Northern River Flood Recovery- Richmond River High Campus Redevelopment

Prepared to Support a Review of Environmental Factors (REF) for the rebuild of Richmond River High Campus

Prepared for School Infrastructure NSW / 16 July 2025

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2	16/01/2025	AV	EC	
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Glossary and Abbreviations

Annual Exceedance Probability	AEP	The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage
Australian Height Datum	AHD	A common national surface level datum often used as a referenced level for ground, flood and flood levels, approximately corresponding to mean sea level.
Average Recurrence Interval	ARI	The long-term average number of years between the occurrence of a flood equal to or larger in size than the selected event. ARI is the historical way of describing a flood event. AEP is generally the preferred terminology.
Bureau of Meteorology	BoM	An executive agency of the Australian Government responsible for providing weather services to Australia and surrounding areas.
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.

Executive Summary

This Flood Impact and Risk Assessment (FIRA) has been prepared to inform the Review of Environmental Factors (REF) for the proposed rebuild of Richmond River High Campus (RRHC). The REF supports the approval process for the RRHC development in accordance with Section 68 of the NSW Reconstruction Authority Act 2022.

Lismore is one of Australia's most flood-prone urban areas due to its location at the confluence of the Wilsons River and Leycester Creek. Flood behaviour in this region is influenced by complex catchment conditions, rainfall distribution, and the presence of hydraulic controls such as levees, floodgates, and embankments. The proposed site is located near first-order creeks, making it susceptible to riverine and local catchment flooding. This report addresses these challenges by conducting comprehensive hydrological modelling and proposing targeted mitigation strategies.

Flood modelling was performed for events ranging from the 10% Annual Exceedance Probability (AEP) to the Probable Maximum Flood (PMF). The results demonstrate that the proposed development will not adversely impact surrounding properties during the 10%, 1%, 0.2% and PMF events. Hazard assessments have been conducted in accordance with the Australian Disaster Resilience Handbook Collection.

Mitigation measures incorporated into the design include a stormwater system, a diversion channel, retaining wall and longitudinal road drainage. These measures effectively address residual flooding to the west of the site by managing runoff and minimizing inundation risks. The proposed buildings are designed to a Finished Floor Level (FFL) of 17.45 m AHD, exceeding the required flood planning levels and aligning with the regional PMF level plus a 500 mm freeboard. To enhance resilience, flood-resistant materials will be used for structures below or at the flood planning level, with essential services such as air conditioning units and electrical switchboards elevated above this level. Permeable or collapsible fencing and design features to allow floodwater passage will also be incorporated.

The current Development Control Plan (DCP) for Lismore, published in 2012, and the draft Revised Flood Prone Lands DCP, published in 2023, were both reviewed for this study. Additionally, a new version of the DCP, titled *Revised Flood Prone Lands DCP - Post Exhibition [Clean]*, was provided to TTW for use in this assessment. This updated DCP is largely consistent with the 2023 draft version, with only minor differences. According to the guidance in this DCP, schools are categorized as commercial developments, and the site is classified within low flood risk precincts.

1.0 Introduction

This Flood Impact and Risk Assessment (FIRA) has been prepared to support a Review of Environmental Factors (REF) for the rebuild of Richmond River High Campus (the activity) (RRHC). The REF has been prepared to support an approval for the RRHC development under Section 68 of the NSW Reconstruction Authority Act 2022 (RA Act).

The purpose of this report is to address the flood related engineering design considerations of development site, alongside the relevant requirements of Lismore City Council's Development Control Plan (DCP).

1.1 Guidance documents

The following documents have been reviewed and referenced in preparing this report:

- Australian Institute of Disaster Resilience (AIDR) Guideline 7-3: Flood Hazard (2017)
- Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors) Australian Rainfall and Runoff: A Guide to Flood Estimation, © Commonwealth of Australia (Geoscience Australia), 2019. Book 6 – Flood Hydraulics, Chapter 6 - Blockage of Hydraulic Structures.
- Bureau of Meteorology (BoM) Service Level Specification for Flood Forecasting and Warning Services for New South Wales and the Australian Capital Territory – Version 3.13
- Considering Flooding in Land Use Planning Guideline DPE 2021
- CSIRO (2022) Characterisation of the 2022 floods in the Northern Rivers region, https://nema.gov.au/
- Department of Environment and Heritage – Flood Risk Management Guideline LU01, June 2023
- Department of Planning, Housing and Infrastructure – Planning Circular PS 24-001, Update on addressing flood risk in planning decisions, 1st March 2024
- Engeny Water Management (2021) Lismore Floodplain Risk Management Study – Report, https://flooddata.ses.nsw.gov.au/related-dataset/lismore-floodplain-risk-management-study-report
- Engeny Water Management (2023) Lismore Floodplain Risk Management Plan – Land Use Planning and Development Control, Draft Interim Report May 2023.
- FloodSafe guidelines and the relative FloodSafe Tool Kits
- Lismore City Council (2012) Lismore Development Control Plan – Part A. Chapter 8 Flood Prone Lands. https://lismore.nsw.gov.au/files/Part_A_Chapter_8_Flood_Prone_Lands_LEP_2012.pdf.
- Lismore City Council (2012) Local Environmental Plan (LEP) 2012: https://mapping.lismore.nsw.gov.au/intramaps99/?project=LismorePublic
- Lismore City Council (2014) Lismore Floodplain Risk Management Plan 2014, https://flooddata.ses.nsw.gov.au/flood-projects/lismore-floodplain-risk-management-plan
- Lismore City Council (2023) Draft Revised Flood Prone Lands DCP for exhibition, https://yoursay.lismore.nsw.gov.au/flood-planning
- NSW Department of Planning and Environment (2023) Flood Risk Management Manual https://www.environment.nsw.gov.au/topics/water/floodplains/floodplain-manual
- NSW Department of Planning and Environment Flood Risk Management Manual (2023)
- The Echo (2022) 'Rebuild of flooded school campus in North Lismore unlikely'. Available at: https://www.echo.net.au/2022/06/rebuild-of-flooded-school-campus-in-north-lismore-unlikely/

1.2 Consultation and Engagement

A risk workshop was conducted on December 18, 2024, to assess the flood risks associated with this project. The workshop brought together a wide range of experts and stakeholders from various organizations, including, but not limited to, the Department of Education (DoE), the Department of Planning, Housing and Infrastructure (DPHI), and the Department of Climate Change, Energy, the Environment and Water (DCCEEW). This collaborative approach ensured that the flood risks were evaluated from multiple perspectives, incorporating technical expertise, environmental considerations, and community impact.

During the workshop, risks were systematically identified and categorized into specific groups, such as evacuation, environmental, structural, climate change, evacuation procedures, social impact, and community-related concerns, with additional focus on warning systems, infrastructure resilience, and the capacity for safe evacuation in flood-prone areas. The discussions emphasized the importance of pre-emptive action and collaborative planning to effectively mitigate flood-related risks, with experts sharing practical solutions, including structural reinforcements, improved evacuation protocols, and measures to enhance community preparedness.

Once identified, the risks were further assessed based on their potential impact and likelihood of occurrence, and they were classified into three distinct levels: High, Medium, and Low. High risks were prioritized for immediate attention, with an emphasis on implementing mitigation strategies to reduce their potential consequences. Medium and low risks were also addressed, with appropriate control measures planned to ensure the safety and functionality of the project during flood events.

The workshop emphasized the importance of pre-emptive action and collaborative planning to mitigate flood-related risks effectively. Experts shared insights on practical solutions, including structural reinforcements, improved evacuation protocols, and measures to enhance community preparedness.

The complete list of identified risks, along with detailed control measures and recommendations for mitigation, is provided in Appendix A-Part A for further reference and action.

Furthermore, a meeting was held on 26 February 2024 with Council, DPHI, and SES. The purpose of the meeting was to discuss the findings of the Department of Education's (DOE) due diligence for the proposed redevelopment of RRHC. Key considerations included flood modelling, evacuation strategies, and the integrity of the site's structural and service systems.

The meeting's primary purpose was to review these findings before submitting a request for SEARs to the Department of Planning, Industry and Environment (DPIE). However, due to planning approval pathway reforms introduced in late 2024, this project will no longer be assessed as a State Significant Development Application (SSDA) and is now subject to assessment and determination by the NSW Reconstruction Authority. The objective of the meeting was to identify any additional due diligence requirements—particularly related to flood safety and other planning considerations—to ensure the project proceeds with all necessary assessments and approvals in place. The meeting minutes are provided in Appendix A-Part B.

1.3 Proposed Activity Description

The proposed activity comprises the relocation and rebuilds of the Richmond River High Campus from its existing temporary location alongside The Rivers Secondary College Lismore High Campus at East Lismore to the proposed site at 163 and 170 Alexandra Parade, North Lismore.

The school proposal will be delivered in one stage. A detailed description of the proposal is as follows:

1. Demolition of existing features including existing buildings, cattle drinking well, cattle sheds, and wire fencing, and removal of 19 trees to accommodate school development.
2. Construction of a new 3 storey building on the northeastern portion of the site for the proposed public secondary school including:

   a. General and Specialist Learning Spaces and Workshops
   b. Administration and Staff facilities,
   c. Library, Hall and Movement Studio
   d. Construction, Hospitality and Agricultural Learning Facilities
   e. Amenity, Plant, Circulation and Storage areas
   f. Outdoor Learning Spaces and play spaces

3. Landscaping and public domain works, including tree planting and boundary treatments.
4. Public domain works comprising:
   - Access road off Dunoon Road, comprising a separate shared bicycle/pedestrian pathway, and internal access roundabout.
   - Kiss and ride drop-off and pick up zones.
   - Bus transport arrangements with a separate bus zone.
5. Outdoor spaces including assembly zones, agricultural spaces, sports fields, games courts, dancing circles, yarning and dancing circles, seating and shade structures.
6. On-site carparking, including accessible spaces and provision for EV charging spaces.

Figures 2 below show the scope of works.

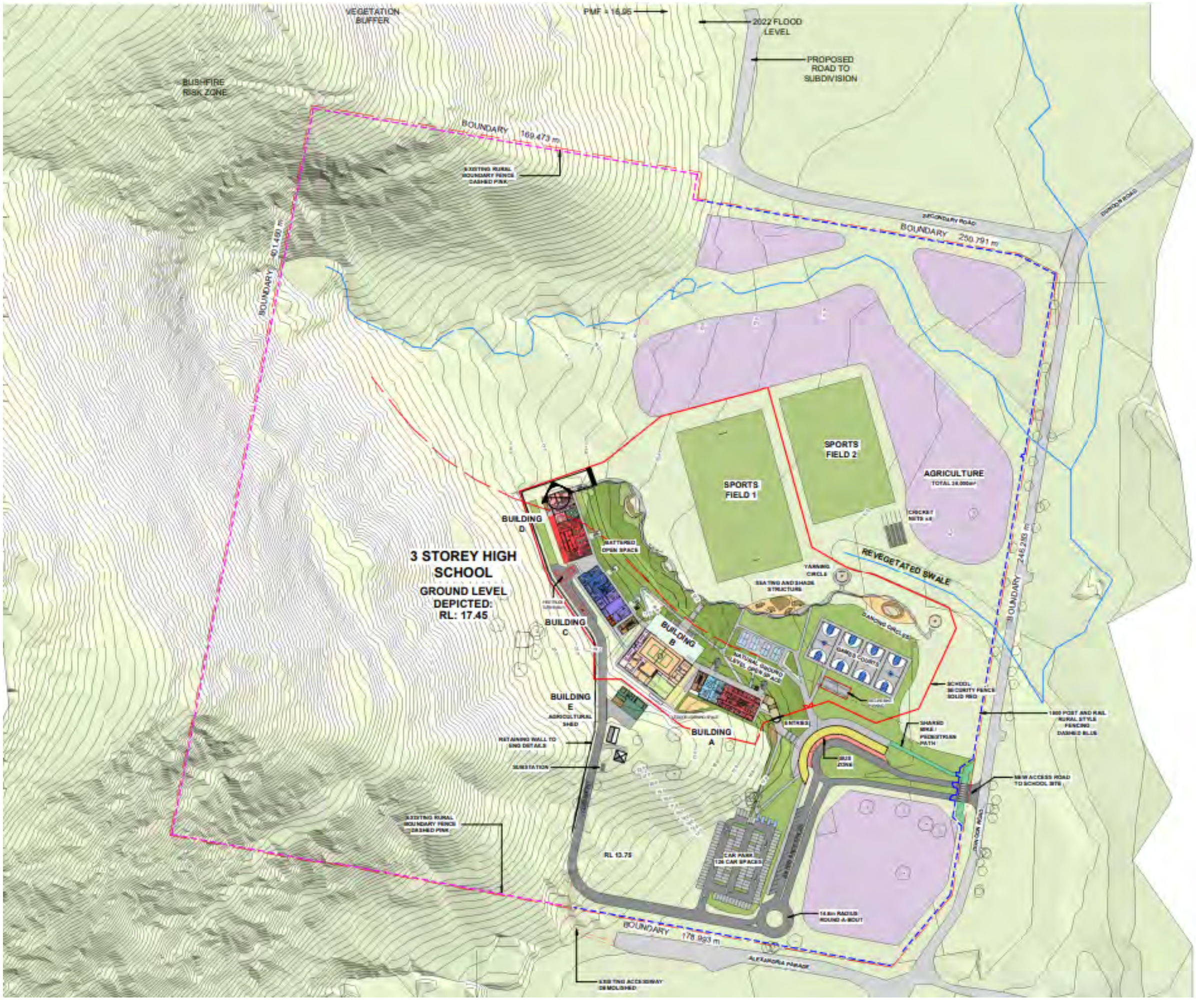


Figure 1: Proposed Ground Floor Layout – Option 6 (Source: obtained from EJE Architecture)

2.0 Site Information

2.1 Site Description

The site is located at Dunoon Road, North Lismore, also known as 163 and 170 Alexandra Parade, North Lismore. The site comprises of three separates lots located to the north of Alexandra Parade, with Dunoon Road running parallel to the eastern boundary of the site.

The site is legally described as:

- Lot 1 DP 539012
- Lot 2 DP 539012
- Lot 1 DP 376007

The site area is approximately 33.53 hectares. The proposed activity will be undertaken mainly within the southeastern portion of the site. The site is outlined in Figure 2.

Figure 2: Aerial image of site (Source: Nearmap)

The site is located at a transition between undulating topography associated with the North Lismore Plateau, comprising rolling hills generally sloping at approximately 5° to 15°, and the relatively flat land around Wilsons River and Leycester Creek to the south and south-east. The site itself is located on the southeastern flank of the North Lismore Plateau, with ground surface varying between a high of 50 m AHD in the northwest, and a low of 13 m AHD in the southeast. The elevation of the site and surrounding area is shown in Figure 3.

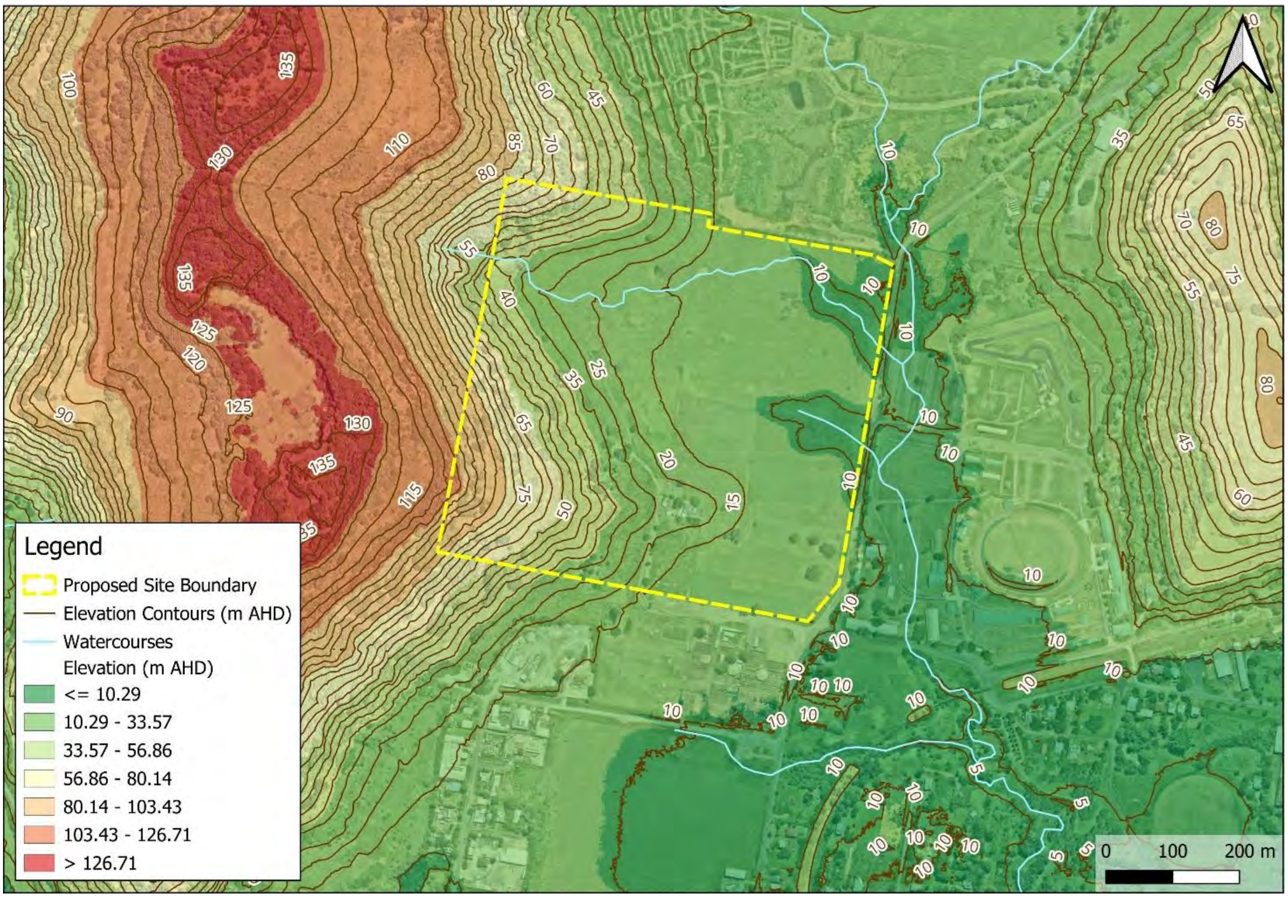


Figure 3: Elevation of the proposed RRHC site and surrounding area

2.2 Catchment Information

Lismore stands as one of the most flood-prone urban areas in Australia, characterised by a lengthy history of destructive floods due to its geographical location at the junction of two major streams: Leycester Creek and Wilsons River. The catchment above Lismore is intricate, with flooding outcomes influenced by various factors such as catchment conditions, rainfall distribution, and rainfall intensity. The Wilsons River and Leycester Creek, fed by numerous major creeks, converge in the vicinity of Lismore. Major flooding events can arise from increased water levels in either the Wilsons River or Leycester Creek. Significant flooding may also occur when both watercourses experience flooding simultaneously.

There are several significant hydraulic controls within the Lismore floodplain, including the South Lismore Levee, CBD Levee, Gasworks Creek floodgates, Hollingworth Creek floodgates, Bruxner Highway, and the railway embankment. Some of these hydraulic controls are shown in Figure 4. North Lismore is a low flood island that is not protected by any of these hydraulic controls, which are situated in South and Central Lismore.

Figure 4: Hydraulic controls in the vicinity of the site

2.3 Flood Sources and Behaviour

2.3.1 Regional Flooding – Wilsons River and Leycester Creek

The proposed relocation site is susceptible to both local and regional riverine flooding. Major flooding at the site can arise from increased water levels in either the Wilsons River or Leycester Creek. The primary flood control in North Lismore is the Wilsons River. The Wilsons River Rowing Club Gauge (Station Number 058176) is the guide for riverine flood levels that impact North Lismore. The gauge first became operational in 1917. The Bureau of Meteorology have defined the minor, moderate and major flood levels at the gauge as 4.2m, 7.2m and 9.7m, respectively.

Dominant flows in the Wilsons River can result in fast rates of rise in North Lismore, with initial flood effects occurring when levels are as low as 4.3 metres AHD at the Rowing Club gauge (NSW SES, 2018). This water then backs up in close proximity to the site. Figure 5 illustrates the catchments, watercourses and typical flow paths around the proposed site location, sourced from a Wilsons River and Leycester Creek flood.

2.3.2 Local Catchment Flooding

As depicted in Figure 5, a first order creek runs through the proposed relocation site, draining into Slater Creek, a tributary of the Wilsons River. Figure 6 presents the two local catchments contributing to overland flows across the site before draining into the creeks to the east. Given the proposed development's proximity to these first-order watercourses, it is susceptible to inundation during local catchment flooding.

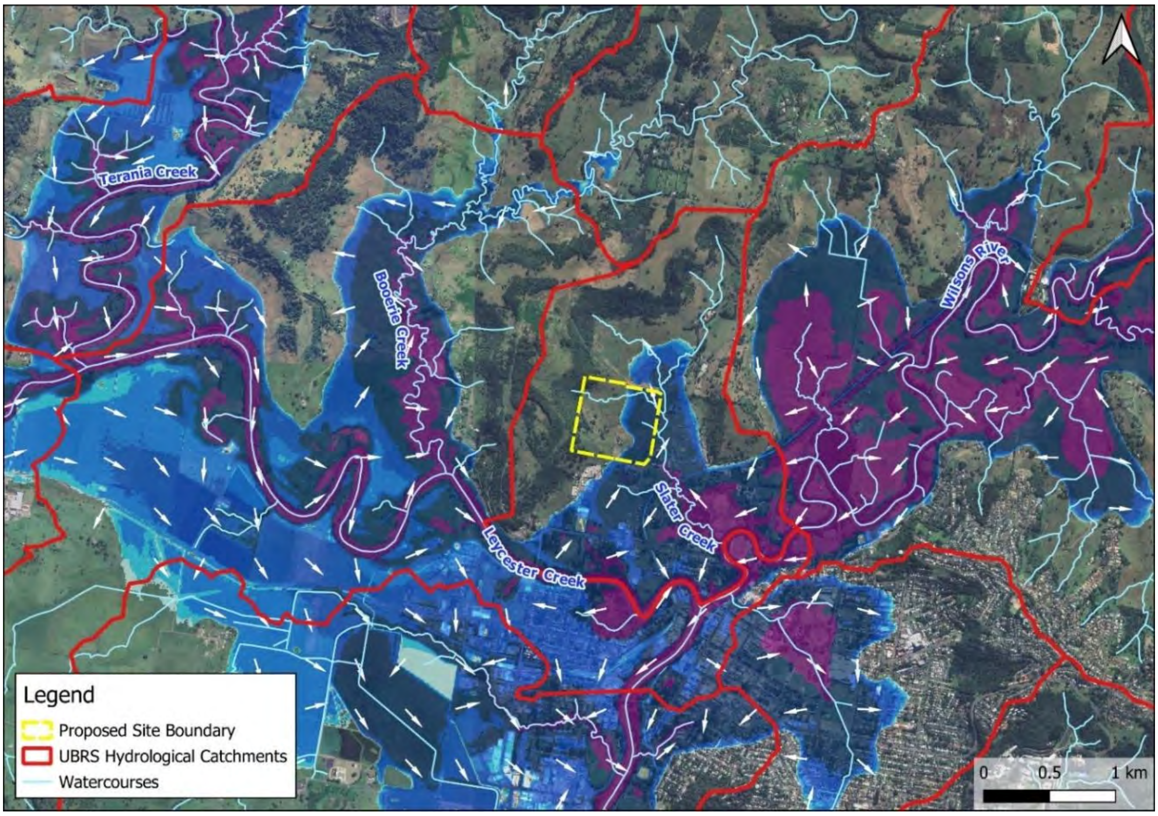


Figure 5: Hydrological catchments and watercourses around the site in the 1% AEP event under existing conditions

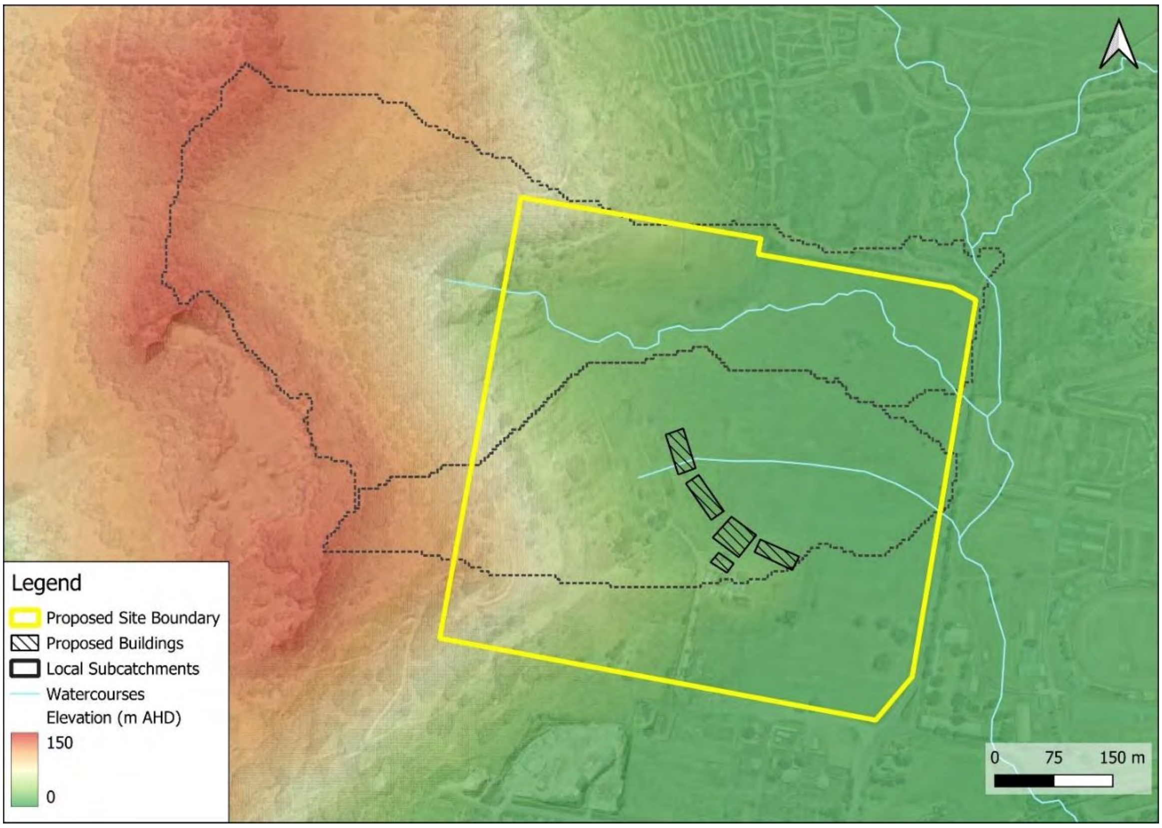


Figure 6: Local catchments contributing to overland flow across the site area towards the first order creeks

The Rous County Council Lismore Floodplain Management study analyses river and creek flood behaviour only, and does not consider the impact of overland flows and local catchment flooding.

Conducting a local catchment flood study that includes an assessment of overland flows across these catchments is crucial to determine flood characteristics across the site. This information would assist in evaluating the suitability of current site plans in terms of the placement of buildings, car parks, and playing fields, ultimately assisting in the effective mitigation of flood risks. This gap in the currently available flood information is addressed by TTW's updated modelling in this report.

2.4 Historical Floods

The most severe recorded flood in Lismore occurred on February 28, 2022, with the flood level at the Rowing Club Gauge on the Wilsons River peaking at 14.4m AHD. Prior to this event, the record stood at 12.11m AHD, a height reached during floods in February 1954 and March 1974. Additionally, the flood in March 2017 reached a level of 11.6 m AHD.

Lismore has experienced intense rainfall throughout the last century. Figure 7 shows the flood height for events higher than 6.0m AHD from 1870 to 2022. These values are based on measurements from the Lismore Rowing Club gauge, and flood height will vary across the flood plain.

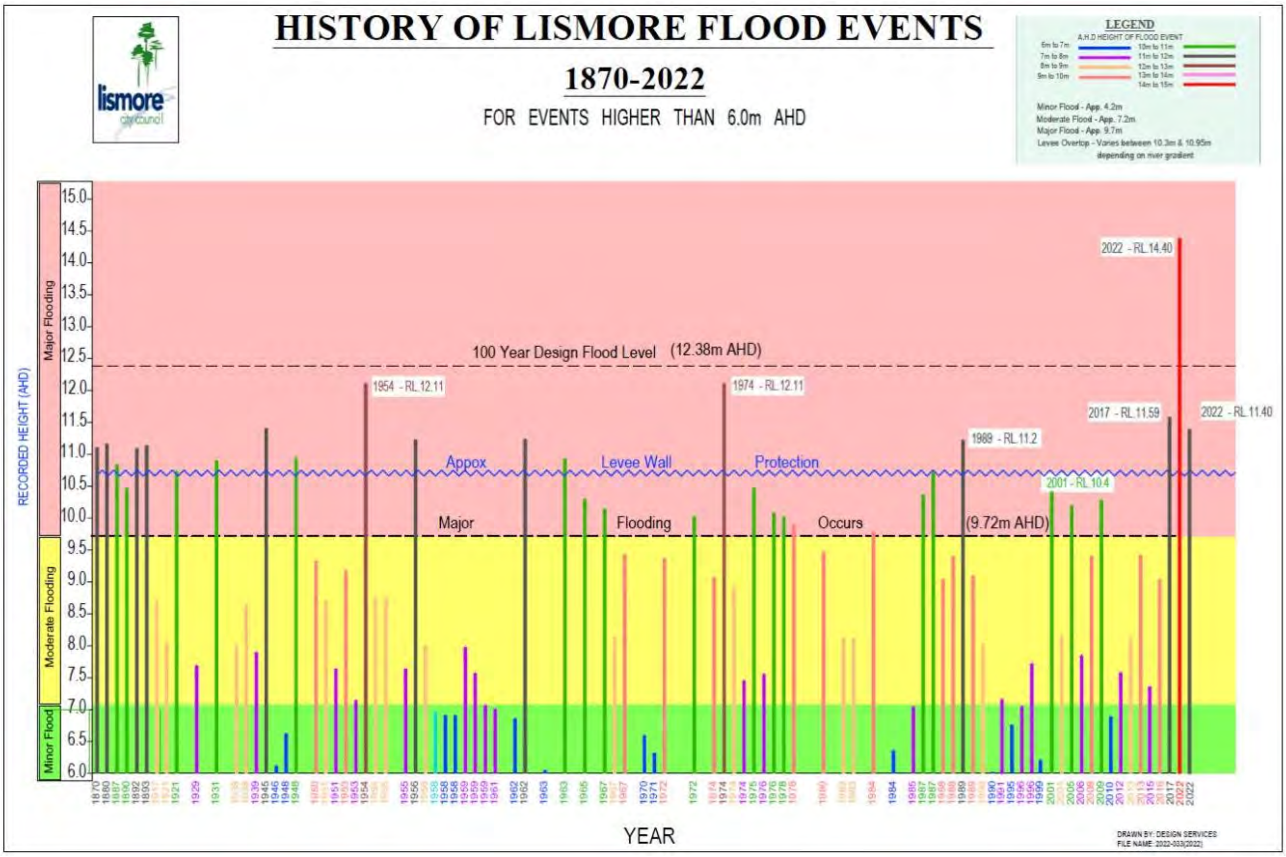


Figure 7: History of Lismore flood events, taken from the Rowing Club Gauge

3.0 Hydraulic Model Setup

3.1 Lismore Floodplain Risk Management Study (2021)

TTW obtained Rous County Council's TUFLOW model files for the Lismore Floodplain Risk Management Study, developed by Engeny. This represents the most comprehensive model available for Lismore at the time of writing. A UBRS (Unified River Basin Simulator) hydrological model was created to generate hydrological input for the TUFLOW and was calibrated using historical events in 2017, 2013, 2012, and 1989 and later utilised for design event modelling. Both models are based on Australian Rainfall and Runoff 2019 (ARR2019).

The general Council TUFLOW model configurations are as follows:

1. 10m cell size
2. TUFLOW release 2018-03-AD_iSP_GPU
3. Council's URBS hydrographs were used as input to the model for the 10% AEP, 5% AEP, 1% AEP, 1% AEP + climate change, and 0.2% AEP events, alongside the Probable Maximum Flood (PMF).

3.2 2D Model Domain

To complete a full assessment of flood impacts from both local and regional sources, TTW completed model runs covering the entirety of the Rous County Council's TUFLOW model extent, an area of approximately 130 km^2, representing the full extent of flood prone land in Lismore LGA (sourced from Wilsons River and Leycester Creek flooding). The output from these regional-scale model runs then provided input data for a smaller, local catchment flood model produced by TTW, enabling analysis of the maximum flood risk from both flood sources. Figure 8 presents the extent of Council's TUFLOW model boundary, which was utilised to assess regional-scale flood impacts from the Wilsons River and Leycester Creek.

