Flood Assessment Report

The King's School Masterplan

Prepared for The King's School c/o TSA Management Pty Ltd/ Nov 2023

221272 CAAB

TTW (NSW) PTY LTD (ACN 649 974 112)
(ABN 74 649 974 112) I Consulting Engineers
Level 6, 73 Miller Street, North Sydney NSW 2060

Your Partner in Engineering

Contents

1.0 Introduction

Taylor Thomson Whitting (NSW) Pty. Limited has been engaged by The King's School c/o TSA Management Pty Ltd to prepare a Flood Assessment Report to address the concept and Stage 1 State Significant Development Application (SSDA) for the proposed master planning development at The Kings School located at 87-129 Pennant Hills Rd, North Parramatta NSW 2151 (the site).

The proposal seeks to establish the design and construction of a new Senior School Building (STEAM-Science, Technology, Engineering, Arts and Mathematics) with associated landscaping, upgrades to the Preparatory School, new road, staff residences, day boy boarding house and staff residence, as well as a new sport pavilion. An overall site plan showing these 8 sites is shown below in Figure 1.

Figure 1: Overall Site Plan (Source: Nearmaps)

1.1 Site Location and Context

The King's School is located at 87-129 Pennant Hills Road, North Parramatta and is approximately 115.395ha, which comprises of Lot A/DP329288, Lot 10/DP812772, Lot 1/DP57491, Lot 1/DP64765, Lot 1/DP59169, Lot A/DP321595, Lot 1/DP581960, B/DP329288 and 2/DP235857. The site is within the City of Parramatta Council Local Government Area (LGA) and is zoned R2 Low Density Residential and SP2 Infrastructure Educational Establishment under the Parramatta LEP 2023.

The extent of the master planning works is shown in Figure 1 and is approximately 2 hectares. The site is bounded by vegetated areas and Hunts Creek to the north and west, low-density residential buildings to the east and south along Bettington Road and Pennant Hills Road. Several sports fields, agricultural pastures, open grass areas, and large tracts of forested riparian corridor to the north are all part of the site. The main administrative and educational complexes are located along the Pennant Hills Road entrances in the south.

This State Significant Development Application (SSDA) seeks consent for the staged redevelopment of The King's School, including:

Concept Proposal for the provision of new and upgraded facilities, including:

- Building envelope for a new Sports Pavilion within the western sports field precinct (subject to further detailed approval).
- Building envelope for a new Boarding House within the northern residential precinct to the north of the Doyle Sports Fields and adjacent building envelope for Staff Quarters (subject to further detailed approval).
- Building envelope for a new Day Boy House between Dalmas House and Burkitt House, including the associated relocation of Ryrie Road (subject to further detailed approval).
- Earthworks and the associated demolition of existing buildings and structures, and removal of trees and landscaping.
- Staged increase in staff and student numbers.
- Detailed Stage 1 works (as outlined below).

Detailed Stage 1 works, including:

- Earthworks and the associated demolition and existing buildings and structures.
- Traffic upgrade works including the construction of a new vehicular entrance into the site from Masons Drive, new drop-off pick up facilities, internal access roads and increased car parking and bus parking.
- The construction of a new Staff Residence Building comprising residences for staff and their families within the Senior School Boarding Precinct.
- The construction of a new building for Science, Technology, Engineering, Arts and Maths (the 'STEAM building') within the Senior School and associated landscaping.
- The staged construction of new buildings required to upgrade the Preparatory School, including:
- Construction of a new Performing Arts and Music Centre comprising a dedicated performance space and music practice rooms to the northwest of Horrocks Road.
- Construction of a new General Learning Unit building comprising additional classrooms / general learning spaces adjacent to the existing dam.
- Upgrades to pedestrian access throughout the school.
- Staged increase in staff and student numbers.
- The removal and replacement of trees and associated landscaping.

1.2 Topography

The site area is 122ha, (Approx.) with the highest level of 90.67m AHD at the south-eastern boundary of the site, falling to 32.68m AHD towards the mid-northwest of the site as shown in Figure 2. The area around the existing pool area is within a local depression below the raised oval to the southeast. The local depression leads to a watercourse that is a tributary of Hunts Creek.

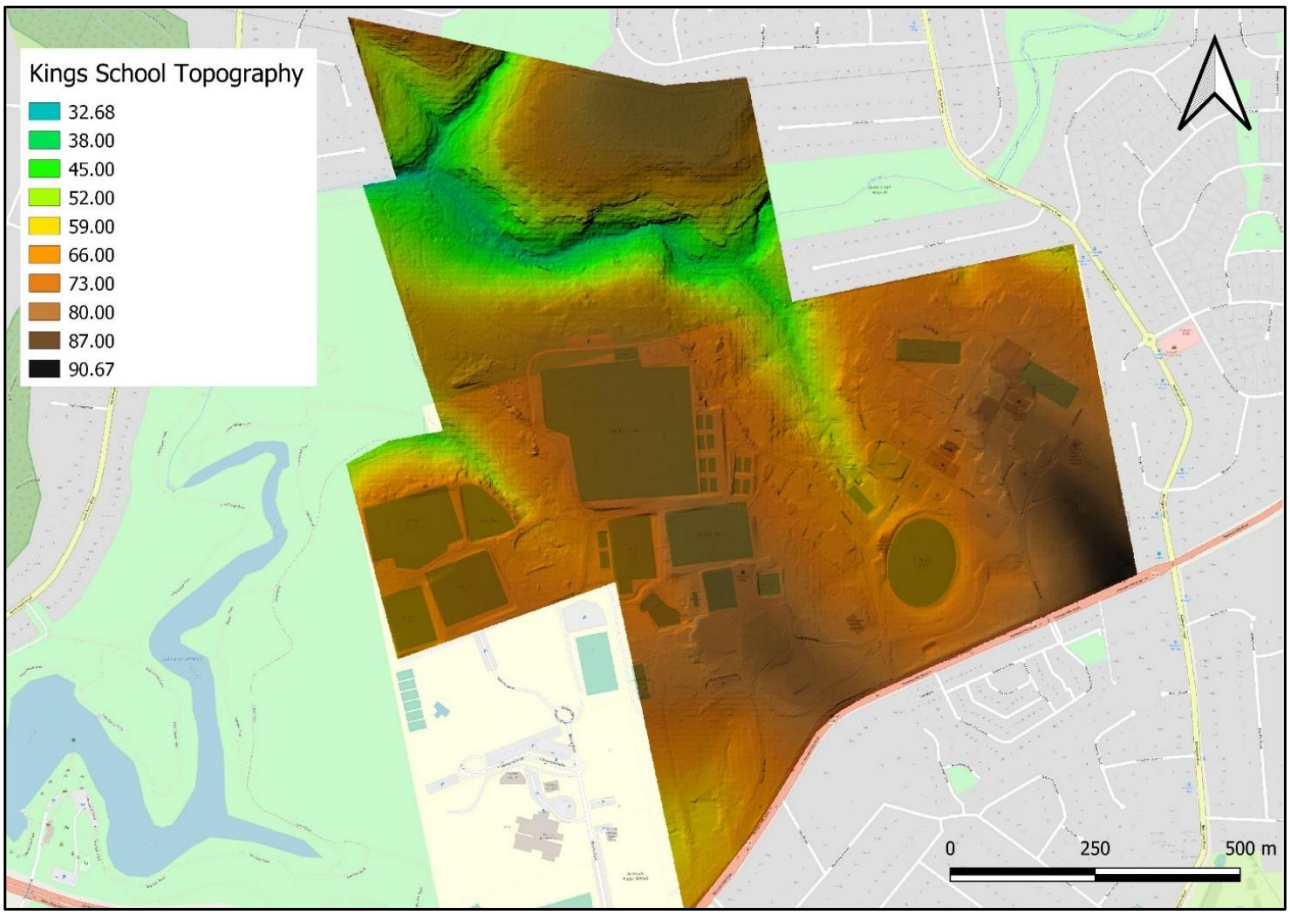

Figure 2: Site Topography

1.3 Relevant Documents

The civil engineering components of this report has been prepared in accordance with the following documents, guidelines and policies:

- Parramatta Development Control Plan 2023
- Guide to Road Design Part 1 and Part 5 (Austroads guidline)
- City of Parramatta Council's Development Design Guidelines (2018), Policies and Engineering Specifications
- Australian Rainfall and Runoff (2019)

2.0 Existing Flooding

2.1 Available Data and Flood Study

The City of Parramatta Council have confirmed that an existing flood model and study has been completed for the catchment area. The Urban Overland Flow Study, Catchment Simulations (May 2017), was originally completed for the Hills Shire LGA and covers the full catchment area of this development. The full study and report have been provided by Council and have been used as the base for the site flood assessment. The 1% AEP storm event overland flow paths extent is shown in Figure 3.

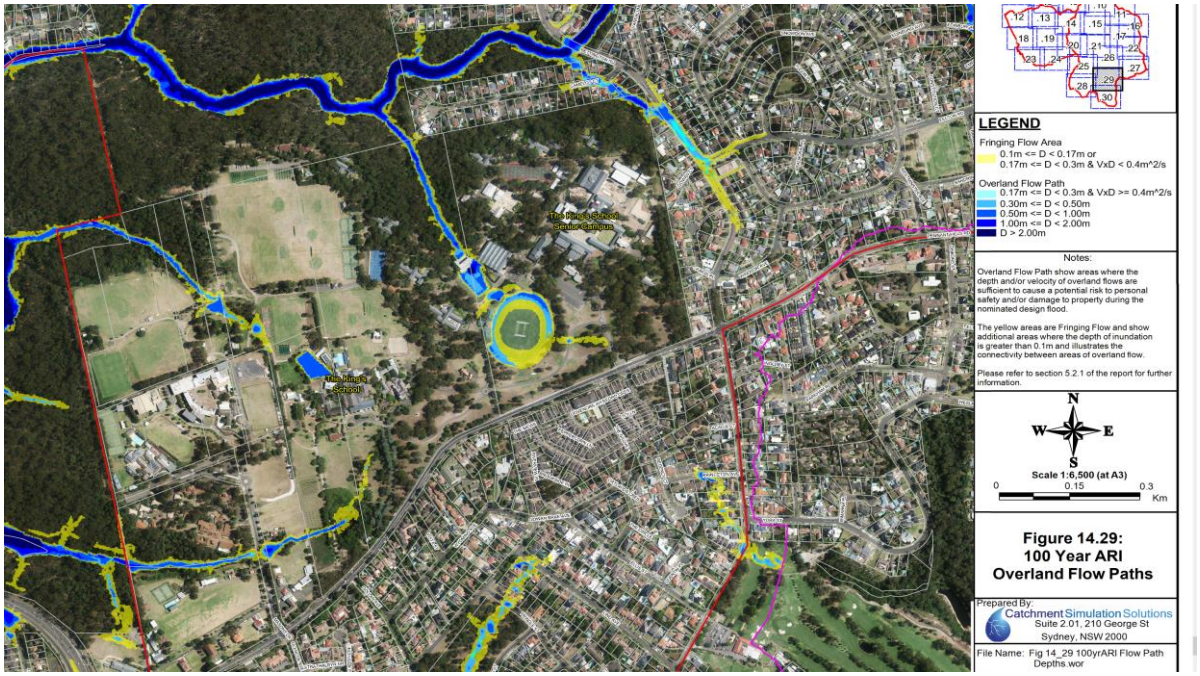

Figure 3 : Council's existing 1%AEP overland flow paths map

2.2 Updates to the Existing Council Model

The existing council flood model has been used as the basis for the existing flood conditions at the site. However, a cut-off model has been created for each development site scale, rather than using the catchment wide scale. All parameters of the existing flood model remain unchanged for the existing condition except for the following:

- Model grid size reduced from 4m to 2m to provide better resolution at the development scale.
- 2d and 1d model time steps have been reduced accordingly to reflect the smaller grid size.
- Lidar data around the development sites was replaced by topographical survey.

2.3 Existing Flood Conditions

Site 1 (New Steam Building & Landscaping)

The updated 1% AEP flood results, as depicted in Figure 4, are generally consistent with the existing council flood model results. The site is not susceptible to 1% AEP flooding. A minor depression is observed to the south of the site, with water depths measuring less than 0.5 meters, and water level is less than RL 81.30 mAHD.

The site is impacted by PMF flooding. The existing PMF flood level around the Site 1 is RL 80.60 mAHD.

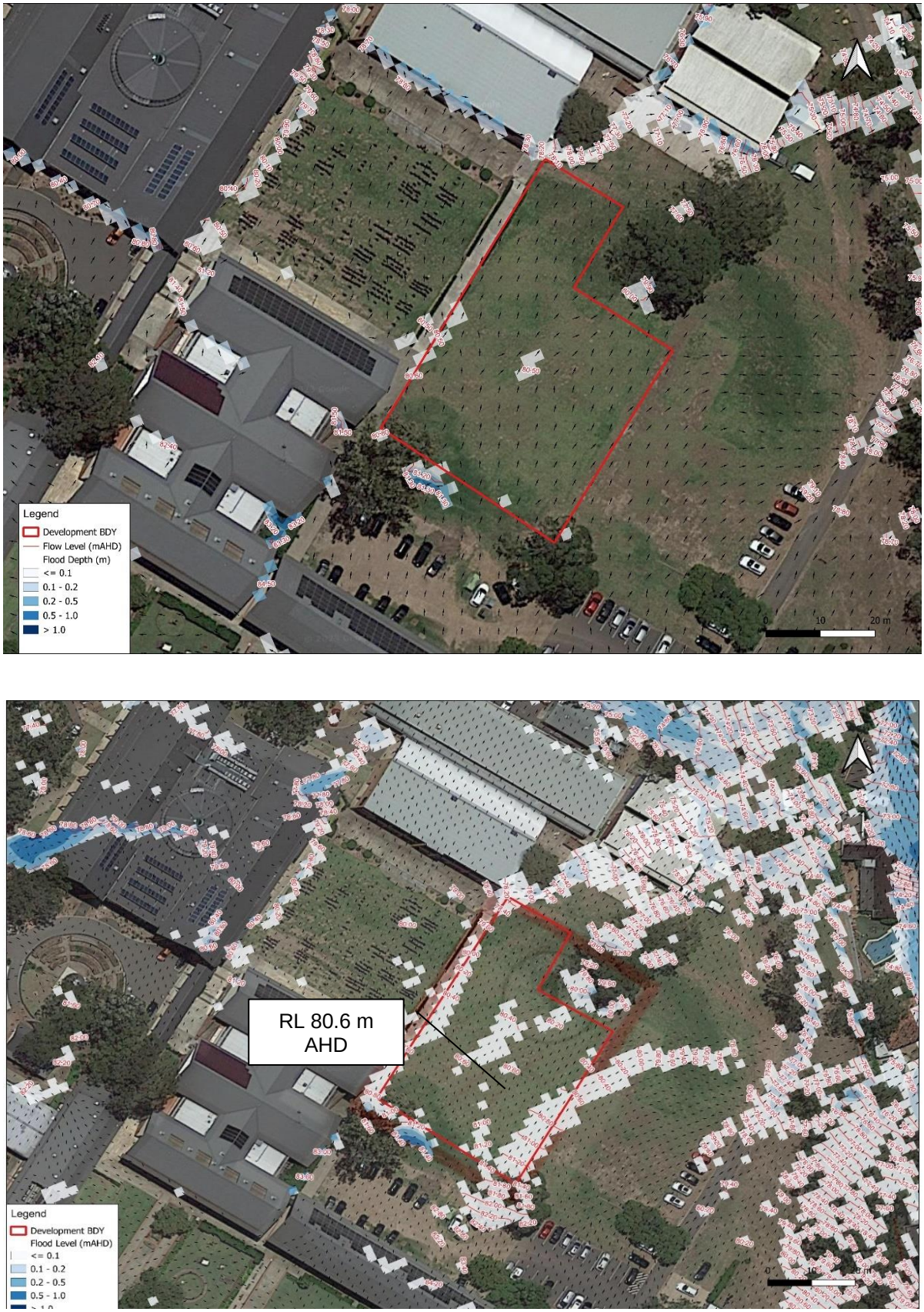

Figure 4 : Existing 1%AEP (above) and PMF (below) Flow Depths and Levels

Site 2A (New Prep School General Learning Building) and Site 2B (New Prep School Performing Art Centre)

The updated existing 1% AEP flood results as shown in Figure 5 are generally consistent with the existing council flood model results. The site is not affected by overland 1% AEP and PMF flooding.

