Flood Risk Emergency Assessment

New High School for Schofields and Tallawong

Prepared for NSW Department of Education c/o TSA Riley / 21 January 2025

241460

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

Rev	Date	Prepared By	Approved By	Remarks
1	05/12/2024	RC	MK	
2	10/01/2025	RC	MK	
3	21/01/2025	RC	MK	

1.0 Introduction

This Flood Risk Emergency Assessment (FREA or FERP) has been prepared to support a Review of Environmental Factors (REF) for the Department of Education (DoE) for the construction and operation of the new Schofields - Tallawong High School (the activity).

The purpose of the REF is to assess the potential environmental impacts of the activity prescribed by *State Environmental Planning Policy (Transport and Infrastructure) 2021* (T&I SEPP) as "development permitted without consent" on land carried out by or on behalf of a public authority under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The activity is to be undertaken pursuant to Chapter 3, Part 3.4, Section 3.37 of the T&I SEPP.

This document has been prepared in accordance with the *Guidelines for Division 5.1 assessments* (the Guidelines) by the Department of Planning, Housing and Infrastructure (DPHI). The purpose of this FERP is to summarise the flood risks associated with the site, identify preparation measures that should be undertaken to mitigate such risks, and provide an action plan with steps to be completed during a flood event. The details of this report are based on currently available information and correspondence undertaken at the time of writing.

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);
- Blacktown City Council (BCC) Development Control Plan (DCP), 2015;
- Blacktown City Council (BCC) Engineering Guide for Development (EGD), 2005;
- Blacktown City Council (BCC) Water Sensitive Urban Design (WSUD) Developer Handbook MUSIC Modelling and Design Guide, 2020;
- Blacktown City Council (BCC) and NSW State Emergency Services (SES) Blacktown City Flood Emergency Sub Plan, 2023;
- Department of Planning and Environment (2021) Considering Flooding in Land Use Planning Guideline;
- Department of Planning and Environment (2023) Flood Impact and Risk Assessment – Flood Risk Management Guide LU01;
- Department of Planning, Housing and Infrastructure – Planning Circular PS 24-001, Update on addressing flood risk in planning decisions, 1st March 2024;
- NSW Department of Planning and Environment (2025) Shelter-in-place guideline for flash flooding (https://pp.planningportal.nsw.gov.au/draftplans/made-and-finalised/shelter-place-guideline-flash-flooding)
- 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 (2023) Support for Emergency Management Planning – Flood Risk Management Guideline EM01; and
- NSW Planning Portal Spatial Viewer (Spatial Collaboration Portal - Map Viewers (nsw.gov.au)).

1.2 Site Description

The site is known as 201 Guntawong Road, Tallawong, NSW, 2762 (the site), and is legally described as part of Lot 1 in Deposited Plan 1283186. The site is located at the corner of Guntawong Road and Clarke Street, Tallawong and is approximately 4 hectares in area. The site has an approximately 100-metre-long frontage to Guntawong Road along its northern boundary. Nirmal Street provides a partial frontage along the eastern boundary of the site with plans to extend Nirmal Street to provide a future connection to Guntawong Road.

The site is predominantly cleared land and consists of grassland with several patches of remnant native vegetation particularly within the northern portion of the site. As a result of precinct wide rezonings, the

surrounding locality is currently transitioning from a semi-rural residential area to a highly urbanised area with new low to medium density residential development with supporting services. The site is located approximately 1.5km to the northwest of Tallawong Metro Station and is also serviced by an existing bus stop along Guntawong Road.

Figure 1 below provides an aerial image of the site.

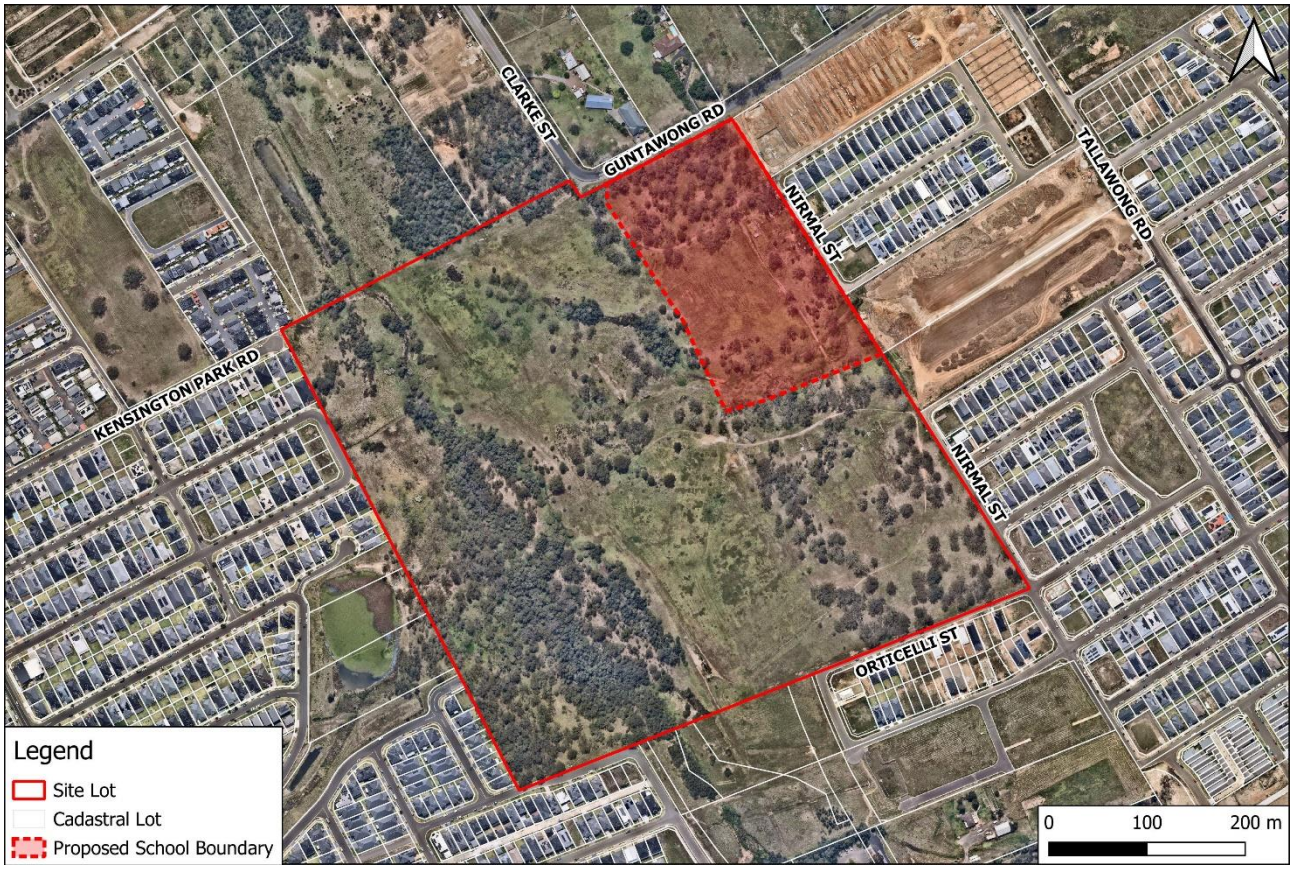

Figure 1: Aerial photograph of site (Source: Nearmap, dated 27th October 2024).

1.3 Proposed Activity Description

The proposed activity is for the construction and operation of a new high school known as Schofields - Tallawong High School. The new high school will accommodate up to 1,000 students. The school will provide 49 permanent teaching spaces (PTS), and 3 support teaching spaces (STS) across three buildings.

The buildings will be three-storey in height and will include teaching spaces, specialist learning hubs, a library, administrative areas and a staff hub. Additional core facilities are also proposed including a standalone school hall, a carpark, a pick-up and drop off zone along Nirmal Street, two sports courts and a sports field.

Specifically, the proposal involves the following:

- Three learning hubs (three-storeys in height) accommodating 49 general teaching spaces and 3 support learning units (SLUs).
- Other core facilities including amenities, library, staff hub and administrative areas.
- Standalone school hall.
- Separate carpark with 72 spaces.
- Kiss and drop zone along Nirmal Street.
- Open play space including sports courts and sports field.

- Public domain works.

The proposed site access arrangements are as follows:

- Main pedestrian entrance to be located off Nirmal Street.
- Kiss and drop zone proposed along Nirmal Street.
- Onsite parking access via Nirmal Street.

Figure 2 provides an extract of the proposed site plan.

Figure 2: Proposed site plan (Source: DJRD Architects, 20th January 2025).

2.0 Methodology

2.1 First Pond's Creek Flood Study Model (Assessment of Site)

To assess flood behaviour at the site, Council provided TTW with the First Ponds Creek (FPC) Flood Study and model (Catchment Simulations Solutions (CSS), 2021). This has been confirmed by Council as suitable to use for this proposed activity and has therefore been used as the basis of the modelling to assess flood behaviour at the site. CSS's flood analysis includes an assessment of two scenarios:

- 'Pre-Development' conditions based on 2010 topographic and catchment development information.
- 'Ultimate Catchment Development' conditions, that assumes full development across the FPC catchment, incorporating proposed changed in land use (i.e. increasing impervious surfaces to reflect the projected increase in development), water management infrastructure (i.e. addition of proposed flood detention basins based on design terrain plus outlet details provided by Council), terrain modifications and hydraulic structure upgrades.

TTW adopted Council's 'Pre-Development' model as a base and updated it with relevant aspects of the 'Ultimate Developed' model. The model was also updated to include new site survey and design information for the proposed construction. The modelling methodology and the flood impact associated with the development are described in detail in the Flood Impact and Risk Assessment Report (FIRA) prepared by TTW (dated December 2024).

For the 1% Annual Exceedance Probability (AEP) event, the 60-minute duration storm was adopted as the critical storm duration. For the Probable Maximum Flood (PMF), the 45-minute storm was provided by Council as it was determined to be the critical storm for the FPC catchment.

2.2 TTW Hydraulic Model (Assessment of Surrounding Roads)

While Council's model is effective in providing an indication of flood behaviour at the school site itself (with an overland flow path from the upstream catchment incorporated upstream of the site), there is not adequate information available for the surrounding area - especially at the access roads.

A new 1D/2D hydraulic model has subsequently been developed to assess flood behaviour at the surrounding roads. The model was developed using TUFLOW software and the following section outlines the hydraulic model setup, with a summary table below.

Model Domain	Dynamic 1D (pipe network) and 2D (floodplain)
Solver	TUFLOW HPC 2023-03-AE
Grid size	3m cell with sub grid sampling (1m)
DEM	2019 LiDAR + topographical survey for site area
Hydrology	ARR 2019 Temporal patterns
Model Inflows	Direct Rainfall applied to full model boundary
Map Cutoff Depth	50mm

2.2.1 2D Model Domain

The model boundary was delineated based on the latest available LiDAR (2019) data obtained from Elevation Information System (ELVIS), which set the Digital Elevation Model (DEM) and catchments that contribute to the access roads for the site. The model extent adopted is shown in Figure 3.

Although a 3-metre grid cell was utilised for this study, this was refined using sub-grid sampling (SGS). SGS improves the accuracy of hydraulic modelling by refining the spatial resolution within a given grid cell without significantly increasing the simulation time. TUFLOW ordinarily samples the digital terrain model (DTM) by taking a singular value at the centroid of each grid cell, which can often mis-represent the topography and potential variation within each cell especially when the adopted grid cell size is not sufficiently fine.