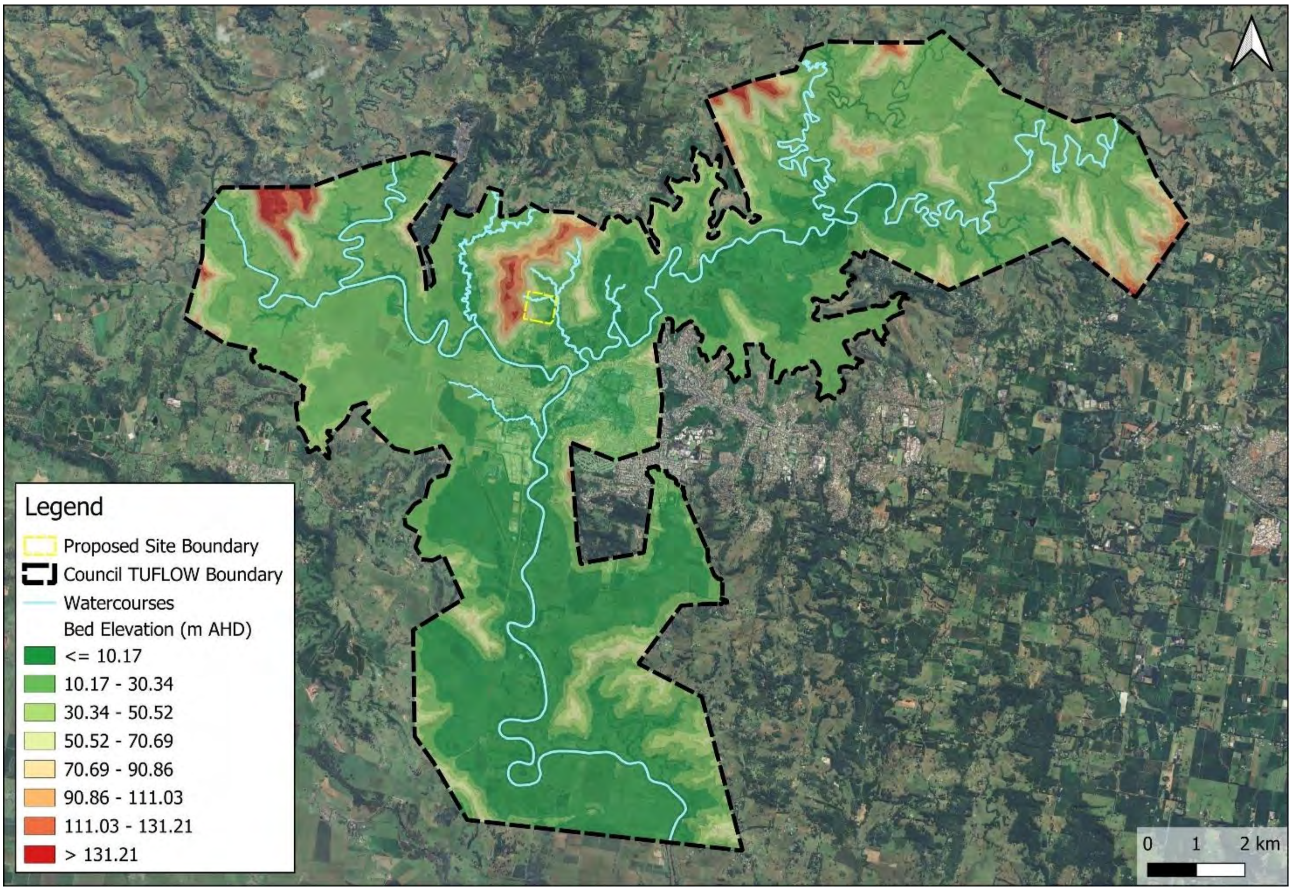


Figure 8: Regional flood model TUFLOW model extent in relation to the proposed RRHC site

Figure 9 presents TTW's local catchment TUFLOW model extent. The model extent is based on the two upstream catchments contributing to local overland flows across the site, shown in Section 2.3.2 investigate the combined "worst-case" impact from both local flooding and regional riverine flooding, initial conditions were applied along the downstream boundary shown in Figure 9, with flood level information taken from the results of the critical duration regional-scale model runs. These initial conditions are discussed in more detail in Section 3.4.

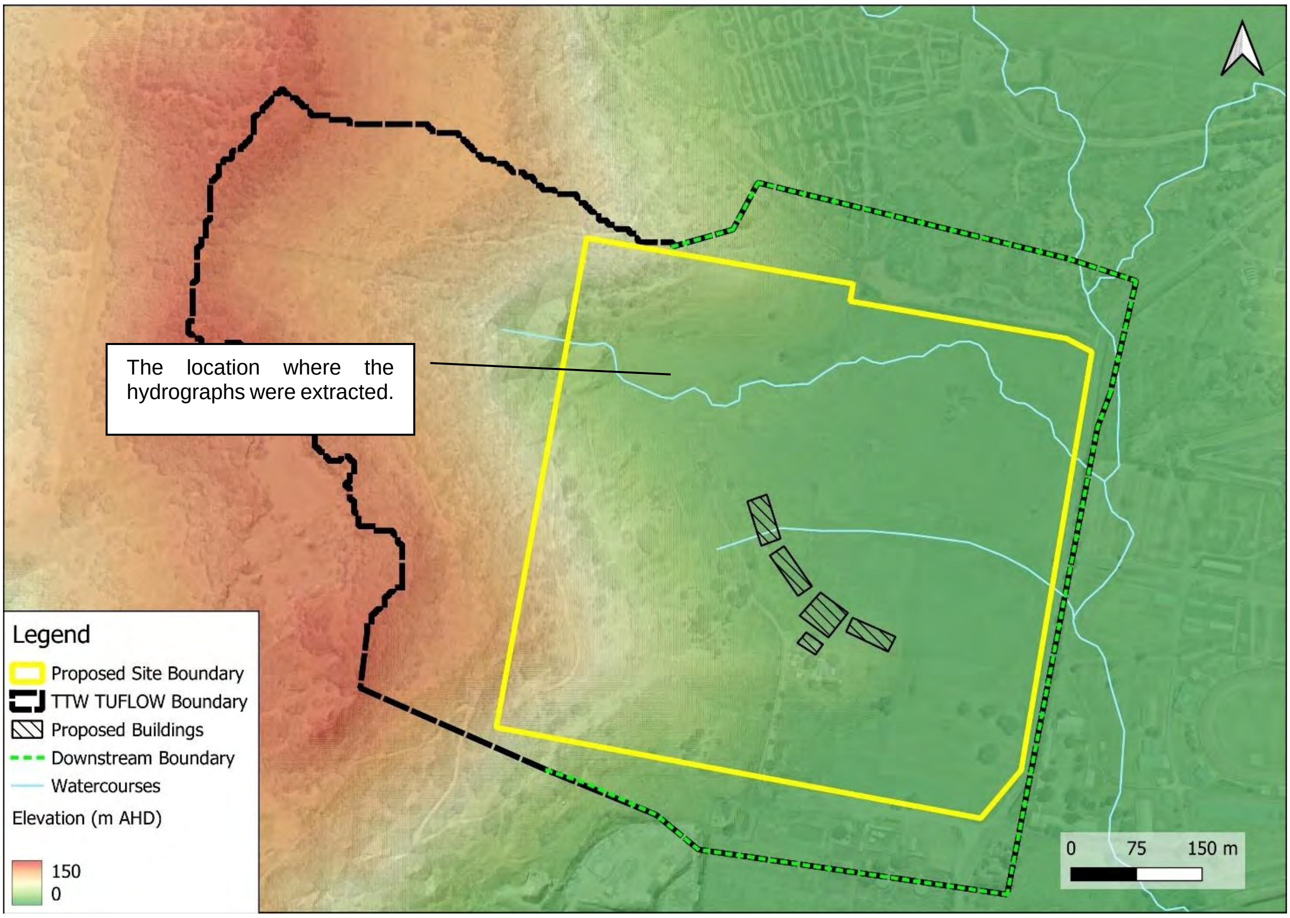


Figure 9: TTW's local catchment flood model extent, which is fed in part by the regional-scale model outputs

This model uses a rainfall-on-grid (ROG) methodology, in which rainfall is applied to each cell in the 2D mesh. Hydrologic losses and runoff are therefore calculated for each cell and routed through downstream cells to evaluate flood depths and velocities. As the ROG method is typically associated with substantial shallow sheet flow, depths of less than 0.1m have been filtered out of PMF hydraulic model outputs, and depths of less than 0.05m have been filtered out of the remaining events.

An XP-RAFTS model has been specifically prepared for this study to simulate and calculate PMF conditions. the Generalised Short-Duration method (GSDM) is applied for the PMF calculation. The hydrographs upstream of the proposed culverts are analysed and compared against the rainfall-on-grid model, which represents the distribution and intensity of rainfall over the catchment area. The comparison, shown in Figure 10, highlights the variations in peak flow and time to peak between the two models. Notably, while the XP-RAFTS model and the TUFLOW model produce slightly different results in terms of peak flow and time to peak, the TUFLOW model demonstrates a more conservative estimate of the flood conditions, offering a higher margin of safety for flood impact assessment.

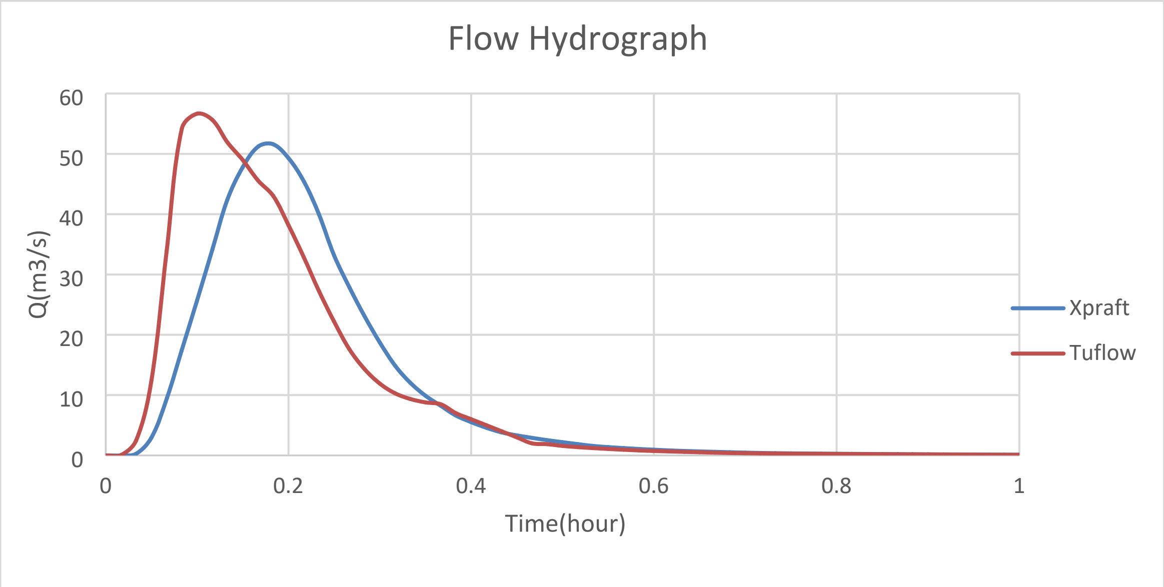


Figure 10: PMF 15 mins Flow Hydrograph at upstream of the school

3.3 Critical Durations

Table 1 outlines the rainfall durations and temporal patterns utilised in this analysis. The regional-scale model parameters are based on the information provided in the Rous County Council's Lismore Floodplain Risk Management Study report (2021). For the local catchment model, runs were completed for the 15-, 30-, 60-, 90-, 120-, 180-, and 360-minute storm durations in order to identify the critical duration for local flood impacts at the site.

Table 1: Critical rainfall and patterns used in the regional-scale model

	REGIONAL-SCALE MODEL		LOCAL CATCHMENT MODEL	
Event	**Critical Duration**	**Temporal Pattern**	**Critical Duration**	**Temporal Pattern**
10% AEP	48 hours	TP03	1 hour	TP08
5% AEP	48 hours	TP04	1 hour	TP08
1% AEP	24 hours	TP08	1 hour	TP08
0.2% AEP	36 hours	TP10	1 hour	TP08
PMF	36 hours	N/A	15 minutes	N/A

3.4 Initial Conditions

A constant downstream water level was applied within the local catchment model that corresponds to the flood level in each modelled event in the regional-scale outputs. Table 2 summaries the constant water levels applied in each event. It should be noted that this is a conservative method, as it is unlikely that the 1-hour local storm would occur and peak at the same time as the 24-hour regional storm.

Table 2: Constant water levels applied within the site in each event, taken from the regional-scale model outputs

Event	Constant Water Level (m AHD)
10% AEP	11.43
5% AEP	12.02
1% AEP	12.841
1% AEP + Climate Change	13.38
0.2% AEP	13.35
February 2022	14.61
PMF	16.95

It should be noted that there are two culverts located on Dunoon Road. The inverts of these culverts, approximately 8.39m AHD and 7.83m AHD, indicate that they are frequently inundated, even during events with a 10% AEP frequency. The locations of these culverts are shown in Figure 11.

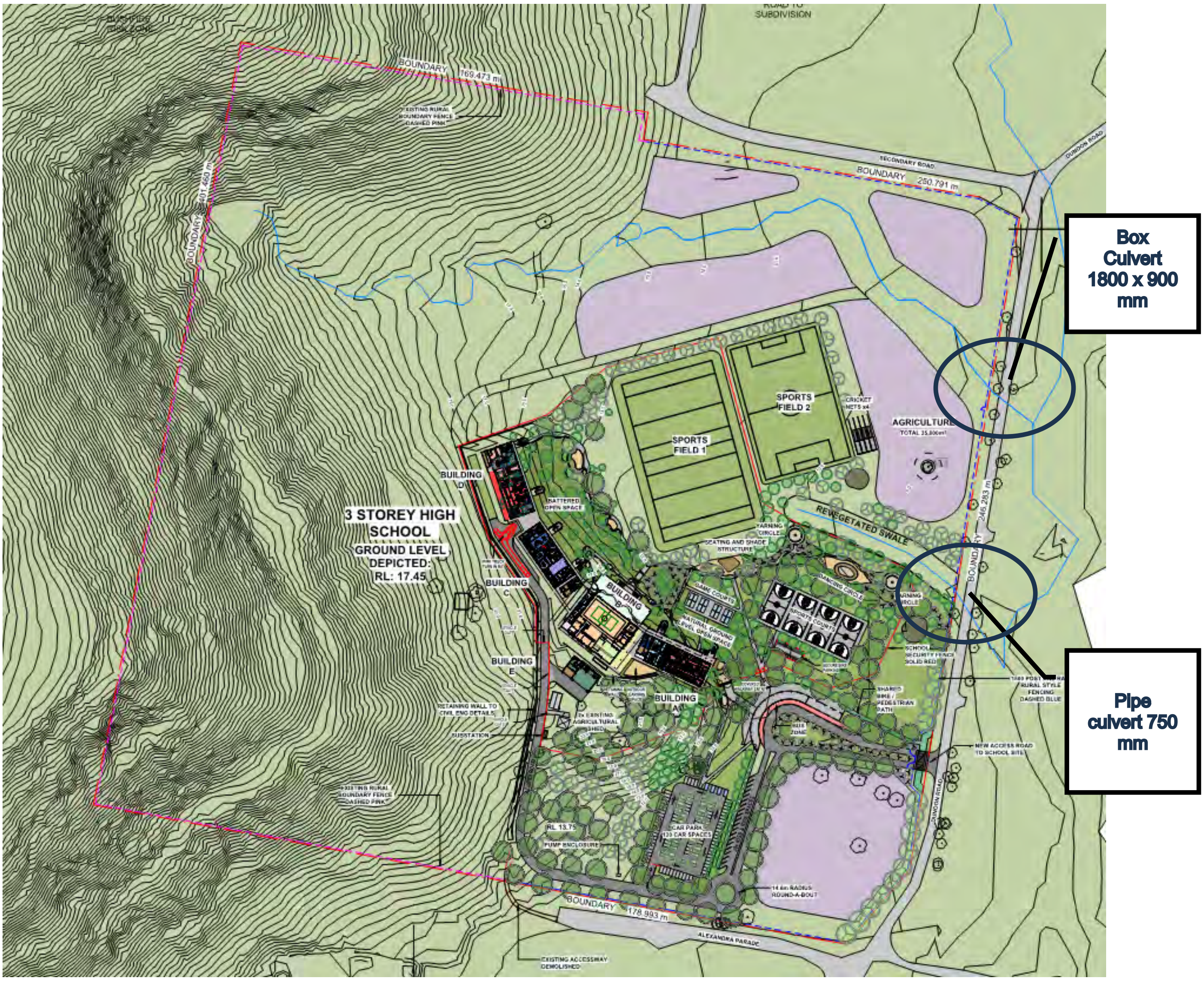


Figure 11- Location of Two Exiting Culverts

3.5 Site Survey

For the existing (pre-development) scenario, both the regional-scale and local catchment models were updated to incorporate new site survey information at a finer spatial resolution. The survey was conducted in February 2024 by RPS Group. The site survey information is shown in Figure 12. A design triangulated irregular network (TIN) has also been prepared for the proposed development and included in the post-development models, depicted in Figure 13.

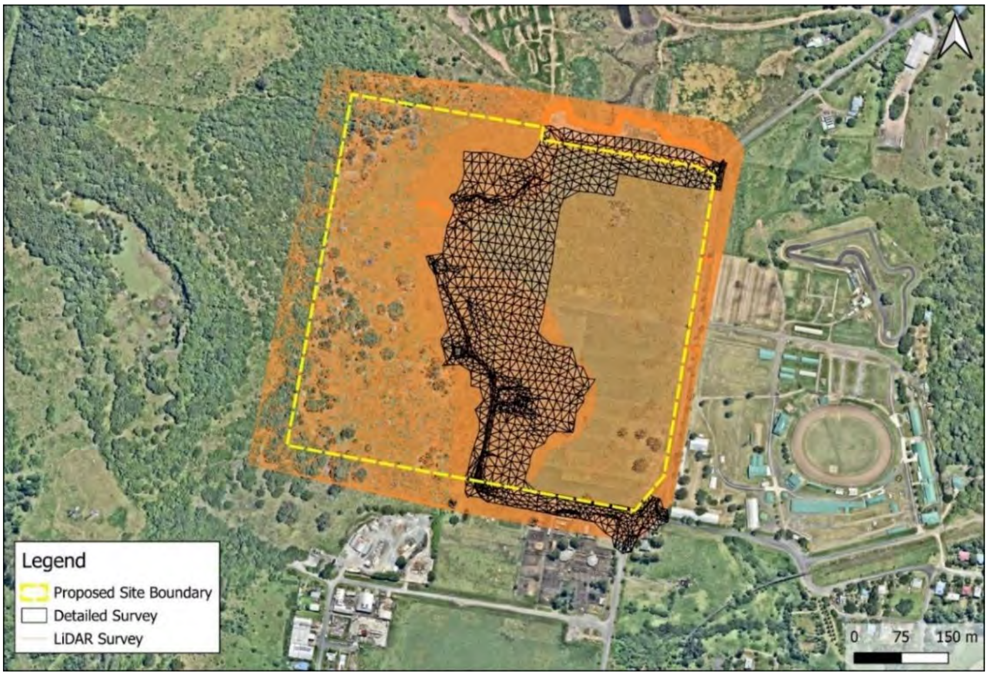


Figure 12: Detailed site survey information for the proposed relocation site – existing conditions

Figure 13: Design TIN used for the post-development model

3.6 Building Representation

The Lismore Floodplain Risk Management Study model represents buildings via an increase in hydraulic roughness (or Manning's 'n' values) within the model. Individual buildings were not represented in the roughness map, but urban areas were assigned a roughness value of 1.0, representing increased energy dissipation of water flowing through and around structures.

In the post-development model, TTW adopted an alternative approach for the proposed buildings, raising the building footprint elevation to create an obstruction to flow, preventing water from passing through the buildings. Cells within the building footprint area were elevated to 21.05m AHD, representing the full height of the building. Figure 14 indicates how buildings were modelled.

Figure 14: Building representation in the post-development model

3.7 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 15, 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 3 outlines the threshold limits for each hazard category.

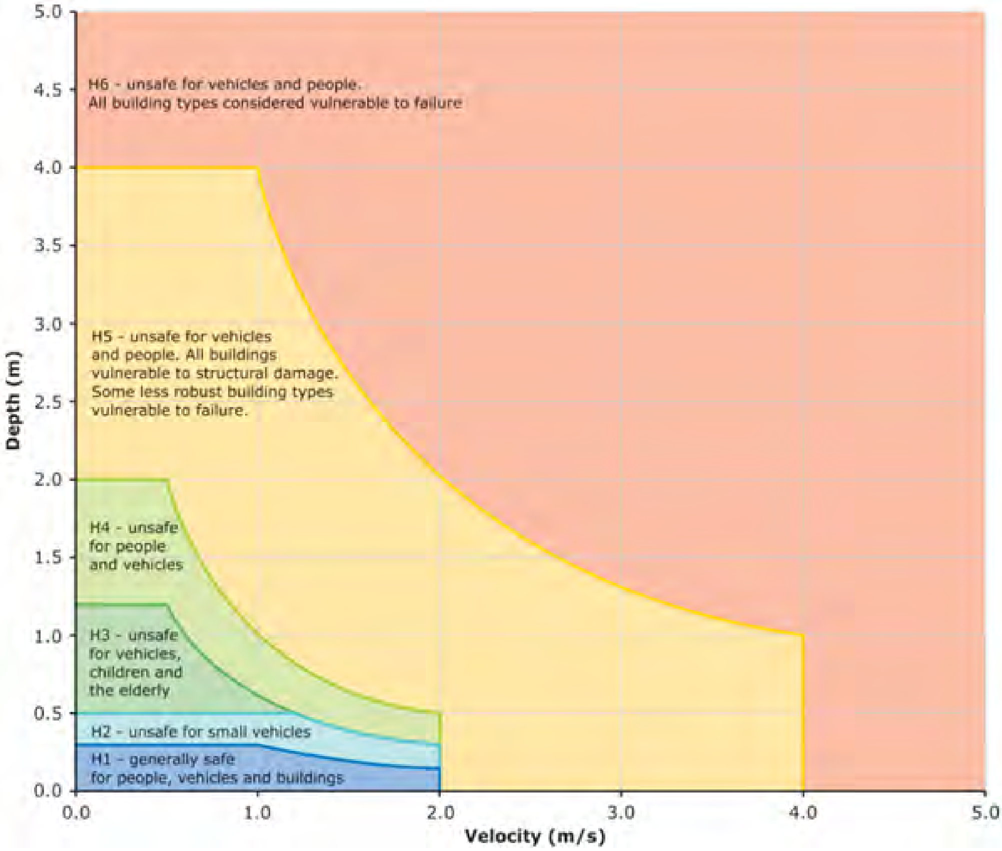


Figure 15: Flood hazard vulnerability curve (Source: Flood Risk Management Guide FB03 - Flood Hazard, NSW Department of Planning and Environment, 2022)

Table 3: Hazard vulnerability threshold limits

Hazard Classification	Description	Classification Limit (m2/s)	Limiting still water depth (D) (m)	Limiting velocity (V) (m/s)
H1	Generally safe for people, vehicles and buildings	D x V ≤ 0.3	0.3	2.0
H2	Unsafe for small vehicles	D x V ≤ 0.6	0.5	2.0
H3	Unsafe for vehicles, children and the elderly	D x V ≤ 0.6	1.2	2.0
H4	Unsafe for people and vehicles	D x V ≤ 1.0	2.0	2.0
H5	Unsafe for people and vehicles. All buildings vulnerable to structural damage.	D x V ≤ 4.0	4.0	4.0
H6	Unsafe for people and vehicles. All building types considered vulnerable to failure.	D x V > 4.0	–	–

4.0 Flood Model Results

4.1 Existing Flood Conditions

Figure 16, Figure 17 and Figure 18 illustrate the 1% AEP peak flood depths and levels, velocities and hazard categorisation under existing site conditions, respectively. PMF results are presented in Figure 19, Figure 20 and Figure 21. Flood depth and level, velocity and hazard maps for the 10% AEP, 5% AEP and 0.2% AEP events are attached in Appendix B. Assessment of flood model results indicates that flooding within North Lismore begins when the Wilsons River backs up into Slater Creek, inundating low-lying areas including McKenzie Park less than an hour after the onset of the 1% AEP storm.

In the 1% AEP event, results indicate that the maximum flood level within the site boundary varies from 39.93 m AHD at the northwest to 12.84m AHD to the east. Flood depths are highest to the east (derived from Wilsons River and Leycester Creek), reaching a maximum of 4.59m. Depths derived from the first-order creek reach a peak of 0.73m. Flood velocities in the 1% AEP are largely below 0.5 m/s to the east of the site, though velocities are higher in the first-order creek reaching between 2.0 – 3.0 m/s, peaking at 3.47 m/s at the western boundary of the site. In terms of hazard categorisation, most of the flows within both the first-order creek and the flooding to the east of the site are categorised as either H4 hazard (unsafe for people and vehicles) or H5 hazard (unsafe for people and vehicles, with all buildings vulnerable to structural damage). There is an area of H6 hazard at the eastern boundary, where depths reach almost 4.6m (unsafe for people and vehicles, all building types considered vulnerable to failure).

In the PMF event, flood extent across the site boundary has increased considerably. Maximum flood levels within the site boundary increase to 40.77m AHD at the northwest, and to 16.94m AHD to the east. Flood depths to the east reach a maximum of 8.68m, while depths in the first-order creek reach 1.22m. As in the 1% AEP event, flood velocities to the east are low at below 0.5 m/s. Much of the flooding onsite is categorised as H6, with the remainder mostly classified as H5.

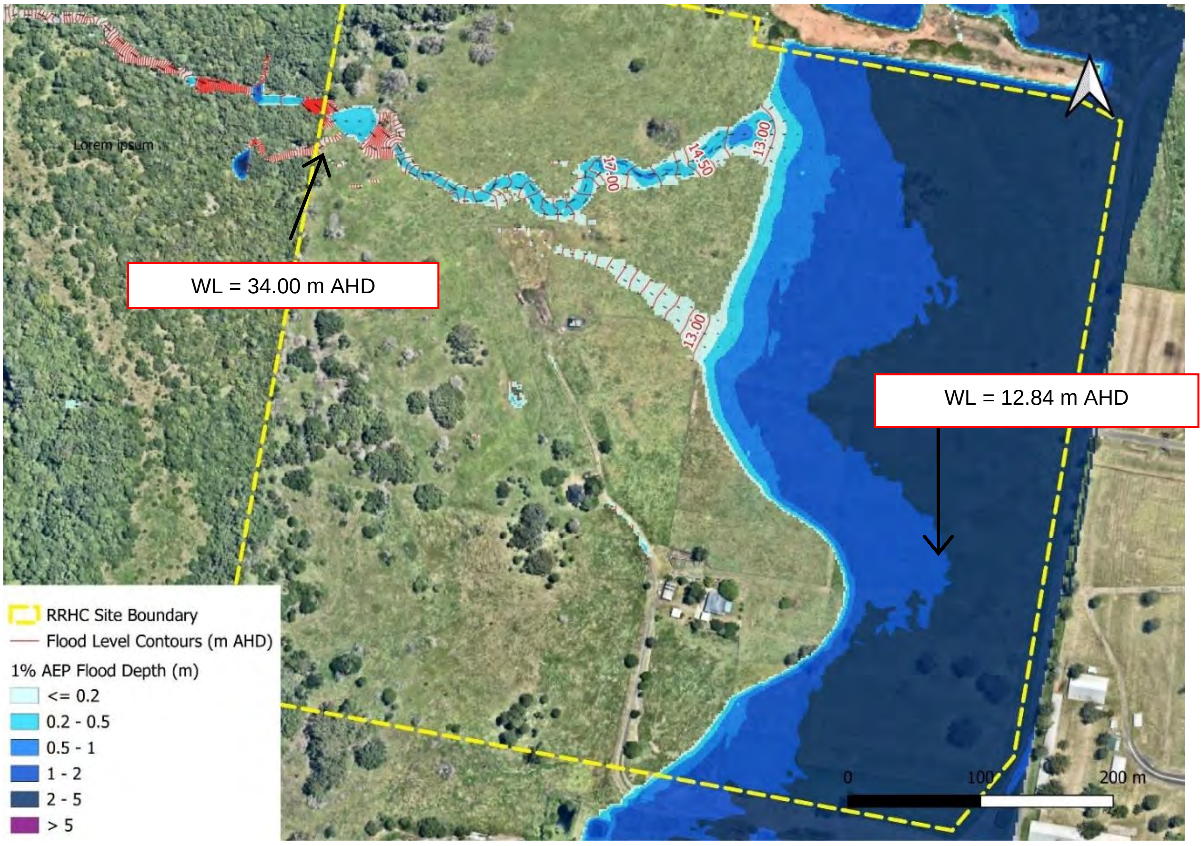


Figure 16: 1% AEP flood depths and levels at the proposed RRHC site under existing site conditions

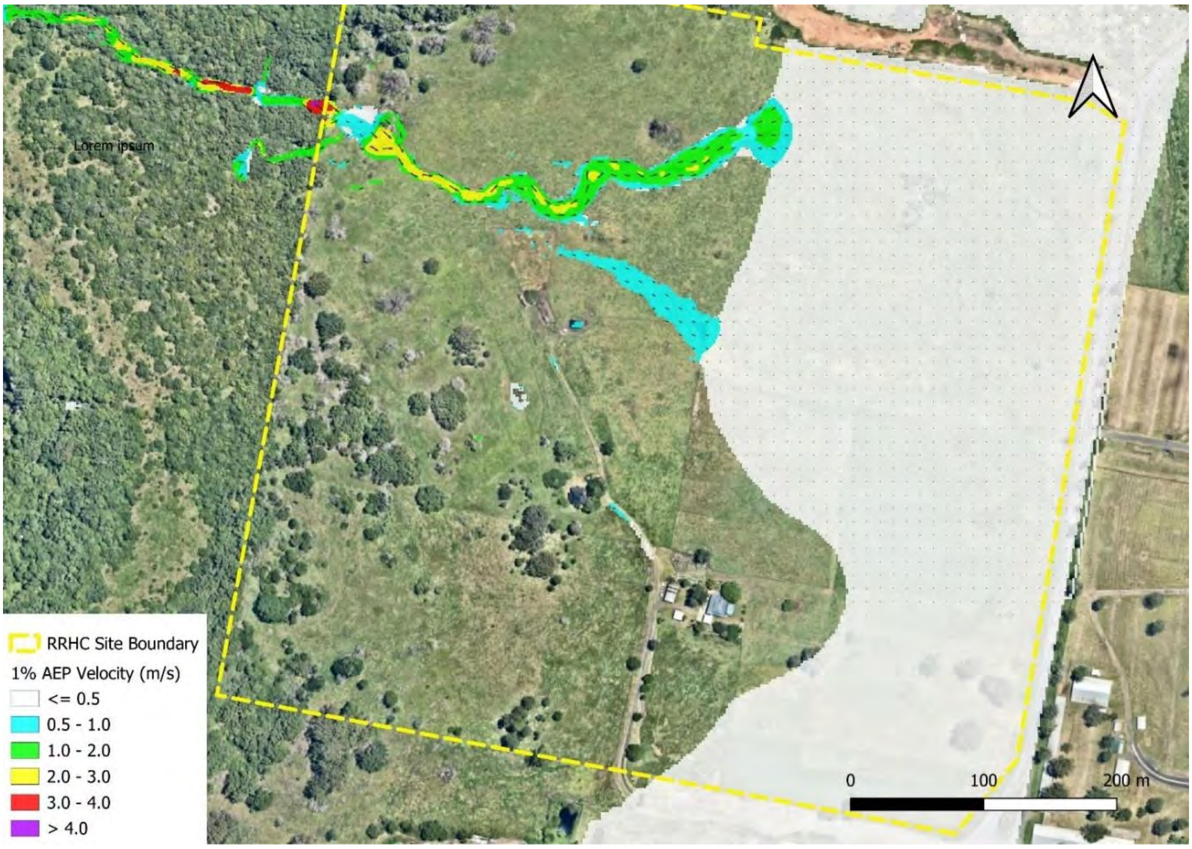


Figure 17: 1% AEP flood velocities at the proposed RRHC site under existing site conditions

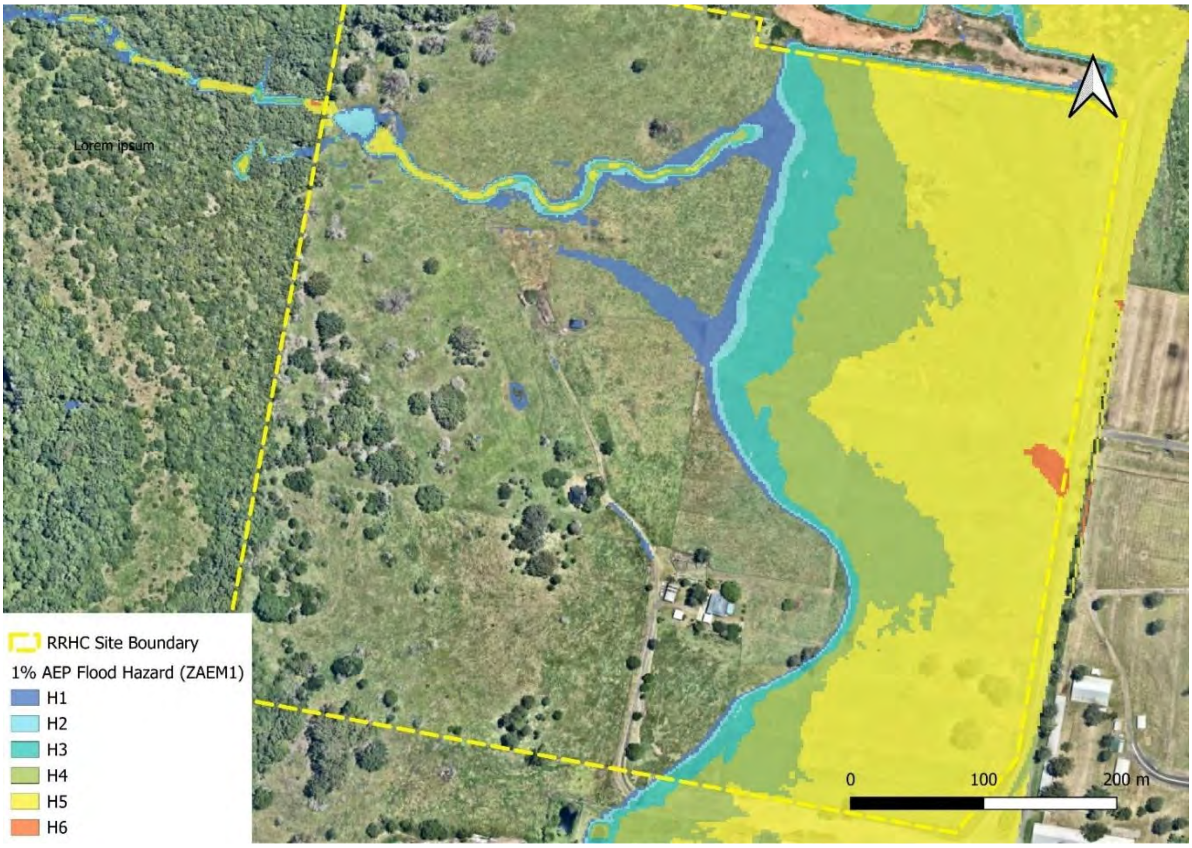


Figure 18: 1% AEP flood hazard categorisation at the proposed RRHC site under existing site conditions