Figure 5 : Existing 1%AEP(above) and PMF(below) Flow Depths and Levels

Site 3 (New Staff Residences)

The updated existing 1% AEP flood results as shown in Figure 6 are generally consistent with the existing council flood model results.

The site is **affected** by overland 1% AEP flooding. The existing 1% AEP flood level is RL 75.2 mAHD.

Figure 6 : Existing 1% AEP Flow Depths and levels

Site 4 (New Road) and Site 8 (New Road and Bus Parking)

The updated existing 1% AEP flood results are shown in Figure 7 and Figure 8 . Our modelling results show more flood areas in comparison with the existing council flood model results.

The northern section of the current road layout site is **affected** by overland 1% AEP flooding.

Figure 7 : Existing 1% AEP Flow Depths and levels for the Proposed Road

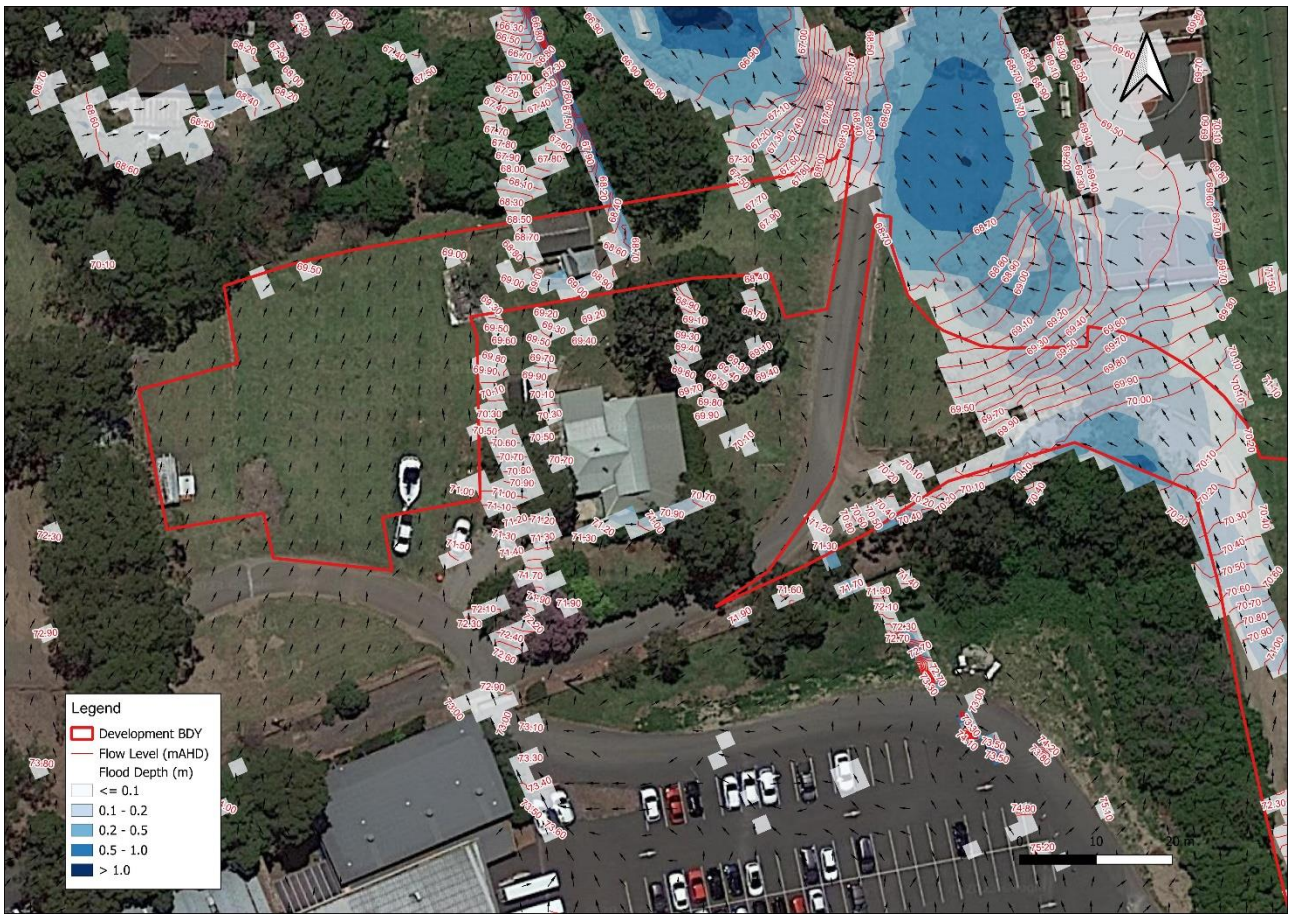

Figure 8- Existing Flow Depth and Levels for the Bus Park

Site 5 (New Day Boy House)

The updated existing 1% AEP flood results are shown in Figure 9 . Our modelling results show some minor flood affectation in comparison with the existing council flood model results.

The northern section of the current site layout is **affected** by overland 1% AEP flooding. The existing 1% AEP flood level is RL 75.0 m.

Figure 9: Existing 1% AEP Flow Depths and levels

Site 6 (New Sport Pavilion)

The updated existing 1% AEP flood results as shown in Figure 10 are generally consistent with the existing council flood model results. The site is **not affected** by 1% AEP flooding.

Figure 10: Existing 1% AEP Flow Depths and levels for Site 6 (New Sport Pavilion)

Site 7 (New Boarding House)

The updated existing 1% AEP flood results as shown in Figure 11 are generally consistent with the existing council flood model results. The site is **not affected** by 1%AEP flooding.

Figure 11 : Existing 1% AEP Flow Depths and levels for Site 7 (New Boarding House)

3.0 Post Development Flooding

The existing flood model was updated with the following changes to reflect the post development conditions:

- Proposed building layouts. (The new developments are nulled out from the TUFLOW model)
- Proposed earth works.
- Proposed storm water drainage design.
- The Manning's n value has been modified for the proposed road.

3.1 Site 1 (New Steam Building & Landscaping)

For Site 1, the existing flood model was updated with the proposed building layout, earthworks, and stormwater design. Figure 12 shows the Site 1 proposed FFLs (Finished Floor Level). These FFLs are varied from RL 78.36 mAHD to 83.10 mAHD.

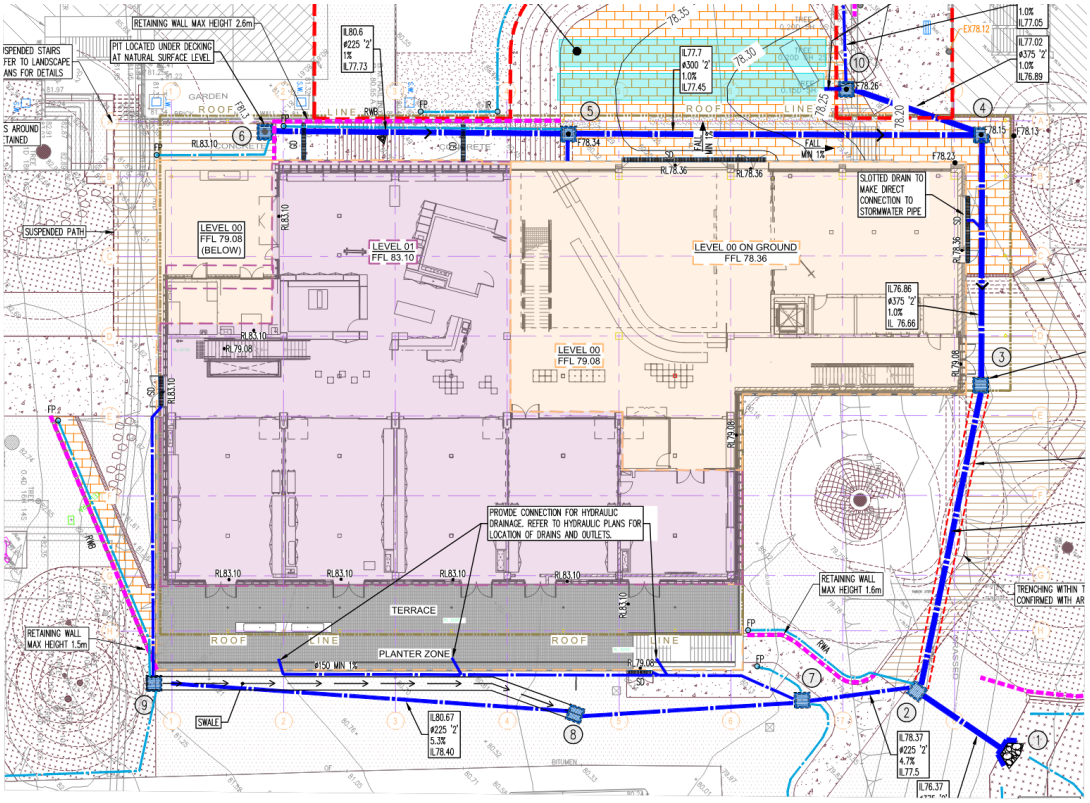

Figure 12: Site 1 - Proposed FFL

The post development flow depths & levels, flow velocities and flow hazards for the 1% AEP are shown in Figure 13,Figure 14 and Figure 15 respectively and flow depths & levels, flow velocity and flow hazards for PMF are shown in Figure 16, Figure 17 and Figure 18 . The flood modelling results confirm that the proposed site is minorly affected by the PMF flood event. The flow depths and levels for the post development PMF event vary from RL 78.40 mAHD to 82.40 mAHD, which is generally lower than their respective FFLs. The flow depths and levels for the post development 1% AEP event vary from RL 78.20 to 82.20 mAHD which is also generally lower than their respective FFLs minus 500 mm.