With sub-grid sampling, the underlying DTM cell elevations are used to determine a water surface elevation

vs volume relationship for each grid cell. This is also performed along the cell faces, using the full topography across the cell face to represent fluxes between adjacent cells. The full array of information in the DTM is therefore being utilised within the 2D hydraulic modelling even where grid resolution is lower, improving the accuracy of simulated results in terms of storages available for each model cell (i.e. note that the improvement of accuracy achieved is dependent on the resolution of the sub-grid sampling distance and the underlying Lidar/survey data used).

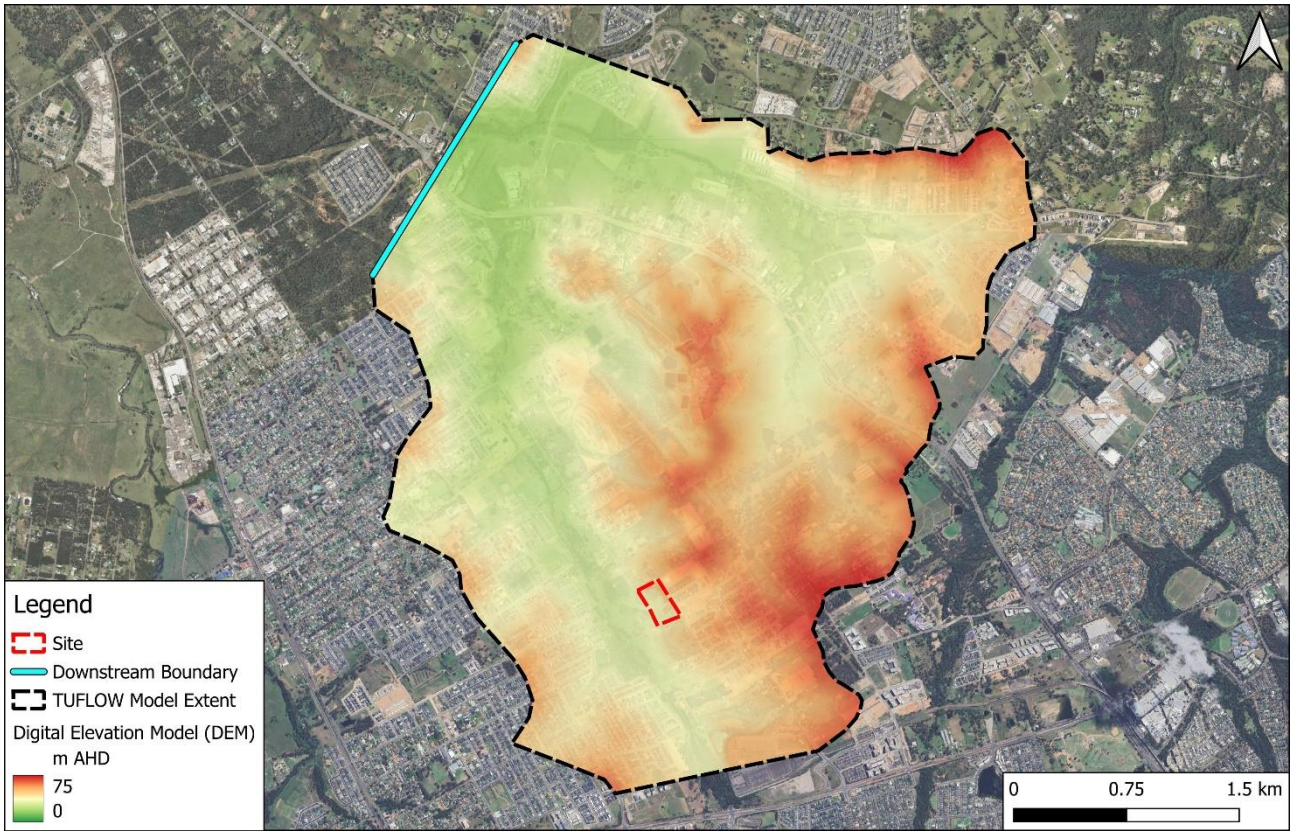

Figure 3: TUFLOW Hydraulic model extent and downstream boundary

2.2.2 Topography

In addition to incorporating 2019 LiDAR from ELVIS, the hydraulic model included topographical survey data of the wider site lot collected by Project Surveyors in June 2022, alongside more recent detailed survey of the proposed site by SDG Pty Ltd in October 2024. In addition to covering the site and wider site lot, the survey captures the Guntawong Road frontage and a portion of Clarke Street to the north, in addition to sections of Nirmal Street.

Aerial imagery obtained from Nearmap indicates there has been significant construction work in the lots to the east of the site (Lots 43 and 42 DP30186). While the lots were shown to be undeveloped with a dam in imagery collected on 28th August 2024, more recent imagery obtained on 27th October indicates that the dam has been filled, changing the existing flow regime in this area. It is understood that the existing flow path is to be culverted under the future Nirmal Street at this location, discharging to the downstream side of Nirmal Street onto the site (i.e. near the site's northeast corner). To capture the changing topography east of the site, the DEM has been adjusted at Lots 43 and 42 DP30186 and at a section of Nirmal Street (soon to be constructed), raising the level here to 42.6m AHD and interpolating elevations to remove the dam. This is based on design drawings indicating the future level of Nirmal Street at this location.

2.2.3 1D Model Domain

In lieu of publicly available data on the stormwater network and culvert crossings, a desktop analysis was undertaken to identify culvert crossings. Assumptions were subsequently made about the culvert dimensions, with aerial imagery (Nearmap, Google Earth) and Google Street View utilised to determine the number of openings and culvert type. If a dimension could not be estimated, the culvert was set as a 0.375m pipe to maintain a conservative approach, in terms of flooding at the road crossing. The 1D model domain is shown in Figure 4, while Table 1 details the dimensions adopted for each culvert crossing identified for the site area.

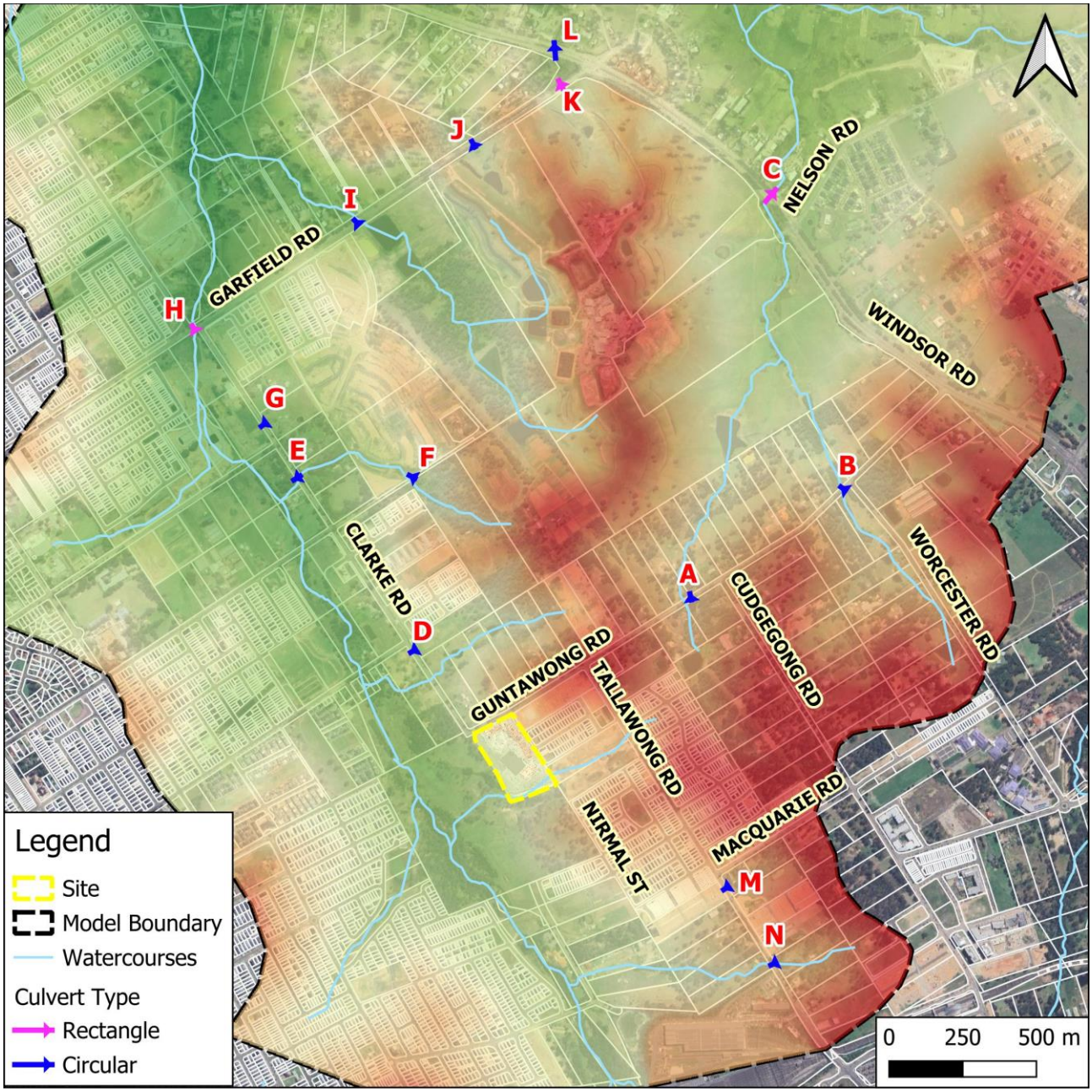

Figure 4: 1D model domain shown against model DEM (refer to Table 1 for culvert information)

Table 1: Crossing (culvert) information. Refer to Figure 4 for location.

Crossing ID	Road	Type	Number of Culvert Adopted	Adotped Dimensions (m)
A	Guntawong Road	Circular	1	0.375
B	Guntawong Road	Circular	1	0.375

C	Windsor Road	Rectangle	3	1.2 x 0.75
D	Clarke Road	Circular	1	0.375
E	Clarke Road	Circular	1	0.375
F	Riverstone Road	Circular	1	0.375
G	Clarke Road	Circular	1	0.375
H	Garfield Road	Rectangle	4	1.8 x 0.9
I	Garfield Road	Circular	1	0.375
J	Garfield Road	Circular	1	0.375
K	Garfield Road	Rectangle	1	0.9 x 0.45
L	Windsor Road	Circular	1	0.375
M	Tallawong Road	Circular	1	0.375
N	Tallawong Road	Circular	1	0.375

2.2.4 Rainfall on Grid Hydrology

A rainfall on grid (ROG) hydrology approach has been adopted, 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 0.05m (50mm) have been filtered out of the modelled results. This allows proper mapping of actual overland flow paths.

Hydrological inputs were derived from the Australian Rainfall and Runoff 2019 (ARR2019) data hub for the 1% AEP event for a range of durations and temporal patterns. Probable Maximum Precipitation (PMP) rainfall data was estimated by following the procedure detailed in the Generalised Short Duration Method (GSDM) report.

2.2.5 Hydraulic Roughness

The hydraulic roughness of a material is an estimate of the resistance to flow and energy loss due to friction between a surface and the flowing water. A higher hydraulic roughness indicates more resistance to the flow. Roughness in TUFLOW is modelled using the Manning's (n) roughness co-efficient, with roughness values assigned to Material IDs.

