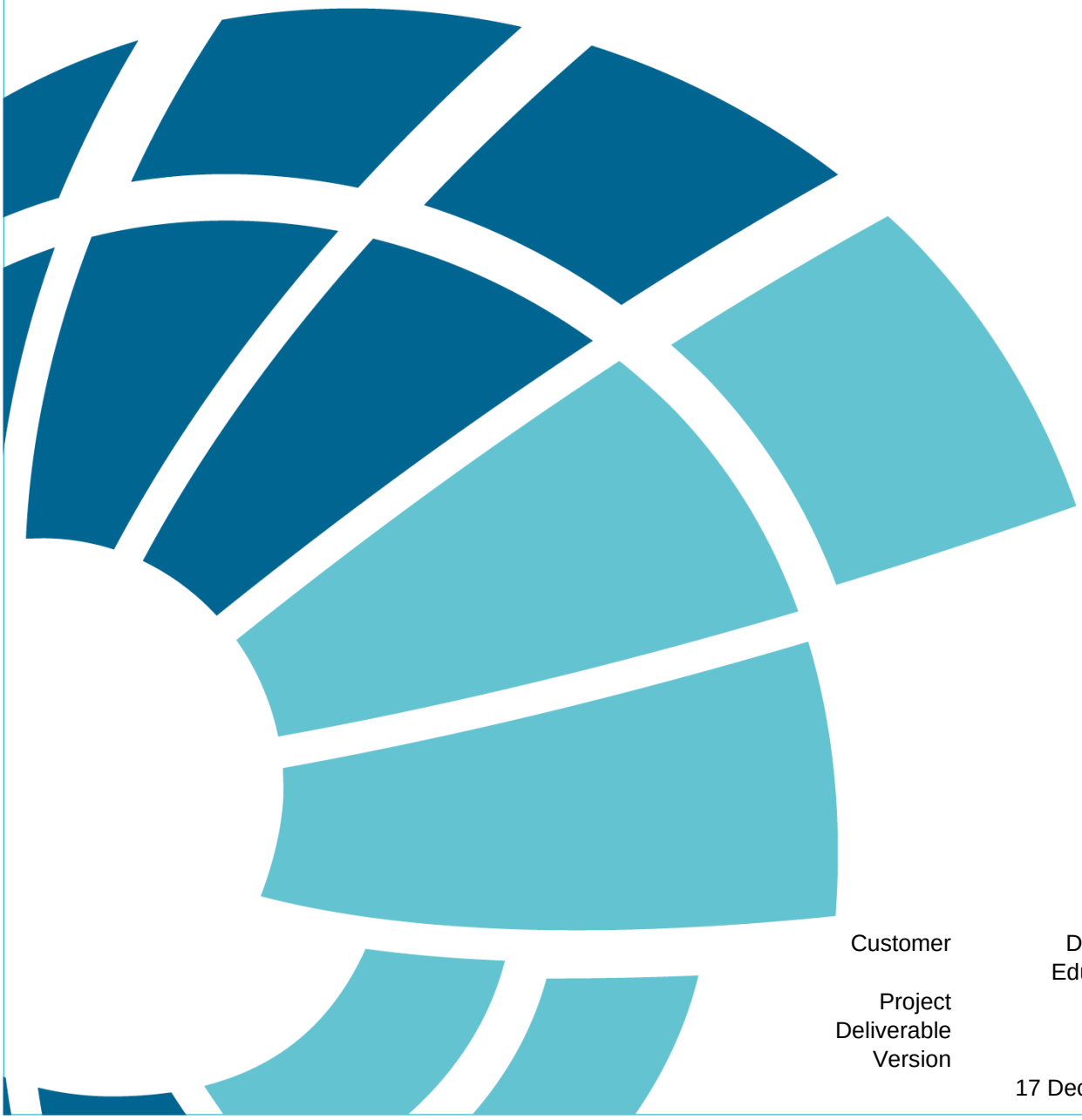
New High School for Jordan Springs - Flood Emergency Response Plan (FERP)



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Amendment Record

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00	15 November 2024	Department of Education, TSA	Draft – For Client Review
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02	17 December 2024	Department of Education, TSA	Final – Issued for REF

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1 Introduction

1.1 Purpose of this Report

This report documents the Flood Emergency Response Plan (FERP) that has been prepared to accompany a Review of Environmental Factors (REF) for the Department of Education (DoE) for the construction and operation of the New High School for Jordan Springs (the activity) under Part 5 of the Environmental Planning and Assessment Act 1979 (EP&A Act) and State Environmental Planning Policy (Transport and Infrastructure) 2021 (SEPP TI).

This document has been prepared in accordance with the *Guidelines for Division 5.1 assessments – Consideration of environmental factors for health services facilities and schools, October 2024* (the Guidelines) by the Department of Planning, Housing and Infrastructure.

This report examines and takes into account the relevant environmental factors in the Guidelines and *Environmental Planning and Assessment Regulations 2021* under Section 170, Section 171 and Section 171A of the EP&A Regulation as outlined in Table 1.1.

Table 1.1 Summary of Relevant Section of the Part 5 Guidelines and EP&A Regulation

Regulation / Guideline Section	Requirement	Response	Report Section
Section 3, Table 1, l)	Consider any risk to the safety of the environment (including runoff patterns, flooding regimes)	This report outlines the proposed flood emergency response strategy for the school in response to flood events.	3 to 8

This report outlines the proposed flood emergency management strategy to be implemented at the school including the decision to stop school operations as well as procedures for flood evacuation, warning systems, signage, and responsibilities of building wardens in case of a flood emergency during school operational phase. It has been prepared with consideration of:

- Hawkesbury-Nepean River flooding, South Creek flooding and local (overland) flooding;
- the proposed activity; and
- relevant local and state government policies and guidelines including the NSW Flood Risk Management Manual (NSW Government, 2023), Hawkesbury-Nepean Valley Flood Emergency Plan (NSWRA, 2024), Hawkesbury-Nepean Valley Flood Evacuation Modelling and Planning (NSW Government, 2023) and Penrith City Local Flood Plan (Penrith City Council, 2012).

The FERP documented in this report reflects the design assessed in the 'New High School for Jordan Springs – Flood Impact and Risk Assessment' (BMT, 2024). If the proposed design changes in the future or in the detailed design stage, the FERP may need to be further updated to reflect relevant modifications. Once the proposed activity is completed, a concise operational flood emergency management plan (OFEMP) is recommended to be developed by the school in consultation with the NSW State Emergency Service (SES) based on this FERP.

It is to be noted that this FERP is a preliminary document. Information and data provided in this report will require ongoing updates to reflect the latest available flood data and evacuation information.

1.2 Documentation Review

The plans and reports identified in Table 1.2 have been reviewed to inform the assessment contained within this report.

Table 1.2 Reviewed Plans and Reports

Discipline	Document name	Revision	Date
Flooding	Wianamatta (South) Creek Catchment Flood Study (INSW)	Rev I	23 May 2022
Flooding	Hawkesbury-Nepean Flood Study (NSWRA)	Rev 07	19 May 2024
Civil Engineering	JORDAN SPRING HIGH SCHOOL (JSHS-TTW-01-00-DR-C)	Rev B	30 October 2024

1.3 Proposed Activity Description

The proposed activity for the construction and operation of the New High School for Jordan Springs (JSHS) is proposed to have a capacity of 1,000 students and 80 staff to meet forecast enrolment demand associated with population growth in Jordan Springs and Ropes Crossing. The school will provide permanent General Learning Spaces (GLS), Support Learning Spaces (SLS), staff facilities and a library across three (3), three storey buildings, a single storey hall, sports field, three (3) outdoor sport courts, 72 operational at grade parking spaces (including two (2) accessible spaces), 100 bicycle spaces and landscaping.

Public domain works and the permanent off-site OSD Basin are to be constructed by others under separate planning pathways.

1.4 Proposed Activity Scenarios

The project scope of works includes two (2) Scenarios, to allow construction and operation of the school, with (Scenario 1 – preferred option) or without (Scenario 2 – Interim Solution) the public domain works and permanent off-site basin being constructed by others under a separate planning pathway.

Scenario 1 – Preferred Option - Road Network completed and permanent OSD Basin Constructed

- External works undertaken by others to facilitate Scenario 1
    - Construction of Park Edge Road;
    - Any adjustments to Infantry Street;
    - Kiss and drop zone along Park Edge Road;
    - Support kiss and drop zone located along Infantry Street; and
    - Construction and operation of permanent OSD Basin off site.

Note – Scenario 1 is not to proceed if external works undertaken by others is not completed.

- Scenario 1
    - Construction and Operation of the New High School for Jordan Springs, including:
        - Decommissioning of existing on-site OSD basin;

- Demolition of roads and associated services within the site boundary;
- Tree removal within the site boundary;
- Earthworks;
- Three (3) multi-storey classroom buildings;
- One (1) school hall;
- Three (3) outdoor sport's courts;
- One (1) sport's field;
- 72 at grade car parking spaces, including two (2) accessible parking spaces, and waste services, accessed via Park Edge Road;
- 100 bicycle parking spaces across the site; and
- Landscaping.

Scenario 2 - Interim Solution – Road network not completed, Permanent OSD Basin not constructed.

- Scenario 2 - Stage 1
  - Construction and operation of a temporary on-site OSD Basin;
  - Construction and operation of the New High School for Jordan Springs, including;
    - Demolition of roads and associated services within the site boundary;
    - Tree removal within the site boundary;
    - Earthworks;
    - Three (3) multi-storey classroom buildings;
    - One (1) sport's field;
    - Temporary carpark - 72 at grade car parking spaces, including two (2) accessible parking spaces and waste services, located on the north-west corner of the site, accessed off Armoury Road;
    - 100 bicycle parking spaces across;
    - Temporary Kiss and drop facilities on Armoury Road; and
    - Associated landscaping.
- Scenario 2 – Stage 2

  Stage 2 is not to be undertaken until the temporary on-site OSD basin under Stage 1 works is completed and operational.

  - Decommissioning of existing on-site OSD basin, prior to the following works being undertaken:

- 72 at grade car parking spaces, including two (2) accessible parking spaces, and waste services, located on the south-east corner of the site. This car park cannot be constructed until the decommissioning of the existing OSD basin is completed and will be non-operational with no road connection until completion of Scenario 2 – Stage 3;
- One (1) school hall; and
- Three (3) outdoor sport's courts.

External works undertaken by others to facilitate Stage 3

- Construction of Park Edge Road;
- Any adjustments to Infantry Street;
- Kiss and drop zone along Park Edge Road;
- Support kiss and drop zone located along Infantry Street; and
- Construction and operation of OSD Basin off site.

Note – Scenario 2 - Stage 3 is not to proceed until the external works undertaken by others have been completed.

- Scenario 2 – Stage 3
  - Connection of the south-east carpark to Park Edge Road;
  - Rectification works along Armoury Road to remove temporary kiss and drop facilities and cross over for temporary carpark;
  - Demolition of temporary carpark, once permanent car park is operational; and
  - Decommissioning of temporary OSD basin.

1.5 Activity Site

The project site is located on the corner of Armoury Road and Infantry Street in Jordan Springs and is legally described as part of Lots 2 and 3 in DP 1248480.

Figure 1.1 provides an aerial photograph of the project site, outlines the boundaries of the project site (in red) and the boundaries of Lots 2 and 3 in DP 1248480 (in blue).

The project site is within the Central Precinct of the St Mary's Release Area in the Penrith City Local Government Area (LGA).

1.6 Other Approvals

External works and construction of the permanent off-site OSD Basin are to be constructed by others.

Figure 1.1 Aerial Photograph

2 Site Description and Proposed Activity

2.1 Site Description

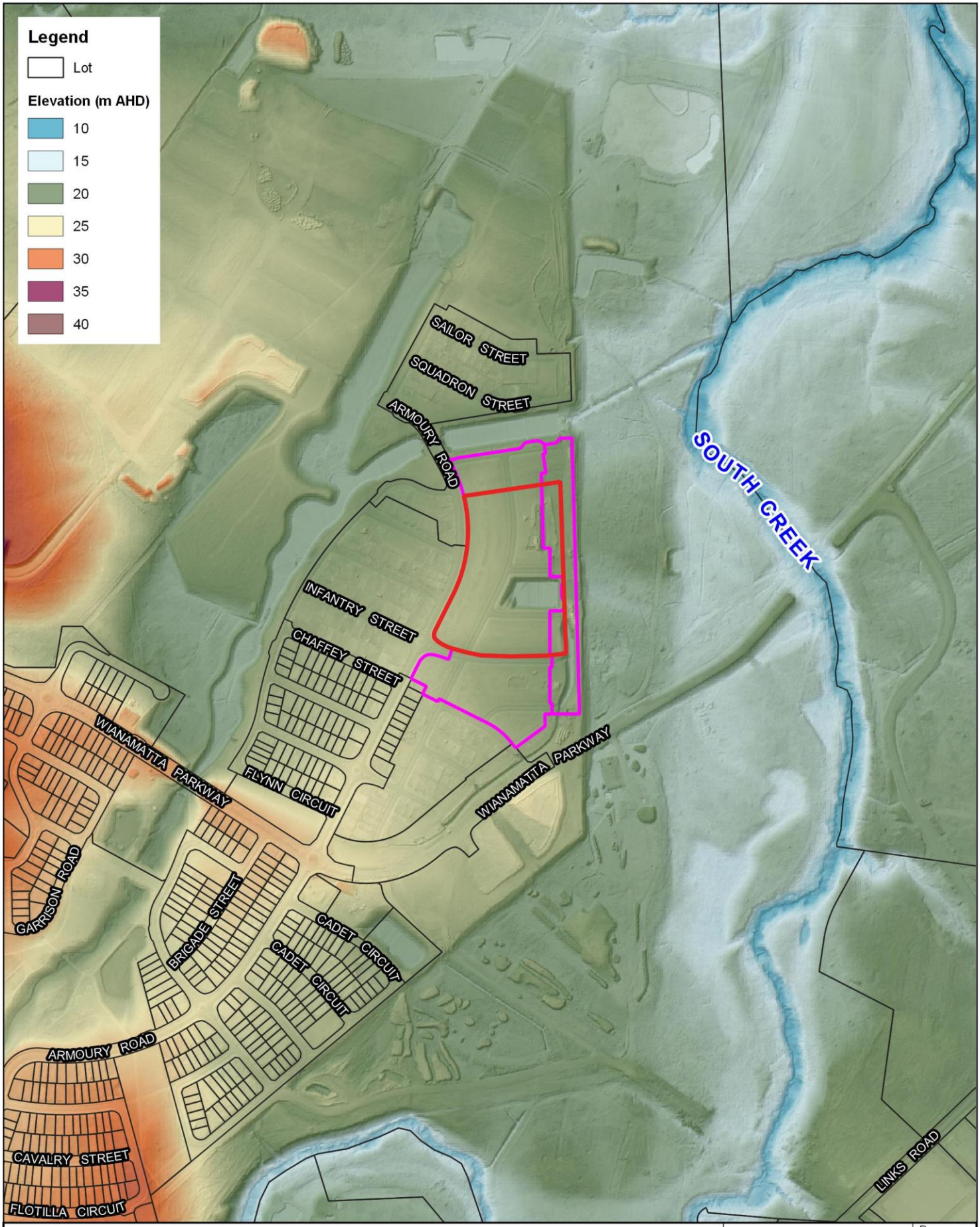
The proposed activity is planned on an approximately 5 ha lot that is bordered by Armoury Road to the west, Charlie Street to the south, and open, cleared areas to the north and east. The study lot, hereafter referred to as ”the Site”, encompasses Lots 2 and 3 (DP 1248480) and provides a relatively spacious and undeveloped setting suitable for future activity. Currently, the Site boundary is characterised by cleared grass vegetation and includes several stormwater basins that manage local surface water runoff.

The on-site elevation varies from 18.4 mAHD at the surface of the existing stormwater basin to 23.7 mAHD in the south-west corner, as illustrated in Figure 2.1. It is understood that between 2011 and 2019 at least 3 m of fill (estimated from a comparison of available LiDAR datasets) was imported onto the Site as part of wider construction within the Jordan Springs suburb.

The Site is located within the catchment of the South Creek watercourse, a major tributary of the Hawkesbury River, and is subject to mainstream flooding. It is noted that the 2022 NSW Flood Enquiry identified the Hawkesbury-Nepean Catchment as a ‘high risk catchment’. The Site is also situated within the Central Precinct of the St Mary’s Release Area, an area earmarked for growth within the Penrith City LGA.

2.2 Proposed Activity

The approximate extent of the new school is shown in Figure 2.2. The proposed activity description and scenarios are described previously in Sections 1.3 and 1.4, respectively.