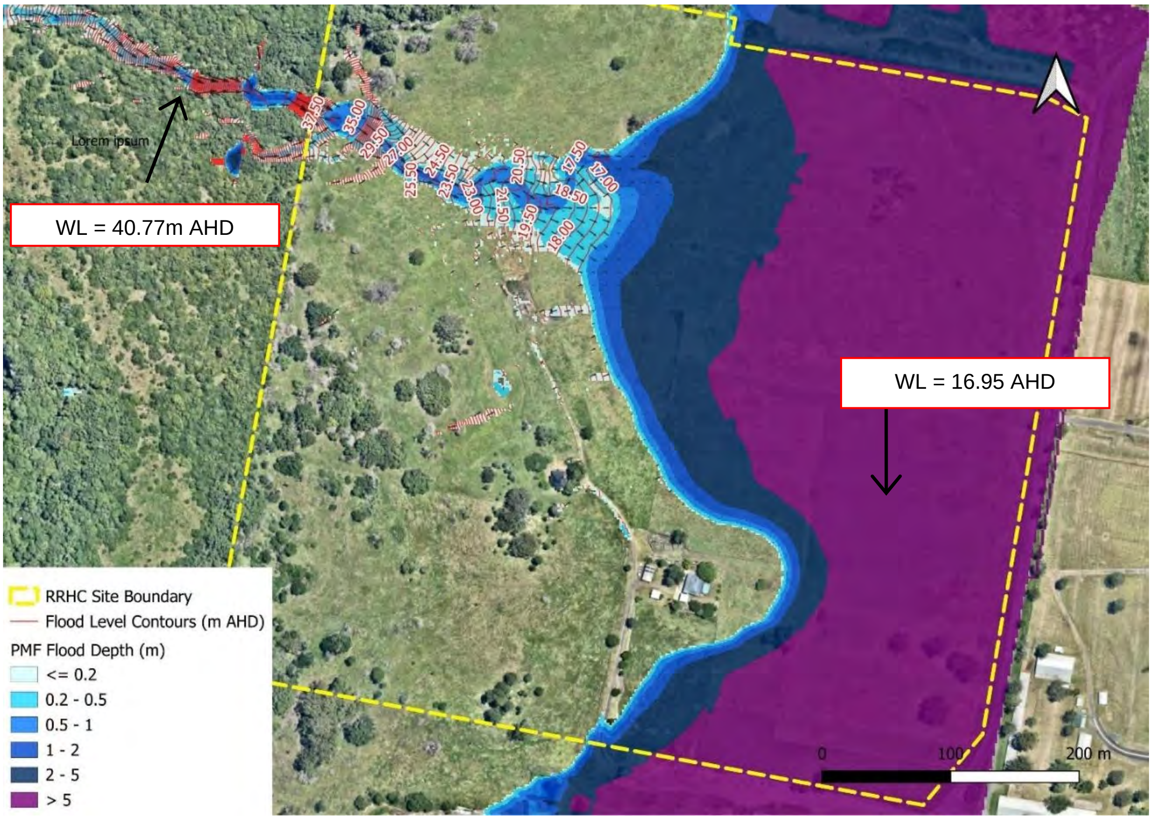


Figure 19: PMF depths and levels at the proposed RRHC site under existing site conditions

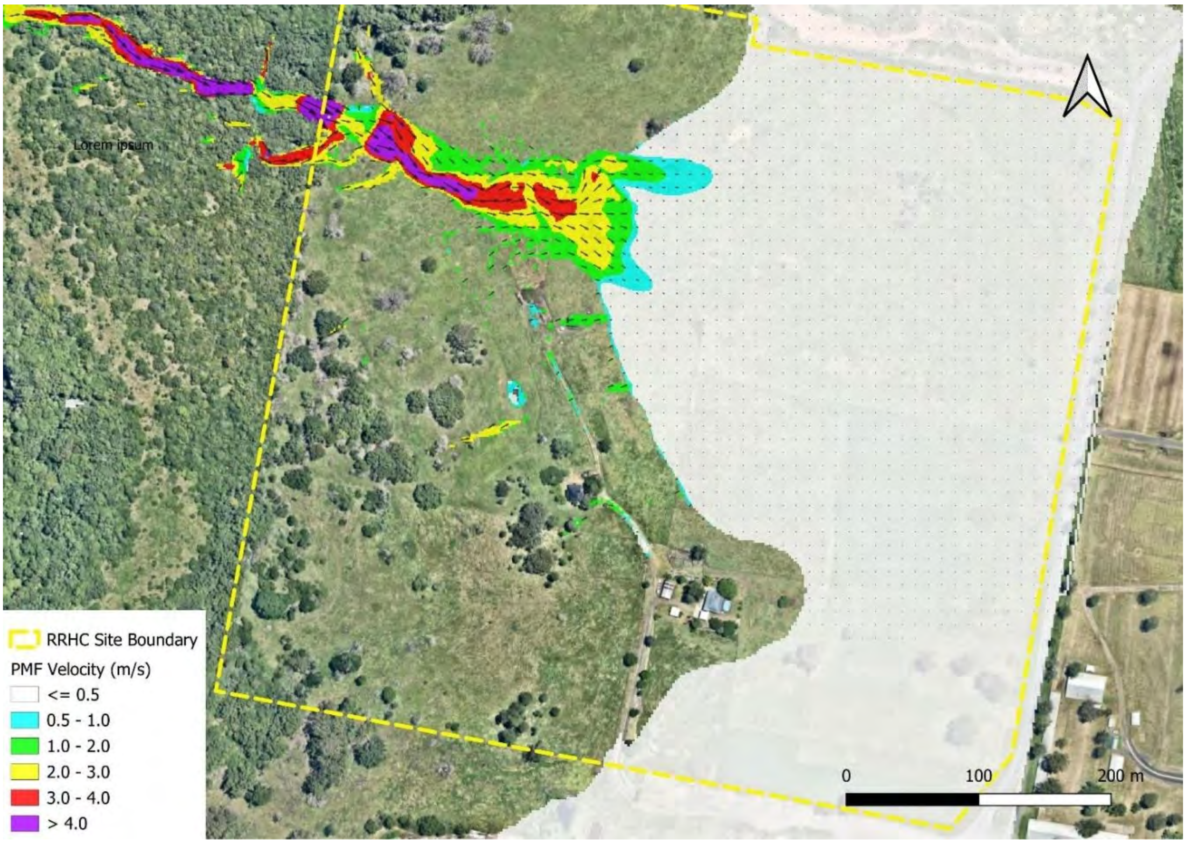


Figure 20: PMF velocities at the RRHC site under existing site conditions

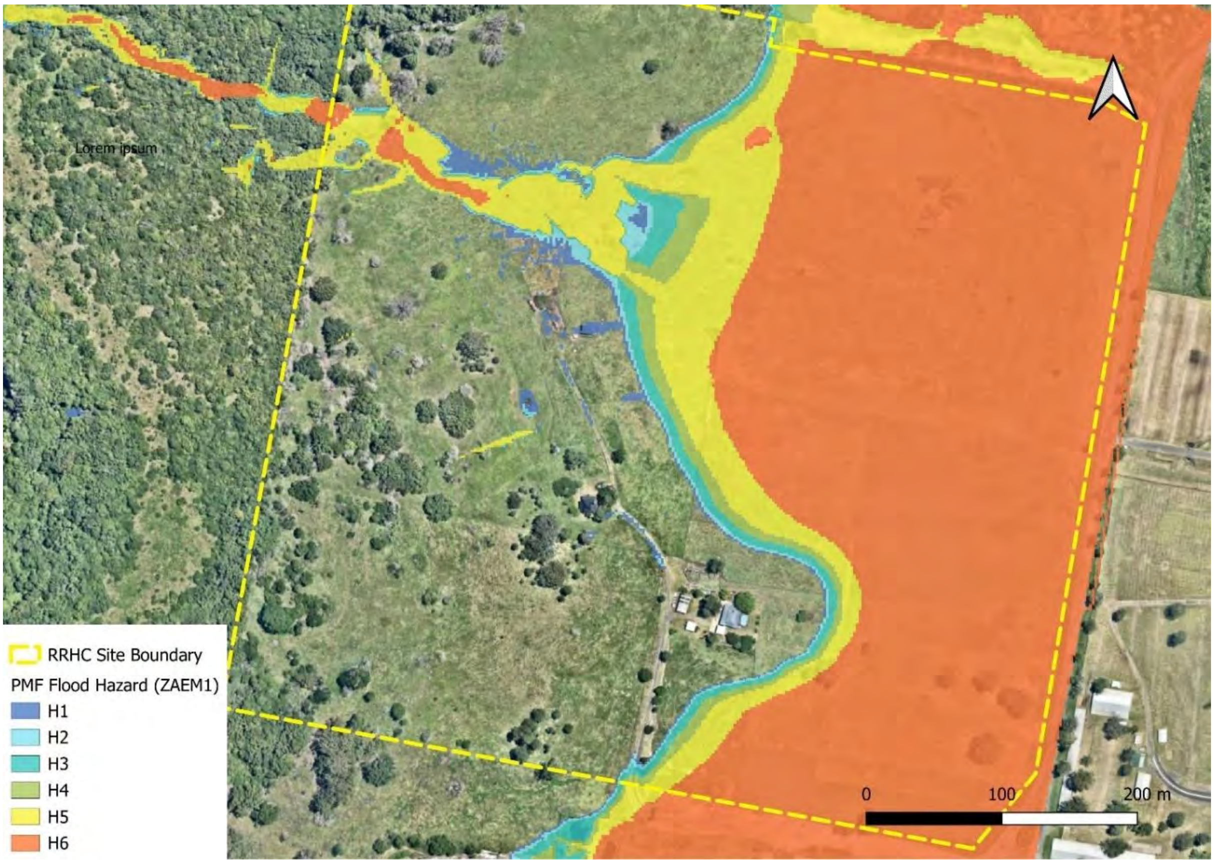


Figure 21: PMF hazard categorisation at the proposed RRHC site under existing site conditions

4.2 Post-Development Flood Conditions

The existing conditions flood model was updated to create a post-development flood model by incorporating the proposed buildings (based on the building footprints shown in the latest site plan in Figure 1), and the design surface levels (via the TIN shown in Figure 13). In addition, given the proposed development site's proximity to the minor overland flow, the design includes the implementation of several mitigation measures, including the following:

- A proposed stormwater system and retaining wall upstream of the proposed school buildings to manage potential flooding from small catchment located upstream of the proposed buildings.
- A diversion channel upstream of the proposed evacuation route to intercept flood from the upstream of the catchment.
- Longitudinal road drainage along the road
- It should be noted that the 1% AEP regional flood level, i.e., 12.841m AHD, is used as the tailwater condition for the proposed stormwater and longitudinal road drainage in all modelled scenarios.

Figure 22 provides an overview of these changes.

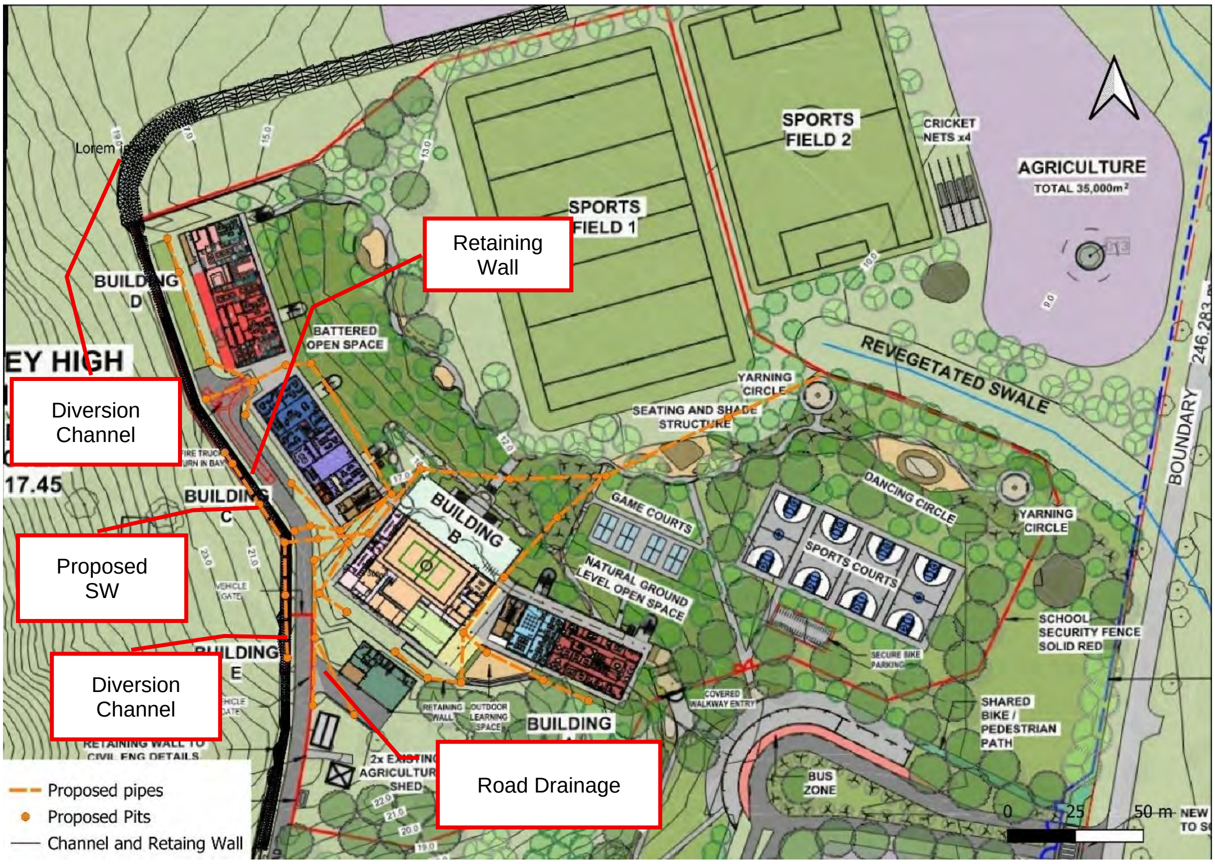


Figure 22: Proposed Mitigation Measure

Figure 23, Figure 24, and Figure 25 illustrate the 1% AEP peak flood depths and levels, velocities and hazard categorisation under post-development site conditions, respectively. PMF results are presented in Figure 26, Figure 27, and Figure 28. Flood depth and level, velocity and hazard maps for the 10% AEP, 5% AEP and 0.2% AEP events are attached in Appendix C.

In the 1% AEP event, results indicate that the maximum flood level within the site boundary varies from 39.73m AHD in the northwest to 12.84m AHD in the east. The flood modelling shows that the proposed buildings are not impacted by the 1% AEP storm event, and the proposed diversion channel and stormwater system divert the flow. The flood depths are highest to the east (derived from Wilsons River and Leycester Creek), reaching a maximum of 4.59m. As in the existing scenario, flood velocities in the post-development 1% AEP event are largely below 0.5 m/s to the east of the site. Velocities in the first-order creek reach between 2.0 – 3.0 m/s, peaking at 3.47 m/s at the western boundary of the site. Hazard categorisation in the post-development scenario is similar to that of the existing scenario, with most of the flows within both the first-order creek and the flooding to the east of the site are categorised as either H4 hazard or H5 hazard, including Dunoon Road.

In the PMF event, the flood extent across the site boundary has increased significantly, with the open space east of the proposed buildings submerged in floodwaters. Despite this, none of the proposed buildings are impacted by the PMF event resulting from the local catchment. The diversion channel, retaining wall, and proposed drainage system work effectively to divert floodwaters away from the proposed buildings, ensuring their safety during such extreme events.

Building A and Building B are affected by riverine flooding and are subject to inundation during a PMF event. However, as both buildings are constructed on piers, they are elevated above the PMF flood levels and are not directly impacted by floodwaters. This inundation is part of the broader riverine flood dynamics associated with the PMF event. Further details are provided in Section 5.1.

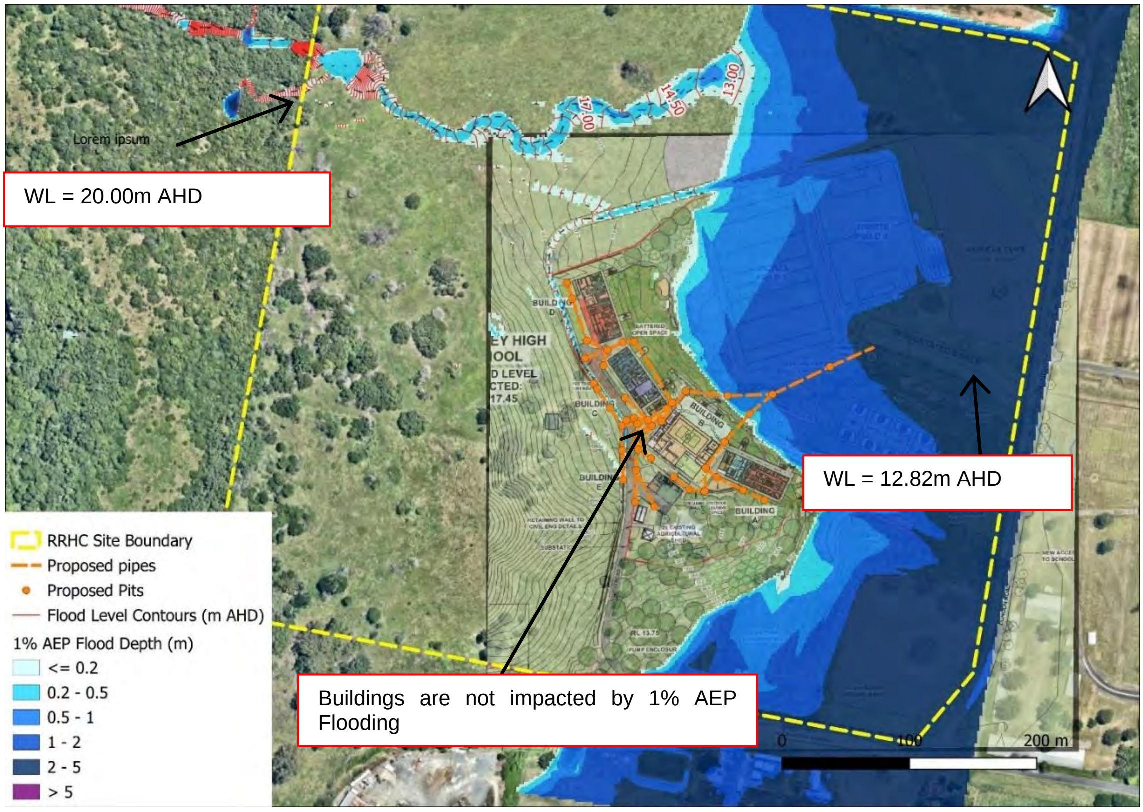


Figure 23: 1% AEP depths and levels at the proposed RRHC site under post-development site conditions

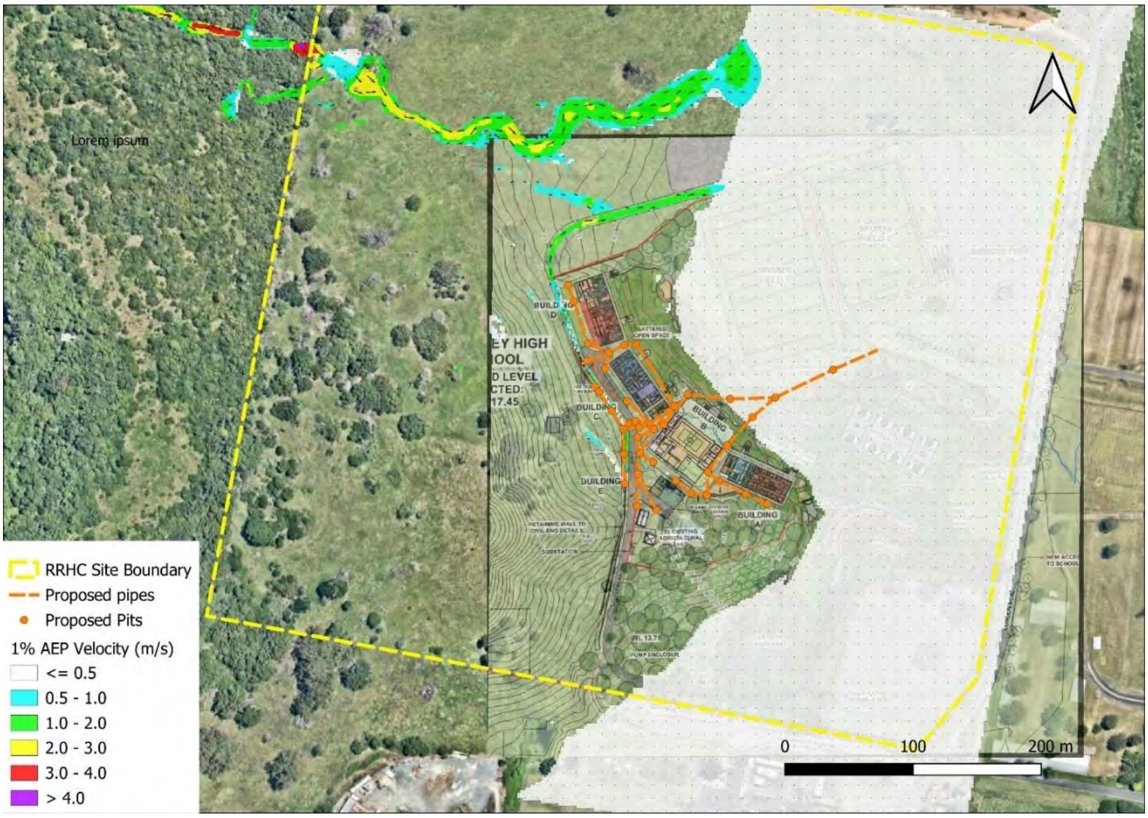


Figure 24: 1% AEP velocities at the proposed RRHC site under post-development site conditions

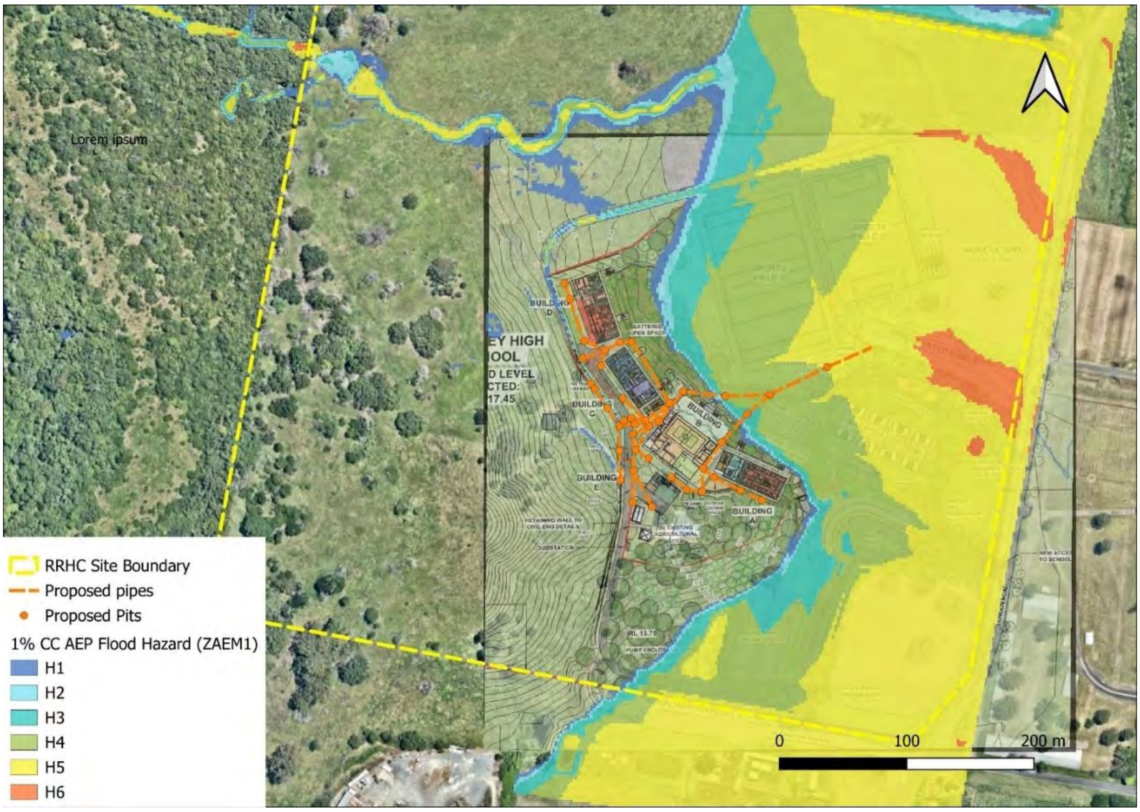


Figure 25: 1% AEP Hazard categorisation at the proposed RRHC site under post-development site conditions

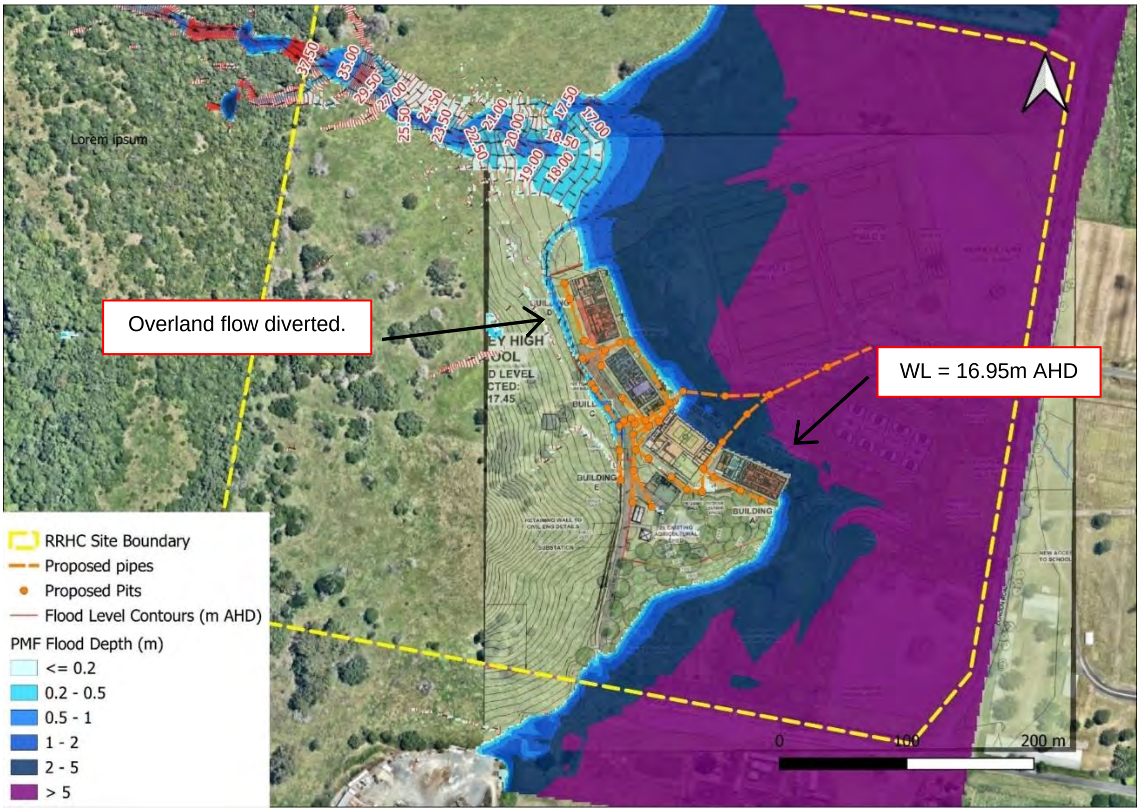


Figure 26: PMF depths and levels at the proposed RRHC site under post-development site conditions

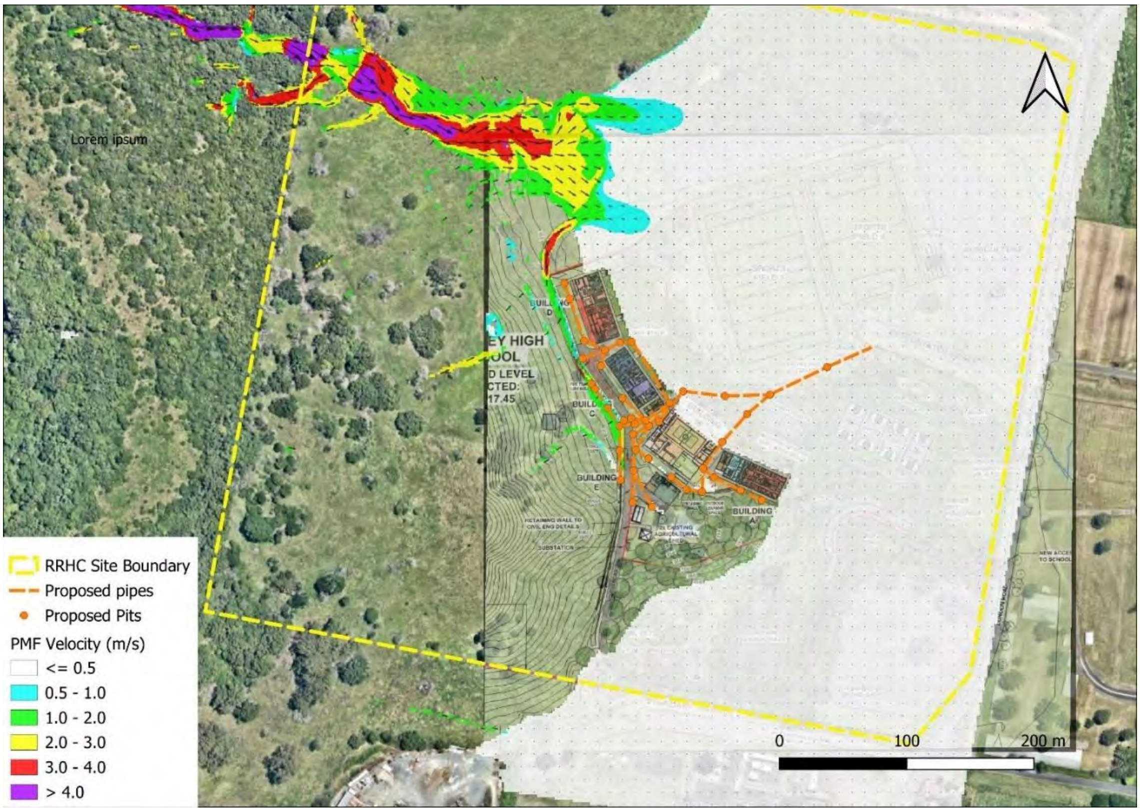


Figure 27: PMF velocities at the proposed RRHC site under post-development site conditions

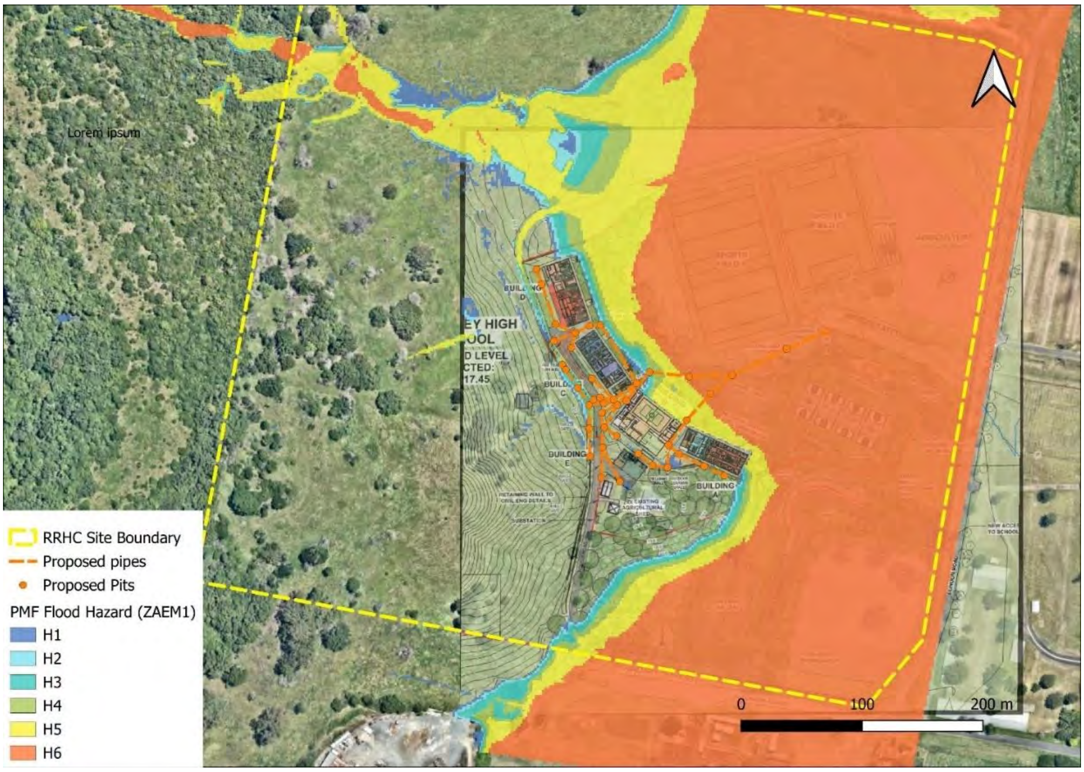


Figure 28: PMF hazard categorisation at the proposed RRHC site under post-development site conditions

4.3 February 2022 Flood Event

The 2022 flood event stood out due to exceptional conditions, widespread, high-intensity (rare) rainfall over a considerable duration across an already saturated catchment. Between February 23rd and March 1st, there was unprecedented daily rainfall in the Richmond, Tweed, and Brunswick basins, particularly in the mid-Richmond and Wilsons River catchment near Lismore. The recorded daily rainfall figures were estimated to significantly exceed the thresholds associated with a 1% AEP event, a crucial benchmark for design considerations. The 2022 flood's frequency was evaluated through an analysis of its AEP.

