

Flood Impact and Risk Assessment

6-8 Julius Avenue North Ryde

Prepared for **ISPT** / 14 Jan 2026

241920

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1	25/05/25	AV	EC	Draft
2	25/06/20	AV	EC	Issued
3	26/01/14	AV, OB	EC	Issued

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 Concentration Pathways	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.

Response to Agency Comments:

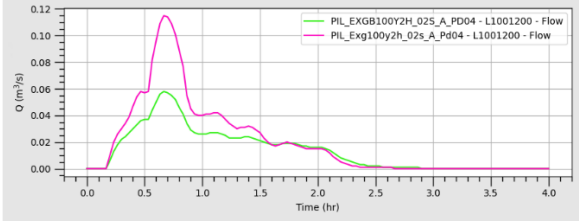
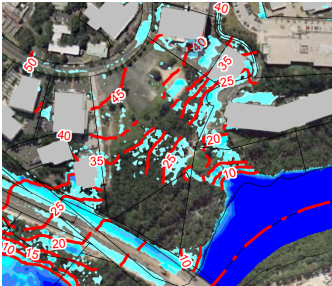
This section has been prepared in response to the Conservation Programs, Heritage and Regulation (CPHR) Group of the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) comments dated 16 September 2025 (Ref ID: SSD-80018208) regarding the proposed Julius Avenue Data Centre.

A summary of the comments and TTW's corresponding responses is provided in the table below, these responses have already been issued and have had provisional approval:

NSW Department Assessment team comments:

No	Comment	TTW response
1	Flood Modelling - Flood modelling 14 The flood modelling does not cover the entire subject land and currently stops at the vegetation line.	Figure 7 in the previous report was included for comparison only, to illustrate the differences between the previous and updated TUFLOW builds. In both the previous report and this report, the flood mapping presented in Sections 6.0 and 7.0 cover the entire subject land.
2	Flood Modelling - The flood modelling also doesn't include the STSS building that is below the access road as shown on civil and architectural design plans.	The proposed site layout has been updated and the STSS building has been relocated. The STSS is now included in the updated TUFLOW model and the flood mapping has been revised accordingly
3	Flood Modelling - The FIRA also indicates that the site survey was used to inform both the pre-development and post development models however the model is clipped at the tree line. The flood modelling for the FIRA must include the entire subject land including the STSS and extend through to the Lane Cove River	Same as above.
4	Pre-development condition - The subject land's current topography which was altered by the previous bulk excavation and retaining wall construction does not reflect its original pre-development condition. These features are currently in the flood mapping which does not represent the flood behaviour of the subject land prior to the initial earthworks. The pre development topography before the previous bulk earthworks should be included in the flood model to reflect the subject land's original landform.	The existing-conditions model retains pre-excavation ground levels within the subject site (i.e. the site levels were not replaced with the post-excavation survey surface). Survey data for the surrounding roads and wider area has been incorporated into both the existing-conditions and post-development TUFLOW models to improve model accuracy, while survey data within the subject site boundary has been applied to the post-development model only (refer Section 5.2 and Figure 8).
5	Flood planning levels - The FIRA indicates that the probable maximum flood (PMF) level and the 1% Annual Exceedance Probability (AEP) flood level are identical.	Please refer to section 4.0. The key access points are shown in Figure 4, and the required Flood Planning Levels and wall heights are summarised in Table 6. Based on the updated design and

	This outcome is not considered realistic as multiple flood planning levels would apply due to the steep topography and flow paths down each side of the subject land. Flood planning levels need to be provided as sections throughout the subject land to demonstrate how the proposal conforms to the flood planning requirements. Further detail is required for the proposed bund wall/cul-de-sac and access road areas. The FIRA indicates there is deeper water in the area upstream of the access road, however the information provided does not clearly explain how stormwater/pavements and overland flow paths would operate in this area. It is also unclear how potential impacts on the cul-de-sac and the City of Ryde Council site will be managed.	modelling outcomes, the proposed bund adjacent to the cul-de-sac is no longer required.
6	Pipe upgrades - The FIRA proposes pipe upgrades to mitigate flood impacts, however the design drawings show large diameter pipes are connected downstream to smaller diameter pipes near the proposed building. While the FIRA states that blockage has been considered, no supporting details or modelling assumptions were provided. Further justification with details and modelling assumptions is required. To verify the adequacy of the proposed drainage system, hydraulic grade lines and long sections are required for all diversion pipework. These should demonstrate that surcharge flow does not occur and confirm that pipework can pass under other services.	It is noted that the pre-excavation ground surface is slightly higher than the post-excavation surface at the site boundary. Accordingly, under the existing-conditions scenario, the model predicts slightly reduced flood encroachment within the subject site and slightly higher flood levels along Julius Avenue compared to a model that adopts the post-excavation survey surface. The updated civil design proposes reduced fill and earthworks along Julius Avenue and the access road to 4 Julius Avenue. In addition, the proposed TIN is generally lower than the existing surface along both side access roads adjacent to the development. As a result of these updates, the revised modelling indicates no afflux along Julius Avenue; therefore, no drainage upgrades are required. The drainage upgrade works previously proposed were intended to mitigate afflux associated with the earlier design and are no longer required under the updated layout Regarding blockage, pit and pipe blockage has been incorporated in the modelling using Council's nominated pit and pipe blockage layers (consistent with Council's blockage allowances). The adopted pit blockage allowances are 10% (kerb inlet on grade), 20% (kerb inlet in sag), 30% (grated surface inlet), and 50% (letterbox/sag, where applicable). Pipe blockage has been applied in accordance with the attributes in Council's pipe blockage layer. A comparison of pit flow capture at the Julius Avenue sag point between the 1% AEP event (magenta) and the 1% AEP with blockage scenario (green) is shown in the figure below.

		 As no drainage upgrade works are proposed, hydraulic grade lines and longitudinal sections for diversion pipework are not applicable.
7	Storage of materials - City of Ryde Council requires that all storage of materials, including fuel should be located above the flood planning level. The proposal includes fuel storage within the basement, but there is no information provided to confirm whether the basement would be located above the flood planning level. Further information is required to demonstrate fuel storage would be located above the flood planning level.	Please refer to section 4.0. The key access points are shown in Figure 4, and the required Flood Planning Levels and wall heights are summarised in Table 6. The fuel tank is located to the south of the development. It is impacted only during the PMF event. The floor level is 36.00 mAHD, which is above the required FPL of 35.80 mAHD (based on the PMF level).
8	Velocity and hazards - The FIRA presents low flood velocities and hazard categories in many locations of the subject land which appears inconsistent given the steep topography. For example, Figure 42 of the FIRA indicates a velocity of just 0.5 m/s at the energy dissipation zone above the pedestrian access path. The velocity and hazard modelling should be reviewed and flood mapping updated accordingly.	The velocity and hazard outputs have been reviewed and the velocity mapping presented in the FIRA is confirmed as correct. In the locations queried, flow is shallow and dispersed, and the corresponding hazard classification is low. Council mapping for this catchment does not provide velocity or hazard maps for direct comparison; however, the modelled flood depth and water level under the 1% AEP event are negligible in this area, which is consistent with the reported velocity/hazard outcomes. The flood maps shown in the Flood Study Report (April 2010), Figure 8 (p. 5). A cutoff depth is likely applied to the council flood map. 
9	Mapping - Multiple flood model outputs use a red colour for depth however, this is not defined in the map legend. Clarification is required to understand how it is defined in the flood mapping. Also, some flood maps for example Figures 34 and 38 are labelled	The red sections indicate areas of very steep terrain where water level contour lines are closely spaced, which can appear as a solid red area. This represents contour symbology rather than a flood depth category. In the updated report, the contours

	as hazard maps but appear to refer to flood depth and not hazard. This inconsistency should be addressed to ensure the maps are accurately labelled and interpreted.	have been removed in these areas to avoid confusion. In addition, Figures 34 and 38 in the superseded study present the Z0 (VxD) (depth–velocity) hazard product, not flood depth.
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Executive Summary

This Flood Impact and Risk Assessment (FIRA) has been prepared for the proposed Julius Avenue Data Centre at 6–8 Julius Avenue, North Ryde. The purpose of the assessment is to confirm that the development can be constructed and operated without causing unacceptable flood impacts on the site or on surrounding properties, and that appropriate flood risk management measures are in place.

Flood modelling was undertaken using the updated Council flood model (with the hydraulic model updated to the current TUFLOW build). The assessment considers existing and post-development conditions for the 1% AEP, 1% AEP with climate change, 1% AEP with blockage, and PMF events. Survey information was adopted to improve model accuracy, with surrounding roads/wider area incorporated into both the existing and post-development models, and the subject-site survey applied to the post-development model.

For existing conditions, the 1% AEP results indicate flood depths across the site are generally less than 50 mm, with two minor flow paths entering from the north, travelling along Julius Avenue and discharging to the Lane Cove River. A sag point is present on Julius Avenue near the access driveway to 4 Julius Avenue, with a modelled flood depth of approximately 476 mm (1% AEP), 487 mm (1% AEP with blockage) and 504 mm (PMF). Flood velocities within the site are generally below 0.5 m/s, and velocities along Julius Avenue are typically below 1 m/s. Flood hazard is predominantly H1 (low hazard) across the site and surrounding area. The 1% AEP climate change scenario produces results within a similar range to the 1% AEP event, with only minor increases in flood depth and extent. For the PMF event, flood depths across the site and surrounding roads are generally less than 0.2 m, with hazard remaining predominantly H1.

A flood impact assessment was completed for post-development conditions. The afflux mapping indicates no adverse impacts on surrounding properties across all modelled events, with changes generally within ± 10 mm, demonstrating that the proposal does not worsen flooding on neighbouring land.

The development has been designed to satisfy flood planning requirements. The main entrance level at Level 2 has a finished floor level of 48.00 mAHD, which exceeds the minimum required level of 47.90 mAHD. Localised mitigation is provided where required: a flood protection wall is proposed adjacent to the building near the driveway to 4 Julius Avenue to protect key access elements (including the stairs at Locations D and E), with the crest level set to 1% AEP + 300 mm freeboard. The fuel tank is located to the south of the development and is impacted only during the PMF event; the floor level is 36.00 mAHD, which is above the required FPL of 35.80 mAHD (based on the PMF level).

Overall, the modelling demonstrates that the proposed development can be delivered with low flood risk, no unacceptable offsite impacts, and appropriate mitigation and finished levels to manage residual flood risk for key access points.

1.0 Introduction

1.1 Project Introduction

This Flood Impact and Risk Assessment (FIRA) has been prepared for ISPT for the proposed Julius Avenue Data Centre at 6–8 Julius Avenue, North Ryde. The report has been prepared in response to the Secretary's Environmental Assessment Requirements (SEARs) and addresses the flood-related requirements relevant to the proposal.

Flood behaviour and potential impacts have been assessed for both existing and post-development conditions using Council's adopted hydraulic model for the catchment. The hydraulic model was upgraded to the current TUFLOW build to resolve prior anomalies and improve model performance, and this upgraded build has been adopted for the assessment. The assessment includes the 1% AEP, 1% AEP (climate change), 1% AEP with blockage, and PMF events. Site survey information has been incorporated to improve model accuracy, with surrounding roads/wider area applied to both existing and post-development models, and the subject-site survey applied to the post-development model only. Pit and pipe blockage have been explicitly represented using Council's nominated blockage layers and blockage allowances. Flood hazard has been assessed using depth–velocity-based hazard categories.

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)
Flooding	Identify the flood planning level as set out in the relevant council LEP or SEPP and identify any: - flood risks on site having regard to adopted flood studies - the potential effects of climate change, and - any relevant provisions of the NSW Flood Risk Management Manual 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. 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).	The site is subject to shallow overland flow during the 1% AEP event, with low depths (<50 mm) and velocities (<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. Section Reference (this Report): Sections 6.0 Finished Floor Levels: 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. Section Reference (this

		Report): Section 4.0 Flood modification measures Provide a flood protection wall adjacent to the building (near the driveway to 4 Julius Avenue; Figure 4) to protect the building stairs (Locations D & E), with crest level set to 1% AEP + 300 mm freeboard. Section Reference (this Report): Section 3.0 and Section 6.0 A separate Flood Emergency Response Plan (FERP) will be prepared specifically for this project to address site-specific flood safety and operational procedures.
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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.

A flood mitigation wall is proposed along the eastern perimeter of the building. The design crest level of the wall is determined by the greater of the 1% AEP flood level plus 300mm freeboard, or the Probable Maximum Flood (PMF) level. Based on these criteria, the top of the wall ranges from RL 38.50 mAHD to RL 45.90 mAHD for mor detail please refer to section 4.0.

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 Proposed Development

The proposal involves the construction and operation of a data centre and associated infrastructure and amenities, identified as the Julius Avenue Data Centre, comprising the following scope of works:

- Site preparation works, including tree removal;
- Earthworks and additional site retaining;
- Infrastructure comprising civil works and utilities servicing;
- Construction of a data centre including the following:
 - Ground level loading dock, services plantrooms and car parking for 38 cars, including 2 accessible;
 - 8 data halls across four (4) storeys with an IT load of 76 MW and a maximum power consumption of 120 MW, plus rooftop plant;
 - Three (3) storey office/front of house building;

- Five (5) storey enclosed generator gantry to rear of data centre.
- New Ausgrid 132 kilovolt (KV) Sub-Transmission Switching Station (STSS);
- A new pedestrian through-site link from Julius Avenue to Richardson Place; and
- Complementary landscaping and offset planting.

The Proposal includes works as identified in Table 3 below.

Table 2: Development Particulars

Component	Documentation
Site Area	28,630sqm
Primary Land Use	Data Centre (16,647 M2 GFA)
Ancillary Land Uses	Office premises (868 M2 GFA)
Gross Floor Area	16,647 M2
Floor Space Ratio	0.58:1
IT Load	76 MW
Maximum Power Consumption	120 MW
Building Height	40m
Car Parking	38 car parking spaces (including 2 accessible)
Landscaping/trees	Total landscaping and tree removal to be confirmed.
Back-Up Generators	48 x 3MW diesel back-up generators (Data Centre) + 1 x 1 MW diesel back-up generator (Office)
Dangerous Goods	955kL diesel storage capacity (Data Centre = 12 x 75 kL bulk tanks + 48 x 1 kL day tanks + Office = 1 x 6kL tank + 1 kL day tank)
Estimated Jobs	Total estimated jobs (construction and operation) to be confirmed.

The proposed site layout is shown in Figure 2 below.



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.

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: - Does not jeopardize public safety and access - Does not cause property damage - Does not worsen pre-developed flood regime 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: - Compliance with the Stormwater Technical Manual - Structural engineer certification for design against 100yr ARI flood forces
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: - Reduce flood storage at pre-development levels - Not increase flood levels or velocities that could adversely affect nearby properties
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 5.

Table 4- Freeboard required based on the Council DCP

Drainage System/ Overland Flow	Residential			Industrial/ Commercial	
	Land Level ^(b)	Habitable Floor Level	Non-Habitable Level ^(c)	Land Level ^(b)	Floor Level
Surface Drainage/ adjoining ground level ^(a)	-	.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 ^(d)	N/A	0.2m	0.1m	N/A	0.2m
Road Drainage Minor Systems (Gutter and pipe flow)		0.15m below top of grate			
Road Drainage		Refer to Figure 2-1.			
Detention Basins ⁽⁴⁾		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 ² /s intervals. VxD afflux maps at 0.04–0.05 m ² /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 ² /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 Level 2 floor plan, which includes the main entrance to the building, is shown in Figure 4 while a section view of the proposed development is provided in Figure 3. A summary of flood impacts and recommended mitigation measures for key access points is presented in Table 6.