Title:

New High School for Jordan Springs Site and Existing Terrain

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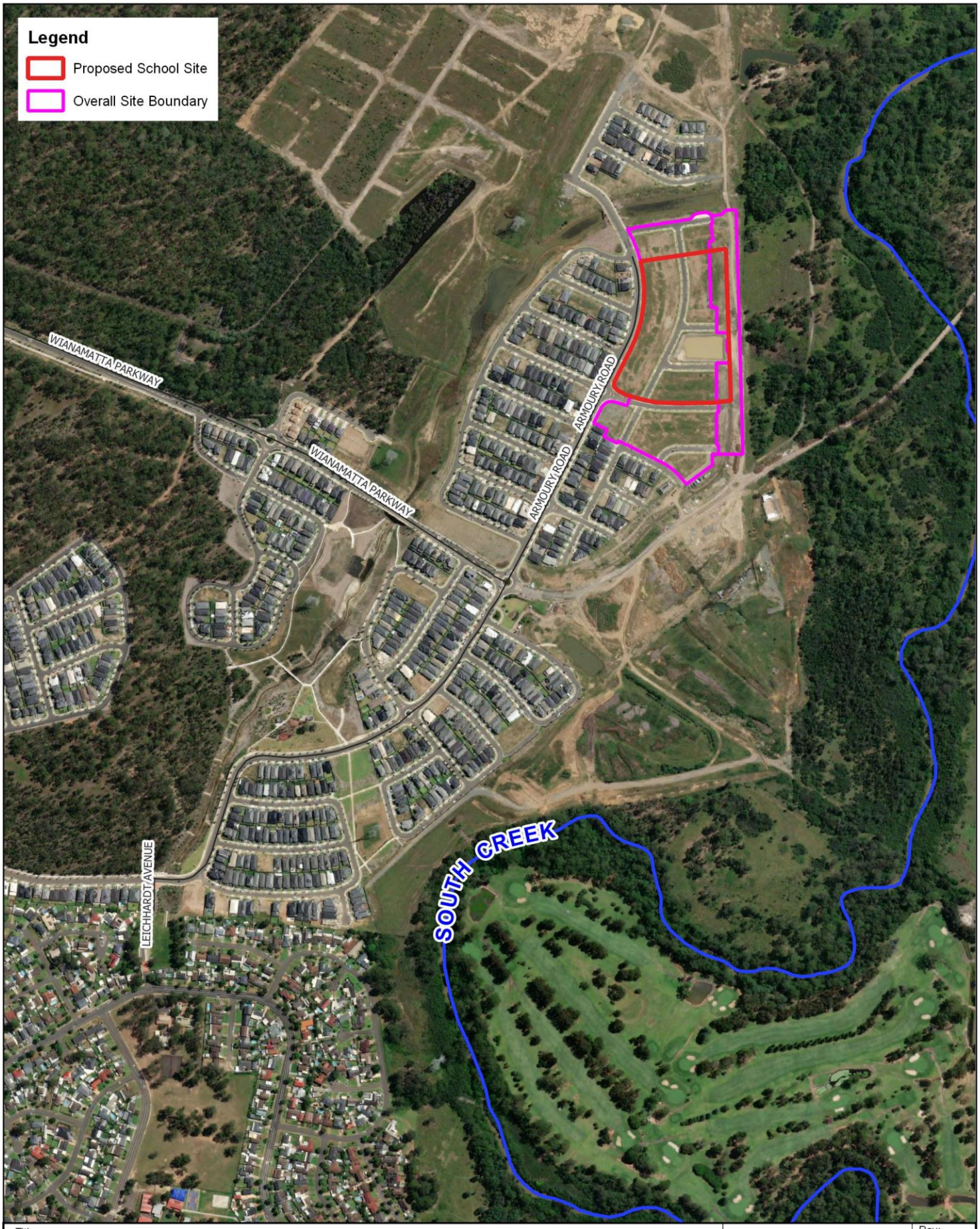

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New High School for Jordan Springs Site Locality

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The proposed Site Plan for Scenario 1 and Scenario 2 (Stage 3 Operational) is shown in Figure 2.3 (north orientated to the right). The proposed Site Plan places the proposed new buildings on the existing higher ground to the west of the Site with car parking at lower level to the east. The sports field is positioned approximately at the centre of the Site. Vehicle access is shown from the proposed new road to the east of the Site. A traffic lane to support drop off is shown on Infantry Street.

Figure 2.3 New High School for Jordan Springs Scenario 1 and Scenario 2 (Stage 3 Operational) Site Plan (Source: DJRD, issue date 11 November 2024)

As described in Section 1.4 and shown in Figure 2.3, there is no difference between completed and operational Scenario 1 and Scenario 2. The difference between these two scenarios is mainly related to construction staging. Scenario 1 proposes the new High School for Jordan Springs to be constructed and operational in one stage, whereas Scenario 2 proposes the new High School for Jordan Springs to be constructed and operational in three stages. Figure 2.4 (north orientated to the right) provides Scenario 2 – Stage 1 & 2 Operational plan for JSHS. Figure 2.5 shows Scenario 2 – Stage 3 Site Works Decommissioning & Construction plan.

This FERP was developed based on the completed and operational JSHS. This means that this FERP was initially applicable to Scenario 1 and Scenario 2 – Stage 3 Operational. However, the developed FERP and its technical assumptions were examined against Scenario 2 – Stages 1 & 2 Operational plan and Scenario 2 – Stage 3 Site Works Decommissioning & Construction plan to determine whether there is a need to develop any variations of this FERP to make it applicable to Scenario 2 – Stages 1 & 2 Operational plan and Scenario 2 – Stage 3 Site Works Decommissioning & Construction plan or not. The examination showed that the FERP is applicable to Scenario 2 – Stages 1 & 2 Operational plan

and Scenario 2 – Stage 3 Site Works Decommissioning & Construction plan as well without a need to develop any variation to the FERP since:

- The shortest potential time for Site inundation (discussed in Section 5) is calculated based on first inundation of the lowest point of the Site which is located along eastern boundary of the Site. This lowest point is independent of Scenario 2 construction staging (i.e., all the construction stages of Scenario 2 have the same lowest point across the Site).
- In this FERP, an evacuation route is proposed (Section 7) which starts from Armoury Road. According to the construction staging plans of Scenario 2 shown in Figure 2.4 and Figure 2.5, people have access from buildings to Armoury Road, and Armoury Road is operational in all the Scenario 2 construction stages.
- In this FERP, a flood emergency response procedure is developed (Section 8) which is triggered by water level at Windsor gauge or the issue of severe thunderstorm or emergency storm warnings. Both water level at Windsor gauge and severe thunderstorm or emergency storm warnings are independent of Scenario 2 construction staging.

Therefore, this FERP is applicable to Scenario 1 and Scenario 2 (i.e. all stages of operations in Scenario 2).

Figure 2.4 New High School for Jordan Springs Scenario 2 – Stages 1 & 2 Operational Plan (Source: DJRD, issue date 5 December 2024)

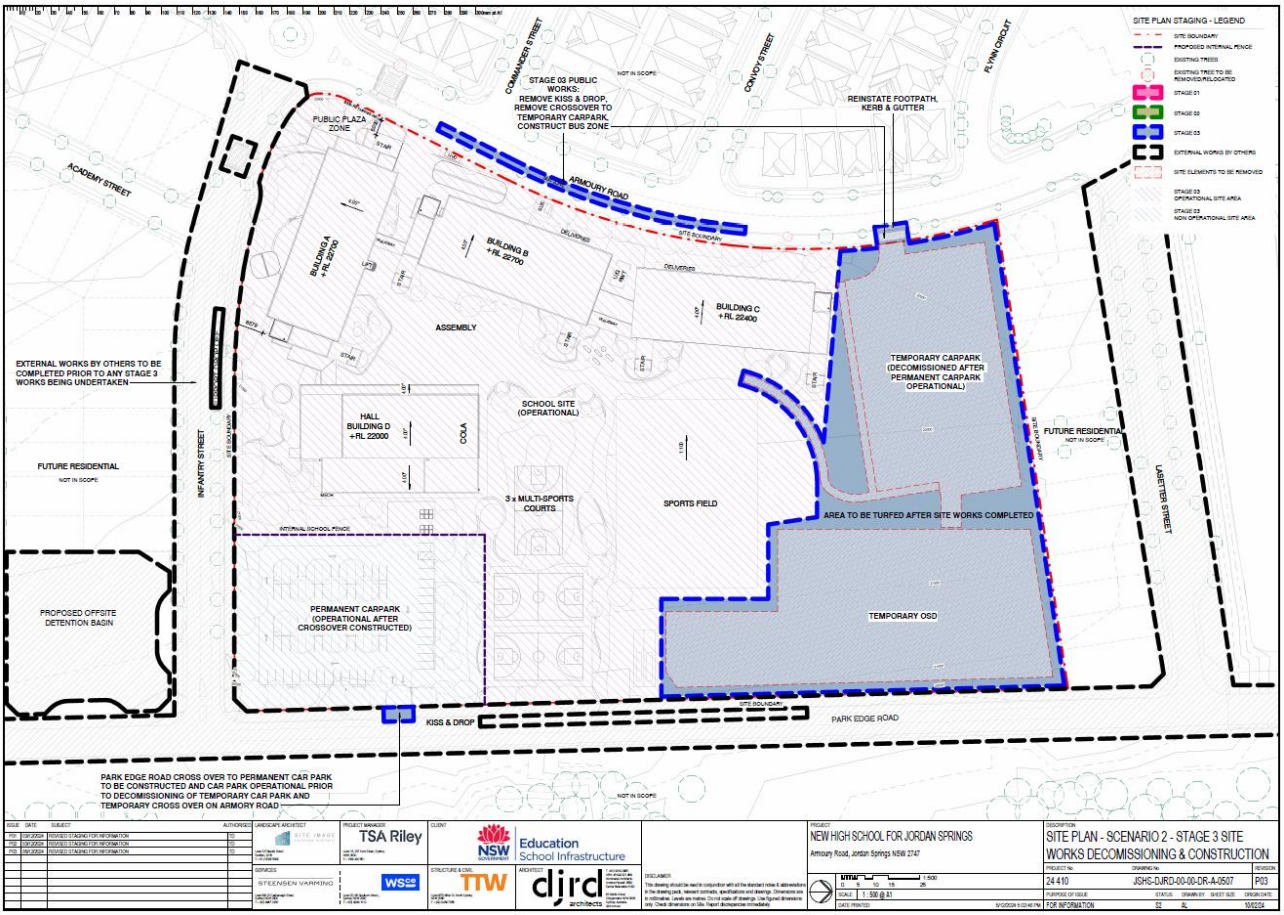


Figure 2.5 New High School for Jordan Springs Scenario 2 – Stage 3 Site Works Decommissioning & Construction Plan (Source: DJRD, issue date 05 December 2024)

3 Site Flood Behaviour

The Site is located adjacent to South Creek, within the South Creek and wider Hawkesbury-Nepean River catchments. As a result, the Site is potentially impacted by multiple flooding sources, including overland flow flooding from the local catchment (referred to as “local (overland) flooding”), South Creek flooding and Hawkesbury River backwater flooding.

As part of this study, BMT has reviewed:

- ‘Wianamatta South Creek Catchment Flood Study – Existing Conditions’ (INSW, 2022) (herein the “South Creek Flood Study”); and
- ‘Hawkesbury-Nepean River Flood Study’ (NSWRA, 2024) (herein the “HN Flood Study”); and
- ‘New High School for Jordan Springs - Flood Risk and Impact Assessment (FIRA)’ (BMT, 2024) (herein the “FIRA”).

The following sections summarise the findings of the BMT’s review.

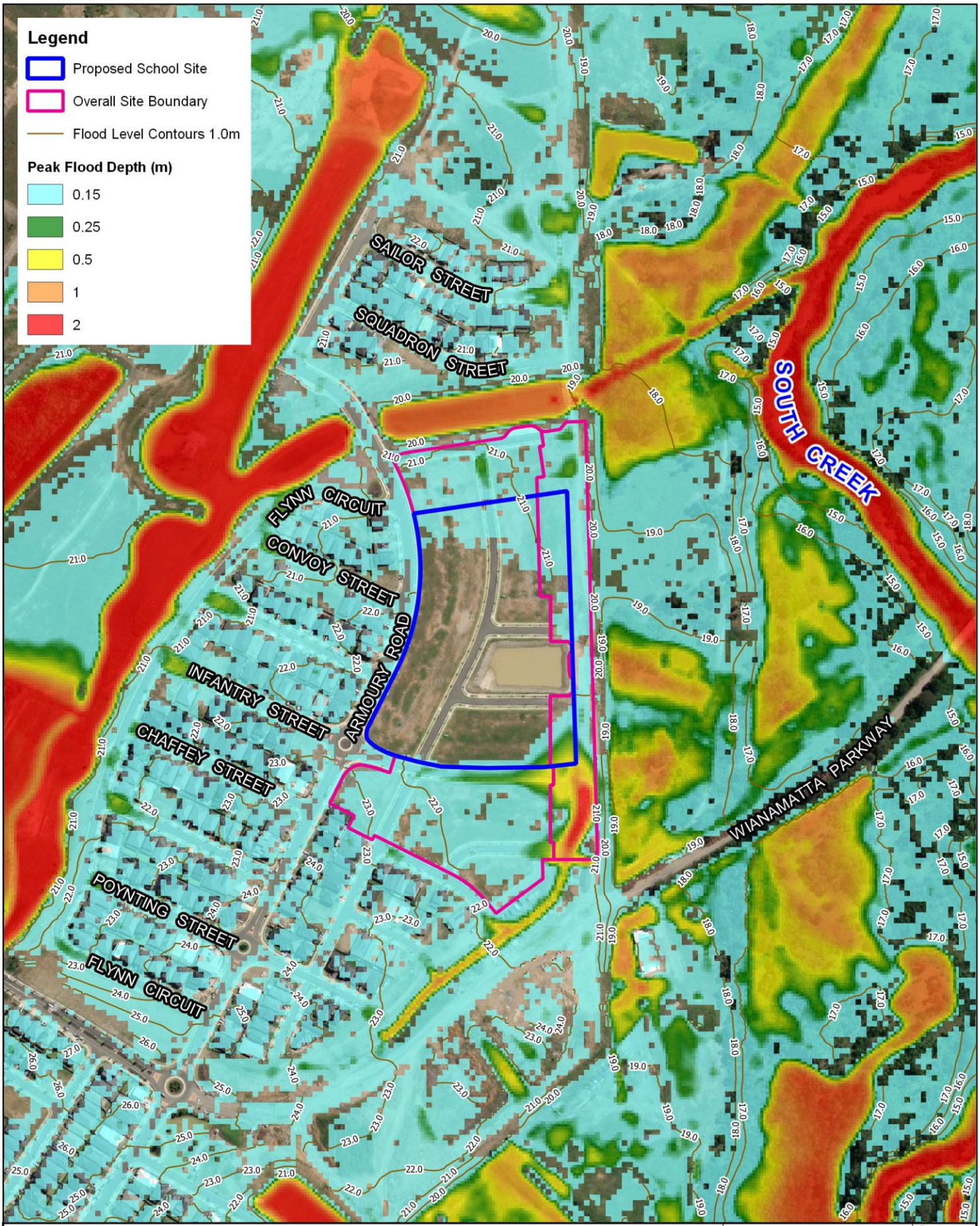
3.1 Local (Overland) Flooding

As part of the FIRA, BMT assessed the impacts of the proposed activity on local catchment overland flow flood behaviour. The assessment shows that the proposed activity will not result in off-site flood impacts and the minimum proposed building finished floor level of 22 mAHD (the proposed Hall – Building D) will be situated above the maximum peak probable maximum flood (PMF) level for local (overland) flood conditions. However, open spaces of the School Site will be affected in a local (overland) PMF event.

Figure 3.1 and Figure 3.2 illustrate local catchment peak depths and hazards for the PMF event. The flood depths within the Site and surroundings are generally less than 0.15 m. These shallow floodwaters are classified as a H1 flood hazard category indicating the Site and surrounds are generally safe for people, vehicles and buildings.

Runoff would occur rapidly following the onset of rainfall in a local (overland) PMF event, and there would not be enough time to close or evacuate the school prior to the peak of the storm. However as noted above, predicted PMF depths and hazards on Site are low and the maximum peak PMF level on Site would fall below the proposed finished floor level (FFL) for the new buildings. The proposed school would not be subject to inundation or isolation above ground floor. Due to the historic filling works across Jordan Springs, it is also not predicted that the local (overland) PMF would result in significant flooding of potential egress routes from the Site, and therefore the risk of isolation from a local catchment flood event is considered to be low. Given the extreme nature of the PMF, in particular the high volume of rainfall, it is recommended that – if the school is in operation during a local (overland) PMF event – following the onset of rainfall, students and staff should seek shelter inside the proposed buildings until rainfall ceases or directed by the SES.

It is noted that the PMF event is likely to be preceded by the issue of several thunderstorm warnings given the event significance and rarity. If multiple severe thunderstorm warnings are issued for Jordan Springs prior to school commencement, closure of the school should be considered in consultation with the SES.