Figure 13 : Post Development 1% AEP Flow depths and levels for Site1

Figure 14: Post Development 1% AEP Flow velocities for Site 1

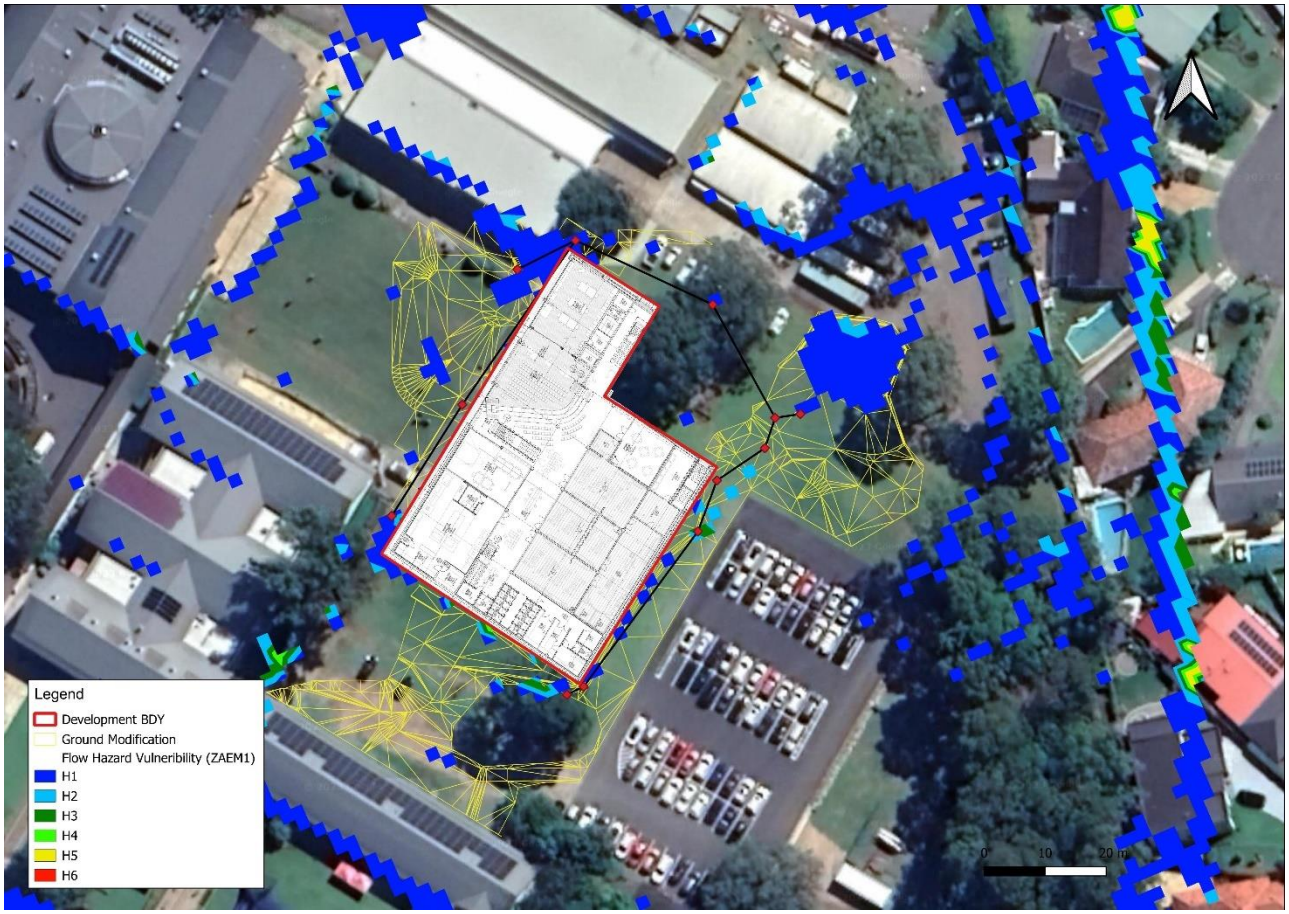

Figure 15: Post Development 1% AEP Flow hazards for Site 1

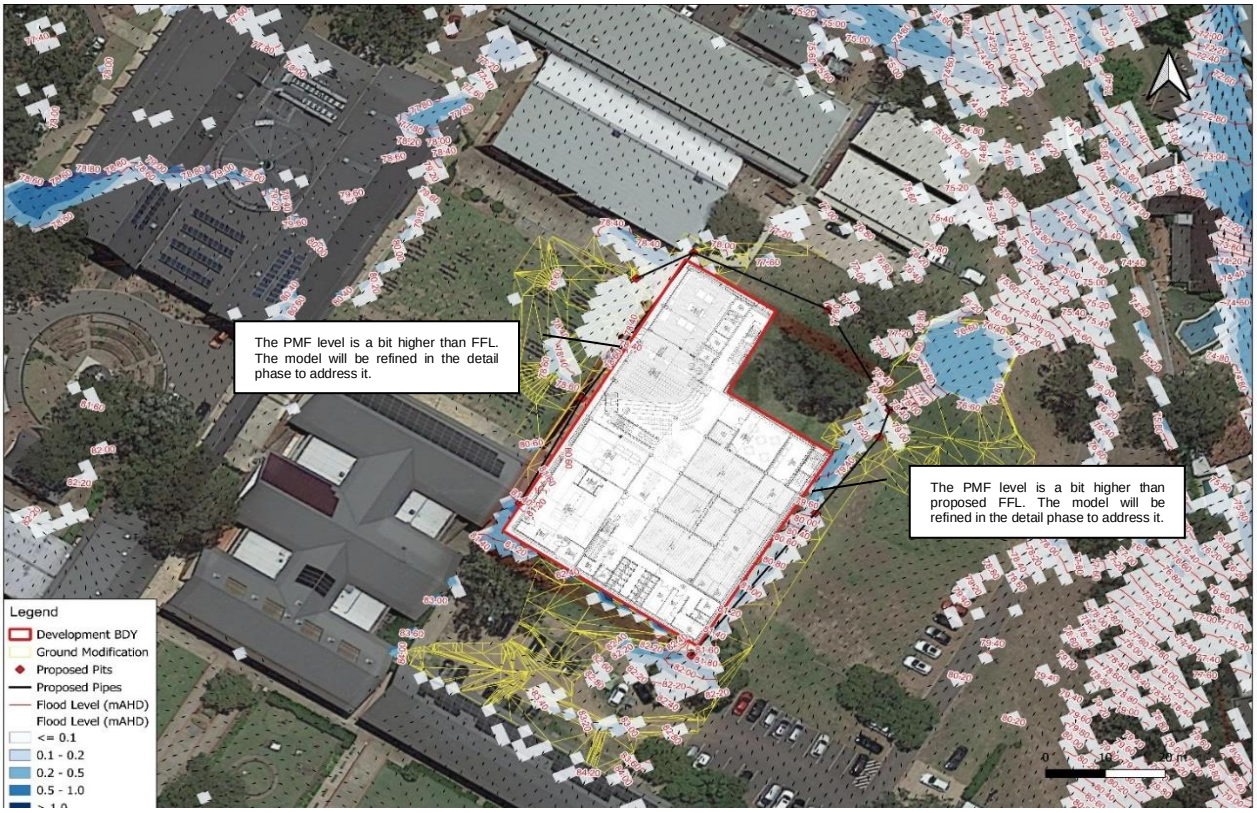

Figure 16: Post Development PMF Flow depths and Levels for Site1

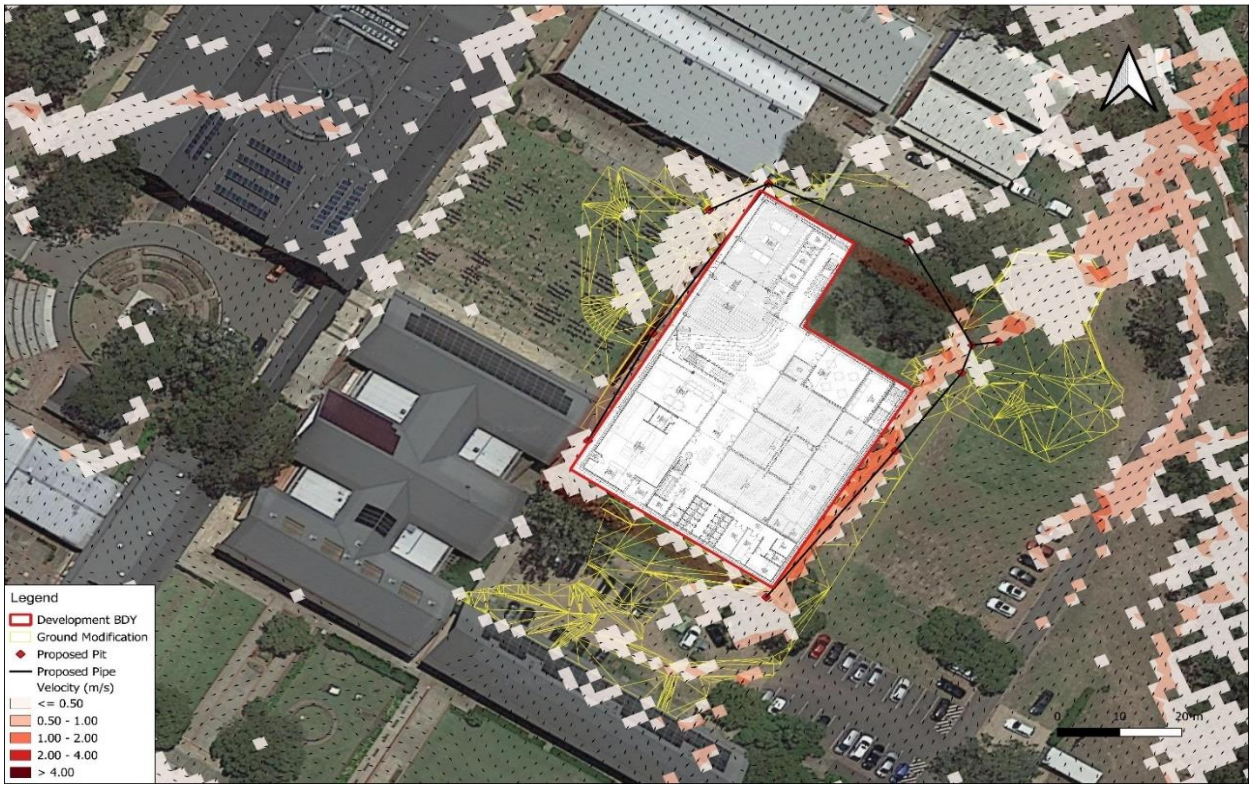

Figure 17: Post Development PMF Velocity for Site 1

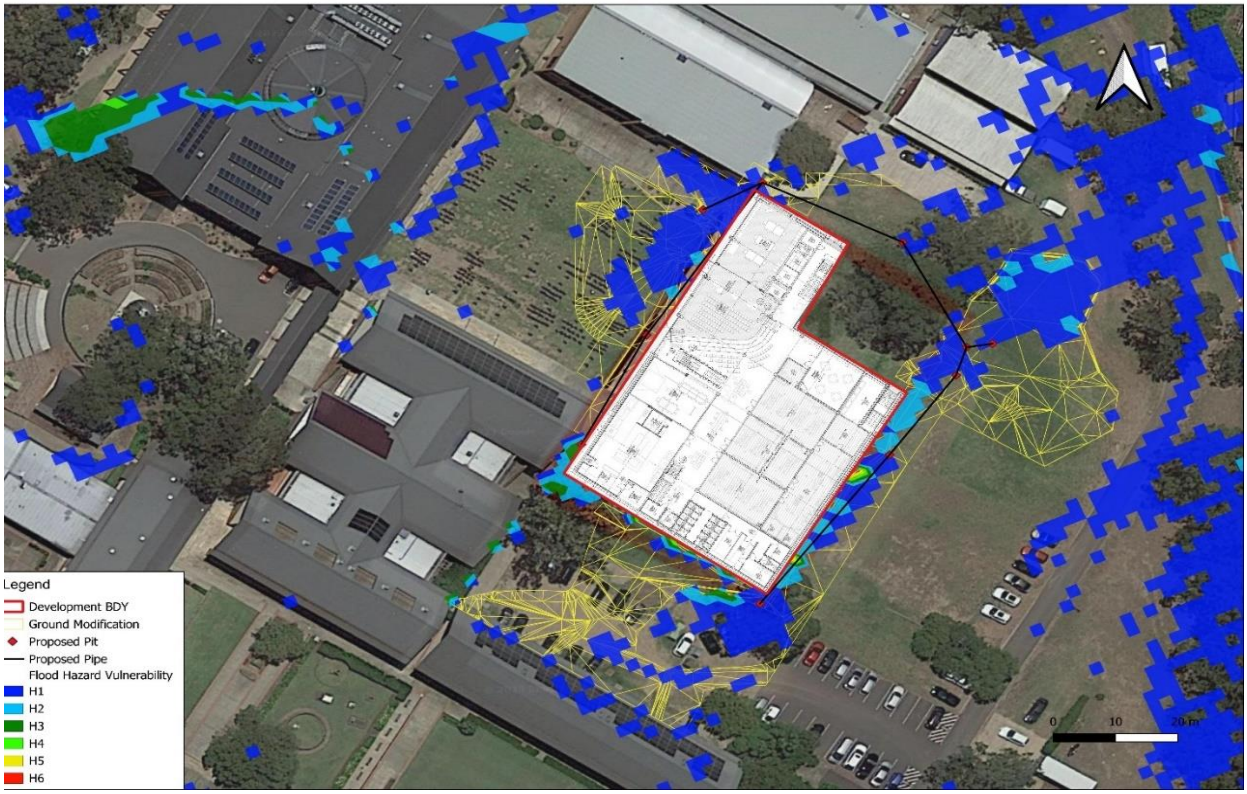

Figure 18: Post Development PMF Flood Hazard for Site1

3.2 Site 2A (New Prep School General Learning Building) and Site 2B (New Prep School Performing Art Centre)

For Site 2B, the existing flood model is revised to incorporate the proposed building layout. As for Site 2A, since it involves a suspended building, the model is updated solely with the new earthworks design. Figure 19 shows the longitudinal section view of Building 2A.

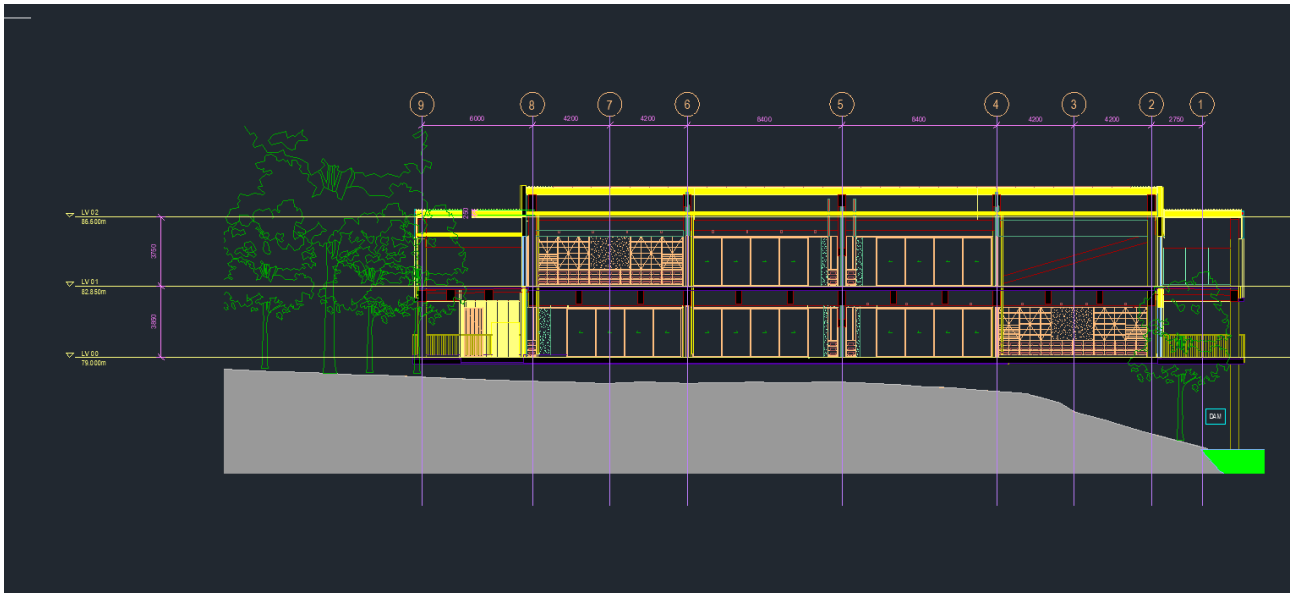

Figure 19- Building 2A longitudinal Section view

The post development flow depths & levels, flow velocities and flow hazards for the 1% AEP are shown in, Figure 20, Figure 21 and Figure 22 respectively and flow depths & levels, flow velocity and flow hazards for PMF event are shown in Figure 23, Figure 24 and Figure 25. The flood modelling results confirm that the proposed site remains unaffected by the PMF flood event. The flow depths and levels for the post-development PMF event at Site 2B vary from RL 77 mAHD to RL 78.8 mAHD, which is lower than the FFL level of RL 79.00 mAHD. Additionally, Site 2A is not impacted by the PMF event.