Manning's zones were set by analysing the latest Nearmap aerial photography of the site and surrounding area. The four material types adopted in the hydraulic model and the subsequent Manning's n value applied to each land use category are outlined in Table 2.

Buildings across the model have not been individually modelled but have instead been accounted for in the higher roughness coefficient for urban residential, in accordance with ARR 2019.

Table 2: Material ID and the corresponding land use category and Manning's n values assigned to each

Material ID	Land use category	Manning's 'n'
1	Road reserve / paved area	0.02
2	Medium density residential	0.20
3	Dense vegetation	0.09
4	Grass (minimal vegetation) - default	0.05

2.2.6 Flood Hazard Assessment

The relative vulnerability of the wider area 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 5, 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.

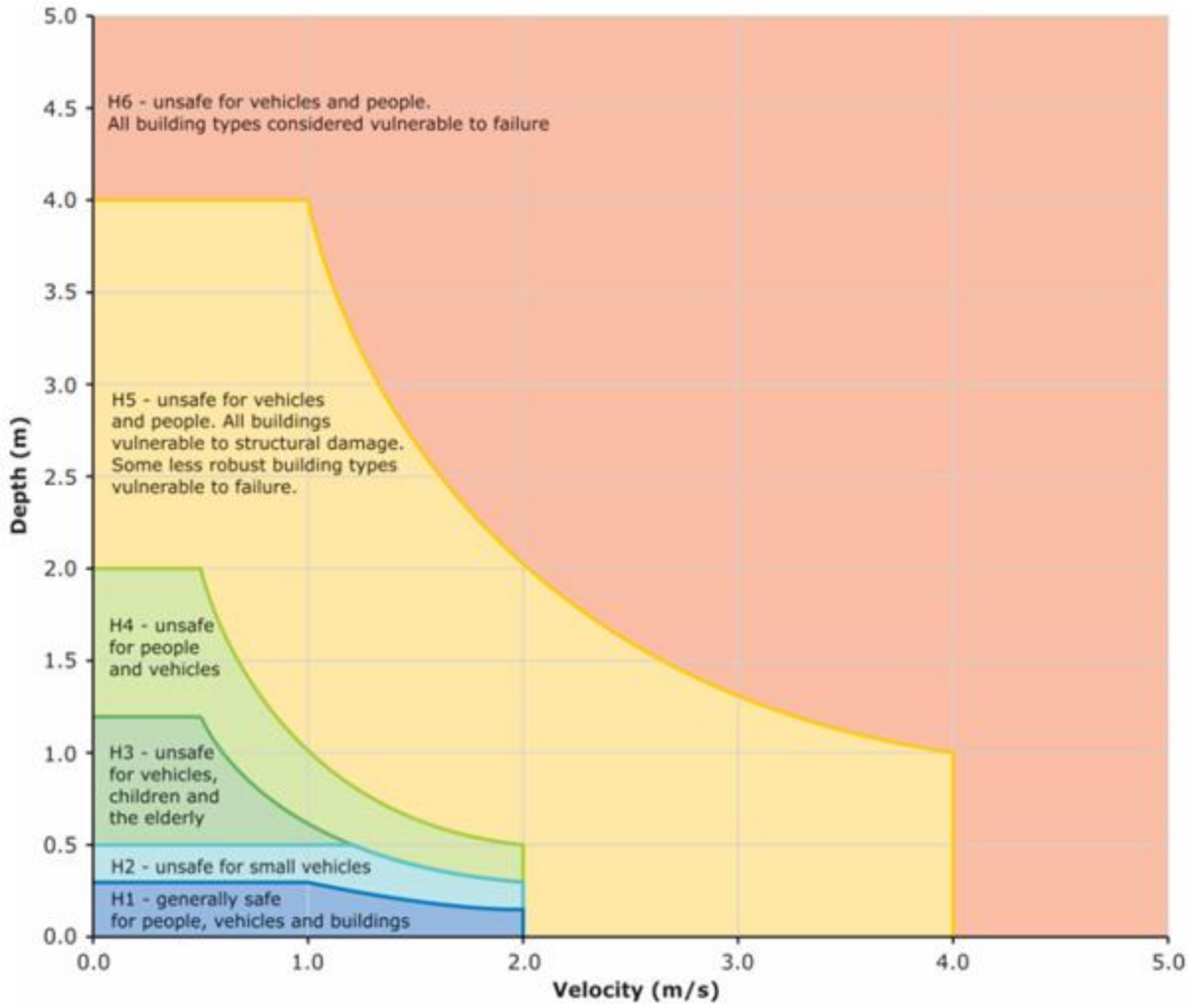

Figure 5: Flood hazard vulnerability curve (Source: Flood Risk Management Guide FB03 - Flood Hazard, NSW Department of Planning and Environment, 2022)

Table 3: Hazard vulnerability threshold limits

Hazard	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	No Limit	No Limit

2.2.7 Critical Duration Assessment

Table 4 summarises the storm duration runs for each event, alongside the critical duration and median temporal pattern identified for the site. For the 1% AEP event, the 60-minute storm was identified as the critical duration. Although the 15-minute storm is critical for the site in the PMF event, this FERP includes an analysis of the critical duration storm and the longer duration storms (up to 6 hour storm) to determine the maximum potential time of inundation of the access roads for the site.

Table 4: Critical duration assessment for the site

Event	Storm Durations Assessed (mins)	Critical Duration	Median Temporal Pattern
1% AEP	10, 20, 30, 45, 60	60 minutes	TP07
PMF	15, 30, 60, 90, 360	15 minutes	N/A

3.0 Flood Behaviour

3.1 Flood Behaviour at the Site

Post-construction flood behaviour at the site is described in detail in the Flood Risk Assessment submitted alongside this report.

3.1.1 1% AEP Event

The peak flood levels and depths during the 1% AEP event are shown in Figure 6, while the peak flood hazard is depicted in Figure 7.

Floodwaters in the post-construction 1% AEP event are contained to the south of the site. Peak depth reaches approximately 1.0m at the southeast within the tail out channel. Flood levels also peak here at approximately 40.13m AHD at the southeastern corner. The flow entering the site from the east peaks at around 3.1m^3/s, approximately 25 minutes after the onset of the critical 1% AEP storm assessed.

Flood velocities peak at around 1.6m/s within the southern tail out channel. Hazards within the channel area are classified as H4 (unsafe for people and vehicles) and H5 hazard (unsafe for people and vehicles, all buildings vulnerable to structural damage).