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Peak Flood Depths and Levels - Post-Activity Conditions - PMF Event

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Peak Flood Hazard - Post-Activity Conditions - PMF Event

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3.2 Flooding From South Creek

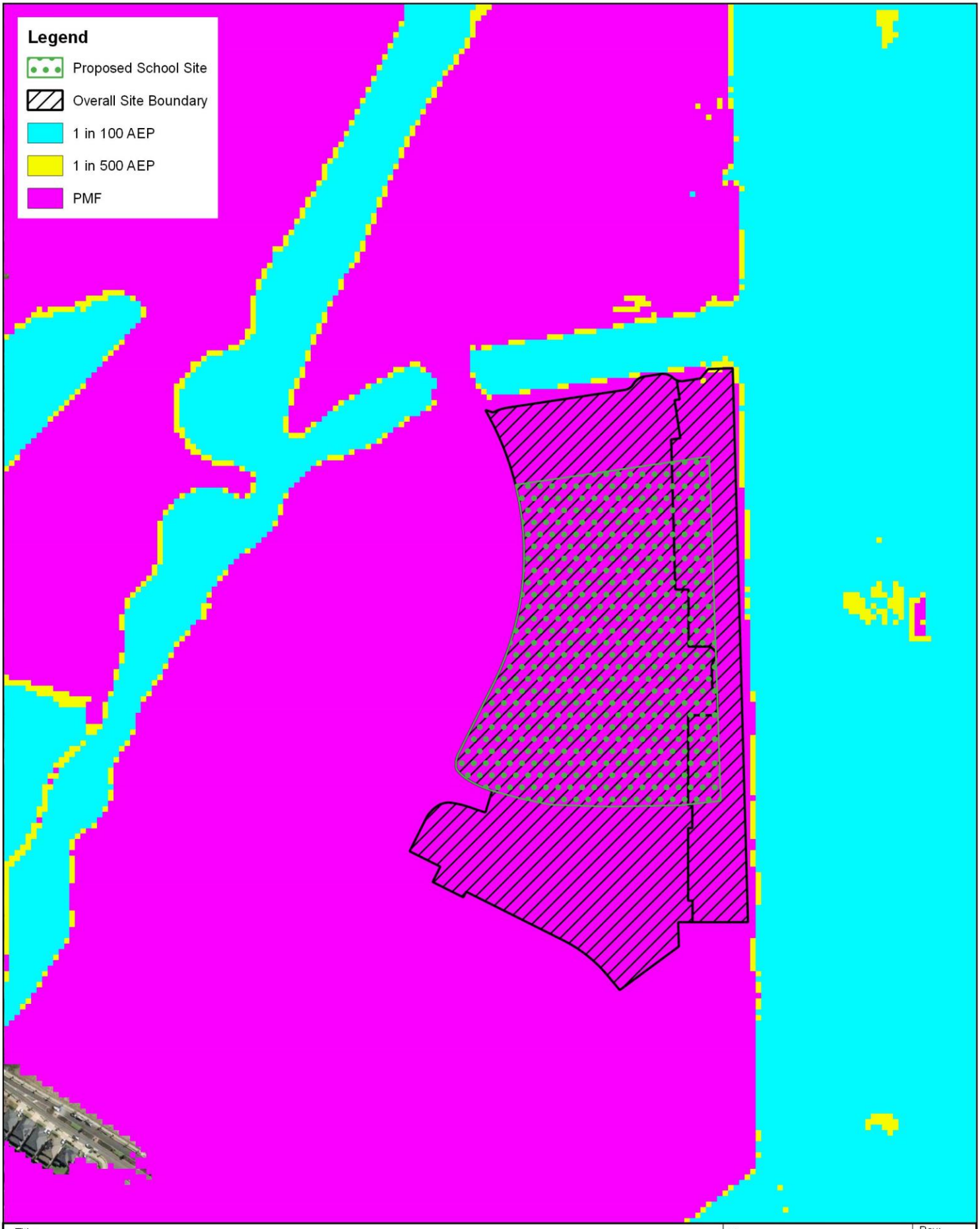
Flooding within South Creek was most recently assessed as part of the South Creek Flood Study. South Creek is a major tributary of the Hawkesbury-Nepean River, draining a 640 km^2 catchment inclusive of the Site from Narellan (in the south) to the confluence with the Hawkesbury River in the north. The study defined existing flood constraints across the catchment with the potential to impact on land use planning and included definition of a range of design flood events up to the PMF.

The study built on flood models and assessments previously completed for the catchment, including the 'Updated South Creek Flood Study' (Penrith City Council, 2015) (herein the "2015 South Creek Flood Study"). Peak flood levels at the Site, as determined in the 2022 South Flood Study, are summarised in Table 3.2.

Table 3.1 South Creek Peak Flood Level at the Site

Design Flood Event	Peak Flood Level (mAHD)
1 in 100 (1%) AEP	19.9
1 in 500 (0.2%) AEP	20.5
PMF	26.9

Peak 1% AEP, 0.2% AEP and PMF extents at the Site have been extracted from the South Creek Flood Study and are shown in Figure 3.3. It can be seen that the peak 0.2% AEP flood extent will potentially encroach only along the eastern Site boundary.



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Extent of South Creek Flooding at Site

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Figure 3.3 indicates that the Site would be impacted by the PMF on South Creek. It is noted that modelling of the South Creek PMF within the South Creek Flood Study includes a PMF tailwater condition on the Hawkesbury River – i.e. it assumes that there are simultaneous PMF events occurring on both South Creek and the Hawkesbury River. The Hawkesbury River PMF level assumed within the South Creek Flood Study is based on peak flood levels extracted from the Hawkesbury-Nepean Valley Regional Flood Study (INSW, 2019).

As part of the 2015 South Creek Flood Study, a sensitivity was undertaken to determine the impact of tailwater assumptions on peak South Creek flood levels. An extract from the study is included as Figure 3.4 below. For reference, the Site is approximately located at the Munitions Road and the Links Road Railway marker circled in the figure. As can be seen in the figure, the Hawkesbury River tailwater level dominates flood conditions at the Site in the PMF event. The adoption of a smaller Hawkesbury River tailwater – even the rare, 1 in 100 AEP flood level – would result in a significantly lower peak PMF level prediction at the Site driven purely by South Creek flood affectation. Peak South Creek Flood Levels determined in the 2015 South Creek Flood Study without the Hawkesbury River tailwater are approximately 22 mAHD. While the South Creek Flood Study is predicted to have slightly higher flood levels than the 2015 South Creek Flood Study, it is not predicted that a South Creek PMF would result in either overfloor flooding of the proposed new buildings or isolation of the Site without a very rare Hawkesbury River tailwater assumption. Flood emergency response requirements for South Creek flooding are therefore in line with those proposed for Hawkesbury River backwater flooding, outlined in this report.

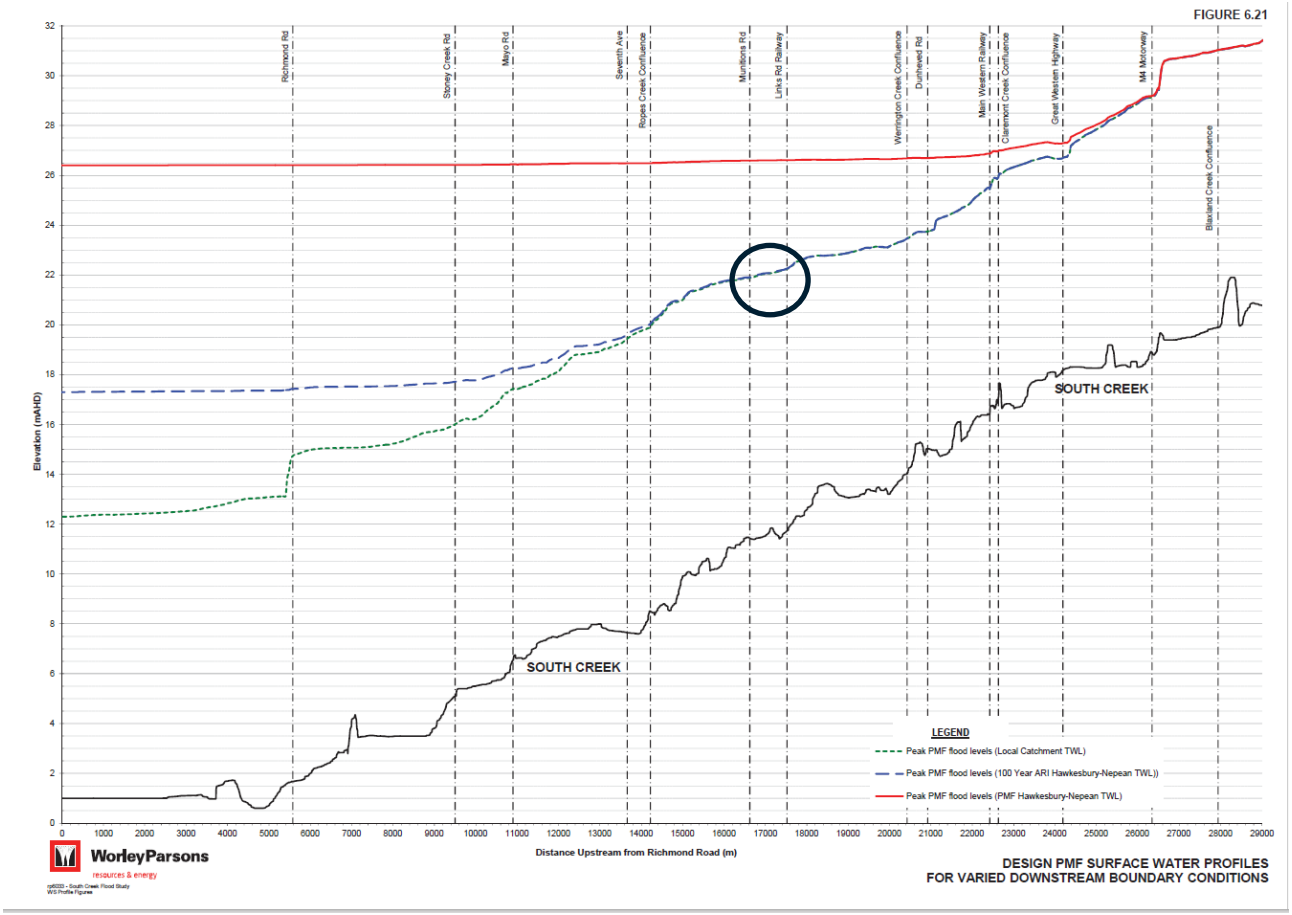


Figure 3.4 South Creek Flood Level – Tailwater Sensitivity (Penrith City Council, 2015)

3.3 Flooding from Regional Hawkesbury-Nepean Basin

The NSW Reconstruction Authority (NSWRA) commissioned Rhelm, Catchment Simulation Solutions, WMAwater and Baird to undertake the HN Flood Study, a comprehensive flood study of the Hawkesbury-Nepean floodplain. The study encompasses the 21,400 km^2 Hawkesbury-Nepean catchment and provides detailed flood information for the 190 km length of the Hawkesbury-Nepean River from Wallacia to Brookyln. It focuses on flooding at a whole of catchment scale, assuming at least 72 hours of rainfall, and does not model localised catchment and overland flow conditions. The HN Flood Study was completed in 2024 and defined flood behaviour for the Nepean River floodplain at Wallacia, Nepean River floodplain at Penrith, Hawkesbury River floodplain at Windsor and the Hawkesbury River floodplain at Wisemans Ferry.

Peak flood levels at the Site, as determined in the HN Flood Study, are summarised in Table 3.2. Flooding at the Site from the Hawkesbury River is the result of backwater flooding.

Table 3.2 Hawkesbury Backwater Flooding - Peak Level at the Site

Design Flood Event	Peak Flood Level (mAHD)
1 in 100 (1%) AEP	17.3
1 in 500 (0.2%) AEP	20.2
1 in 1000 (0.1%) AEP	21.3
1 in 2000 (0.05%) AEP	22.8
1 in 5000 (0.02%) AEP	24.4
PMF	30.6

Mapping provided as part of the HN Flood Study (shown in Figure 3.5 to Figure 3.9) indicates that the Site would be partially inundated from at least a 1 in 1000 AEP event, with several metres of inundation expected in a 1 in 5000 AEP event and significant flood depths likely in excess of 6 m deep in some locations in a PMF event.

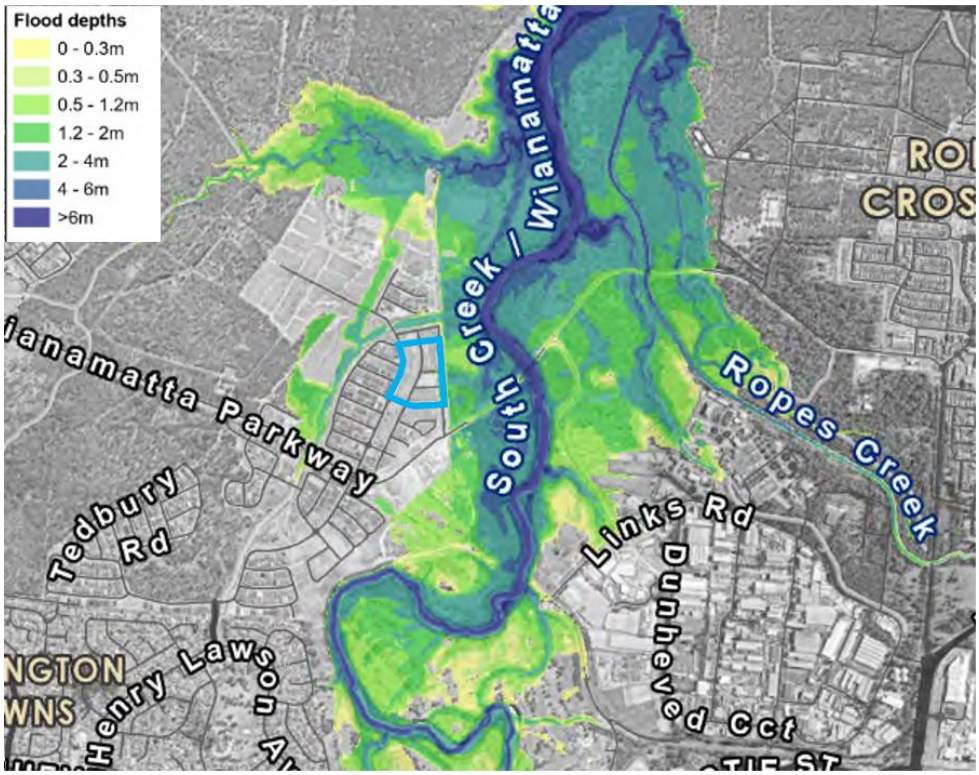


Figure 3.5 1 in 500 (0.2%) AEP Flood Depths, Hawkesbury Nepean Flood Study (NSWRA, 2024)

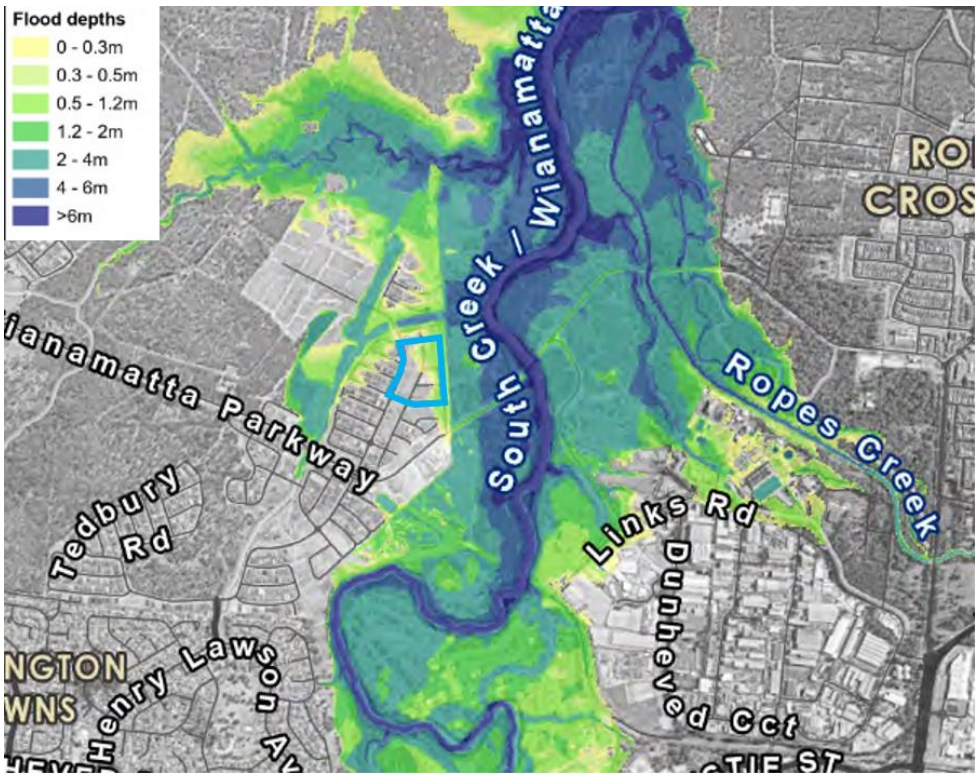


Figure 3.6 1 in 1000 (0.1%) AEP Flood Depths, Hawkesbury Nepean Flood Study (NSWRA, 2024)

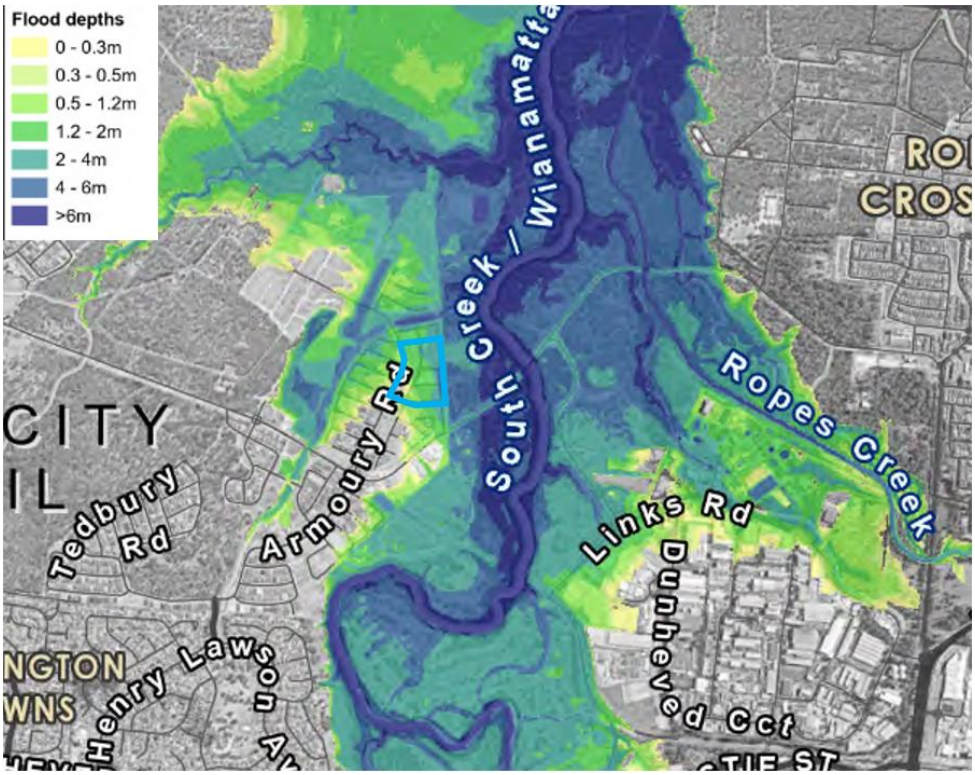


Figure 3.7 1 in 2000 (0.05%) AEP Flood Depths, Hawkesbury Nepean Flood Study (NSWRA, 2024)