In a study by CSIRO (November 2022), the peak flow during the 2022 event was found to be notably higher than the 1% AEP at seven measurement points in the region, including the Lismore partial inflows (a partial estimate of streamflow at Lismore based on the sum of flows at two upstream inflows). These frequency estimates carry a considerable level of uncertainty, ranging from just under a 1 in 100 frequency (1% AEP) to as rare as 1 in several thousand (up to 0.01% AEP for one station). Despite the uncertainty, this study suggested that the 2022 peak flow of Lismore partial inflows surpassed the 1% AEP threshold. This projection yields an expected AEP of 0.4% when excluding the 2022 flood from the frequency fitting, corresponding to a 1 in 250 AEP flood. When considering the 2022 flood, the expected AEP increases to 0.6%, equivalent to a 1 in 170 AEP flood.

Figure 29, Figure 30 and Figure 31 show the modelled flood depths and levels, flood velocities and flood hazard at the site during the February 2022 flood event (under post-development conditions). The modelling results show that none of the proposed buildings are impacted by either local or riverine flooding. A comparison of the February 2022 post-development flood levels and the flood levels simulated in other events is presented in Section 5.1.

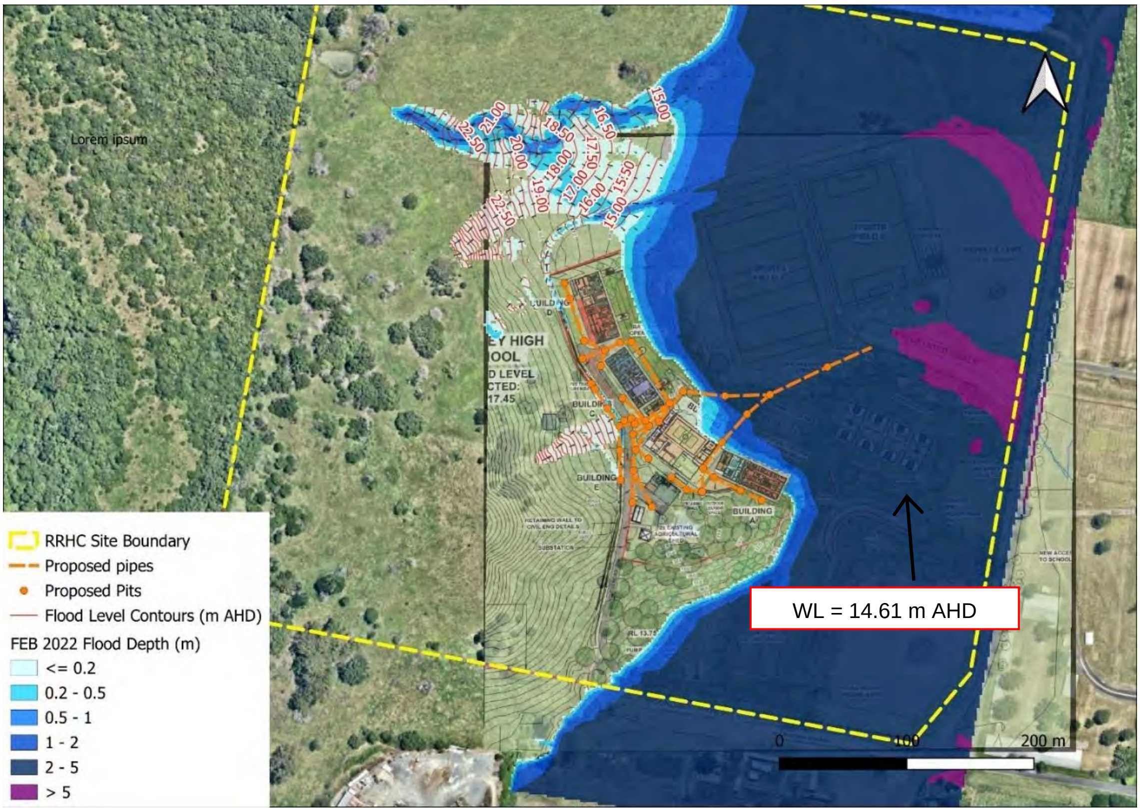


Figure 29: February 2022 flood depths and levels at the RRHC site under post-development site conditions

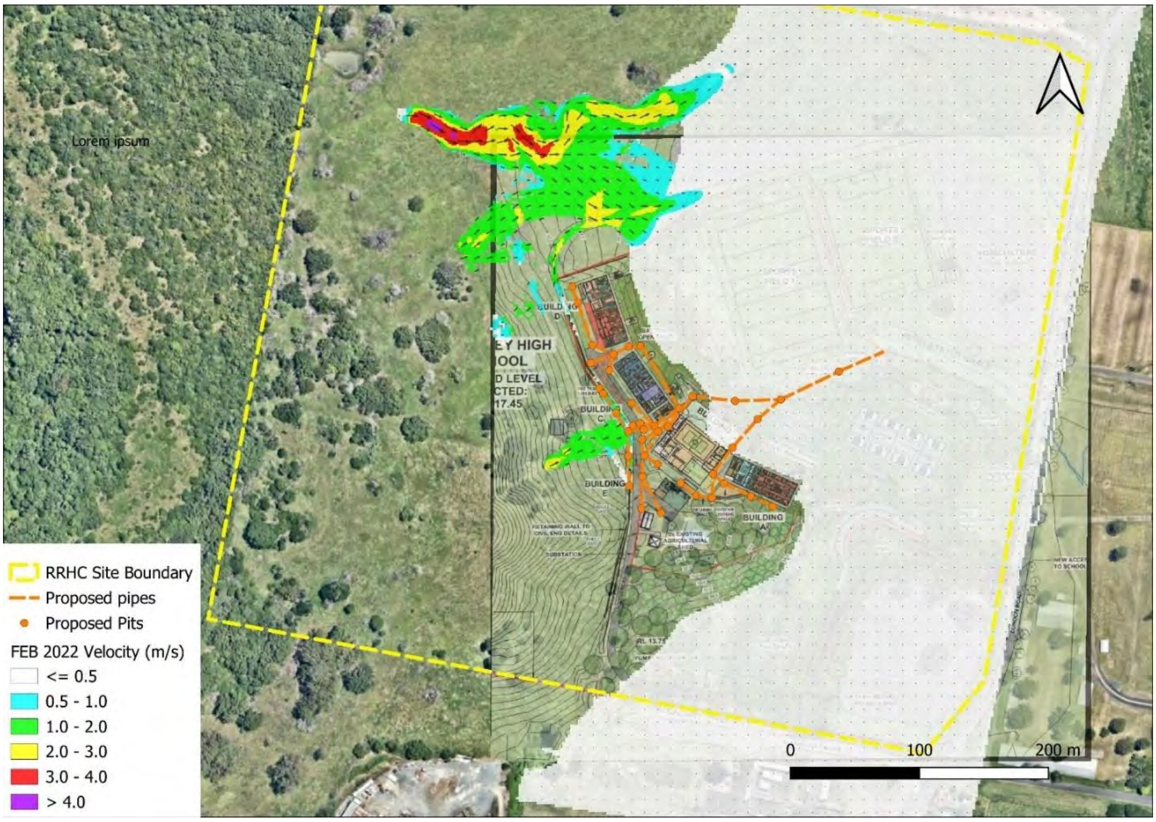


Figure 30: February 2022 flood velocities at the RRHC site under post-development site conditions

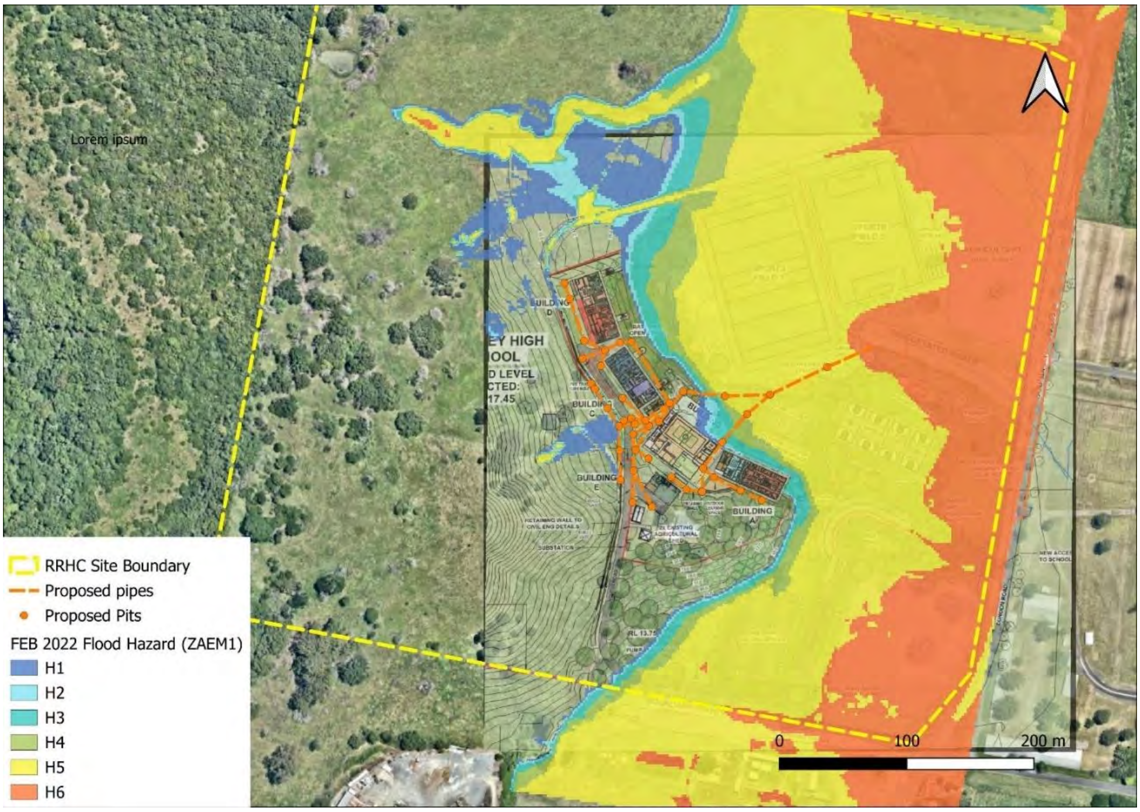


Figure 31: February 2022 flood hazard categorisation at the RRHC site under post-development site conditions

4.4 Blockage Assessment

When estimating design flows, determination of likely blockage levels and mechanisms is an important consideration. For this analysis, two different blockage scenarios have been considered for 1% AEP and PMF event:

- No blockage
- 50% blockage at the proposed culverts and drainage pits

Figure 32, Figure 33 present the 1% AEP and PMF depths and levels at the site when the 50 % blockage is applied. The no-blockage scenario results are presented in Figure 23 and Figure 26 for the 1% AEP and PMF events, respectively. The modelling results show no impact for the 1% AEP and PMF blockage scenarios. In conclusion, the blockage assessment shows no significant change in flood behaviour as a result of the blockage.

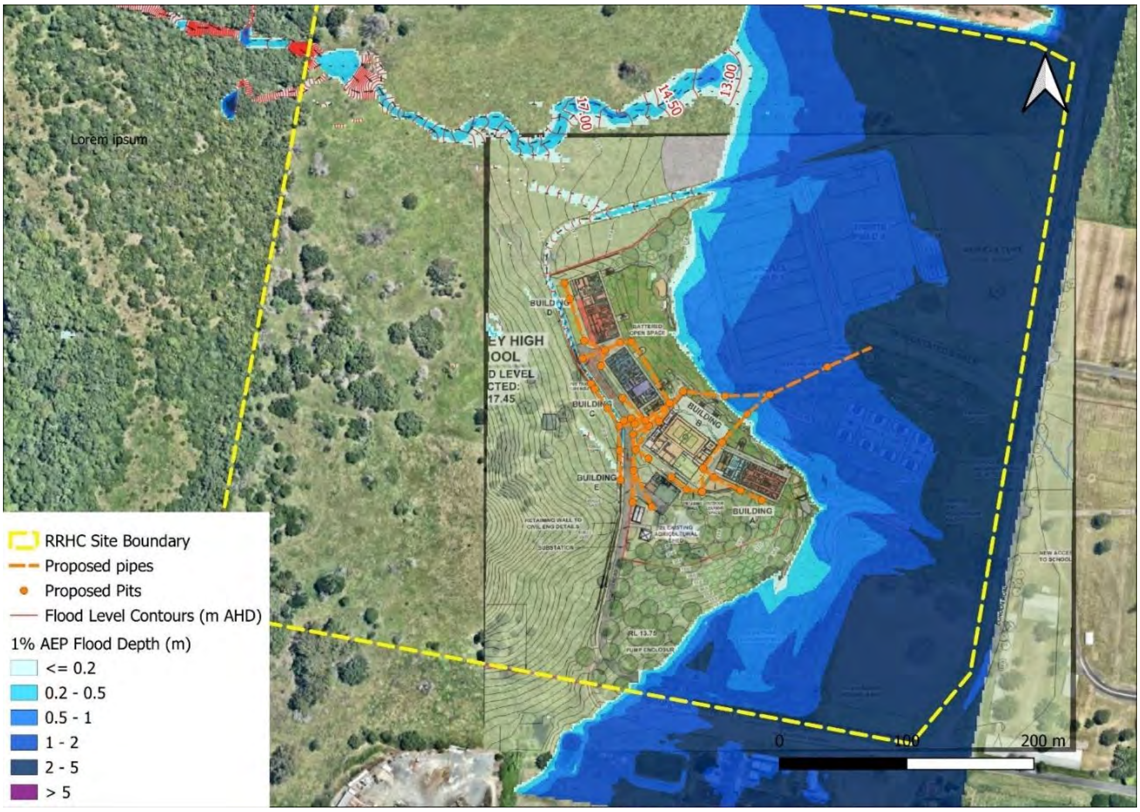


Figure 32 – 1% AEP depths and levels at the site under 50% blockage scenario (post-development conditions)

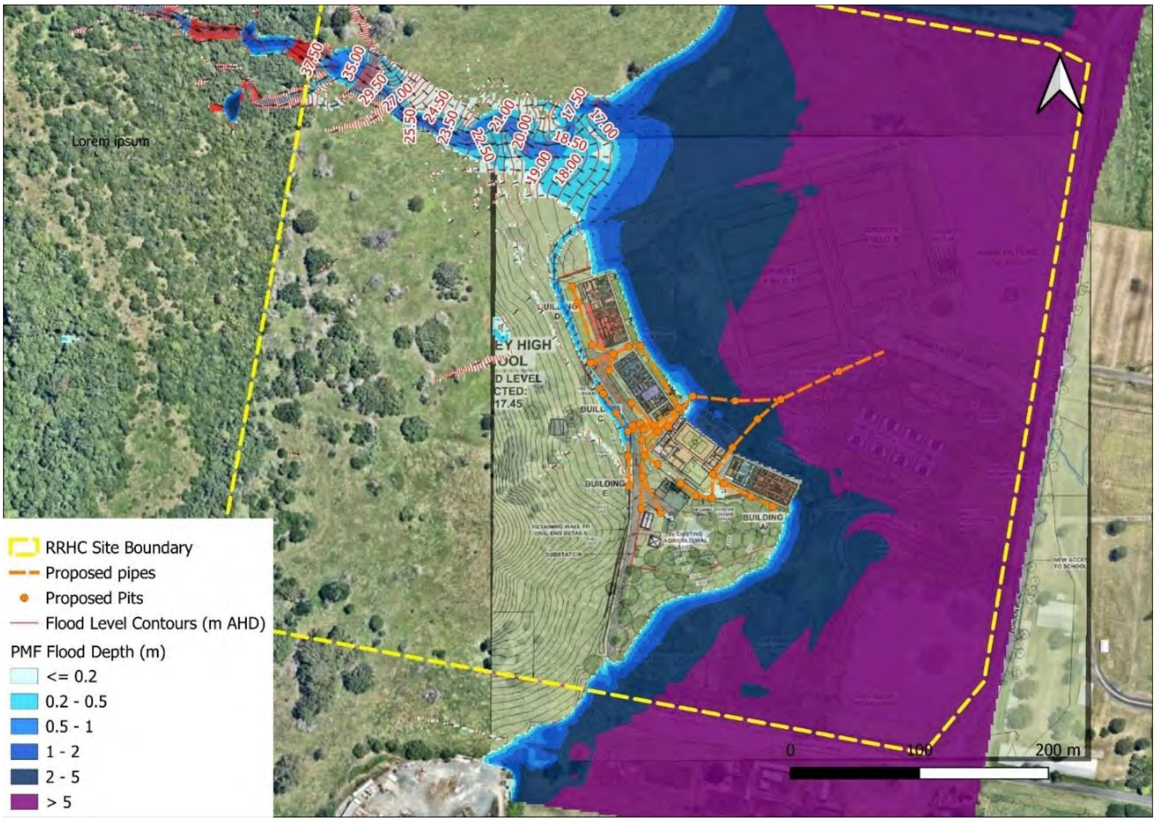


Figure 33: PMF depths and levels at the site under 50% blockage scenario (post-development conditions)

4.5 Offsite Impacts

A flood impact assessment has been carried out to ensure the proposed development would not result in either an unacceptable flood level increase onsite or worsening of the flood conditions over the neighbouring properties in the 10% AEP, 1% AEP and PMF events. These flood level impact maps are shown in Figure 34, Figure 35 and Figure 36 respectively. The flood impact assessment confirms that there is no change to flood levels outside the site boundary, and hence there is no adverse impact on neighbouring properties as a result of the development.

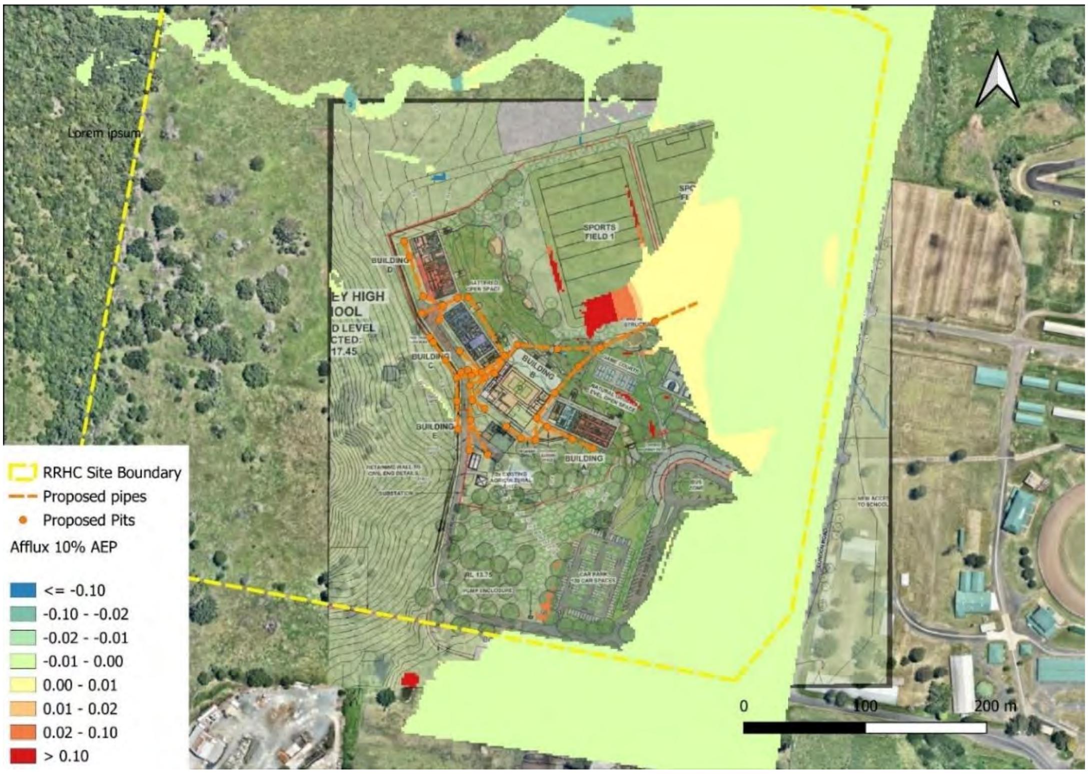


Figure 34: Flood level afflux – Impact of proposed development on flood levels in the 10% AEP event

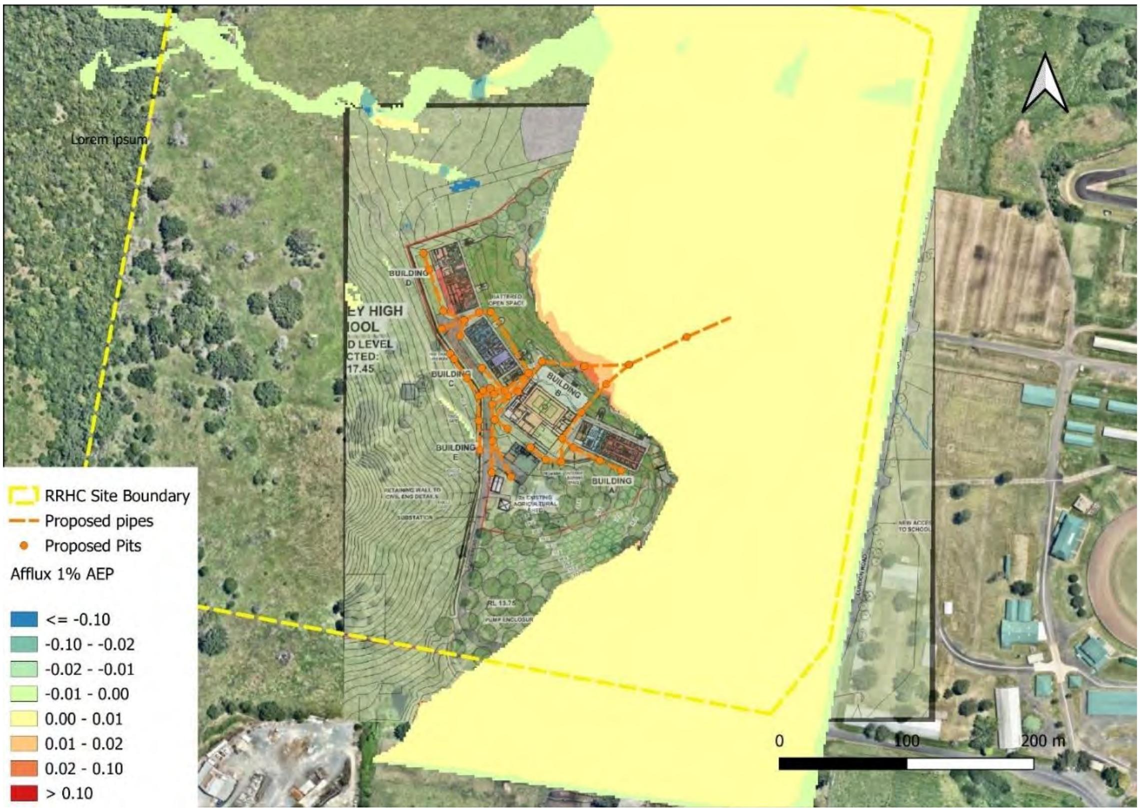


Figure 35: Flood level afflux – Impact of proposed development on flood levels in the 1% AEP event

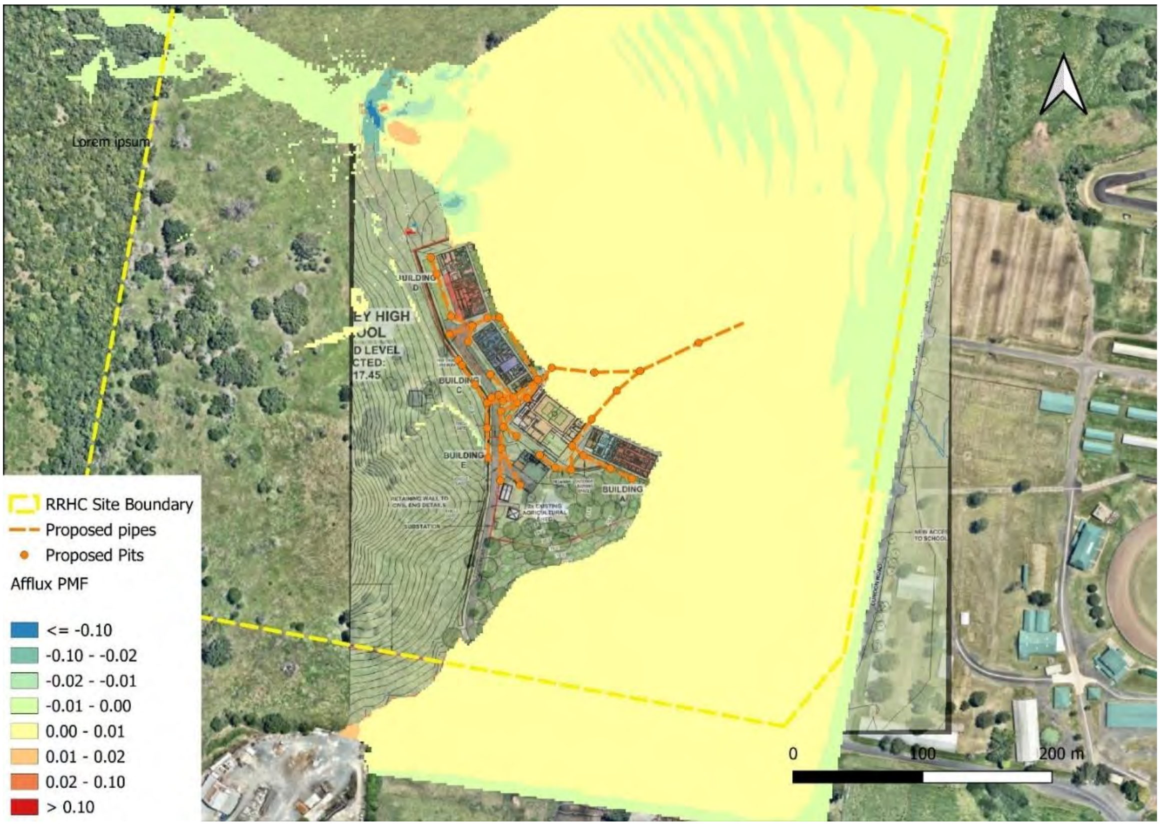


Figure 36: Flood level afflux – Impact of proposed development on flood levels in the PMF event

4.6 Climate Change

Climate Change is expected to have an adverse impact on rainfall intensities, which has the potential to have significant impact on flood behaviour at specific locations. Climate change projections in NSW are generated by the NSW and ACT Regional Climate Modelling (NARCliM) project. The NARCliM projections for extreme rainfall are that both rainfall intensities and the frequency of extreme events will increase.

For this study, a sensitivity analysis has been carried out to determine the impact of climate change on local flood conditions under the 2090 RCP 8.5 climate change scenario. The impact of climate change was assessed through a 19.7% increase in 1% AEP rainfall (RCP 8.5), in accordance with the recommendation of ARR2019. Figure 37 presents the post-development 1% AEP flood levels and depths with the addition of climate change, while Figure 38 quantifies the increase in flood levels when climate change is considered.

It is noted that the ARR2019 guidelines were updated on 27 August 2024 to incorporate revised recommendations for considering climate change in flood planning. These updates include variable rainfall adjustments based on storm duration. A climate change factor of 1.197 used in this study aligns with projections for the year 2100 under the Shared Socioeconomic Pathway (SSP) 1-2.6, a low-emissions scenario assuming global CO_2 emissions reach net zero around 2075.

The climate change results indicate that much of the site is subject to an increase of around 500-550mm compared to current climate conditions. This increase is approximately equivalent to the flood levels in the 0.2% AEP event (see Appendix C for 0.2% AEP maps).

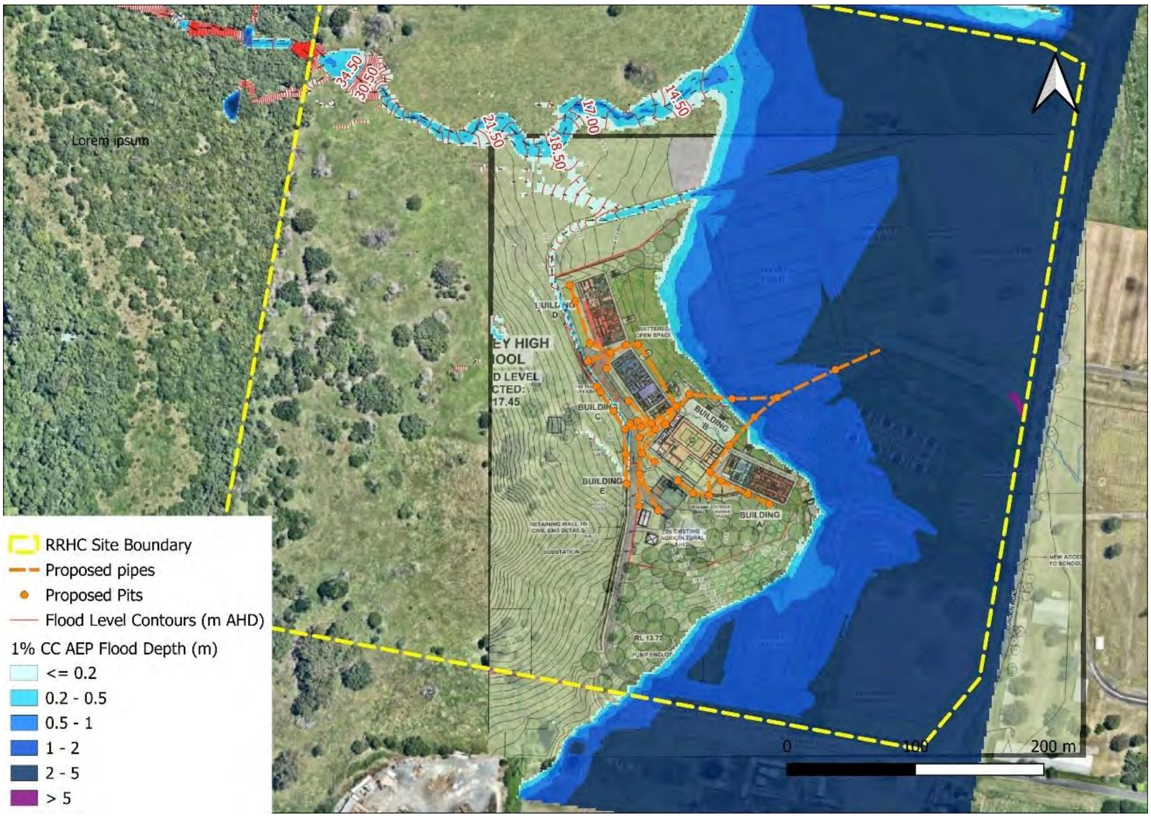


Figure 37: 1% AEP flood depths and levels at the proposed RRHC site with the addition of climate change

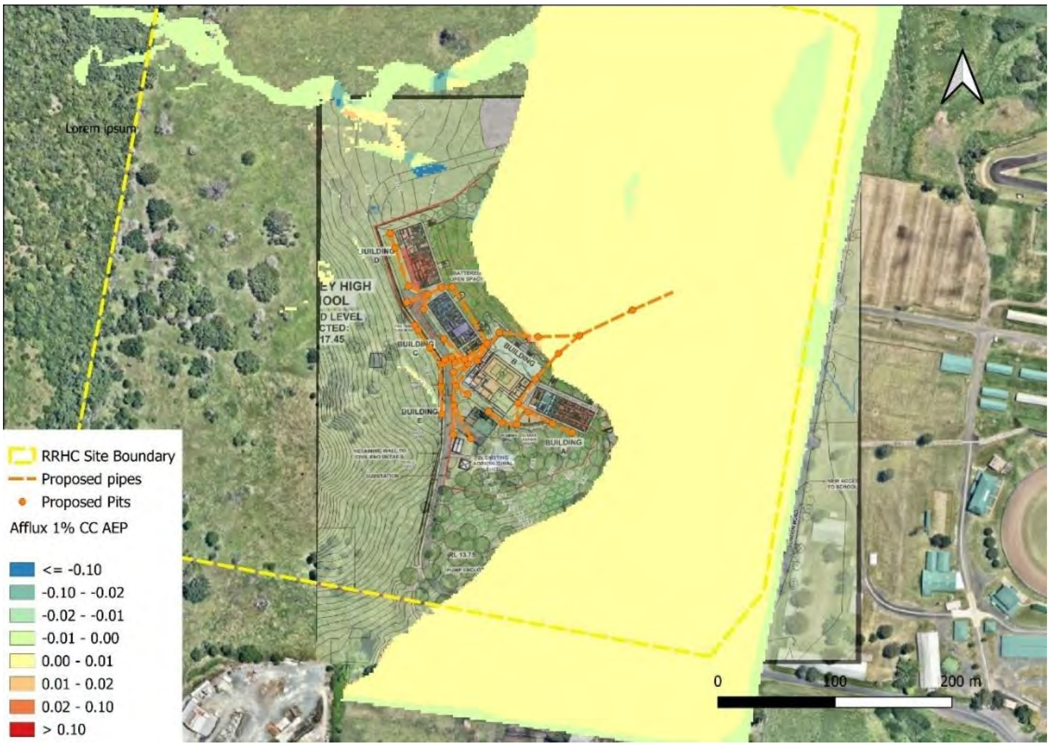


Figure 38: Increase in 1% AEP flood levels at the proposed RRHC site with the addition of climate change

4.7 Evacuation Route

The evacuation route within the site during PMF flooding is illustrated in Figure 39. The map indicates that the road remains flood-free during PMF event. A comprehensive flood emergency response plan is provided with this report.