Figure 20: Post Development 1% AEP Flow depths and levels

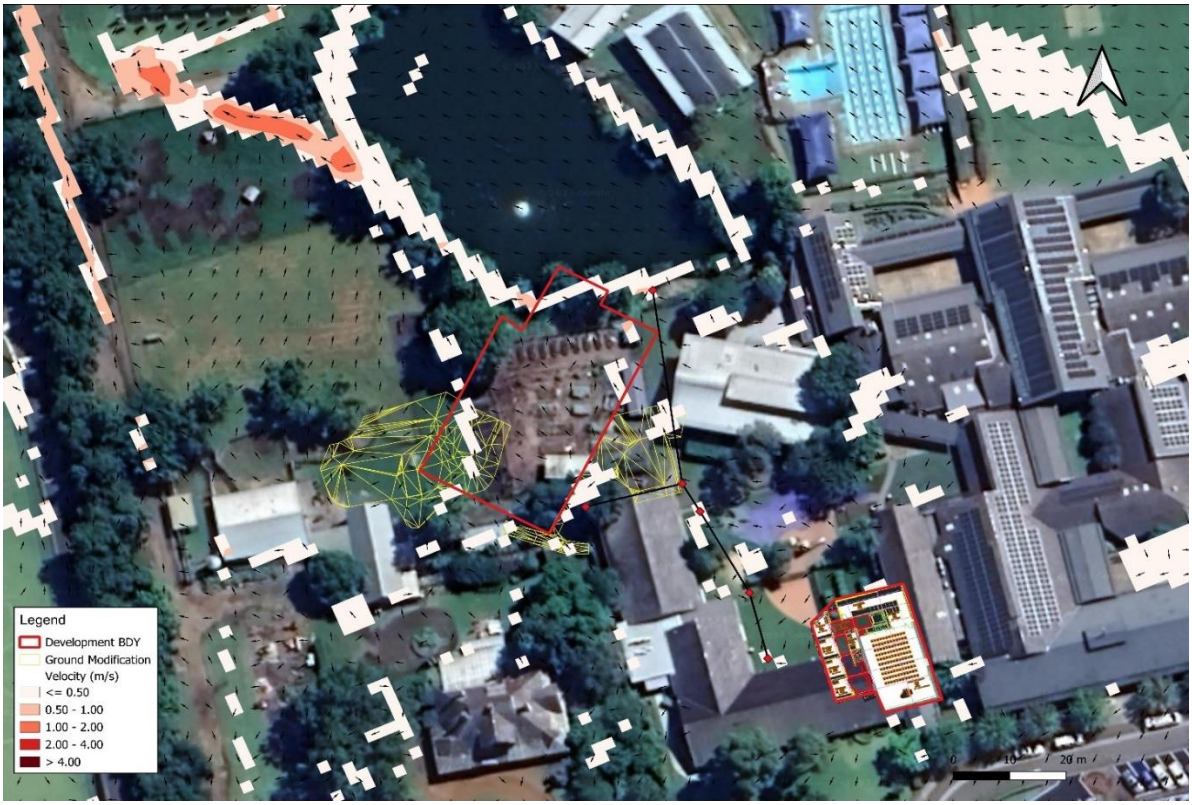

Figure 21: Post Development 1% AEP Flow Velocity

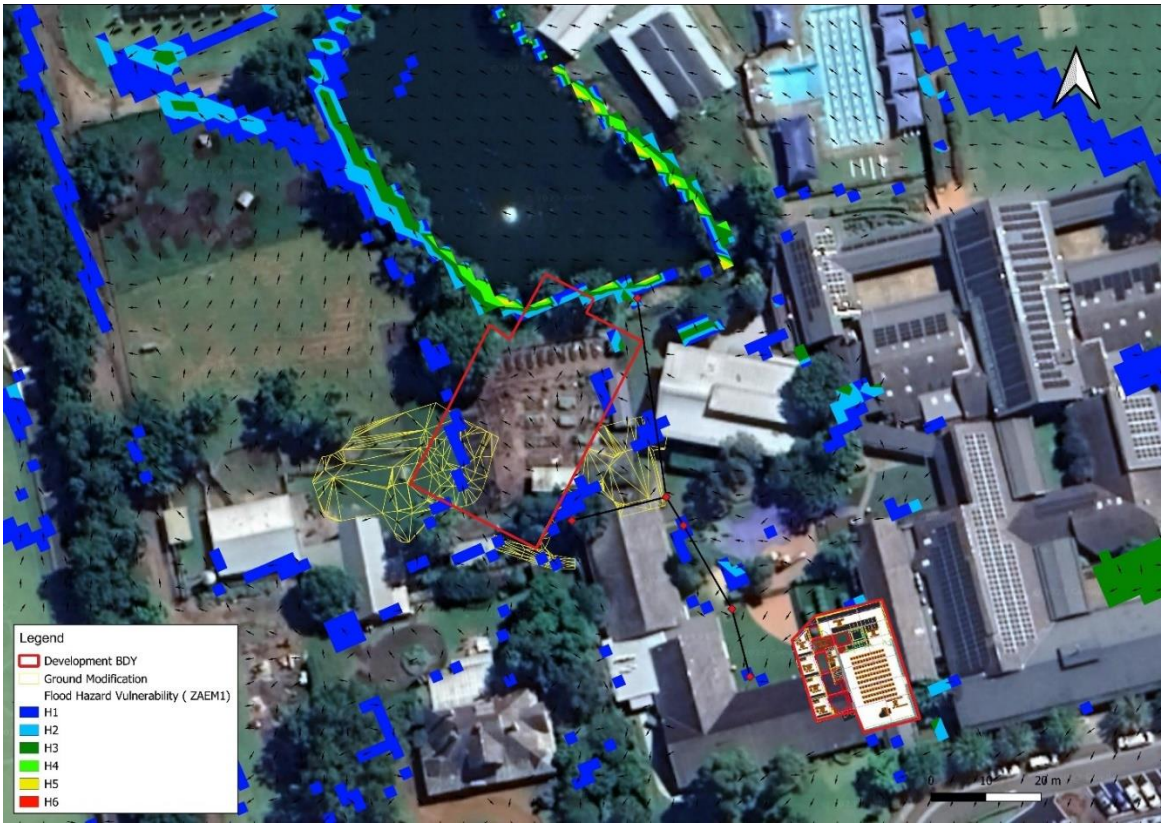

Figure 22: Post Development 1% AEP Flow hazards

Figure 23: Post Development PMF Flow depths and Levels

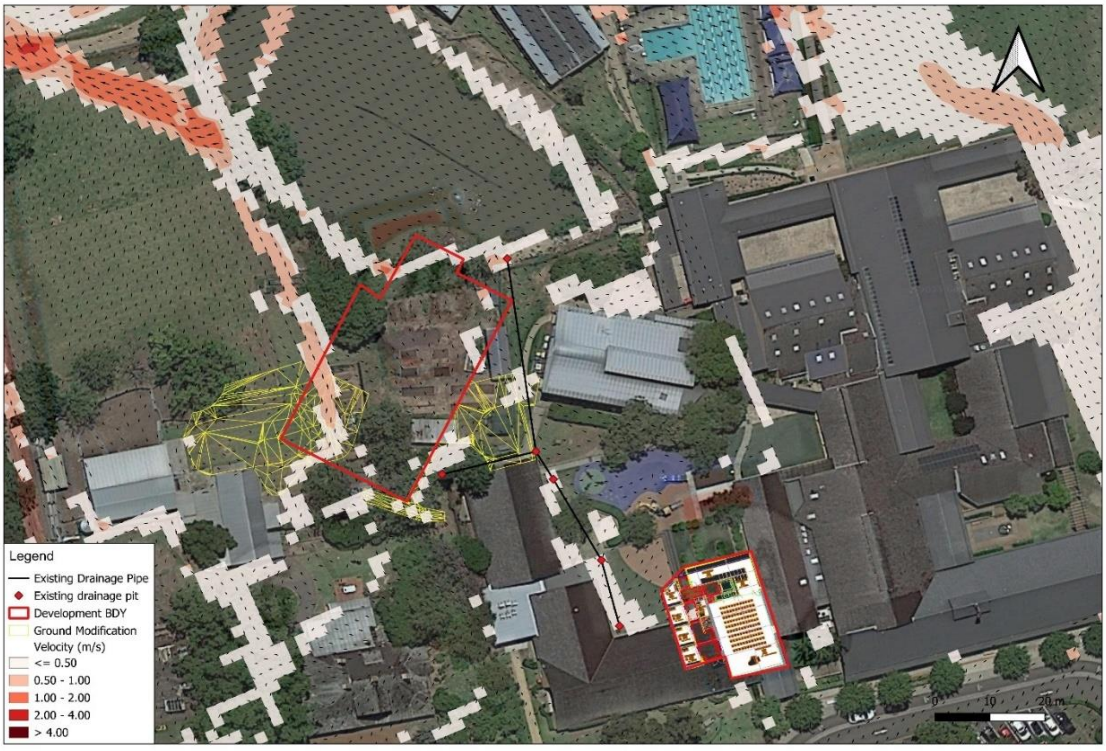

Figure 24: Post Development PMF Flow velocity

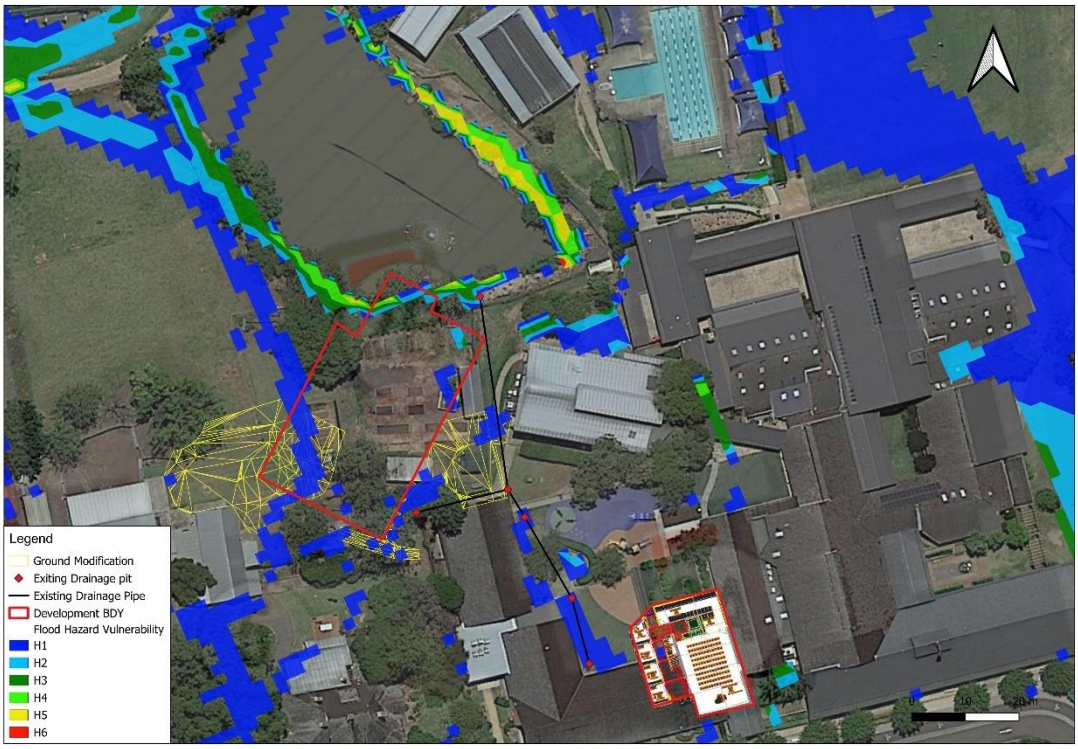

Figure 25: Post Development PMF Flood Hazard

3.3 Site 3 (New Staff Residences)

For site 3 the proposed development is blocked out to analyse the impact on the flood condition. The post development flow depths & levels, flow velocities and flow hazards for the 1% AEP are shown in Figure 26,Figure 27 and Figure 28 respectively. The flow depths and levels for the post-development 1% AEP event at Site 3 range from RL 73.8 mAHD at the northern boundary to RL 77.5 mAHD in the southern boundary. Further detailed assessment of stormwater and flood modelling will be conducted during the site's detailed design phase.

Figure 26- Post Development 1% AEP Flow depths and levels

Figure 27 Post Development 1% AEP Flow velocities

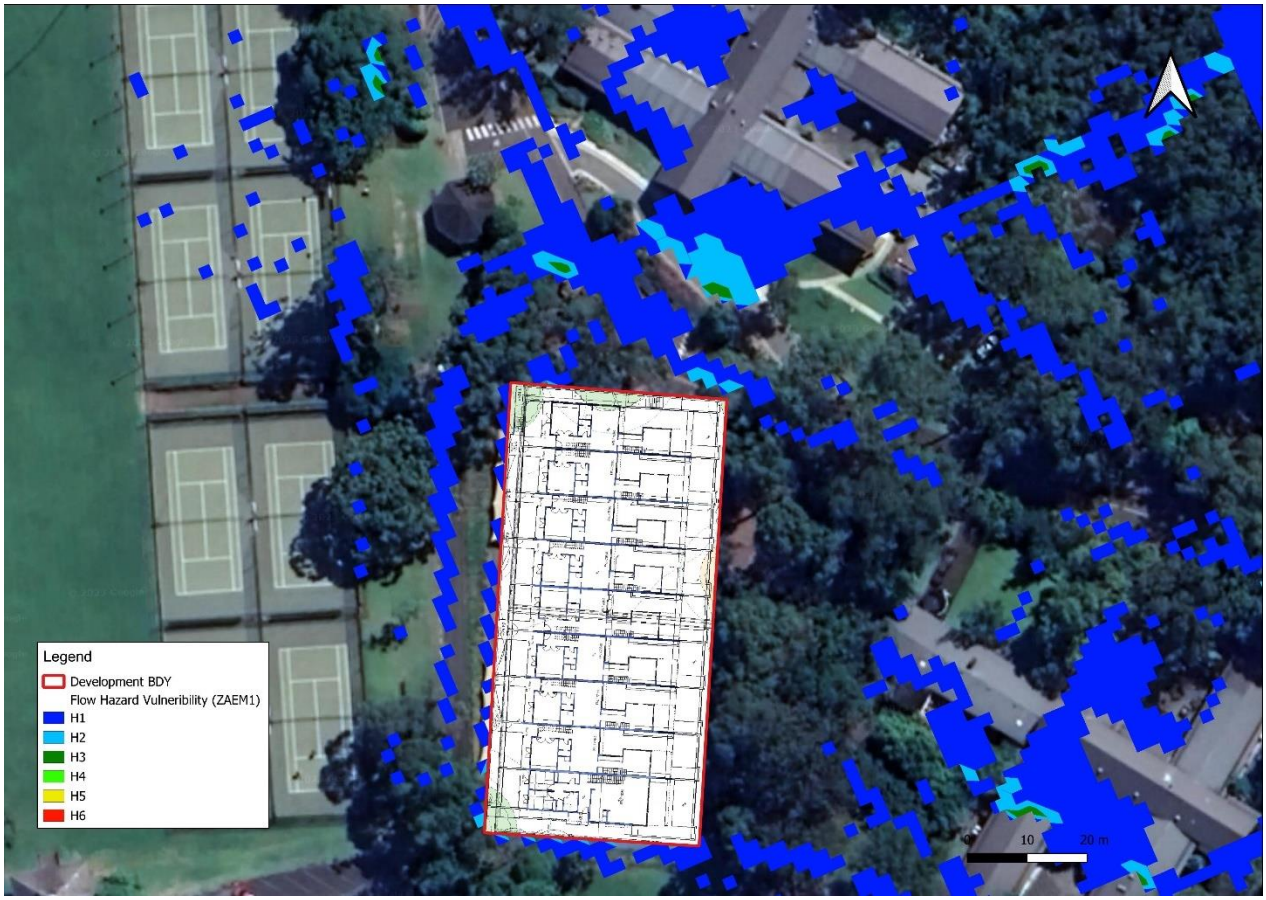

Figure 28- Post Development 1% AEP Flow hazards

3.4 Site 4 (New Road)

A preliminary flood assessment was carried out for the new road. To achieve this, the new road alignment was integrated into the Tuflow model, and a cross drainage culvert was included to the model on the northern side, as illustrated in Figure 29. The flood assessment demonstrates a decrease in flow overtopping the new road alignment during a 10% AEP storm event, but some overflow onto the road persists. Further assessment is required, which will be undertaken during the detailed phase design to address and eliminate the road overflow. Figure 29 and Figure 30 and Figure 31 show post development 1% AEP Flow depths and levels, Velocity and Hazard map for the proposed road.

