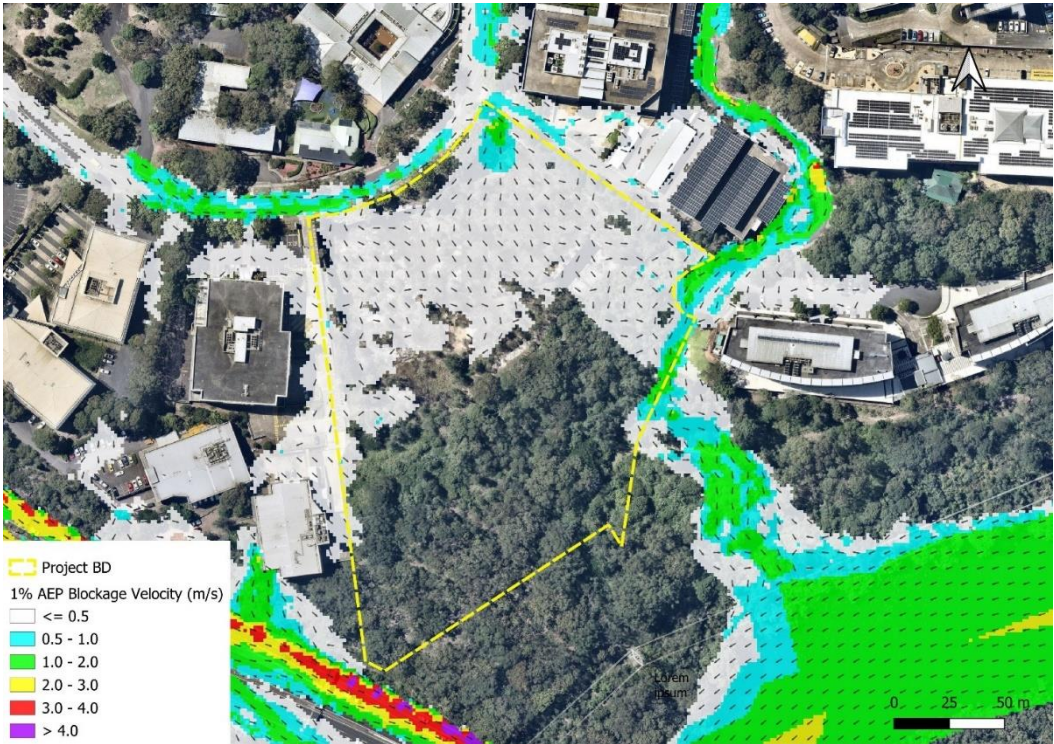


Figure 32-1% AEP+Blockage Flood Velocity -Existing Scenario

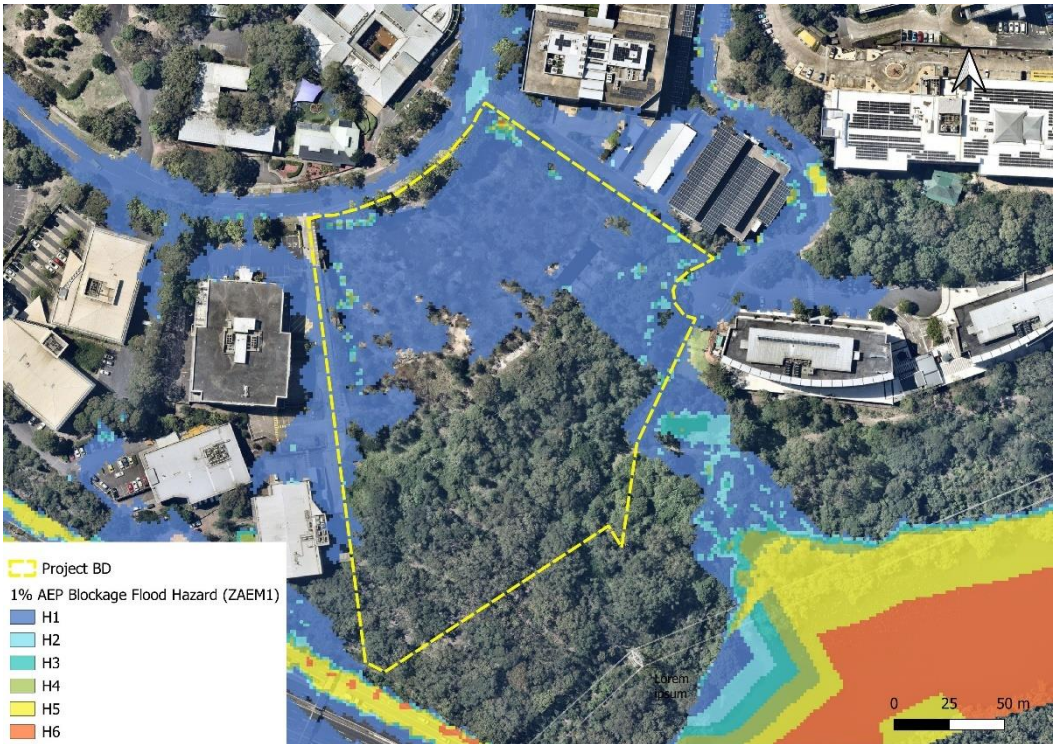


Figure 33 1% AEP+Blockage Flood Hazard (ZAEM1)-Existing Scenario





Figure 34 1% AEP+Blockage Flood Hazard (Z0) - Existing Scenario

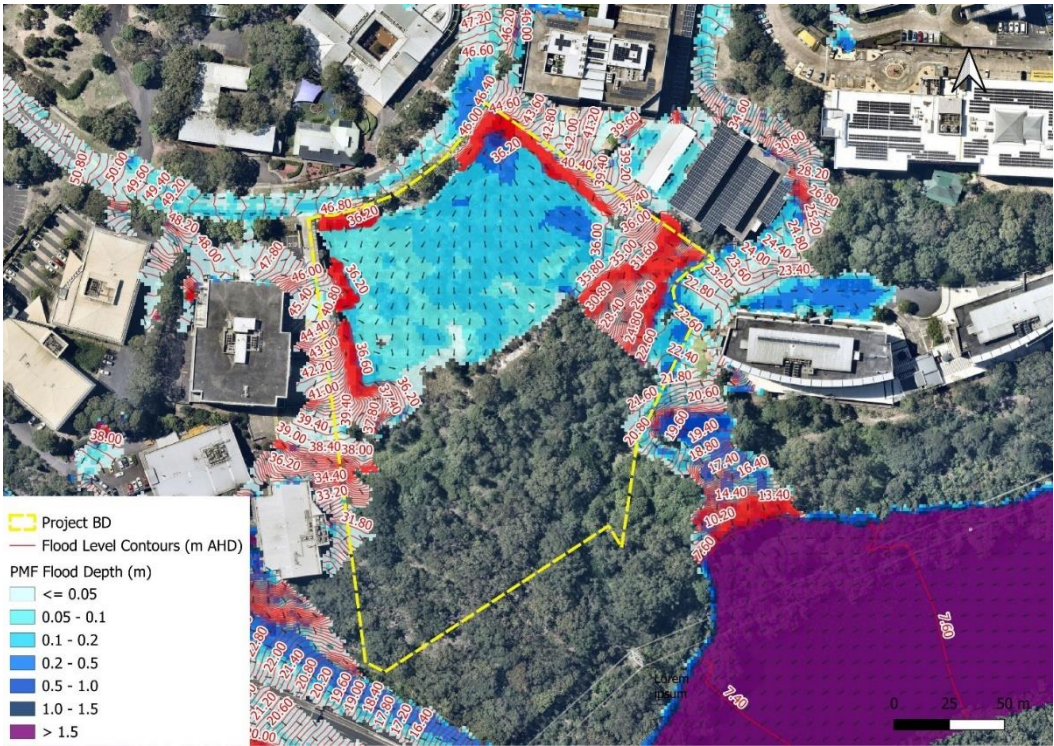


Figure 35- PMF Flood Depths and Levels- Existing Scenario



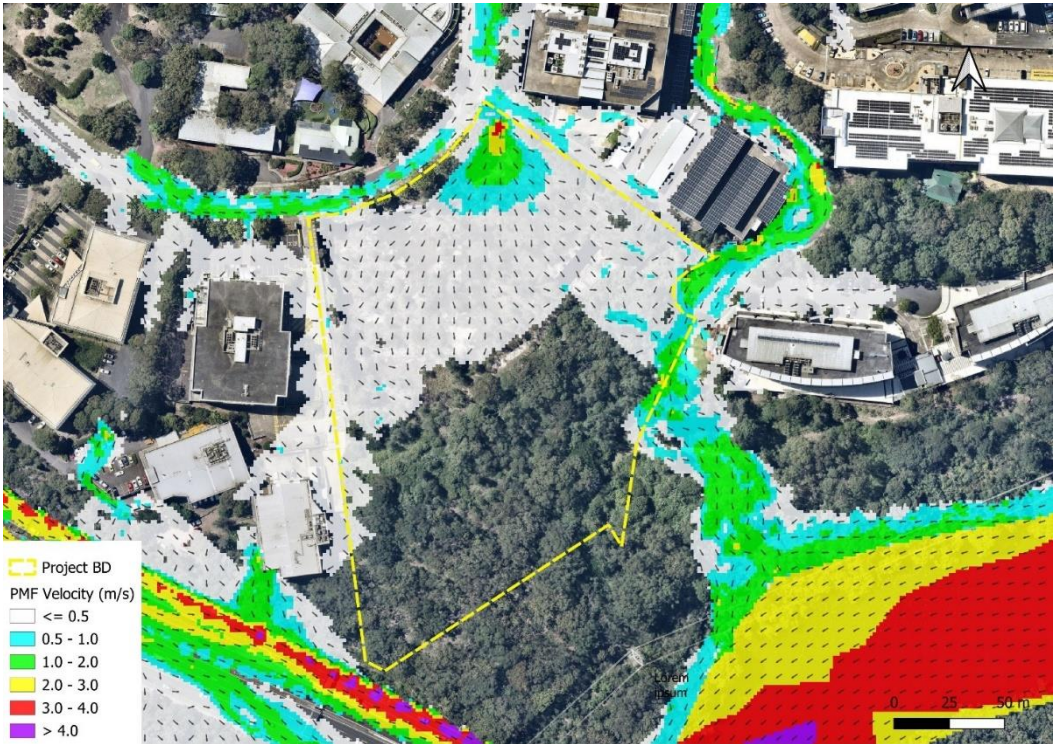


Figure 36- PMF Flood Velocities-Existing Scenario

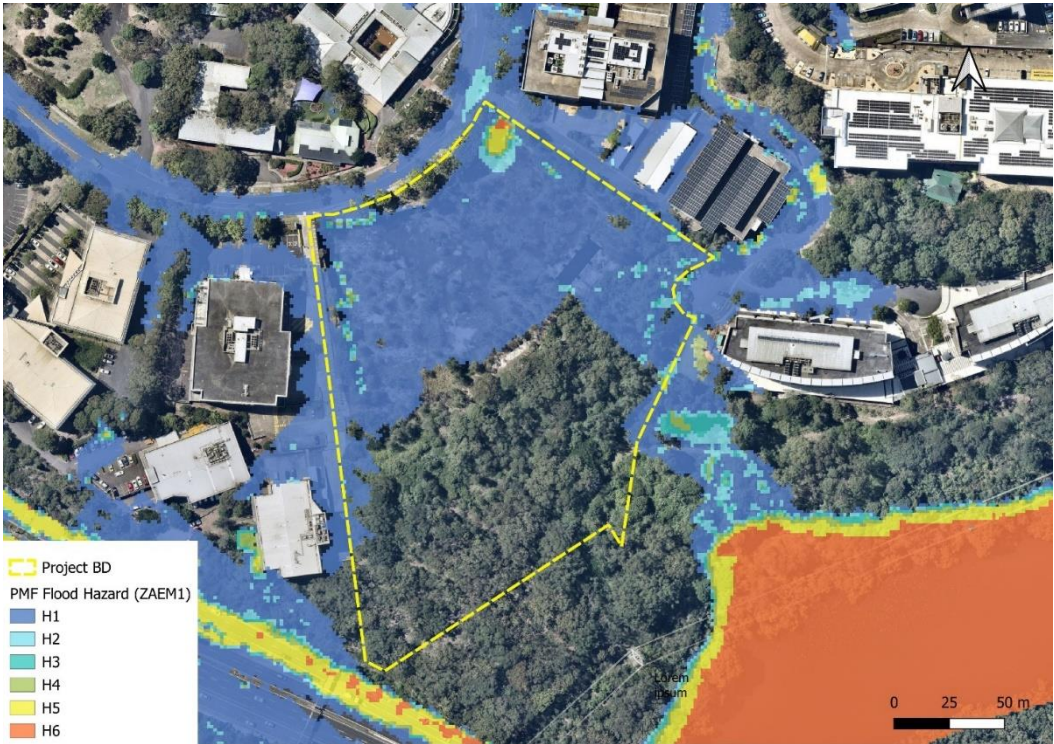


Figure 37- PMF Flood Hazard-(ZAEM1) Existing Scenario





Figure 38- PMF Flood Hazard (Z0)- Existing Scenario

## 6.0 Post-Development Modelling and Result

The flood model has been updated to incorporate the latest proposed architectural layout and landscaping designs. The proposed data centre building has been excluded (nulled out) from the model. Furthermore, the post-development civil design surrounding the site has been incorporated into the model. The extent of this civil design included in the model is shown in Figure 39.



Figure 39- Proposed Design Surface Included in the TUFLOW model.



Two drainage lines have been designed on either side of the proposed development, along with four additional pits on Julius Avenue, to help reduce the impact of the 1% AEP and PMF events on neighbouring properties and Julius Avenue. Additionally, three drainage pipes along Julius Avenue have been upgraded to 525 mm diameter. A short wall, 0.5 m in height, has been constructed next to the cul-de-sac to the south of the development to reduce afflux in that area. These measures are shown in Figure 40



Figure 40- Proposed Mitigation Measures

Flood mapping for Post development conditions, including flood depths, flood levels, velocities, and hazards ZAM1 and Z0 (Vxd) and for the 1% AEP, 1% AEP incorporating climate change, 1% AEP with blockage conditions, and PMF events, is presented in Figure 41 to Figure 56.