Figure 39- Evacuation route during PMF flooding

5.0 Flood Planning Requirements

The current Development Control Plan (DCP) in place in Lismore was published in 2012. However, there is a draft Revised Flood Prone Lands Development Control Plan published in 2023 that outlines the updated regulations for building on flood-prone land in the Lismore LGA. Both documents have been reviewed for the purpose of this study, although it should be noted that the Draft DCP is not yet adopted and is subject to change.

In both DCPs, the type and stringency of controls have been graded relative to the severity and frequency of potential floods and is dependent on the land use type of the development alongside the flood risk categorisation of the site. It should be noted that the relocation of the RRHC site is regarded as a commercial development by Lismore City Council, as stated by Council in the project startup meeting. The development therefore does not require protection up to the PMF (as is usually standard for an educational facility in Lismore LGA, according to Section 4 of the draft 2023 DCP guidance).

5.1 Flood Planning Level

Flood modelling results indicate that the site is subject to flooding, with the most significant impacts observed to the east of the lot. As shown in Table 4, all proposed buildings, except for buildings A and B, remain unaffected during the February 2022 flood and PMF events. Notably, all proposed buildings, including Buildings A and B , are designed with a finished floor level (FFL) of 17.45 m AHD, providing a 500 mm clearance above the PMF flood level. Figure 40 shows the Architectural plan with their FFL and Table 4 shows the flood levels in vicinity of Building E and G.

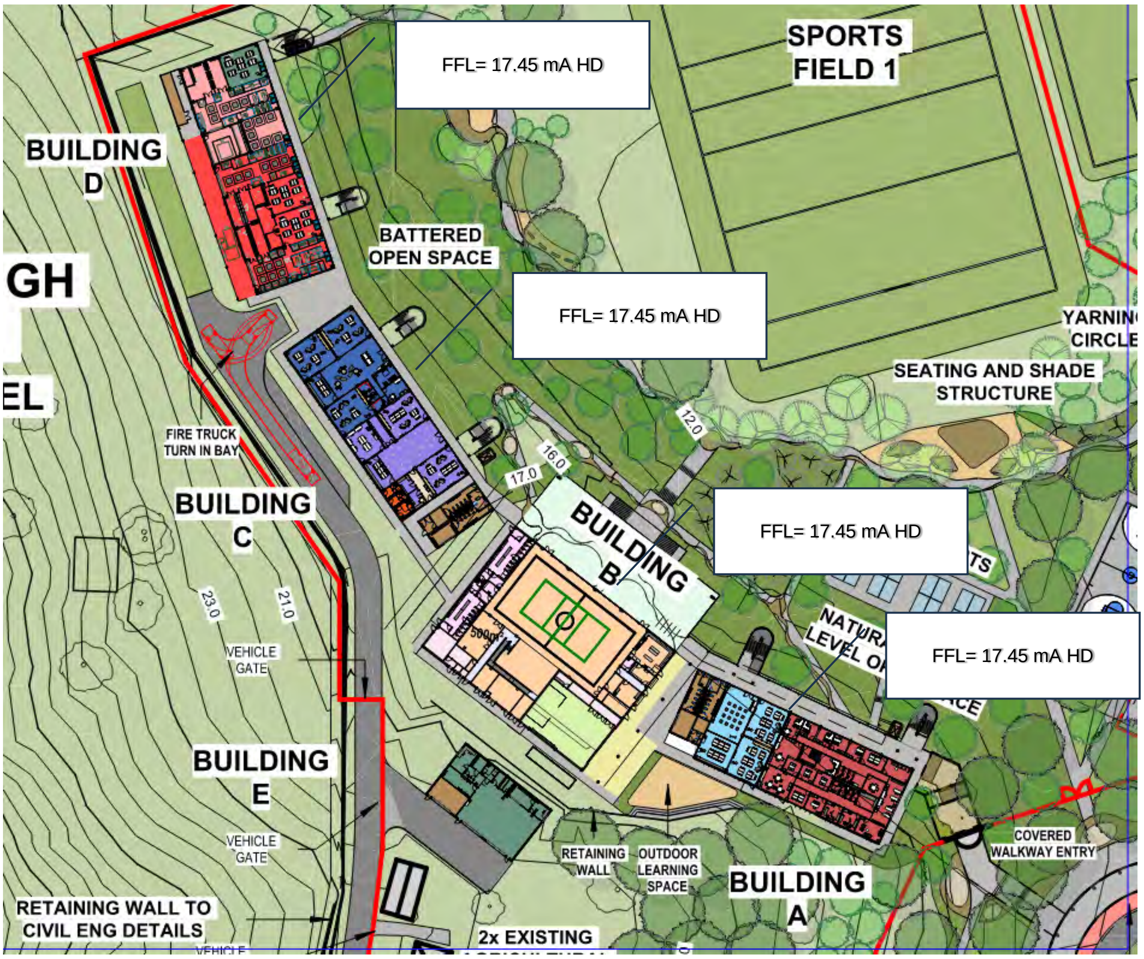
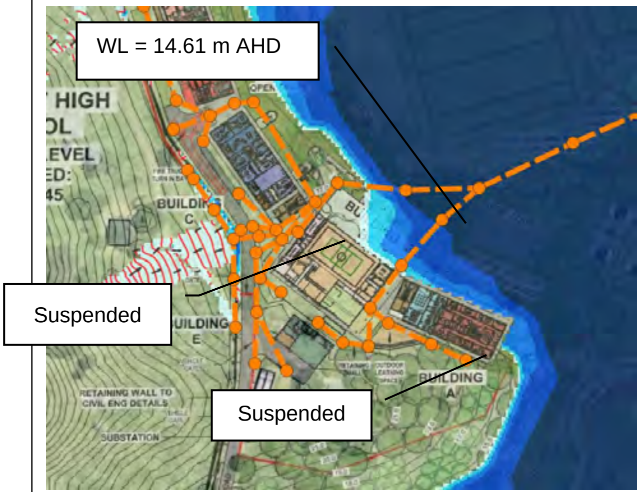
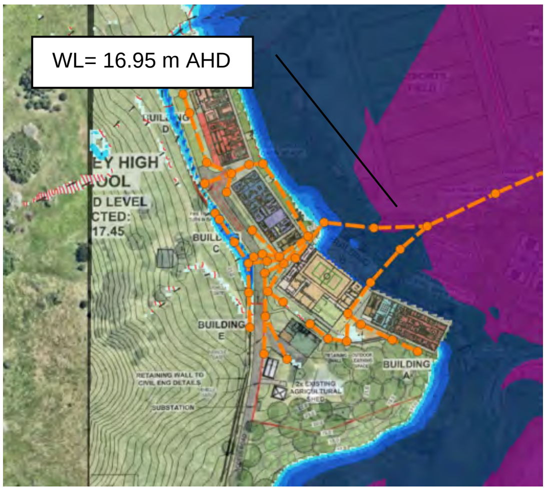


Figure 40- Flood Planning Levels

Table 4- FEB 2022 and PMF Flood modelling results

FEB 2022 Modelling Result	PMF Modelling Result
	

5.2 Current Development Control Plan (2012)

The Council's LEP (2012) indicates that the eastern portion of the site boundary is partially located within the following risk zones (shown in Figure 41):

- **Flood Fringe Area**, which is the remaining area in the 1% AEP flood extents that is not defined as either floodway or flood storage. Flood fringe areas are areas where development will not impact on broad flood behaviour due to alteration of flow conveyance and storage (Flood Risk Management Manual, 2023).
- **Low Flood Risk Area**, which is defined by the limit of the probable maximum flood (PMF) level contour but excludes areas within the Floodway, High Flood Risk Area or Flood Fringe Area.

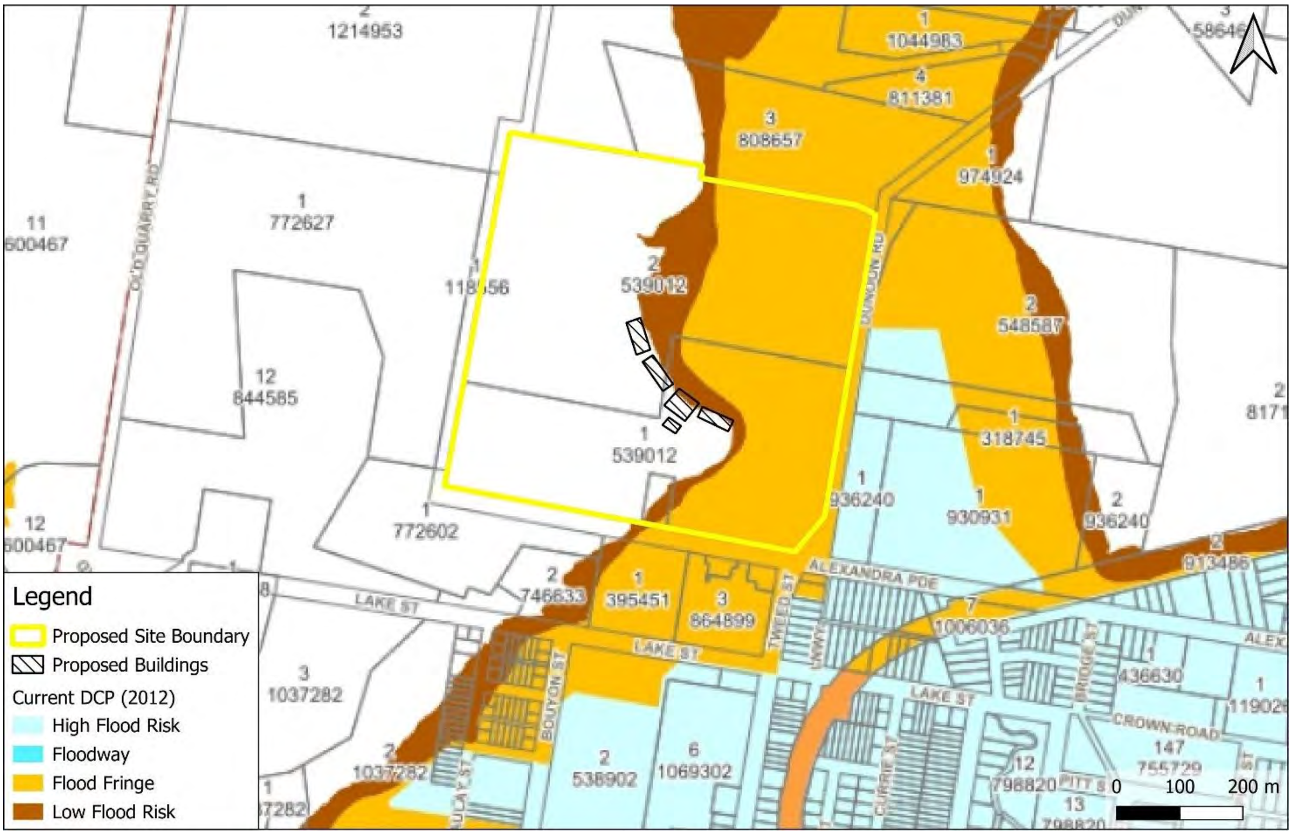


Figure 41: Flood risk categorisation in Lismore LEP (2012) based on the current 2012 DCP definitions

The eastern portion of the property boundary is also located within the following groups in the Floodplain Risk Management Plan 2014 (see Figure 42):

- **High Flood Risk**, which covers areas in which there is:
  1) Potential for flood waters to cause danger to personal safety and/or loss or damage to light structures such as houses. Able bodies adults could have difficulty wading to safety; and/or
  2) Possible danger to personal safety of residents and emergency personnel due to inadequate evacuation routes and time available for evacuation.
- The majority of North Lismore is within the high-risk precinct, reflecting the hydraulic characteristics of the area and its lack of protection by the Lismore Levee Scheme, which means it is affected by the whole range of floods and evacuation time is reduced, along with limited evacuation routes.
- **Medium Flood Risk**, which applies to the areas of flood liable land within the limit of the 1 in 100-year ARI design flood after the Extreme Risk and High-Risk Precincts Areas have been defined. In these areas the risk of damage to buildings is not high and residents are able to evacuate with relative ease due to the proximity of higher ground, numerous possible evacuation routes and sufficient warning time. Most of the Medium Risk Precinct is characterised by depths less than 1.2m and velocity less than 2m/s.
- **Low Flood Risk**: The Low-Risk Precinct applies to the areas of flood liable land within the extent of the Probable Maximum Flood but outside the extent of the 1 in 100-year ARI design flood.

Figure 42: Flood risk categorisation based on the Floodplain Risk Management Plan 2014

This map shows that the eastern part of the site area, where Sports Fields 1, 2, and 3 are located, is within the high flood risk category. Open spaces to the east of the proposed building are within the medium and low flood categories, while the eastern part of the proposed building itself is within the low-risk category.

No development controls apply commercial development within the Low Flood Risk Area according to Section 8.7 of the current DCP (2012). As a commercial development in the Flood Fringe area (Figure 41), the requirements outlined in Table 5 must be for the site.

Table 5: Flood controls for a commercial development in the Flood Fringe, taken from the current 2012 DCP

DEVELOPMENT CONTROL	TTW COMMENTS
An equivalent of 25% of gross floor area of the building to be at or above the FPL.	The recommended FPL in the current 2012 DCP is defined as the 1% AEP flood event plus 500mm freeboard. Based on regional flooding to the east of the site, this FPL equates to: **12.84m AHD (1% AEP flood level) + 500mm = 13.34 m AHD** The site is not impacted by local catchment flooding due to the implementation of mitigation measures.

DEVELOPMENT CONTROL	TTW COMMENTS
A risk analysis report prepared by a structural engineer certifying that the design criteria adopted for the building will withstand the impact of flood waters and debris up to the 1 in 500-year flood ARI event. Such report to be submitted to Council with the Construction Certificate.	A Structural Design Statement will be provided at a later stage of the project.
Bulk fill to within 300mm of finished surfaced level is to be sourced from on-site, from the preferred excavation area or from another area on the floodplain. Minor increases in the depth of imported fill will be considered where it can be demonstrated that this is necessary to complement the design of the footings of a future building. If bulk fill cannot be obtained on-site, from the preferred excavation area or from another area on the floodplain, Council may approve fill imported from another source providing a flood impact assessment has been prepared by a suitably qualified consultant which demonstrates that the fill will have no adverse effects upon flood levels upstream or on flooding behaviour on adjacent properties.	The cut and fill calculations for the project indicate a net fill of 43,400 m³ across the total extent of the project. The cut and fill plan is provided in Appendix D.

5.3 Draft Development Control Plan (2023)

As aforementioned, there is a draft Revised Flood Prone Lands Development Control Plan published in 2023 that outlines the updated regulations for building on flood-prone land in the Lismore LGA. The draft DCP provided updated Flood Risk Precinct zones within Lismore, and updated guidance on the recommended FPL, now accounting for the potential impacts of climate change.

In the draft DCP, the wider site is categorised as within the following precincts (see Figure 43):

- **Extreme Flood Risk Precinct**: this precinct is an extremely dangerous part of the floodplain due to high velocities and/or depths of floodwaters, even during relatively common floods. It includes areas subject to H5 and H6 hazards even in relatively common floods such as the 10% AEP, as well as areas subject to H6 hazards in a 5% AEP or 1% AEP flood. Generally, no new development will be permissible in these areas given the extreme risk to life and property. The area of the Showground lots that fall within this category are isolated to the eastern boundary, where no significant development is planned. The proposed site plan indicates the construction of sports fields in this area, but no habitable buildings.
- **High Flood Risk Precinct**: land within this precinct is characterised by high flood depths with significant risk to life and property. It includes areas that would experience H6 hazard in a 0.2% AEP event or a H5 hazard in the 1% or 5% AEP events. As with the extreme risk area, no significant development is planned in this area.
- **Medium and Low Flood Risk Precincts**: these precincts apply to the rest of the floodplain area not mentioned above, such as flood fringe areas, up to the PMF extent. Most development is permissible in these areas, subject to meeting flood development controls. The proposed building at the Showground site is primarily within the Low Risk Precinct, though there is a small portion to the east within the Medium Risk Precinct.

As the majority of the lot is located within high hazard area, the controls related to a commercial development in the High-Risk Category have been assessed to adopt a conservative approach. The flood controls which apply to the site are outlined in Table 6 and were taken from Section 4 of the draft DCP (2023).

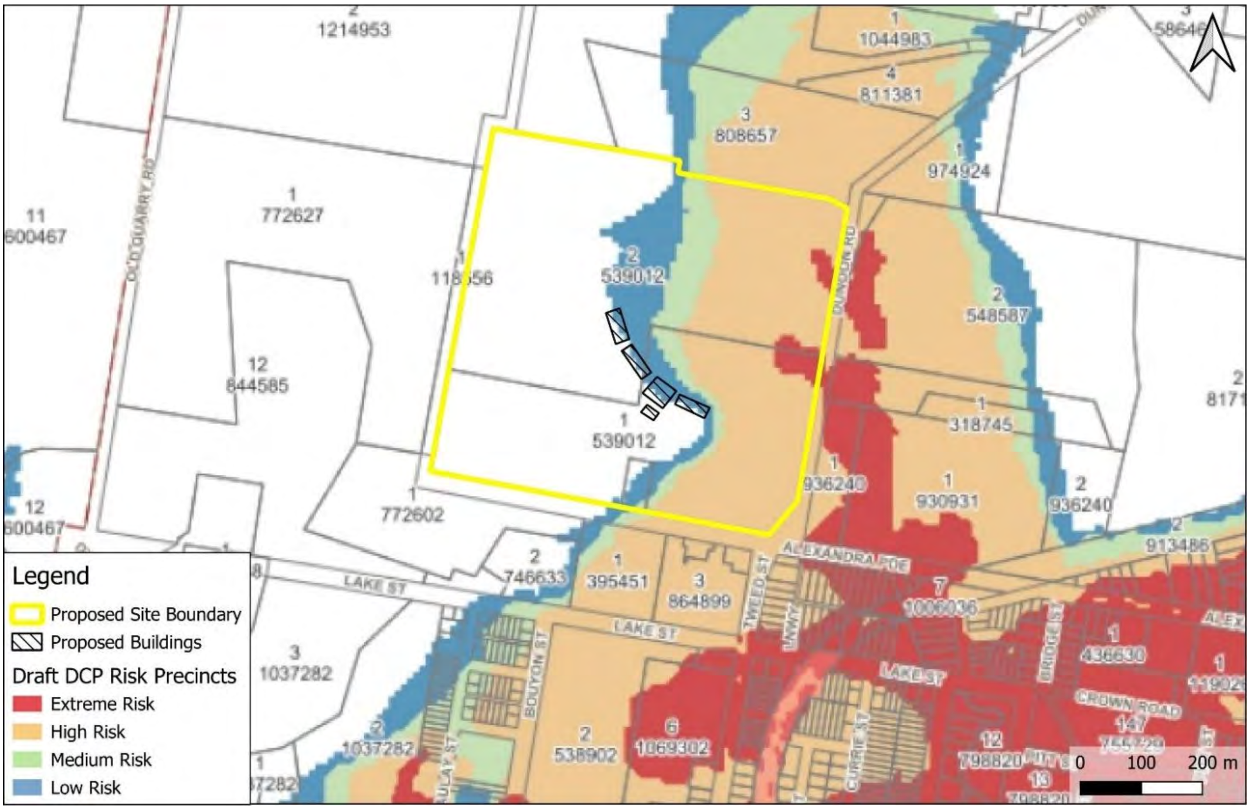


Figure 43: Flood risk categorisation based on the Draft 2023 DCP definitions

Table 6: Flood controls for a commercial development in the Medium Risk Precinct, taken from the draft 2023 DCP

CATEGORY	DEVELOPMENT CONTROL	TTW COMMENTS
FLOOR LEVEL	Non-habitable levels as close to FPL as practical. Where below the FPL, more than 25% of floor space must be above the FPL.	In the draft DCP, the FPL is the 1% AEP flood level + a climate change factor (that varies according to location) + 500mm freeboard. The climate change factor is based upon RCP 8.5, which represents a “worst-case” climate change scenario where rainfall intensity increases by 19.7% in 2090. Based on the climate afflux mapping provided in the draft DCP, the site is within the 0.5-0.6m climate afflux region. Based on regional flooding to the east of the site, this FPL equates to: **12.84m AHD (1% AEP flood level) + 600mm climate change factor + 500mm freeboard = 13.94m AHD.**
FILL	Bulk fill to within 300mm of finished surfaced level is to be sourced from on-site. No filling permissible in land identified as floodway	The cut and fill calculations for the project indicate a net fill of 43,400 m³ across the total extent of the project. The cut and fill plan is provided in Appendix D.
FLOOD AFFECTATION	Development applications must address the impact of development on adjoining sites. Development must not impact flood behaviour on neighbouring properties or change flood	The flood impact assessment (Section 4.5) shows no increase in flood affectation outside the school boundary.

	flow/velocities/levels. A report by a suitably qualified professional may be required	
BUILDING MATERIALS AND DESIGN	All structures to have flood resilient materials below or at the FPL. Services such as air conditioning units, electrical switchboards, storage hot water units and water tanks to be placed above the FPL. Fencing must be permeable to allow the passage of flood flows (minimum 90% void space) or be collapsible under flood flow. Any enclosure below the flood planning level must have openings to allow automatic entry and exit of floodwater.	This is noted and will be addressed by the design team in a later stage of the project.
STRUCTURAL SOUNDNESS	Applicant to demonstrate that any structure can withstand the forces of floodwater, debris & buoyancy up to & including the 0.2%AEP (1:500 probability event), and additionally the PMF for commercial and industrial development. Council may require a report from a suitably qualified professional.	A Structural Design Statement will be provided at a later stage of the project.
EMERGENCY RESPONSE	Development must have a road evacuation route to land above PMF.	The evacuation route, situated to the west of the project, lies above the PMF riverine flood level. Additionally, a diversion channel has been designed to the west of the road to protect the evacuation route from local flooding.
MANAGEMENT	• A business flood safe plan is to be provided addressing how safety and property damage (including fit outs and goods storage) is addressed, considering the full range of floods. • No storage of hazardous materials is allowed below the flood planning level.	A business flood safe plan will be prepared in at a later stage of the project.

5.4 Interim Development Control Plan

A new DCP (Revised Flood Prone Lands DCP - Post Exhibition [Clean]) has been provided to TTW for use in this study. This DCP is very similar to the draft DCP 2023, with only minor differences. Based on this DCP, schools are categorized as Commercial development. The site falls within the high flood risk precincts.

Figure 44 shows the development controls applies to the commercial development within the medium hazard precincts.

Flood risk precinct	Land use category	Floor level	Fill	Flood Affectation	Building materials and design	Structural soundness	Emergency response	Management
Extreme	Critical uses & facilities							
	Sensitive and hazardous							
	Residential							
	Subdivision							
	Commercial, industrial & community							
	Recreation & non-urban	4	3	1	1, 3, 4	1	1	2, 3
	Concessional development	1, 3, 5	3	2	1, 3	2	1	2, 3, 4
High	Critical uses & facilities							
	Sensitive and hazardous							
	Residential							
	Subdivision (except for residential)		1	2				1
	Commercial, industrial & community	4	1	1	1, 3, 4	1	1	2, 3
	Recreation & non-urban	4	1	1	1, 3, 4	1	1	2, 3
	Concessional development	1, 3, 5	1	2	1, 3	2	1	2, 3, 4
Medium	Critical uses & facilities							
	Sensitive and hazardous							
	Residential	1, 5	1	1	1, 3, 4	2	1	
	Subdivision		1	2				1
	Commercial, industrial & community	4	1	1	1, 3, 4	2	1	2, 3
	Recreation & non-urban	4	1	1	1, 3, 4	2	1	2, 3
	Concessional development	1, 3, 5	1	2	1, 3	2	1	2, 3, 4
Low	Critical uses & facilities							
	Sensitive and hazardous	2	1	1	2, 3, 4	3	1	2, 3
	Residential							
	Subdivision							
	Commercial, industrial & community							
	Recreation & non-urban							
	Concessional development	1, 3	1	2	1, 3	2	1	2, 3, 4

Figure 44: Control plans apply to the RRHC based on the Interim Development Plan

Table 7: Minor Changes to DCP

CATEGORY	CONTROL	DEVELOPMENT CONTROL	TTW COMMENTS
STRUCTURAL SOUNDNESS	1	Report required that includes certification by a suitably qualified professional that any structure can withstand the forces of floodwater, debris & buoyancy up to & including the 0.2%AEP (1:500 probability event), and additionally the PMF for commercial and industrial development, and where on-site refuge is required. Such a report, to be provided at Construction Certificate stage, to be satisfactory to Council.	A Structural Design Statement will be provided at a later stage of the project.
MANAGEMENT	2,3	An SES Emergency Business Continuity Plan is to be provided addressing how safety and property damage (including fit outs and goods storage) is addressed, considering the full range of floods. No storage of hazardous material is allowed below the flood planning level	A business flood safe plan is prepared by TTW. The project team has been informed that the storage of hazardous materials below the flood planning level is not allowed.

6.0 Mitigation Measures

Given the site's significant susceptibility to flooding, the floor level of the proposed activity has been elevated to the PMF level plus a 500 mm freeboard (16.95 m AHD + 500 mm) to eliminate flood impacts. Additionally, a Flood Emergency and Risk Management Plan (FERP) has been developed to mitigate risks to students and staff during severe flooding, including PMF event.

To address the site's proximity to a first-order creek, which poses risks from stormwater, overland flows, and flash flooding, the design includes several mitigation measures. These measures include the construction of a flood detention basin and a series of box culverts (5 units, 2.7 m x 1.2 m each) located northwest of the site. A stormwater system upstream of the proposed school buildings is designed to mitigate potential flooding from the road and adjacent batter. Furthermore, a diversion channel upstream of the proposed evacuation route will intercept floodwaters from the upper catchment, while longitudinal road drainage along the evacuation route will manage runoff effectively.

A qualified professional evaluates whether the structures within the proposed activity can withstand the impacts of floodwater, debris, and buoyancy, including events up to the PMF. This assessment is conducted in accordance with relevant guidelines and standards, and the report will be provided at the Construction Certificate stage.

To enhance resilience, flood-resistant materials will be used for structures below or at FPL. Essential services, such as air conditioning units and electrical switchboards, will be located above the FPL. Additionally, permeable fencing with a minimum 90% void space or collapsible fencing will be installed, and enclosures below the FPL will include openings to allow for the automatic entry and exit of floodwaters.

These mitigation measures are summarised in Table 8.

Table 8: Mitigation Measures

Mitigation Number/Name	Aspect/Section	Mitigation Measure	Reason for Mitigation Measure
Flood Emergency Response Plan (FERP)	Flooding	FERP to facilitate flood evacuation during the severe flooding.	To mitigate risk to students and staff during severe flooding.
Structural design for the events up to PMF	Flooding/Structure	Design structures that are exposed to the events up to the PMF that can withstand the effects of floodwater, debris, and buoyancy. A Structural Design Statement will be provided at a later stage of the project.	To ensure that the structure can withstand the flood load during the severe flooding.
Using Flood-resistant material for structures located below or at the Flood Planning Level (FPL), and essential services, such as air conditioning units and electrical switchboards, will be positioned above the FPL.	Flooding	To improve resilience, flood-resistant materials will be applied to structures at or below FPL. Critical services, including air conditioning units and electrical switchboards, will be situated above the FPL.	To reduce the risk of flood damage

7.0 Conclusion and Next Stages

This report provides a Flood Impact and Risk Assessment for the proposed relocation site of Richmond River High Campus in Lismore and identifies the applicable development controls for the site. New site survey data was incorporated into Council's TUFLOW model to assess flood behaviour under existing and proposed site conditions. In addition, a local catchment model was produced to capture the flood impact of the first-order creek within the site. Modelling was completed for a range of flood events from the 10% AEP event to the PMF event. The following observations have been made:

- A flood impact assessment comparing existing and post-development flood levels demonstrates the proposed development has no notable flood impact on surrounding properties in the 10%, 1% and PMF events.
- A hazard assessment has been completed in accordance with the flood hazard vulnerability curves set out in the Australian Disaster Resilience Handbook Collection (2017). The site is impacted by high hazard floodwaters in both the 1% AEP and PMF events (categorised as H4-H5 hazard level in the 1% AEP event, and H6 hazard level in the PMF). This will have implications for the evacuation of the site during rare flood

events. Access and egress from the site are constricted during significant flood events. This is particularly important given that North Lismore is not protected by the Lismore Levee Scheme and therefore has limited warning time for evacuation in comparison to South and Central Lismore. It is recommended that a detailed emergency response strategy is outlined in a Flood Emergency Management Plan in consultation with NSW SES.

- The impact of climate change has been assessed for the site in accordance with the recommendation of ARR2019. Modelling suggests that the 1% AEP flood level at the site will increase by 0.54m due to climate change, with flood levels across the site similar to those in the 0.2% AEP event.
- Residual flooding to the west of the proposed school buildings has been addressed in the post-development scenario through effective management of runoff from the adjacent western slope. A diversion channel and retaining wall upstream of the buildings will intercept floodwaters from the upper catchment, while longitudinal drainage along the road will effectively manage surface runoff.
- The proposed redevelopment of RRHC is regarded as a commercial development by Lismore City Council, and therefore it does not require protection up to the PMF event. Based on the current DCP (2012) the minimum Flood Planning Level is the 1% AEP + 500mm freeboard. Based on the draft DCP (2023) the minimum Flood Planning Level is 1% AEP + 600mm climate change factor + 500mm freeboard.
- The proposed buildings have been designed to an FFL of 17.45m AHD, which was based on the regional PMF level plus a 500mm freeboard.
- The implementation of building and material design controls, such as utilising flood-resistant materials for structures below or at the FPL, positioning services like air conditioning units and electrical switchboards above the FPL, ensuring permeable fencing with a minimum 90% void space or collapsible fencing, and incorporating openings in enclosures below the flood planning level for automatic entry and exit of floodwater, is to be integrated into the masterplan and detailed design phases.
- A qualified professional will assess whether structures in the proposed development can withstand the effects of floodwater, debris, and buoyancy, covering events up to the 0.2% AEP. This evaluation will follow relevant guidelines and standards, and the resulting report will be delivered during at a later stage of the project.