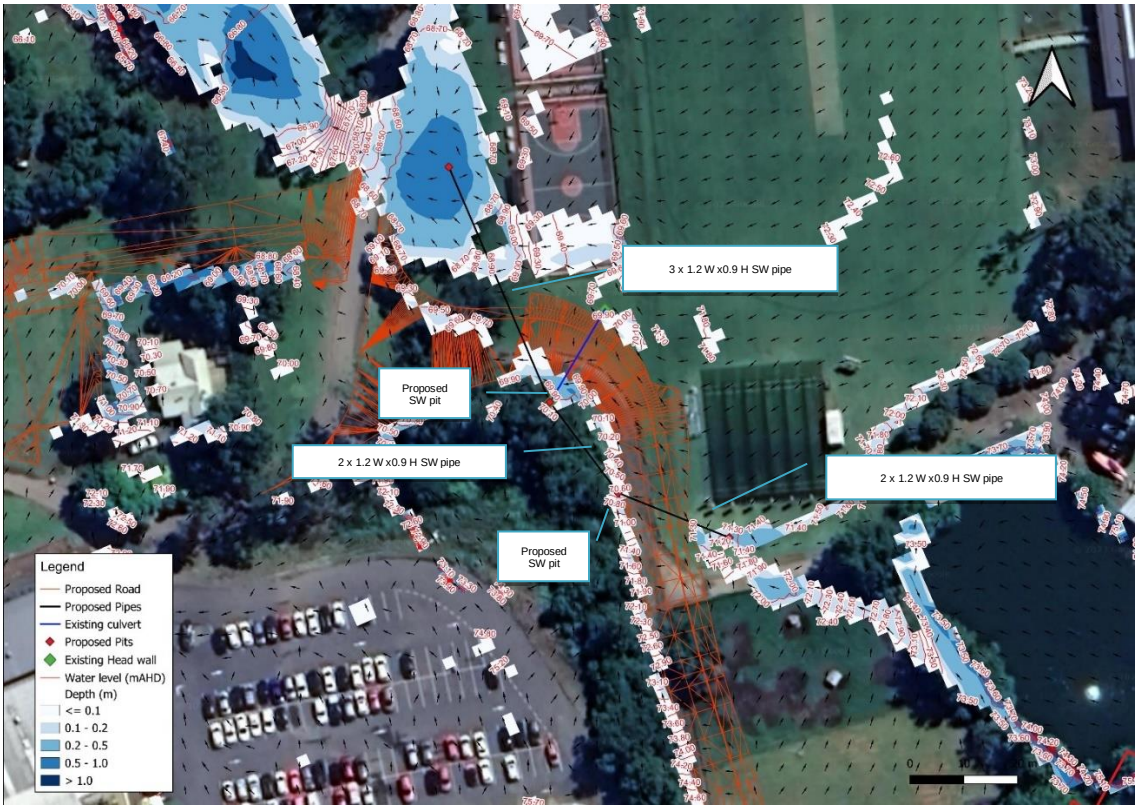

Figure 29- Post Development 10% AEP Flow depths and levels for the proposed road

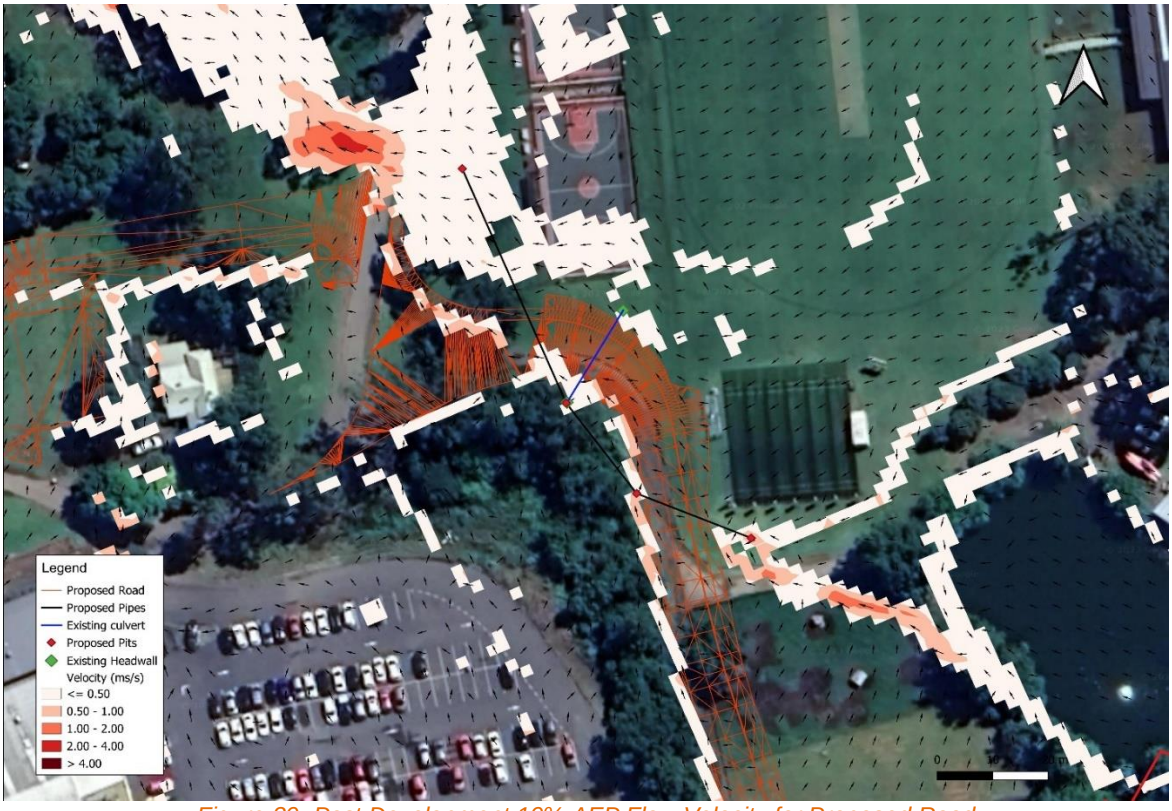

Figure 30- Post Development 10% AEP Flow Velocity for Proposed Road

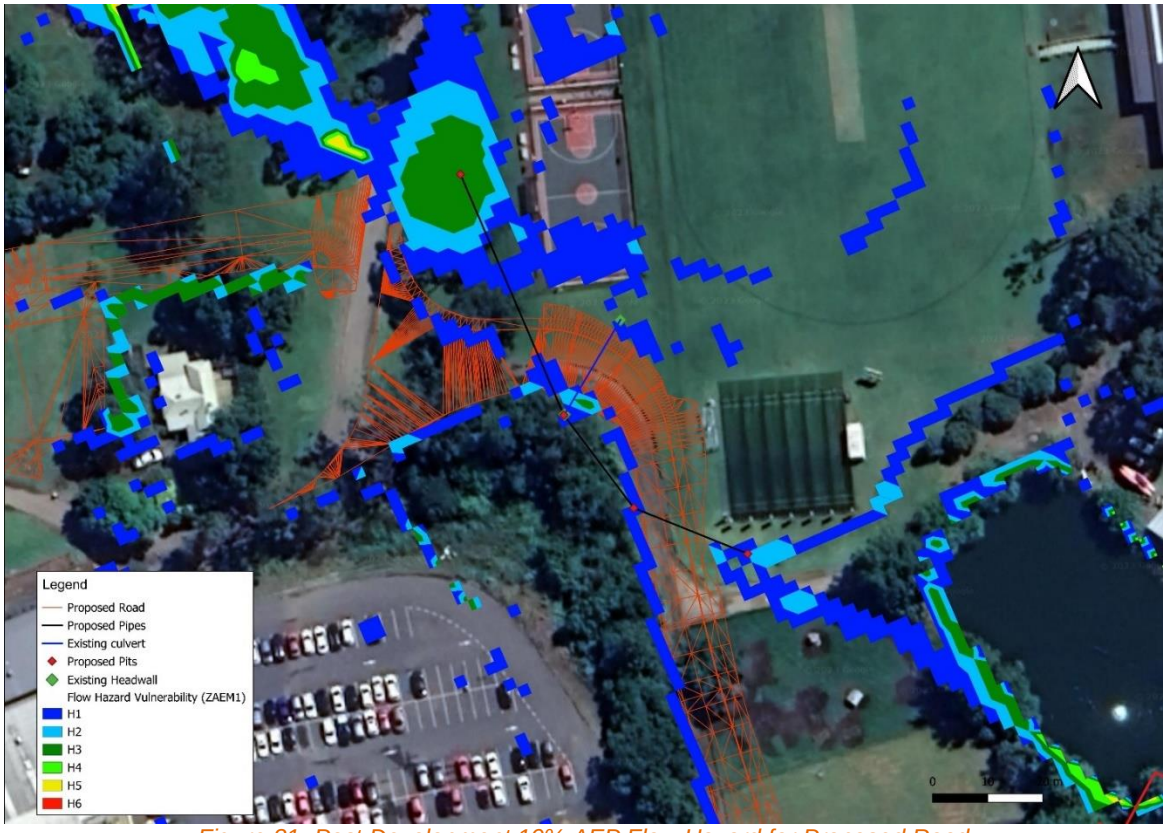

Figure 31- Post Development 10% AEP Flow Hazard for Proposed Road

3.5 Site 5 (New Day Boy House)

For site 5 the proposed development is blocked out to analyse the impact on the flood condition. The post development flow depths & levels, flow velocities and flow hazards for the 1% AEP are shown in Figure 32, Figure 33 and Figure 34 respectively. The flow depths and levels for the post-development 1% AEP event at Site 5 range from RL 74.8 mAHD to RL 76 mAHD at the southern boundary. This overland flow appears to be shallow and can be addressed by a combination of inground pipe system and overland flow diversion. A comprehensive assessment of stormwater and flood modelling will be conducted during the detailed design phase.

Figure 32: Post Development 1% AEP Flow depths and levels

Figure 33: Post Development 1% AEP Flow velocities

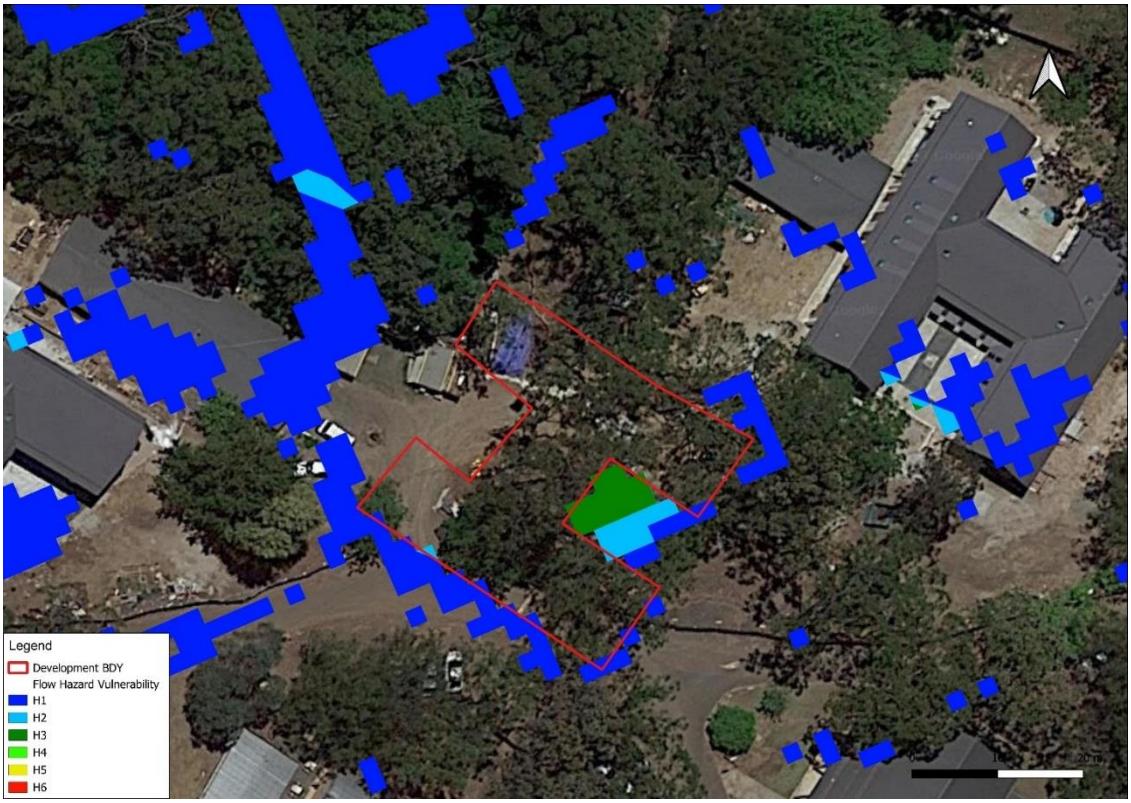

Figure 34: Post Development 1% AEP Flow hazards

3.6 Site 6 (New Sport Pavilion)

The post development flow depths & levels, flow velocities and flow hazards for the 1%AEP are shown in Figure 35 and Figure 36 and Figure 37 respectively.

The site is not **affected** by post development overland 1%AEP flooding.