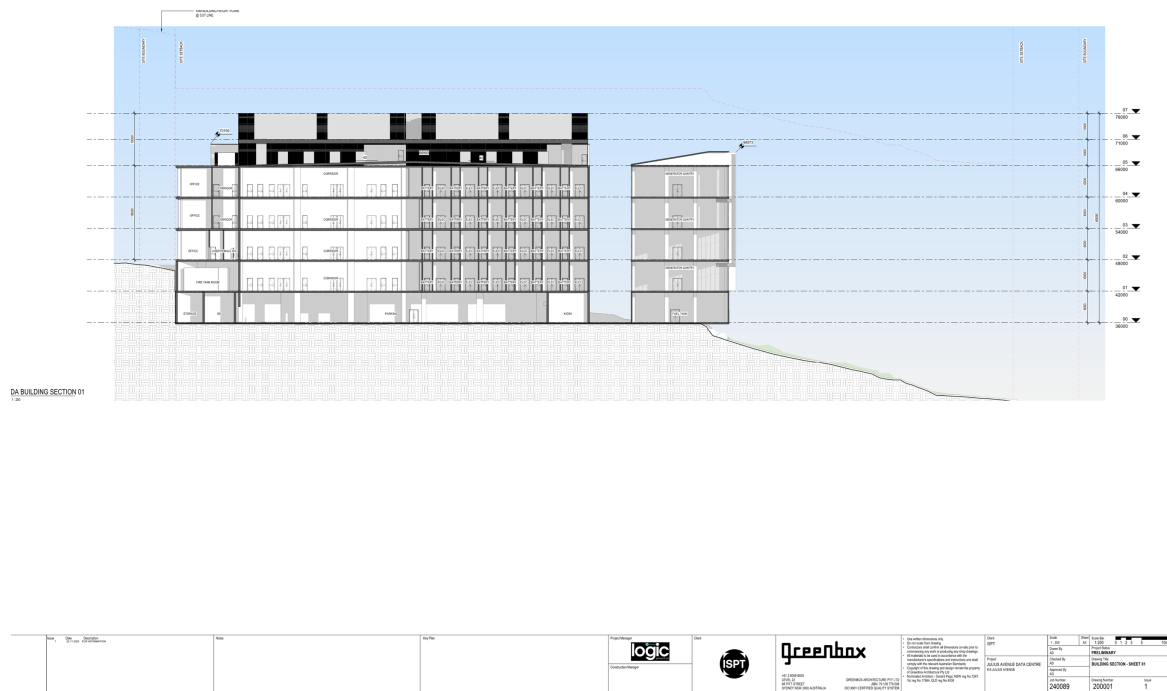


Figure 3- Section view of the Proposed Development (Provided Green Box Architecture)

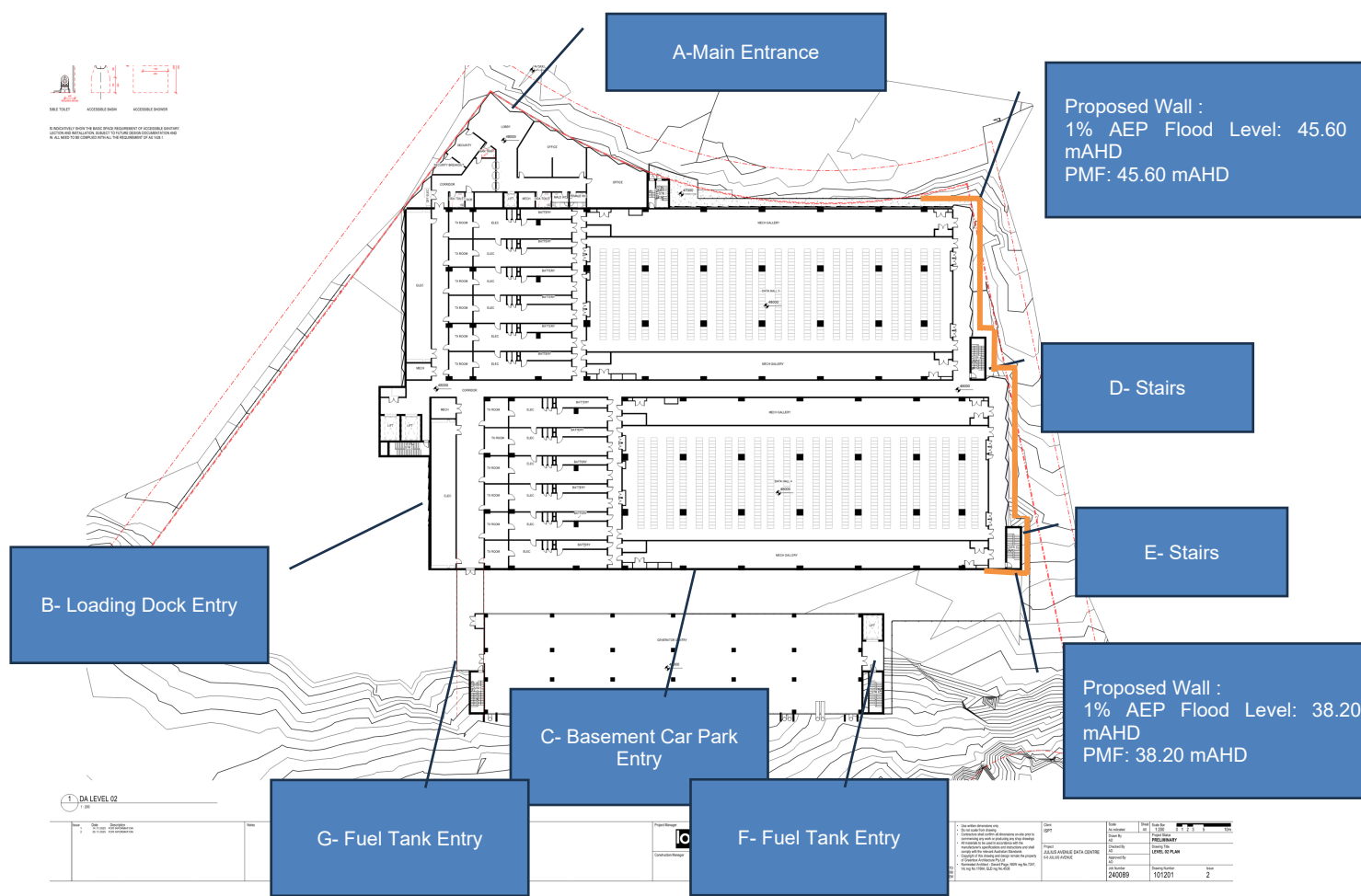


Figure 4- Level 2 Floor Plan (Provided Green Box Architecture)

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

ID	Location	Flood Conditions	Flood Planning Level	Proposed Floor Level
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.	The proposed Floor level at lobby is 48.00 m AHD which is 0.1 m higher than the required flood planning level.
B	Loading Dock	Not Impacted	-	-
C	Basement Carpark Entry	Not Impacted	-	-
D and E	Stairs	Impacted 1% AEP and PMF flooding	The PMF flood level along the building boundary adjacent to the driveway to 4 Julius Avenue ranges from 38.20 to 45.60 m AHD, as shown in Figure 4. The 1% AEP flood level along this frontage is very similar.	A flood protection wall is proposed adjacent to the access driveway to 4 Julius Avenue, as shown in Figure 4 (orange). The wall crest level is set to the 1% AEP flood level + 300 mm freeboard. The corresponding PMF flood level along this frontage ranges from 38.50 to 45.90 m AHD.
F	Fuel Tank Entry	Impacted only under the PMF event	Flood level: 1% AEP: Not impacted; PMF: 35.80 m AHD	The required FPL is 35.80 m AHD (PMF level). The floor level is 36.00 m AHD, which is above the FPL
G	Fuel Tank Entry	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.

The stairs (Locations D and E) are affected under both the 1% AEP and PMF events. Along the building boundary adjacent to the driveway to 4 Julius Avenue, the modelled PMF flood level ranges from 38.20 to 45.60 mAHD (Figure 4), and the 1% AEP flood level along this frontage is similar. To mitigate this risk, a flood protection wall is proposed adjacent to the access driveway to 4 Julius Avenue (Figure 4, orange). The wall crest level is set to the 1% AEP flood level plus 300 mm freeboard. The corresponding PMF flood level along this frontage ranges from 38.50 to 45.90 mAHD.

The fuel tank entry (Location F) is impacted only under the PMF event. The 1% AEP flood level does not impact this location, and the PMF flood level is 35.80 mAHD. The required FPL is therefore 35.80 mAHD (PMF level). The floor level is 36.00 mAHD, which is above the FPL. The fuel tank entry (Location G) is not impacted under any of the modelled events.

5.0 Hydraulic and Hydrologic Modelling

5.1 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 5.

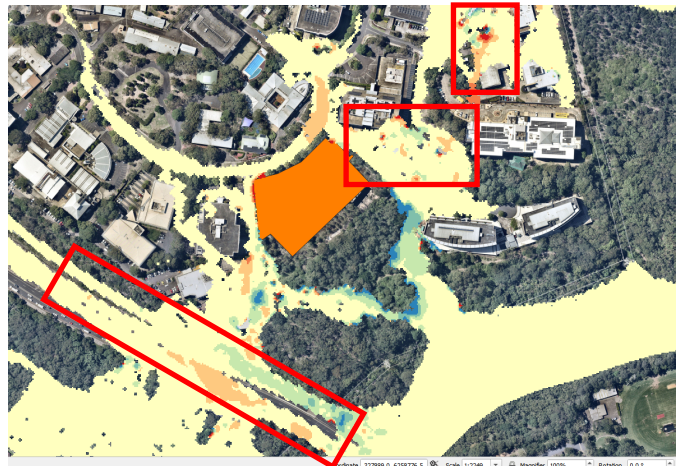


Figure 5- Afflux anomaly around the model (2008 TUFLOW Build)

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 6.



Figure 6- Afflux map around the model (2025 TUFLOW Build)

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 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.

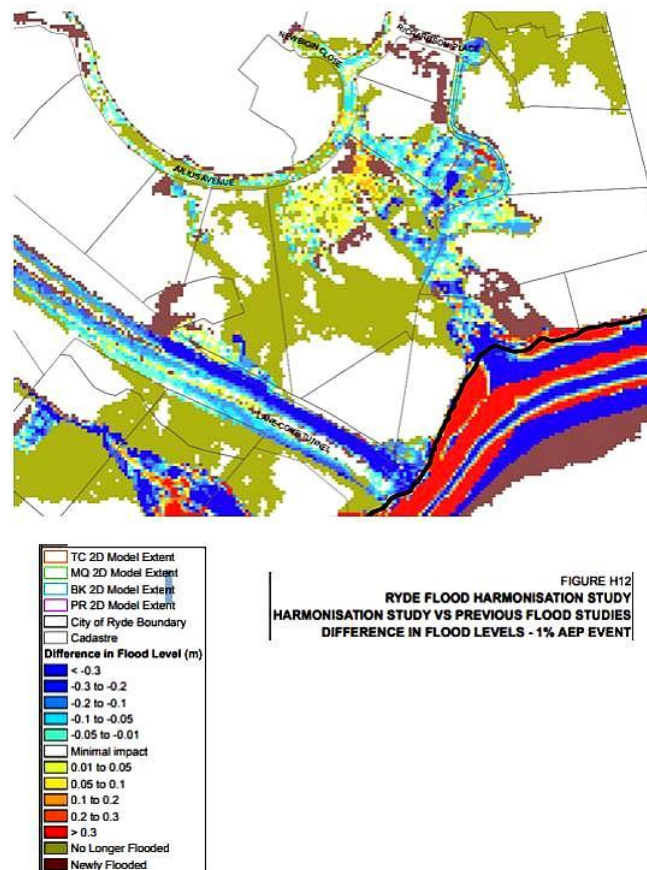


Figure 7- Difference in 1% AEP Flood Levels – Previous vs 2023 Ryde Council Flood Study

5.2 Site Survey

The site survey provided by Beveridge Williams has been completed and was used for this study. Survey data for the surrounding roads and wider area has been incorporated into both the existing-conditions and post-development TUFLOW models to improve model accuracy. Survey data within the subject site boundary has been applied to the post-development model only. For the existing-conditions model, pre-excavation ground levels have been retained (i.e. the site levels were not replaced with the post-excavation survey surface). A comparison of the pre-excavation and post-excavation ground surfaces is shown in Figure 8.

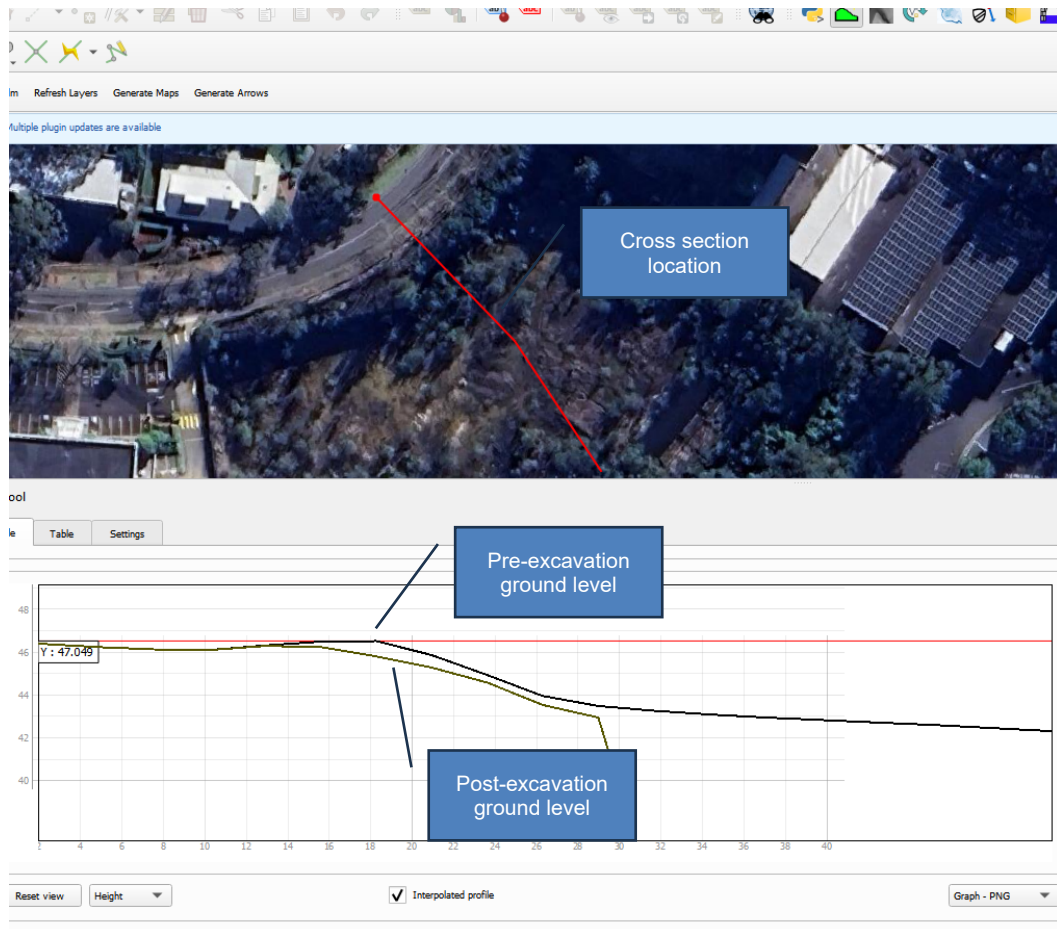


Figure 8- Comparison of Pre-Excavation and Post-Excavation Ground Levels

It is noted that the pre-excavation ground surface is slightly higher than the post-excavation surface at the site boundary. Accordingly, under the existing-conditions scenario, the model is likely to predict slightly reduced flood encroachment within the subject site and slightly higher flood levels along Julius Avenue, relative to a model that adopts the post-excavation survey surface.