Prepared by
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ALI VAHIDI
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Authorised By
TTW (NSW) PTY LTD

Erian Crabbe
Associate Director

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Appendix A

Part A

To be completed

Appendix A

Part B- Meeting Minutes

NSW | Education
School Infrastructure

TSA

NORTHERN RIVERS FLOOD RECOVERY
RICHMOND RIVER HC & LISMORE SOUTH PS
COUNCIL, SES AND DPHI MEETING
MEETING MINUTES

Meeting Title:	Northern Rivers Flood Recovery – Richmond River HC & Lismore South PS Council and SES Meeting		
Date:	Monday, 26 February 2024	Time:	10:30am-11:35am
Location:	Microsoft Teams		

Attendees:	Role:	Email:
Mark Coyte (MCo)	Senior Project Director, SINSW	Mark.Coyte1@det.nsw.edu.au
Krystal Porteus (KP)	Project Officer, SINSW	Krystal.Porteus@det.nsw.edu.au
Andrew Robinson (AR)	Principal Specialist environment Planner, SINSW	Andrew.Robinson64@det.nsw.edu.au
Mikayla Ward (MW)	Senior Flood Officer, DPHI	mikayla.ward@environment.nsw.gov.au
Toong Chin (TC)	DPHI	Toong.Chin@environment.nsw.gov.au
Jason McCosker (JM)	Project Director, TSA	Jason.Mccosker@tsamgt.com
Elise Harrison (EH)	Project Manager, TSA	Elise.Harrison@tsamgt.com
Daniel Ilievski (DI)	Assistant Project Manager, TSA	Daniel.Ilievski@tsamgt.com
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Rodney Mallam (RM)	Planning Coordinator, Lismore Council	rodney.mallam@lismore.nsw.gov.au
Lucas Myers (LM)	Planning Coordinator, Lismore Council	
Peter Cinque (PC)	Senior Manager Emergency Risk Management, SES	peter.cinque@ses.nsw.gov.au
Elspeth O'Shannessy (EO)	Emergency Risk Assessment Manager, SES	elspeth.oshannessy@ses.nsw.gov.au
Gillian Webber (GW)	SES	gillian.webber@ses.nsw.gov.au

NSW Education School Infrastructure TSA

Item	Description		
	3. Planning advice. This due diligence has been completed, and the principal consultants summarised their findings.		
6.	**Flood Impact Assessment Results**		
6.1	PM Summarised the flood modelling findings also refer to the presentation in Appendix A: Site Flood Category: H5 • This is generally unsafe for vehicles and people regarding depth • Buildings will require special engineering design and construction • A flood evacuation strategy will be required. Planning Considerations and Floor Levels: • DCP categories define the area as industrial and community, which means there is no required protection at PMF event • Draft DCP floor level is set at the one in 500-year flood level+ 500mm freeboard. • This floor level is 13.7 which is 0.7m below peak level in 2022 at the existing site. • The project intends to a flood planning level of 14.6m is recommended for habitable spaces. This is based on 2022 level and in considerations of other flood events (2%, 5%, 10%). • DOE are further considering designing the flood level at 14.9 as further risk mitigation. This equates to 0.5m above the 2022 flood level.		Note
6.2	JM confirmed the LSPS minimum habitable floor level will be at 14.9 which is based on the February 2022 flood level +500mm freeboard.		Note
6.3	PM confirmed that the 0.2% AEP flood level was less than the February 2022 level.		Note
6.4	TC stated in 1989, a 1% flood made its way into Lismore from Leycester Creek. It is recommended that flood modelling consider the scenario where the Leycester Creek catchment (only) well creates a flooding event.	TTW	11/03/24
6.5	MCo noted setting the building floor height under the above criteria is viable for DOE. However, planning floor levels to the PMF level is unviable. Meeting attendees noted and supported the above approach.		Note
7.	**Flood Emergency Response for the School**		
7.1	PM summarised the draft evacuation strategy that has considered SES initial comments, also refer to the presentation in Appendix A: Key findings: • During a PMF event, the site is impacted by flooding approximately 11-12 hours after the onset of the storm. • Forty-eight (48) hours following the first impact at the school, the site remains inundated with hazard levels of H5, therefore shelter in place is not a viable emergency response strategy for the school. Flood Response: • Based on previous floods the LSPS can be evacuated between 2- 4 hours.		Note

NSW Education School Infrastructure

TSA

Item	Description	
	• Major plant such as hot water cylinder for hydraulic to be positioned above flood level where possible. • Usage of PVC for corrosion resistance and the drainage is to include expansion joints to prohibit damage from another flood. • It appears the electrical substation is sufficient however this is to be confirmed at the next design stage and will be upgraded if required.	
9.	**Preferred Masterplan**	
9.1	KG confirmed considerable consultation with the school has taken place to develop the design. KG presented the plans and blocking package, refer Appendix A.	Note
10.	**Planning and Authority Process**	
10.1	MK summarised the planning analysis and strategy, also refer to Appendix A: • The project will be via the SSDA pathway based on the CIV being above $50M. • The SEARs process is currently critical path and the team is proceeding with a project specific SEARs in lieu of industry specific. This will require a more detailed request for SEARs. • The agreed process with DPHI is to request industry specific SEARS, which is to be rejected and then we reapply for project specific SEARs. • Once SEARs has been provided the project team is to address all technical points and further engagement to develop the Environmental Impact Statement. Additionally, the LEP will be addressed. • Considerations for the requirements of the Draft DCP will also be addressed.	Note
10.2	AP advised that the Council did not recently endorse the Draft DCP via the last Council meeting. Therefore, there is no time frame for a new DCP. MK requested clarity on the classification of commercial establishments and whether this is likely to shift. AP stated this is a difficult position as it has been rejected by Council, however the reasoning for Council not supporting the Draft DCP was not connected to the planning matters considered at LSPS and thus unlikely to change. AP further noted the Engeny interim report is available for flood planning controls and recommendations made for DCP. RM noted uncertainty regarding Council debating establishment of DCP, noting this is not believed to be an issue and even if draft DCP is not adopted based on this presentation best practice is expected for this site.	Note
10.3	MK noted a full scoping report is to be included in SEARs request and proposed approach, advising any feedback in the submission is to be included.	Note
11.	**Open Discussion**	
11.1	MCo invited Council, SES, and DPHI to furnish any additional responses regarding the Project Team's due diligence and recommendations. It is critical to comprehend key issues or critical areas that require attention.	Note
11.2	Council: AP noted given this will be an SSD, the approach to rebuild at existing site which is above 2022 flood event which	Note

NSW Education School Infrastructure

TSA

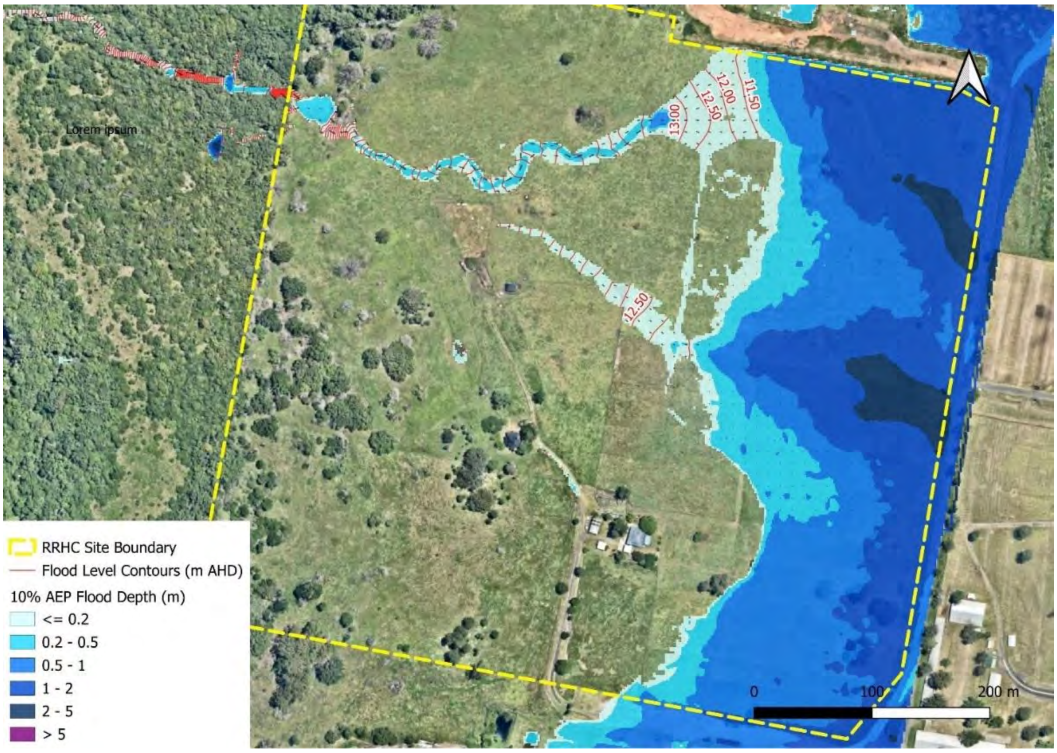
Item	Description		
	is to service the community is a great outcome for the council. The proposal is looking to rebuild the school in a better way will be supported by Council.		
11.3	Council: RM noted that the LEP will need to be addressed as apart of the SSD. MK believes that the proposal will address this and will be fully detailed in the authority submission.	Gytte	11/03/24
11.4	DPHI: TC stated it is common to assess risk versus consequence, noting this is a H5 risk and an assessment is normally conducted of consequence and potential outcomes. The Project Team to consider a risk assessment for the site.	TSA	11/03/24
11.5	SES: No further comment to those provided through the meeting.		Note
11.6	JM noted that there appear to be no obstacles to rebuilding the school on the current location, and all present are supportive. All significant meeting actions should be considered by the Project Team. Key Actions: • All surrounding catchments to be considered in the flood model. • The evacuation strategy to consider closing the school at flood watch with notifications to be clearly detailed. • Evacuation strategy for the school to be assessed and determine if buses are available for students that do not have parents to collect them. • Detailed risk analysis to be considered in the authority submission.		Note
12.	**Other Business**		
12.1.	JM noted that Richmond River High Campus is still looking for a preferred locality and is under due diligence on a number of sites. Once a preferred site is selected further engagement with this group will be requested.		Note

Appendices:
Appendix A – NRFR – SES_Council Meeting Presentation - 240221

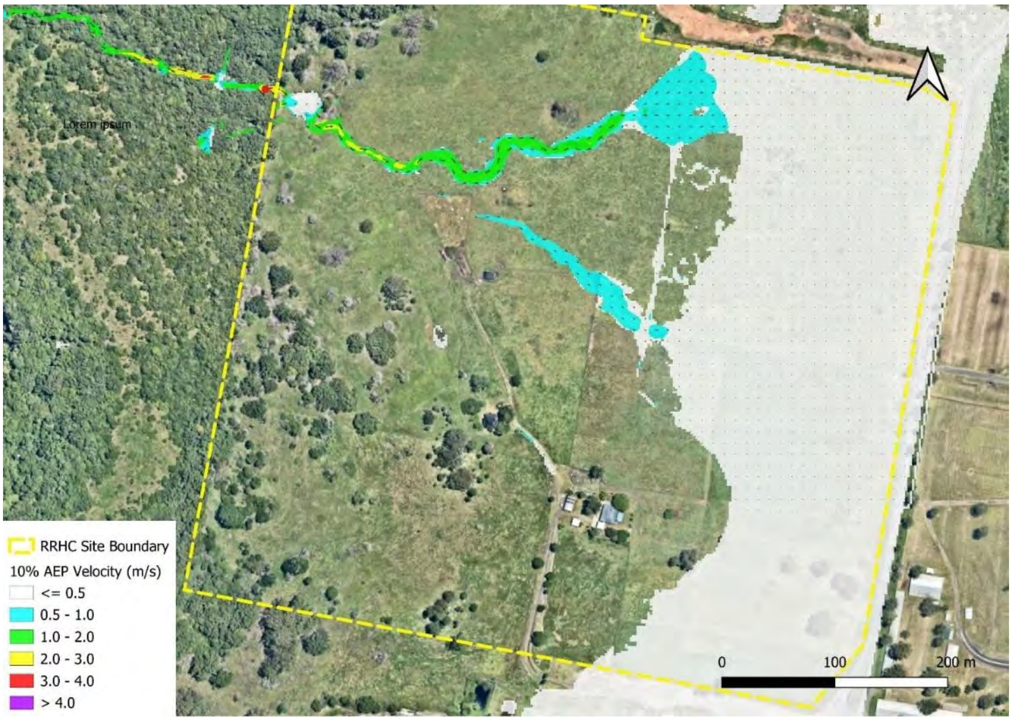
Appendix B

Flood Maps – Existing Scenario

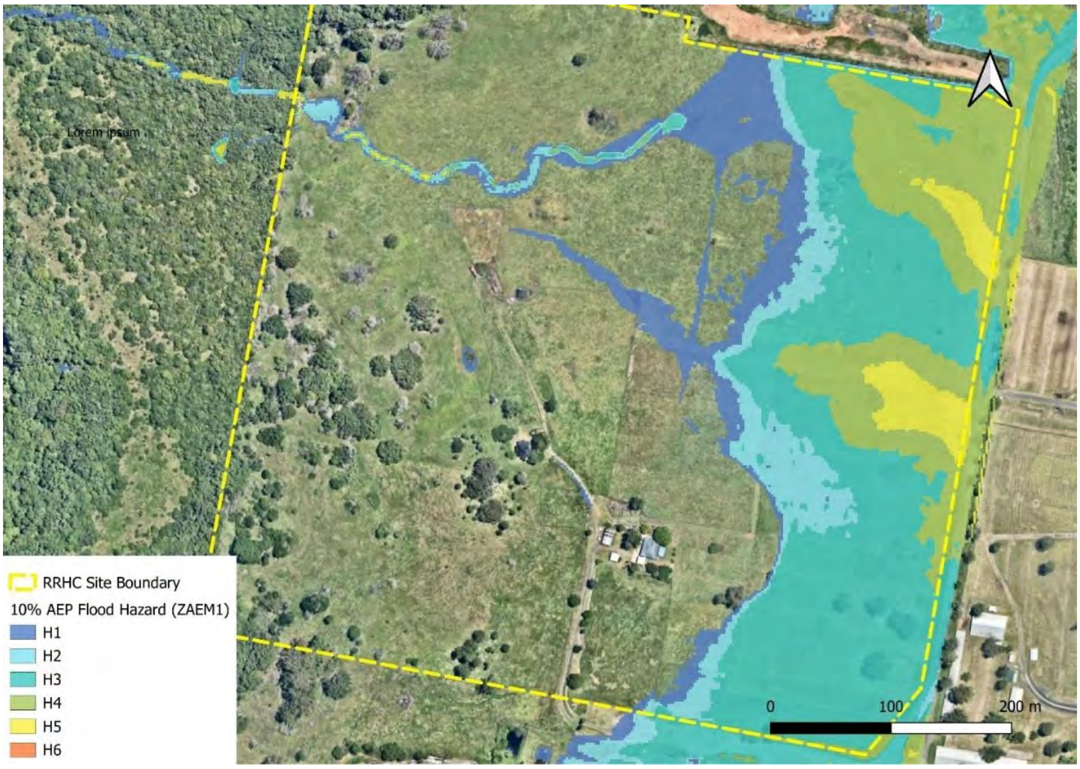
10% AEP Event



Appendix B 1: 10% AEP flood depths and levels at the proposed RRHC site under existing site conditions



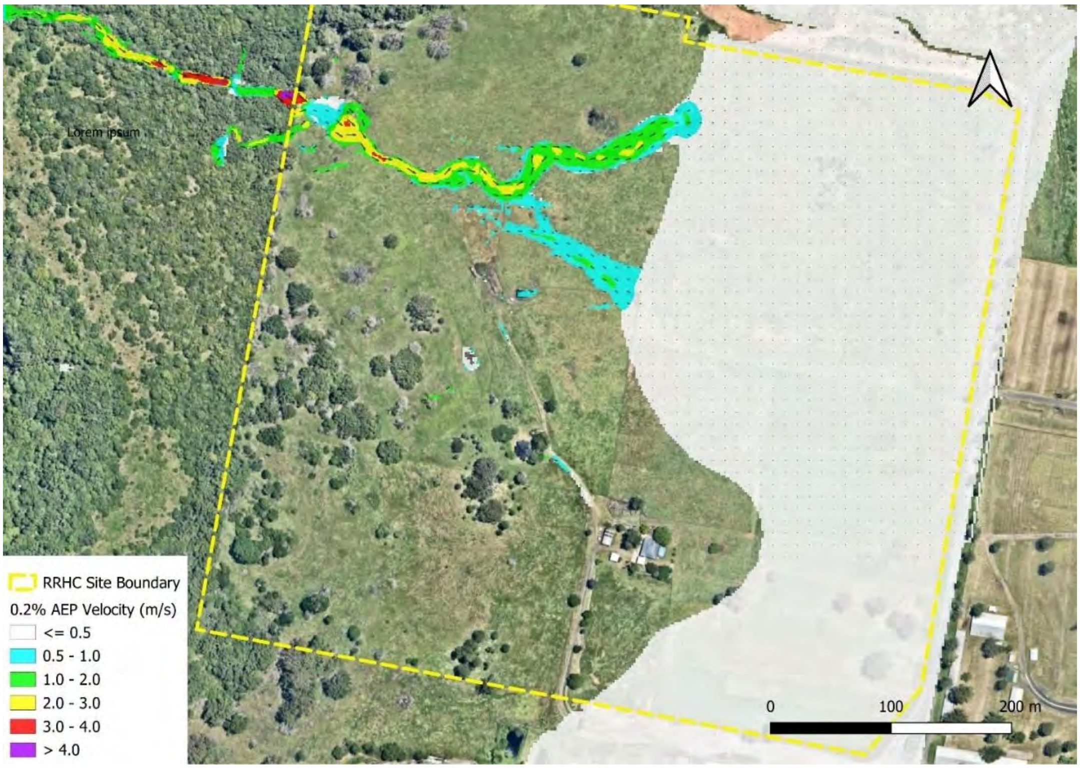
Appendix B 2: 10% AEP flood velocities at the proposed RRHC site under existing site conditions



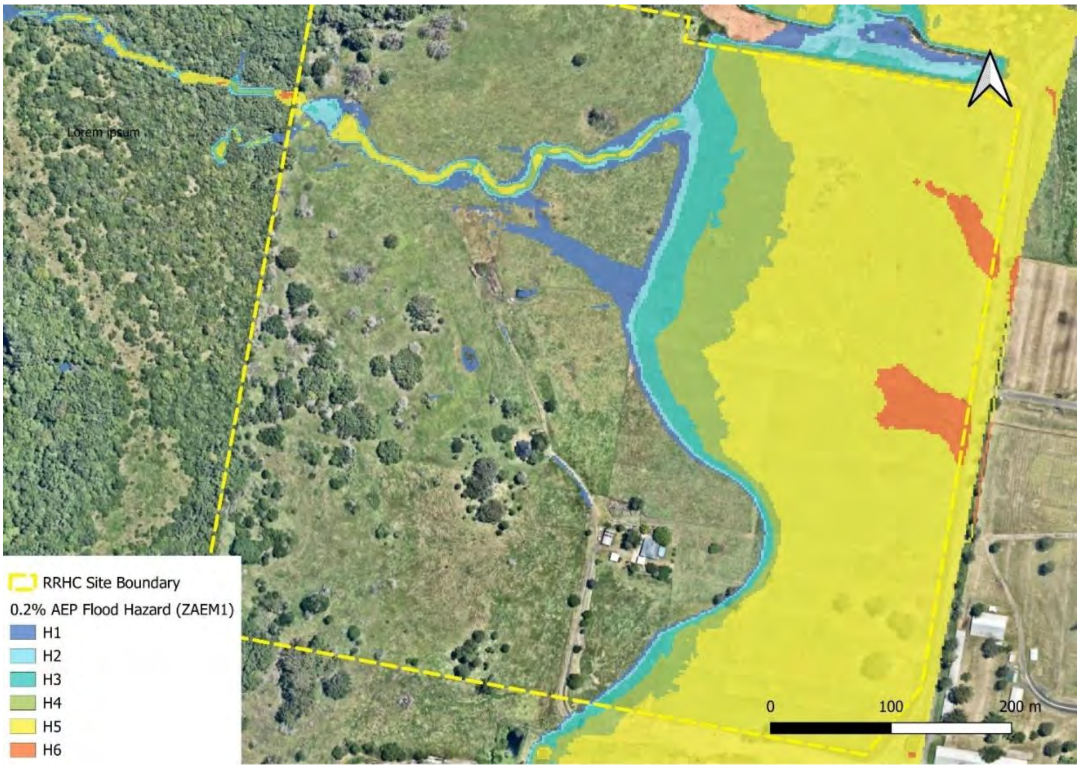
Appendix B 3: 10% AEP flood hazard categorisation at the proposed RRHC site under existing site conditions

5% AEP Event

Appendix B 4: 5% AEP flood depths and levels at the proposed RRHC site under existing site conditions

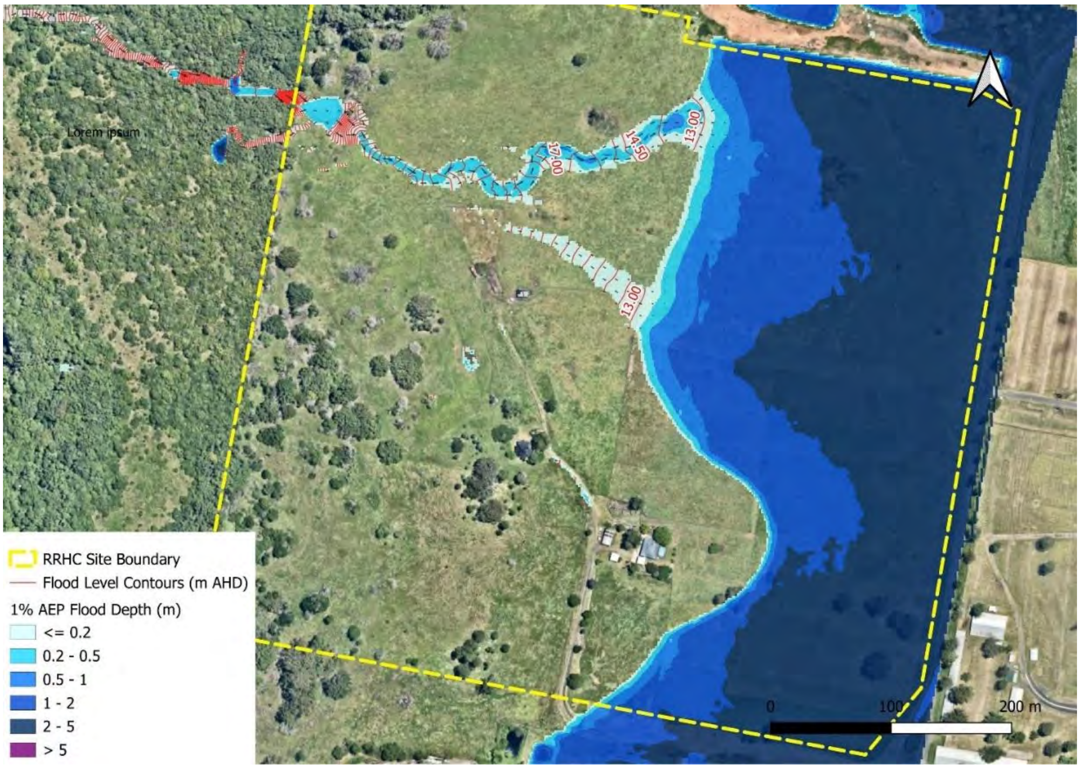


Appendix B 5: 5% AEP flood velocities at the proposed RRHC site under existing site conditions

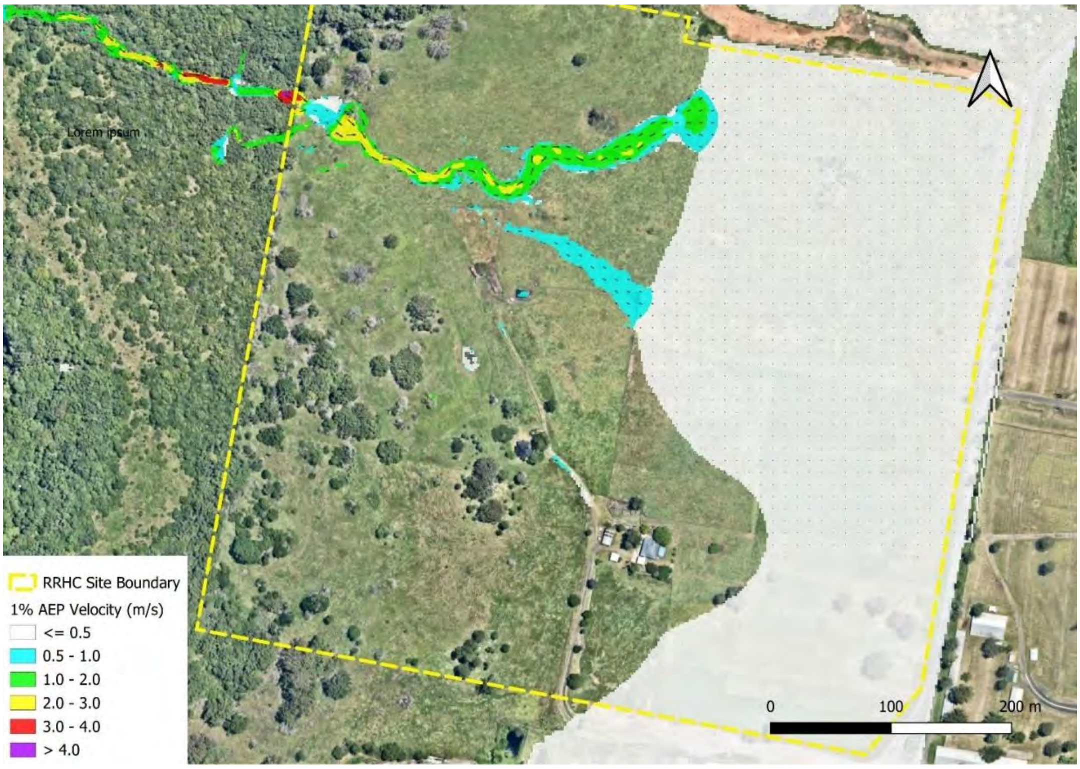


Appendix B 6: 5% AEP flood hazard categorisation at the proposed RRHC site under existing site conditions

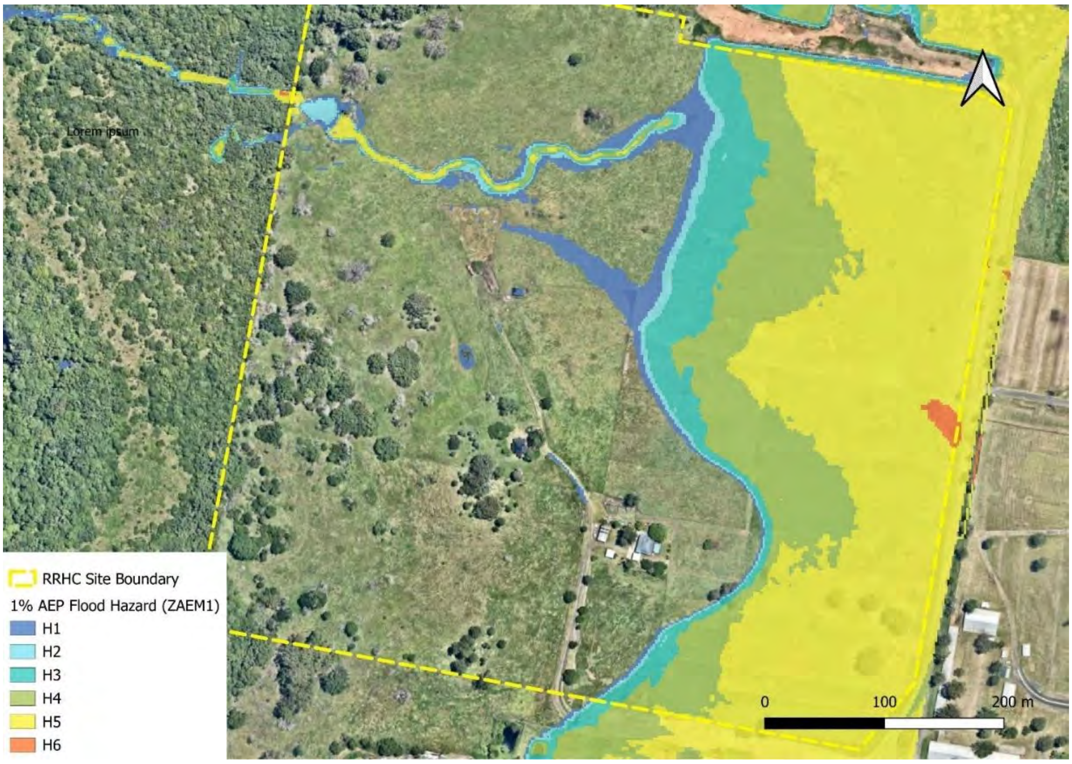
1% AEP Event



Appendix B 7: 1% AEP flood depths and levels at the proposed RRHC site under existing site conditions



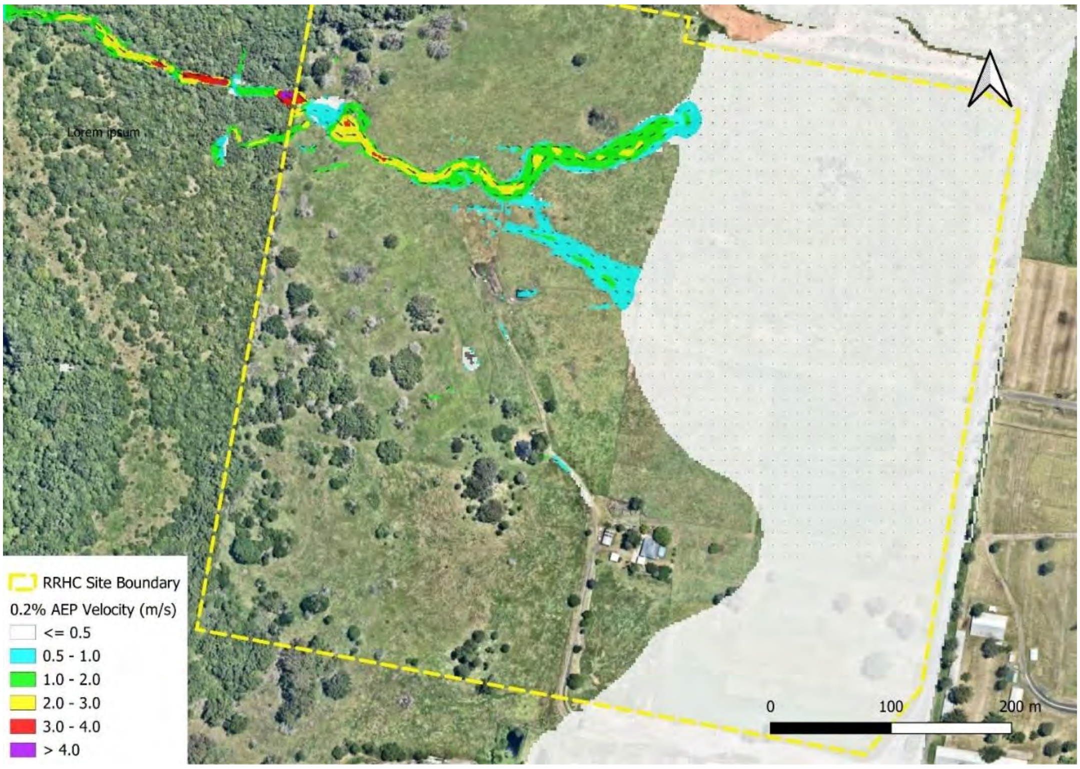
Appendix B 8: 1% AEP flood velocities at the proposed RRHC site under existing site conditions



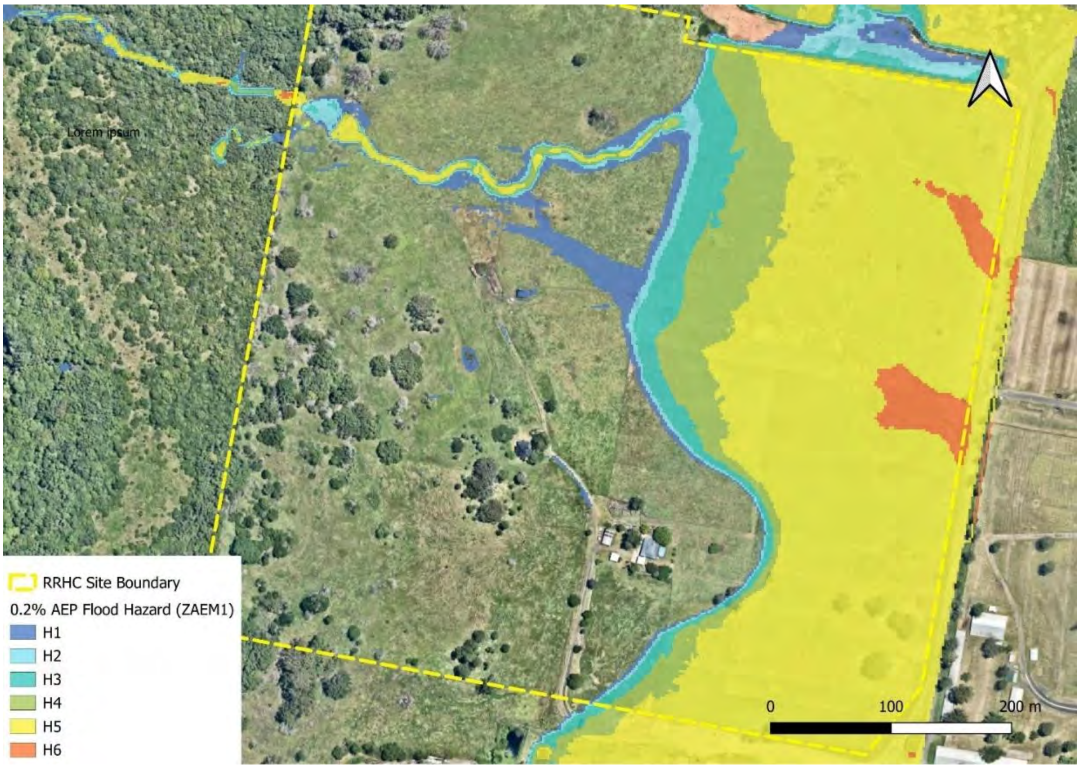
Appendix B 9: 1% AEP flood hazard categorisation at the proposed RRHC site under existing site conditions

0.2% AEP Event

Appendix B 10: 0.2% AEP flood depths and levels at the proposed RRHC site under existing site conditions