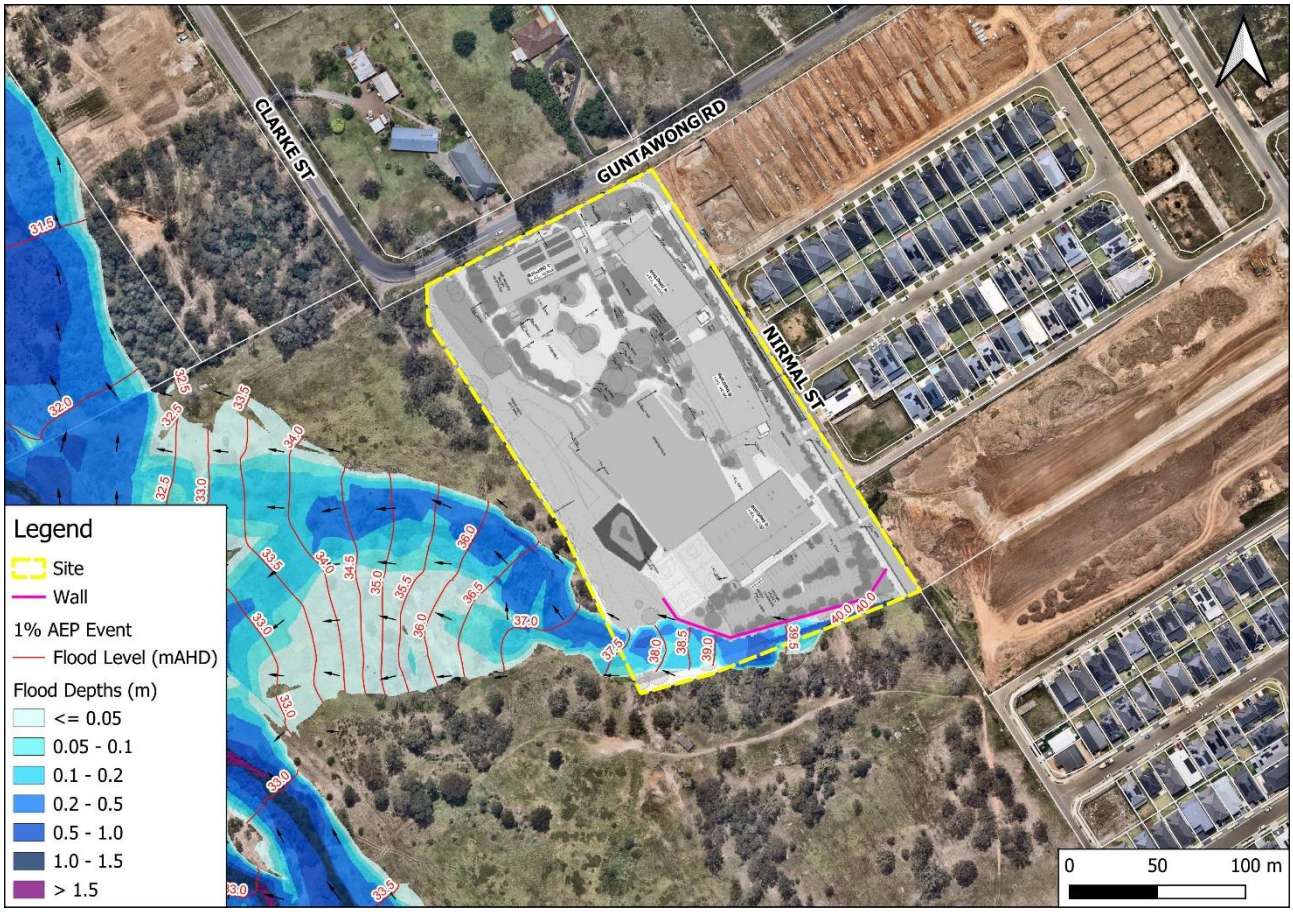

Figure 6: Flood levels and depths (1% AEP event) – Post Construction Conditions

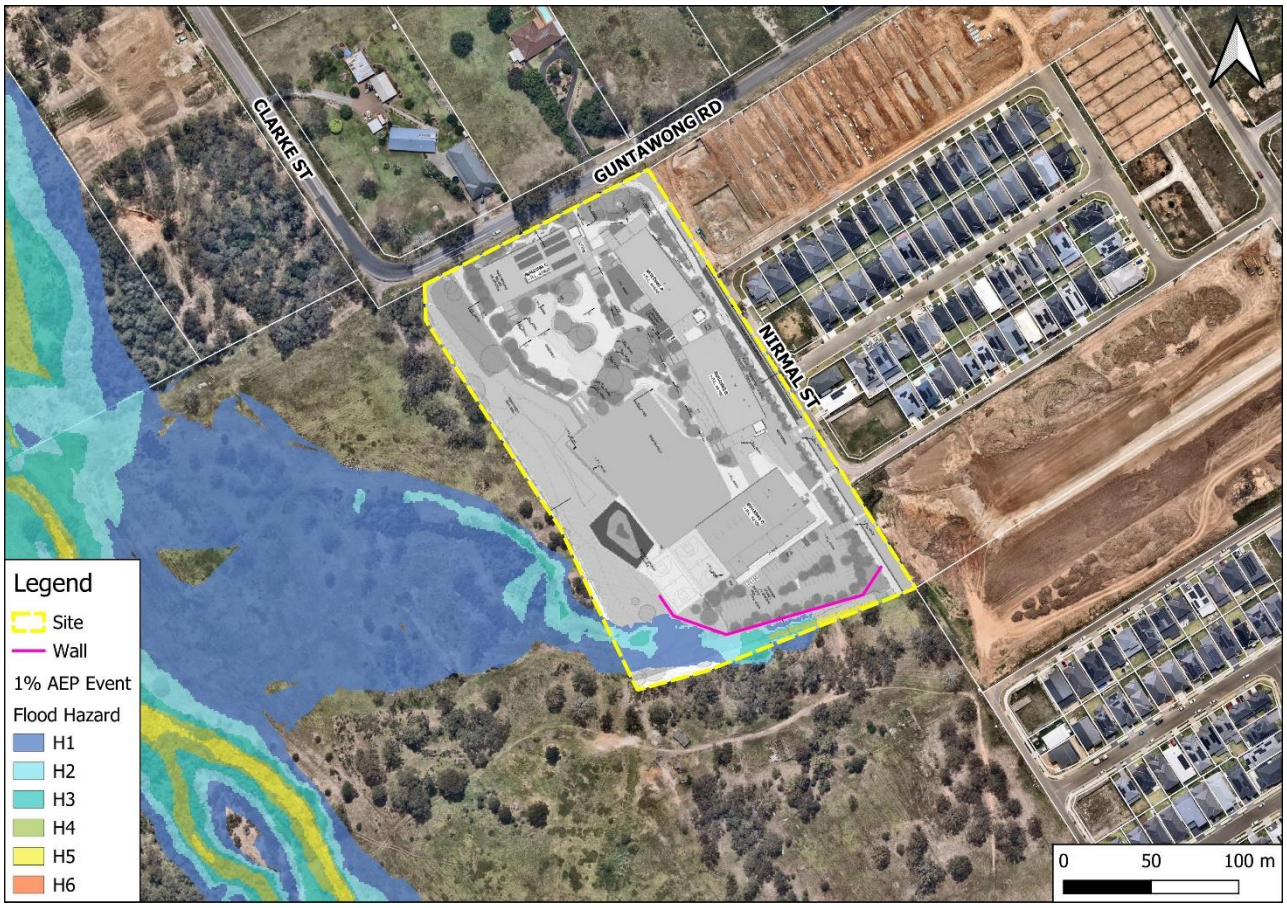

Figure 7: Flood hazards (1% AEP event) – Post Construction Conditions

3.1.2 PMF Event

The peak flood levels and depths during the PMF event are shown in Figure 8, while the peak flood hazards are depicted in Figure 9.

Under the post-construction conditions, the PMF extent breaches the tail out channel and reaches the retaining wall south of the carpark. Peak depths within the site are at the southeastern channel, at 2.5m depth, while depths at the southwestern boundary of the carpark reach 1.0m. Peak flood levels increase to approximately 41.6m AHD at the upstream end of the southeastern channel. The flow entering the site from the east peaks at around 20m^3/s, approximately 20 minutes after the onset of the critical PMF storm assessed.

Flood velocities have also notably increased, peaking at around 2.2–2.5 m/s, reaching a high of 3.0m/s within the tail out channel. Flood hazard within the channel reaches H6 along a 30m distance (unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust building types vulnerable to fail).

However, both the carpark and the proposed school buildings are not expected to be impacted by flood inundation in the PMF event assessed.

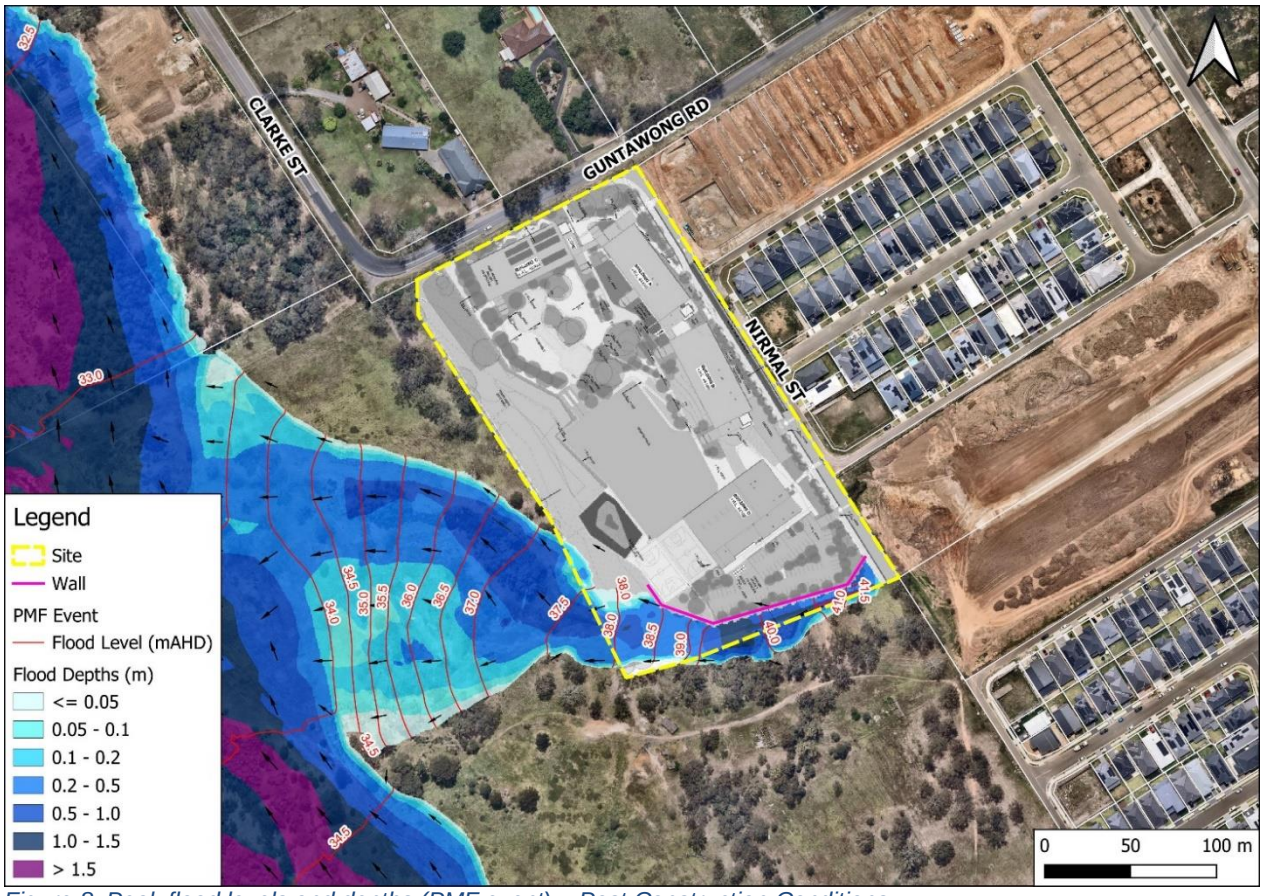

Figure 8: Peak flood levels and depths (PMF event) – Post Construction Conditions

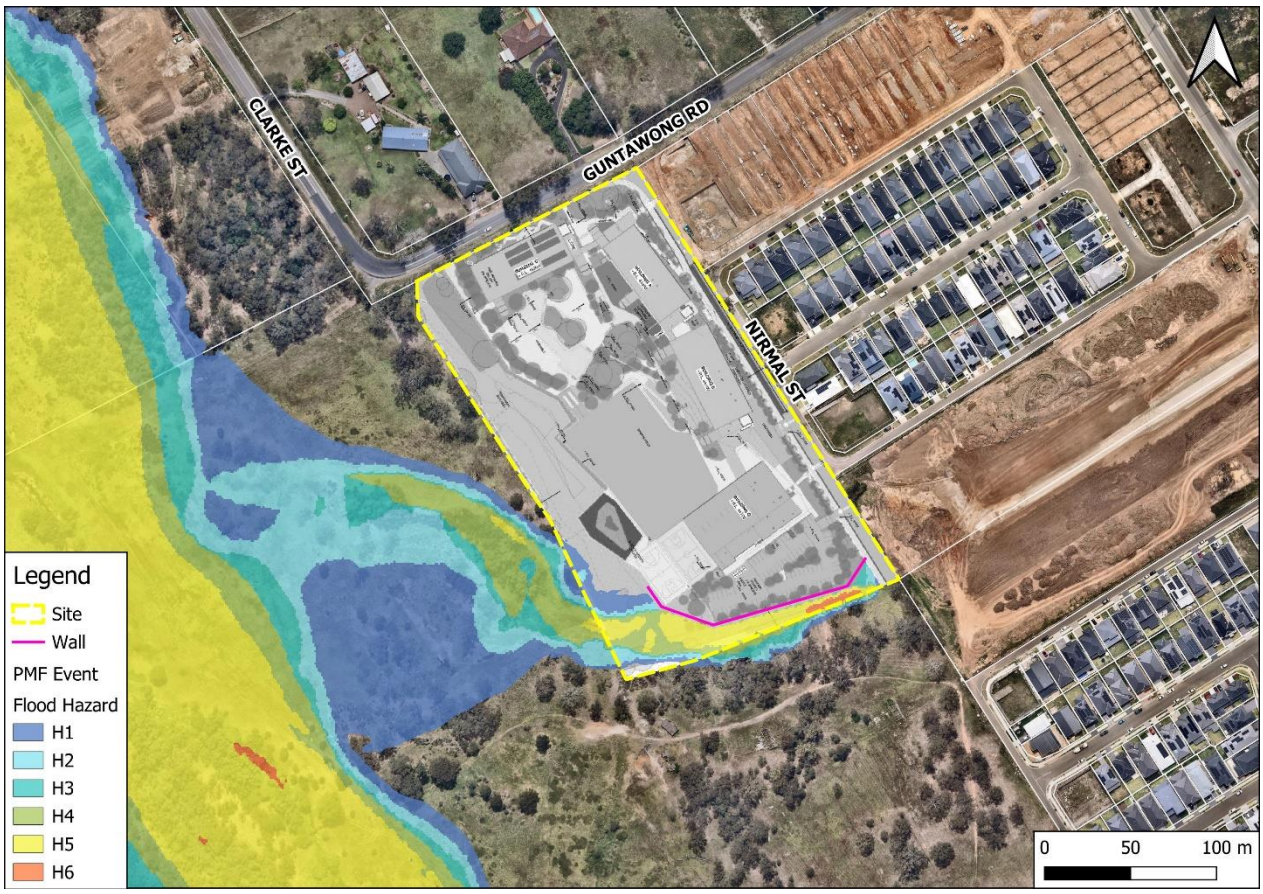

Figure 9: Peak flood hazards (PMF event) – Post Construction Conditions

3.2 Flood Behaviour at Surrounding Roads

The main purpose of this analysis is to assess flood behaviour at the surrounding roads only. Flooding at the school site will differ in this analysis than that of the Flood Risk Assessment results shown in Section 3.1 due to differing modelling methodologies and assumptions adopted. This analysis uses a ROG hydrology in which rainfall is applied to every cell in the model, resulting in flooding for the entire model area. To understand flood risk at the site itself, refer to Section 3.1 and the Flood Risk Assessment submitted alongside this report.