The survey extent is shown in Figure 9.

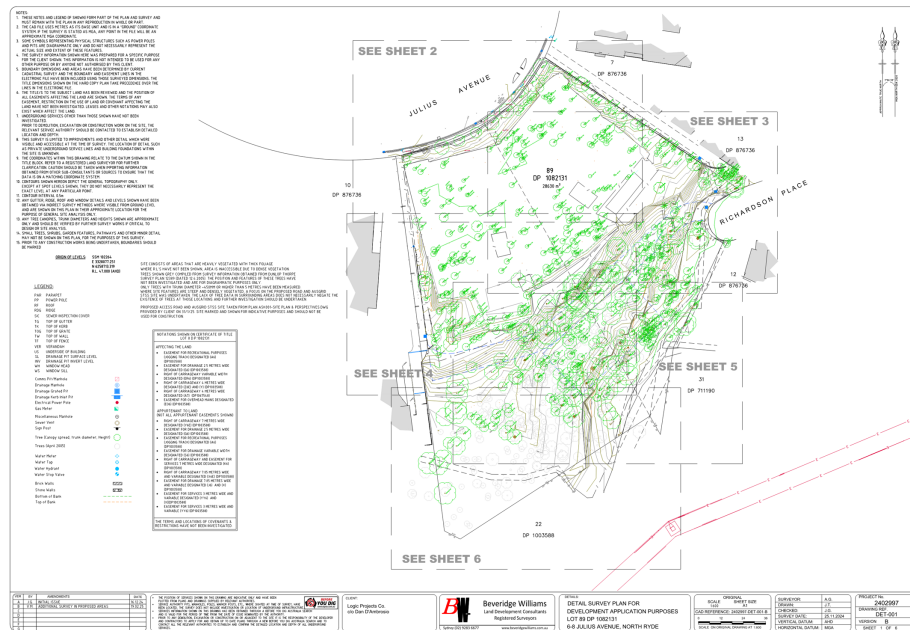


Figure 9- Survey which is used for this study

5.3 Flooding Impact Due to Climate Change

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

5.4 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 10, 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.

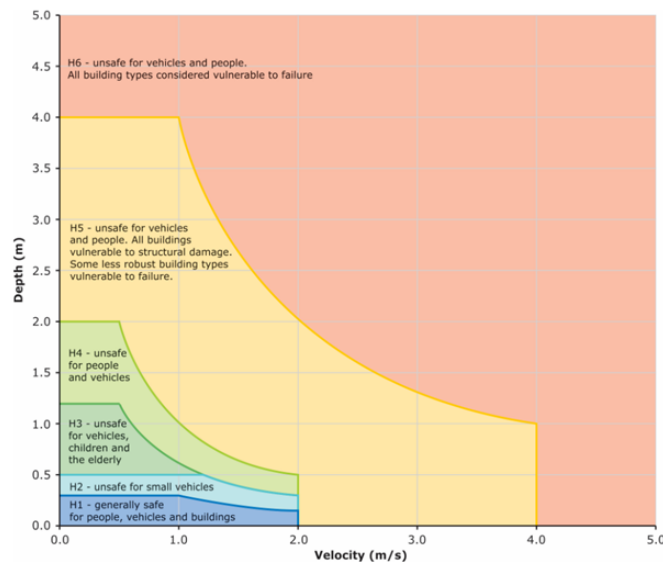


Figure 10- Flood hazard vulnerability curve (Source: Flood Risk Management Guide FB03 - Flood Hazard, NSW Department of Planning and Environment, 2022)

Table 7- Hazard vulnerability threshold limits

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

6.0 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 11.

It is also noted that a sag point exists on Julius Avenue near the access driveway to 4 Julius Avenue. The modelled flood depth at this sag point is approximately 476 mm for the 1% AEP event, 487 mm for the 1% AEP with blockage scenario, and 504 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 11 to

Figure 26.