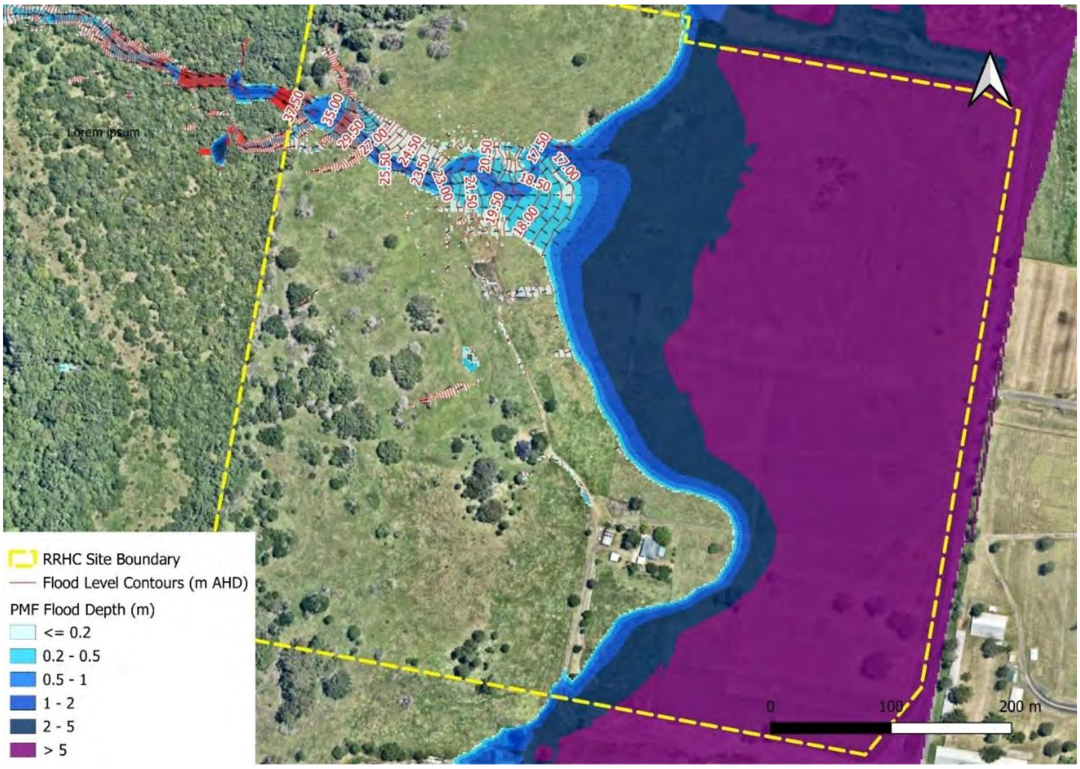


Appendix B 11: 0.2% AEP flood velocities at the proposed RRHC site under existing site conditions

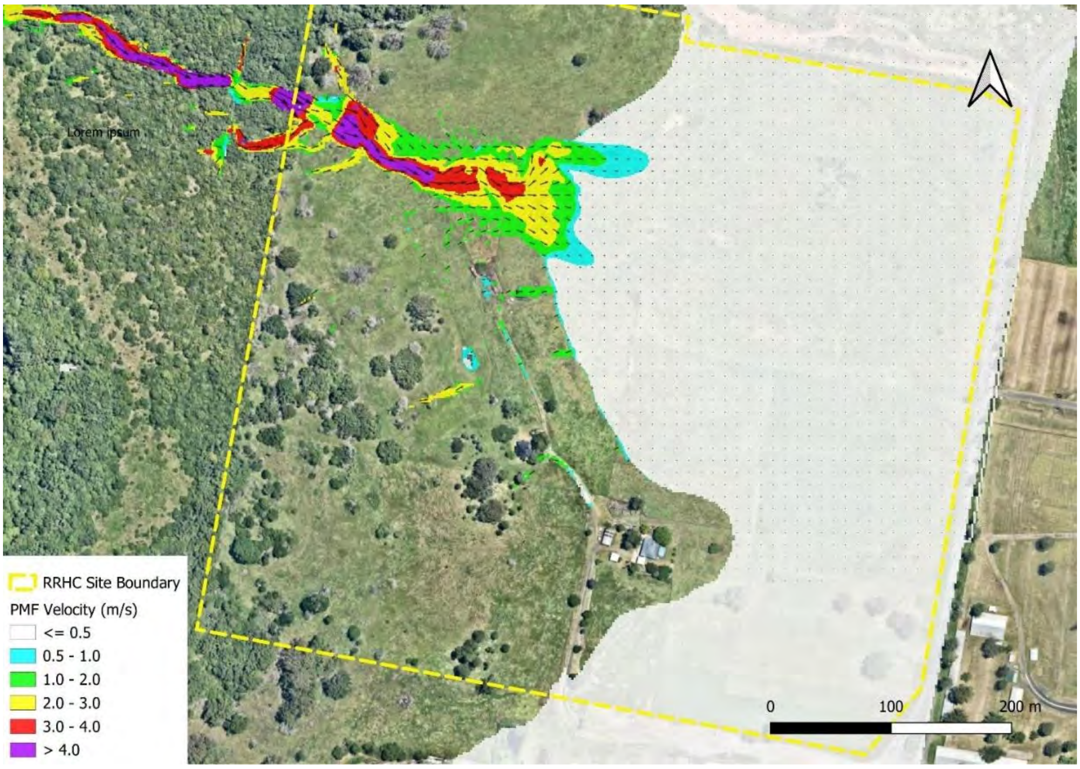


Appendix B 12: 0.2% AEP flood hazard categorisation at the proposed RRHC site under existing site conditions

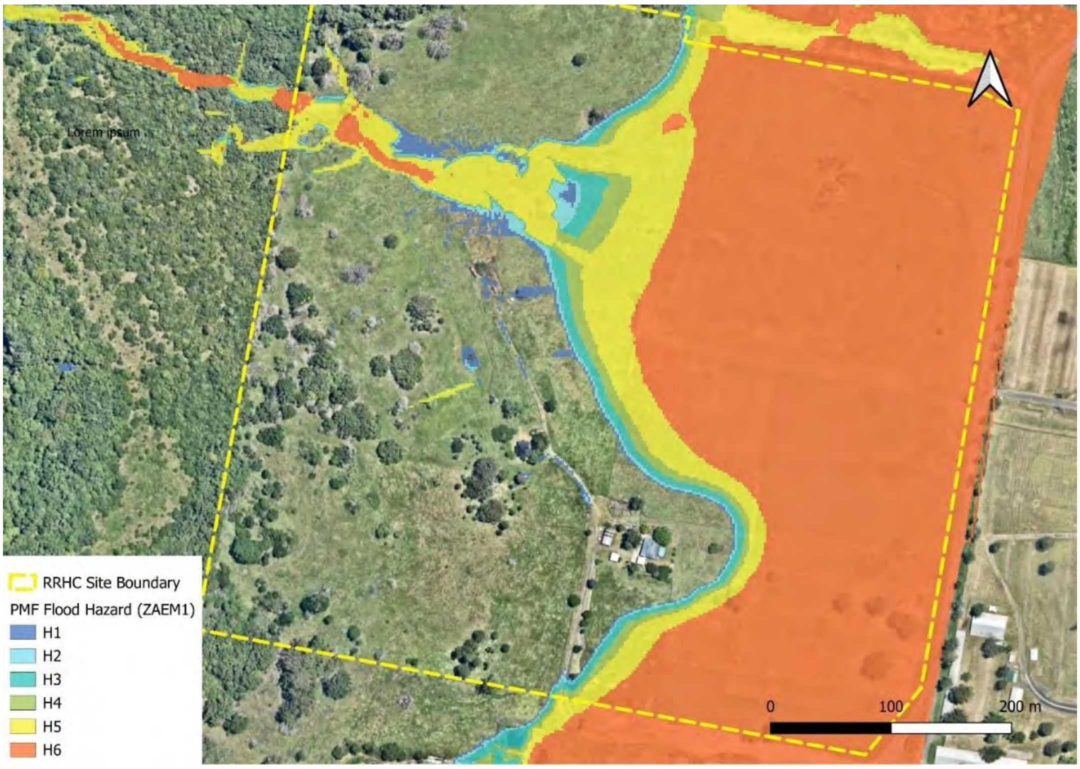
PMF Event



Appendix B 13: PMF depths and levels at the proposed RRHC site under existing site conditions



Appendix B 14: PMF velocities at the RRHC site under existing site conditions

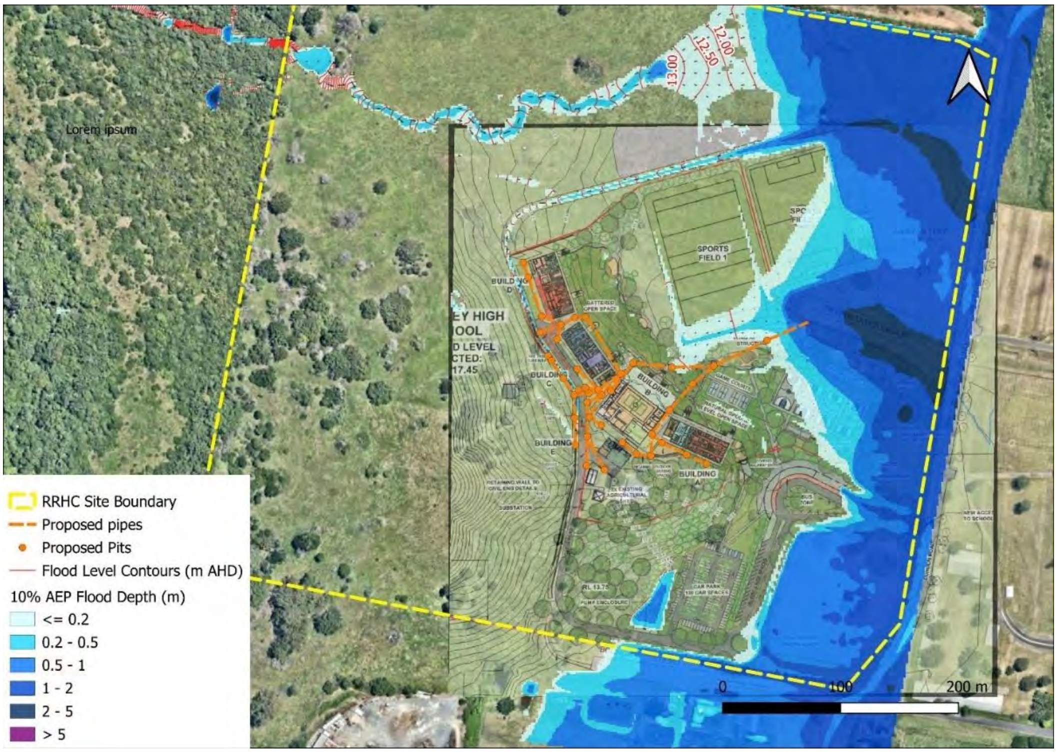


Appendix B 15: PMF hazard categorisation at the proposed RRHC site under existing site conditions

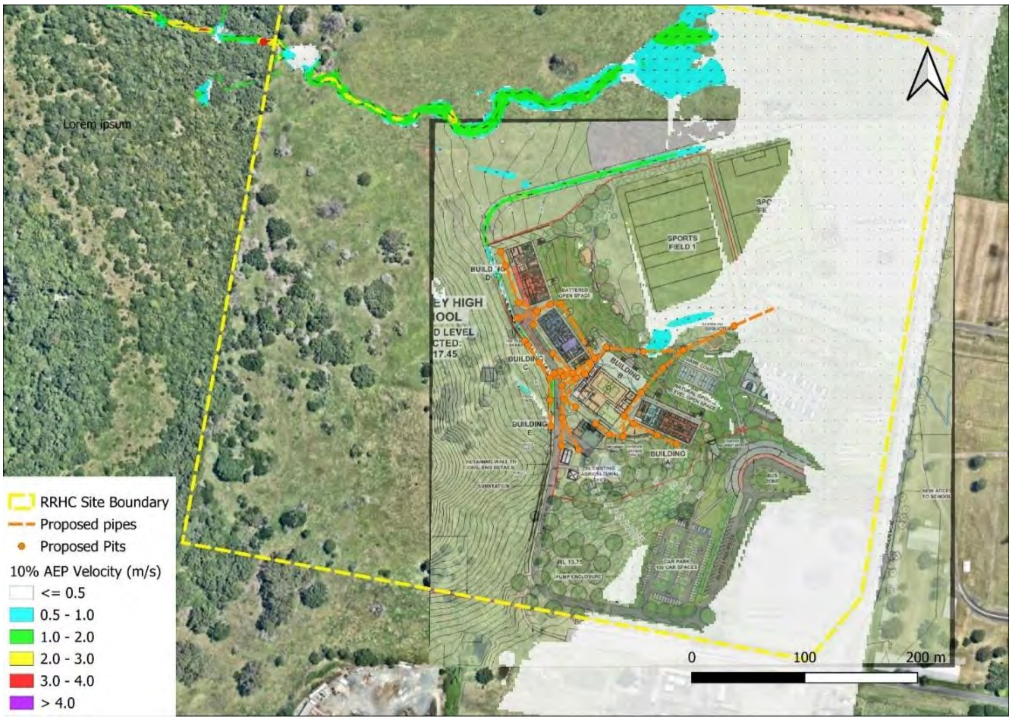
Appendix C

Flood Maps – Post-Development Scenario

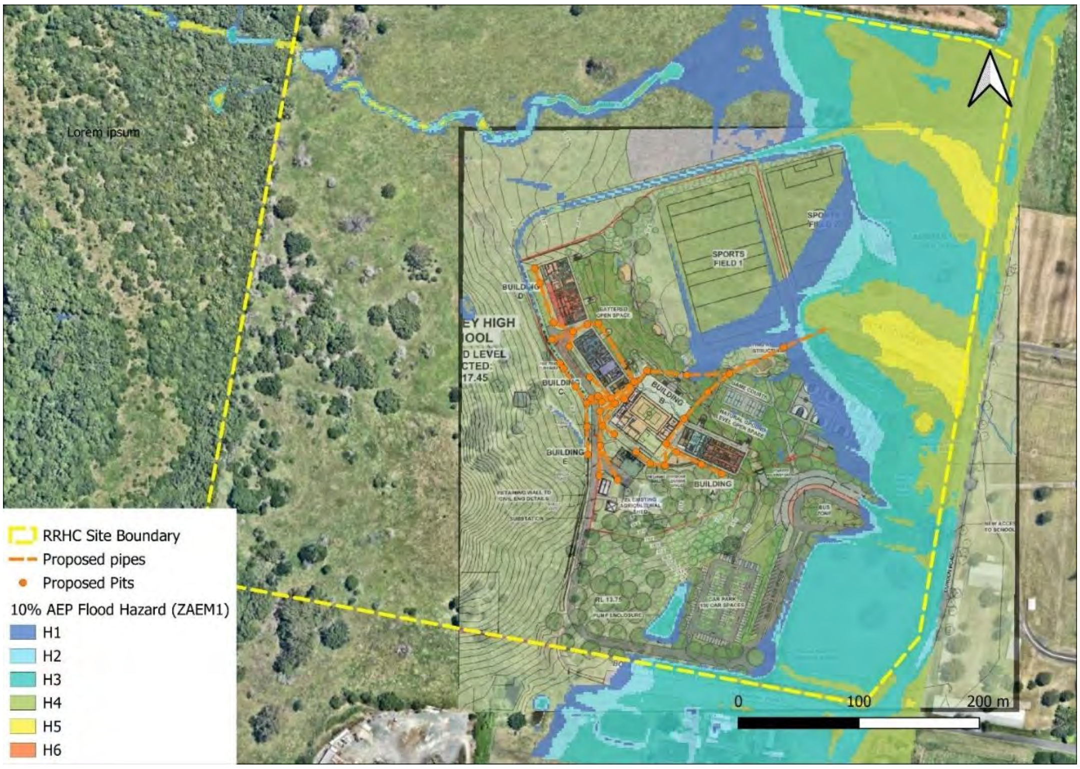
10% AEP Event



Appendix C 1: 10% AEP flood depths and levels at the LSPS site under post-development site conditions

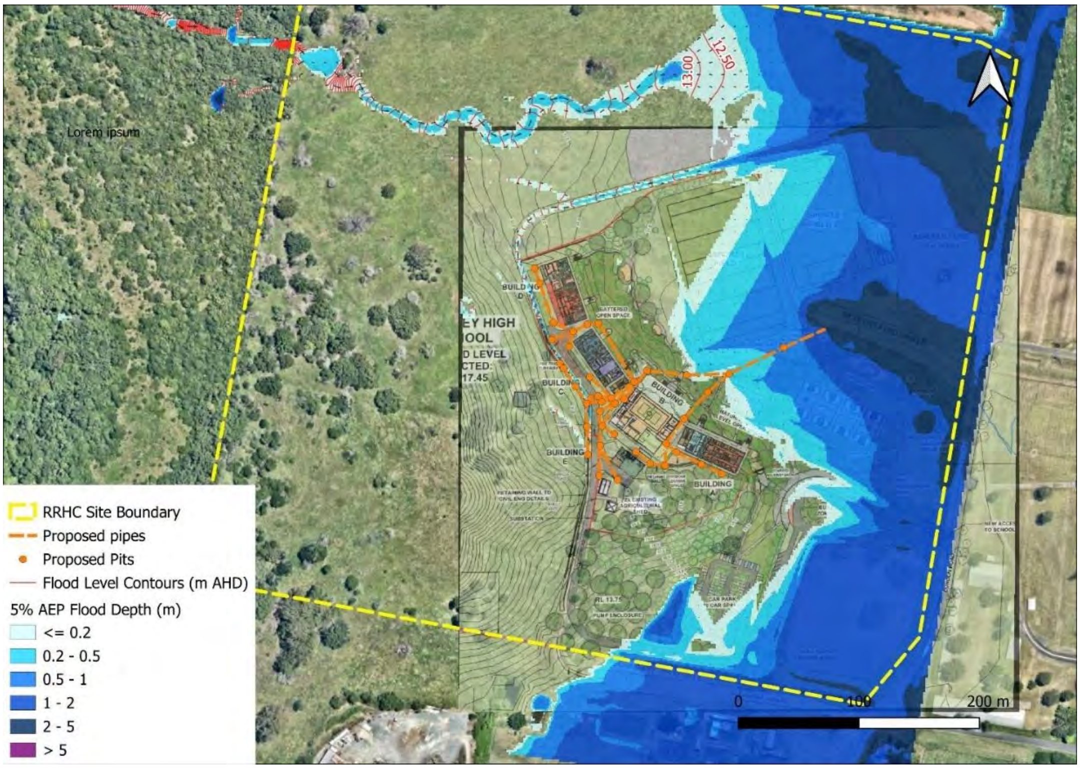


Appendix C 2: 10% AEP flood velocities at the LSPS site under post-development site conditions

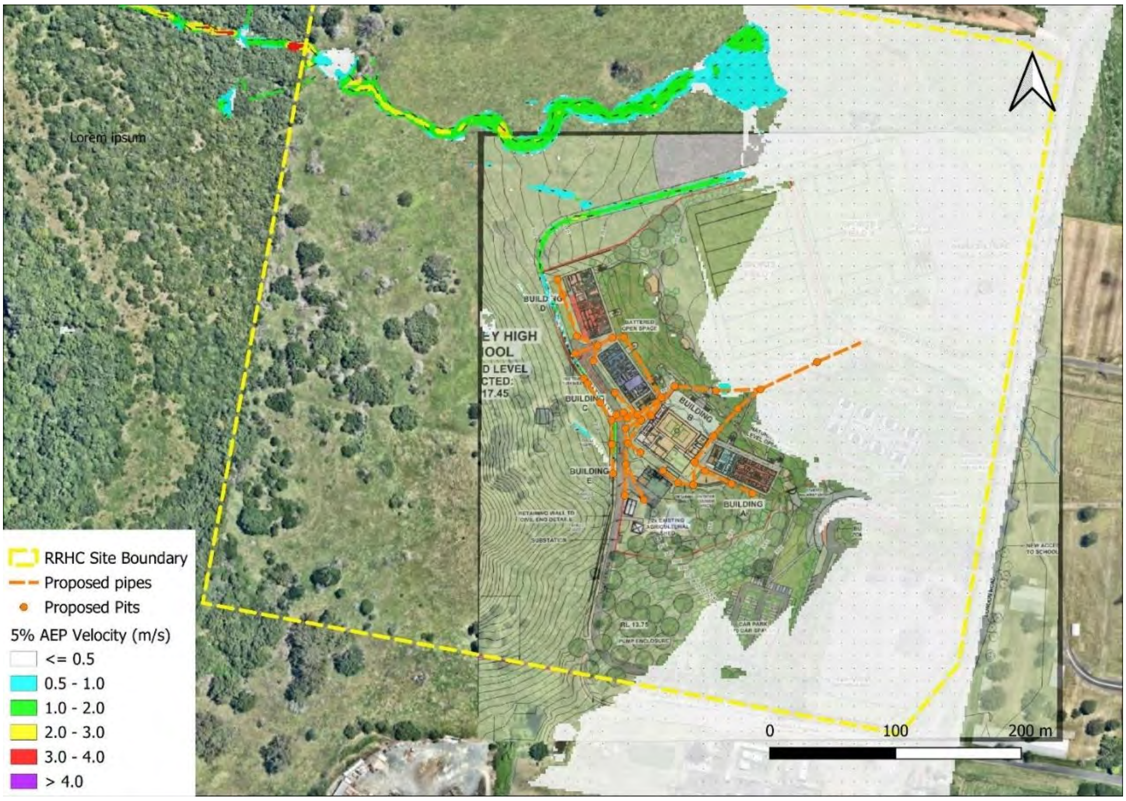


Appendix C 3: 10% AEP flood hazard categorisation at the LSPS site under post-development site conditions

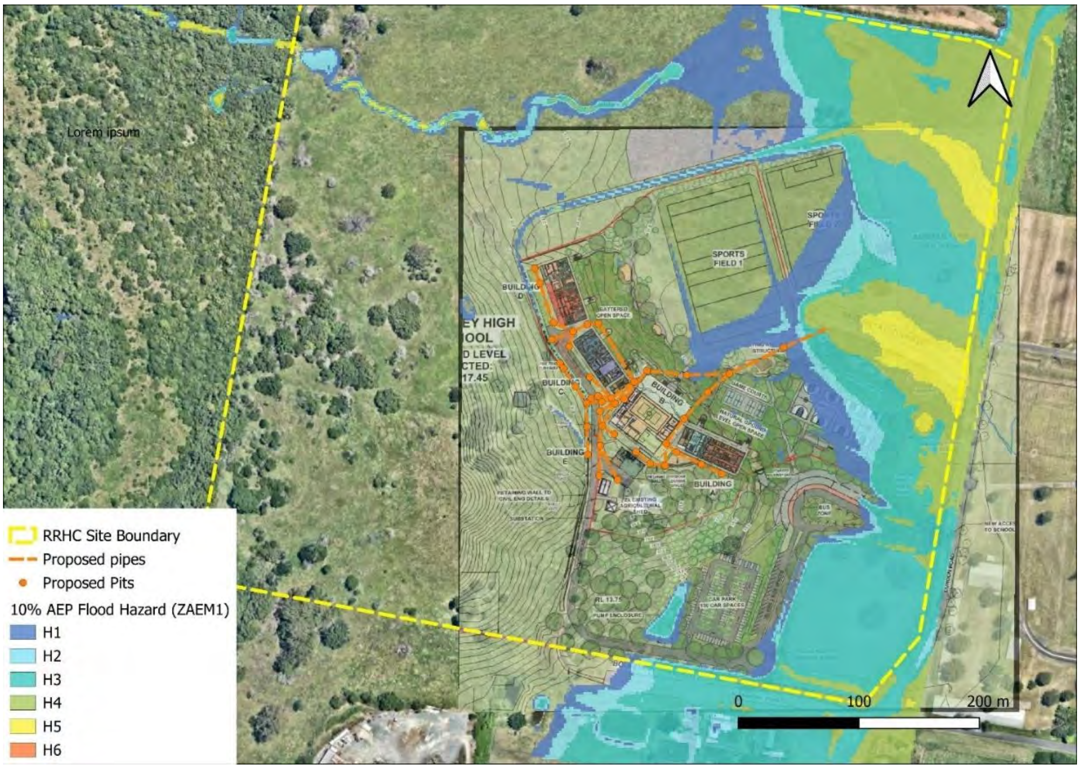
5% AEP Event



Appendix C 4: 5% AEP flood depths and levels at the RRHC site under post-development site conditions

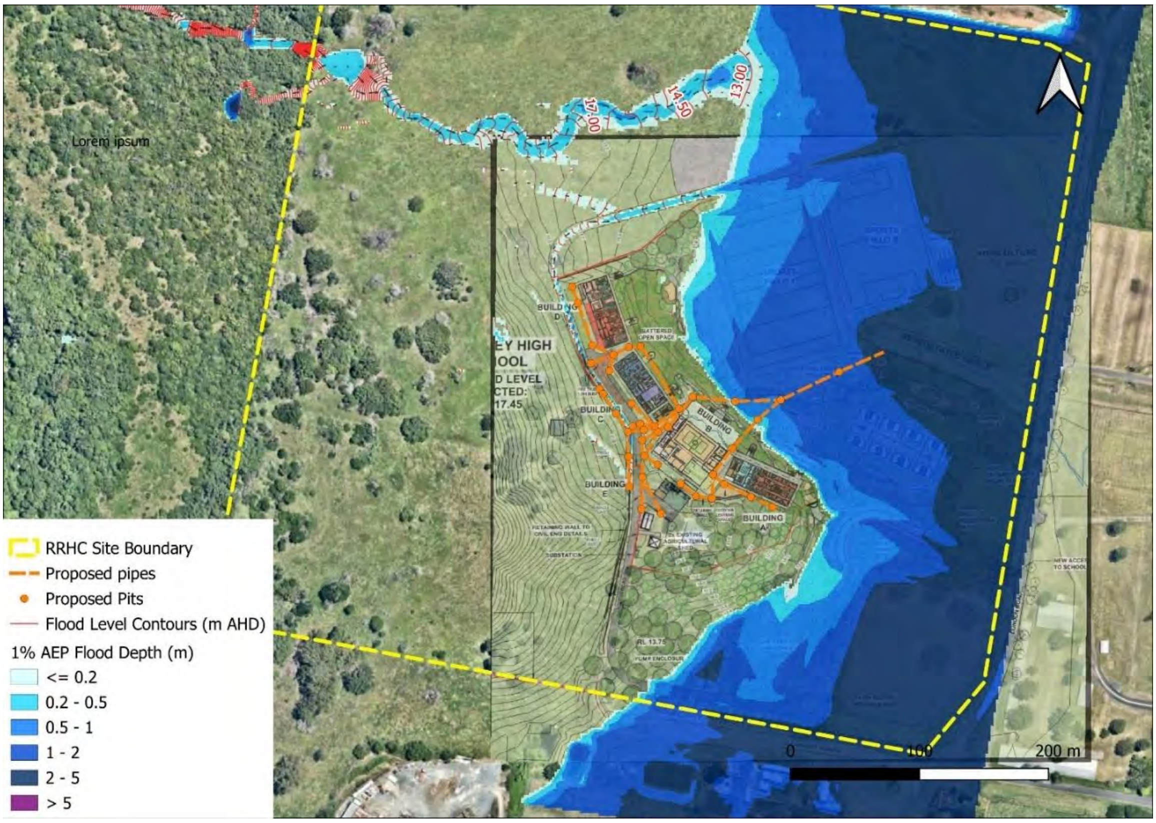


Appendix C 5: 5% AEP flood velocities at the RRHC site under post-development site conditions

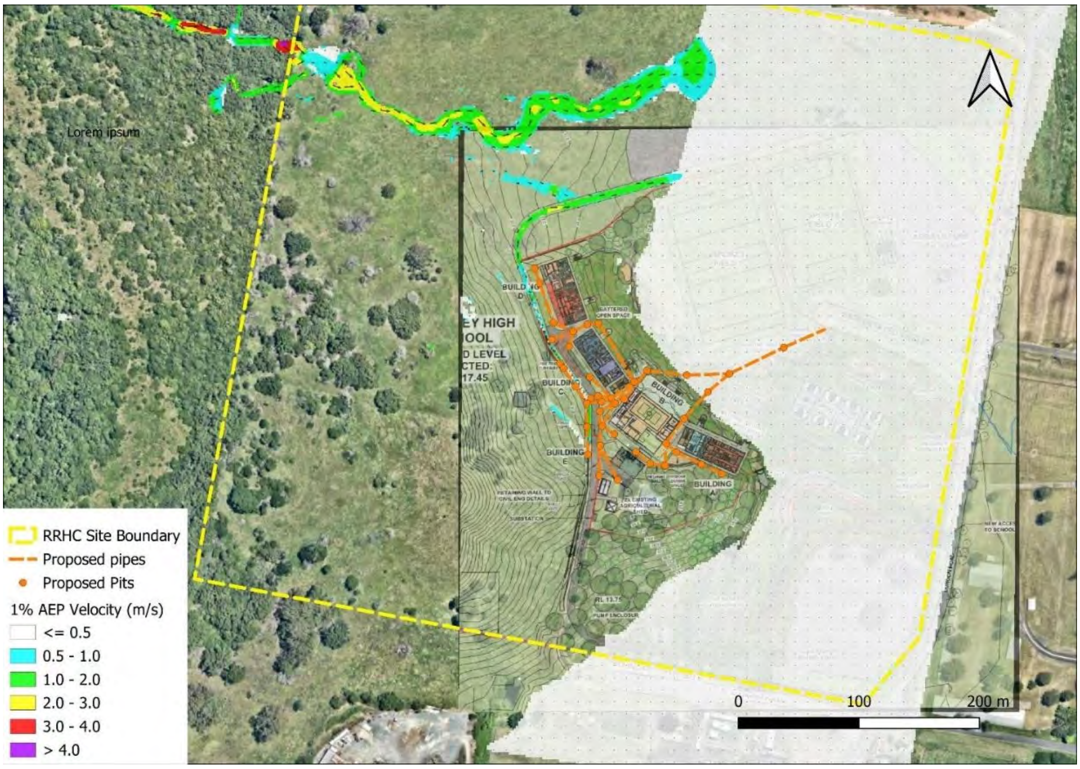


Appendix C 6: 5% AEP flood hazard categorisation at the RRHC site under post-development site conditions

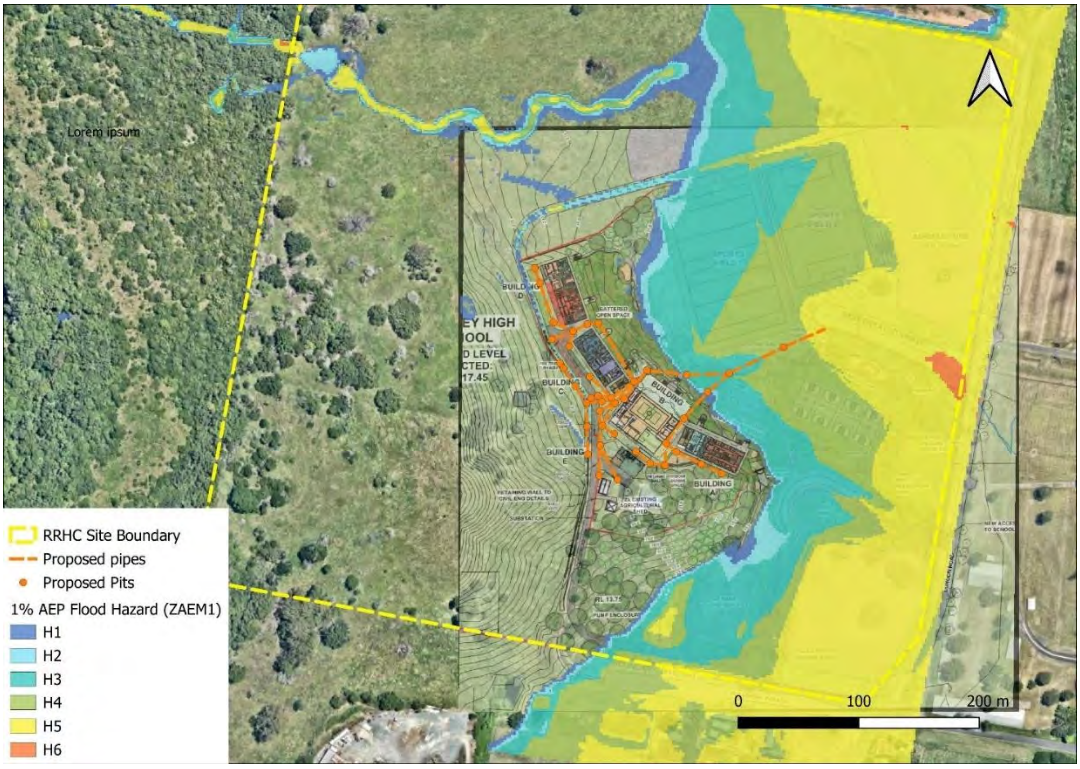
1% Event



Appendix C 7: 1% AEP flood depths and levels at the LSPS site under post-development site conditions