3.2.1 1% AEP Event

The peak flood levels and depths at the surrounding area during the critical 1% AEP event is shown in Figure 10, while the peak flood hazard is depicted in Figure 11.

In the 1% AEP, Guntawong Road remains passable directly north of the school site, though floodwaters are present at the crossing of the first-order creek just downstream of the Cudgegong Road turnoff (Culvert A – refer Figure 4), where elevations sag. This crossing shows a peak flood depth of around 0.2m along the road. Flood hazard along the road is categorised as H1-H2, though this increases to H5 at the downstream end of the creek close to the road corridor.

Further east, Guntawong Road is again impacted by flooding in the 1% AEP event as a result of a crossing of another first-order creek (Culvert B), with peak flood depth of approximately 0.45m. Nonetheless, hazard along the road is mostly H1 with spots of H2-H3 across a 70m stretch of the road.

While the A2 Windsor Road is largely unaffected, there are again instances of flooding at culvert crossings, with the northbound lane notably impacted by H3 flooding at the Killarney Chain of Ponds (second-order creek) crossing (Culvert C). This is located just west of Nelson Road, with approximately 180m of the northbound A2 lane impacted by H3 floodwaters.

Clarke Road to the northwest of the site is impacted by small patches of H1 flooding that are mainly limited to the kerb and gutter from Culvert D, with a peak depth of about 0.1m.

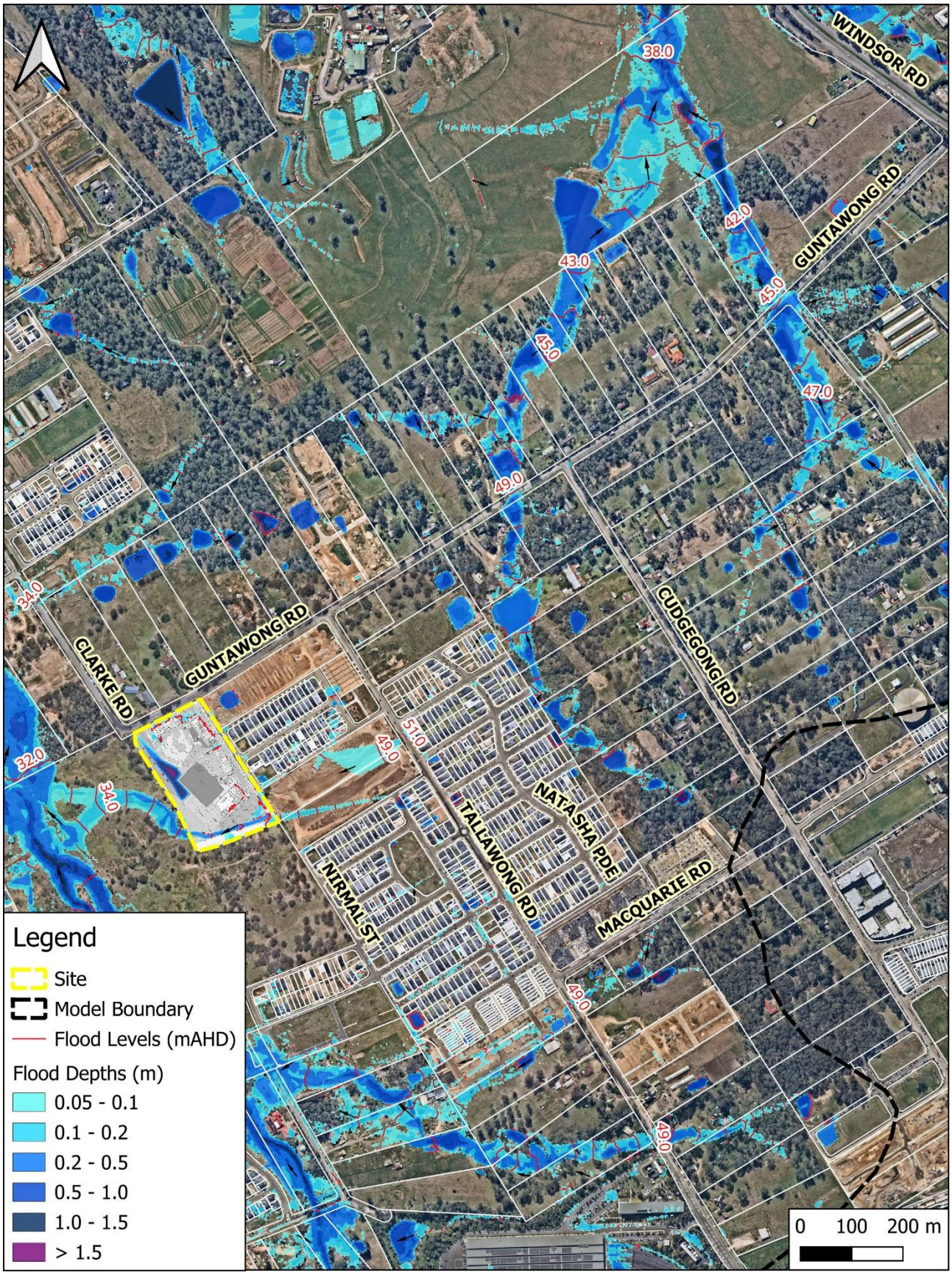

Figure 10: Peak flood levels and depths in the surrounding area (1% AEP event)

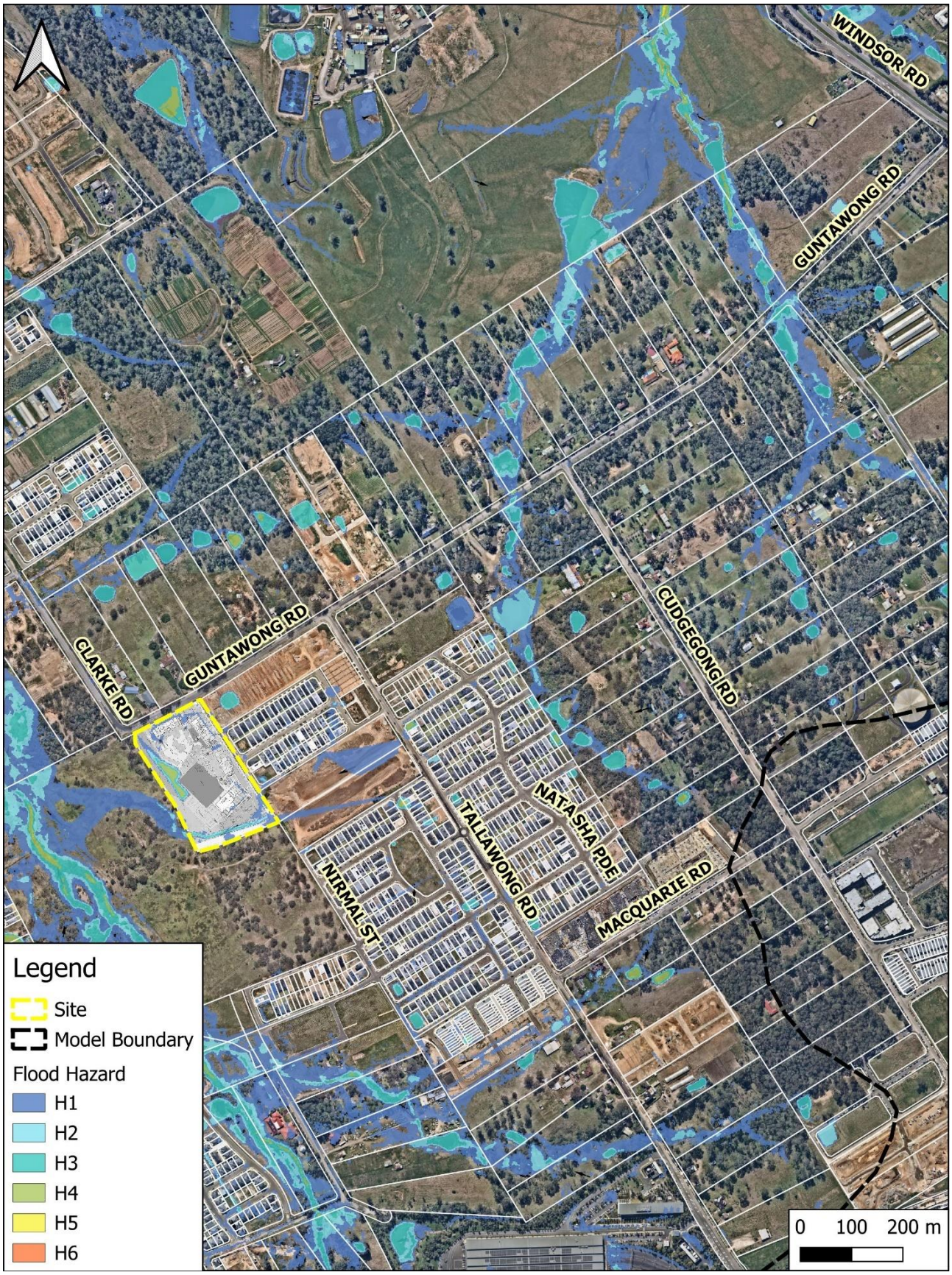

Figure 11: Peak flood hazard in the surrounding area (1% AEP event)

3.2.2 PMF Event

The peak flood levels and depths at the surrounding area during the critical PMF event is shown in Figure 12, while the peak flood hazard is depicted in Figure 13.

In the PMF event, Guntawong Road similarly remains largely passable directly north of the school site, though flooding at the crossing of the first-order creek near Cudgegong Road turnoff has significantly increased (Culvert A). This crossing shows a peak depth of around 0.7m along the road. Flood hazard of H2-H5 affects a 65m stretch of road.

Further east, flooding at the second road crossing on Guntawong Road close to Worcester Road (Culvert B) has similarly increased, with H5 hazard along a 70m length of road, and peak flood depth similarly reach more than 0.7m.

On the A2 Windsor Road at the Killarney Chain of Ponds crossing (Culvert C), flood depth along the northbound lane increase to over 1.3m, with widespread H5 hazard across both lanes.

While the Clarke Road crossing to the northwest of the site (Culvert D) is only shown to be impacted by a relatively small patch of H5 flooding (peaking at 0.3m depth) in Figure 12 and Figure 13, there are multiple instances of floodwaters pooling at culvert crossings, with the road significantly impacted by H5 further north where it joins with Garfield Road.