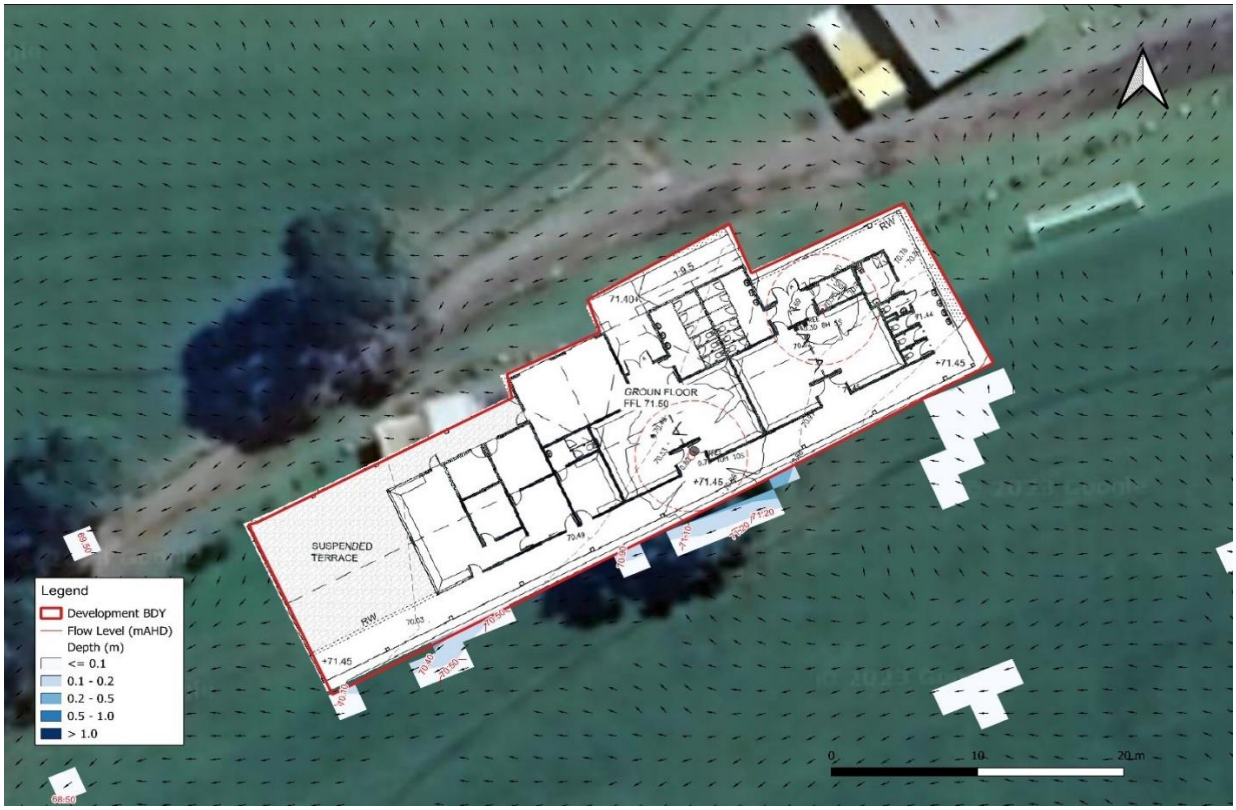

Figure 35- Post Development 1% AEP Flow depths and levels for New Sport Pavilion

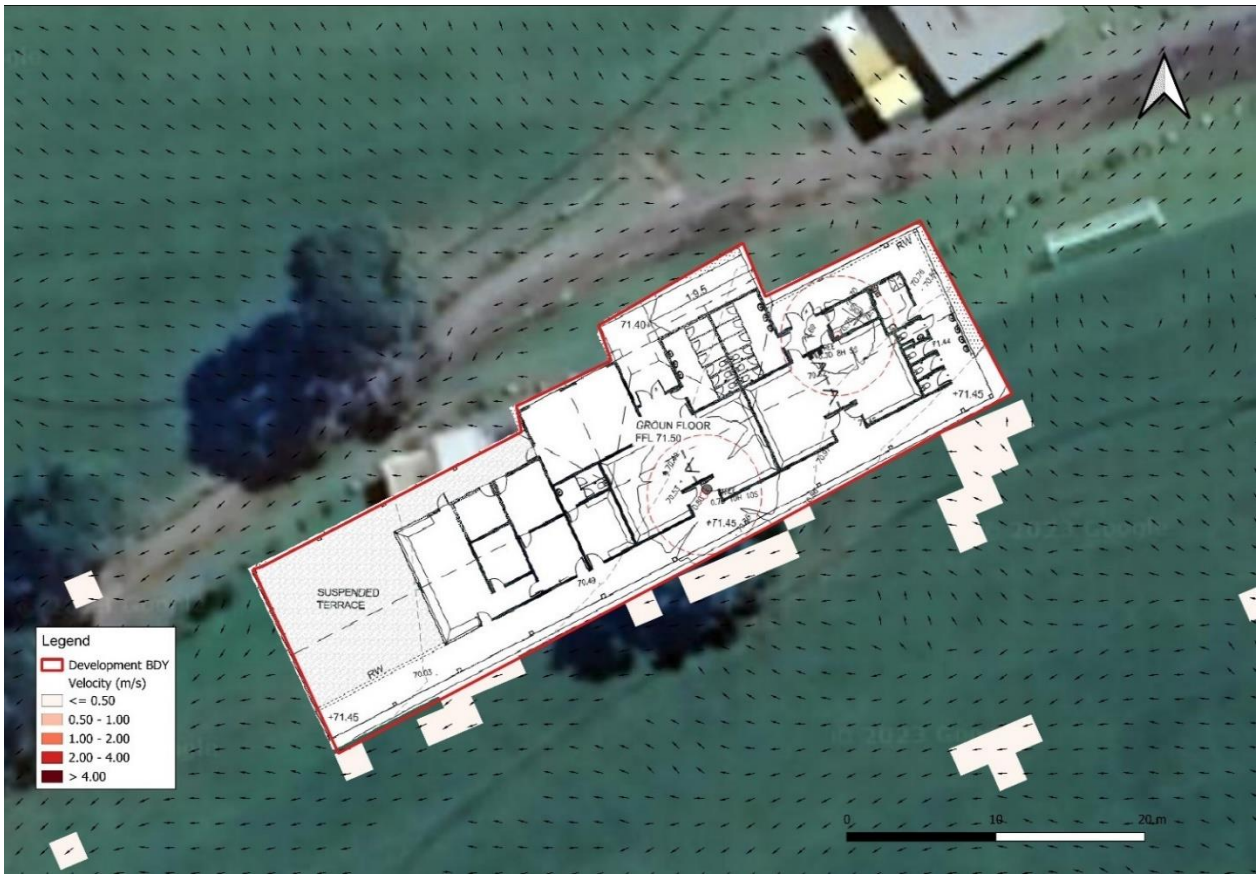

Figure 36: Post Development1% AEP Flow velocities for New Sport Pavilion

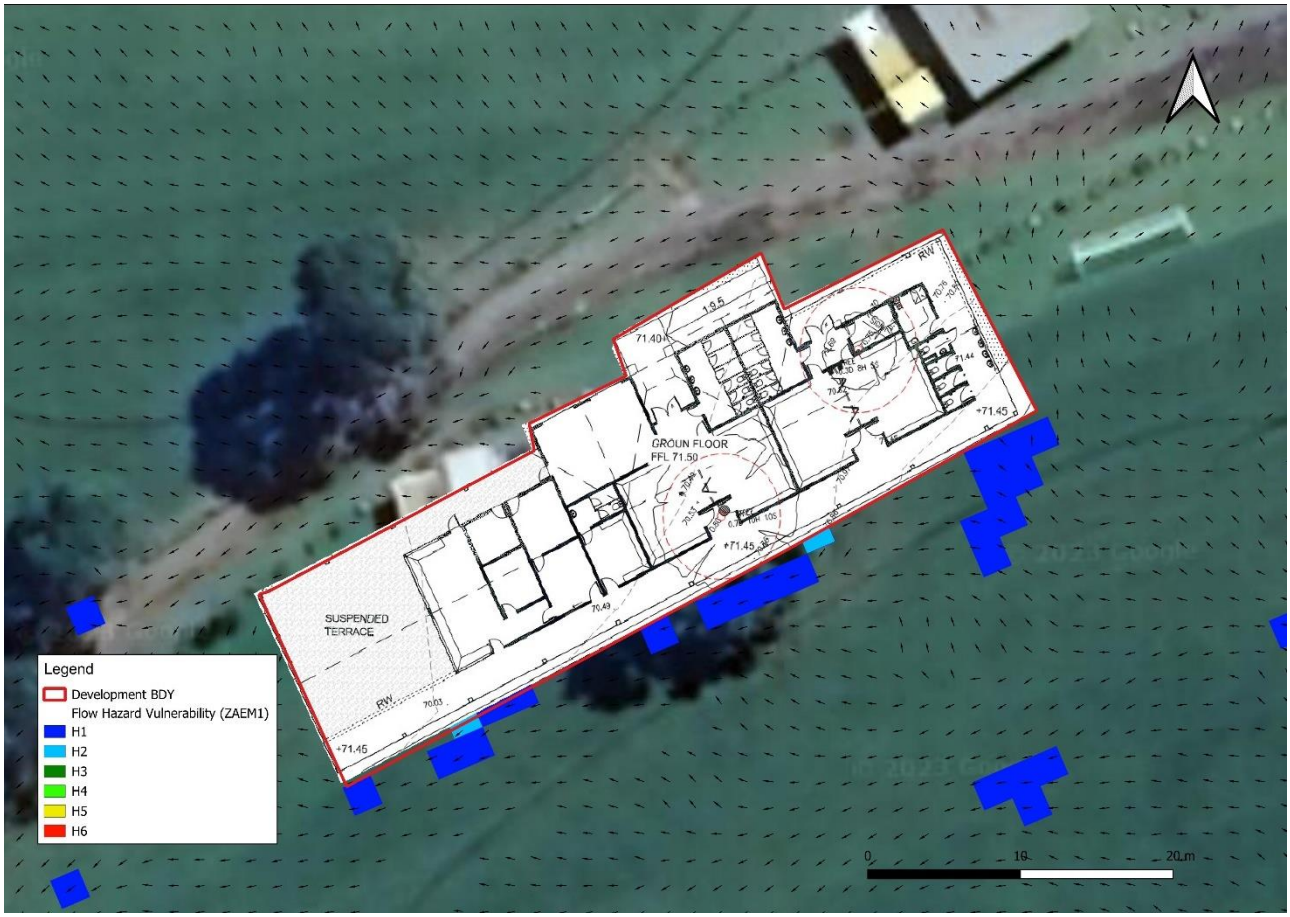

Figure 37- Post Development 1% AEP Flow hazards for New Sport Pavilion

3.7 Site 7 (New Boarding House)

The post development flow depths & levels, flow velocities and flow hazards for the 1%AEP are shown in Figure 38, Figure 39 and Figure 40. The site is situated on a hilly slope and blocks the sheet flow, causing ponding in front of the building. To address this issue, a stormwater channel and pipe is proposed, as illustrated in Figure 38. This design facilitates the diversion of stormwater around the buildings and directs it towards the valley located behind the proposed development. The post-development flood level is approximately 74.40 mAHD for the Boarding House building and ranges from 72.30 mAHD to 72.80 mAHD for the Boarding House -Staff residence building.

Figure 38- Post Development 1% AEP Flow depths and levels for the New Boarding House

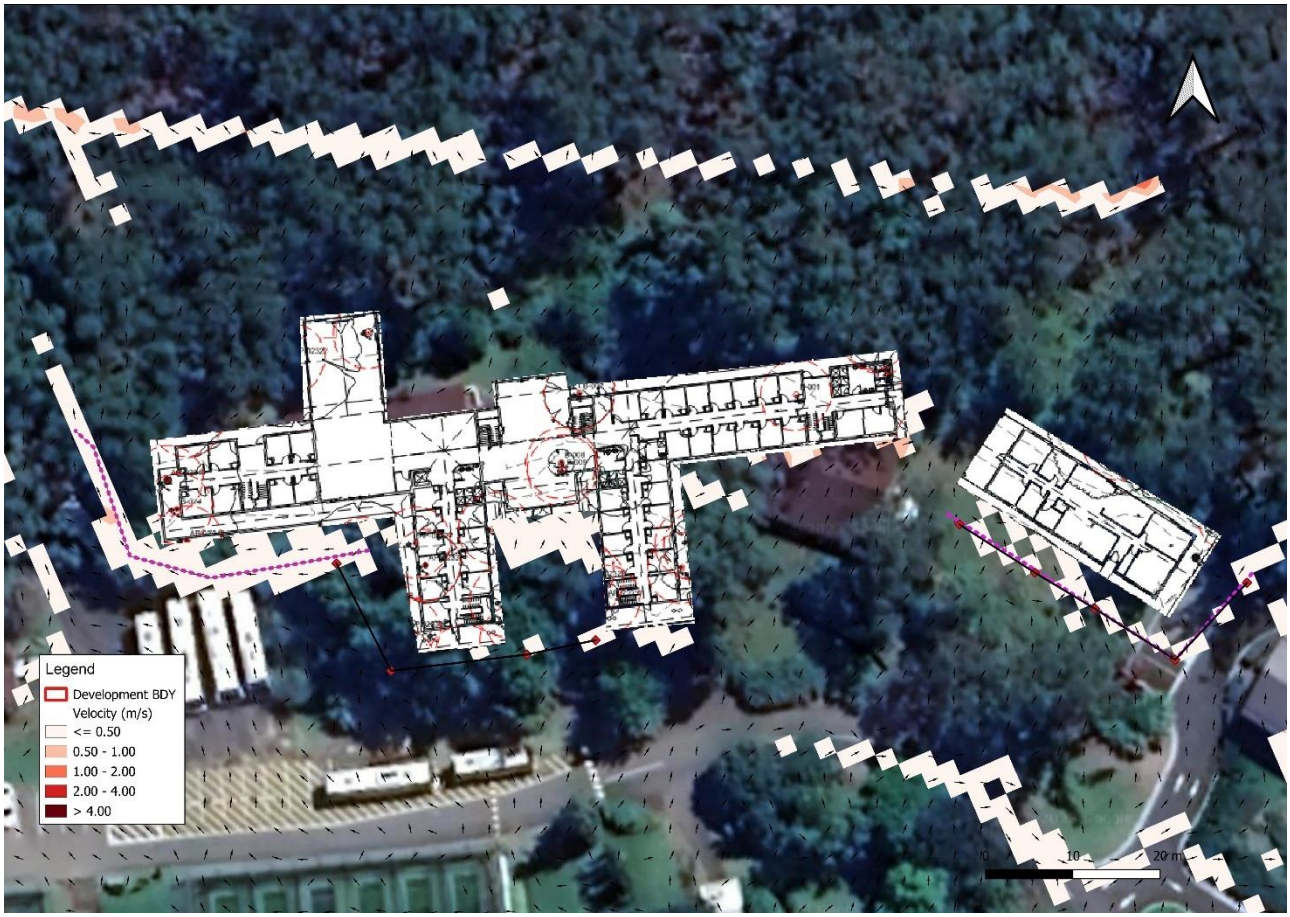

Figure 39: Post Development 1% AEP Flow Velocities for the New Boarding House

Figure 40- Post Development1% AEP Flow hazards for the New Boarding House

3.8 New Road and Bus Parking (Site 8)

A new road and a bus parking area are proposed around the existing building on Massie Rd. This leads to additional flooding on this property. To address this issue, a new channel and cross-drainage system are proposed at this location. Figure 41 illustrates these proposed channel and cross-drainage features.

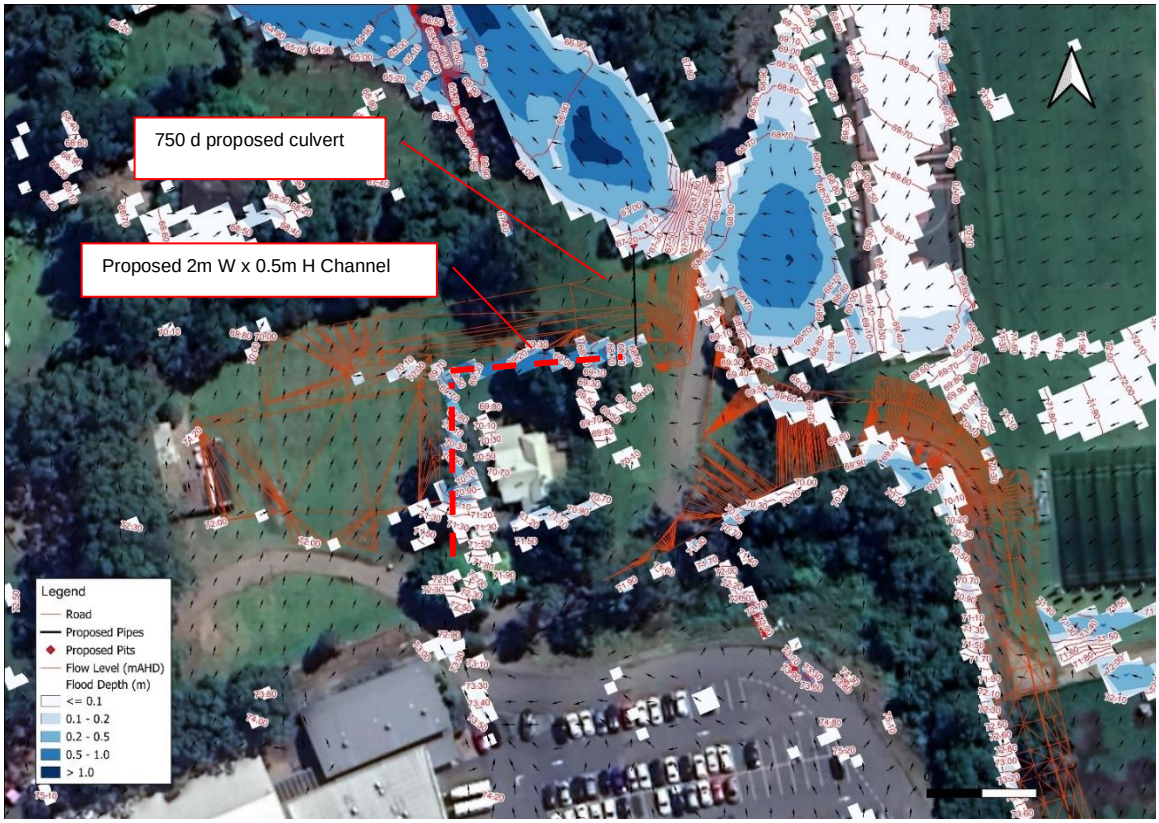

Figure 41- Post Development 1% AEP Flow depths and levels for the New Road and Bus Parking

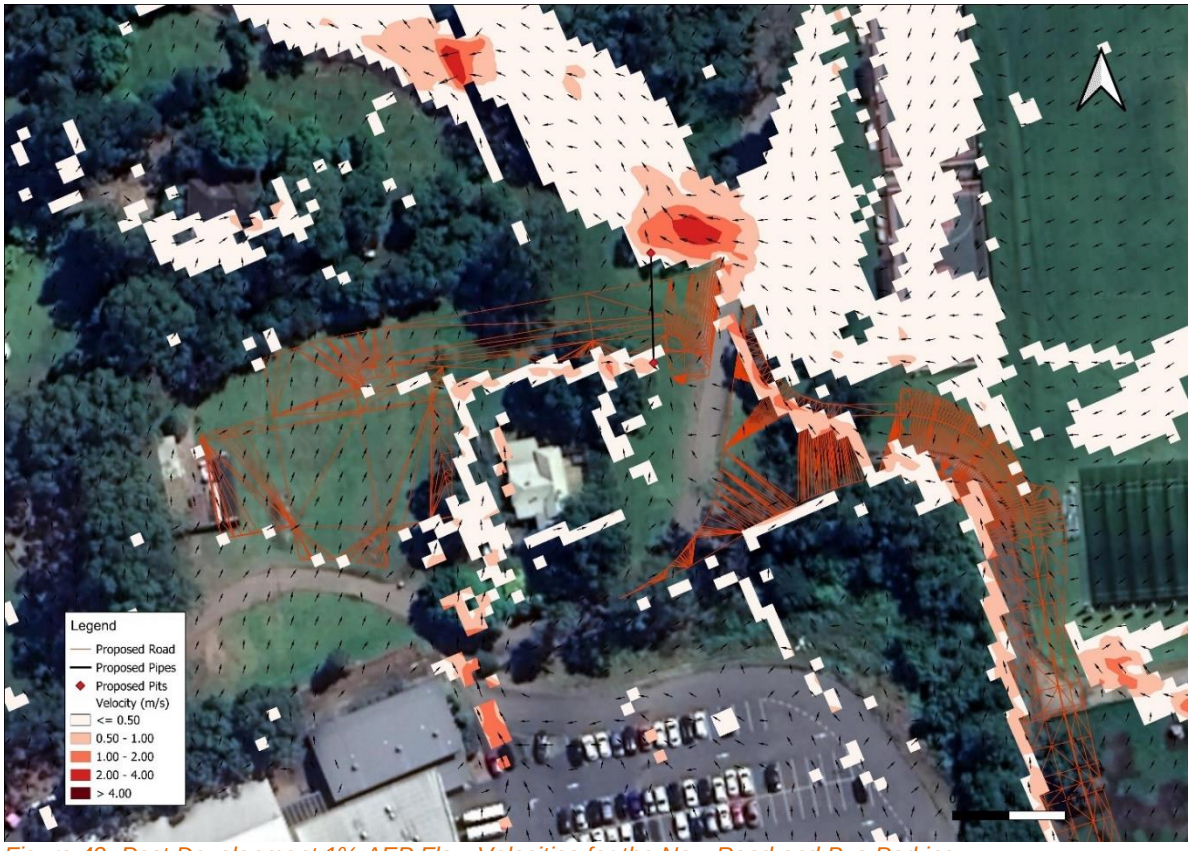

Figure 42- Post Development 1% AEP Flow Velocities for the New Road and Bus Parking

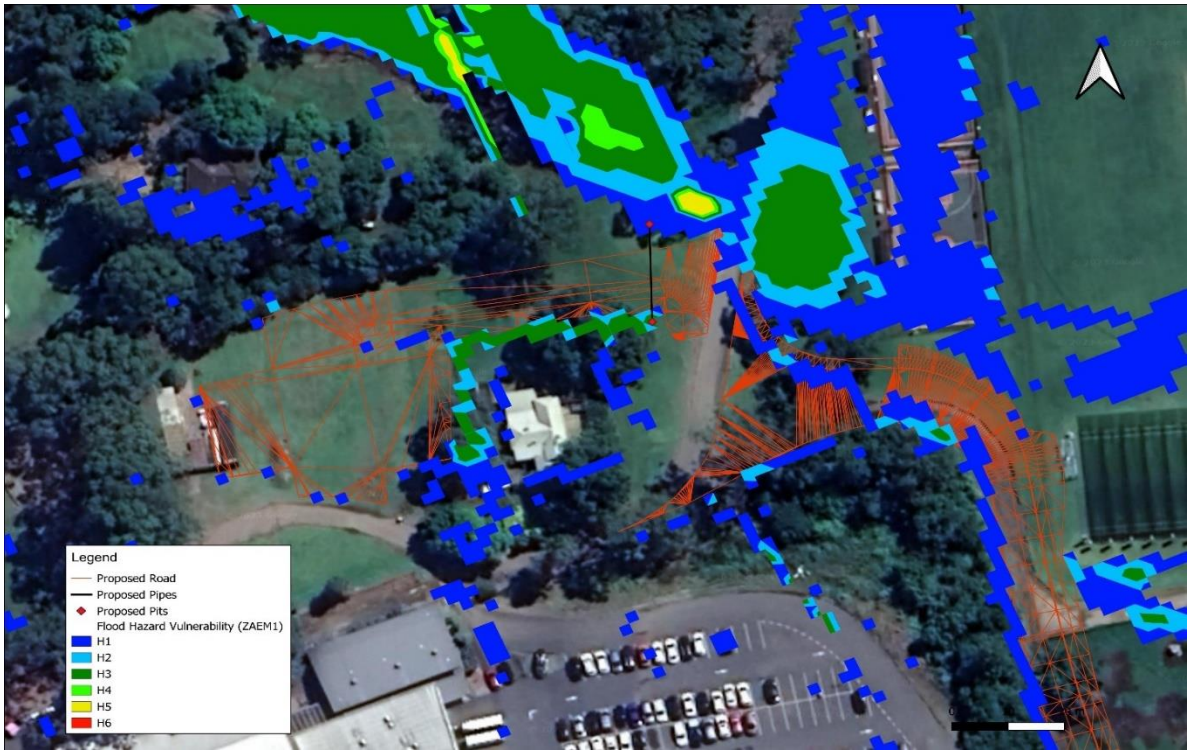

Figure 43- Post Development1% AEP Flow hazards for the New Road and Bus Parking

4.0 Post Development Flood Hazard Assessment

For this study Flood Hazard Vulnerability method is used to assess the Flood hazard. Flood hazard vulnerability as presented in AIDR (2017) is based on the combined flood hazard curves vulnerability as presented in AIDR (2017) is based on the combined flood hazard curves (presented in Figure 44) which set hazard thresholds that relate to the vulnerability of the community when interacting with floodwaters. The combined curves are divided into hazard classifications that relate to specific vulnerability thresholds. This classification includes six categories, ranging from H1 (no restrictions) to H6 (not suitable for people, vehicles or buildings) as described in Table 1.