Figure 11-1% AEP Flood Depths and Levels-Existing Scenario

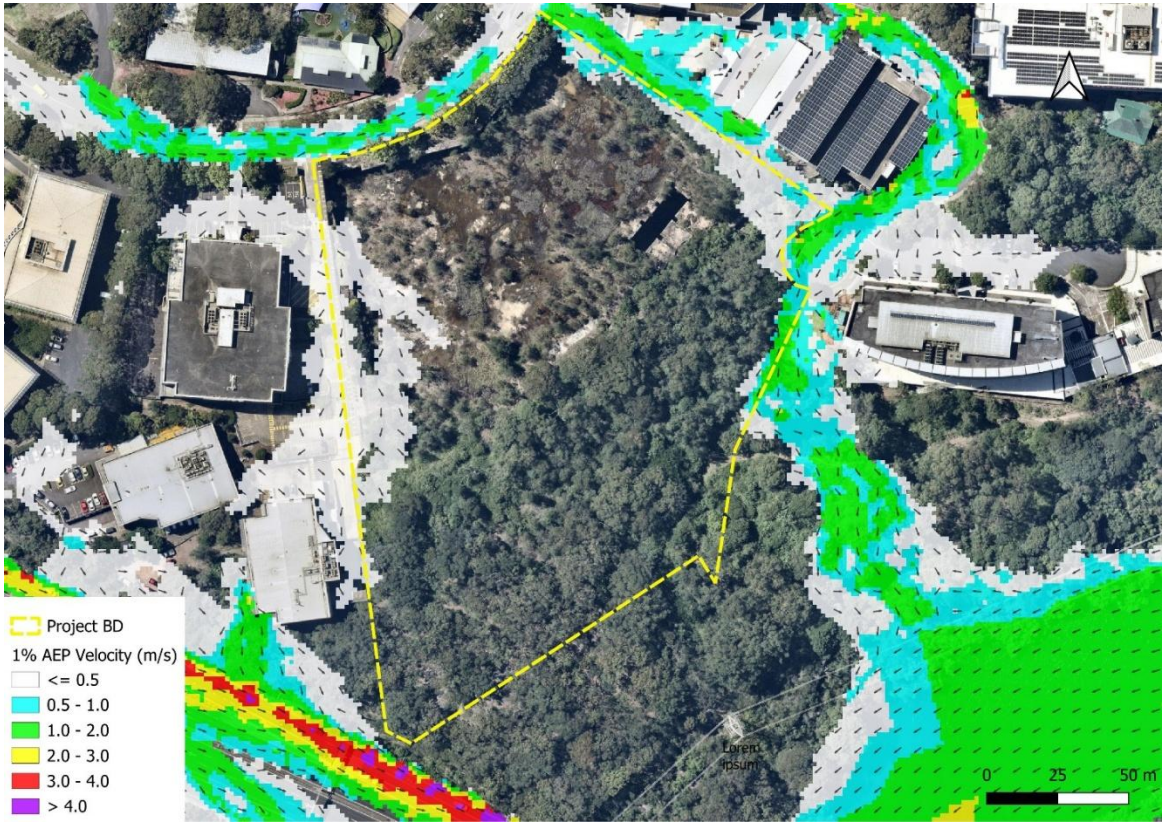


Figure 12-1% AEP Flood Velocities-Existing Scenario

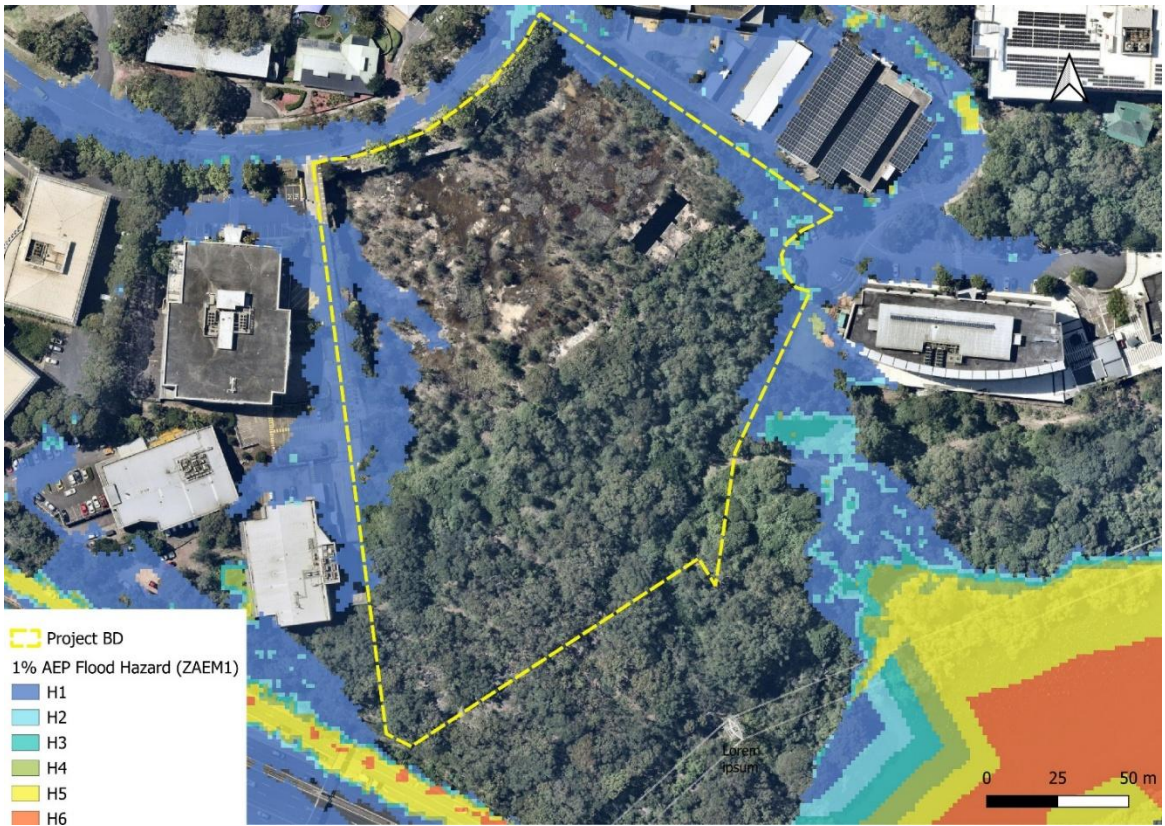


Figure 13-1% AEP Flood Hazard (ZAEM1)- Existing Scenario



Figure 14-1% AEP Flood Hazard (Z0)- Existing Scenario



Figure 15-1% AEP CC Flood Depths and Levels-Existing Scenario

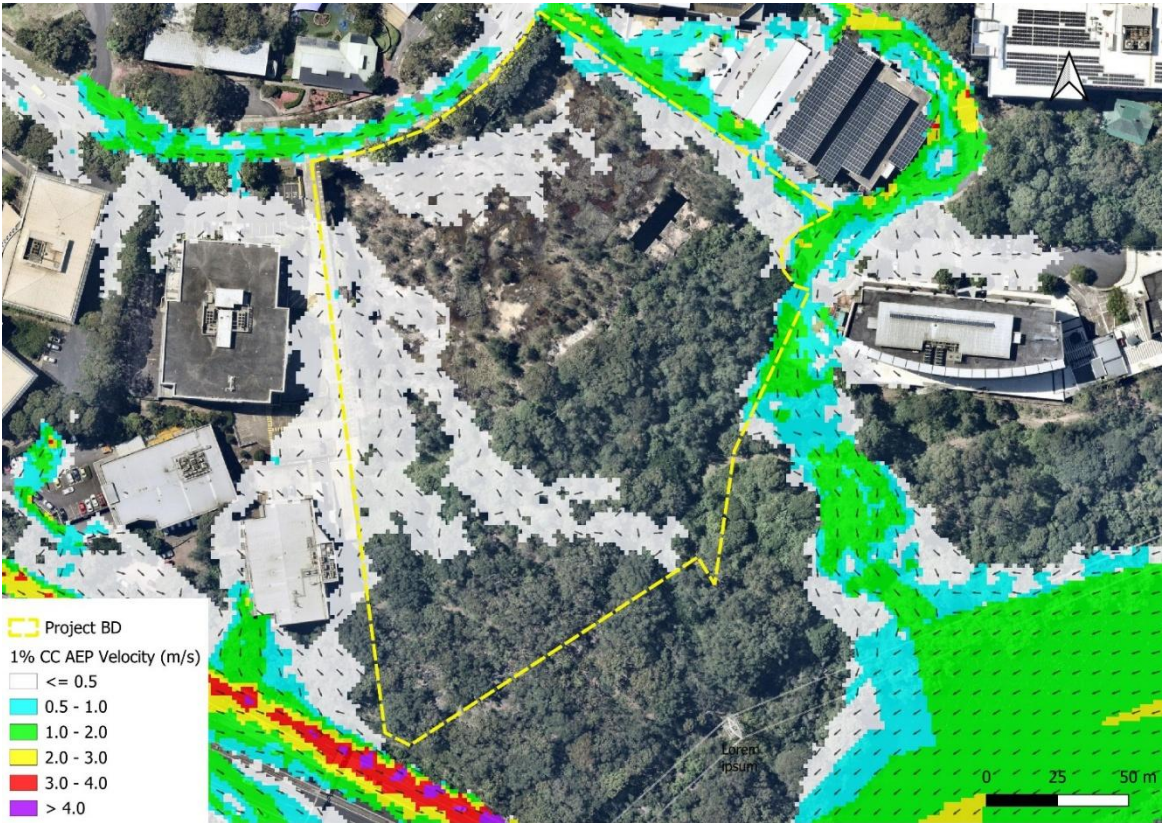


Figure 16-1% AEP CC Flood Velocities-Existing Scenario



Figure 17-1% AEP CC Flood Hazard (ZAEM1) -Existing Scenario



Figure 18-1% AEP CC Flood Hazard (Z0) - Existing Scenario



Figure 19- 1% AEP+Blockage Flood Depths and Levels-Existing Scenario

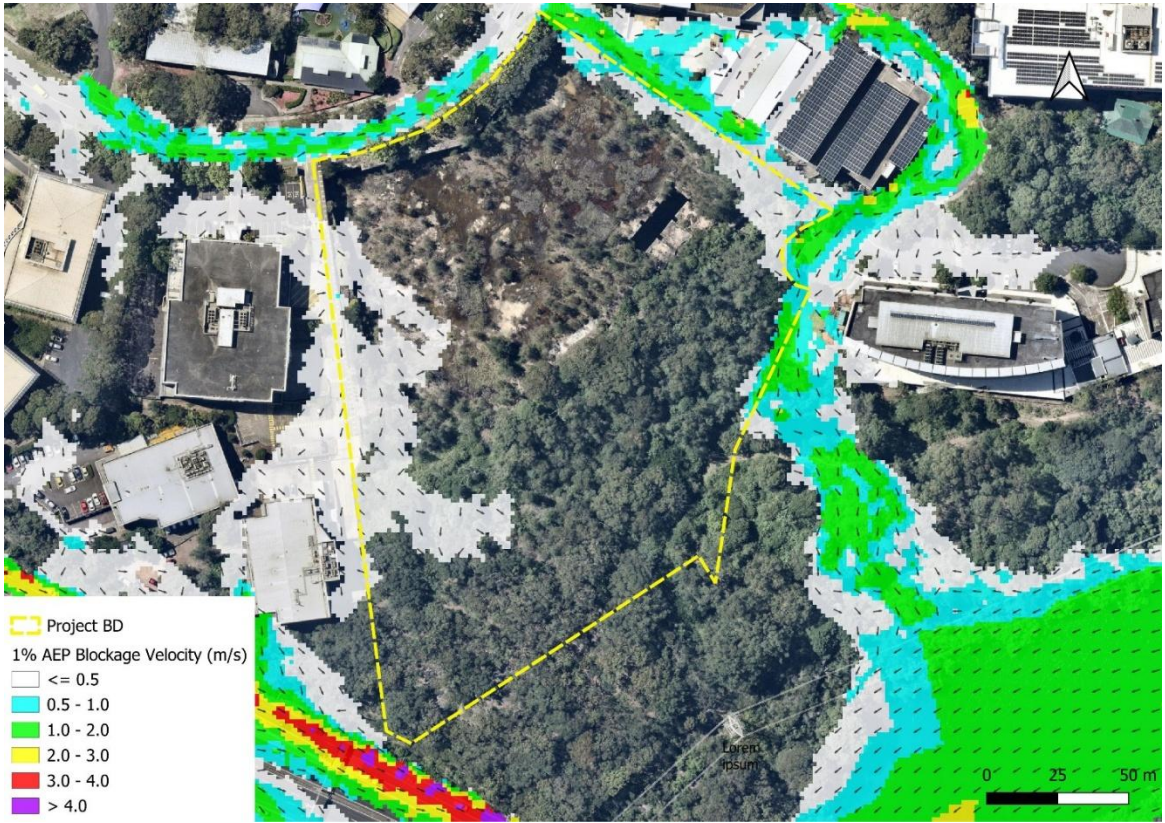


Figure 20-1% AEP+Blockage Flood Velocity -Existing Scenario

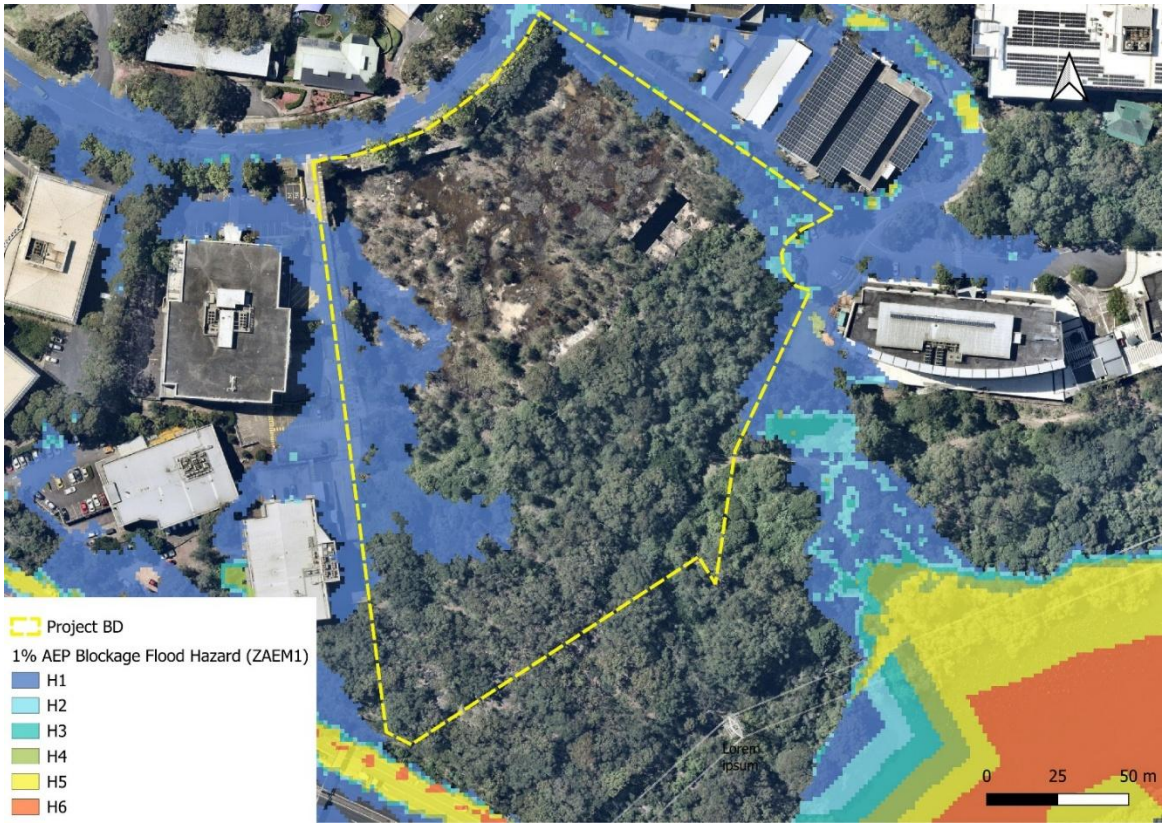


Figure 21 1% AEP+Blockage Flood Hazard (ZAEM1)-Existing Scenario



Figure 22 1% AEP+Blockage Flood Hazard (Z0) - Existing Scenario



Figure 23- PMF Flood Depths and Levels- Existing Scenario

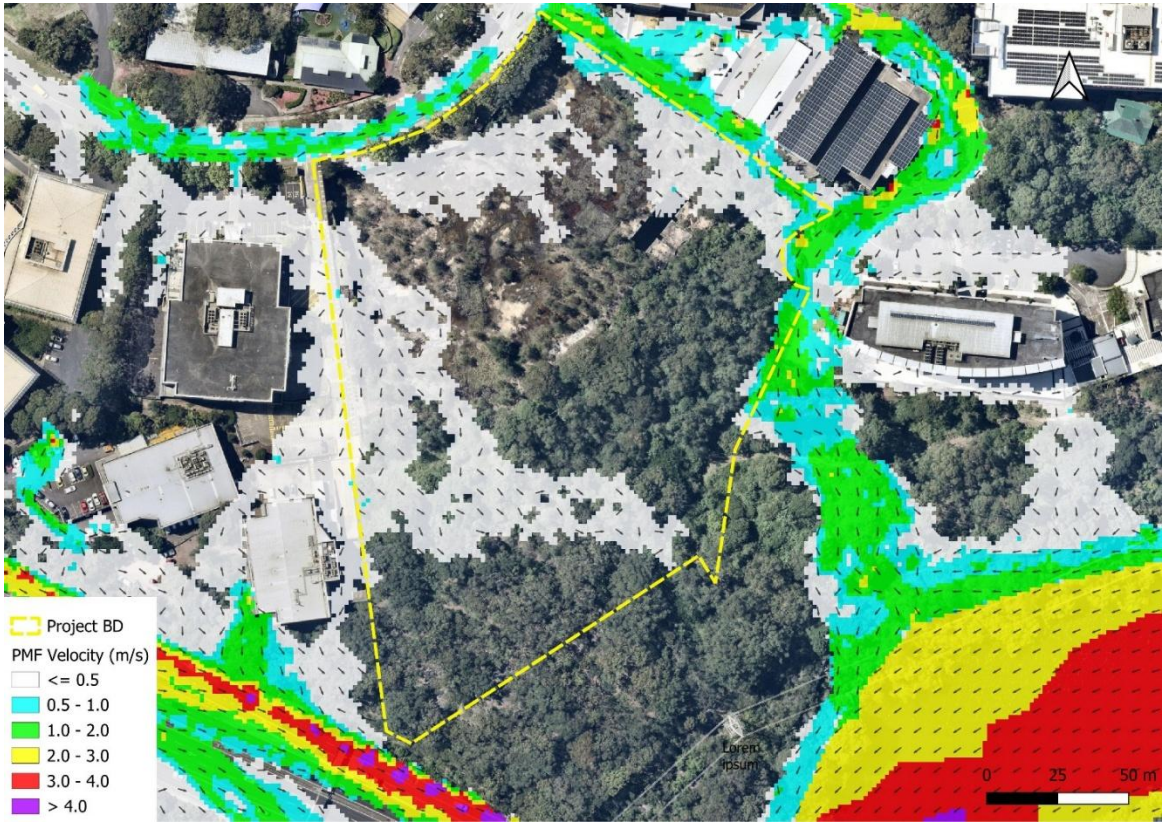


Figure 24- PMF Flood Velocities-Existing Scenario

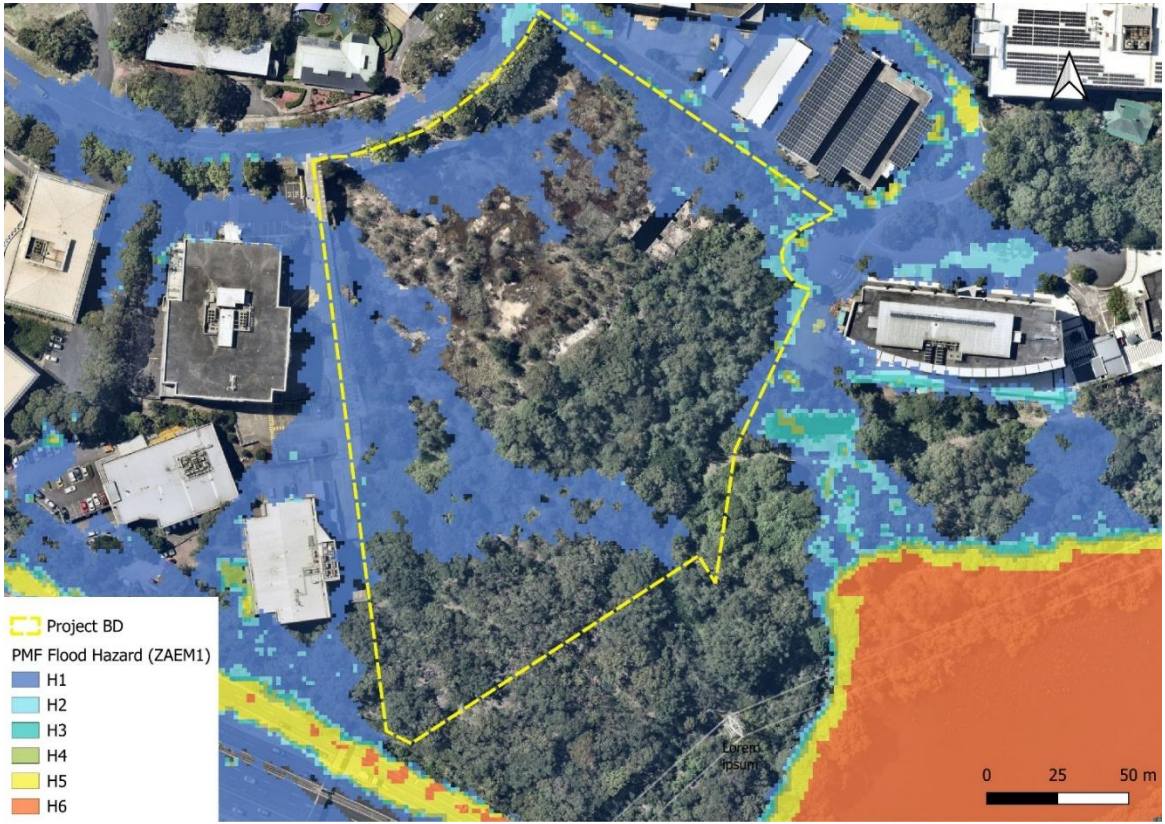


Figure 25- PMF Flood Hazard-(ZAEM1) Existing Scenario



Figure 26- PMF Flood Hazard (Z0)- Existing Scenario

7.0 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 27.

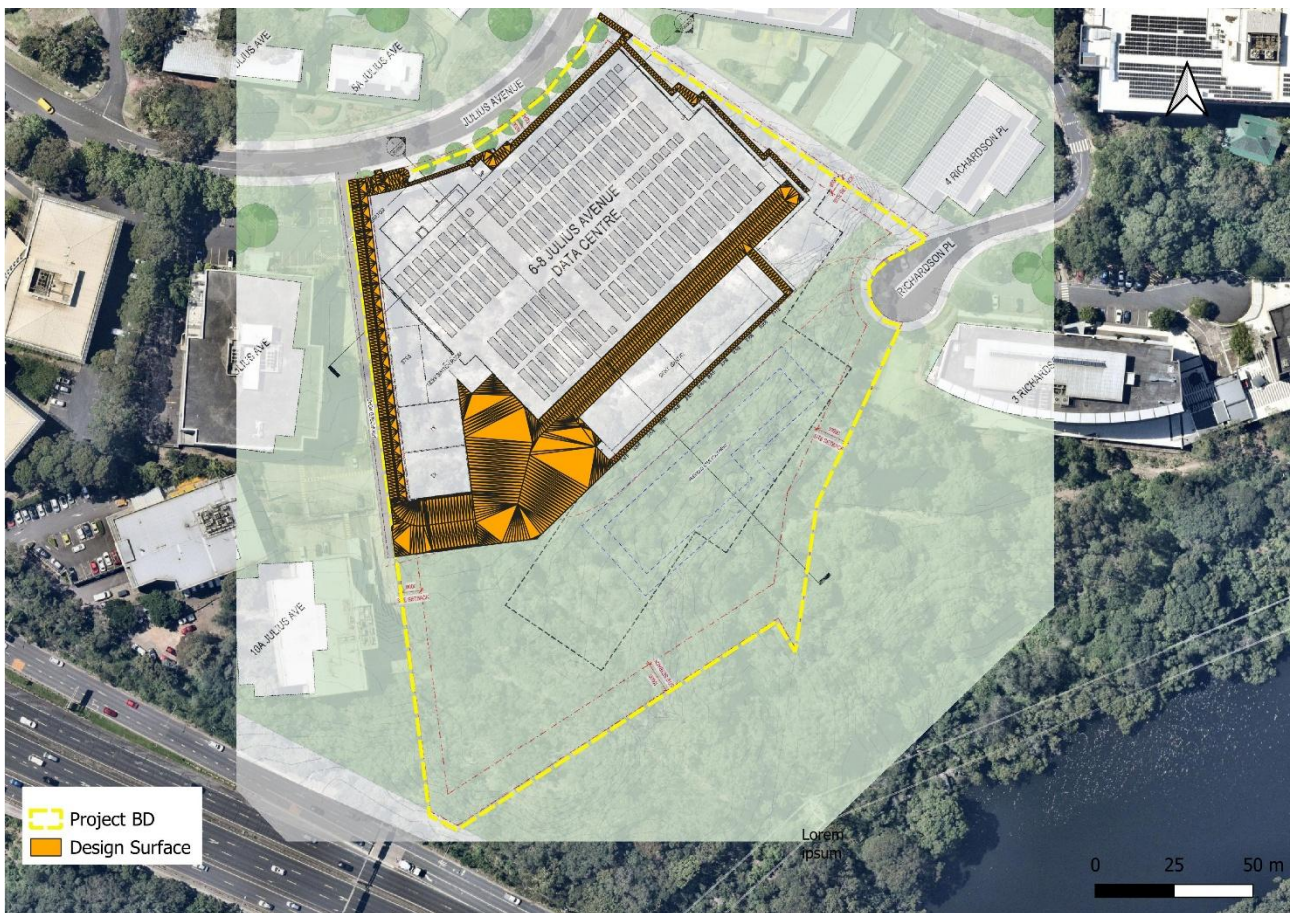


Figure 27- Updated Proposed Design Surface Included in the TUFLOW model.