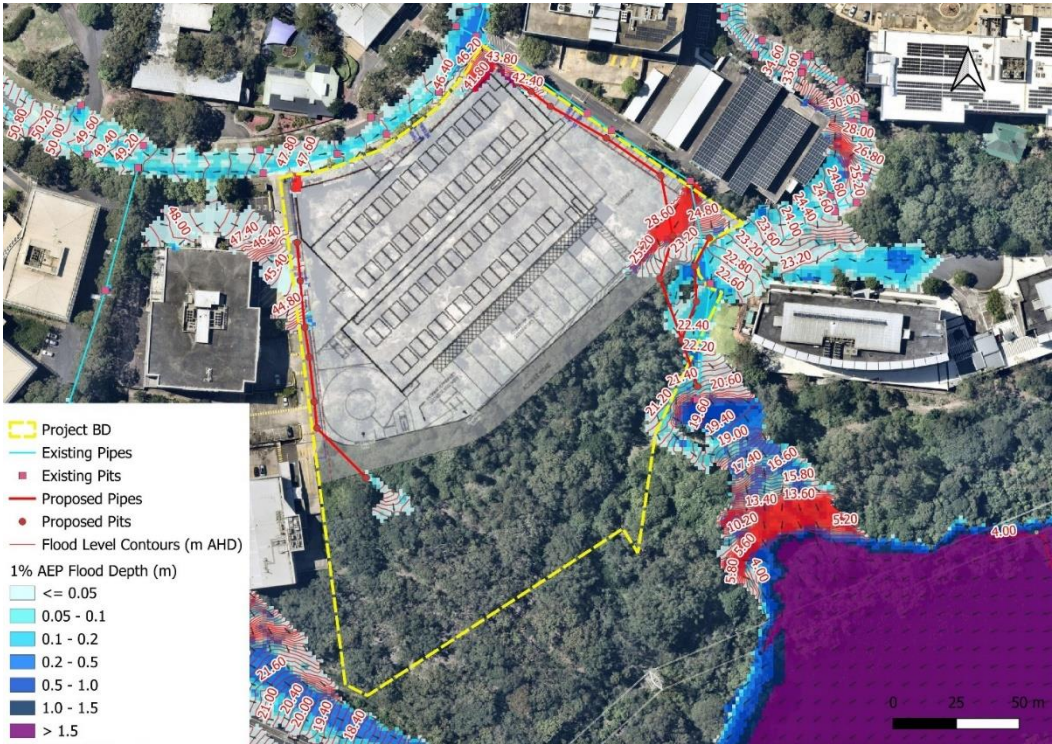


Figure 41- 1% AEP Flood Depths and Levels- Post Development Scenario

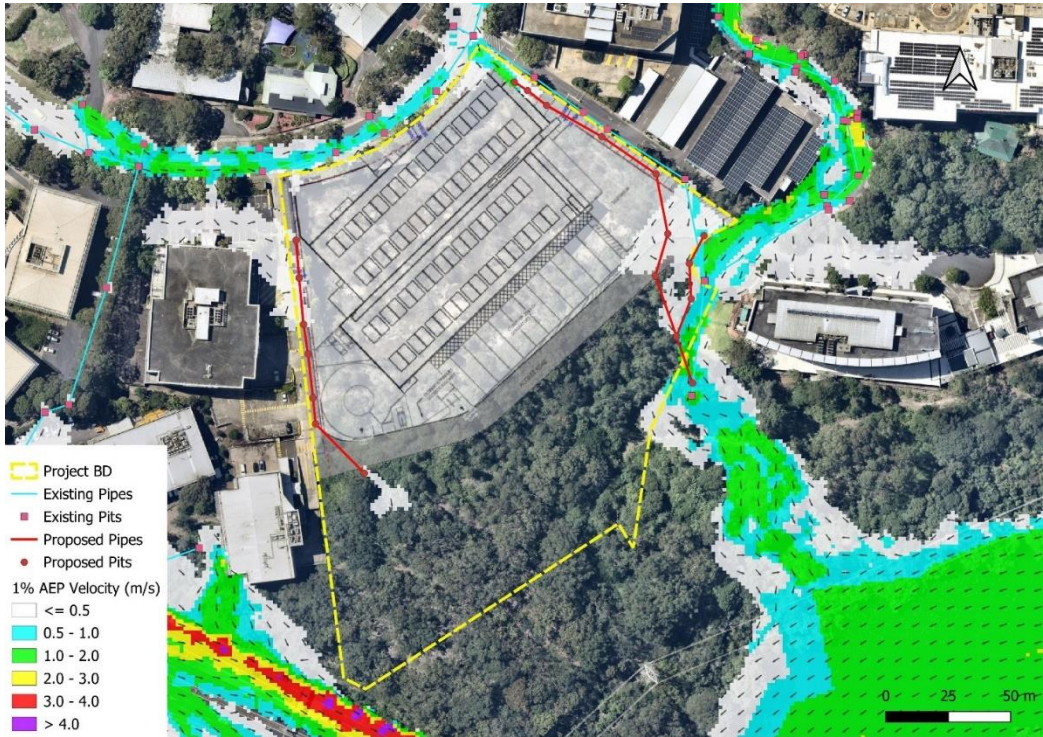


Figure 42- 1% AEP Flood Velocities- Post Development Scenario



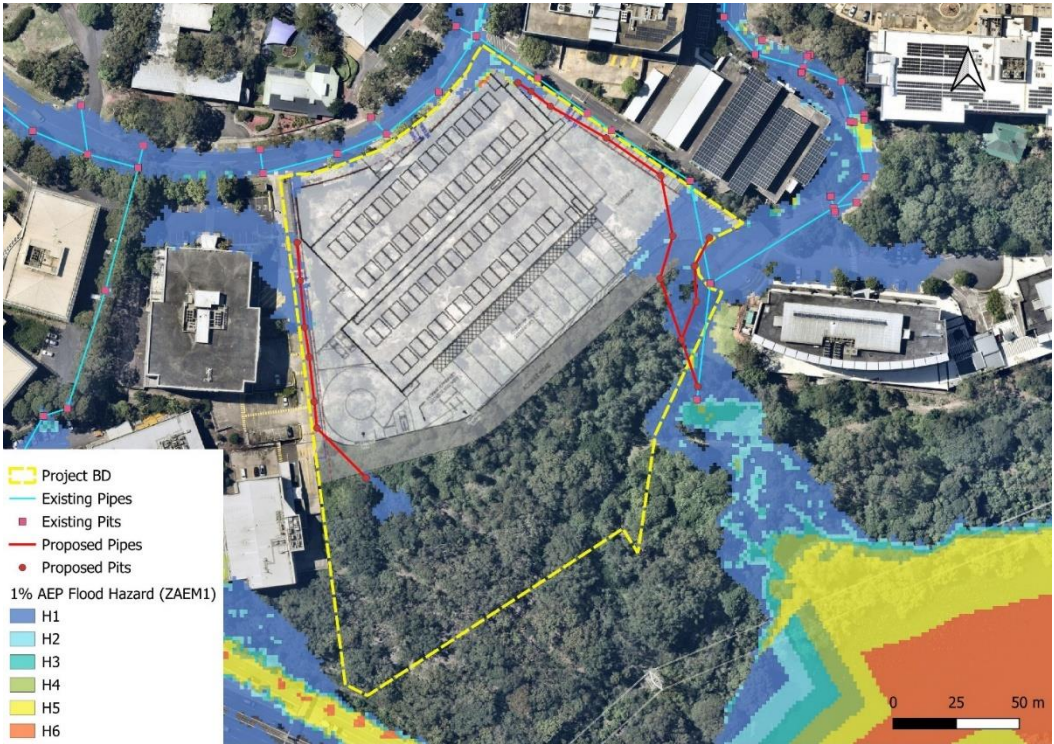


Figure 43-1% AEP Flood Hazard (ZAE1)- Post Development Scenario

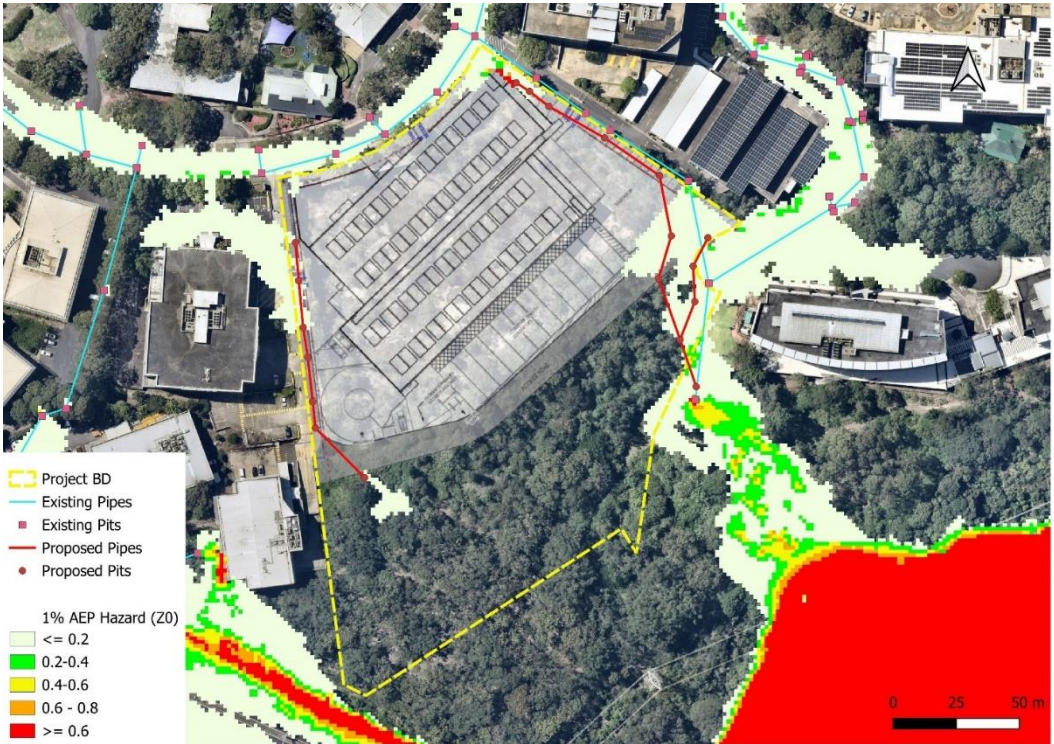


Figure 44 - 1% AEP Flood Hazard (Z0)- Post Development Scenario



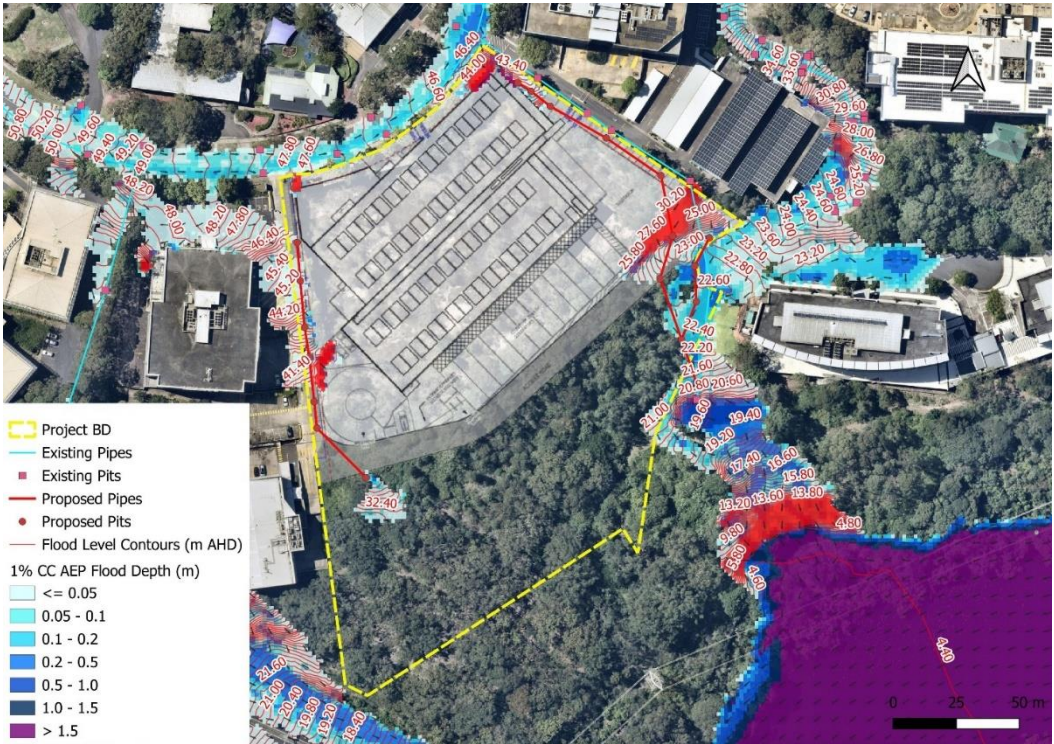


Figure 45-1% AEP CC Flood Depths and Levels - Post-Development Scenario