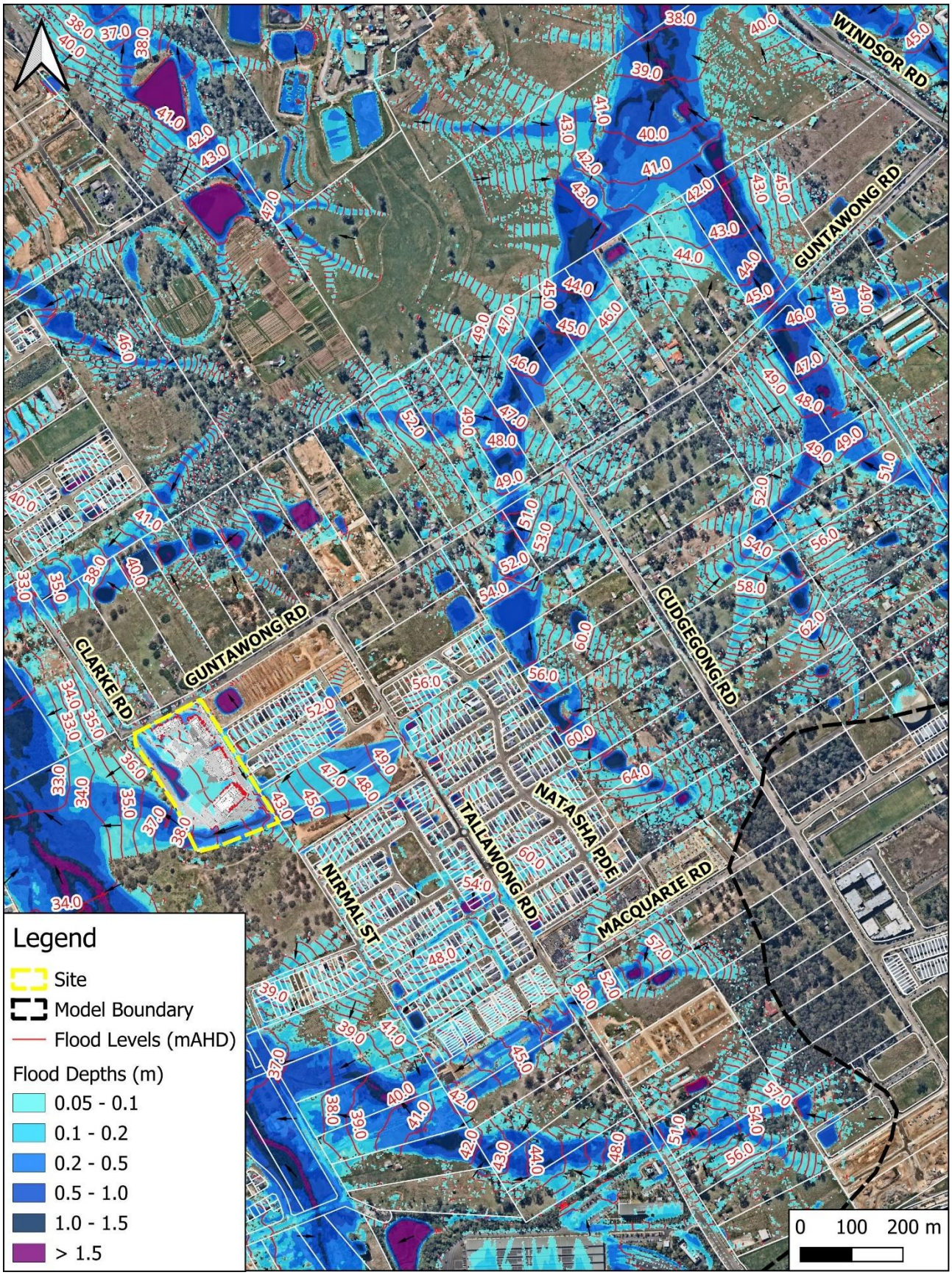

Figure 12: Peak flood levels and depths in the surrounding area (PMF event)

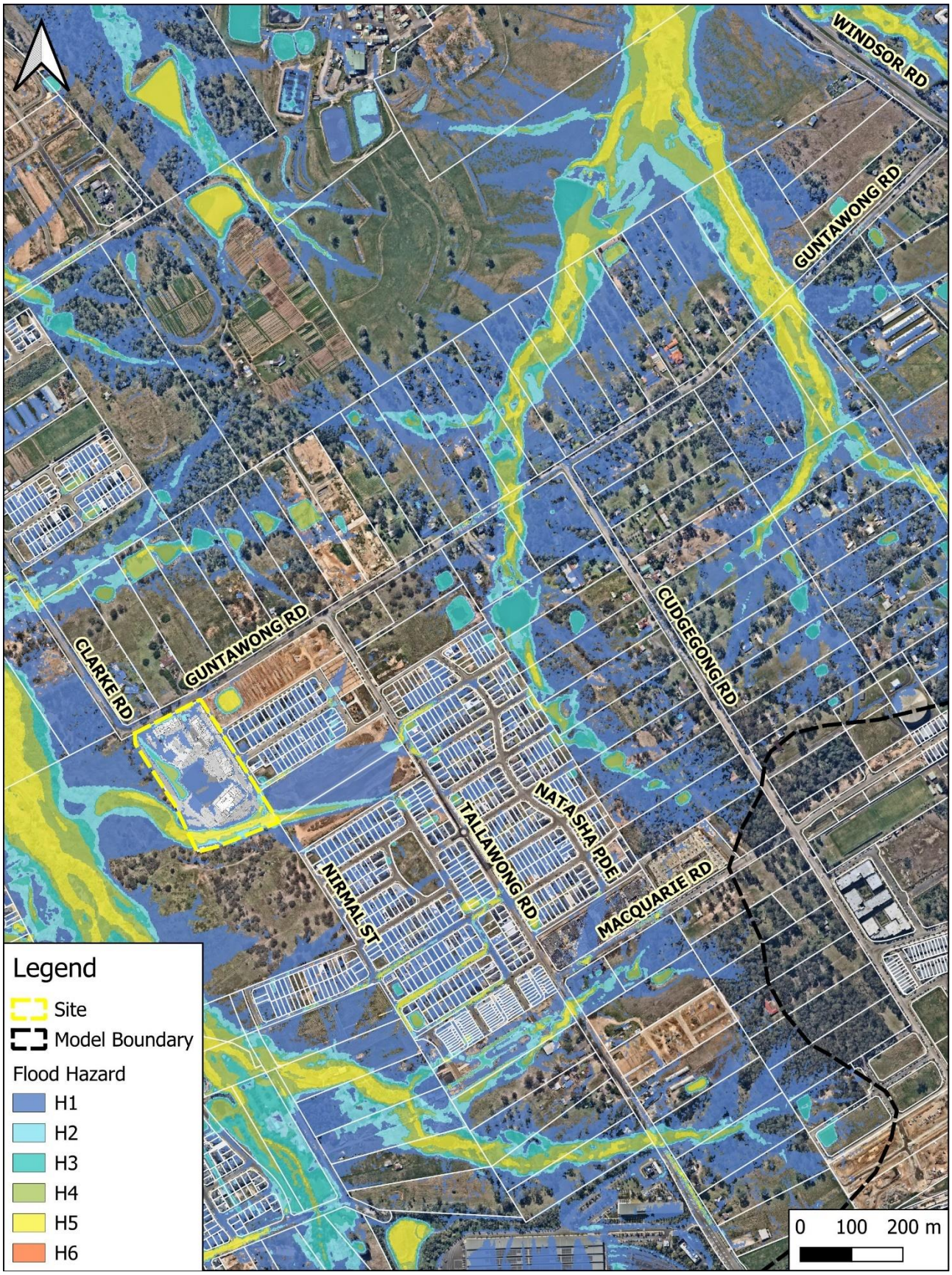

Figure 13: Peak flood hazard in the surrounding area (PMF event)

3.3 Inundation and Recession Times

Table 5 presents a summary of the inundation and recession times for a range of PMF storm durations, including the critical duration (15-minutes). Longer durations, including a 6-hour storm event, have been assessed in order to consider the possibility of longer isolation periods.

Due to the ROG modelling methodology, the surrounding roads will always be flood affected in the PMF event, though it is important to consider the flood hazard and whether roads are trafficable. For the purpose of this assessment, the recession time is regarded as the time taken for roads to return to a trafficable, low hazard (H1) state.

The short critical duration for the catchment indicates that roads are unlikely to be isolated for an extended period of time. The route that is deemed the first to return to a low hazard, trafficable state is via Guntawong Road, turning right onto Tallawong Road, and turning left onto Macquarie Road, and right onto Cudgegong Road. Vehicles should travel south towards Schofields Road.

Analysis indicates that across the range of PMF durations assessed, the maximum time the school is isolated for is less than 3 hours.

Table 5 - Time to inundation and recession at the site in PMF storm events

PMF Storm Duration	Time to Inundation (minutes)	Recession Time
15 minutes (Critical duration)	< 10 minutes until flows reach a H5 hazard level at Clarke Road to the north (Crossing D), and at Crossing A and B along Guntawong Road. North bound lane of the A2 Windsor Road impacted by H5 hazard for approximately 430m north of Crossing C. All routes out of the site have been cut off less than 10 minutes after the onset of the storm.	Egress is possible about 30 minutes after the onset of the storm by travelling south via Tallawong Road, east onto Macquarie Road, and continuing south towards Schofields Road via Cudgegong Road. Isolation time of approximately 20-30 minutes.
30 minutes	< 10 minutes until flows reach a H5 hazard level at Crossing A and B along Guntawong Road. North bound lane of the A2 Windsor Road impacted by H5 hazard for approximately 430m north of Crossing C. Tallawong Road is similarly impacted by H5 flooding at road crossings. All routes out of the site have been cut off less than 10 minutes after the onset of the storm.	Egress is possible about 40 minutes after the onset of the storm by travelling south via Tallawong Road, east onto Macquarie Road, and continuing south towards Schofields Road via Cudgegong Road. Isolation time of approximately 30-40 minutes.
60 minutes	< 10 minutes until flows reach a H5 hazard level at Crossing A along Guntawong Road. Flooding along Windsor Road reaches H5 hazard north of Crossing C, affecting a 360m length of the northbound lane. Tallawong Road impacted by H5 hazard, Garfield Road impacted by H1-H3. All routes out of the site have been cut off less than 10 minutes after the onset of the storm.	Egress is possible about 60 minutes after the onset of the storm by travelling south via Tallawong Road, east onto Macquarie Road, and continuing south towards Schofields Road via Cudgegong Road Isolation time of approximately 50-60 minutes.

90 minutes	< 20 minutes until flows reach a H5 hazard level at Guntawong Road and Windsor Road. H3-H4 hazard is present at Clarke Road and Garfield Road. All routes out of the site have been cut off less than 20 minutes after the onset of the storm.	Egress is possible about 90 minutes after the onset of the storm by travelling south via Tallawong Road, east onto Macquarie Road, and continuing south towards Schofields Road via Cudgegong Road. Isolation time of approximately 60-70 minutes.
6 hrs (Long duration)	< 30 minutes until Guntawong Road is cut off at Crossing A and B (H1-H3). Windsor Road is also cut off at Crossing L with H1-H3 hazard. Travel south via Tallawong Road is cut off at Crossing N with H1-H2 hazard. Access and egress from the site (30 mins after the onset of the storm) is still possible via Tallawong Rd/east to Macquarie Road. Also possible via Clarke Road and travelling west at Garfield Road. All routes are eventually cut off less than 40 minutes after the onset of the storm.	Egress is possible about 60 minutes after the onset of the storm by travelling south via Tallawong Road, east onto Macquarie Road, and continuing south towards Schofields Road via Cudgegong Road. Isolation time of approximately 20-30 minutes.

It should be noted that in all simulated events, the model indicates that there is a flood free route in and out of the site via Tallawong Road, travelling east onto Natasha Parade, before travelling south to Macquarie Road and entering onto Cudgegong Road. However, the lidar (captured April 2019) has not fully captured the road corridor along some sections of Natasha Parade, which was still partially in construction at the time the lidar was taken. Therefore, this road cannot be relied upon as a safe egress route for the site at the time of the assessment without detail information of the constructed Natasha Parade.

Figure 14 shows the flood hazard categorisation within the entire model during the critical PMF storm event. This indicates that there is no way in or out of the site in the critical PMF event that does not go through high or medium hazard waters, though floodwaters quickly recede.