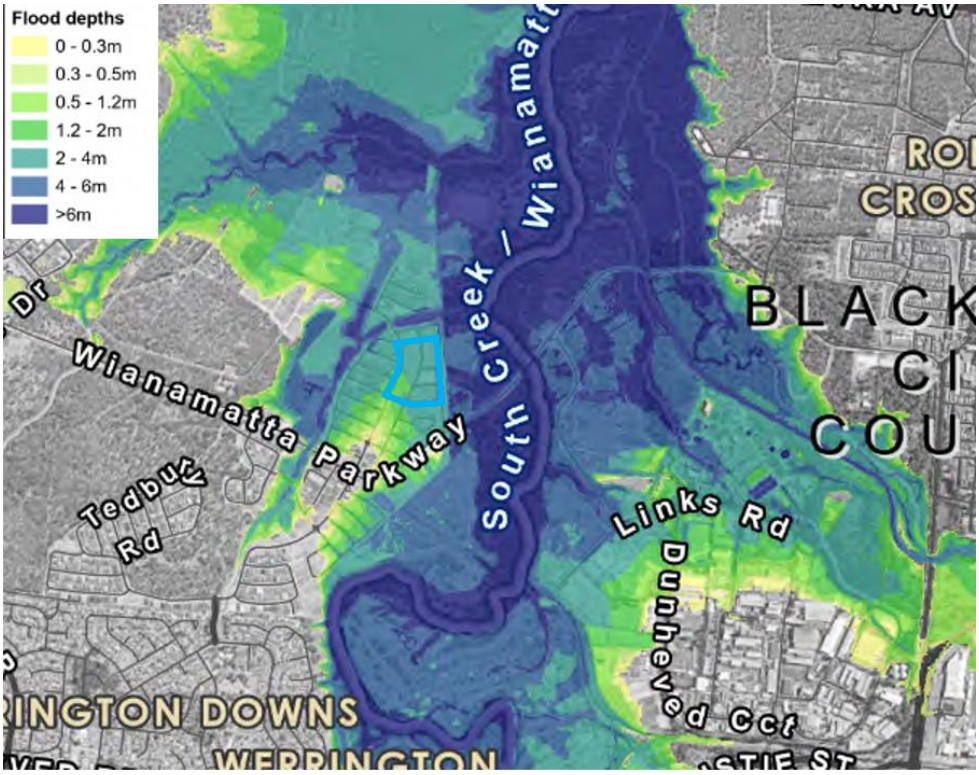


Figure 3.8 1 in 5000 (0.02%) AEP Flood Depths, Hawkesbury Nepean Flood Study (NSWRA, 2024)

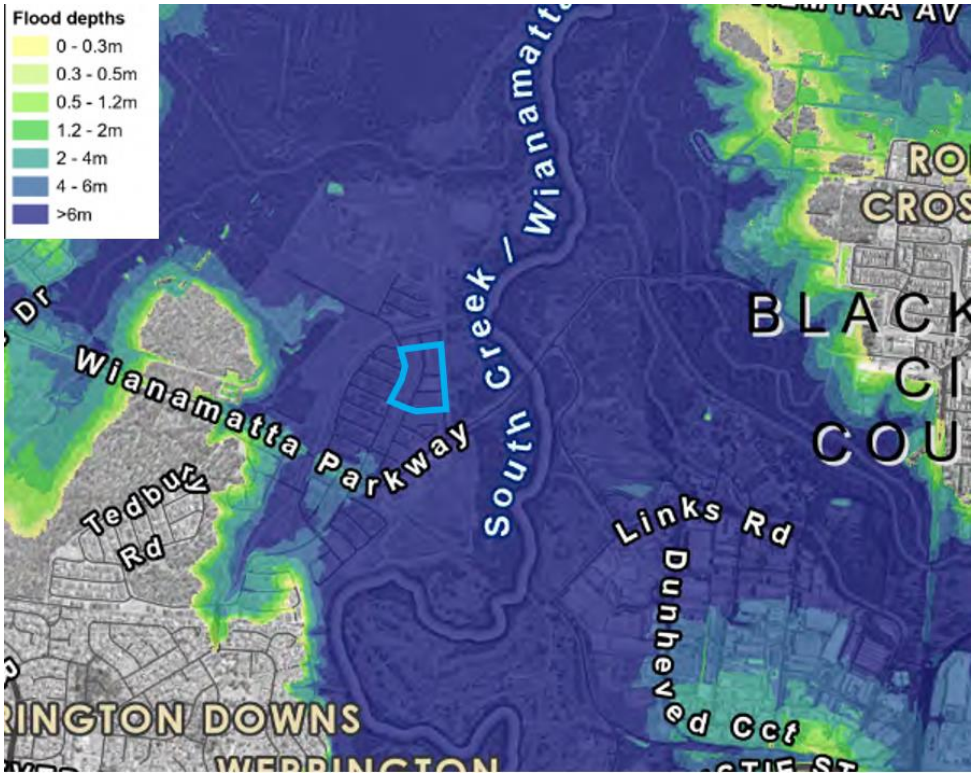


Figure 3.9 PMF Depths, Hawkesbury Nepean Flood Study (NSWRA, 2024)

3.4 Summary of Existing Flood Conditions

A comparison of the flood levels from the South Creek Flood Study and HN Flood Study indicates that for rare events (such as the 1 in 100 AEP), higher flood levels are predicted in the South Creek Flood Study when compared to the HN Flood Study (Table 3.1 and Table 3.2). This indicates for rare events, higher flood levels are driven by local catchment flooding from South Creek rather than Hawkesbury River backwater flooding. However, the HN Flood Study predicts a significant increase in the predicted peak PMF level at the Site when compared to the South Creek Study, indicating that conditions for very rare and extreme events are backwater dominant (Table 3.1 and Table 3.2). It is noted that the proposed activity areas will be free from inundation for events up to and including the 1 in 500 AEP event as a result of flooding from either South Creek or the Hawkesbury River.

Given the significance of Hawkesbury River backwater flooding at the Site in very rare and extreme events, flood emergency response management is primarily focussed on this flood mechanism. The proposed emergency management response outlined herein is also considered appropriate to manage the potential flood risks associated with very rare and extreme South Creek flood events in the unlikely event that they occur in isolation (i.e. where an extreme event occurs on South Creek in combination with a minor or frequent event on the Hawkesbury River). The proposed emergency management response is not considered to be impacted by local catchment flows (i.e. local (overland) flooding) draining to the Site/South Creek.

4 Consideration of Available Flood Emergency Plans and Best Practice Evacuation Strategies

The following sections include a review of regional flood emergency plans applicable to the Site and extracts of relevant information upon which the FERP is built.

4.1 Hawkesbury-Nepean Valley Flood Emergency Plan 2020-1.0

The Hawkesbury-Nepean Valley Flood Emergency Plan 2020-1.0 (herein the “HNV FEP”) (SES, 2020) is a Sub-Plan of the State Emergency Management Plan (EMPLAN) and outlines multi-agency arrangements for the emergency management of flooding affecting the Hawkesbury-Nepean Valley.

4.1.1 Division, Sectors and Sub-sectors

The SES has assigned divisions, sectors, and localities (subsectors) for catchments within the Hawkesbury-Nepean Valley which are outlined within Annex C of the HNV FEP. The HNV FEP:

- Shows all Sectors and Sub-sectors within the area of operation of the plan; and
- Details the grouping of sectors into divisions, localities covered by each sector, relevant flood gauges for each Sector and possible locations for sector control centres where required in a particular flood event.

The Site is situated in the of South Creek West division, Londonderry sector and Llandilo sub-sector areas shown in Figure 4.1 which has been extracted from the HNV FEP. Figure 4.2, indicates that the relevant flood gauge for the Londonderry Sector is the Windsor gauge (BoM Number 212426). Flood warnings provided by the BoM at the Windsor gauge are quantitative in nature (see Section 4.1.3).

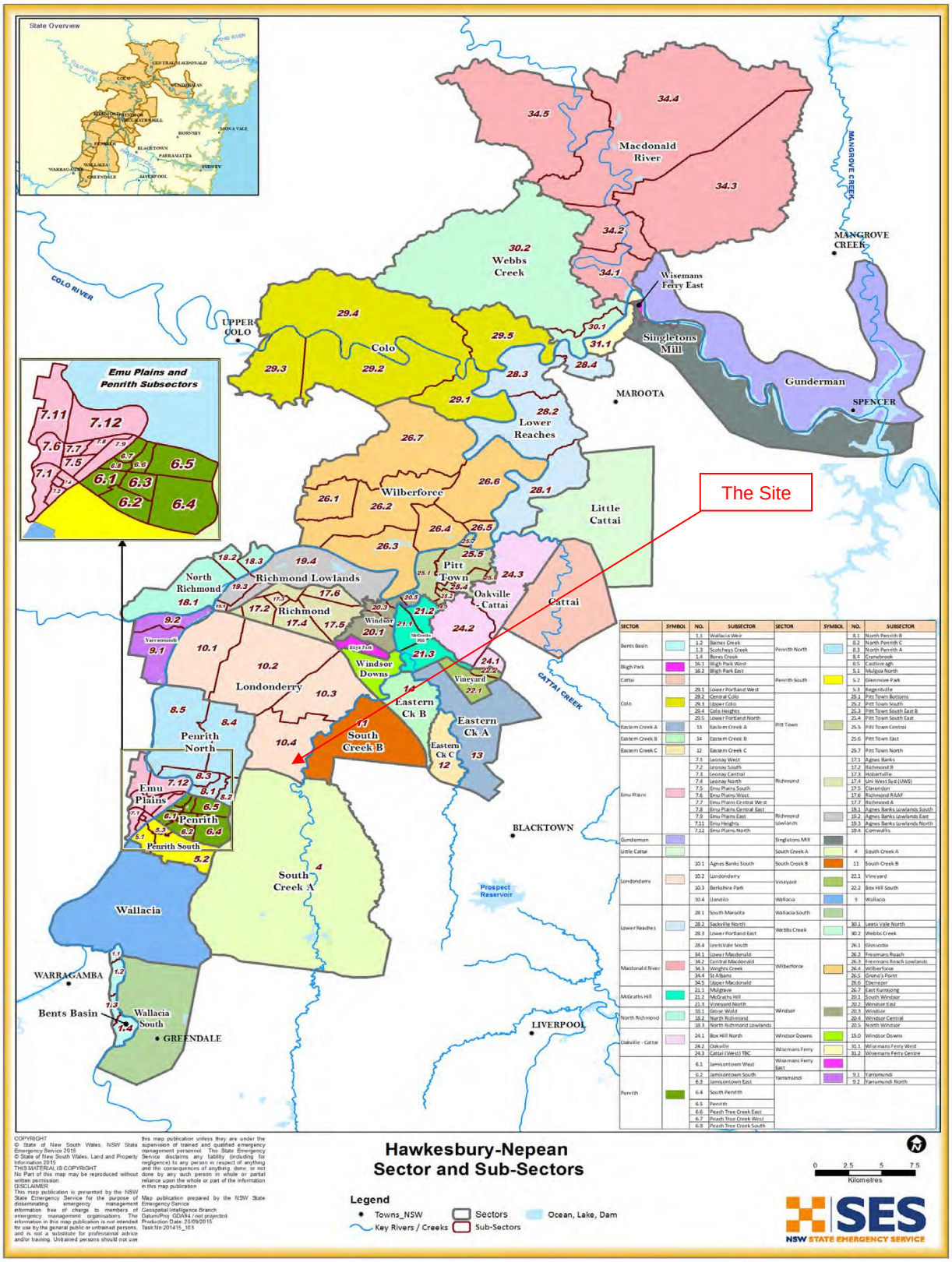


Figure 4.1 Sectors and Sub-sectors within the Hawkesbury-Nepean Flood Plan area of Operation (Source: HNV FEP 2020-1.0)

Local Government Area	Division	Sector	Localities	Relevant Gauge	Possible locations for Sector Control Centre
Penrith	Lower Nepean River Division	Wallacia Wallacia South Bents Basin	Wallacia, Mulgoa Rd and Bents Basin Road areas	Wallacia	Wallacia Shopping Centre (using Penrith Control vehicle)
		Emu Plains	Emu Plains, Emu Heights and Leonay areas	Victoria Bridge	Intersection of Mitchell's Pass and the Great Western Highway, Blaxland (using SES Blue Mountains Control Caravan)
		Penrith South	Mulgoa, Regentville and Glenmore Park areas	Victoria Bridge	Regentville Community Hall Jeanette Street Regentville
		Penrith	Penrith, Jamisontown, Peach Tree Creek	Victoria Bridge	NSW SES Penrith HQ
		Penrith North	North Penrith, Penrith Lakes (lower Castlereagh) and Cranebrook areas	Victoria Bridge	Community Centre Hosking Street Cranebrook
	South Creek West Division	Londonderry	Upper Castlereagh, Agnes Banks (South), Londonderry, Berkshire Park and Llandilo areas	Windsor Bridge	Community Centre Hosking Street Cranebrook

Figure 4.2 Divisions and Sectors within the Hawkesbury-Nepean Flood Plan Area of Operation (NSWRA, 2024)

4.1.2 Critical Flood Heights for Strategy Selection

To assist with strategy selection for each Sector / Sub-sector, the HNV FEP details in general order of predicted flood height and decreasing overall risk, the Sectors and Sub-sectors to be evacuated according to the floodplain that they are located in. The HNV FEP provides the following for each Sector and Sub-sector:

- Flood classification;
- Height at which the last evacuation route is inundated; and
- Submersion height (where applicable).

Figure 4.3 indicates the flood classification for the Llandilo sub-sector, within which the Site is situated, has been determined as having rising road access. Areas with rising road access are those that are flooded in the PMF but not isolated from community evacuation facilities, where evacuation routes from the area follow roads that rise out of the floodplain. Evacuation can therefore take place by foot or by vehicle and will occur progressively to higher ground as the flood level increases.

Section 5.1.15 of the HNV FEP describes the SES Flood Emergency Response Operation Strategy for areas classified as having rising road access as progressive evacuation noting "*The only strategy needed for these areas should be to progressively evacuate depending on the expected upper limit of flooding. Evacuation can take place by vehicle or as a last resort on foot along roads as floodwaters advance*."

Sector	Sub-sector	Flood Classification	Last Road Cut m AHD	Windsor Gauge Height m	Submersion Height m AHD	Comments
Richmond	Richmond RAAF	Low Flood Island	20.1m (6)		20.4m (6)	Flooding begins at around 16.4m at the Richmond gauge.
	Hobartville	Low Flood Island	20.2m (6)		23.6m (6)	Progressively inundated from 17.5m (at Richmond gauge) (6).
	Clarendon	Overland Access)				
Windsor Downs	Windsor Downs	Flood Island (Parts are Low and parts are High)	23.8m	23.65m	26.4m (PMF)	Progressively inundated from 16m. Llandilo evacuation route is cut at 23.8m AHD.
Eastern Creek A	Eastern Creek A	Rising Road Access	Not applicable			
Eastern Creek B	Eastern Creek B	Low Flood Island				
Eastern Creek C	Eastern Creek C	Rising Road Access	Not applicable			
Cattai	NA	Rising Road Access	Not applicable			Flooding mostly affects along the creek lines. May result in some isolations, however overland escape is possible.
Little Cattai	NA	Rising Road Access	Not applicable			Mostly affects along the creek's lines. Evacuation is via Wisemans Ferry or Halcrows Roads.
Londonderry	Agnes Banks South	Rising Road Access	Not applicable			
	Londonderry	Rising Road Access	Not applicable			Small flood islands can form within the Sector.
	Berkshire Park	Rising Road Access	Not applicable			
	Llandilo	Rising Road Access	Not applicable			
South Creek B	South Creek B	Rising Road Access	Not applicable			

Figure 4.3 Summary of Critical Flood Heights for Strategy Selection – Richmond Windsor Wilberforce Floodplain (NSWRA, 2024)

4.1.3 Target Warning Lead Time

The response strategy, which is progressive evacuation through rising access road for the Site, is formulated using target warning lead times. Target warning lead times provide a minimum timeframe before a trigger height or flood class level is exceeded. Target warning lead times are provided in Service Level Specification for Flood Forecasting and Warning Services for New South Wales and the Australian Capital (BOM, 2024), which indicates two target warning lead times at the Windsor Gauge:

- 6 hrs for flood levels above 9.6m; and
- 15 hrs for flood levels above 13.7m.