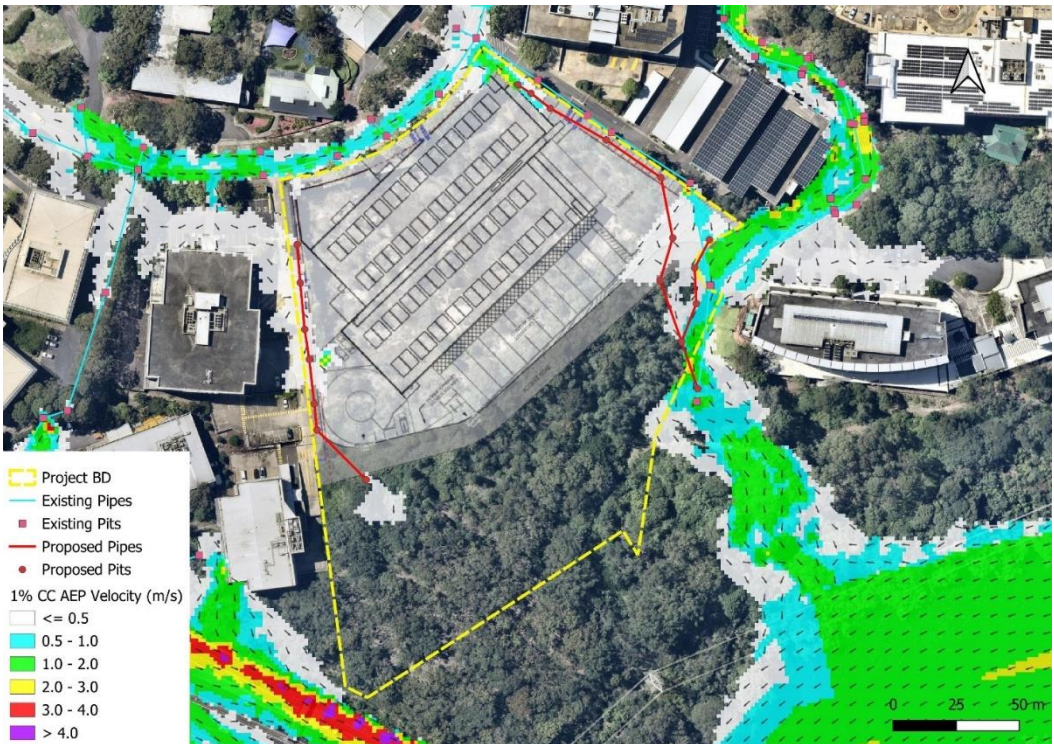


Figure 46- 1% AEP CC Flood Velocities- Post-Development Scenario



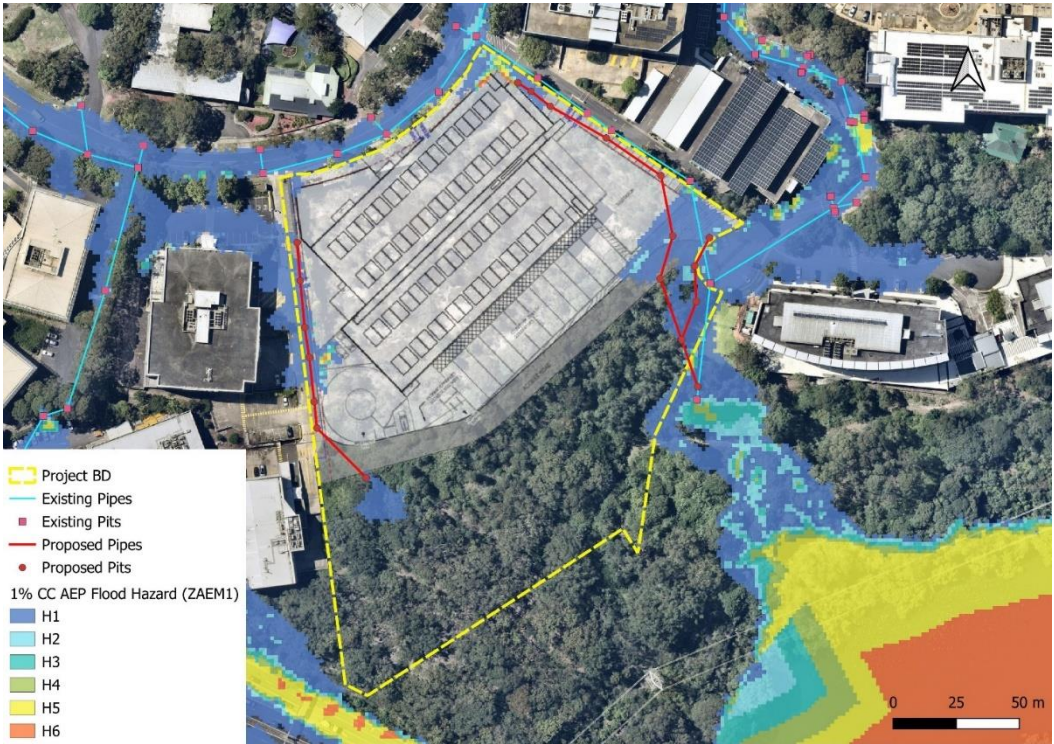


Figure 47-1% AEP CC Flood Hazard(ZAEM1)- Post-Development Scenario

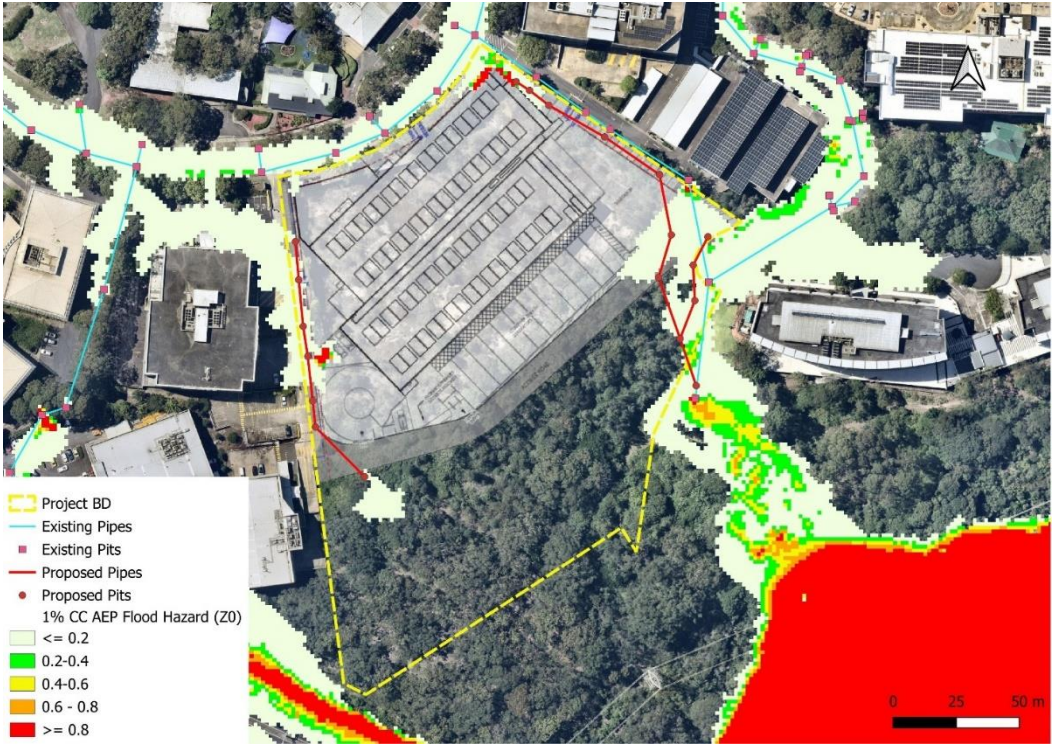


Figure 48-1% AEP CC Flood Hazard(Z0)- Post-Development Scenario



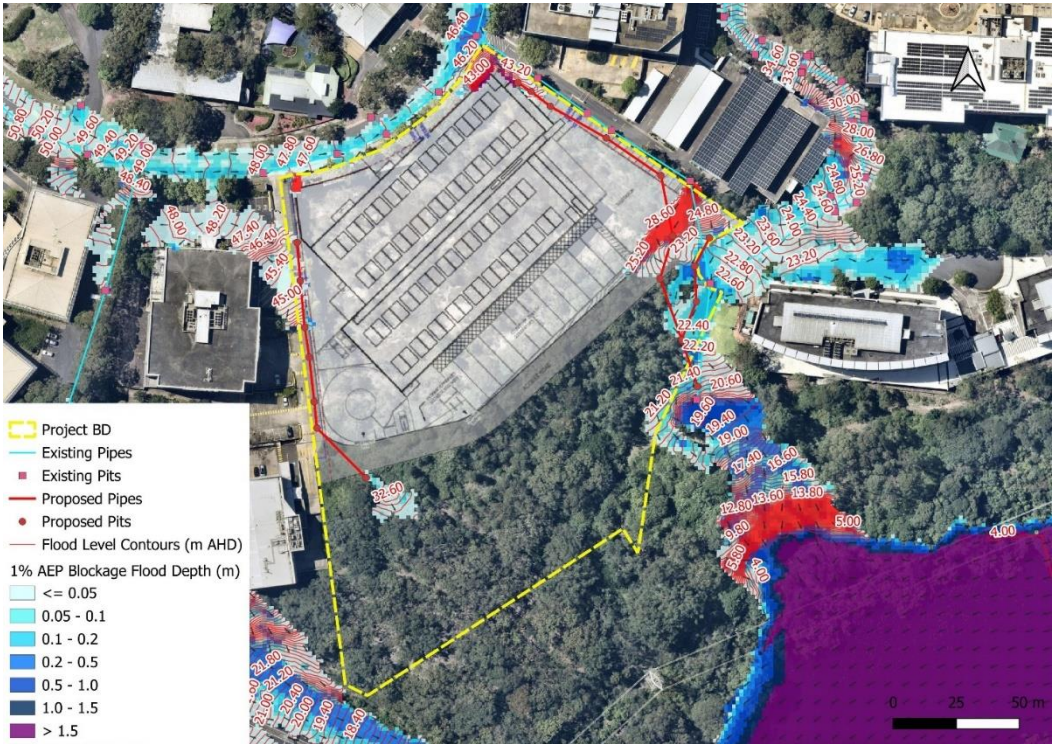


Figure 49-1% AEP+Blockage Flood Depths and Levels- Post-Development Scenario

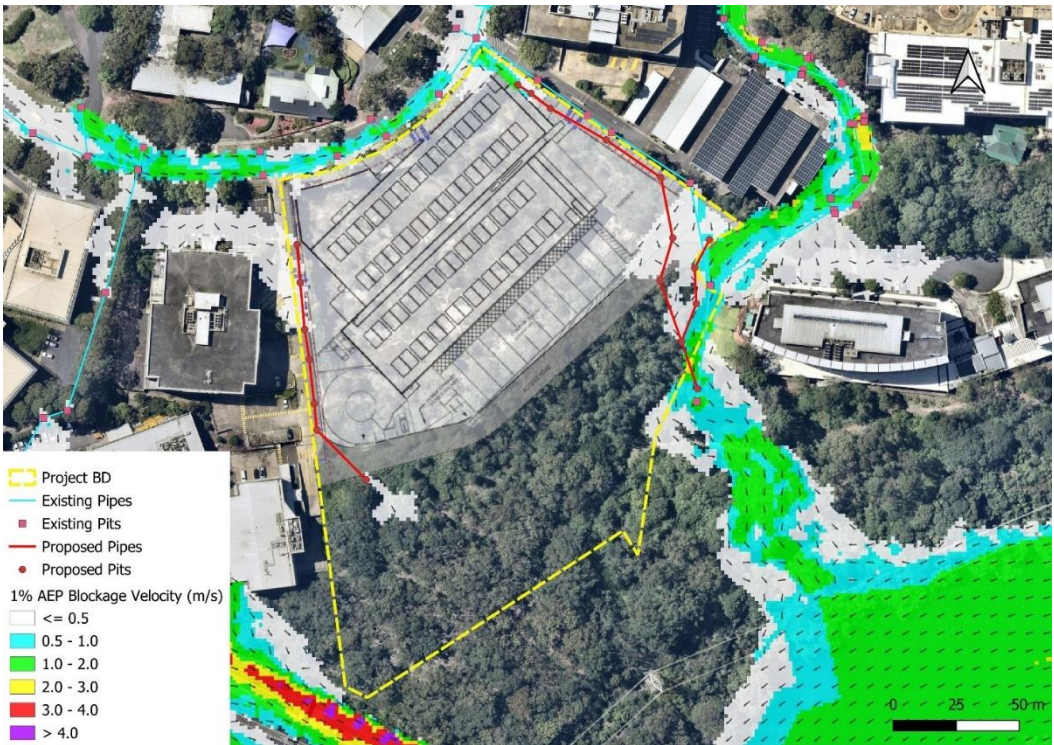


Figure 50-1% AEP+Blockage Flood Velocities- Post-Development Scenario