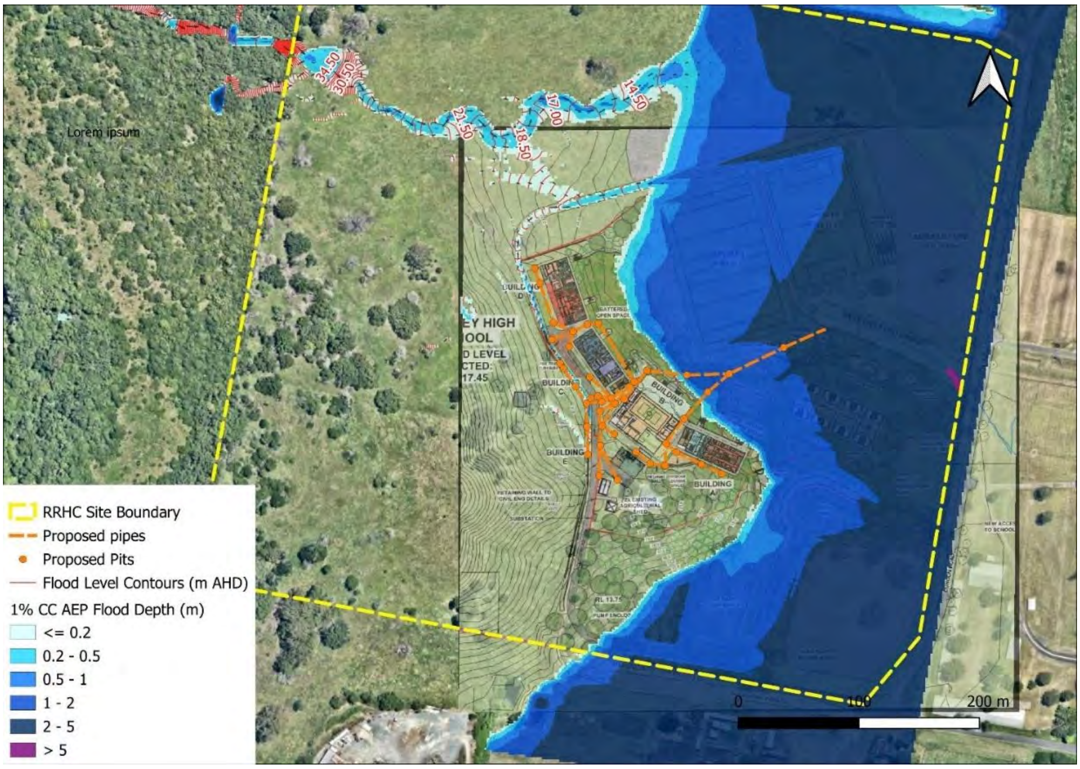


Appendix C 8:*1% AEP flood velocities at the RRHC site under post-development site conditions*

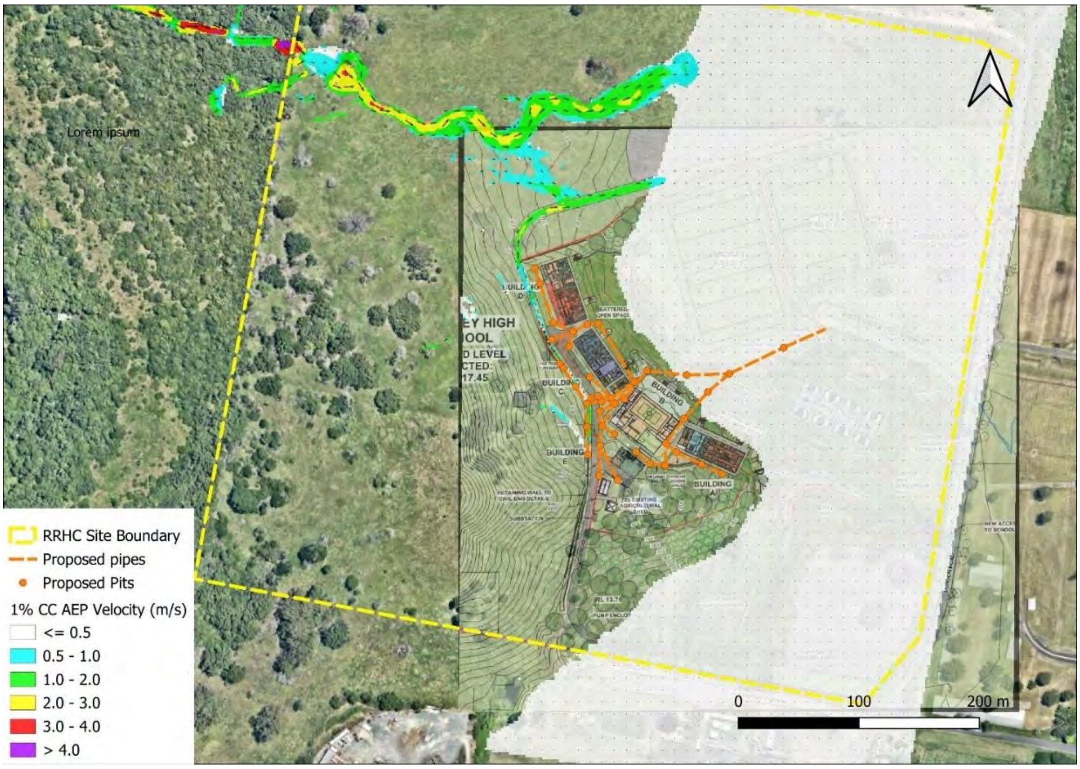


Appendix C 9: 1 % *AEP flood hazard categorisation at the RRHC site under post-development site conditions*

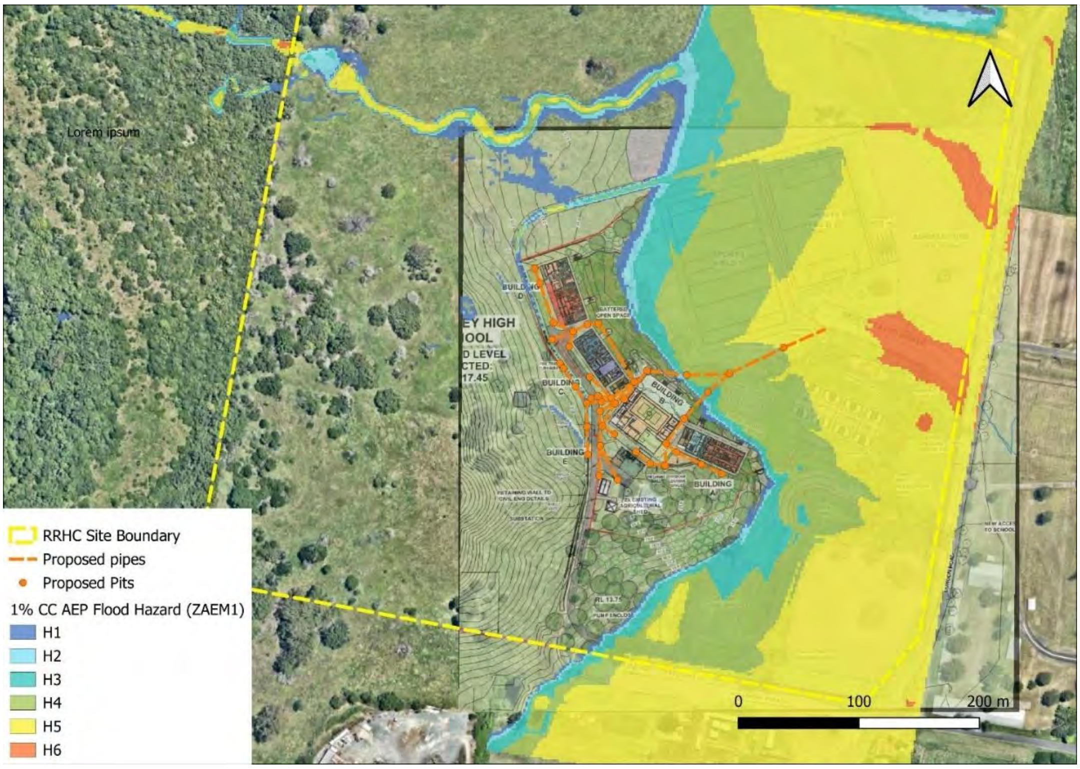
1% CC Event



Appendix C 9: 1% CC AEP flood depths and levels at the RRHC site under post-development site conditions

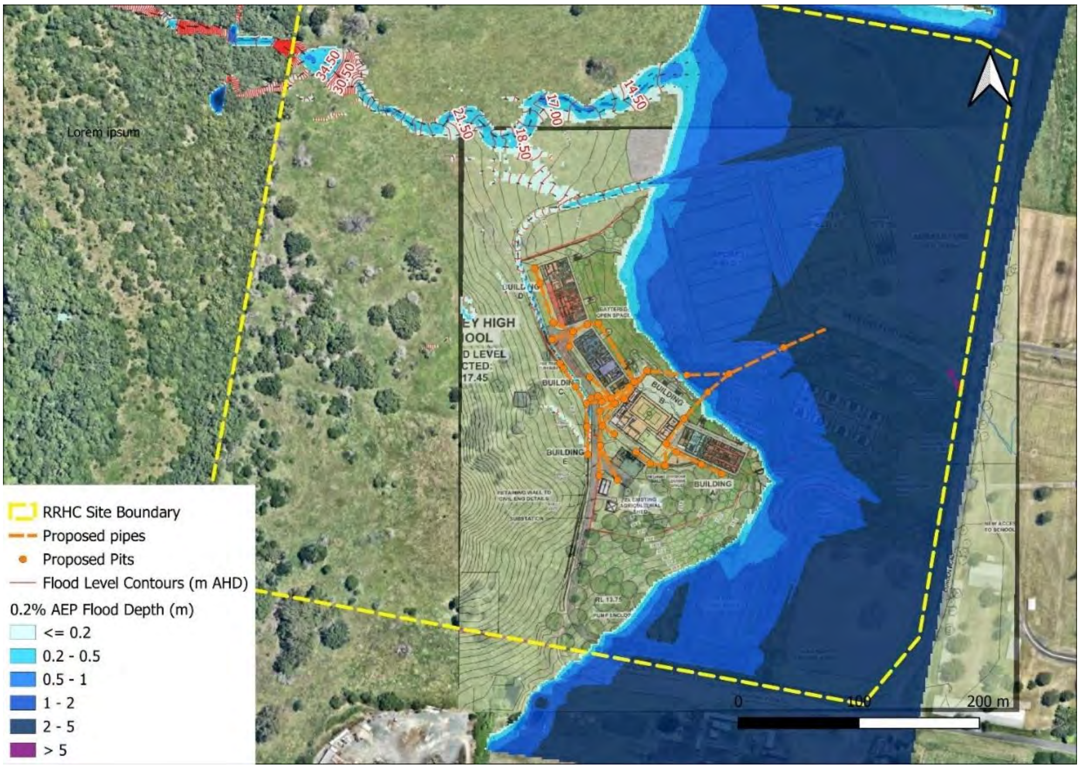


Appendix C 10*: 1% CC AEP flood velocities at the RRHC site under post-development site conditions*

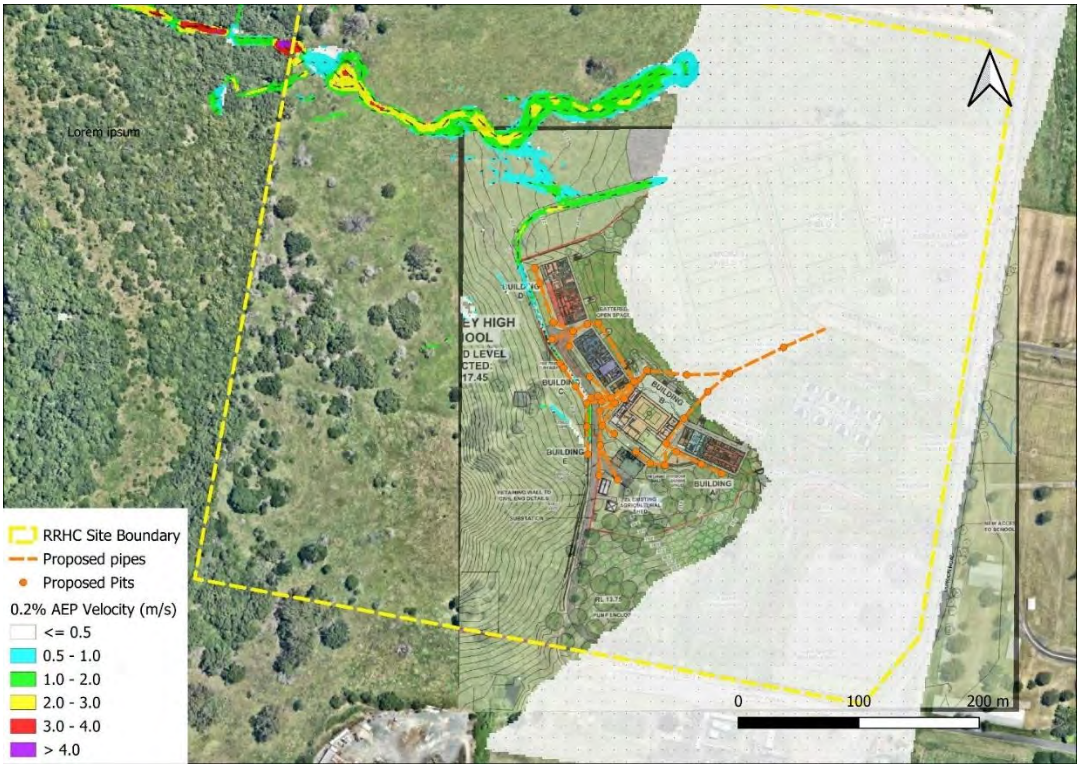


Appendix C 11- 1% *CC AEP flood hazard categorisation at the RRHC site under post-development site conditions*

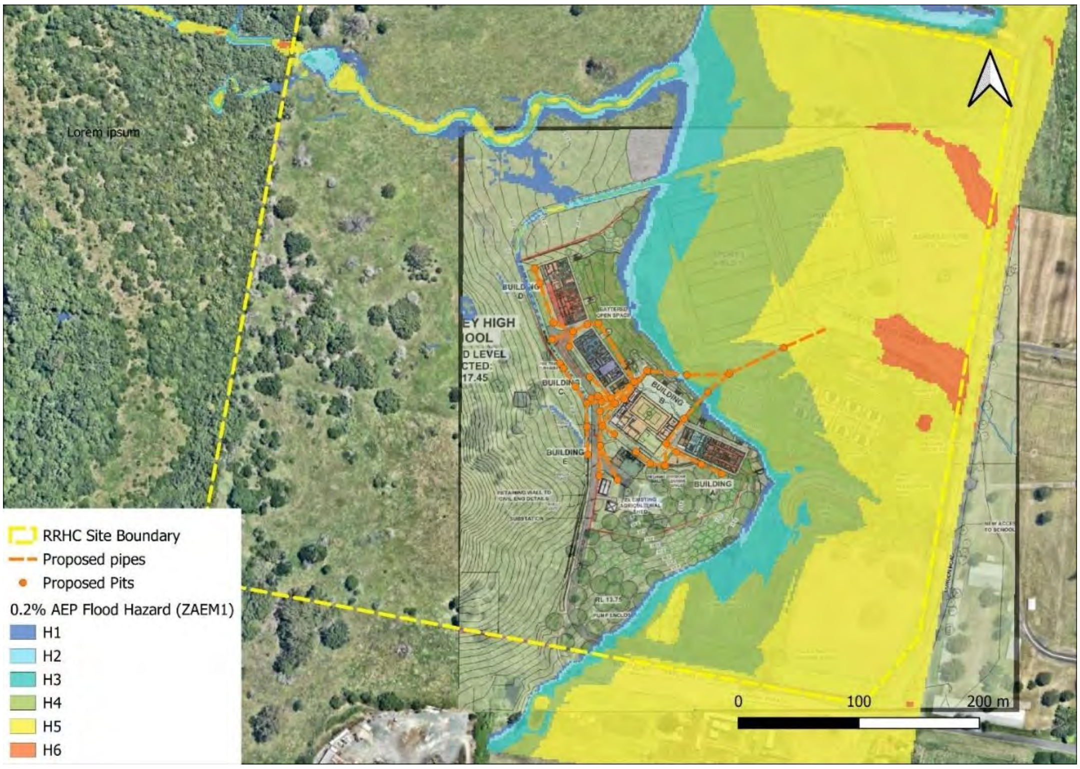
0.2% AEP Event



Appendix C 12: 0.2% AEP flood depths and levels at the RRHC site under post-development site conditions

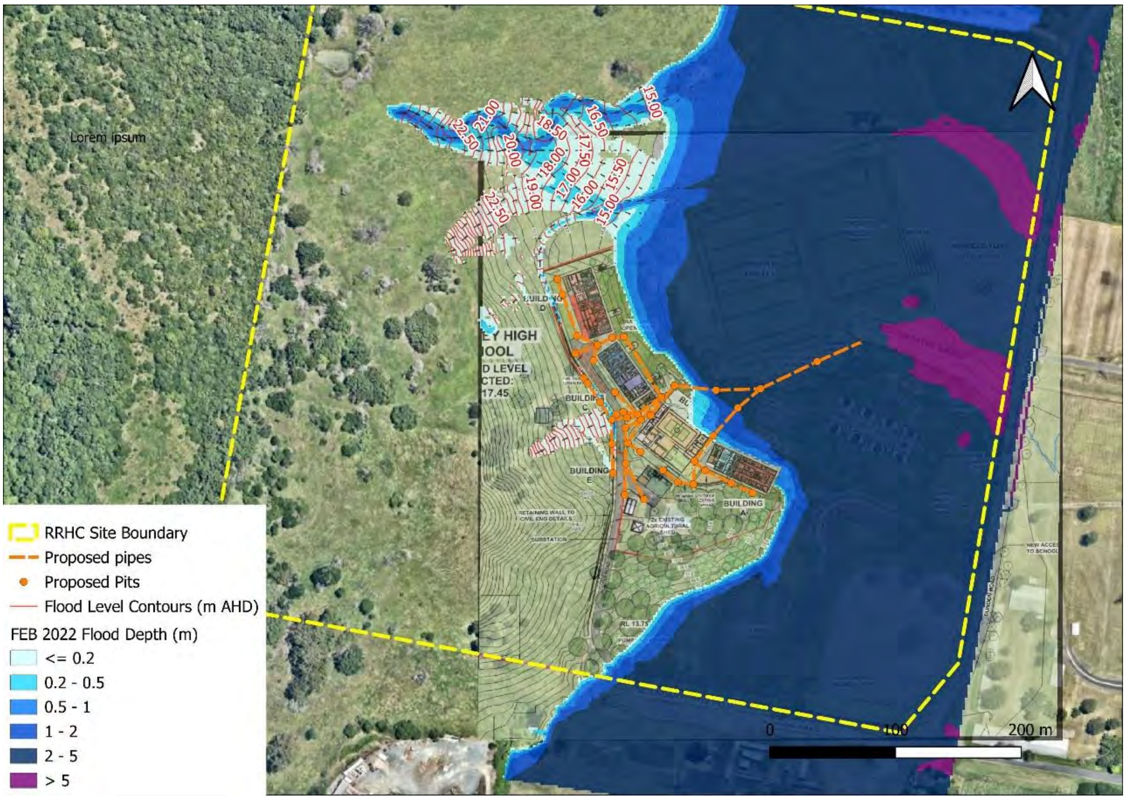


Appendix C 13: 0.2% AEP flood velocities at the RRHC site under post-development site conditions

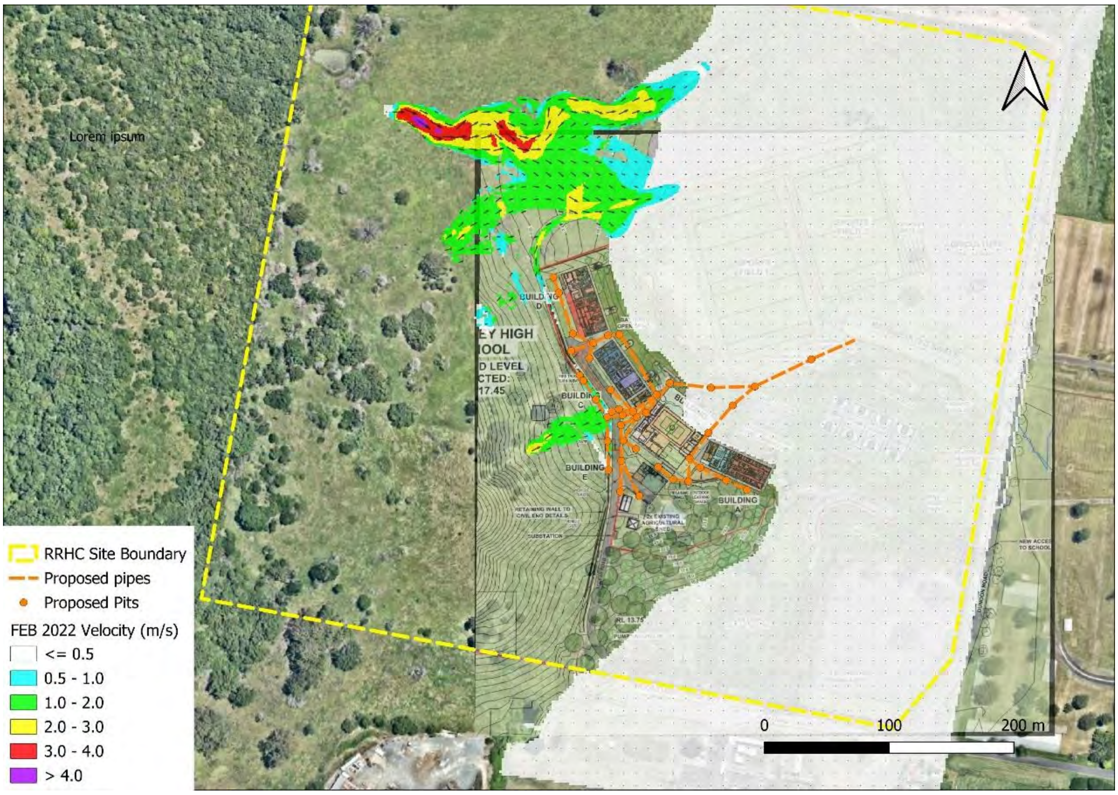


Appendix C 14: 0.2% AEP flood hazard categorisation at the RRHC site under post-development site conditions

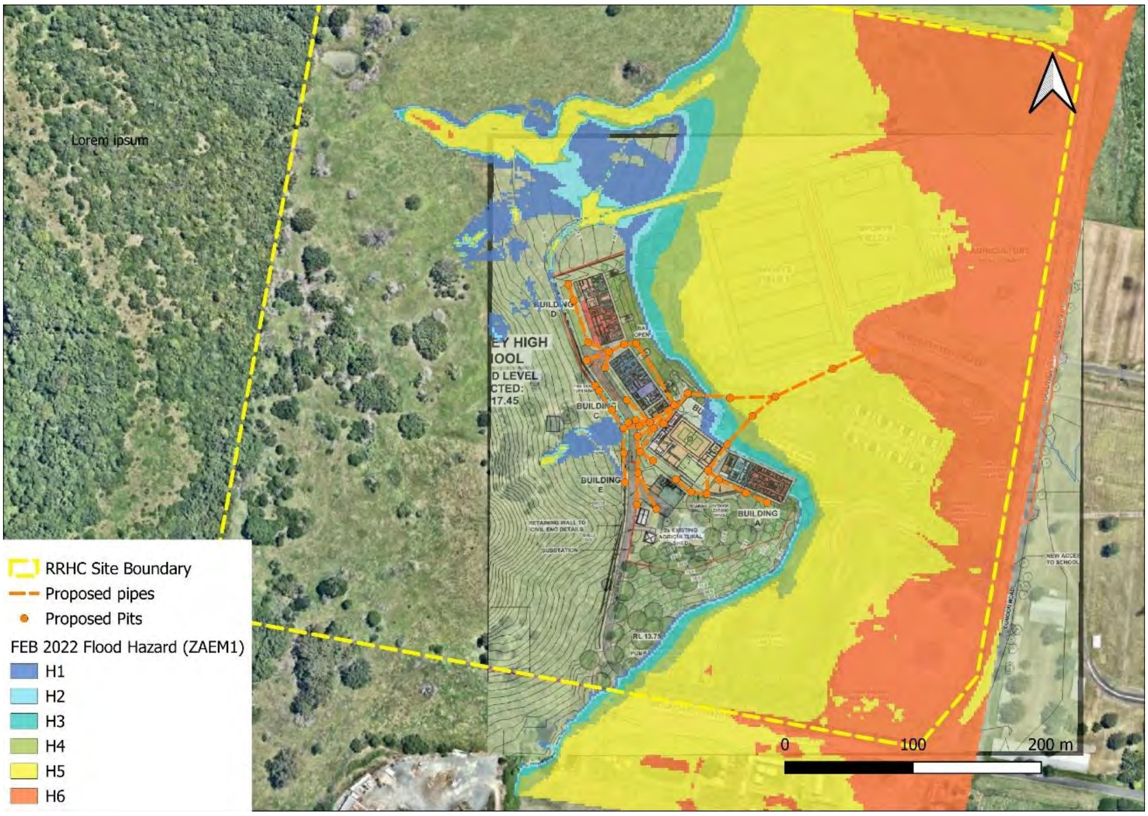
Feb 2022 Event



Appendix C 15: Feb 2022 flood depths and levels at the RRHC site under post-development site conditions

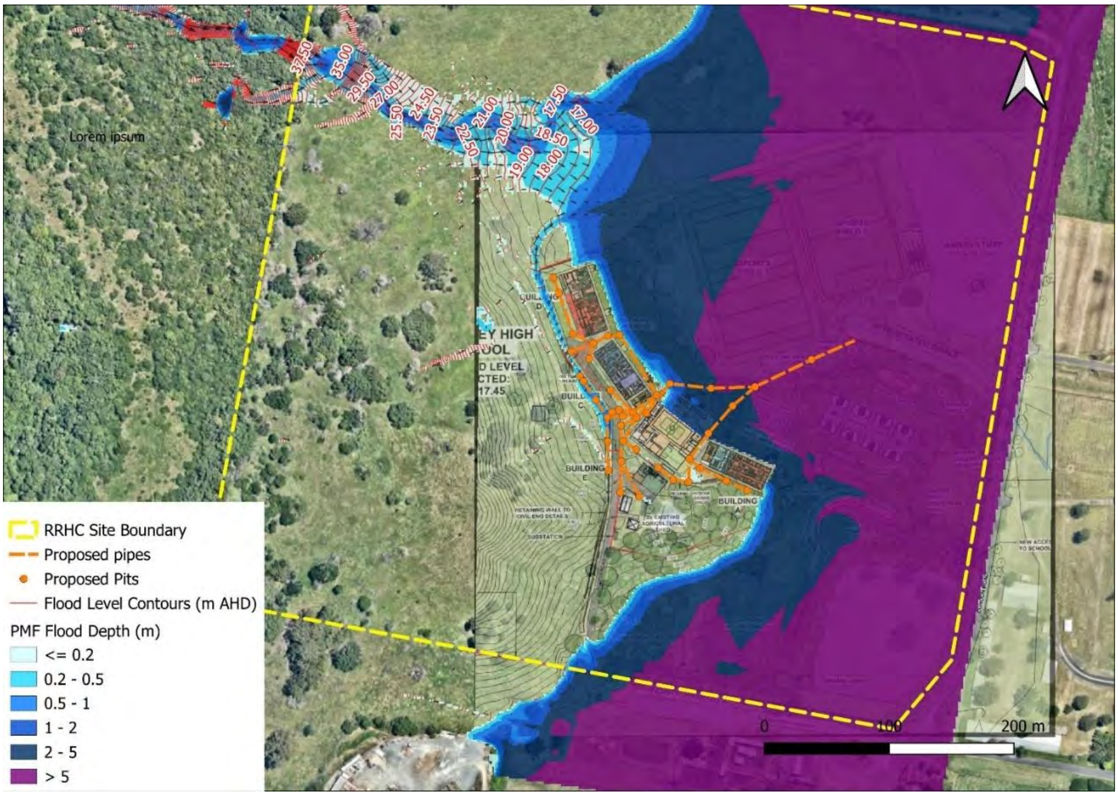


Appendix C 16: *Feb 2022 flood velocities at the RRHC site under post-development site conditions*

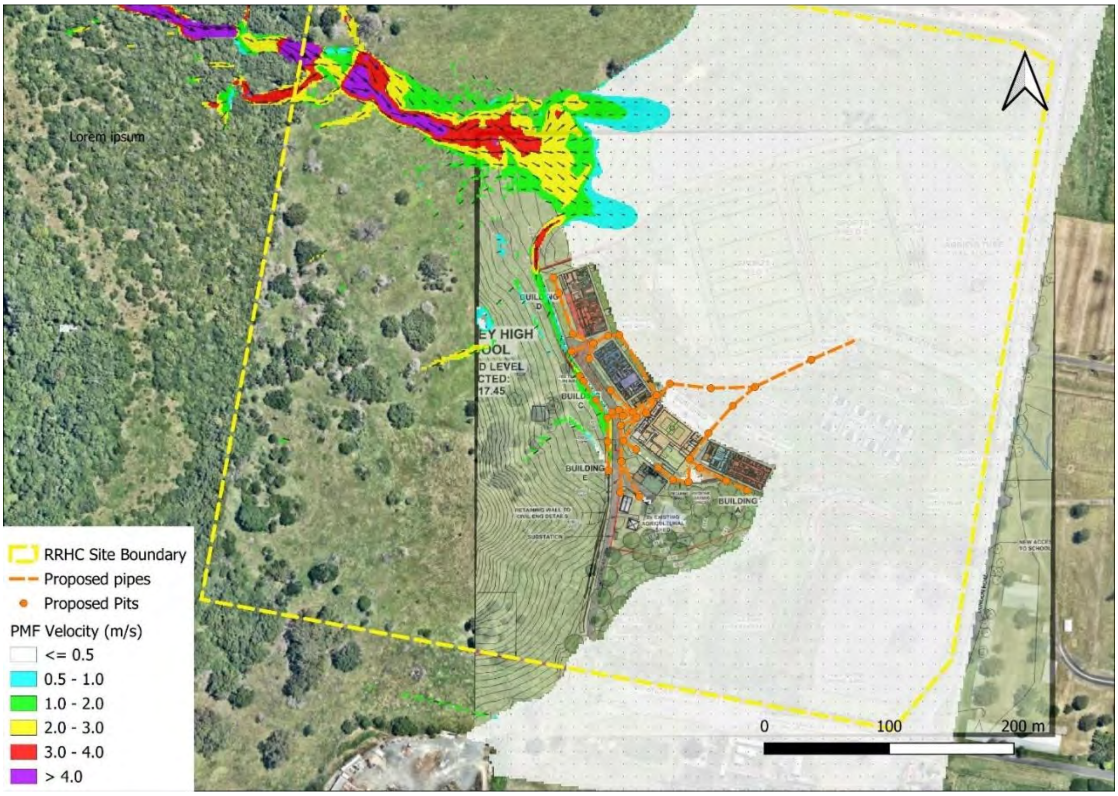


Appendix C 17 : Feb 2022 Flood hazard categorisation at the RRHC site under post-development site conditions

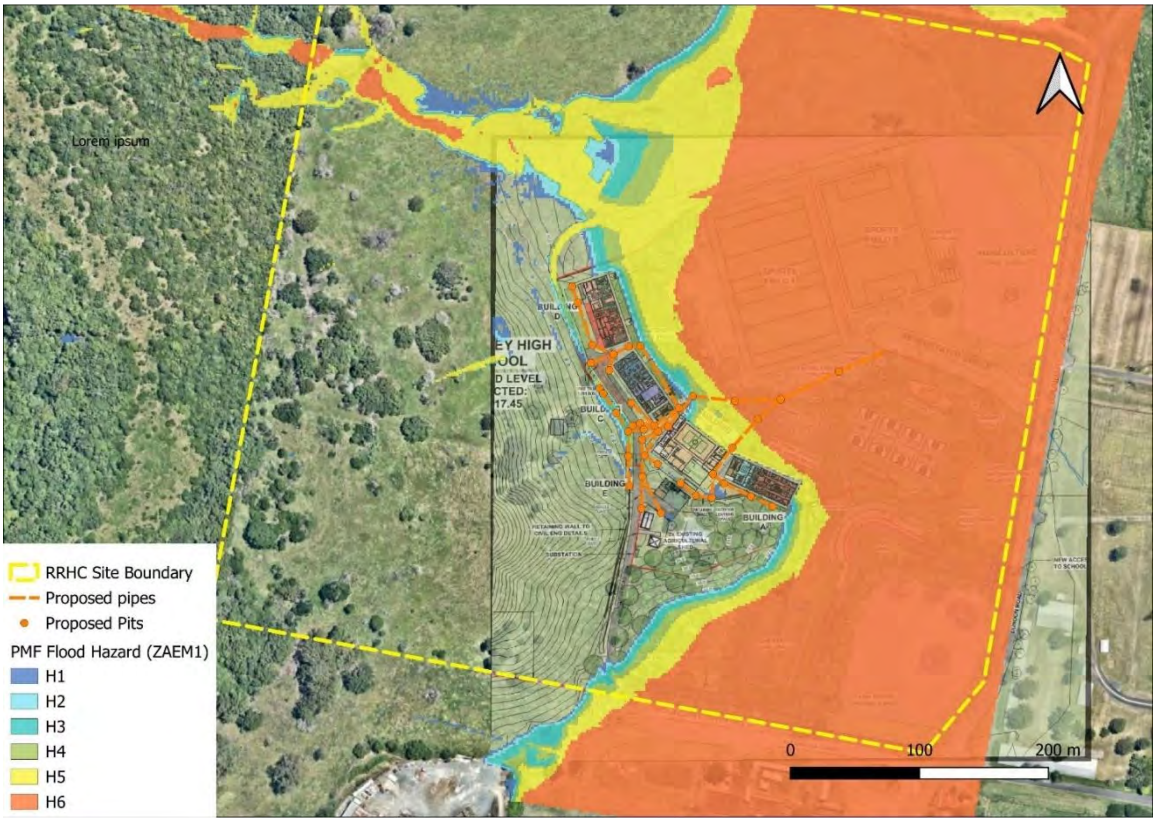
PMF Event



Appendix C 18: PMF flood depths and levels at the RRHC site under post-development site conditions



Appendix C 19*: PMF flood velocities at the RRHC site under post-development site conditions*



Appendix C 20: PMF flood hazard categorisation at the RRHC site under post-development site conditions

Appendix D

Cut and Fill plan