Bureau number	AWRC number	Forecast location	Station owner	Gauge type	Gauge datum	Flood classification (m)			Prediction type	Target warning lead time		70% of peak forecasts within	Priority
						Minor	Moderate	Major		Time (hrs)	Trigger height (m)		
212 – Hawkesbury Nepean River Valley													
68216	212904	Menangle Bridge	Bureau	Automatic	Local	5.2	9.2	12.2	Quantitative	6 hrs	>5.2 m	+/- 0.3 m	High
568154	212216	Camden Weir	WaterNSW	Automatic	Local	6.8	8.3	13.8	Quantitative	12 hrs	>6.8 m	+/- 0.3 m	High
67093	212202	Wallacia Weir	WaterNSW	Automatic	Local	5.0	8.7	11.0	Quantitative	12 hrs	> 5.0 m	+/- 0.3 m	High
567047	212201	Penrith	WaterNSW	Automatic	Local	3.9	7.9	10.4	Quantitative	6 hrs 8 hrs	>8.9 m >11.3 m	+/- 0.3 m	High
567098	212200	North Richmond (WPS)	WaterNSW	Automatic	Local	3.8	7.9	10.5	Quantitative	6 hrs 15 hrs	>16.0 m >18.0 m	+/- 0.3 m	High
63280	212406	Sackville	WaterNSW NSW DCCEEW	Automatic	AHD	4.6	7.3	9.7	Quantitative	18 hrs	>4.6 m	+/- 0.3 m	High
63288	212908	Putty Road	-	Manual	Local	2.7	5.7	10.7	Quantitative	12 hrs	>5.7 m	+/- 0.3 m	High
567044	212426	Windsor (PWD)	NSW DCCEEW	Automatic	AHD	5.8	7.0	12.2	Quantitative	6 hrs 15 hrs	>9.6 m >13.7 m	+/- 0.3 m	High
67094	212407	Lower Portland	NSW DCCEEW	Automatic	AHD	4.6	6.1	7.6	Quantitative	18 hrs	>4.6 m	+/- 0.3 m	High
561004	212408	Webbs Creek (Wisemans Ferry)	WaterNSW NSW DCCEEW	Automatic	AHD	n/a	3.5	4.2	Quantitative	12 hrs	>3.5 m	+/- 0.3 m	High

Figure 4.4 Forecast Locations and Levels of Service within Hawkesbury-Nepean River Valley (BOM, 2024)

4.1.4 Regional Evacuation Route

Annex B of the HNV FEP details SES Evacuation Arrangements and provides detailed regional evacuation route arrangements for each Sector.

As per the HNV FEP, "*the Londonderry Sector is a large Sector that crosses a number of Regional Evacuation Routes including:*

- *Castlereagh Road Evacuation Route;*
- *Londonderry Road Evacuation Route; and*
- *Llandilo Road Evacuation Route.*

These evacuation routes all eventually merge onto the Northern Road Evacuation Route. The choice of evacuation route will be dependent on where within the sector the people evacuating live. This sector is broken into sub-sectors. The sub-sector level evacuation arrangements for the Londonderry Sector are provided within the Penrith City Local Flood Plan."

Figure 4.5 shows evacuation routes proposed by the HNV FEP for the Londonderry Sector. The Northern Road Route is the closest evacuation route from the Site.

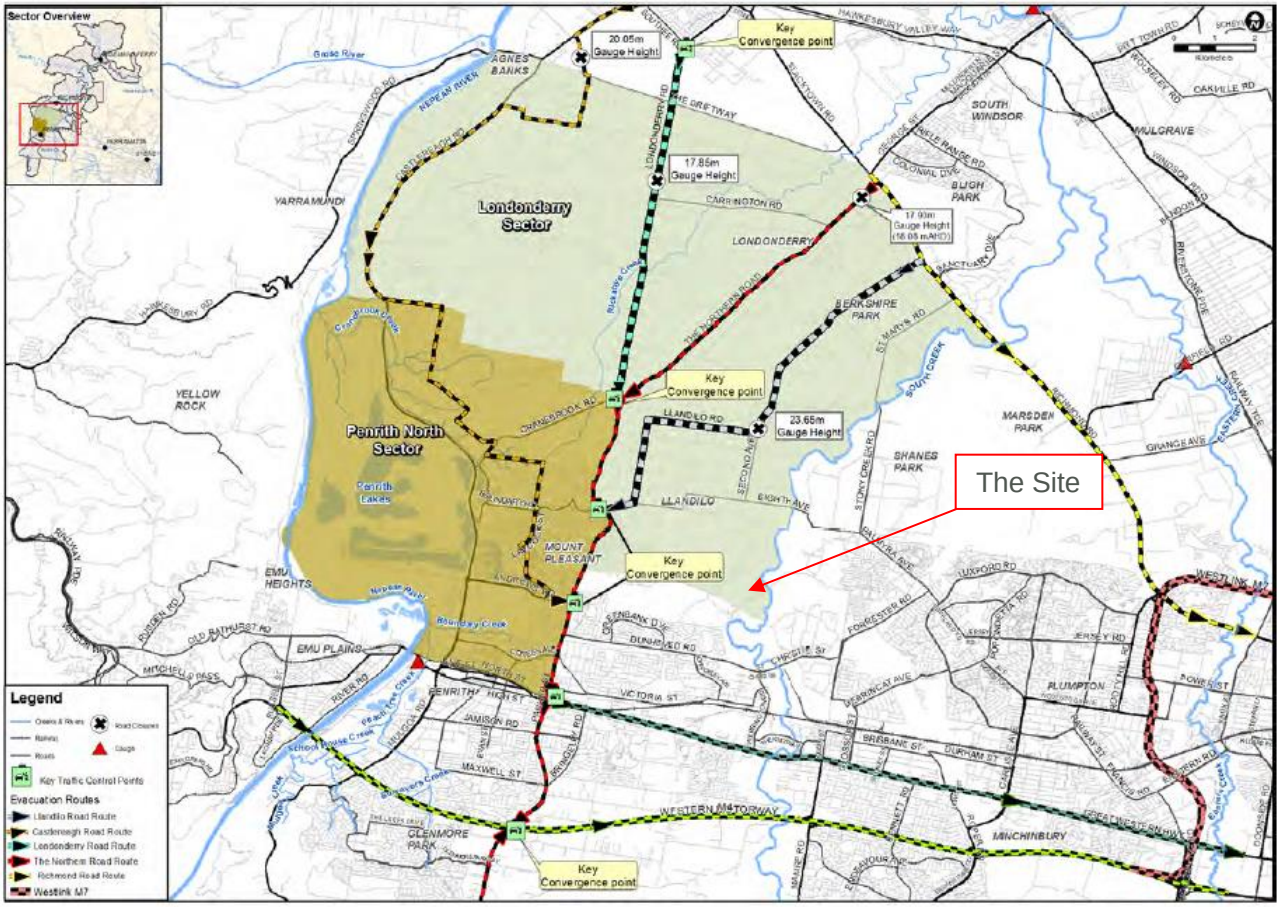


Figure 4.5 Londonderry and Penrith North - Evacuation Routes (Source: Map 9 within Annex B of the HNV FEP)

4.1.5 Evacuation Timeline and Methodology

Annex C of the HNV FLP states that the SES uses an evacuation timeline methodology to determine evacuation timings and to guide evacuation decision making. Figure 4.6 shows the conceptual framework for evacuation timelines.

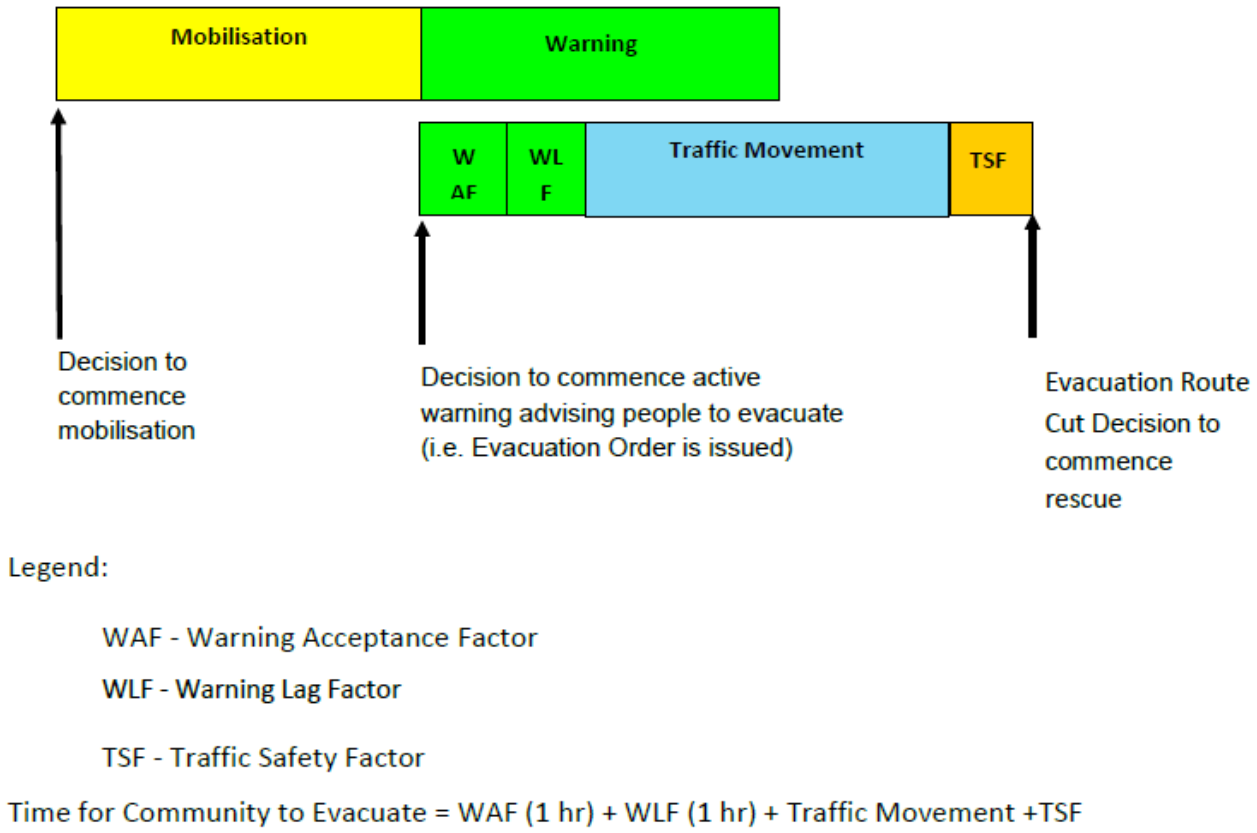


Figure 4.6 Evacuation Timeline Components (SES, 2020)

The HNV FLP also notes on the components of the timeline as follows:

Mobilisation and Warning

1. Warnings (i.e. Evacuation Orders) will be disseminated concurrently with expected traffic movement and therefore do not affect the total time required for evacuation. The time taken to warn is the time taken to doorknock the sector plus a warning lag factor (WLF) of 1 hour to allow time for people to pack their essential items.

2. A 6-hour time allowance (i.e. Mobilisation time) is assumed to cater for the mobilisation for emergency resources as well as for the evacuation decision process. This time precedes the commencement of the concurrent warning and traffic movement phases.

Traffic Movement

3. The estimated number of vehicles is based on studies which estimate the number of dwellings and businesses requiring evacuation and used a conversion factor to estimate the number of vehicles. In addition to this there is a provision for buses.

4. Note that traffic movement rates will be slower on some road segments due to convergence of road evacuation routes so the time frames estimated above should be considered indicative only.

5. Based on extensive advice from traffic engineers and experience in the US vehicle movement assumes an evacuation traffic rate of 600 vehicles per hour per lane.

Time to evacuate

6. The estimated time required for the community to evacuate is the time taken by the community to evacuate once a warning (i.e. evacuation order) is issued and when the last vehicle is expected to be out (assuming mobilisation has already occurred).

7. It is based on an assumed vehicle movement plus a 1-hour allowance for acceptance of warnings (WAF) + a 1-hour warning lag factor to account for people packing (WLF) + a traffic safety factor to cater for vehicle breakdowns/road crashes (TSF).

8. In order to generate vehicle movements of 600 vehicles per hour or more, a minimum number of 28 doorknocking teams are required for each sector. However, this may need to be varied if these vehicle movement rates are not being achieved. An average doorknock rate of 5 minutes per dwelling is used in calculating the time taken to warn.

Using HNV FLP notes on the SES evacuation timeline, the timeline is summarised as follows and is used in this study (Section 7.2).

Time for Community to Evacuate = Warning Acceptance Factor + Warning Lag Time + Traffic Movement + Travel Safety Factor

- Warning Acceptance Factor = 1 hour allowance for acceptance of warnings
- Warning Lag Time = 1 hour allowance for warning lag factor to account for people packing
- Traffic Movement = variable based on an evacuation traffic rate of 600 vehicles per hour per lane
- Travel Safety Factor = variable to cater for vehicle breakdowns/road crashes

4.1.6 Evacuation Centre Locations

The HNV FLP has specified Penrith High School Public School, Jamison High School and Nepean College of TAFE – Kingswood as potentially suitable facilities that may be chosen for use during minor to moderate flood events. All three are potentially suitable facilities for an evacuation location. Selection of a final evacuation route and potential evacuation location should be determined during preparation of the Operational Flood Emergency Response Plan (OFERP) for the school in consultation with the SES.

4.2 Penrith City Local Flood Plan

Penrith City Local Flood Plan (Penrith City Council, 2012) (herein the “PCLFP”) covers the preparedness measures, the conduct of response operations and the co-ordination of immediate recovery measures for all levels of flooding on the Nepean River within the boundaries of the Penrith City. A review of the PCLFP has been undertaken as part of this FERP. As per the PCLFP, school administration offices are encouraged to liaise with the SES prior to and during flood events and arrange for the early release of students whose travel arrangements are likely to be disrupted by flooding and/or road closures. They are also encouraged to pass on information to school bus drivers/companies and/or other school principals on expected or actual impacts of flooding. The key strategy for flood operations is provision of warnings, information and advice to communities. The response strategies for flood operations include property protection, evacuation, rescue and resupply.

Flood operations in the Penrith LGA are controlled on a Sector basis. The Site is located within the Londonderry Sector.

Division	Sectors	Comments
Nepean River Division	Wallacia Sector Penrith South Sector Penrith Sector Penrith North Sector Emu Plains Sector	Flooding in these sectors is due to flooding on the Nepean River.
South Creek Division	Londonderry Sector South Creek A Sector	Flooding in these sectors is due to backup flooding from the Hawkesbury River along Rickabys Creek, South Creek and Ropes Creek
Nepean Flood Rescue Division		This Division controls local and out of area flood rescue resources. The area of operations covered by this Division will expand into the areas inundated in the other Divisions.

Figure 4.7 PCLFP Division and Sector Breakdown

The PCLFP specifies the following for the Londonderry Sector:

- Flooding in the Londonderry Sector is mainly due to backup flooding along Rickabys Creek and South Creek.
- The relevant flood gauge is the Windsor Bridge flood gauge.
- The flood area type for this Sector is area accessible overland - areas that are flooded in the PMF but not isolated from community evacuation facilities, where evacuation relies upon overland escape routes that rise out of the floodplain.

5 Flood Scenario

As discussed in Section 3.3, the Site is affected by regional Hawkesbury River backwater flooding. Figure 5.1 shows the 1 in 100 (1%) AEP, 1 in 1000 (0.1%) AEP and 1 in 5000 (0.02%) AEP Hawkesbury-Nepean River flood extents in the vicinity of and downstream of the Site. Backwater flooding from the Hawkesbury River flows down South Creek in a southerly direction, breaking out and impacting the Site in very rare and extreme events. The figure also shows locations of Points of Interest (POs) extracted from the HN Flood Study TUFLOW model around the Site. POI 'HN-144' is the closest PO to the Site and is situated downstream. There is also a 'Windsor PWD' POI defined in the HN Flood Study TUFLOW model representative of the Windsor gauge.

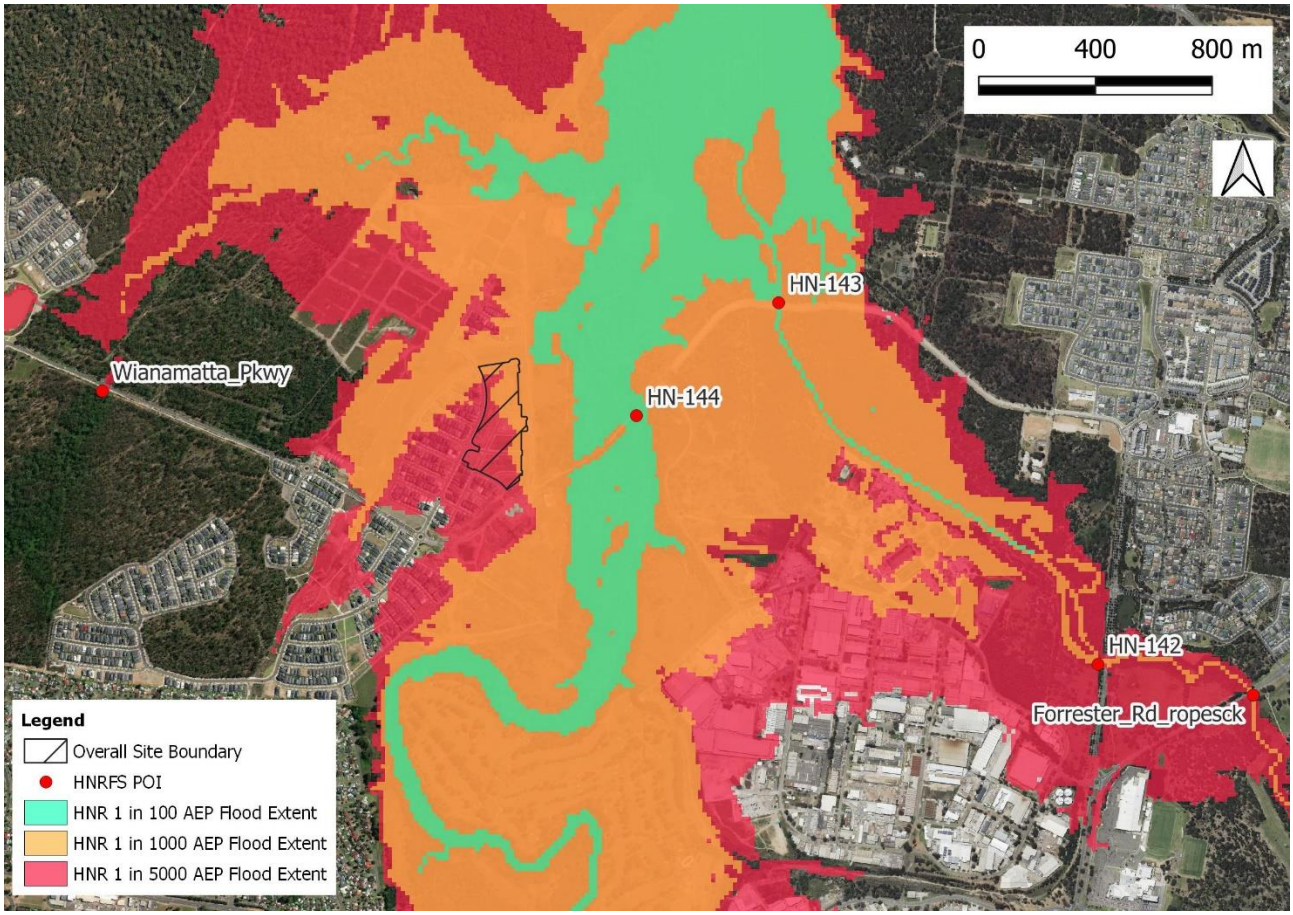


Figure 5.1 Hawkesbury-Nepean River Flood Study Model PO Points

Figure 5.2 shows Water Level (WL) time series across various AEP flood events at the Windsor gauge ('Windsor PWD' POI in the model) extracted from the HN Flood Study model results. Figure 5.3 shows WL time series across various AEP flood events at HN-144 POI (adjacent to the Site). It is noted that the water level time series shown in Figure 5.2 represents the storm with the fastest rate of rise for each flood event (rather than the critical flood event) in order to determine the shortest potential time for Site inundation. Critical flood levels at the Site are shown in Figure 5.4.