Figure 51-1% AEP+Blockage Flood Hazard (ZAEM1)- Post-Development Scenario

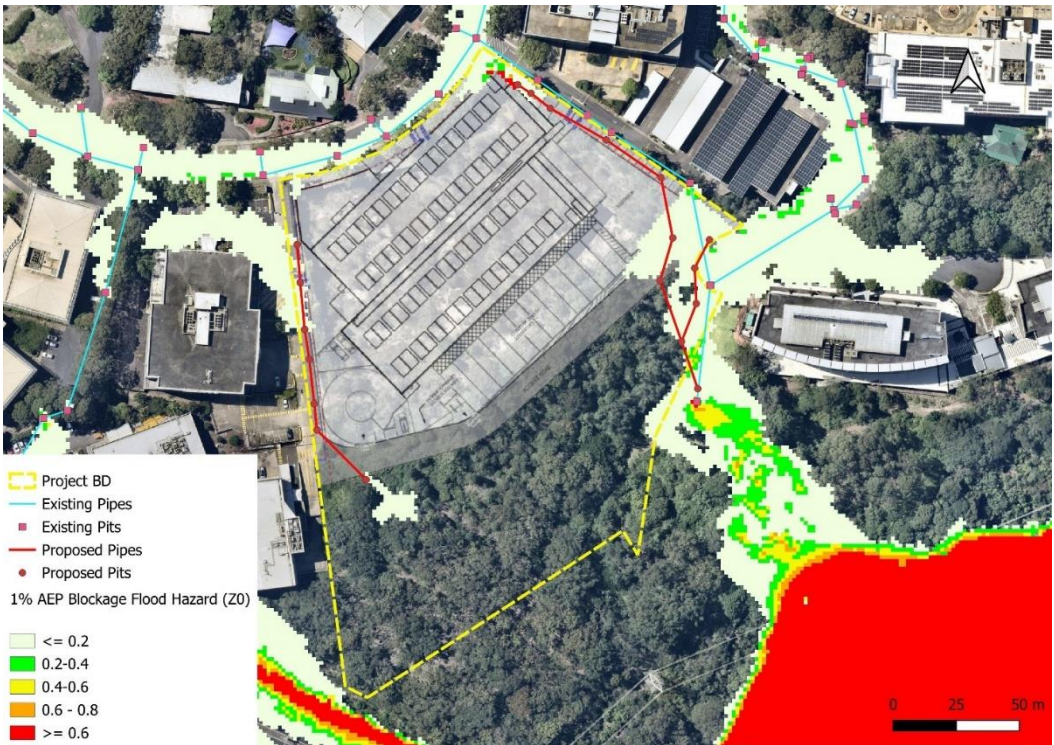


Figure 52-1% AEP+Blockage Flood Hazard (Z0)- Post-Development Scenario



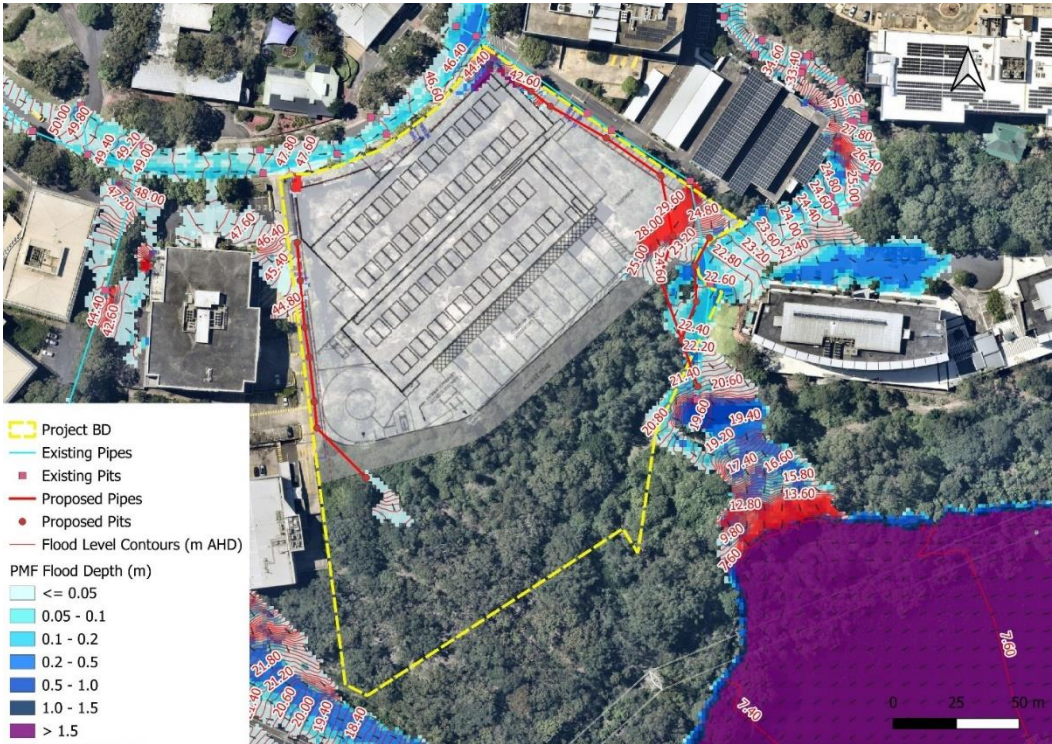


Figure 53- PMF Flood Depths and Levels- Post-Development Scenario

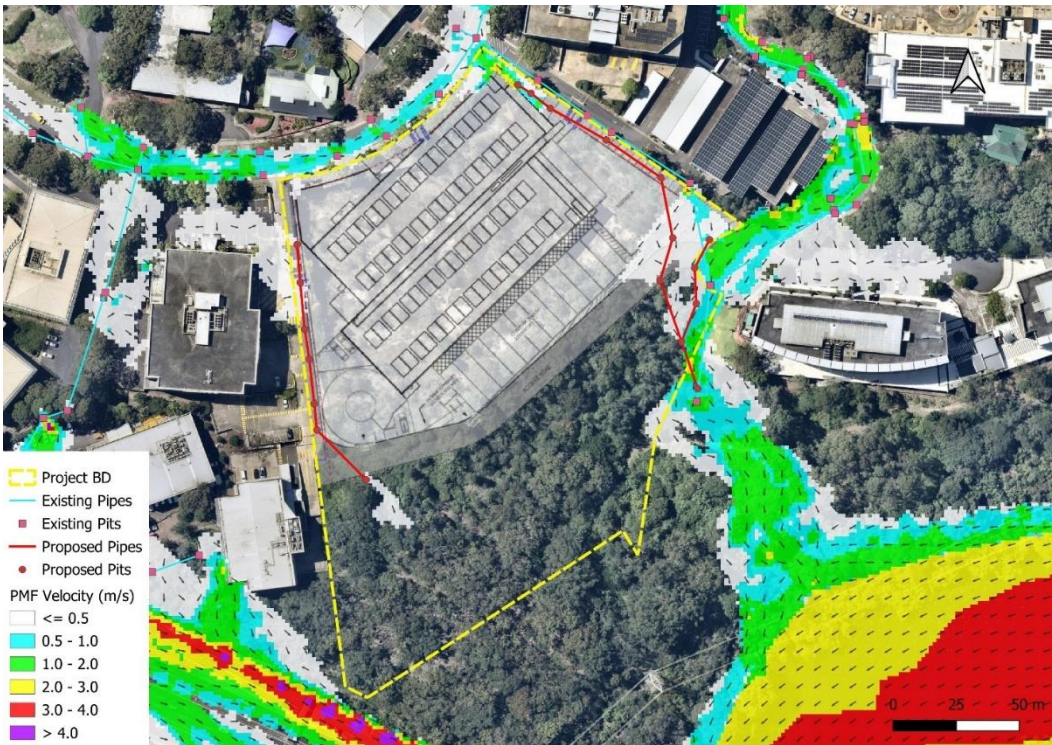


Figure 54- PMF Flood Velocities- Post-Development Scenario



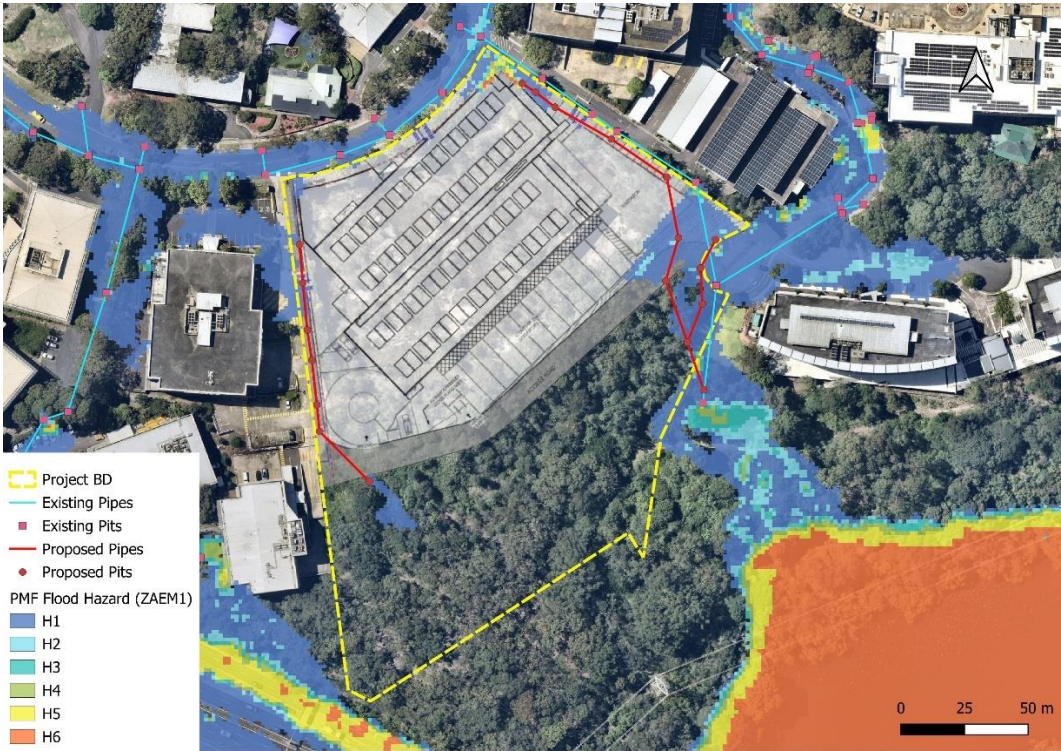


Figure 55- PMF Flood Hazard (ZAEM1)- Post-Development Scenario

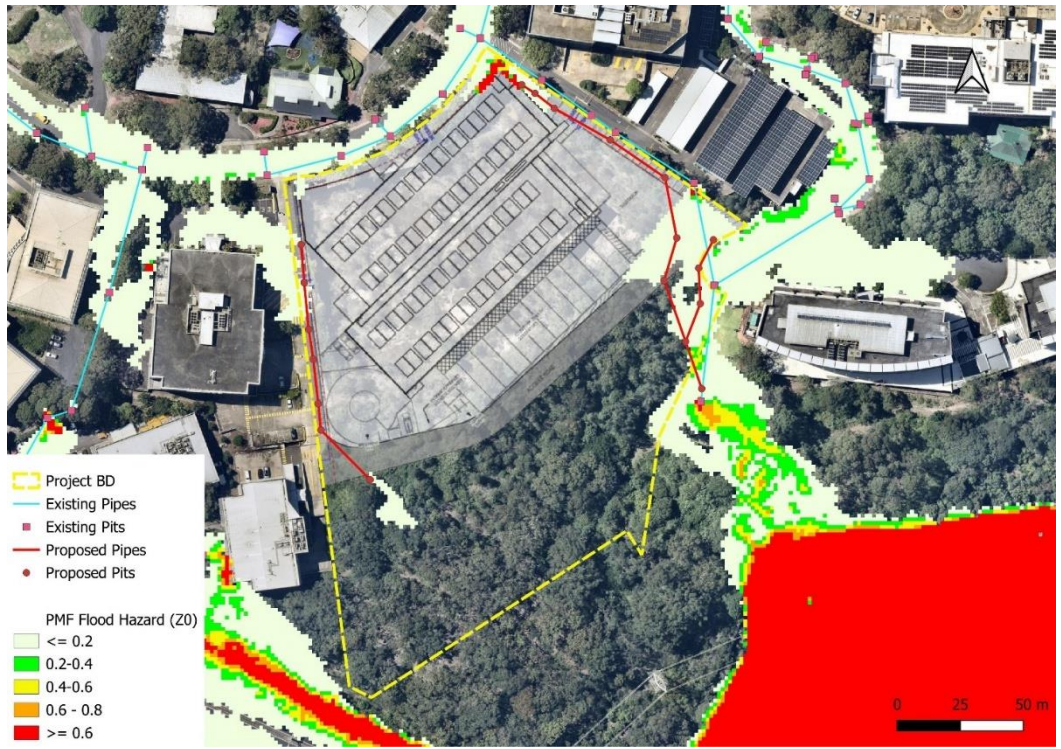


Figure 56- PMF Flood Hazard (Z0)- Post-Development Scenario