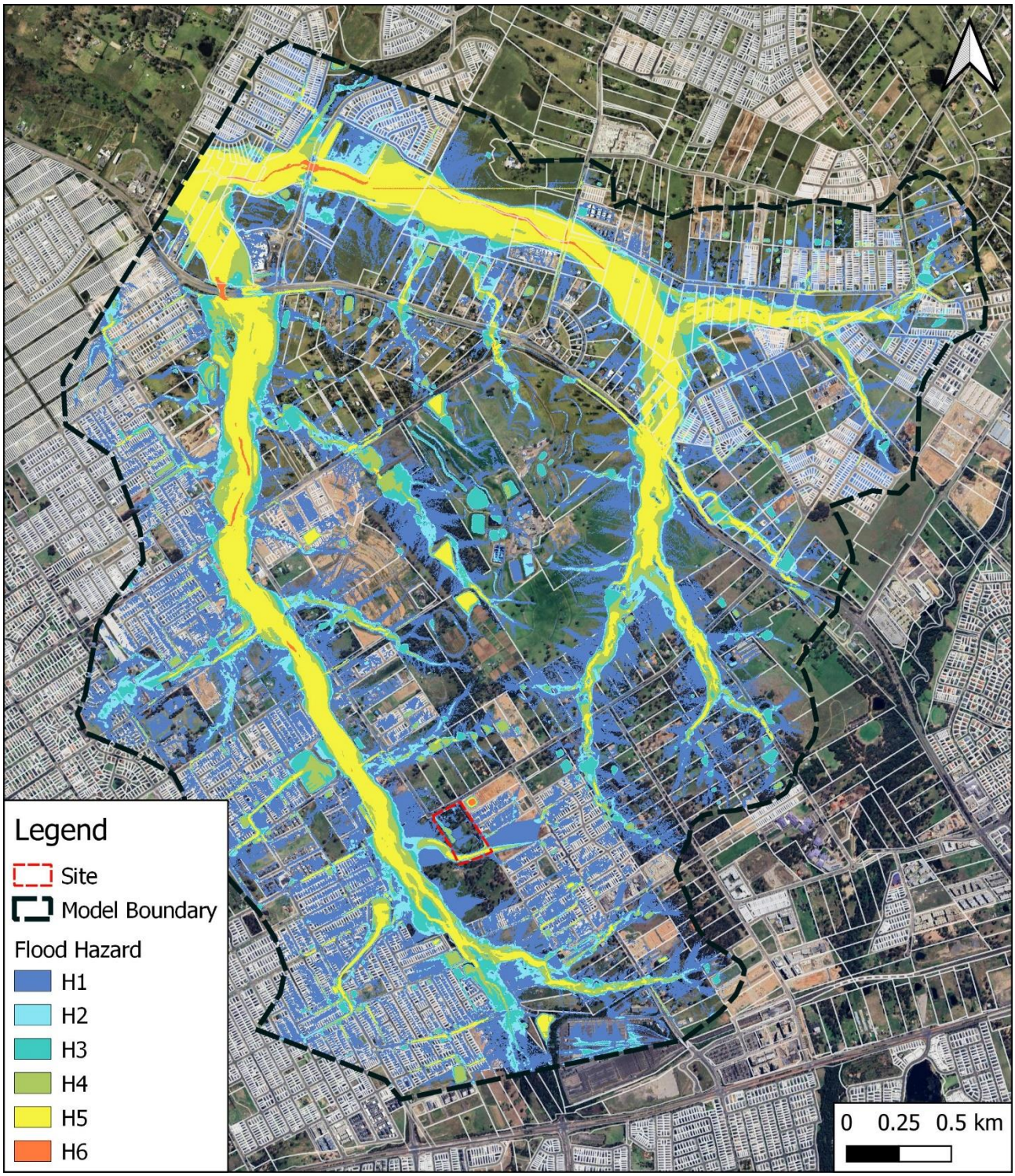

Figure 14: Peak flood hazard categorisation for the site and its surrounding area during the critical PMF storm event.

4.0 Consultation

TTW met with NSW SES on 31st October 2024 to discuss the impact of the proposed site activity and considerations for the flood emergency management of the site. The meeting minutes are attached in Appendix A. NSW SES noted that due to the area's susceptibility to flash flooding, it may be challenging to relocate offsite, with little warning time before peak flooding occurs.

5.0 Flood Response Strategy

5.1 Preferred Strategy

5.1.1 Pre-Emptive Closure

Section 1.6.2 of the Blacktown City Local Flood Emergency Sub Plan states that evacuation is the primary response strategy for people impacted by flooding. Section 5.8.5 similarly highlights pre-emptive evacuation as a potential flood emergency strategy in Blacktown. Pre-emptive closure of the school is the preferred flood emergency strategy for the school site if advanced warning is received outside of school hours, or where a severe event is forecast several hours in advance.

Although flash flood events are characterised by minimal warning times, there may be advanced notice of the extreme rainfall experienced in a 1% AEP–PMF event. During the operational phase, where there is enough warning prior to school opening hours, the school should be closed in advance of the flood event so children can be safe at home and parents do not have to drive though roads that could become hazardous.

In this strategy, the Blacktown Flood Emergency Sub Plan states that School administration offices (Department of Education) will coordinate the evacuation of schools in consultation with the NSW SES and Welfare Services, if not already closed.

An SMS must be sent to staff and parents at the earliest opportunity (once the severe weather warning is issued by BOM) to ensure no site users enter dangerous road conditions.

5.1.2 Shelter-in-Place

While there is often advanced warning time of extreme rainfall events such as those endured in a 1% AEP-PMF event, this cannot be relied upon. Severe weather events may lead to flash flooding with little to no warning time, and pre-emptive closure of the school cannot be accomplished, as was acknowledged by SES during consultation.

Shelter-in-place (SIP) guidance published by the NSW Department of Planning and Environment (DPE) in January 2025 states that SIP is an appropriate emergency management response when the flood warning time and flood duration are both less than six hours. With less than 10 minutes from the onset of the critical PMF storm until inundation of the adjoining roads for the proposed school site, it is recommended that the school is prepared for a shelter-in-place strategy.

As evident in Figure 14, there is no way in or out of the site that does not go through high or medium hazard waters during the critical duration PMF event. NSW SES state that evacuation of a site must not require people to drive or walk through flood water. The duration of isolation is short due to the flashy nature of flooding in the area, with the school only cut off from access roads for approximately 30 minutes in the critical PMF event (Section 3.3), though this increases to up to 2 hours in longer duration PMF events. It should also be noted that all proposed buildings are to be set above the PMF level and will not experience above-floor inundation. As a result, all buildings are safe to shelter in from the ground floor and upwards.

The DPE shelter-in-place guideline recommends a minimum floor space of $2m^2$ per person. Based on current site plans (DJRD Schedule of Accommodation), the overall indoor floor space area across all four buildings is approximately $11,400m^2$. Even when applying a 60% reduction to account for furniture, toilets and storage facilities, this leaves a 'usable' floor area of $4,575m^2$ to shelter within, with the site having capacity to shelter over 2,200 people. The site can therefore accommodate the 1,000 proposed students in addition to staff and site visitors.

During the shelter-in-place strategy, all staff and students are to remain indoors. The Site Manager must ensure that there are no site users outdoors, including within the car park area.

5.2 Secondary Emergency

Although shelter-in-place is the preferred emergency response strategy should a severe event begin without sufficient warning, any decision to shelter-in-place must be accompanied by alternative plans for evacuation in the event of a secondary emergency (e.g. medical or fire) or if some site users refuse to shelter-in-place. If there is a secondary emergency, the least hazardous route and the first to clear is via Tallawong Road. Travel east onto Macquarie Road before travelling south towards Schofields Road via Cudgegong Road.

6.0 Flood Warnings and Notifications

6.1 Bureau of Meteorology

Severe weather and thunderstorm warnings are issued by the Bureau of Meteorology (BoM). These warnings are continually updated with descriptions of the likely conditions, including predicted extreme rainfall depths. Flood warnings are issued by the BoM when flooding is occurring or is expected to occur in an area. Warnings may include specific predictions of flood depths dependent on real-time rainfall and river level data. These warnings are distributed by BoM to councils, police and the relevant local SES, as well as being available on the BoM website.

- A ***Flood watch*** is issued by the BoM up to four days prior to a flood event. A watch is generally updated daily and may be issued before, during, or after rainfall has occurred.

- ***Flood warnings*** are issued by the BoM when flooding is occurring or expected to occur in a particular area. Warnings may include specific predictions of flood depths dependent on real-time rainfall and river level data. These warnings are distributed to Council, Police, and the relevant local SES, as well as being available on the BoM website, through telephone weather warnings and radio broadcasts.

6.2 NSW SES Australian Warning System

NSW SES has recently implemented the Australian Warning System (AWS) which replaces their previous evacuation orders and warnings system. The AWS is a new national approach to information and 'Calls to Actions' for hazards including flooding. The System uses a nationally consistent set of icons, with three warning levels: Advice, Watch and Act, and Emergency Warning. The flood warnings are described in Figure 15.

Figure 15: Australian Warning System - Three Warning Levels

The NSW SES utilises a range of sources to build detailed flood intelligence within local communities, including information from flood studies and historical flood data. As part of the transition to the Australian Warning System, the NSW SES has increased flexibility to tailor warnings at the community level, based on the expected consequences of severe weather events.

The Site Manager is responsible for monitoring information from the AWS. Impacted communities will continue to receive flood warnings through the NSW SES website, NSW SES social media channels and by listening to local ABC radio stations. The NSW SES has also developed an all-hazards warning platform, Hazard Watch, to provide an additional channel for communities to access important warning information.

Each warning has three components:

1) **Location and hazard**: The location and the type of hazard impacting the community.
2) **Action statement**: For each warning level there are a range of action statements to guide protective action by the community. These statements evolve as the warning levels increase in severity.

Statements range from ‘prepare now’ and ‘monitor conditions’ at the Advice level, to ‘stay indoors’ at the Watch and Act level, to ‘seek shelter now’ in the Emergency Warning level. As the situation changes and the threat is reduced, the level of warning will decrease accordingly.

3) **The warning level**: The severity of the natural hazard event based on the consequence to the community.

As the site is affected by flash flooding, little to no warning time is likely to be available, with Severe Storm Warnings and Severe Thunderstorm Warnings likely to be the only warnings available.

It is also important to acknowledge that neither the NSW SES nor the Bureau of Meteorology can provide special individual flood warning services for each affected property or school. The more specific the warning requirement for individuals and sites becomes, the more difficult it is for the NSW SES to deliver warnings in the short time frames that often apply. School operators must be weather aware and act early on publicly broadcast severe weather and flood warnings.

6.3 Triggers

The flashy nature of flooding at the site (and the inherently limited warning time associated with this type of flooding) limits the capacity of NSW SES to issue flood notifications and action statements with sufficient lead time. It is important to note that the warnings outlined above may not be available or occur with advanced warning.

To ensure adequate response time, alternative triggers should be monitored, including severe weather warnings, media updates via local radio stations and social media. While the Chief Warden is responsible for monitoring information from the AWS, NSW SES recommend that all site users (namely, all staff members and wardens) refer to the HazardWatch website and the Hazards Near Me app.

6.4 Emergency Signals

The site should have a Public Announcement (PA) system that can be used by the Site Manager to inform all staff of the chosen response strategy in the event of a flood emergency. This ensures that staff with key responsibilities in the Plan can begin to fulfil their duties without delay.