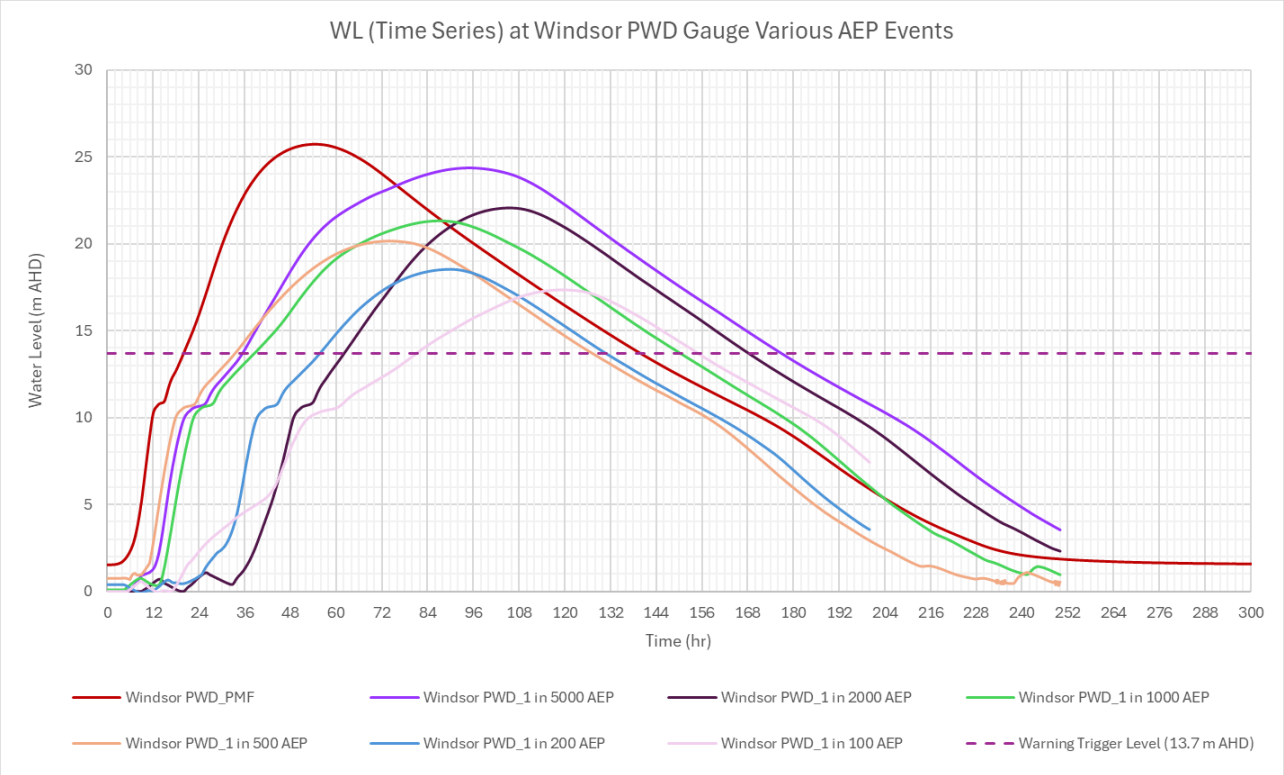


Figure 5.2 Water Level (WL) Time Series at Windsor PWD Gauge

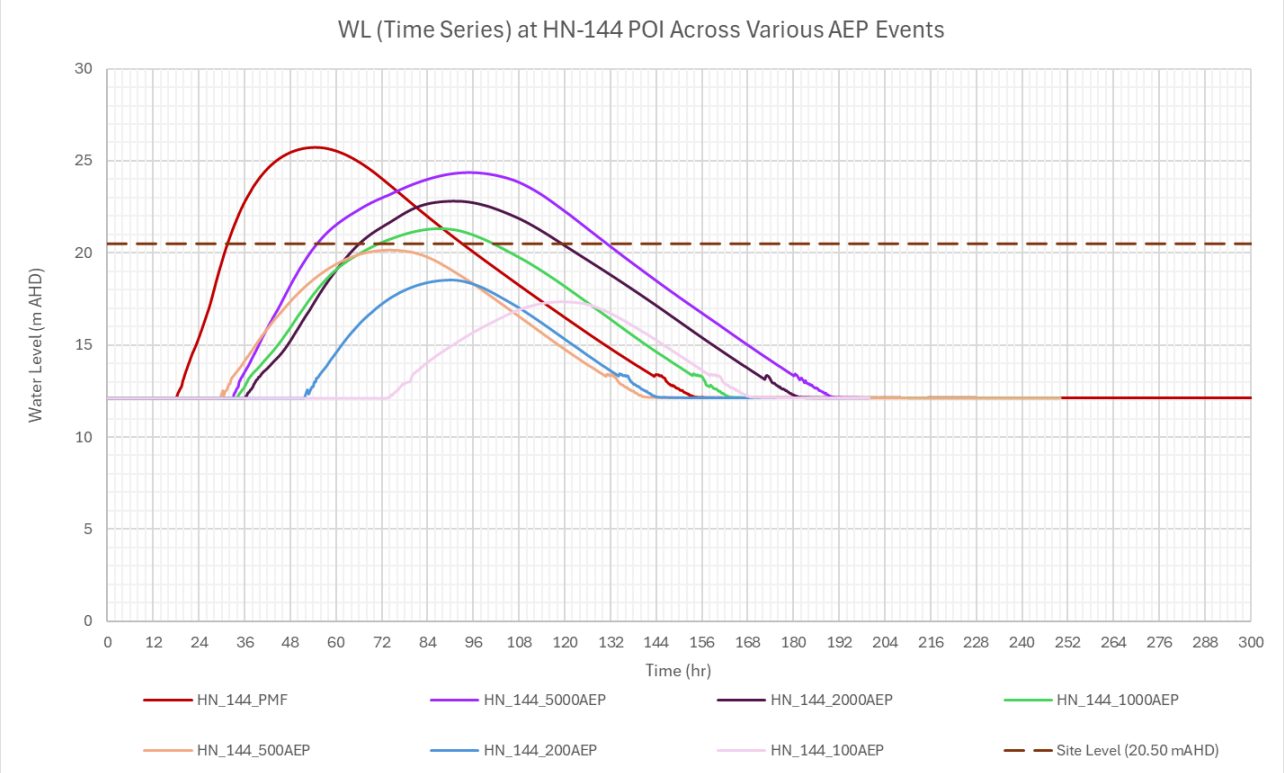


Figure 5.3 Water Level (WL) Time Series at HN-144 POI

Figure 5.4 demonstrates the various AEP flood events' extent as well as a terrain profile and WL profile across various AEP flood events between South Creek and the Site. It can be seen that inundation of the Site as a result of Hawkesbury River backwater flooding would be expected from the 1 in 1000 AEP flood event, with inundation increasing with event rarity. Overfloor flooding of the proposed new buildings would be expected when the water level exceeds 22.0 mAHD at the Site.

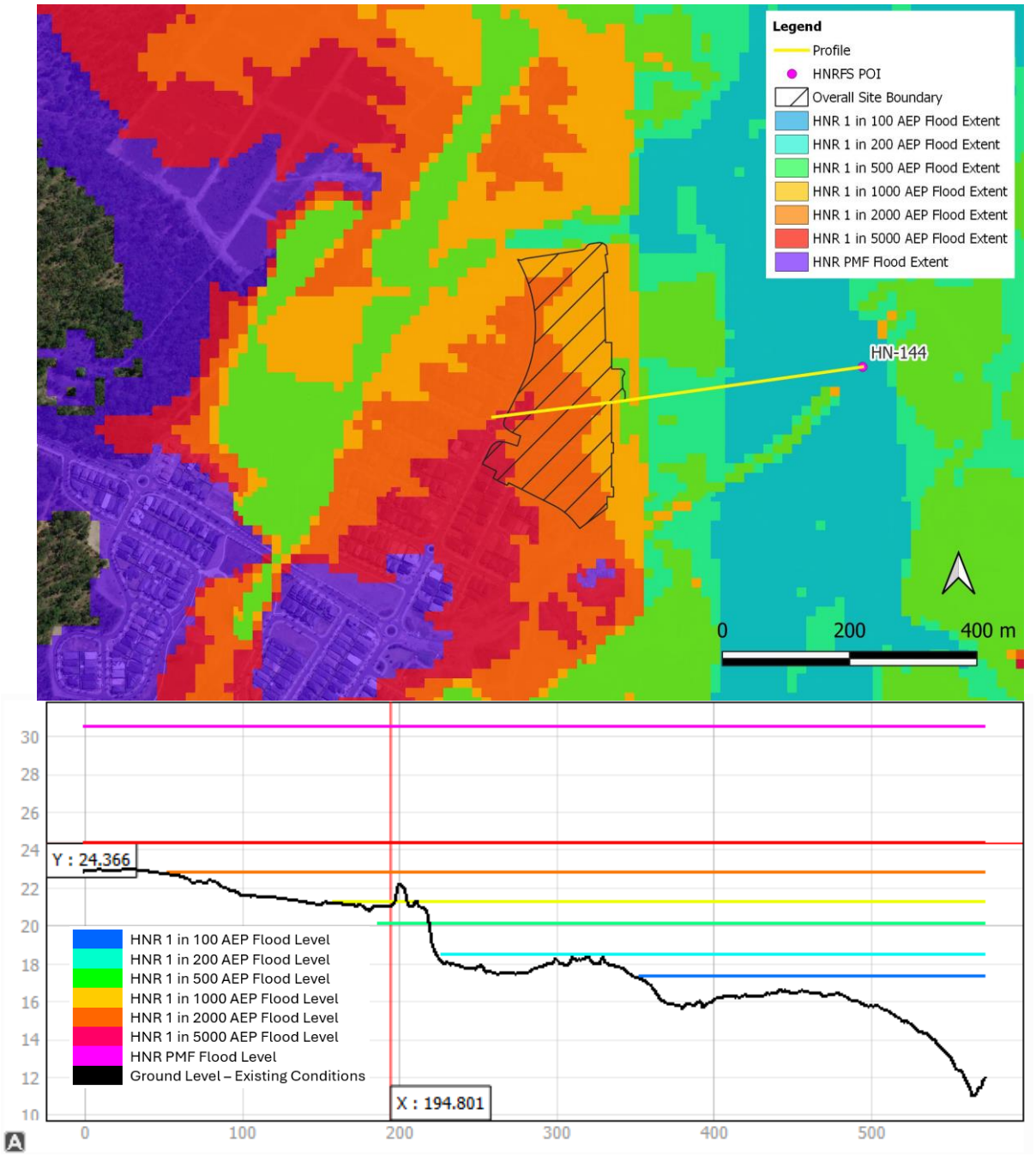


Figure 5.4 Terrain Profile and Flood Level Profile Between 'HN-144' POI and the Site

6 Flood Emergency Response to Flood Scenarios – Priority 1, Closure of School

6.1 Flood Emergency Response to Regional Hawkesbury-Nepean Basin Flooding Warnings

In general, flood warnings are issued based on the following criteria:

- The flood classification levels or trigger heights defined at a forecast location are expected to be reached or exceeded, or has been exceeded; and
- River levels above the minor flood levels are expected at widespread information locations (BoM, 2024).

A Target Warning Lead Time (TWLT) is the minimum lead time that will be provided before the height or the flood classification level given is exceeded (BoM, 2024).

As discussed in Section 4.1.3,

- Two target warning lead time scenarios for the associated flood gauge located at Windsor Bridge (the Windsor gauge) have been defined as follows:
  - A minimum lead time of 6 hours will be provided before the food level is exceeded 9.6 mAHD at the Windsor gauge.
  - A minimum lead time of 15 hours will be provided before the food level is exceeded 13.7 mAHD at the Windsor gauge.

6.1.1 Flood Emergency Response based on Target Warning Lead Time

The 13.7 mAHD target water level is the highest flood level classification issued for the Windsor gauge, higher than both the other target water level (9.6 mAHD) and the Major flood classification level (12.2 mAHD). It is acknowledged that a flood which reaches a 13.7 mAHD level at the Windsor gauge would not result in backwater flooding at the Site. However, the flood emergency response for the school has been developed based on a 13.7 mAHD target water level at the Windsor gauge given:

- The high flood hazards present at the Site in very rare or extreme events when backwater flooding is expected to occur;
- The large student population; and
- The lack of alternate flood warning triggers.

On this basis, BMT has developed and considered the following scenarios:

- Scenario 1: a warning is issued when a rising WL has reached at 13.7 at Windsor gauge (Water Level trigger = 13.7 mAHD, TWLT = 0 hours).
- Scenario 2: a warning is issued 15 hours before rising WL reaches at 13.7 at Windsor gauge (Water Level trigger = 13.7 mAHD, TWLT = 15 hours).

Scenario 1 provides the least time to complete an emergency response procedure. This would mean that if an emergency response undertaken under Scenario 1, that emergency response procedure can

be completed in any other scenario. BMT has analysed potential emergency response procedures against both Scenario 1 and Scenario 2 in the following sections.

Developing an Appropriate Emergency Response Procedure
Since all flood events that would result in overfloor flooding at the Site, including the PMF, exceed the maximum 13.7 mAHD warning level at the Windsor gauge, operation of the school should cease if a rising water level has reached or is going to reach at 13.7 mAHD at the Windsor gauge. Therefore, the proposed flood emergency procedure is as follows:

- if a warning is issued based on a WL of 13.7 mAHD being reached or predicted at the Windsor gauge during non-working hours of the School (typically from the time when the School closes in the afternoon until the day after in the morning when the School starts), school operations should be cancelled and the school closed for the day prior to the arrival of staff and students.
- if a warning is issued based on a WL of 13.7 mAHD being reached or predicted at the Windsor gauge during school operational hours, the School must be evacuated.

BMT has assessed the required timelines for the proposed emergency response below.

Table 6.1 indicates the period of time taken to reach a 13.7 mAHD water level at Windsor gauge from the onset of rain across rare and very rare flood events.

Table 6.1 Time Taken for WL to Reach at 13.7 mAHD at Windsor Gauge

Flood Event	1 in 1000 AEP	1 in 5000 AEP	PMF Wallacia
Time (hr)	38.50	35.33	20.00

Table 6.2 indicates the time that takes for WL to reach at 22.0 mAHD at the Windsor Gauge from the onset of rain across rare and very rare flood events.

Table 6.2 Time Taken for WL to Reach at 22.0 mAHD at HN-144 POI

Flood Event	1 in 1000 AEP	1 in 5000 AEP	PMF Wallacia
Time (hr)	87.00^	63.17	34.33

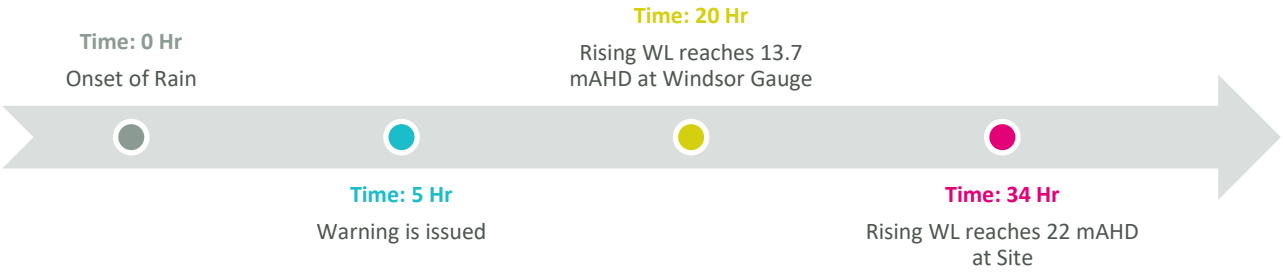
^ Since the 1 in 1000 AEP flood event does not reach 22.0 mAHD at the Windsor Gauge, this time has been calculated for WL to reach at its maximum level at Windsor Gauge (21.32 mAHD).