## 7.0 Flood Impact

A flood impact assessment has been undertaken to ensure that the proposed development would not result in an unacceptable increase in flood levels onsite or adversely impact flood conditions on neighbouring properties during the 1% AEP event, the 1% AEP event incorporating climate change, and the 1% AEP event with blockage conditions and PMF.

The flood afflux maps indicate no adverse impact on surrounding properties across all modelled events; in fact, some improvements are observed. Localised afflux of generally less than 20 mm is observed along the northern boundary for all events, while flood levels are reduced by more than 30 mm at the sag point in the same area.

Some afflux is observed within the site near the northern boundary, this is not considered as true afflux, as it is primarily due to raised surface levels in the post-development TIN. The difference between post Tin design and existing tin is shown in Figure 57.

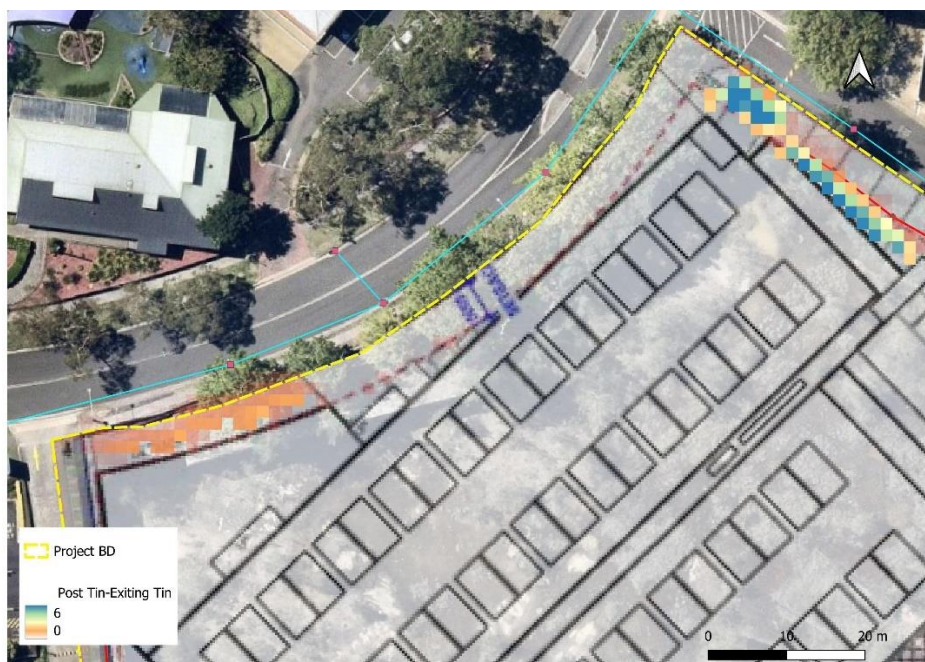


Figure 57-Post tin VS Existing Tin Comparison

The corresponding afflux maps are presented Figure 58 to Figure 61.