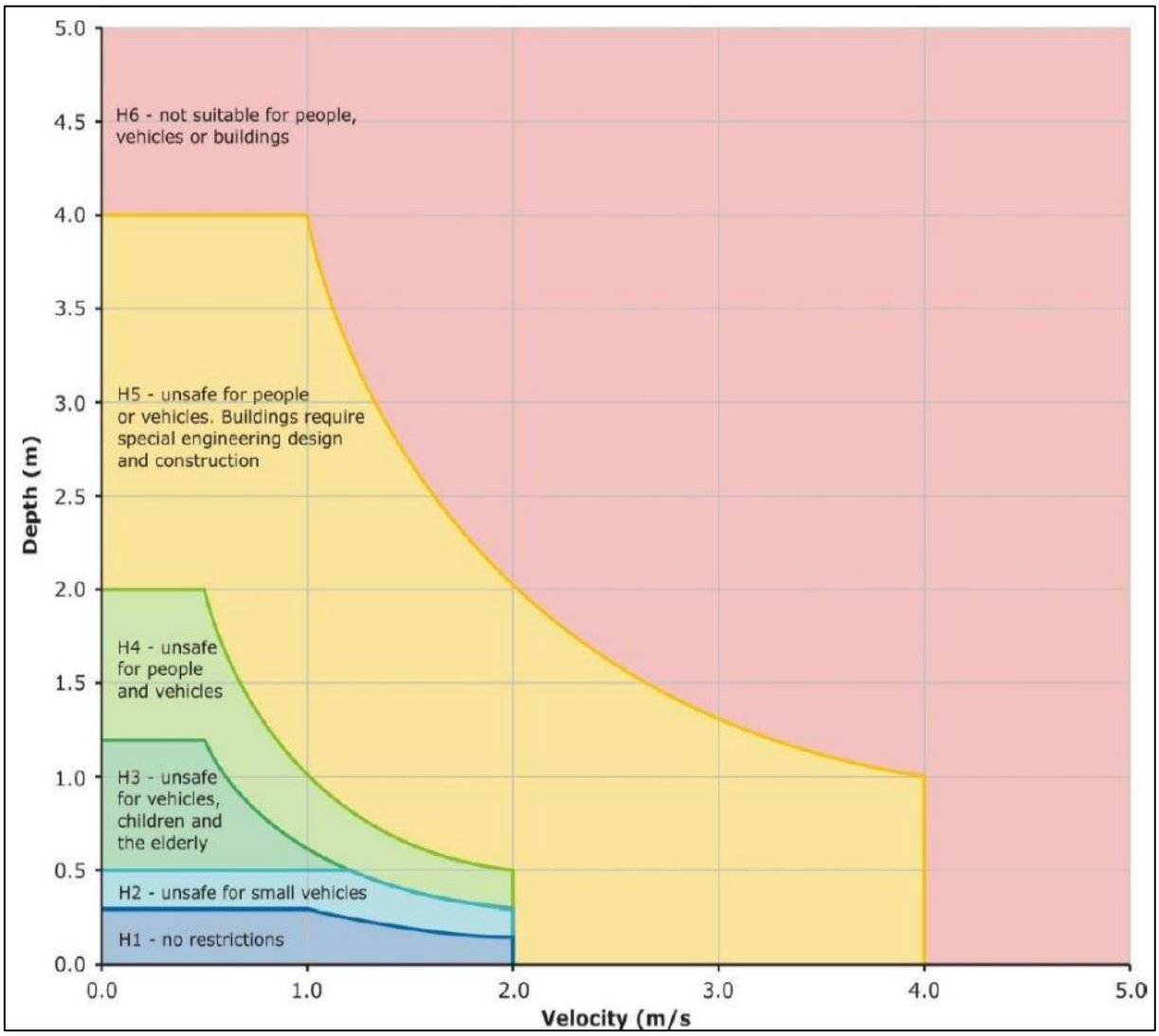

Figure 44- General flood hazard vulnerability curve

Table 1. Flood Hazard Vulnerability Classification

Hazard Classification	Description
H1	Relatively benign flow conditions. No vulnerability constraints.
H2	Unsafe for small vehicles.
H3	Unsafe for all vehicles, children and the elderly.
H4	Unsafe for all people and all vehicles.
H5	Unsafe for all people and all vehicles. Buildings require special engineering design and construction.
H6	Unconditionally dangerous. Not suitable for any type of development or evacuation access. All building types considered vulnerable to failure.

The flood hazard vulnerability categories in the 1% AEP storm events for the proposed site conditions are shown in Figure 44 . The 1% AEP flood hazards based on this category was previously presented in Figure 15, Figure 18, Figure 22,Figure 28,Figure 34, Figure 37,Figure 40 and Figure 43 which suggested that most sites are generally in low hazard category (H1) during the 1% AEP storm event. Higher hazards were observed at sites 3 which can be reduced through the implementation of flood mitigation measures.

4.1 Post Development Flood Impact

The post-development flood impact assesses flood levels in comparison to the existing scenario. The flood impact map, as shown in Figure 45 to Figure 52, shows the flood impacts of this proposal. Some minor flood impacts from Site 3 and Site 5 are observed on surrounding buildings.These flood impacts are within the school boundary and can be addressed by proposing local drainage solutions for these two sites.
Furthermore, no flood impact is observed for the building on Massie Rd. However, some afflux is noted at Masons Rd because of the proposed road.

Figure 45- Post Development Afflux (change in flood level) - 1% AEP Storm Event for site1

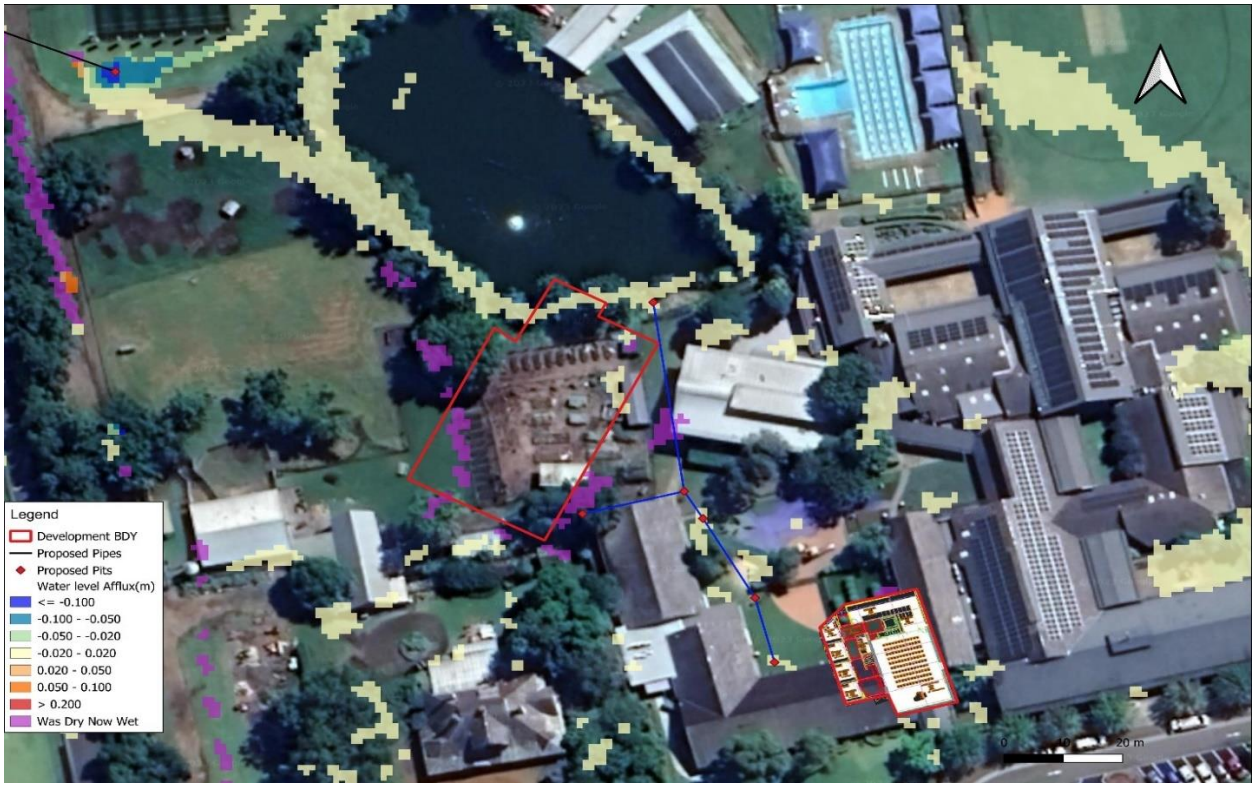

Figure 46- Post Development Afflux (change in flood level) - 1% AEP Storm Event for Site 2A and 2B

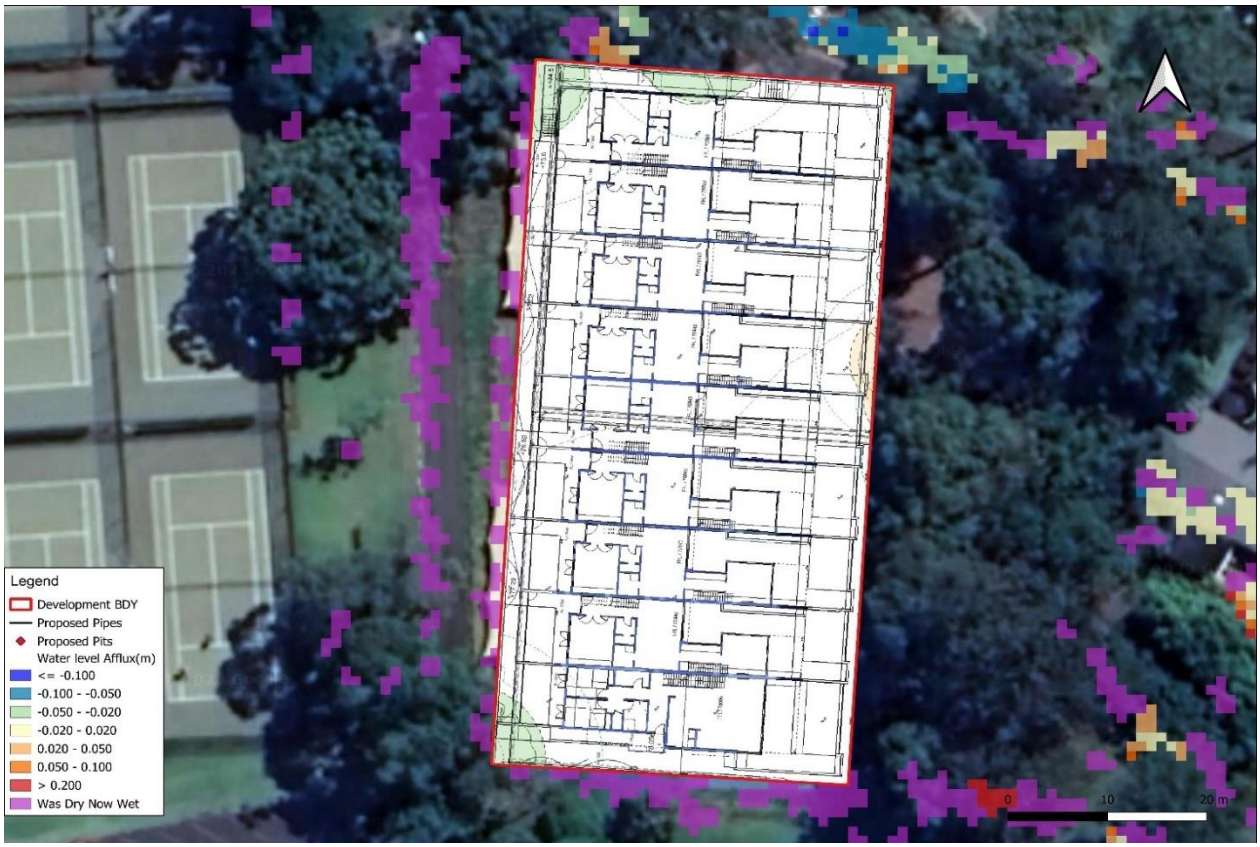

Figure 47- Post Development Afflux (change in flood level) - 1% AEP Storm Event for Site 3

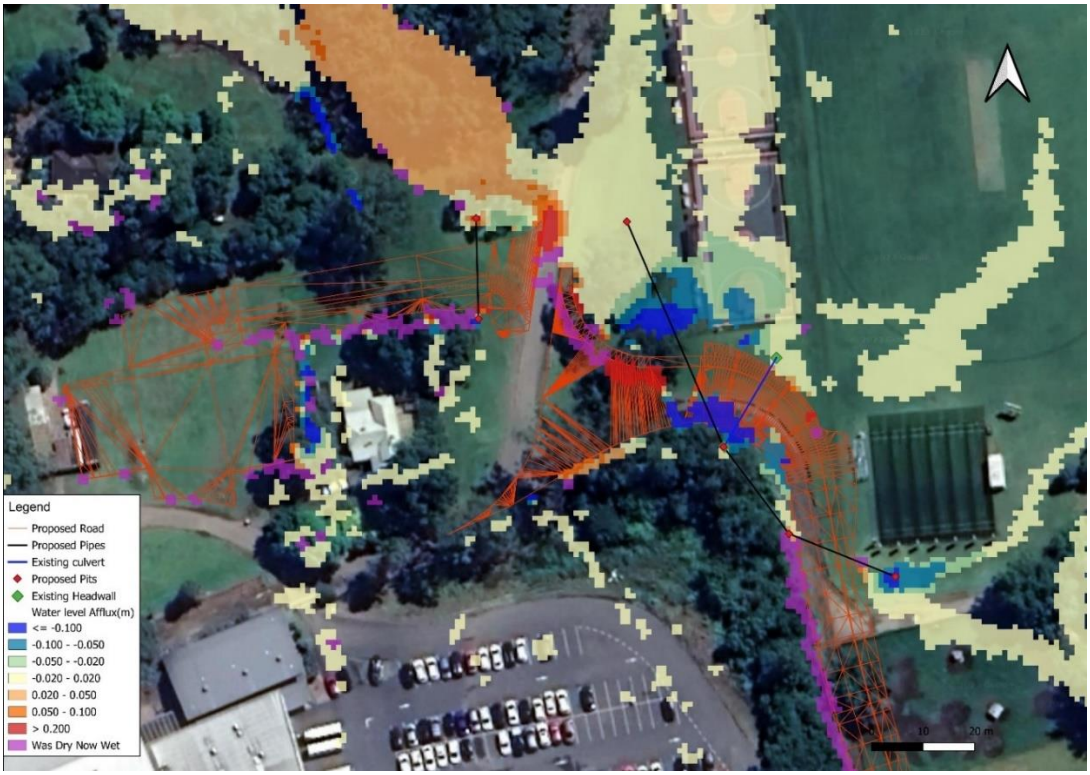

Figure 48- Post Development Afflux (change in flood level) - 1% AEP Storm Event for Site 4 and site Site 8

Figure 49 Post Development Afflux (change in flood level) - 1% AEP Storm Event for Site 4

Figure 50- Post Development Afflux (change in flood level) - 1% AEP Storm Event for Site 5

Figure 51- Post Development Afflux (change in flood level) - 1% AEP Storm Event for Site 6

Figure 52- Post Development Afflux (change in flood level) - 1% AEP Storm Event for Site 7

5.0 Flood Planning Requirements

The 2023 Council DCP (Development Control Plan) is utilized to identify flood control requirements. According to the Council DCP, the following procedure is followed:

C.24 :

All proposals must take into account the relevant controls applicable to the proposed land use category and flood risk category, as specified in Table 5.1.1.1. The process for determining which controls apply to the proposed development involves the following steps:

Step 1: Identify the land use category of the development from Table 5.1.1.1 of DCP.