Table 6.3 indicates a lag time between the time that taken to reach 22.0 mAHD at the HN-144 POI point (the Site) and the time when WL has reached at 13.7 mAHD at the Windsor gauge. This lag time has been calculated by subtracting the time taken for the WL to reach at 13.7 mAHD at Windsor Gauge from the time taken for WL to reach at 22.0 mAHD at the Site. Table 6.3 shows that 14.33 hours is the minimum lag time for Scenario 1, which is the most critical Scenario.

Table 6.3 Lag Time between 13.7 mAHD WL at Windsor Gauge and 22.0 mAHD WL at HN-144 POI

Flood Event	1 in 1000 AEP	1 in 5000 AEP	PMF Wallacia
Time (hr)	48.50	27.84	14.33

Based on the above, the following timeline schematically shows flood behaviour at the Site and the Windsor gauge for a PMF event, assuming warnings were issued at least 15 hours prior to a 13.7 mAHD threshold being reached (Scenario 2). Under such a scenario, 29 hours are available from the warning being issued before the water level reached 22.0 mAHD at HN-144 POI and the proposed school buildings start to be inundated.



In the worst-case scenario, if a warning is issued when WL reaches at 13.7 mAHD at Windsor Gauge (0 hours warning lead time), 14 hours would still be available before the water level reaches 22.0 mAHD at HN-144 POI and the proposed school buildings start to be inundated.

On the basis of the analysis undertaken, a minimum of 14 hours of would be available to make the decision to close the school prior to the onset of flooding at the new buildings. It is considered that even this conservative time period would facilitate a decision to close the school in the worst-case PMF event, and it is more likely that in excess of a day's notice would be given to close school operations.

7 Flood Emergency Response to Flood Scenarios – Priority 2, Evacuation

7.1 Proposed Evacuation Route

Evacuation in a safe manner is dependent on warning time and availability of easily identifiable routes. If evacuation of the Site is required during a flood event, egress from the Site is proposed along a route which follows Armoury Road, Wianamatta Parkway, Lakeside Parade and Jordan Springs Boulevard to reach The Northern Road. This evacuation route is shown in Figure 7.1.

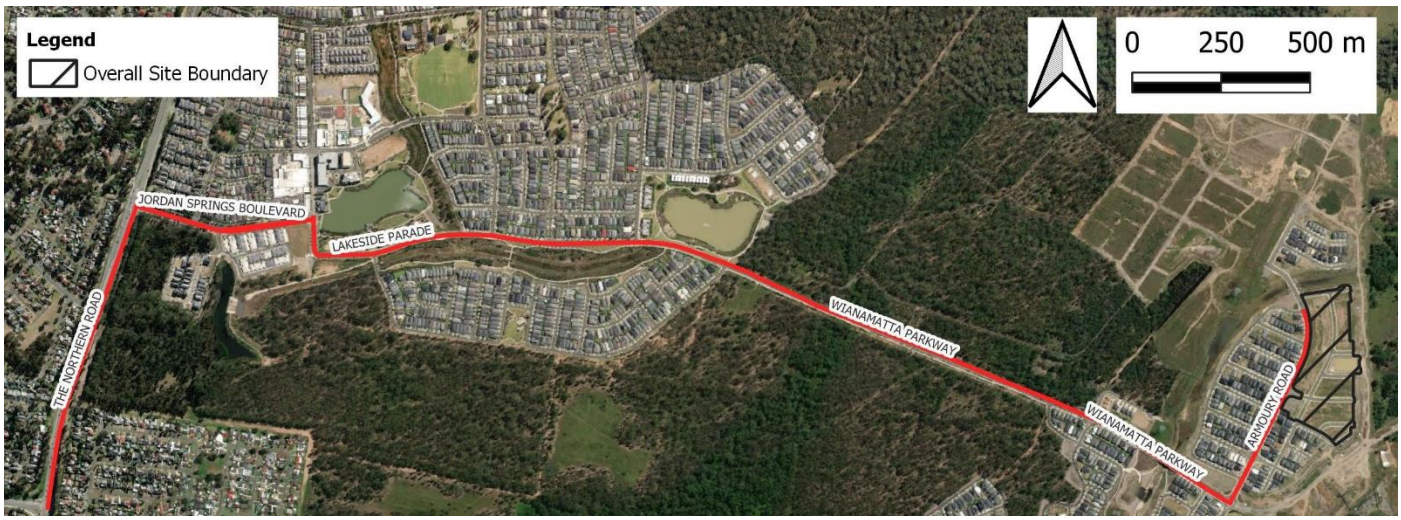


Figure 7.1 Proposed Off-Site Evacuation Route

The proposed evacuation route, which has a 3,970 m (~ 4 km) length, will be overtopped in a Hawkesbury-Nepean River PMF event as shown in Figure 7.2. However, results extracted from the HN Flood Study TUFLOW model indicate that this will not occur until a significant period of time after rainfall begins (within the modelling in excess of 60 hours) and after a 13.7 mAHD threshold is reached at the Windsor gauge (within the modelling up to 30 hours). If evacuation of the school occurs prior to or following the 13.7 mAHD trigger being met at the Windsor gauge, it is not expected that the proposed route would be inundated by Hawkesbury River flooding during evacuation of the school.

The nominated evacuation route would also provide an appropriate flood emergency response to a South Creek PMF event in the unlikely scenario this occurs without a 13.7 mAHD flood level being reached at the Windsor gauge. Furthermore, the local (overland) PMF is not expected to result in high hazard flooding along the nominated route (see Figure 3.2).

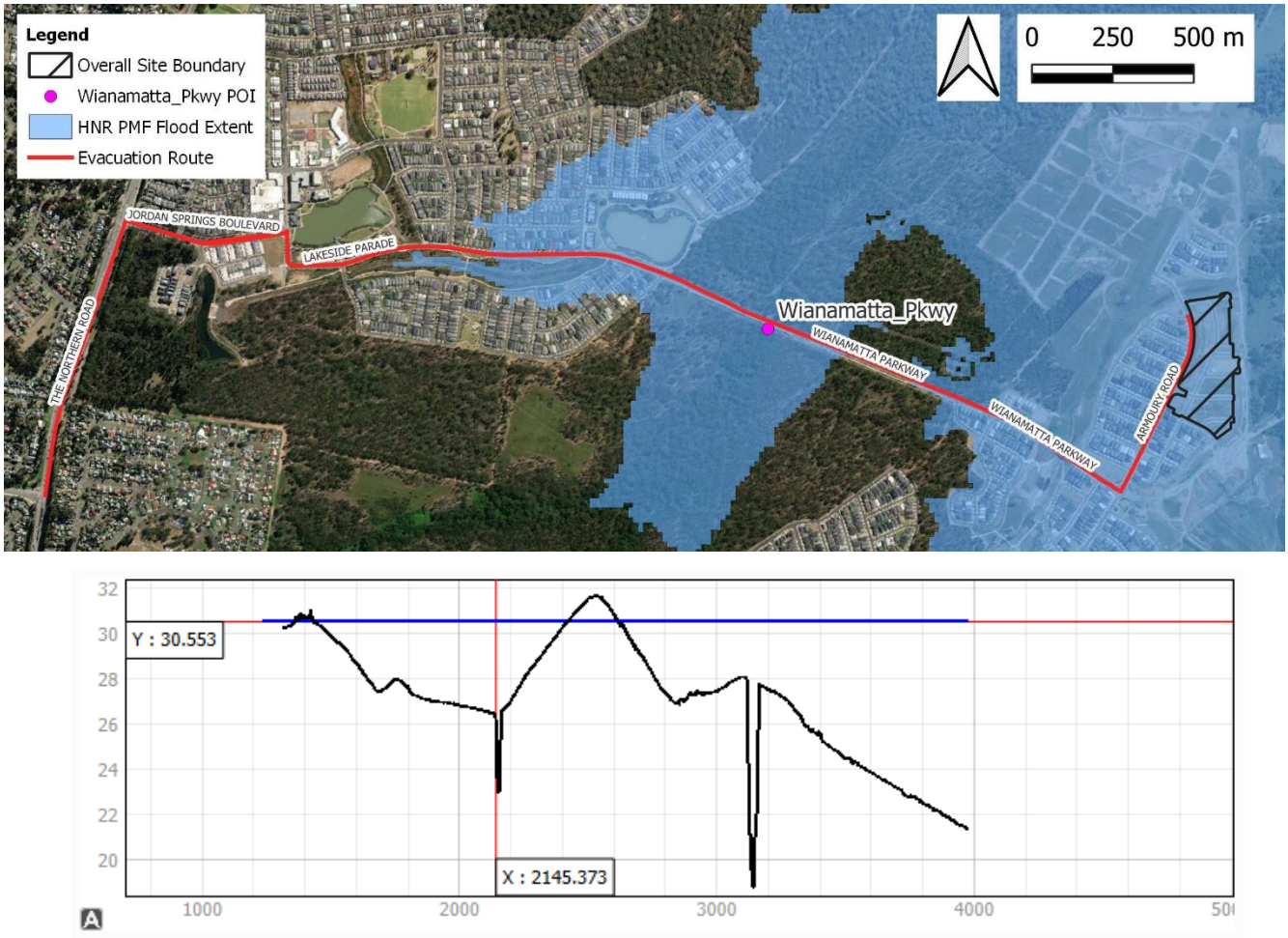


Figure 7.2 Impact of PMF on the Proposed Evacuation Route

7.2 Evacuation Timing

As discussed in Section 4.1.5, the HNV FLP calculates time required for community to evacuate using the following equation along with recommended values by default.

Time for Community to Evacuate = Warning Acceptance Factor (1 hr) + Warning Lag Time (1 hr) + Traffic Movement +Travel Safety Factor

- WAF = 1 hour allowance for acceptance of warnings
- WLT = 1 hour allowance for warning lag factor to account for people packing
- Traffic Movement = variable based on an evacuation traffic rate of 600 vehicles per hour per lane
- TSF = variable to cater for vehicle breakdowns/road crashes

Based on the worst-case scenario discussed in Section **6.1.1**6.1.1**,** 14.33 hours is the minimum time available for communication and evacuation after a warning is issued from when the water level reaches 13.7 mAHD at the Windsor Gauge. Therefore, factoring for the WAF and WLT, a 12.33-hour time window is available for Traffic Movement and TSF. With an assumed average speed of 12 km/hr, 20 minutes (0.33 hour) is required to drive through a 4.0 km path. BMT recommends the inclusion of 2

hours for student pick-up[1] and 1 hour for the School staff to check the Site to ensure all the students have been evacuated and then to leave the School themselves. Therefore, evacuation timing for the proposed route is as follows:

- WAF = 1 hour
- WLT = 1 hour
- Traffic Movement and TSF = 0.33 hour (based on an average speed of 12 km/hr for a 4-km length evacuation route)
- Completion of the students' pick-up = 2 hours
- Staff to check the School and leave = 1 hour

Time for Community to Evacuate = 1hr (WAF) + 1hr (WLT) + 0.33hr (Traffic Movement and TSF) + 2hrs (completion of students' pick-up) + 1hr (staff to check and leave) = 5.33 hours

The above calculation shows that the evacuation could be completed, with all staff and students reaching The Northern Road well before the onset of flooding at the Site in the PMF event. Final evacuation traffic calculations should be determined at a future detailed design phase, during development of the OFERP when the final evacuation route and location are known.

7.2.1 Hawkesbury-Nepean Valley Flood Evacuation Modelling to Inform Flood Risk Management Planning (NSW Government, 2023)

The Hawkesbury-Nepean Valley Flood Evacuation Modelling (NSW Government, 2023) (herein the ("HNV FEM") outlines the flood evacuation modelling work undertaken as part of the Hawkesbury-Nepean Valley Flood Risk Management Strategy (the ""). The FEM simulates the SES evacuation timeline and arrangements under a range of assumptions. It provides the NSW Government with a repeatable process to quantify existing and ongoing risk associated with the cumulative impact of growth and climate change on road evacuation capacity in the valley.

An FEM scenario is the simulated evacuation of the valley based on an actual or projected population and road network under various modelled flood events. Many scenarios have been modelled and analysed to describe changes in the potential risk to life associated with different development and road options. These have been modelled over 3 points in time – December 2018, 2026 and 2041 (NSW Government, 2023).

A suite of representative flood events has been used, from a 1 in 50 chance per year flood up to a 1 in 5000 chance per year flood. The analysis focused on two major flood events – the 1 in 500 chance per year (equivalent to the worst flood on record), and the 1 in 1000 chance per year (considered more probable with climate change and the flood event which cuts off the last major evacuation route for the flood islands.

Based on 2018 data, around 43,100 residential properties would need to be considered for evacuation within the Hawkesbury-Nepean Valley, including 36,700 dwellings, 1,900 caravans/manufactured dwellings and 4,500 isolated dwellings (NSW Government, 2023).

[1] No flood evacuation transport assessment for evacuation of the JSHS had been undertaken till this FERP. BMT estimation of 2 hours for students' pick-up is based on experience of similar assessments and 1,000 enrolments and 80 staff as proposed for Stage 1 of the JSHS for 2027.

Future development options are included in the scenarios with projections for 2026 and 2041, based on advice from the Department of Planning and Environment (DPE), using:

- **committed development only** (development that has been zoned under existing planning instruments)
- **committed and potential development combined** (including development that has been announced but still requires a rezoning of land to proceed) (NSW Government, 2023).

Similar to the approach adopted for future development, the following assumptions for the road network were included in the scenarios based on advice from Transport for NSW (TfNSW):

- for 2018, roads that were in existence; and
- for 2026 and 2041, the projected network as well as possible but uncommitted new roads and road upgrades that would enhance overall network capacity for day-to day performance and flood evacuation.

Section 4.3 of the HNV FEM provides an understanding of the spatial distribution of risk for people unable to evacuate based on the following 12 assessments:

- two flood frequencies – 1 in 500 chance per year (worst historic flood) and the 1 in 1000 chance per year flood (cuts last major evacuation route) - for existing development (late 2018), committed development and committed plus potential development (10 assessments).
- number of additional people at risk for different flood events for potential development options (1 assessment).
- The Castlereagh Connection, as an example of how additional road capacity could change the risk to life for different flood events across the floodplain (1 assessment).

The HNV FEM also provides mapped results for the 12 assessments. A review of the maps indicates that none has mapped the Jordan Springs area as a place that accommodates people unable to evacuate for all events and scenarios up to and including the 1 in 1000 chance per year flood in 2041. This is in line with the findings of this report and the HNV FEP, that rising road access is available from the Site for all events up to and including the PMF.

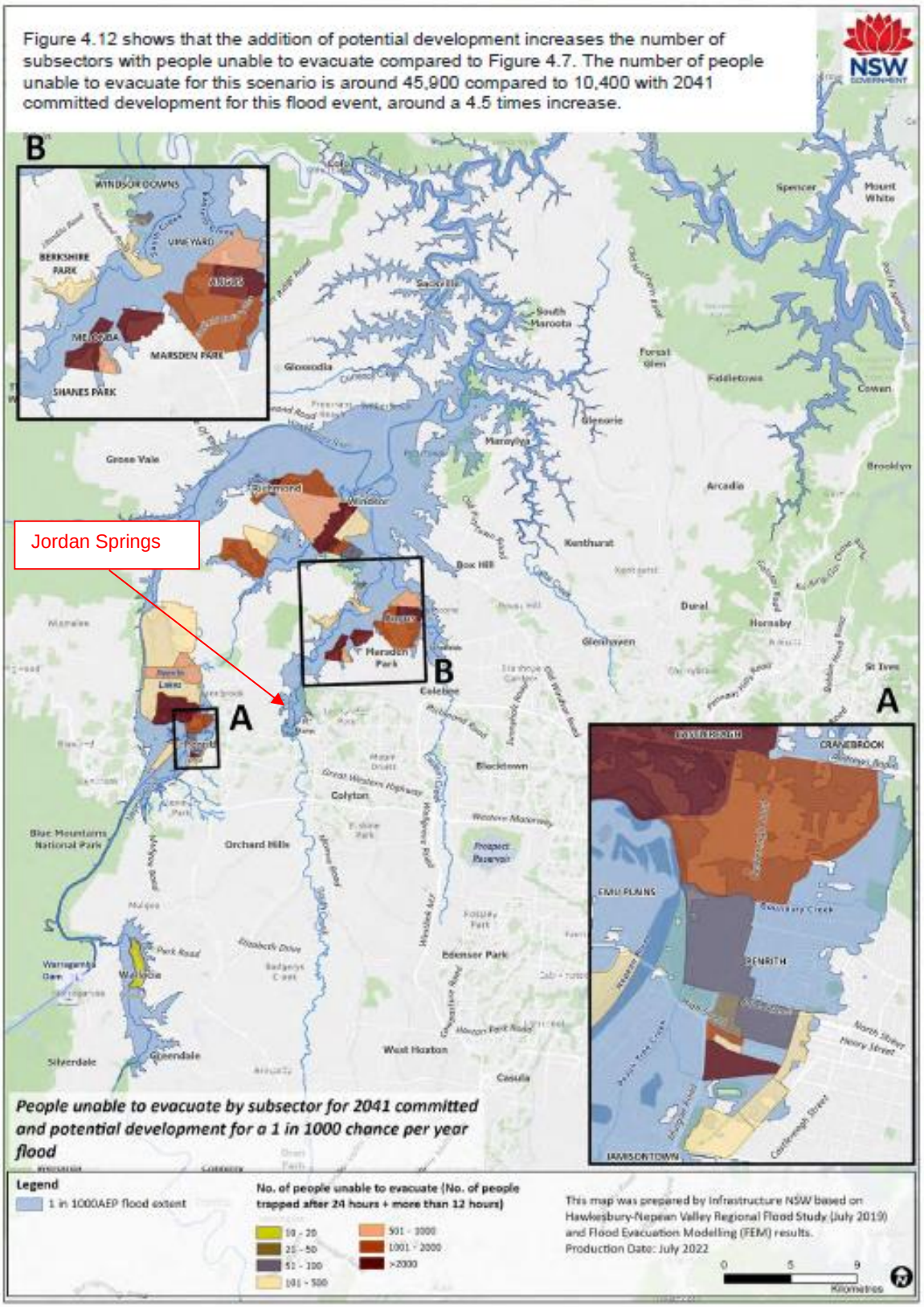


Figure 7.3 People Unable to Evacuate by Subsector for 2041 Committed and Potential Development for a 1 in 1000 Chance Per Year Flood (NSW Government, 2023)

8 Flood Emergency Response Procedure

This section describes some of the specific actions to be undertaken in anticipation of a flood event, as well as actions recommended during and after a flood event.