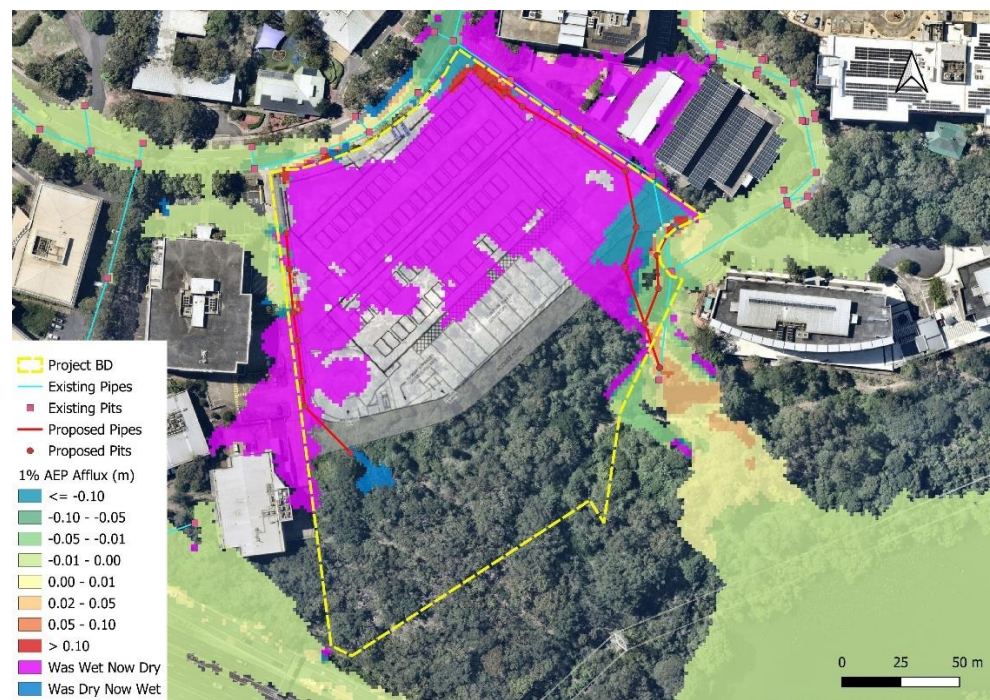


Figure 58- Afflux Map for 1% AEP Event (Post vs Pre Development)

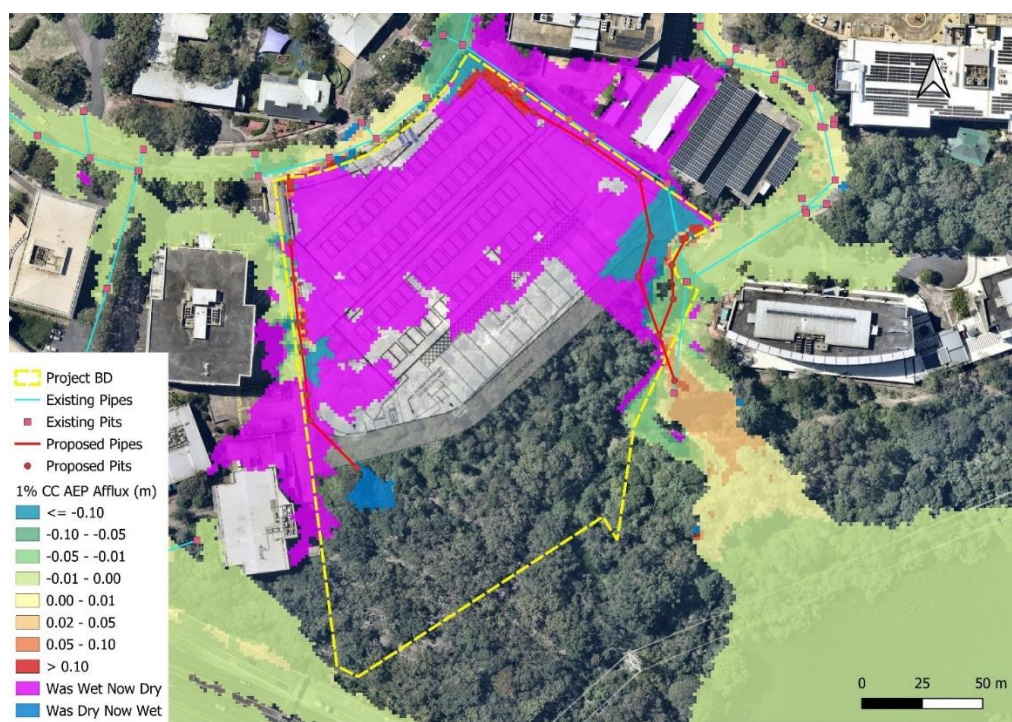


Figure 59- Afflux Map for 1% CC AEP Event (Post vs Pre Development)



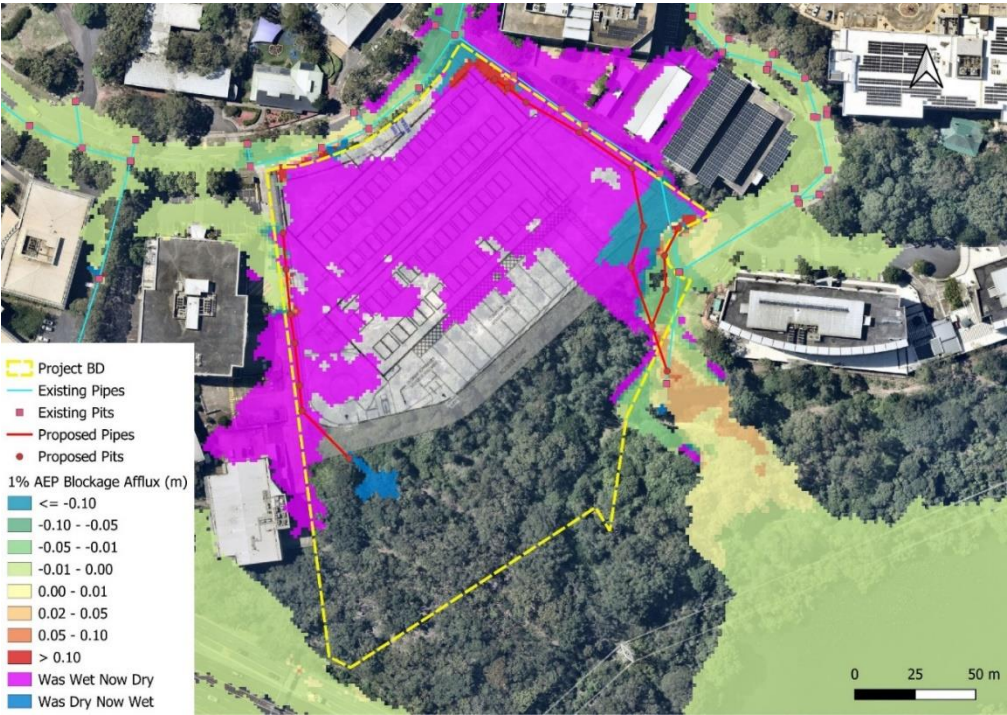


Figure 60- Afflux Map for 1% Blockage AEP Event (Post vs Pre Development)



Figure 61- Afflux Map for PMF Event (Post vs Pre Development)

## 8.0 Conclusions

The results of this Flood Impact and Risk Assessment (FIRA) confirm that the proposed Julius Avenue Data Centre can safely be built without causing adverse flood impacts on neighbouring properties or increasing the risk of flood damage.

Hydraulic modelling for a range of design events — including 1% AEP, 1% AEP with climate change, blockage scenarios, and the PMF — demonstrates that flood levels and velocities across the site remain low, with hazard classifications predominantly in the H1 category. Minor affluxes observed within the site are not considered true afflux but are instead a product of the updated digital surface levels used in the post-development TIN. The results show a reduction in flood levels at key locations, including the sag point on Julius Avenue.

The proposed development incorporates a range of flood mitigation and stormwater management strategies, including new drainage infrastructure, pipe upgrades. These measures ensure that flood conveyance and storage are preserved and enhanced where needed. Furthermore, the assessment confirms the basement car park entry, loading dock, and substation, are located outside flood-affected areas and are protected up to the PMF level.

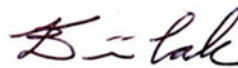
In conclusion, the proposed development meets the relevant floodplain development controls and satisfies the flood-related requirements of both the Ryde Council and State planning authorities. With the implementation of the recommended design and operational measures, the site poses minimal flood risk and is deemed suitable for the intended use.

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**Erian Crabbe**  
**Associate Director**

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