For comparison, the superseded civil design is shown in Figure 27. The updated civil design proposes reduced fill and earthworks along Julius Avenue and the access road to 4 Julius Avenue. As a result, reduced (or no) afflux is expected under the updated design.



Figure 28- Superceded proposed Design Surface

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 29 to Figure 44.

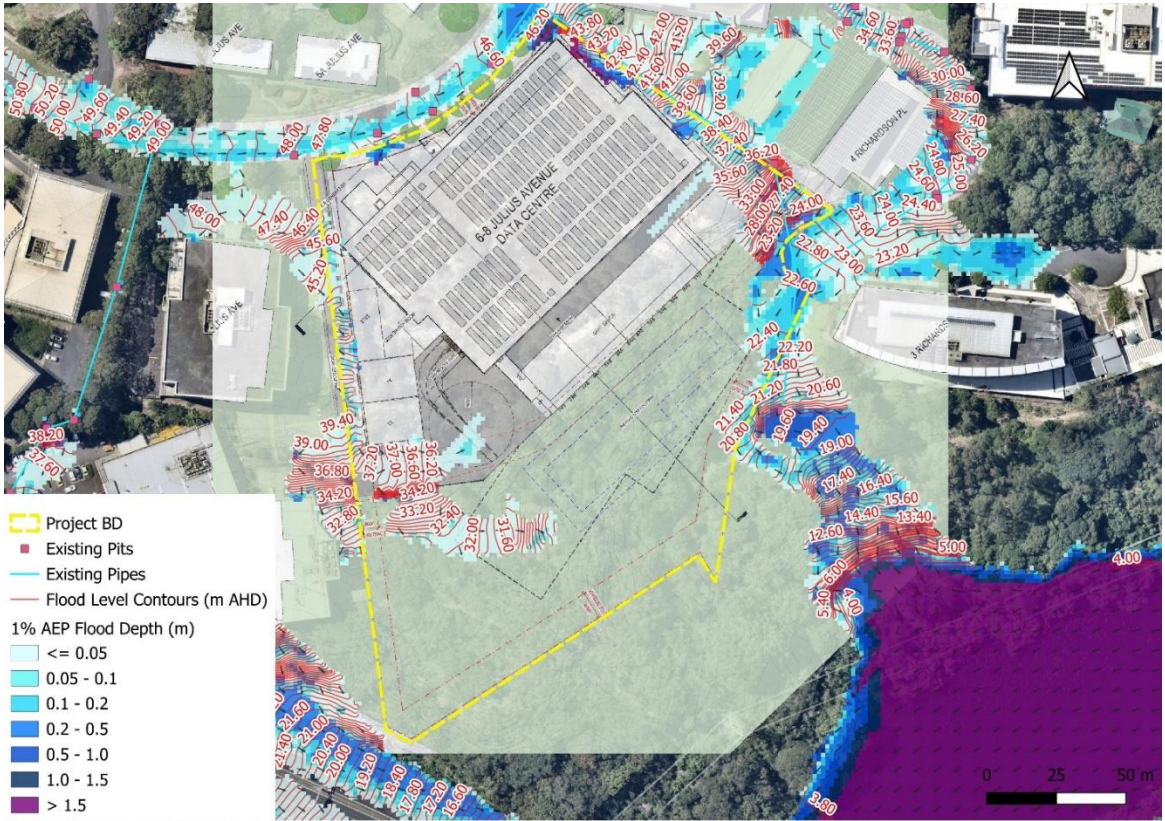


Figure 29- 1% AEP Flood Depths and Levels- Post Development Scenario

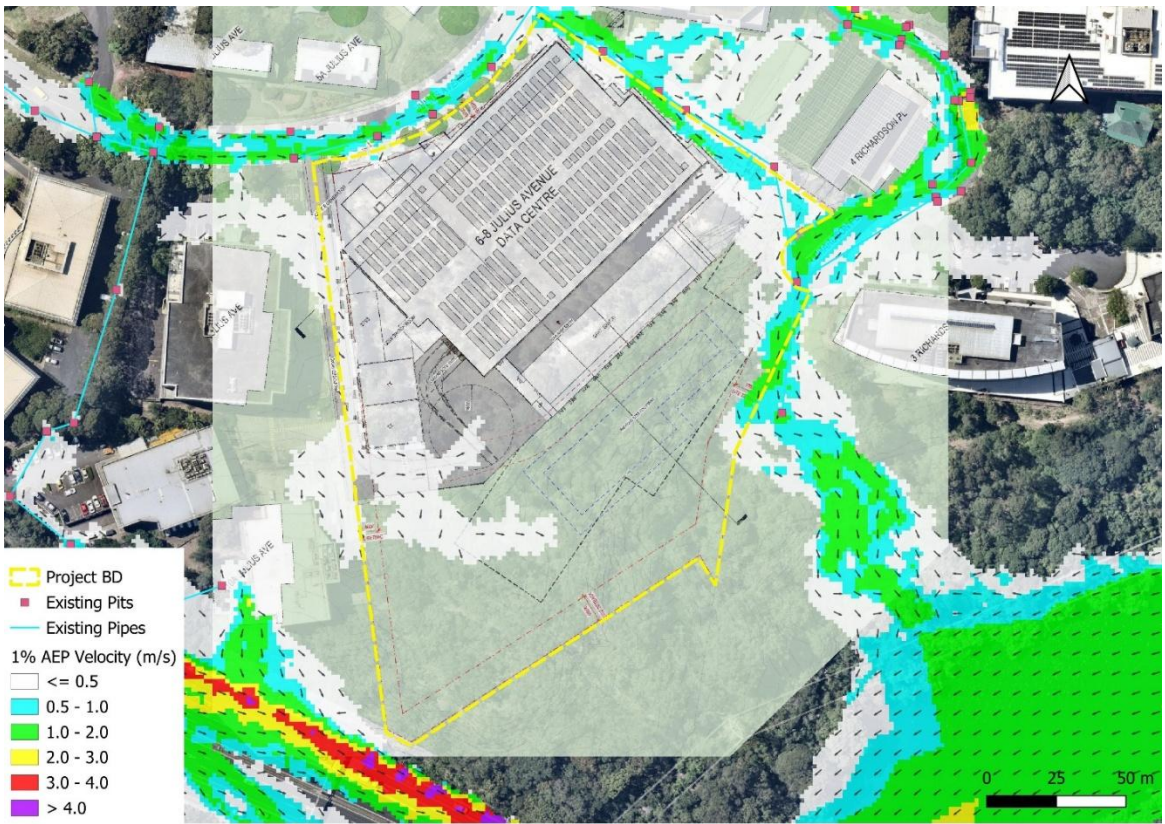


Figure 30- 1% AEP Flood Velocities- Post Development Scenario

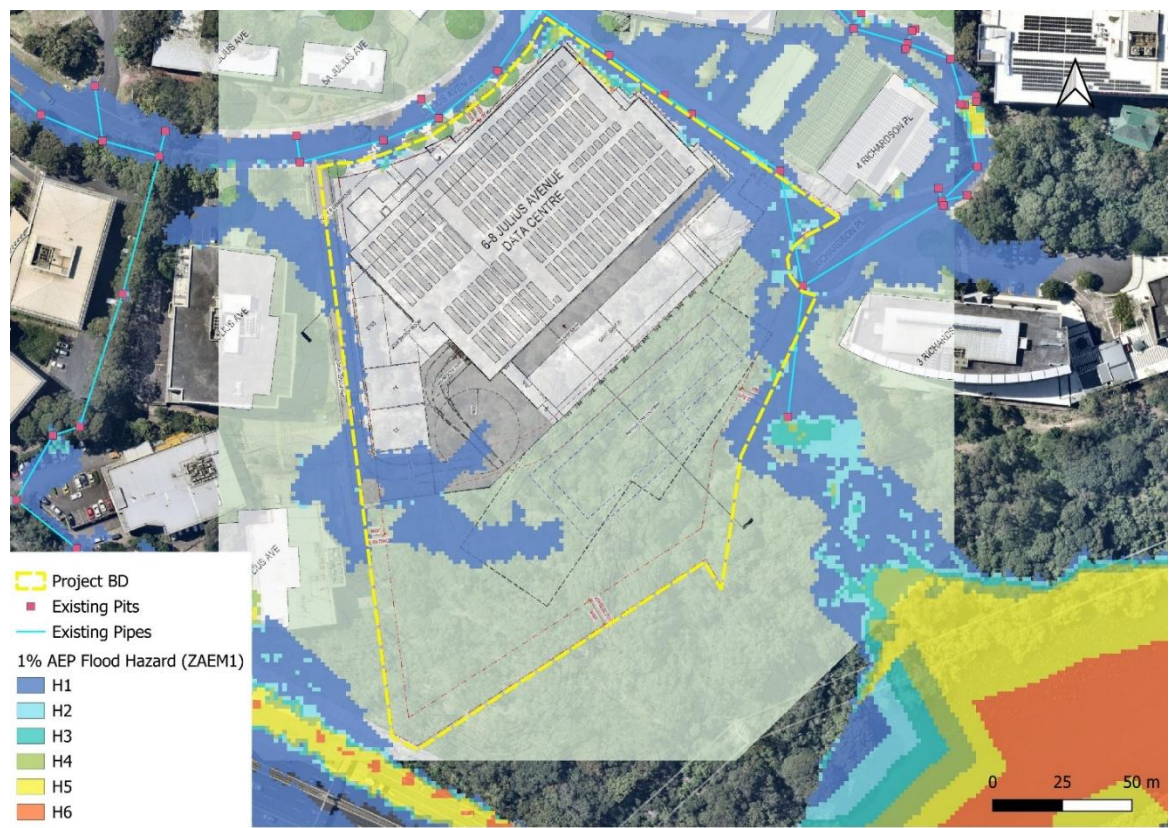


Figure 31-1% AEP Flood Hazard (ZAE M1)- Post Development Scenario

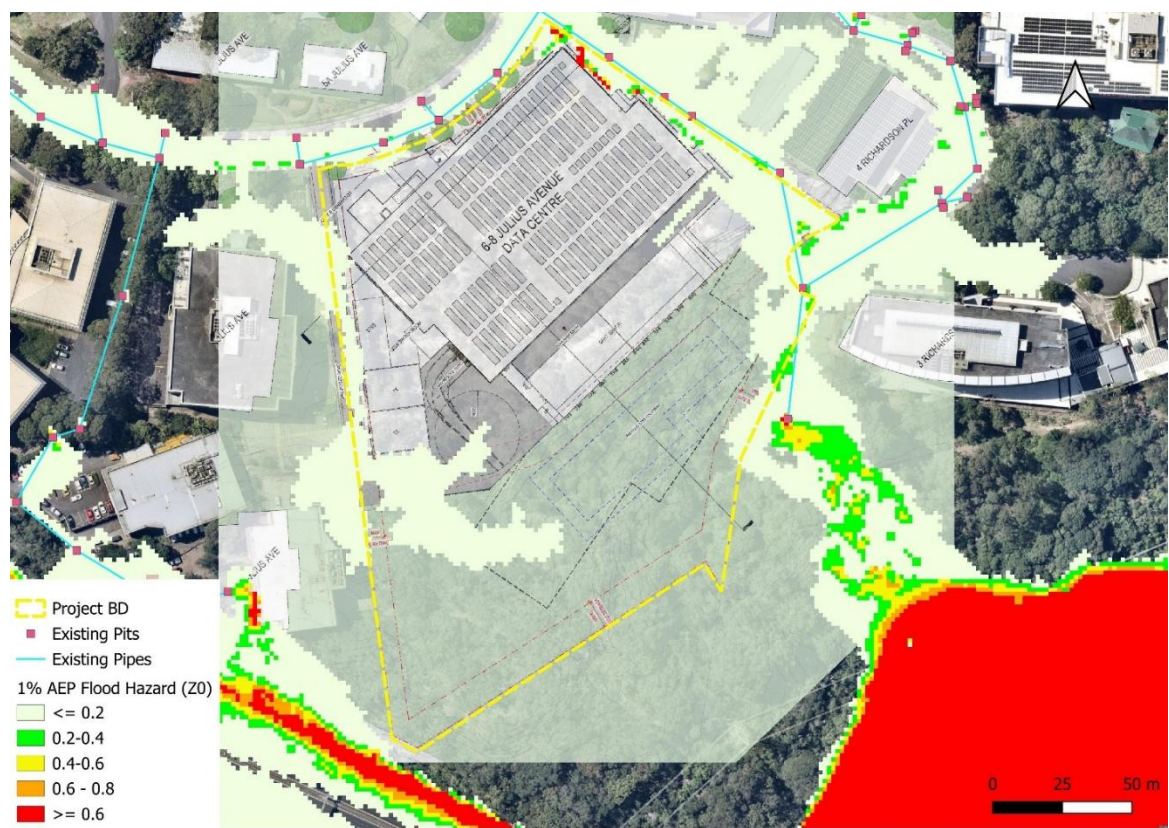


Figure 32 - 1% AEP Flood Hazard (Z0)- Post Development Scenario

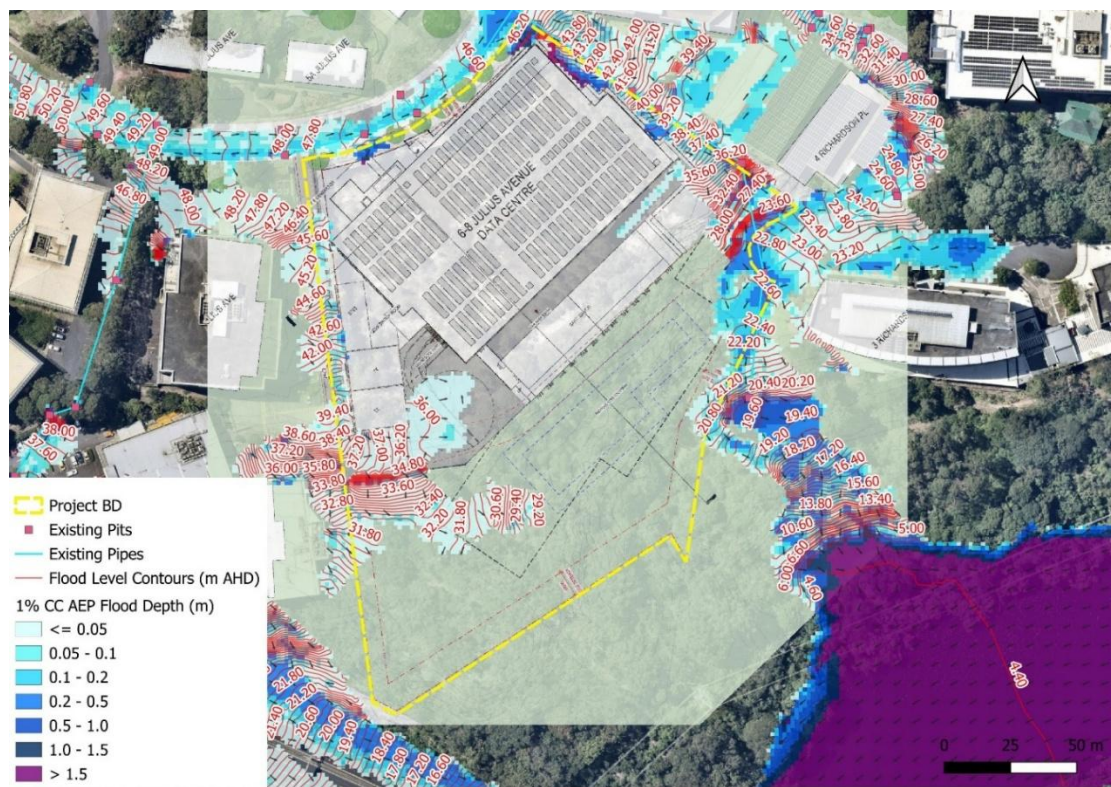


Figure 33-1% AEP CC Flood Depths and Levels - Post-Development Scenario

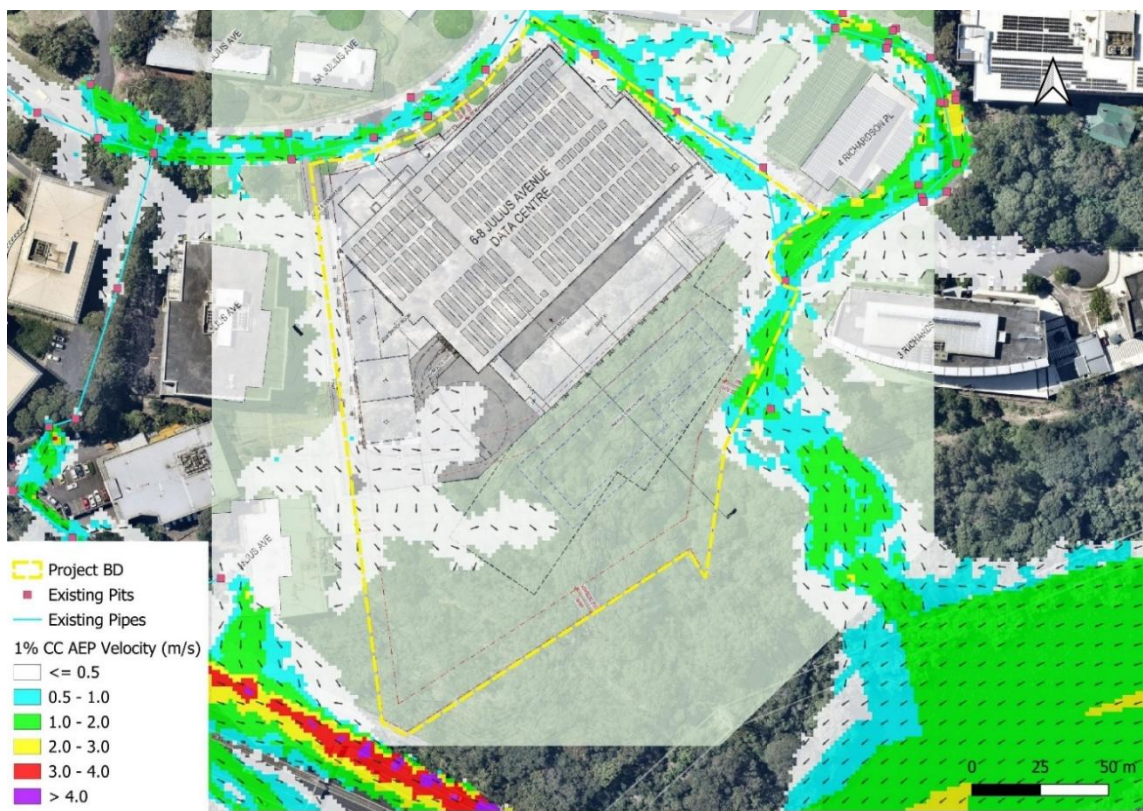


Figure 34- 1% AEP CC Flood Velocities- Post-Development Scenario

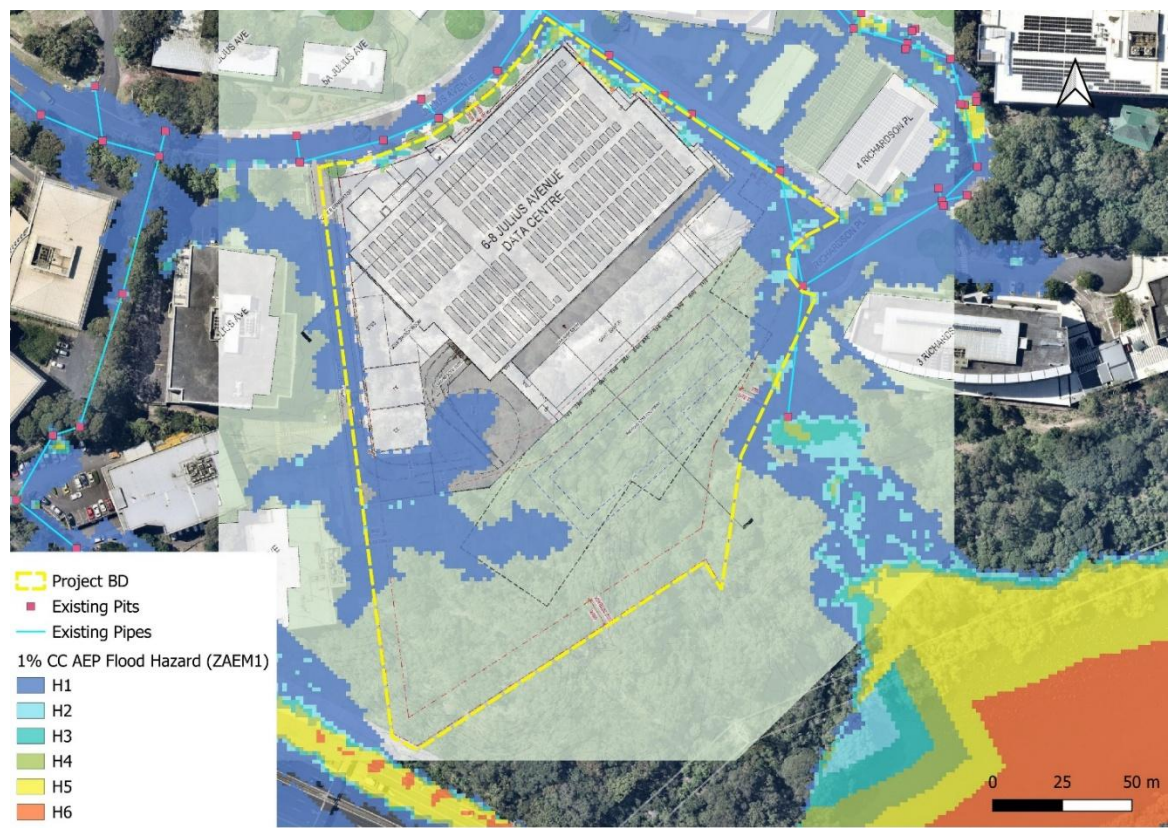


Figure 35-1% AEP CC Flood Hazard(ZAEM1)- Post-Development Scenario

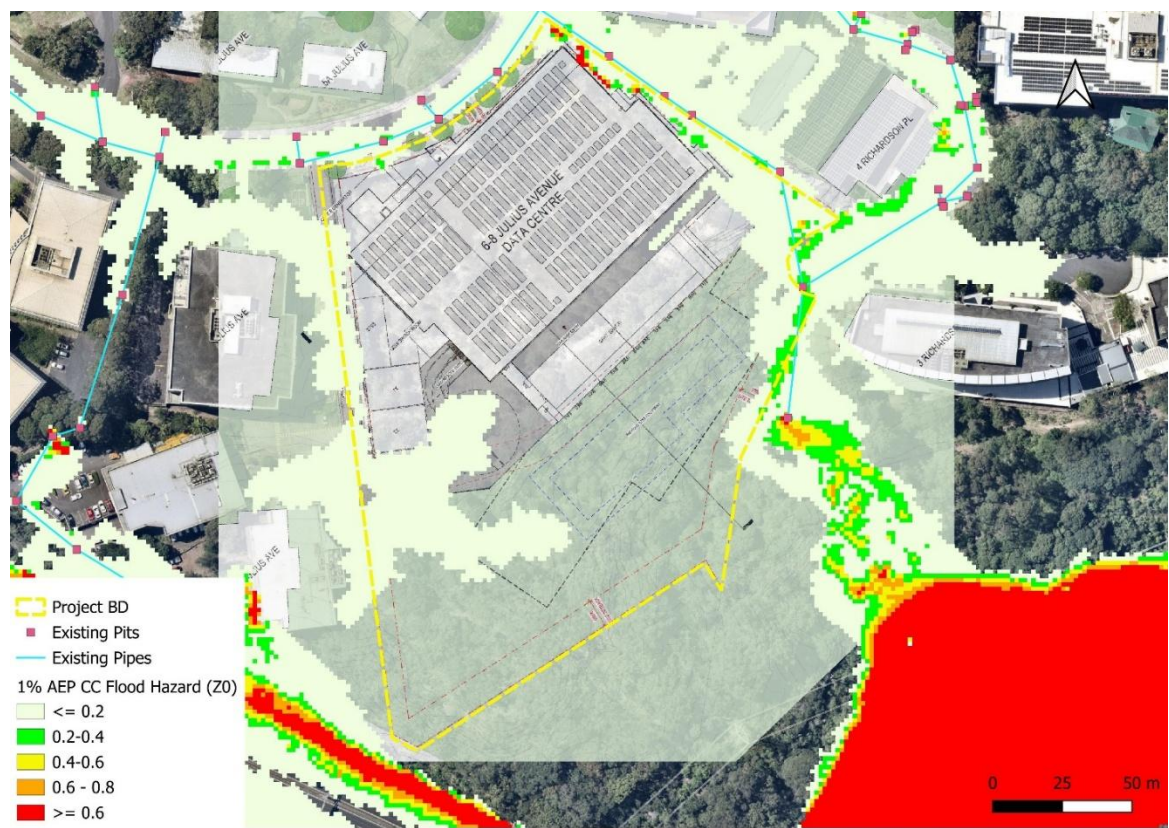


Figure 36-1% AEP CC Flood Hazard(Z0)- Post-Development Scenario

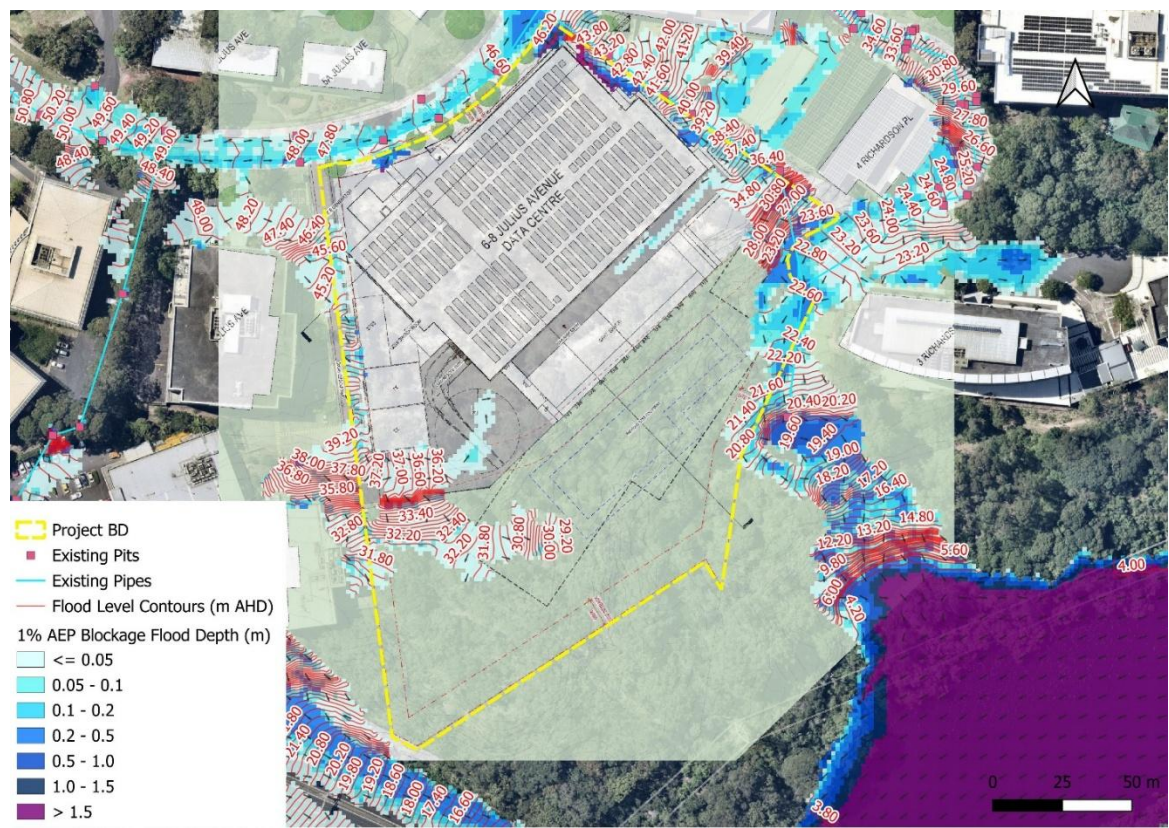


Figure 37-1% AEP+Blockage Flood Depths and Levels- Post-Development Scenario