8.1 Overview

The following procedures are proposed as part of the FERP:

- **Priority 1** -

  Closure of the School prior to the start of operations based on:

  - A forecast 13.7 mAHD flood level at the Windsor Gauge (as discussed in this FERP); or
  - A recorded 13.7 mAHD flood level at the Windsor Gauge (as discussed in this FERP); or
  - Issue of severe thunderstorm or emergency storm warnings in consultation with the SES.

  Issued by BoM or the SES during non-operational school hours. School closure is in line with current DoE practice, which is to advise parents of possible flooding events the day before or morning prior to commencement of the School, if they occur and suggest that students be kept at home.

- **Priority 2** -

  - Closure and evacuation of the School if a flood warning is issued by BoM or SES based on a forecast or recorded 13.7mAHD flood level at the Windsor Gauge during school hours.

8.2 Emergency Warning System Overview

Warning in case of a flood event is required to alert wardens and other people on-site that an extreme flood event may be imminent. Flood levels can rise rapidly, and it is necessary to ensure that sufficient warning time is given so that personnel could implement off-site evacuation effectively and safely. The flood warning system for the Site is proposed to include the following:

- BoM's and SES Existing Flood Warning; and
- BoM's and SES Rainfall and Dangerous Thunderstorm Forecast.

8.2.1 BoM's Existing Flood Warning System

Flood warning information such water levels can be accessed via the BoM webpage as per the following link:

- Flood Warning: http://www.bom.gov.au/nsw/warnings/

The BoM's Flood Warning System should provide effective flood warning to facilitate safe evacuation. BoM provides flood forecasting and warning services based on a number of rainfall and stream level gauges scattered throughout the catchment. The nearest flood forecasting location to the Site is the Windsor PWD Gauge at the Windsor Bridge as discussed in this FERP.

8.2.2 BoM's Rainfall Forecast System

Rainfall forecast information can be accessed via the BOM webpage as per the following links:

- Rainfall Forecast: New South Wales Forecasts (bom.gov.au)
- BOM's Rainfall Radar: http://www.bom.gov.au/australia/radar/
- Rainfall Gauge Totals: New South Wales Rainfall and River Conditions (bom.gov.au)
- MetEye: http://www.bom.gov.au/australia/meteye/

8.2.3 Flood Warning Communication

An SES Watch and Act order will be provided to the Department of Education Liaison Officer by the Incident Controller at SES when floodwaters at a relevant flood gauge reach a pre-determined flood level.

The Watch and Act order will consist of the following actions:

- **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 is 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.

It is understood that the Department of Education Liaison Officer contacts the School personnel as described in Section 8.3 as soon as the SES Watch and Act order is received.

8.3 Flood Response Personnel

Positions and responsibilities will need to be assigned to on-Site personnel for managing the flood response. A chief or head flood warden will need to be nominated to manage the evacuation of the Site during a flood. Individual building wardens will also need to be nominated for each of the buildings on Site.

Warden responsibilities shall include evacuation of students, staff and any visitors. Contact details of the head warden and all individual building wardens shall be presented in an Operational Flood Emergency Response Plan (OFERP) OFERP to facilitate contact with the SES. The OFERP is to be prepared by the school operator to formalise flood evacuation planning and strategy with respect to flood intelligence, the flood behaviour presented in this report, and relevant procedures. The OFERP will be expected to build on the strategy and intent presented in this report.

The wardens will be identified by wearing reflective safety vests and coloured hard hats so that visitors to the site will be able to recognise the wardens with ease. The wardens will need to be familiar with the details in the OFERP and will direct people to safety via the evacuation routes.

The warden's responsibilities may involve checking classrooms, vehicles and other spaces to ensure there are no personnel remaining, before directing all parties towards the Site's exits. Wardens will coordinate evacuation of students, staff and visitors from this point via private car and/or bus as appropriate.

If the SES takes control of the Site, then they may override the provisions of the OFERP. Further coordination of the proposed OFERP will need to be undertaken with the SES. Regular drills will be required of the wardens to ensure flood/emergency awareness and preparedness of the wardens and employees.

Table 8.1 demonstrates flood response personnel positions and responsibilities proposed in this FERP.

Table 8.1 Flood Response Personnel Positions and Responsibilities

Position	Responsibilities
Director of the Campus	Coordinate preparation of an OFERP implementing the recommendations of this report. Closure of the School prior to flooding based on a forecast or recorded 13.7 mAHD flood level at the Windsor Gauge warning (as discussed in this FERP) **OR** based on a rainfall and dangerous thunderstorm warning or an emergency storm warning issued by BOM or the SES during non-working hours of the School. Closure and evacuation of the School if a flood warning is issued by BoM or SES based on a forecast or recorded 13.7 mAHD flood level at the Windsor Gauge during school hours.
Chief/Head Flood Warden	Coordinate flood evacuation drills – preliminary suggestion of one on the first day of operation each year and a second drill throughout the year Monitor weather at 4pm daily for upcoming extreme rainfall events Liaise with Director of Campus to decide school closure or evacuation Liaise with SES or Emergency Services personnel if they attend the Site
Building Flood Wardens	Liaise with the Chief Flood Warden Monitor weather at 4pm daily for upcoming extreme rainfall events Coordinate Site evacuation Coordinate assistance for staff, students and visitors with mobility difficulties
First Aid Officers	Prepare and maintain Flood Emergency Kit Manage Individual Health Care Plans where applicable
Staff	Maintain calm and direct students and visitors through evacuation process.

8.4 Education

The JSHS management should educate all occupants to be aware of and adequately trained in emergency response procedures and as such, advocate for the implementation of a training program (the FERP Training Program) to ensure all occupants receive appropriate training to enable them to act in accordance with this FERP. It is anticipated that the FERP Training Program includes necessary training requirements which will be reviewed and updated as a result of including the Flood Emergency Management Plan.

8.5 Flood Signage

It is recommended that flood warning signage be installed around the Site, particularly in locations where a flood hazard of H3 or higher hazard is predicted which would cover the entire Site in a PMF (based on AIDR (2017) or NSW Government (2023) hazard classification). Signs should be installed at key entrances/ exits to the Site and along high trafficable footpaths. An example of a sign is shown in Figure 8.1.

Figure 8.1 Example of a Flood Zone Sign (Source: nationalsafetysigns.com.au)

8.6 Before a flood

Outlined below are several flood safety actions to be followed by students, staff and visitors on Site in anticipation of a potential flooding event:

- Monitor Local ABC radio, Live Traffic NSW app, BOM Flood Warnings and BOM Rain and River Data for water levels, evacuation alerts and road closures. Prepare for a potential school closure should severe rainfall be forecasted by the BOM. Closure of the school should occur when a flood warning is issued by BOM or the SES based on a 13.7 mAHD flood level trigger at the Windsor Gauge by the BOM.
- Review and be familiar with the applicable *SES Emergency Business Continuity Plan*.
- Ensure that the FERP and OFERP is up to date.
- Check (or prepare) the contents of the Emergency Flood Kit(s) and ensure that it is at the correct location.
- Identify the needs of vulnerable persons likely to be on-Site during the flood emergency.
- Inspect the property for hazardous substances, furniture, equipment and sensitive belongings, and relocate to another flood free area if possible.
- Check communication devices such as internet connections, mobile phone, landline phone or radio. If a device has become inoperable, identify a suitable alternative (such as a back-up device or using the device of someone else in the building).
- Communicate to all students, parents, staff, and visitors of the premises the requirements of the applicable *SES Emergency Business Continuity Plan*, location of the Emergency Flood Kit, and discuss the risk of flooding to the site, contact/communication methods, and actions to take before, during and after a flood event.

- Appropriately train people in key roles (such as Chief Warden) and appropriately train/drill students and staff in flood evacuation procedures.

- Ensure that any electrical equipment located below the PMF level is disconnected or isolated from the electricity and gas supplies.

8.7 During a Flood

8.7.1 Priority 1: Non-attendance (i.e. Closure) of School

Non-attendance (i.e. Closure) of the school based on BoM's 13.7 mAHD flood level warning at the Windsor Gauge OR rainfall and dangerous thunderstorm or emergency storm warnings. The BoM has a target warning lead time of 15 hours for a 13.7 mAHD flood level at the Windsor Gauge.

Parents and caregivers should be kept informed about potential flash flooding based on BoM's forecast systems described above. School closure should be communicated with parents and staff to advise parents of possible flooding events the day before they occur and suggest that students be kept at home.

8.7.2 Priority 2: Evacuation

Off-Site Evacuation
If the BoM's 13.7 mAHD flood level warning at the Windsor Gauge occurs during school hours, off-site evacuation should commence. Confirmation of evacuation arrangements – i.e. whether JSHS will allow parents to pick-up students or evacuate the students via bus to a nominated evacuation location – should be confirmed during detailed design or the development of the operational FERP, noting:

- Non-attendance is the priority emergency management response and there is ample warning time available to facilitate school closure; and

- There would be up to 12 hours to evacuate the school (if required) in the worst-case PMF event, which is considered to provide enough time for either option given the availability of rising road access at the Site.

8.8 After a Flood

Outlined below are a few key flood safety measures to be followed by all occupants after a flood event has occurred:

- Check that electrical power and gas has been isolated to all flood affected areas of the building. If electrical systems or appliances (including items such as hot water systems) have become inundated, these should be inspected by a qualified electrician. Gas appliances and any gas bottles should also be inspected for safety before use.

- Check any flooded areas for safety hazards and structural stability. For example, items may have moved as a result of floodwater. Have flood sensors and alarm system professionally assessed to ensure they are still in working order following event.

- Review evacuation performance during the flood. Identify any areas for improvement and update flood emergency response plan if required.

Further information is provided in the SES "*After a flood*" fact sheet.

9 Recommendations

This report outlines a flood emergency management strategy for the New high school for Jordan Springs that has been developed with consideration of:

- the nature of flooding and flood hazard at the Site from mainstream Hawkesbury-Nepean River Valley and South Creek flooding, and local (overland) flooding for design flood events including and up to the PMF;
- the proposed design and use of the Site; and
- best practice guidance and documents for flood risk management in NSW.

Critical flooding at the Site is driven by backwater flooding from the Hawkesbury River. The assessment shows that while the Site is largely flood free for all events up to and including the 1 in 500 AEP flood, it will be inundated from the 1 in 1000 AEP flood with inundation increasing with rarity up to the PMF. Substantial inundation is predicted in the PMF, with depths in excess of 6 m in some locations.

The potential for long isolation periods and high hazard flooding in very rare and extreme events means school closure is the best emergency management strategy at the Site (Priority 1) with consideration of the long available forecasting times within the Hawkesbury-Nepean River Valley at the Windsor Gauge. The assessment completed as part of this FERP indicates there is sufficient warning time to close the school prior to operation on the basis of a forecast or recorded 13.7 mAHD water level at the Windsor Gauge. Consideration should also be given to school closure if a severe thunderstorm or emergency storm warning is issued for the Jordan Springs and South Creek areas.

If school closure cannot occur prior to the commencement of a flood event, the required flood emergency management strategy is off-site evacuation before evacuation routes and buildings becoming flooded (Priority 2). As detailed within this FERP, the recommended evacuation route follows Armoury Road, Wianamatta Parkway, Lakeside Parade and Jordan Springs Boulevard to reach The Northern Road. Access is then available to local evacuation centres (such as Penrith High School) and regional evacuation centres (such as the Olympic Park Precinct). It is estimated that a minimum of 12 hours would be available to evacuate the Site in a worst-case scenario PMF event following a 13.7 mAHD level being reached at the Windsor gauge prior to flooding of the evacuation route (and more time available if a forecast trigger was adopted). The following considerations are to be made beyond this FERP report:

- Confirmation with SES that the available warning time is sufficient for safe Site evacuation and the preferred evacuation modality (private cars, emergency buses, parent’s pick-up etc.).
- Confirmation of the proposed evacuation route with SES.
- Periodic and scheduled review and revision of the FERP after it is finalised and implemented;.
- Evacuation drills are recommended at least once per year.
- The FERP should be regularly exercised, reviewed, and updated to ensure wardens and staff are aware of the procedure and that it remains current and relevant and ensure consistency with the contemporary emergency management arrangements relevant to the area (i.e. the Hawkesbury Nepean Flood Plan).

- Once the proposed activity is completed, an OFEMP is recommended to be developed by the school in consultation of SES based on this FERP.

- It is noted that closure or non-attendance (Priority 1) and off-site evacuation (Priority 2) following the issue of a 13.7 mAHD flood level warning at the Windsor Gauge is a conservative flood risk strategy. However, it is considered an appropriate preliminary approach given the potential for isolation, the vulnerable nature of the development type and its occupants, and the size of the PMF. Frequent review of the FERP, and specifically the selected flood level triggers, should be undertaken to ensure that the proposed approach is fit for purpose and does not result in unnecessary frequent school closures and/or evacuation.

9.1 Flood Emergency Mitigation Measures

Table 9.1 summarises recommendations made throughout this report into mitigation measures. However, it is noted that a FERP, by itself, is a risk-to-life mitigation measure that is often undertaken to follow findings or recommendations of a flood risk assessment.

Table 9.1 Flood Emergency Response Mitigation Measures

Mitigation Number/Name	When is Mitigation Measure to be complied with	Mitigation Measure	Reason for Mitigation Measure
Flood response personnel	Prior to the commencement of operation.	Flood response personnel's positions and responsibilities will need to be assigned to on-Site personnel for managing the flood response. For details, refer to Section 8.3.	To undertake actions defined by an OFERP before a flood, during a flood and after a flood.
Education	Prior to the commencement of operation	Developing a FERP Training Program. For details, refer to Section 8.4.	To make all occupants aware of and adequately trained in emergency response procedures and as such, advocate for the implementation of the training program.
	After the commencement of operation	Implementing the FERP Training Program	
Flood signage	Prior to the commencement of operation	Flood warning signage to be installed around the Site. For detail, refer to Section 8.5.	To make all occupants aware of probable flood danger
Preparedness	After the commencement of operation and before a flood	Flood safety actions to be followed by students, staff and visitors on Site in anticipation of a potential flooding event. For details, refer to Section 8.6.	To prepare for an anticipated potential flood

Mitigation Number/Name	When is Mitigation Measure to be complied with	Mitigation Measure	Reason for Mitigation Measure
Non-attendance (i.e. Closure) of School	After the commencement of operation and during a flood	Based on BoM's 13.7 mAHD flood level warning at the Windsor Gauge OR rainfall and dangerous thunderstorm or emergency storm warnings, School closure should be communicated with parents and staff to advise parents of possible flooding events the day before they occur and suggest that students be kept at home. For details, refer to Section 8.7.1.	To keep the School closed to avoid parents, caregivers, students and staff entering roads and the School potentially getting flooded.
Evacuation	After the commencement of operation and during a flood	If the BoM's 13.7 mAHD flood level warning at the Windsor Gauge occurs during school hours, off-site evacuation should commence. For details, refer to Section 8.7.2.	To evacuate the School prior to the Site being flooded
Recovery	After the commencement of operation and after a flood	Key flood safety measures to be followed by all occupants after a flood. For details, refer to Section 8.8.	To ensure that the School is safe for operation due to probable impacts from an occurred flood

9.2 Evaluation of Environmental Impacts

The FERP is focused on managing flood risk and planning for a flood-related emergency. As such, it does not include an assessment of the environmental impacts associated with the proposed activity. Therefore, the evaluation of environmental impacts is outside the scope of this assessment.

10 References

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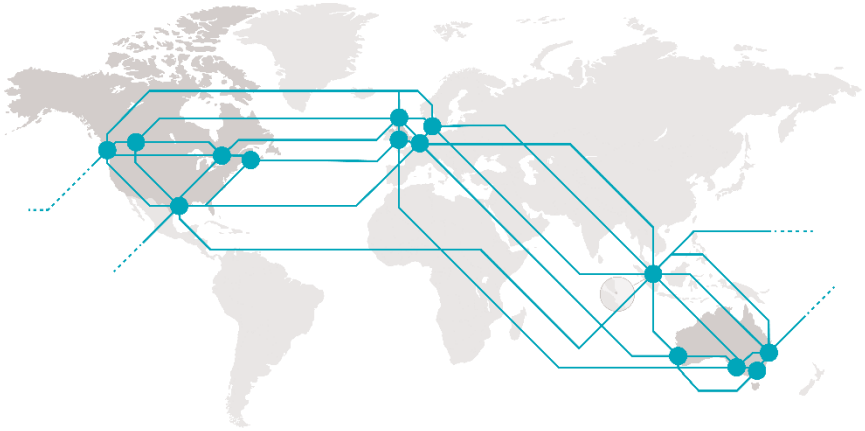

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