Based on this table, the land use category of the development is summarized below.

Table 2 - Site land use category based on DCP

Site	Category
New Steam Building & Landscaping (Site 1)	Sensitive Uses and Facilities
Site 2A (New Prep School General Learning Building)	Sensitive Uses and Facilities
Site 2B (New Prep School Performing Art Centre)	Sensitive Uses and Facilities
Site 3 (New Staff Residences)	Residential (Dwelling houses)
Site 4 (New Road)	Ausroads guideline is used
Site 5 (New Day Boy House)	Residential (Bording Houses)
Site 6 (New Sport Pavilion)	Commercial(Recreation facilities (indoor)
Site 7 (New Boarding House)	Residential (Bording Houses)
Site 8 (New Road and Bus Parking)	Ausroads guideline is used

Step 2: Determine which flood risk categories apply to the land.

Table 3 – Technical description of areas at risk

Risk area	Common description	Technical description
High risk area	• Frequent flooding is common • Near the main river and creeks where water flows during a flood, including overflow from drainage • This area will see the fastest flowing and deepest water and cause a significant risk to life	High hazard flood area within the 1% annual exceedance probability (AEP) (1:100)
Medium risk area	• Frequent flooding will be rare • Where the flood water goes once the creek/river areas overflow • In rare floods these areas have the potential for deep and fast flowing water	Medium and low hazard area in the 1% AEP (1:100)
Low risk area	• Flooding is extremely rare • Generally, away from the river or creek and higher up • If a flood affects these areas it will cover a large area with dangerous water in many places	Area from the 1% AEP (1:100) up to the Probable Maximum Flood
Everywhere else	Not expected to flood but there still could be local incidents water running off the land and of street drainage not coping with rainfall amounts.	Area outside the Probable Maximum Flood. There may still be isolated impacts from local overland flow.

The following table shows the site risk assessment based on the existing flood information:

Table 4 – site risk assessment

Site	Flooding description	Risk assessment
New Steam Building & Landscaping (Site 1)	Isolated impact from local overland flow	No risk (everywhere else)
Site 2A (New Prep School General Learning Building)	Isolated impact from local overland flow	No risk (everywhere else)
Site 2B (New Prep School Performing Art Centre)	Isolated impact from local overland flow	No risk (everywhere else)
Site 3 (New Staff Residences)	Isolated impact from local overland flow	No risk (everywhere else)
Site 4 (New Road)	Austroads guideline is used	-
Site 5 (New Day Boy House)	Isolated impact from local overland flow	No risk (everywhere else)
Site 6 (New Sport Pavilion)	Isolated impact from local overland flow	No risk (everywhere else)
Site 7 (New Boarding House)	Isolated impact from local overland flow	No risk (everywhere else)
Site 8 (New Road and Bus Parking)	Austroads guideline is used	-

Step 3: Apply the relevant controls outlined in the planning matrix as applicable to the floodplain and land use category.

Table 5 – Planning matrix.

Flood Risk Precincts (FRPs)	Planning Consideration	Floor Level	Building Components	Structural Soundness	Flood Affectation	Car Parking & Driveway Access	Evacuation	Management & Design
High Flood Risk	Sensitive Uses & Facilities	X	X	X	X	X	X	X
	Critical Uses & Facilities	X	X	X	X	X	X	X
	Residential*	X	X	X	X	X	X	X
	Commercial & Industrial	X	X	X	X	X	X	X
	Open Space & Non-Urban	1	1	1	1	2, 4, 6, 7	1, 4	2, 3, 4
	Subdivision	X	X	X	X	X	X	X
	Filling	X	X	X	X	X	X	X
	Concessional Development	4	1	1	1	1, 5	3, 4, 6	2, 3, 4
Medium Flood Risk	Sensitive Uses & Facilities	X	X	X	X	X	X	X
	Critical Uses & Facilities	X	X	X	X	X	X	X
	Residential*	2	1	1	1	1, 3, 5, 6, 7	3, 4, 6	2, 3, 4
	Commercial & Industrial	2	1	1	1	1, 3, 5, 6, 7	3, 4, 6	2, 3, 4
	Open Space & Non-Urban	1	1	1	2	2, 4, 6, 7	1, 4	2, 3, 4
	Subdivision				1		3, 4, 5	1
	Filling	X	X	X	X	X	X	X
	Concessional Development	4	1	1	1	1, 5	2, 5	2, 3, 4
Low Flood Risk	Sensitive Uses & Facilities	X	X	X	X	X	X	X
	Critical Uses & Facilities	3	2	2	2	1, 3, 5, 6	2, 4, 6	2, 3, 4
	Residential*	2			2	1, 3, 5, 6	3, 4	
	Commercial & Industrial	2			2	1, 3, 5, 6	4	
	Open Space & Non-Urban					2, 4, 6, 7		
	Subdivision				2		5	1
	Filling				1			
	Concessional Development							

As there is no information available in this table regarding land subjected to local flooding, we have turned to two clauses from the DCP to determine the floor level for the proposed developments.

C.03 The Flood Planning Level under normal circumstances shall be the higher of the 1% AEP riverine flood level or the 1% AEP overland flow flood level, as accepted by Council, plus a minimum 500mm freeboard safety factor. Council may require additional freeboard to manage risk in exceptional circumstances.

C.16 Sensitive Uses and Facilities' and 'Critical Uses and Facilities,' as defined in Table 5.1.1.1, in general, not permitted on land subject to flooding in a PMF event.

Based on these two clauses and the development category, the floor levels requirements designated for each site are summarized in Table 6 below:

Table 6 – Flood Planning levels

Site	Flood Planning Requirement Level
New Steam Building & Landscaping (Site 1)	PMF Flood Level
Site 2A (New Prep School General Learning Building)	PMF Flood Level
Site 2B (New Prep School Performing Art Centre)	PMF Flood Level
Site 3 (New Staff Residences)	1% AEP Flood level +0.5 m free board
Site 4 (New Road)	NA
Site 5 (New Day Boy House)	1% AEP Flood level +0.5 m free board
Site 6 (New Sport Pavilion)	No overland flow is observed.
Site 7 (New Boarding House)	1% AEP Flood level. (we believe that the flow is sheet flow)
Site 8 (New Road and Bus Parking)	NA

Other considerations included:

C.01 Development is to be compatible with any relevant Floodplain Risk Management Plan and consistent with the current NSW Floodplain Development Manual, unless otherwise accepted by Council.

C.04 Significant filling or excavation of land below the Flood Planning Level is generally not permitted. If required by Council, development proposals must demonstrate, through detailed hydraulic modelling, that any proposed filling or excavation of land above the Flood Planning Level up to the Probable Maximum Flood (PMF) will not adversely impact flood behaviour.

C.09 Where hydraulic flood modelling is required, flow hazard categories H1 to H6 as set out in Figure 5.1.1.1 must be identified and adequately addressed in the design of the development. Where available, Council will issue flood and hazard levels to be adopted in any hydraulic flood modelling, unless an alternative approach is agreed with Council. Flood modelling will need to account for any projected changes to flood levels or behaviour as a result of climate change over the design life of the development.

C.11 Development with high sensitivity to flood risk (e.g. critical public utilities) must be sited and designed to provide reliable access and an acceptably minimal risk from flooding.

C.12 Design responses as part of flood mitigation measures associated with new and existing developments should not result in significant impacts upon the amenity of an area by way of unacceptable overshadowing of adjoining properties, privacy impacts (e.g. unsympathetic house raising) or by being incompatible with the streetscape or character of the locality (including heritage).

C.14 Development must not divert flood waters, nor interfere with floodwater storage, nor the natural function of waterways

The following guidelines are used for culvert design:

Guide to Road Design Part 1 – Objectives of Road Design (Table 4.2: Urban Road functional classification).

Guide to Road Design Part 5 - Guide to selection of road flood immunity (Table 6.4).

Table 4:2 and table 6.4 are shown in the Figure 53 and Figure 54 respectively.

Table 4.2: Urban road functional classification

Type of road	Function
Controlled access highways (motorways or freeways)	Motorways and freeways have an exclusive function to carry traffic within cities and to ensure the continuity of the national or regional primary road system. As they are designed to accommodate through traffic, they do not offer pedestrian or frontage access.
Urban arterial roads	Urban arterial roads have a predominant function to carry traffic but also serve other functions. They form the primary road network and link main districts of the urban area. Arterial roads that perform a secondary function are sometimes referred to as sub-arterial roads.
Urban collector/distributor roads	These are local streets that have a greater role than others in connecting contained urban areas (e.g. residential areas, activity areas) to the arterial road system. Generally, consideration of environment and local life predominate, and improved amenity is encouraged over the use of vehicles on these roads.
Urban local roads	These are roads intended exclusively for access with no through traffic function.

Figure 53- Urban road functional classification (Source: Austroads)

Table 6.4: Guide to selection of road flood immunity

Element	Austroads road classification	AEP
Cross drainage (culverts & bridges)	Controlled Access Highways Includes: Motorways & Freeways (National/State/Territory)	1%
	Arterial Roads Classes 1 & 2 Includes: National/State/Territory Highways, Urban Arterial Roads	2 – 1%
	Arterial Road Class 3 Includes: State/Territory main roads	2%
	Local Roads Classes 4 & 5	10 – 5%
	Urban Collector/Distributor Roads	10 – 2%
	Urban Local Roads	10%
Diversion channels	All roads	Adopt the AEP for cross drainage
Cross drainage (floodways)	Arterial Road Class 3	5%
	Local Roads Classes 4 & 5	20 – 10%
	Urban Local Roads	20 - 10%
Road surface (network drainage including kerb and channel with inlet pit & pipe systems, bridge decks)	All roads other than Local Roads	10% (4)
	Local Roads	20% (3)
Trapped flows (roads where there is no escape path for water including at a sag in cut)	All roads	2%
Longitudinal open drainage (table drains, diversion drains, catch drains and banks etc.)	All roads	10%, unless cross drainage immunity is less, then adopt the lesser value

Figure 54-Guide to selection of road flood immunity (Source : Austroads)

Based on the information provided in these tables, the proposed road considered as an urban local road and the 10% AEP storm is chosen for the road flood immunity.

The Hydraulic models' results for flood planning levels for the projects sites are summarized in the table 7:

Table 7- Flood Planning Levels for the Project's Sites

Site	Flood planning requirement	Model results	Design FFL
Site 1	PMF Flood Level	RL 78.40 to 82.20 mAHD	Please refer to Figure 12
Site 2A	PMF Flood Level	RL73.70 mAHD	79.00
Site 2B	PMF Flood Level	Not Impacted	-
Site 3	1% AEP Flood Level + 0.5 m free board	RL 74.8-77.5 mAHD	RL75.84 to RL 77.40 mAHD
Site 4	Austroads guideline is used	-	-
Site 5	1% AEP Flood level +0.5 m free board	RL 74.8-76 mAHD	RL 73.5m mAHD
Site 6	No overland flow is observed	-	-
Site 7 (Boarding House building)	1% AEP Flood Level	RL 74.40 mAHD	Level 1 FFL 75.7 m AHD
Site 7(Boarding House -Staff residence)	1% AEP Flood Level	RL 72.30 to 72.80 mAHD	RL 72.6 mAHD
Site 8	Austroads guideline is used	-	-

6.0 Summary and Recommendations/Conclusion

Taylor Thomson Whitting (NSW) Pty. Limited has been engaged by The King's School c/o TSA Management Pty Ltd to prepare a Flood Assessment Report to address the conceptual State Significant Development Application (SSDA) for the proposed master planning development at The Kings School located at 87-129 Pennant Hills Rd, North Parramatta NSW 2151 (the site). A hydraulic model has been developed for this assessment using Council's accepted TUFLOW model and adding proposed design elements to assess local flood characteristics in existing and proposed site conditions. Flood planning requirements for this assessment have been obtained from Parramatta Development Control Plan 2023 . The flood assessment for the project sites have been conducted in accordance with the specified requirement and flood maps have been created for each specific site based on these requirements. Modelling concluded that:

Site 1: It is considered as sensitive facility and PMF flood level is used as flood planning requirement. The PMF flood level around the Site 1 is RL 78.20 to 82.20 mAHD which is generally lower than their respective FFLs.

Site 2A and 2B: Site 2A and 2B are considered as sensitive facility and PMF flood level is used as flood planning requirement. PMF event at Site 2B vary from RL 77 mAHD to RL 78.8 mAHD, which is lower than the FFL level of RL 79.00 mAHD. Site 2A is not impacted by the PMF event.

Site 3: It is considered as residential facility and 1% AEP+ 500 mm freeboard is used as flood planning requirement level. The existing 1% AEP flood level is RL 74.8-77.5 mAHD. A detailed assessment of stormwater and flood modelling will be conducted during the site's detailed design phase.

Site 4: A cross drainage is designed based on Austroads guidelines.

Site 5: The post-development flow depths and levels for the 1% AEP event at Site 5 range from RL 74.8 mAHD to RL 76 mAHD at the southern boundary. This shallow overland flow can be effectively managed through a combination of an in-ground pipe system and overland flow diversion. A comprehensive assessment of stormwater and flood modelling will be conducted during the detailed design phase**.**

Site 6: No overland flow is observed.

Site 7: It is considered as residential facility. 1% AEP freeboard is used as flood planning requirement level (No overland flow, only sheet flow is observed here).The post-development flood level is approximately 74.40 mAHD for the Boarding House building and ranges from 72.30 mAHD to 72.80 mAHD for the Boarding House -Staff residence building.

Site 8: the construction of a new road and a bus parking area surrounding the pre-existing building on Massie Rd. This development results in increased flooding on the property. To mitigate this concern, a new channel and cross-drainage system is suggested for this site.

The 1% AEP flood hazards based on Flood Hazard Vulnerability method suggested that most sites are generally in low hazard category (H1) during the 1% AEP storm event. Higher hazards were observed at sites 3 which can be reduced through the implementation of flood mitigation measures. This will be done during detailed design phase.

The flood impact map, displayed in Figures 45 through 52, reveals the flood impacts of this project. Minor flooding affects the buildings around Site 3 and Site 5. These impacts are confined within the school's boundaries and can be mitigated by suggesting local drainage solutions for these two areas. Additionally, no flooding is observed for the building on Massie Rd. Nevertheless, some afflux is detected at Masons Rd due to the proposed road.

Prepared by
TTW (NSW) PTY LTD

Authorised By
TTW (NSW) PTY LTD

ALI VAHIDI
Senior Civil Engineer

Philip McAteer
Associate Director

P:\2022\2212\221272\Reports\TTW\Civil\Flood Assessment Report\Issued\Rev\20230817_Kings School Flood Assessment Report_Rev_1.docx