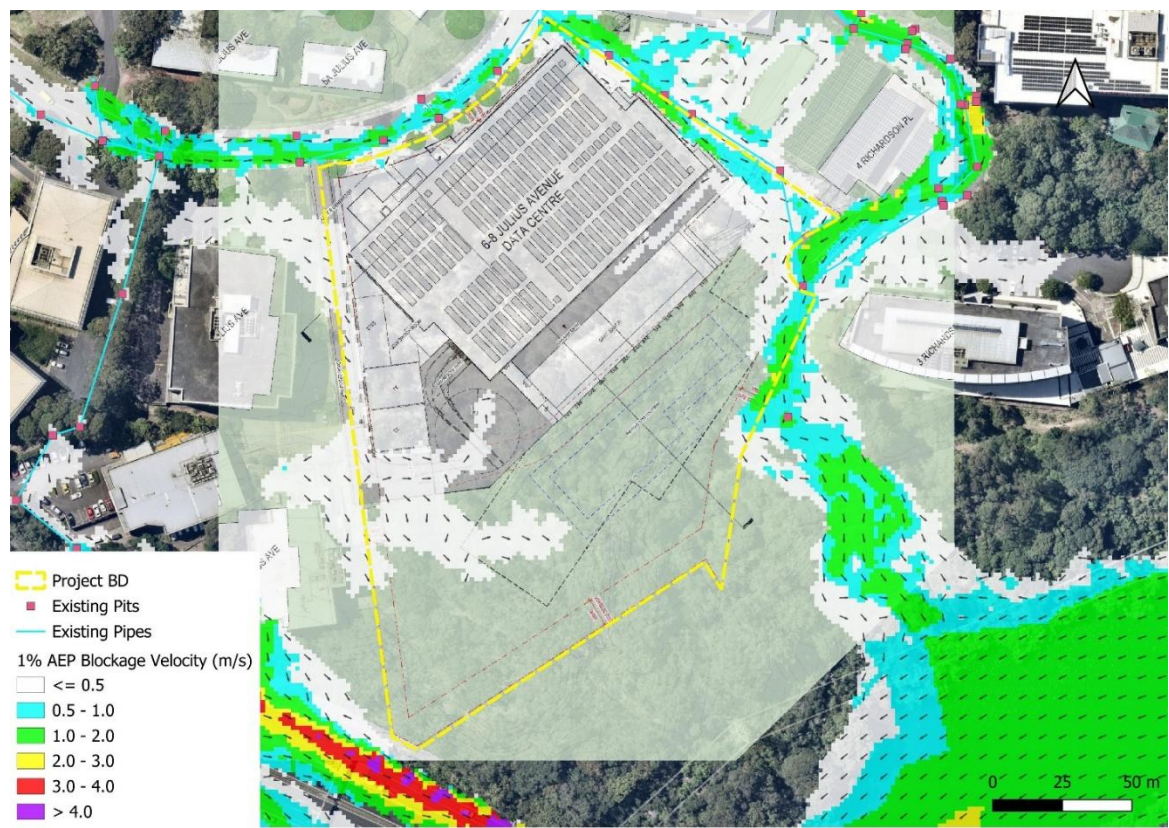


Figure 38-1% AEP+Blockage Flood Velocities- Post-Development Scenario

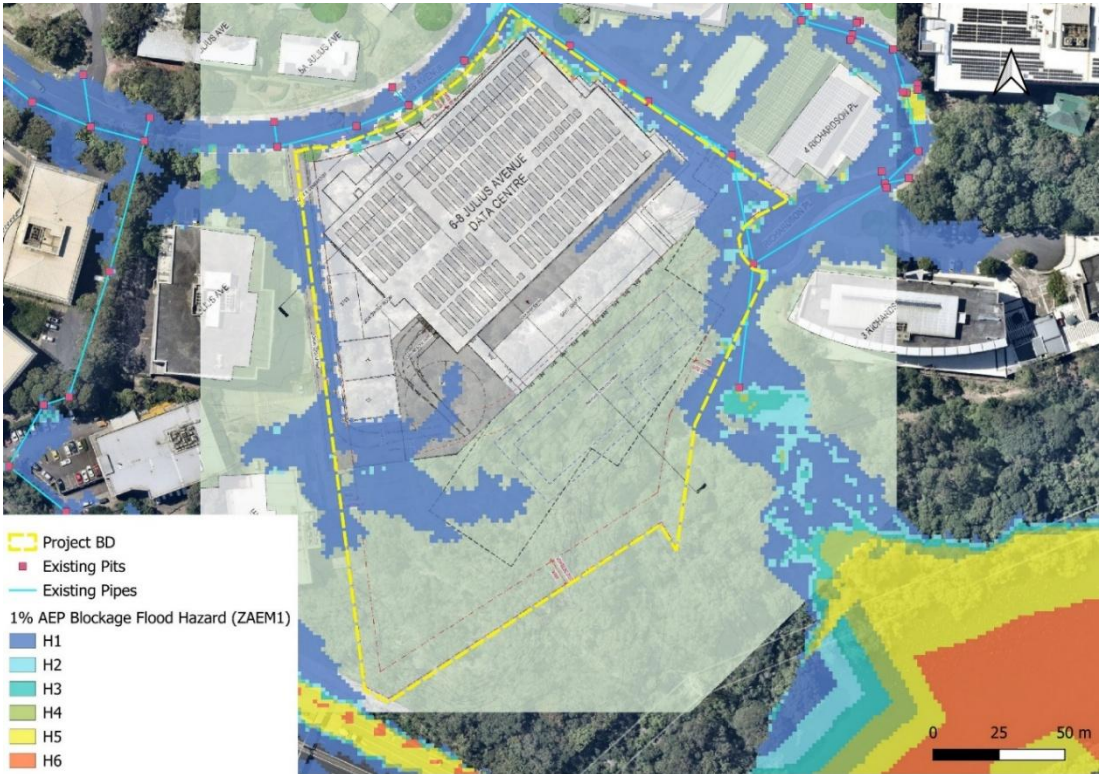


Figure 39-1% AEP+Blockage Flood Hazard (ZAEM1)- Post-Development Scenario

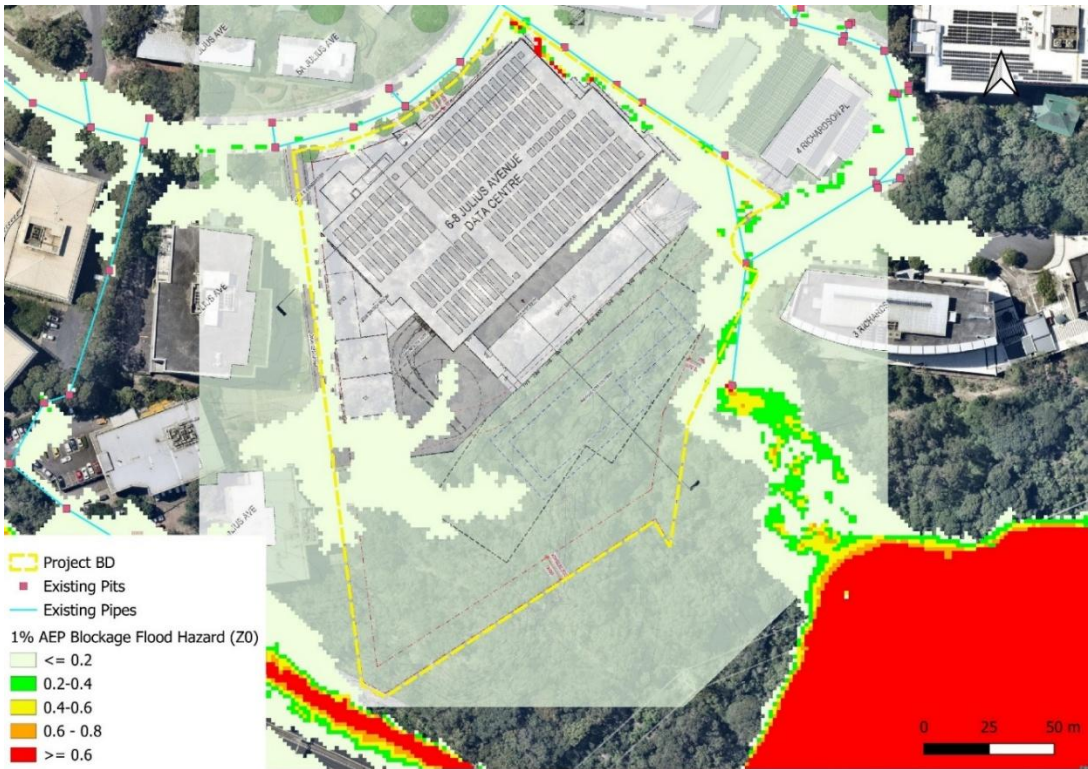


Figure 40-1% AEP+Blockage Flood Hazard (Z0)- Post-Development Scenario

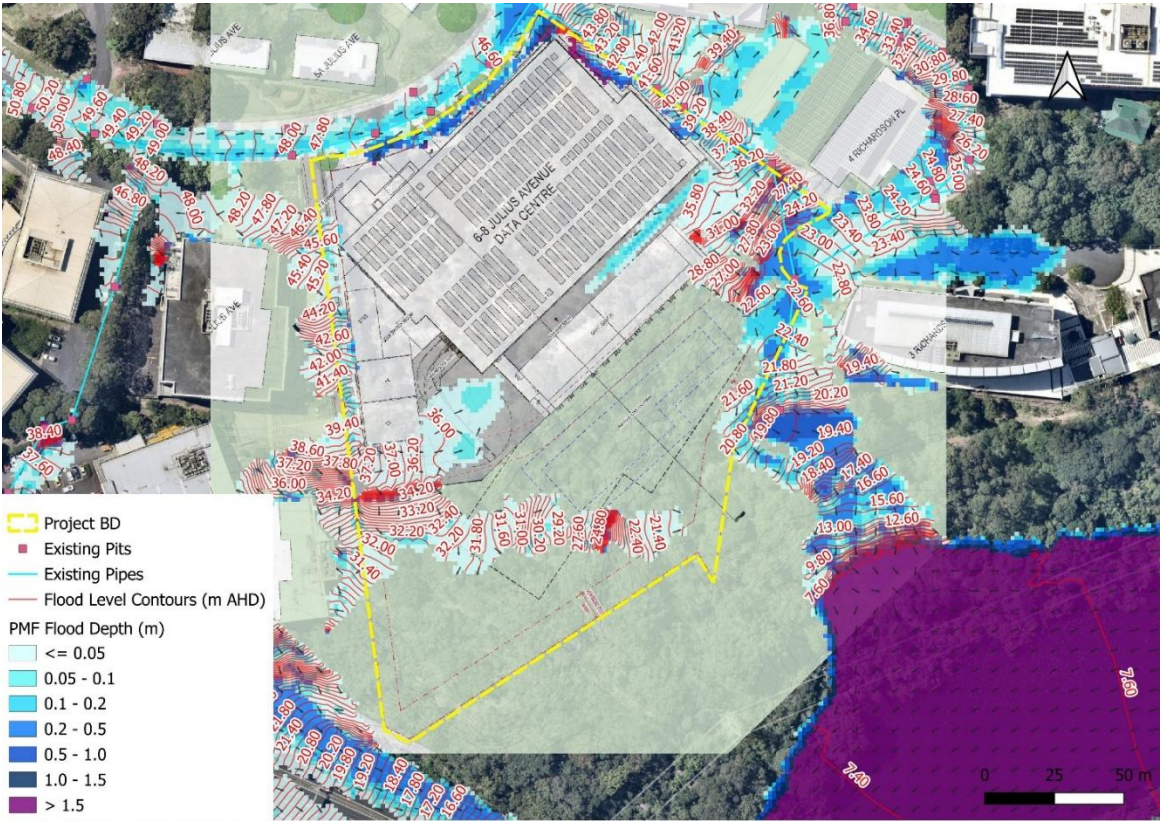


Figure 41- PMF Flood Depths and Levels- Post-Development Scenario

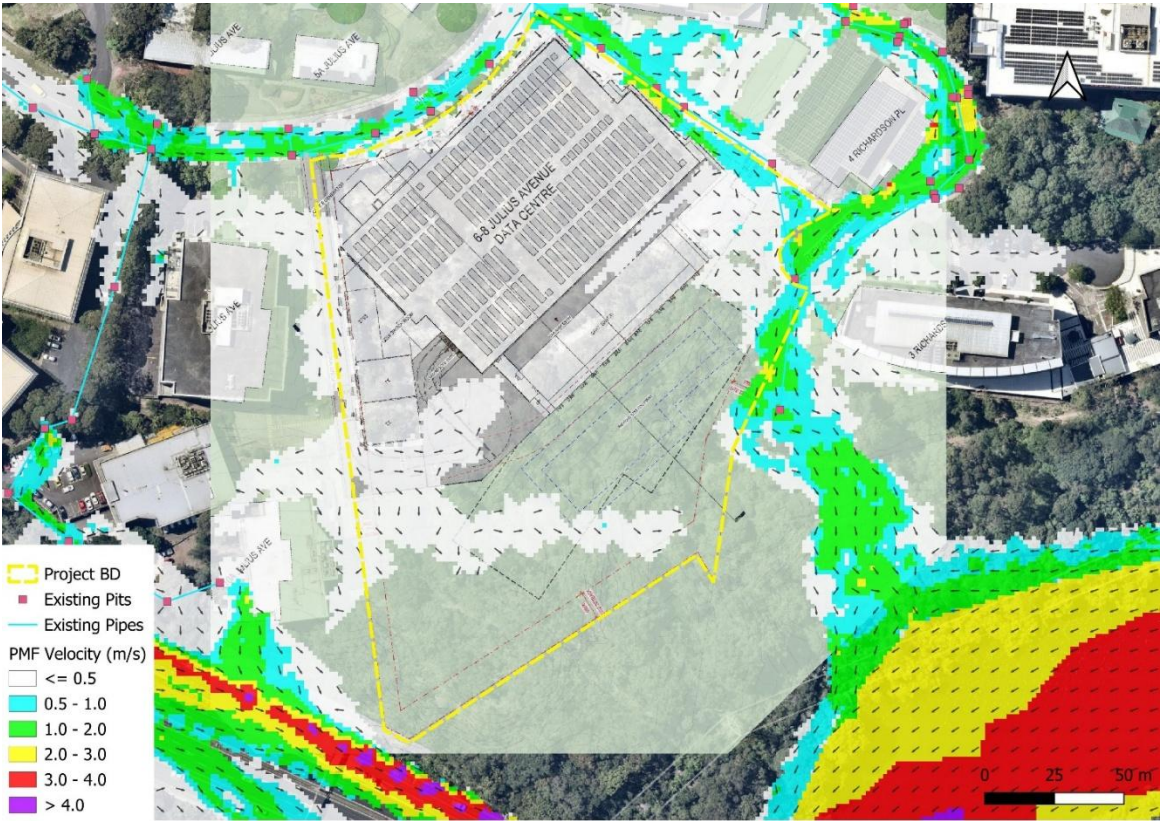


Figure 42- PMF Flood Velocities- Post-Development Scenario

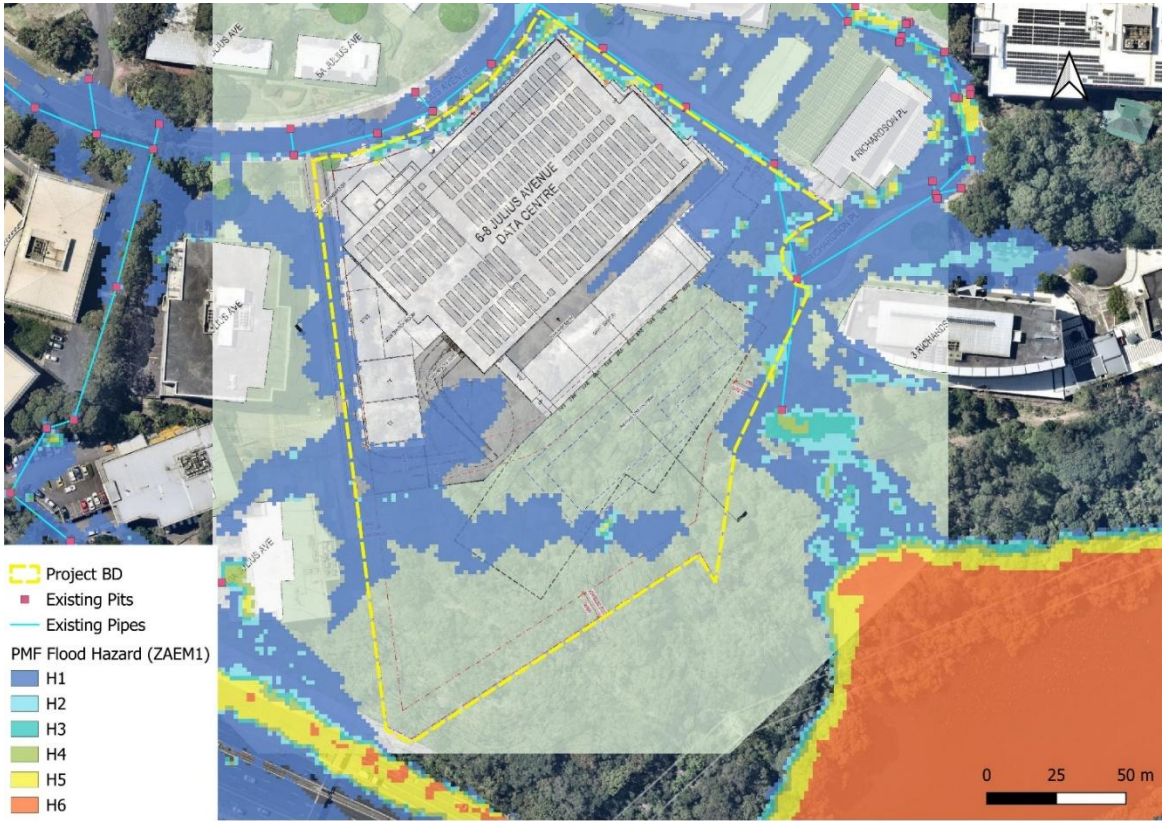


Figure 43- PMF Flood Hazard (ZAE1)- Post-Development Scenario

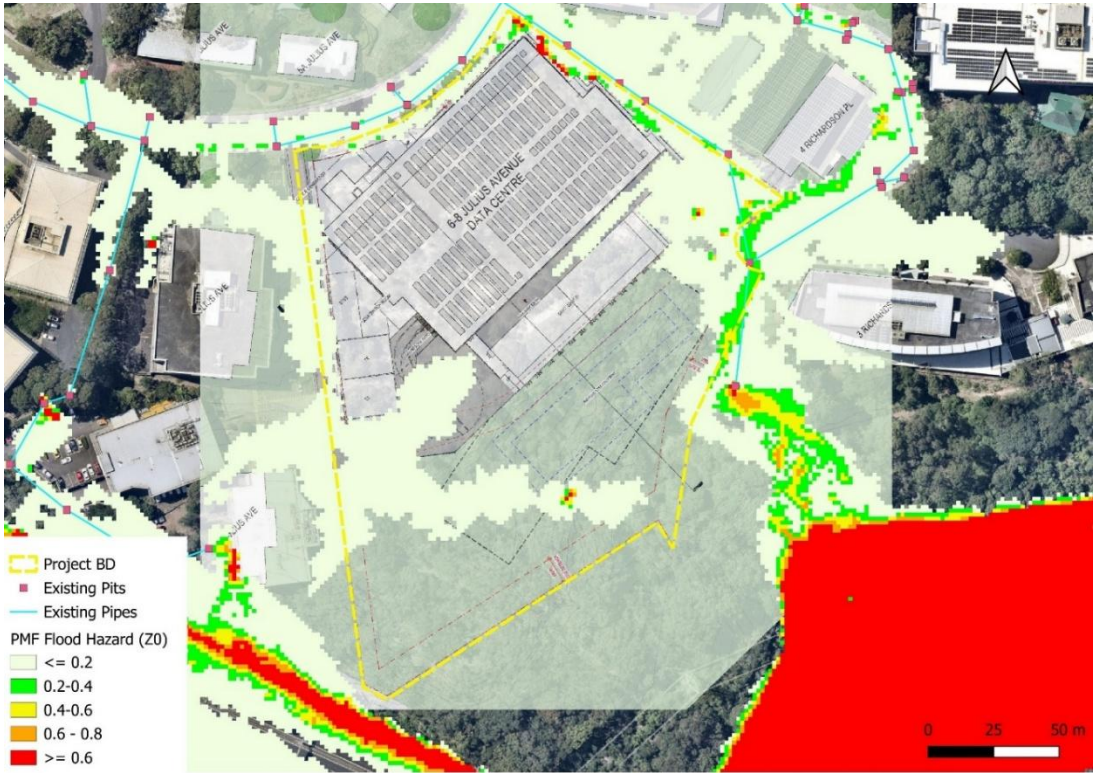


Figure 44- PMF Flood Hazard (Z0)- Post-Development Scenario

8.0 Flood Impact

A Flood Impact Assessment has been undertaken to confirm that the proposed development does not result in an unacceptable increase in flood levels on site or adversely affect flood behaviour on neighbouring properties for the 1% AEP event, the 1% AEP event with climate change, the 1% AEP event with blockage conditions, and the PMF event. Flood afflux mapping indicates no adverse impact on surrounding properties across all modelled events, with changes generally within ± 10 mm. The corresponding afflux maps are presented Figure 45 to Figure 48.