The PA system should be used alongside SMS and email updates to staff and students to inform them of any severe weather or flood warnings covering the site.

7.0 Flood Response Team

7.1 Staff Responsibilities

In the event of a severe flood, various staff members will be responsible for specific tasks as detailed in Table 6. Before the site is in operation, these roles must be delegated to specific staff members.

Table 6: Staff Flood Responsibilities

Role	Responsibilities
Site Manager	- Decide if pre-emptive closure can occur if warnings are received prior to school opening hours or with several hours' notice - Monitor flood warnings and notifications from BoM and AWS - Monitor BOM lidar and weather in the area of the site - Inform staff and students/parents of flood risk - Coordinate flood SIP drills
First Aid Officer	- Coordinate assistance for less able students and pre-school age children, and staff - Prepare a Flood Emergency Kit that includes a portable radio, torch, spare batteries, first aid materials, emergency contact numbers, candles, waterproof matches, waterproof bags and required medications.
Staff	- Check visitor log and student registers so all site users can be accounted for. - Report missing students or site visitors to Site Manager

7.2 Key Contact Details

In the event of a severe flood, key telephone numbers have been listed in Table 7 below.

Table 7: Key Contact Numbers

IMPORTANT TELEPHONE NUMBERS	
Site Manager	tba
Deputy Manager	tba
Safety/First Aid Officer	tba
Centre Staff	tba
External Contacts	
Police/Ambulance (for life-threatening emergencies)	000
NSW State Emergency Services (SES)	132 500
Fire & Rescue NSW – Blacktown	02 9493 1063
Blacktown Police Station	02 9671 9199
Blacktown Hospital	02 9881 8000

8.0 Preparation for Flood Response

8.1 Education and Signage

As part of the preparation for a flood event, all staff and students will be made aware and advised of the flood risks present on site and the flood protocols & procedures via signage. All staff on site will be made aware of the flood risk (including their management responsibilities) via briefing and signage. This will form part of the mandatory site inductions that all staff must undertake prior to commencing work. A copy of this FERP which includes emergency response procedures will be made available at communal areas within the site as well as the main office. This FERP must be regularly reviewed by the Site Manager, or in the event of any staff restructure or other significant change, to ensure it is up to date.

8.2 Flood Drills

It is recommended that flood drills be held by staff annually to ensure all staff workers and students are familiar with the sound of the alert and their subsequent flood response actions. It is the responsibility of the Site Manager to ensure that evacuation drills are organised and that any issues with these drills are attended to, and if necessary, rerun.

These drills are required to test the suitability of the plan, identify gaps and to provide staff the opportunity to put into practice their specific responsibilities. If issues arise, this plan should be reviewed and updated. The Site Manager will also ensure that all site drills are recorded in an appropriate records book and any non-conformities reported and responded to.

8.3 Flood Emergency Kit

A Flood Emergency Kit should be prepared prior to a flood event taking place and regularly checked to ensure that supplies within the kit are sufficient and in working condition. This check could occur after the evacuation drill takes place to provide a regular schedule. The Kit should include:

- Radio with spare batteries;
- Torch with spare batteries;
- First aid kit and other medicines;
- Candles and waterproof matches;
- Waterproof bags;
- A copy of the Site Emergency Management Plan; and
- Emergency contact numbers.

This Emergency Kit should be stored in a waterproof container, and it is the responsibility of the Site Manager to make sure that this kit is maintained and available during an emergency.

9.0 Flood Response Actions

The flood response actions are outlined in Table 8.

Table 8: Flood Emergency Response Actions for the site

Flood Emergency Response Plan	
Flood Warning and Notification Procedures	**Evacuation and Refuge Protocols**
1) Weather forecast predicts significant rainfall event in the area or BoM issues a **FLOOD WATCH** or NSW SES issue a yellow "**ADVICE**" warning 	The following actions must be undertaken by the Site Manager: 1) Notify all staff, site users and parents of the flood watch via SMS and email and confirm availability of relevant staff to assist with emergency actions if required. 2) Ensure the emergency kit is ready to use. 3) Listen to the local radio station for updates on forecasted flood heights and timings. Monitor updates on social media and NSW SES platform Hazard Watch. 4) Ensure staff are familiar with their responsibilities.
2) Flash flooding is reported in the media / via visual observation or BoM issues a **FLOOD WARNING** or NSW SES issue an amber "**WATCH AND ACT**" or red "**ACT NOW**" warning 	If the flood event is not anticipated to impact the site (either directly or indirectly), the **Site Manager** is to continue hourly check-ins and postpone high risk activities (e.g. unnecessary deliveries etc.). If flood event is anticipated to impact the site, the **Site Manager** must undertake the following actions: • **For life-threatening emergencies phone 000 immediately.** **If outside of operational school hours or where several hours of notice has been given:** • Implement pre-emptive closure of school. Send SMS to staff and parents to inform them and advise them of closure. **If during school hours or where warning time is deemed insufficient:** • An alert and warning message should be broadcast over the PA system confirming a significant flood event, notifying all students and staff to begin **shelter-in-place** procedures. • Ensure no one is outdoors. • Send SMS to parents, advising them of SIP strategy and asking them not to travel to school. • Direct all students and staff to shelter in their classrooms. Unnecessary movement between buildings should be avoided. Staff must check student registers and complete a headcount to ensure all site users are accounted for. • The **Site Manager** is to follow any action statements provided via the AWS. **NOTE: Avoid driving or walking through floodwaters. These are the main causes of death during flooding.**
3) Visual observation shows flood is receding or the alert has been downgraded by the relevant authorities and any flood event that occurred has passed. 	• The **Site Manager** is to confirm floodwater has subsided below the ground level and that there is no ponding within the site. • Flooded areas are to remain off limits until ponding has cleared. Site is to be inspected by the **Site Manager** if required. Once it has been confirmed that the water level has reduced to a suitable level, and if determined safe, the **Site Manager** may announce that staff and students no longer need to shelter-in-place.

10.0 Limitations and Revision of the Flood Emergency Response Plan

This FERP only addresses the shelter-in-place strategies during extreme flooding events for students and staff within the site itself and is considered a guide only. It does not cover students and staff individual safe travel arrangements to the site or when their safe travel arrangements may be disrupted by flooding and/or road closures. This FERP also cannot account for the behaviour of individuals (e.g. site visitors), such as choosing not to remain isolated in a building on a floor above the PMF for an extended flood duration or attempting to enter dangerous areas during a flood.

In addition, this FERP is based on the currently available information for the proposed site, and must be updated following the detailed design stage, prior to the site becoming operational. Flood Emergency Response Plans are 'living documents' which need to be regularly reviewed once the school is operational to ensure they remain appropriate to address the risk to the site, can be practically implemented, and consider changing information and lessons learnt from any floods since the last review.

It is the NSW Department of Education & Communities' responsibility to ensure this FERP is current and updated as necessary to be in line with relevant standards, directorate, legislation, and the Regional's State Emergency Management Plan to ensure the health, safety and welfare of all staff, students and others.

11.0 Mitigation Measures and Recommendations

Mitigation Number	Aspect/Section	Mitigation Measures	Reason for Mitigation Measure
1	Design, operation	Regularly review and update FERP.	This FERP is based on the currently available information for the proposed site, and must be updated following the detailed design stage, prior to the site becoming operational.
2	Prior to commence of operation	Delegate staff responsibilities.	To ensure all staff are aware of their specific roles and associated flood response actions.
3	Prior to commence of operation	Education and signage	As part of the preparation for a flood event, all staff and students must be made aware and advised of the flood risks present on site and the flood protocols & procedures via signage. This will enhance preparedness for a flood.
4	During operation	Flood drills	It is recommended that flood drills be held by staff annually to ensure all staff workers and students are familiar with the sound of the alert and their subsequent flood response actions.
5	Prior to commence of operation	Flood emergency kit	A Flood Emergency Kit should be prepared prior to a flood event taking place and regularly checked to ensure that supplies within the kit are sufficient and in working condition.

Evaluation of Environmental Impacts

The Flood Risk Assessment (TTW, December 2024) submitted alongside this report assesses the impact of the activity associated with flooding. Based on the identification of potential issues, and an assessment of the nature and extent of the impacts of the proposed activity, it is determined that:

- The flood impact assessment for the 1% AEP event, the 1% AEP with climate change event and the PMF event confirms that changes to offsite flood levels are generally within +/- 10mm, and are mainly located within existing waterway corridor. Therefore, the proposed activity is considered to result in negligible offsite impacts and will not have significant adverse effects on the locality, community and the environment.
- Potential flood risks and impacts can be appropriately mitigated or managed to ensure that there is minimal effect on the locality, community through recommended measures as outlined above.
- The activity is not considered to produce a significant impact.

Prepared by
TTW (NSW) PTY LTD

RACHEL CALDWELL
Civil Flood Modeller

Reviewed & Authorised By
TTW (NSW) PTY LTD

MICHAEL KOI
Associate (Flood)

Appendix A

NSW SES Meeting Minutes – 31st October 2024

TSA Riley

Schools: 128-134 Rickard Road, Leppington NSW 2179

9 Gregory Hills Drive, Gledswood Hills NSW 2557

Lot 2, Infantry Street, Jordan Springs NSW 2747

201 Guntawong Road, Tallawong NSW 2762

Agency Consultation: NSW State Emergency Service – Meeting Minutes

Meeting Purpose: Discussion of impacts

Meeting Time: Thursday 31st October 2024 from 1pm – 1:45pm online (MS teams)

Meeting Attendees: Sonia Mallos (Schools); Luke Zajac (Schools); Jarred Statham (Schools); Rory Wynbergen (Schools); Shay Bergin (Schools); Nick Jennings (Schools); Andrew Craddock (SitePlus); Claire Flashman (SES); Kate Dawes (SES); Elspeth O'Shannessy (SES); Michael Koi (TTW); Rachel Caldwell (TTW); Kieran Smith (BMT); Sam Bush (TSA)

No.#	Issue:	Notes:
1	<u>Jordan Springs</u> *SES commented on the need to consider the SES Flood Evacuation Modelling Report and wider Hawkesbury-Nepean Flood Emergency Sub-Plan to ensure that any evacuation strategy was viable, compatible with the road capacity and in line with their existing strategy.* *SES commented that the proposed strategy for the school is closure in response to a flood warning trigger prior to commencement and the onset of flooding, but that the FIRA will consider the above in terms of evacuation.*	SINSW to consider Flood Evacuation Modelling Report and wider Hawkesbury-Nepean Flood Emergency Sub-Plan in conjunction with TfNSW consultation inputs
2	<u>Leppington</u> *SES commented on potential complexities of evacuation as there is comparatively less warning time and so flood impact studies should include duration of isolation, depths hazard frequency and time to onset.*	SINSW to consider evacuation procedures at operational level
3	<u>Gledswood</u> *SES commented that is evacuation prior to the event is their preferred option and that a flood emergency response plan should include details of the evacuation route, inundation times and event details. I.e. evacuation of the site via Gledswood Road is only unsafe in the PMF event for 4-hour maximum.*	SINSW to consider evacuation route via Digitaria Drive
4	<u>Tallawong</u> *SES commented on potential re-configuration of carpark – important that site users can access cars.* *SES noted that due to the area's susceptibility to flash flooding, it may be challenging to relocate offsite with little warning time.*	SINSW to consider carpark design in conjunction with TfNSW consultation inputs. SINSW noted that the post-development design mitigates flooding to the south of the site, channelling floodwaters into an open swale.