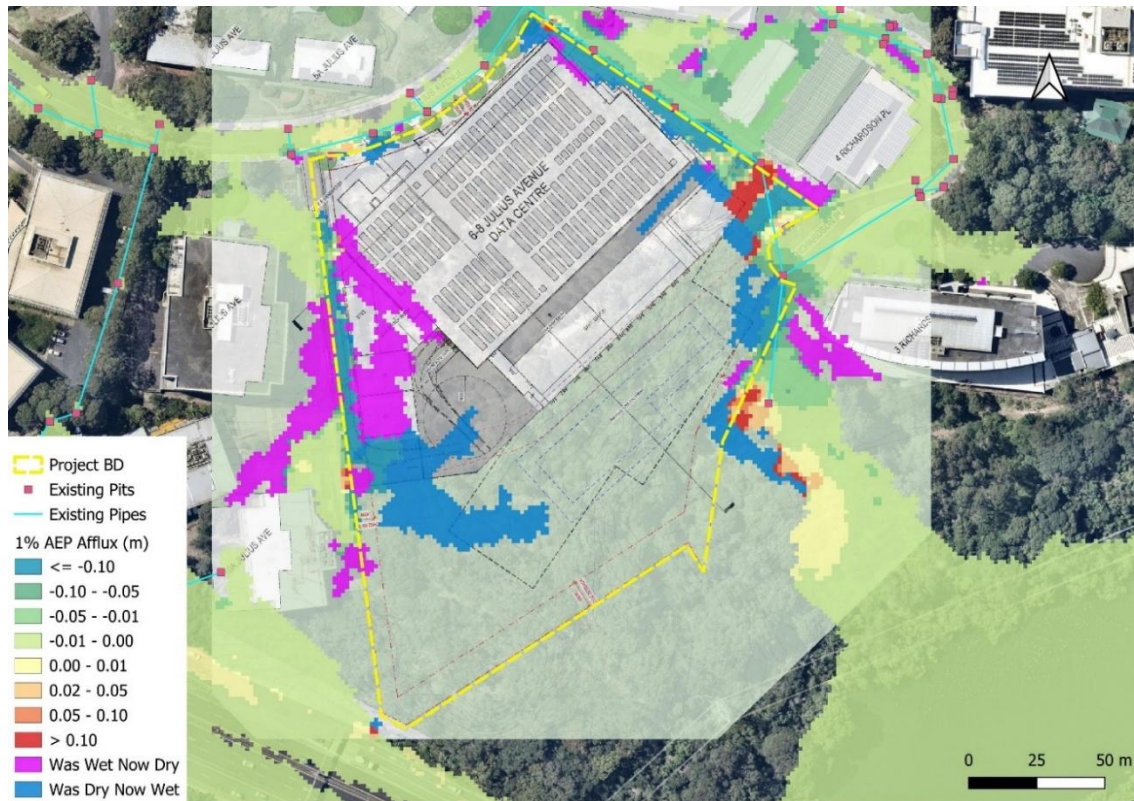


Figure 45- Afflux Map for 1% AEP Event (Post vs Pre Development)

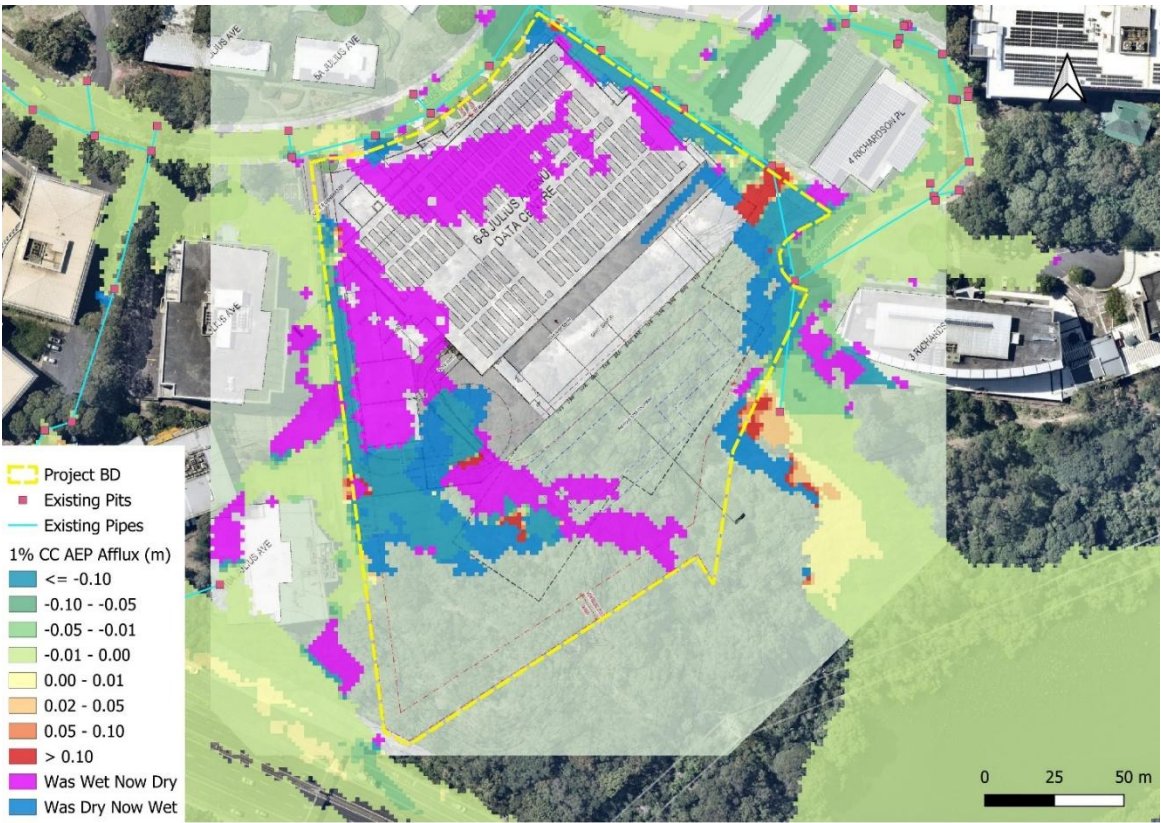


Figure 46- Afflux Map for 1% CC AEP Event (Post vs Pre Development)

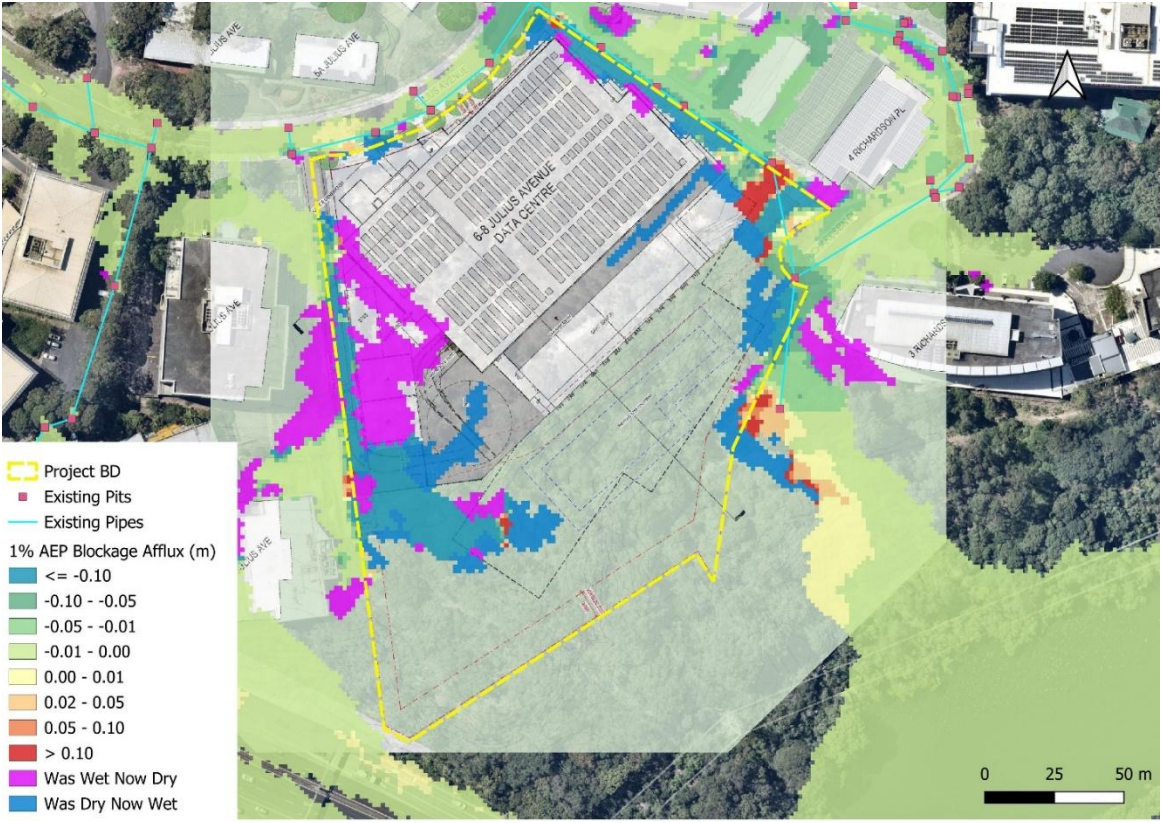


Figure 47- Afflux Map for 1% Blockage AEP Event (Post vs Pre Development)



Figure 48- Afflux Map for PMF Event (Post vs Pre Development)

9.0 Conclusions

Flood modelling has been undertaken for existing and post-development conditions using the updated Council flood model for the 1% AEP, 1% AEP with climate change, 1% AEP with blockage, and PMF events. The results indicate that flooding across the subject site is generally shallow and low hazard, with site velocities typically low and hazard predominantly H1.

For existing conditions, flood depths across the site are generally minor in the 1% AEP event, with overland flow conveyed along Julius Avenue toward the Lane Cove River. A sag point on Julius Avenue near the driveway to 4 Julius Avenue experiences deeper ponding under the modelled events, but the broader site remains low hazard.

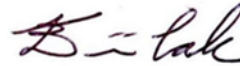
For post-development conditions, the development and associated civil works have been incorporated into the model, including explicit pit and pipe blockage representation consistent with Council's blockage allowances. Flood impact assessment confirms the proposal does not cause unacceptable impacts on neighbouring properties. Afflux mapping indicates no adverse offsite impacts across all modelled events, with changes generally within ± 10 mm.

The development has been designed to meet flood planning requirements. Finished floor levels at key access points exceed the adopted Flood Planning Levels (based on the higher of 1% AEP plus freeboard or PMF, as applicable). Localised mitigation is provided where required, including a flood protection wall adjacent to the building near the driveway to 4 Julius Avenue to protect the affected stairs/access elements, with crest level set to the 1% AEP flood level plus 300 mm freeboard. The fuel tank entry to the south is only impacted during the PMF event and its floor level is above the applicable Flood Planning Level. No drainage upgrade works are required under the updated design, as the revised modelling indicates no afflux along Julius Avenue.

Overall, the modelling demonstrates that the proposed development can be delivered with low flood risk, appropriate compliance with flood planning controls, no unacceptable offsite impacts, and targeted mitigation to manage residual risks at key access locations.

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